ICES WGCSE REPORT 2009

ICES ADVISORY COMMITTEE

ICES CM 2009/ACOM:09

Report of the Working Group on the Celtic Seas Ecoregion (WGCSE)

13–19 May 2009

Copenhagen, Denmark

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

Recommended format for purposes of citation:

ICES. 2010. Report of the Working Group on the Celtic Seas Region (WGCSE), 13–19 May 2009, Copenhagen, Denmark. ICES CM 2009/ACOM:09. 1430 pp.

Contents

Contents ..... **i**

1 General **1**

1.1 Participants 1

1.2 Terms of Reference 2

1.3 Stock assignments in 2009 4

1.4 Recent ICES advice in the context of mixed fisheries 5

1.4.1 Mixed fisheries advice for 2008 5

1.4.2 Mixed fisheries advice for 2009 5

1.5 Information provided as working documents 6

2 Data and Methods **12**

2.1 References 12

3 West of Scotland **14**

3.1 West of Scotland area overview 14

3.1.1 Description of fisheries 14

3.1.2 Regulations and their effects 18

3.1.3 Changes in fishing technology and fishing patterns 20

3.1.4 Impacts of fisheries on the ecosystems 21

3.2 Cod in Subarea VIa 23

3.2.1 General 23

3.2.2 Data 24

3.2.3 Historical stock development 26

3.2.4 Short-term stock projections 27

3.2.5 Medium-term stock projections 28

3.2.6 Biological reference points 28

3.2.7 Management plans 28

3.2.8 Uncertainties and bias in assessment and forecast 29

3.2.9 Recommendation for next Benchmark 30

3.2.10 Management considerations 31

3.3 Haddock in Division VIa 71

3.3.1 General 71

3.3.2 Data 72

3.3.3 Historical stock development 74

3.3.4 Short-term projections 76

3.3.5 3.3.5 Medium-term forecasts 77

3.3.6 3.3.6 Biological reference points 77

3.3.7 Management plans 78

3.3.8 Uncertainties and bias in assessment and forecast 78

3.3.9 Recommendations for next benchmark 79

3.3.10 Management considerations 80

3.4 Whiting in Subarea VIa 113

3.4.1 General 113

3.4.2 Data 114

3.4.3 Historical stock development 115
3.4.4 Biological reference points 116
3.4.5 Uncertainties and bias in the assessment and forecast 116

3.5 North Minch 133

3.5.1 General 133
3.5.2 Data 134
3.5.3 Data Analysis 135
3.5.4 Final assessment 136
3.5.5 Historical stock trends 136
3.5.6 Recruitment estimates 136
3.5.7 Short-term forecasts 137
3.5.8 Reference points 137
3.5.9 Uncertainties and bias in assessment and forecast 137
3.5.10 Management considerations 138

3.6 South Minch 153

3.6.1 General 153
3.6.2 Data available 153
3.6.3 Data analysis 155
3.6.4 Final assessment 156
3.6.5 Historical stock trends 156
3.6.6 Recruitment estimates 156
3.6.7 Short-term forecasts 156
3.6.8 Biological reference points 157
3.6.9 Uncertainties and bias in assessment and forecast 157
3.6.10 Management considerations 158

3.7 Firth of Clyde 167

3.7.1 General 167
3.7.2 Data available 167
3.7.3 Data analyses 169
3.7.4 Final assessment 170
3.7.5 Historical stock trends 170
3.7.6 Recruitment estimates 170
3.7.7 Short-term forecasts 170
3.7.8 Biological reference points 171
3.7.9 Uncertainties and bias in assessment and forecast 171
3.7.10 Management considerations 172

3.8 Other *Nephrops* populations within Division VIa 172

3.8.1 Stanton Bank 172
3.8.2 Shelf edge west of Scotland 173

4 Rockall Area 182

4.1 Area overview 182

4.2 Cod in Division VIb 184

4.3 Haddock in Division VIb (Rockall) 186

4.3.1 General 186
4.3.2 Data 189
4.3.3 Historical stock development 191
4.3.4 Short-term projections 193

4.3.5 Medium-term projection....194
4.3.6 Biological reference points....194
4.3.7 Management plans....194
4.3.8 Uncertainties and bias in assessment and forecast....194
4.3.9 Recommendation for next Benchmark....195
4.3.10 Management considerations....195

5 Northern Shelf Area....240

5.1 Northern Shelf Area overview....240

5.1.1 Description of fisheries....240
5.1.2 Regulations and their effects....241
5.1.3 Changes in fishing technology and fishing patterns....241

5.2 Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Division IIa, IIIa, Subarea IV and VI....242

5.2.1 Anglerfish in Division IIIa, Subarea IV and VI....242
5.2.2 Anglerfish in Division IIa....252

5.3 Megrim in division IV and VI....278

5.3.1 General....278
5.3.2 Data....279
5.3.3 Historical stock development....281
5.3.4 Short-term projections....281
5.3.5 Biological reference points....281
5.3.6 Uncertainties and bias in assessment and forecast....281
5.3.7 Recommendation for next Benchmark....281
5.3.8 Management considerations....281

6 Irish Sea....291

6.1 Area overview....291

6.2 Cod in VIIa....299

6.2.1 General....299
6.2.2 Data....300
6.2.3 Historical stock development....302
6.2.4 Short-term predictions....304
6.2.5 Medium-term projections....304
6.2.6 Biological reference points....305
6.2.7 Management plans....306
6.2.8 Uncertainties and bias in assessment and forecast....306
6.2.9 Recommendations for next benchmark assessment....308
6.2.10 Management considerations....309

6.3 Haddock in Division VIIa....334

6.3.1 General....334
6.3.2 Data....335
6.3.3 Historical stock development....337
6.3.4 Short-term projections....339
6.3.5 Medium-term predictions....339
6.3.6 Biological reference points....339
6.3.7 Management plans....339
6.3.8 Uncertainties and bias in assessment and forecast....339

6.3.9 Recommendations for next benchmark assessment 340
6.3.10 Management considerations 341

6.4 *Nephrops* in Division VIIa (Irish Sea East, FU14) 360
6.4.1 General 360
6.4.2 Data 361

6.5 Irish Sea West, FU15 371
6.5.1 General 371
6.5.2 Data 372
6.5.3 Historical stock development 373
6.5.4 Short term projections 373
6.5.5 Medium-term projection 374
6.5.6 Biological reference points 374
6.5.7 Management plans 375
6.5.8 Uncertainties and bias in assessment and forecast 375
6.5.9 Quality of assessment 375
6.5.10 Management considerations 376

6.6 Whiting in VIIa 387
6.6.1 General 387
6.6.2 Data 388
6.6.3 Historical stock development 389
6.6.4 Short-term predictions 389
6.6.5 Biological reference points 389
6.6.6 Uncertainties and bias in assessment and forecast 390
6.6.7 Recommendations for next benchmark assessment 390

6.7 Plaice in Subdivision VIIa 412
6.7.1 General 412
6.7.2 Data 414
6.7.3 Stock assessment 416
6.7.4 Short-term projections 417
6.7.5 Medium-term projections 418
6.7.6 Biological reference points 418
6.7.7 Management plans 419
6.7.8 Uncertainties and bias in assessment and forecast 419
6.7.9 Recommendations for next benchmark 419
6.7.10 Management considerations 420

6.8 Sole in Division VIIa (Irish Sea) 462
6.8.1 General 462
6.8.2 Data 464
6.8.3 Historical stock development 466
6.8.4 Short-term projections 468
6.8.5 Medium-term projection 468
6.8.6 Biological reference points 468
6.8.7 Management plans 469
6.8.8 Uncertainties and bias in assessment and forecast 469
6.8.9 Recommendations for next Benchmark 470
6.8.10 Management considerations 470

7 Celtic Sea and West of Ireland (VIIb, c, f, g, h, j and k) 496

7.1 Fisheries overview Celtic Sea and West of Ireland 496
7.2 Cod in Division VIIe–k (Celtic Sea)...507
7.2.1 General 509
7.2.2 Data...511
7.2.3 Stock Assessment 513
7.2.4 Short-term projections...513
7.2.5 Medium-term projection...513
7.2.6 Biological reference points..513
7.2.7 Management plans 514
7.2.8 Uncertainties and bias in assessment and forecast..........................514
7.2.9 Recommendation for next Benchmark...514
7.2.10 Management considerations 514
7.3 Cod in Divisions VIIb, c 552
7.4 Haddock in Divisions VIIb–k...553
7.4.1 General 553
7.4.2 Data...555
7.4.3 Historical stock development..556
7.4.4 Short-term projections...558
7.4.5 Medium-term projection...558
7.4.6 Biological reference points..558
7.4.7 Management plans 558
7.4.8 Uncertainties and bias in assessment and forecast..........................558
7.4.9 Recommendation for next Benchmark...559
7.4.10 Management considerations 559
7.5 *Nephrops* in Division VIIb (Aran Grounds, FU17) 595
7.5.1 General 595
7.5.2 Data...598
7.5.3 Assessment 599
7.5.4 Short-term forecasts...600
7.5.5 Biological reference points..600
7.5.6 Management strategies 600
7.5.7 Uncertainties and bias in assessment and forecast..........................600
7.5.8 Recommendation for next Benchmark...601
7.5.9 Management considerations 601
7.6 *Nephrops* in Division VIIb,c,j,k (Porcupine Bank, FU16).............................614
7.6.1 General 614
7.6.2 Data...616
7.6.3 Stock assessment..619
7.6.4 Short-term projections...619
7.6.5 Medium-term projection...619
7.6.6 Biological reference points..619
7.6.7 Management plans 619
7.6.8 Uncertainties and bias in assessment and forecast..........................620
7.6.9 Recommendation for next Benchmark...620
7.6.10 Management considerations 620
7.6.11 References 620
7.7 *Nephrops* in the Celtic Sea (FU20–22)...631

7.7.1 General 631
7.7.2 Data..634
7.7.3 Historical stock development...637
7.7.4 Short-term projections...639
7.7.5 Medium-term projections..639
7.7.6 Biological reference points...639
7.7.7 Management plans 639
7.7.8 Uncertainties and bias in assessment and forecast..........................639
7.7.9 Recommendation for next Benchmark...640
7.7.10 Management considerations 641
7.7.11 References 642

7.8 *Nephrops* in Divisions VIIjg (South and SW Ireland, FU 19) 679

7.8.1 Ecosystem aspects...679
7.8.2 Fishery description 679
7.8.3 Data..680
7.8.4 Commercial catches and discards..680
7.8.5 Biological sampling 680
7.8.6 Information from surveys..681
7.8.7 Assessment 681
7.8.8 Management considerations 681

7.9 Plaice in West of Ireland Division VII b, c..688

7.9.1 General 688
7.9.2 Data..688
7.9.3 Historical stock development...689
7.9.4 References 689

7.10 Plaice in Divisions VIIf,g (Celtic Sea)...701

7.10.1 General 701
7.10.2 Data..702
7.10.3 Stock assessment...704
7.10.4 Short-term projections...705
7.10.5 Medium-term projection...706
7.10.6 Biological reference points...706
7.10.7 Management plans 707
7.10.8 Uncertainties in assessment and forecast 707
7.10.9 Recommendation for next Benchmark...708
7.10.10 Management considerations..708
7.10.11 References 709

7.11 Plaice in the Southwest of Ireland (ICES Divisions VIIh–k) 757

7.11.1 General 757
7.11.2 Data..757
7.11.3 Historical stock development...757
7.11.4 References 758

7.12 Sole in West of Ireland Division VIIb, c...769

7.12.1 General 769
7.12.2 Data..769
7.12.3 Historical stock development...770

7.13 Sole in Divisions VIIfg, Celtic Seas Stock 780

7.13.1 General 780
7.13.2 Data 782
7.13.3 Stock assessment 783
7.13.4 Short-term projections 785
7.13.5 Medium-term projection 786
7.13.6 Biological reference points 786
7.13.7 Management plans 787
7.13.8 Uncertainties and bias in assessment and forecast 787
7.13.9 Recommendation for next Benchmark 788
7.13.10 Management considerations 788
7.13.11 References 788

7.14 Sole in the Southwest of Ireland (ICES Divisions VIIh–k) 826

7.14.1 General 826
7.14.2 Data 826
7.14.3 Historical stock development 826
7.14.4 References 827

7.15 Whiting in Division VIIe–k 838

7.15.1 General 838
7.15.2 Data 840
7.15.3 Historical stock development 843
7.15.4 Short-term projections 845
7.15.5 Medium-term projection 845
7.15.6 Biological reference points 846
7.15.7 Management plans 846
7.15.8 Uncertainties and bias in assessment and forecast 846
7.15.9 Recommendation for next Benchmark 847
7.15.10 Management considerations 848

7.16 Whiting in Divisions VIIb, c 903

8 Western Channel (ICES Division VIIe) 904

8.1 Area overview 904

8.2 Plaice in the Western Channel (ICES Divisions VIIe) 907

8.2.1 General 907
8.2.2 Stock assessment 910
8.2.3 Short-term projections 912
8.2.4 Medium-term projection 913
8.2.5 Biological reference points 913
8.2.6 Management plans 913
8.2.7 Uncertainties and bias in assessment and forecast 913
8.2.8 Recommendation for next Benchmark 914
8.2.9 Management considerations 914

8.3 Sole in Division VIIe 950

8.3.1 General 951
8.3.2 Data 952
8.3.3 Stock assessment 954
8.3.4 Short-term projections 956
8.3.5 Biological reference points 956
8.3.6 Medium-term projections 956

8.3.7 Management plan 956
8.3.8 Uncertainties in assessment and forecast 956
8.3.9 Recommendation for the next Benchmark 958
8.3.10 Management considerations 958
8.3.11 Ecosystem considerations 959
8.3.12 Regulations and their effects 959
8.3.13 Changes in fishing technology and fishing patterns 959
8.3.14 Changes in the environment 959

9 Cod management plan evaluations 986

9.1 Background 986

9.2 Review of evaluations of management plans for WGCSE cod stocks 988

9.3 West of Scotland cod 990

9.4 Irish Sea cod 991

9.5 References 991

10 Recommendations 992

Annex 1: List of participants 999

Annex 3.2: Stock Annex for CodVIa 1004

Annex 3.3: Quality Handbook: Haddock VIa 1025

Annex 3.4: Quality Handbook: Whiting in Area VI 1039

Annex 3.5: Stock Annex: FU11, North Minch 1051

Annex 3.6: Stock Annex: FU12, South Minch 1059

Annex 3.7: Stock Annex: FU13, Clyde 1067

Annex 4.3: Quality Handbook: Haddock VIb 1078

Annex 5.2: Quality Handbook: Northern Shelf Anglerfish 1094

Annex 6.2: Quality Handbook: Cod VIIa 1108

Annex 6.3: Quality Handbook: Haddock VIIa 1122

Annex 6.4: Quality Handbook: Irish Sea East *Nephrops* (FU14) 1132

Annex 6.5: Stock Annex: Irish Sea West *Nephrops* (FU15) 1138

Annex 6.6: Quality Handbook: WhitingVIIa 1145

Annex 6.7: Quality Handbook: Irish Sea Plaice 1158

Annex 6.8: Quality Handbook SoleVIIa 1172

Annex 7.2: Stock Annex: Cod VII e–k 1179

Annex 7.4: Quality Handbook: Stock Annex Haddock VIIb–k 1197

Annex 7.5: Stock Annex: FU17, Aran Grounds 1205

Annex 7.6: Quality Handbook: Stock Annex *Nephrops* FU16.......................1223

Annex 7.7: Quality Handbook Stock Annex: WGCSE-*Nephrops* FU 20–22 (Celtic Sea; VIIfgh) 1229

Annex 7.10: Stock Annex WGCSE: Celtic Sea Plaice 1263

Appendix 1: Beam trawl surveys of the Bristol Channel (ICES Division VIIf) 1279

Annex 7.13: Quality Handbook Celtic Sea Sole 1281

Annex 7.15: Stock Annex Whiting VIIe–k: Quality Handbook 1293

Annex 8.2: WGCSE-Western Channel Plaice...1302

Appendix A: Beam trawl surveys of the western English Channel (ICES Division VIIe) 1315

Annex 8.3: Stock Annex: Sole in Division VIIe 1318

Appendix 1: Beam trawl surveys of the western English Channel (ICES Division VIIe) 1330

Annex 10: Technical Minutes of the Celtic Sea Review Group 2009 1333

Annex 11: Reopening of the advice for *Nephrops* FU15 and FU17..............1389

1 General

1.1 Participants

Robert Bellail	France
Otte Bjelland	Norway
Richard Briggs	United Kingdom (Northern Ireland)
Sarah Clarke	United Kingdom (Scotland)
Sarah Davie	Ireland
Helen Dobby	United Kingdom (Scotland)
Jennifer Doyle (by correspondence)	Ireland
Jon Elson (by correspondence)	United Kingdom (England and Wales)
Paul Fernandes	United Kingdom (Scotland)
Spyros Fifas	France
Ross Fitzgerald (by correspondence)	Ireland
Steve Flatman	United Kingdom (England and Wales)
Hans Gerritsen	Ireland
Norman Graham	Ireland
Deirdre Hoare (by correspondence)	Ireland
Ian Holmes	United Kingdom (England and Wales)
Steven Holmes	United Kingdom (Scotland)
Andrzej Jaworski	United Kingdom (Scotland)
Vladimir Khlivnoy	Russian Federation
Sven Kupschus	United Kingdom (England and Wales)
Colm Lordan (chair)	Ireland
Chris Lynam	United Kingdom (England and Wales)
Charlotte Main	United Kingdom (Scotland)
Sara-Jane Moore (by correspondence)	Ireland
Kelle Moreau	Belgium
Sten Munch-Petersen	Denmark
Matthew Parker-Humphreys	United Kingdom (England and Wales)
Pieter-Jan Schön (chair)	United Kingdom (Northern Ireland)
Willy Vanhee	Belgium
Joël Vigneau	France

1.2 Terms of Reference

The following ToRs apply to: AFWG, HAWG, NWWG, NIPAG, WGWIDE, WGBAST, WGBFAS, WGNSSK, WGCSE, WGHMM and WGANSA.

The working group should focus on:

ToRs a) to g) for stocks that will have advice,

ToRs b) to d) and f) for stocks with same advice as last year.

ToRs b) to c) and f) for stocks with no advice.

Produce a first draft of the advice on the fish stocks and fisheries under considerations and the regional overview according to ACOM guidelines.

Update, quality check and report relevant data for the working group:

- i) Load fisheries data on effort and catches (landings, discards, bycatch, including estimates of misreporting when appropriate) in the INTERCATCH database by fisheries/fleets;
- ii) Abundance survey results;
- iii) Environmental drivers.
- iv) Propose specific actions to be taken to improve the quality of the data (including improvements in data collection).

Produce an overview of the sampling activities on a national basis based on the INTERCATCH database);

In cooperation with the Secretariat, update the description of major regulatory changes (technical measures, TACs, effort control and management plans) and comment on the potential effects of such changes including the effects of newly agreed management and recovery plans.

For each stock update the assessment by applying the agreed assessment method (analytical, forecast or trends indicators) as described in the stock annex. If no stock annex is available this should be prepared prior to the meeting.

Produce a brief report of the work carried out by the Working Group. This report should summarize for the stocks and fisheries where the item is relevant:

- v) Input data (including information from the fishing industry and NGO that is pertinent to the assessments and projections);
- vi) Where misreporting of catches is significant, provide qualitative and where possible quantitative information and describe the methods used to obtain the information;
- vii) Stock status and 2010 catch options;
- viii) Historical performance of the assessment and brief description of quality issues with the assessment;
- ix) Mixed fisheries overview and considerations;
- x) Species interaction effects and ecosystem drivers;
- xi) Ecosystem effects of fisheries;
- xii) Effects of regulatory changes on the assessment or projections;

Where appropriate, check for the need to reopen the advice in autumn based on the new survey information and the guidelines in AGCREFA.

2008/2/ACOM09 The **Working Group for the Celtic Seas Ecoregion** [WGCSE] (co-chairs: Colm Lordan, Ireland and Pieter-Jan Schön, UK) will meet at ICES Headquarters, 13–19 May 2009 to:

a) address generic ToRs for Fish Stock Assessment Working Groups (see table below);

The assessments will be carried out on the basis of the stock annex in National Laboratories, prior to the meeting. This will be coordinated as indicated in the Table below.

Fish Stock	Stock Name	Stock Coord.	Assessment Coord. 1	Assessment Coord. 2	Advice
ang-ivvi	Anglerfish (Lophius piscatorius and L. budegassa) in Division IIa, IIIa, Subarea IV and VI	UK (Scotland)	UK (Scotland)	Denmark, Norway	Advice
cod VIIe–k	Cod in Division VIIe-k (Celtic Sea)	France	France	Ireland	Advice
cod-iris	Cod in Division VIIa (Irish Sea)	UK (England)	UK (England)		Advice
cod-rock	Cod in Division VIb (Rockall)	UK (Scotland)	UK (Scotland)		No advice
cod-scow	Cod in Division VIa (West of Scotland)	UK (Scotland)	UK (Scotland)		Advice
had-7b–k	Haddock in Divisions VIIb-k	Ireland	Ireland	France	Same as last year
had-iris	Haddock in Division VIIa (Irish Sea)	UK (Northern Ireland)	UK (Northern Ireland)		Advice
had-rock	Haddock in Division VIb (Rockall)	Russia	Russia	UK (Scotland)	Advice
had-scow	Haddock in Division VIa (West of Scotland)	UK (Scotland)	UK (Scotland)		Advice
meg-scrk	Megrim (Lepidorhombus spp) in Subarea VI (West of Scotland and Rockall)	Ireland	Ireland	UK (Scotland)	Advice
nep-11	*Nephrops* in Division VIa (North Minch)	UK (Scotland)	UK (Scotland)		Advice
nep-12	*Nephrops* in Division VIa (South Minch)	UK (Scotland)	UK (Scotland)		Advice
nep-13	*Nephrops* in Division VIa (Firth of Clyde)	UK (Scotland)	UK (Scotland)		Advice
nep-14	*Nephrops* in Division VIIa (Irish Sea East)	UK (England)			No advice
nep-15	*Nephrops* in Division VIIa (Irish Sea West)	UK (Northern Ireland)	UK (Northern Ireland)	Ireland	Advice
nep-7bcj	*Nephrops* in Division VIIb,c,j,k (Porcupine Bank)	Ireland	Ireland		No advice
nep-17	*Nephrops* in Division VIIb (Aran Grounds, FU 17)	Ireland	Ireland		Advice
nep-19	*Nephrops* in Division VIIa,g,j (South East and West of IRL, FU 19)	Ireland	Ireland		No advice
nep-2022	*Nephrops* in Divisions VIIfgh (Celtic Sea, FU 20-22	France	France	Ireland	No advice

Fish Stock	Stock Name	Stock Coord.	Assessment Coord. 1	Assessment Coord. 2	Advice
ple-7b–c	Plaice in Division VIIb,c (West of Ireland)	Ireland			No advice
ple-7h–k	Plaice in Divisions VIIh,k (Southwest of Ireland)	Ireland	Ireland	Belgium	Same as last year
ple-celt	Plaice in Divisions VIIf,g (Celtic Sea)	UK (England)	UK (England)	Belgium	Advice
ple-echw	Plaice in Division VIIe (Western Channel)	UK (England)	UK (England)	France	Advice
ple-iris	Plaice in Division VIIa (Irish Sea)	UK (England)	UK (England)s		Advice
sol-7b–c	Sole in Division VIIb, c (West of Ireland)	Ireland			No advice
sol-7h–k	Sole in Divisions VIIh-k (Southwest of Ireland)	Ireland			No advice
sol-celt	Sole in Divisions VIIf,g (Celtic Sea)	Belgium	Belgium	UK (England)	Advice
sol-echw	Sole in Division VIIe (Western Channel)	UK (England)	UK (England)	France	Advice
sol-iris	Sole in Division VIIa (Irish Sea)	Belgium	Belgium		Advice
whg-7b–c	Whiting in Division VIIb, c (West of Ireland)	Ireland			No advice
whg-7e–k	Whiting in Divisions VIIe-k	Ireland	Ireland	France	Same advice as last year
whg-iris	Whiting in Division VIIa (Irish Sea)	Ireland	Ireland	UK (Northern Ireland)	Same as last year
whg-rock	Whiting in Division VIb (Rockall)	Ireland			No advice
whg-scow	Whiting in Division VIa (West of Scotland)	UK (Scotland)	UK (Scotland)		Advice

WGCSE will report by 25 May 2009 for the attention of ACOM.

1.3 Stock assignments in 2009

In accordance with the revised advisory framework, all assessments conducted by WGCSE in 2009 were update analyses. ICES has previously defined an update assessment as having the following key components: an update of all relevant time-series; application of agreed assessment model including short-term and medium-term forecast settings as appropriate and limited exploratory work to check consistency. It is considered that the update assessment should not be accepted with closed eyes and that where input data give unusually large differences in the stock development history this should be investigated.

The Working Group has this year attempted to adhere, where possible, to the rigid approach required for update assessments. For assessment methods such as XSA, ICA and SURBA the approach described above can easily be applied. For TSA a slightly different approach has been required. In order for the TSA assessment model to run successfully, some starting parameter values must be modified slightly from those used last year. This is a standard procedure when setting up and running the model. Although some input values have been modified slightly the same protocol for model fitting has been used as last year. No further exploratory analyses have been conducted and the Working Group considers therefore, that this approach constitutes an update assessment.

Under the revised structure of the advisory process update assessments should follow a full benchmark analysis of the stock and its assessment. Following the series of benchmark workshops in 2009, new protocols were applied to the *Nephrops* assessments using underwater TV survey abundance estimates. No assessment methods were proposed through the benchmark process for VIIe sole and VIIe–k cod. In these cases the Working Group examined all available information on these stocks and presented conclusions that should be considered for managing the stock and formulating advice.

1.4 Recent ICES advice in the context of mixed fisheries

1.4.1 Mixed fisheries advice for 2008

For Celtic Seas mixed-species fisheries ICES gave the following advice for 2008 (ACFM report, October 2007):

Fisheries in the Celtic Seas should in 2008 be managed according to the following rules, which should be applied simultaneously:

They should fish:

- with no catch or discard of spurdog, cod in Division VIa, in Division VIIa and in Divisions VIIe–k, and sole in Division VIIa;
- with minimal catch for whiting in Division VIa and in Division VIIa;
- without jeopardizing the recommended reduction in fishing mortality of haddock in Division VIa, plaice in Divisions VIIfg; plaice and sole in Division VIIe; whiting in Divisions VIIe–k; and Celtic Sea herring and herring in Divisions VIa south and VIIbc;
- concerning deep-water stocks fished in Subareas VII and VIII, see ICES Advice 2006 Volume 9;
- within the biological exploitation limits for all other stocks (see text table above).

Furthermore, unless ways can be found to harvest species caught in mixed fisheries within precautionary limits for all those species individually, then fishing should not be permitted.

1.4.2 Mixed fisheries advice for 2009

For Celtic Seas mixed-species fisheries ICES gave the following advice for 2009 (ACOM report, 2009):

Fisheries in the Celtic Seas should in 2009 be managed according to the following rules, which should be applied simultaneously. In these fisheries, there should be:

- no catch or discard of cod and whiting in Division VIa and in Division VIIa, of haddock in Division Via and sole in Division VIIa, or of spurdog, white skate, and angel shark;
- minimal catch of common skate and undulate ray;

- adherence to the recommended reduction in fishing mortality for cod in Divisions VIIe–k, whiting in Divisions VIIe–k, plaice in Divisions VIIfg, and plaice and sole in Division VIIe;
- development of rebuilding plans for herring in Divisions VIa (South) and VIIb,c and Celtic Sea herring (VIIg,j, VIIa south). Both stocks are in need of rebuilding and fishing should not proceed without rebuilding plans;
- consideration of ICES Advice 2008 Volume 9 for deep-water stocks fished in Subareas VII and VIII:
- fisheries for all stocks fisheries for all other stocks that were conducted within the exploitation boundaries (see text tables above).

Furthermore, unless ways can be found to harvest species caught in mixed fisheries within precautionary limits for all those species individually, then fishing should not be permitted.

1.5 Information provided as working documents

WD1: Spatial distribution of Irish Landings, Effort and lpue of Demersal Stocks in Divisions VI and VII in 1995–2008. Hans Gerritsen, Marine Institute, Galway

This very substantial WD gives a spatial and temporal overview of landings, effort and cpue for demersal stocks relevant to WGCSE. Two types of maps are presented. Landings and effort data are available from the logbooks database from 1995 onwards with a spatial resolution of one statistical rectangle. These data were used to create maps of landings, effort and lpue for the years 1995–2009. Since 2005 VMS data (GPS positions of individual vessels) are available for fishing vessels of 15 m and over. By assigning the daily catch data from the logbooks to the VMS positions where the vessels were deemed to be fishing (based on speed and direction criteria) it was possible to create high resolution maps landings, effort and lpue for the years 2005 onwards. No VMS maps are presented for gillnetters as it was not possible to accurately identify which VMS positions correspond to fishing and many of the vessels in this fleet are <15 m and are therefore not required to have VMS. Data were available for Irish vessels only (landing in Ireland or abroad).

WD 2: Maturity-at-age estimates for Irish Demersal Stocks in VIa and VIIabgj 2004–2008. Hans Gerritsen, Marine Institute, Galway

This document provides maturity-at-age estimates for stocks assessed by the WGCSE. All data are obtained on surveys carried out by the Marine Institute. The maturity ogives are compared with those used by the WG.

WD 3: Discarding of Haddock in VIIb–k; Comparison between the Irish and French discard data 2005–2008. Hans Gerritsen, Marine Institute, Galway

A large proportion of haddock catches are discarded up to age three. Because recruitment is highly variable and the stock is relatively short-lived, it is important to take these discards into account in the assessment. Discard data are available from the Irish otter trawl fleets in VIIbgj from 1995 onwards. French discard data are available from 2005 onwards.

Because the Irish discard data cover nearly the entire time-series, these data are used to estimate discard numbers-at-age by raising them to the international level. However, Irish catches do not account for the majority of the international landings; France usually takes 50–80% of the landings. It is therefore important to establish if the Irish data are representative of the international discarding patterns. The aim of this working document is to compare the French and Irish discarding patterns over the period where data from both countries are available (2005–2008).

It appears that the French and Irish fleets have similar discard ogives, but the Irish fleets tend to catch (and discard) considerable numbers of one-year-old fish, whereas the French fleets tend to catch haddock from the age of two. It is therefore possible that the use of Irish discard data for estimating international discard numbers-at-age, results in an overestimate of the numbers-at-age one. To investigate the effect on the assessment of the one-year-old fish in the catch numbers-at-age matrix, the WGCSE 2009 final assessment was compared with an XSA run with all 1-group catch numbers set to zero (Figure 4). Estimates of SSB and Fbar were affected to a minor extent only in the final year. Estimated recruitment-at-age 0 was much less variable after removing 1-year-olds from the analysis but demonstrated the same trend with exception of the 1999 year class.

Recruitment appears to be quite well estimated by the EVHOE and IGFS surveys, which demonstrate similar trends for most years (WGCSE, 2009). Estimates of discard numbers-at-age, on the other hand, are quite uncertain and likely to be biased. It might be worth considering removing the catch numbers-at-age 1 from the assessment and allow recruitment to be estimated by the surveys to a larger extent.

WD 4: Irish Sea cod Management Plan Evaluations. Matthew Parker-Humphreys, CEFAS, Lowestoft

Irish Sea cod evaluations were conducted for the Irish Sea cod management plan, as described in Council Regulation (EC) 1342/2008. The evaluation was conducted along the same lines as that for AGCREMP 2008 using the EU rule. The TAC constraint was set at ±20% in all but one model, where no TAC constraint was applied. The operating model is based on the ICES WGNSDS, 2008 B-Adapt assessment. B-Adapt generated bootstrapped estimates of F and N were incorporated into the FLR implementation of the management strategy evaluation (MSE), together with time-series (1968–2007) of landings and weights-at-age, and values for natural mortality (0.2) and maturity-at-age from ICES WGNSDS, 2008.

The results of the analysis formed an important input into the WGs conclusions in Section 9.

WD 5: An evaluation VIa cod management plan. Chris Darby, CEFAS, Lowestoft

Evaluations were conducted for the VIa cod management plan, as described in Council Regulation (EC) 1342/2008. The evaluation was conducted along the same lines as that for AGCREMP 2008.The AGCREMP operating model was based on a B-Adapt assessment of the VIa data. However, the model currently used to assess the VIa cod at the Working Group on the Assessment of Northern Shelf Demersal Stocks (ICES WGNSDS 2008) is Time-Series Analysis (TSA). The model does not produce output that could readily be converted to the format required for the AGCREMP simulation framework and consequently using TSA output as a basis for the operating model was not feasible. Therefore a B-Adapt model as applied in the North Sea and Irish Sea cod was specified in order to mimic the time-series analysis assessment and characterize the TSA analysis as closely as possible.

The results of the analysis formed an important input into the WGs conclusions in Section 9.

WD 6: Reviews of the Review Group on Cod Management Plans. Coby Needle, Marine Laboratory, Aberdeen, Jan Horbowy, MIR, Gdynia, Poland, Alexander Kempf, vTI-SF, Hamburg

This WD reviewed the results of WD 4 and 5. The review formed an important input into the WGs conclusions in Section 9.

WD 7: FSP Western Channel Sole and Plaice 2008. Georg H. Engelhard, Julian Martin and Mike Armstrong, Cefas, Lowestoft

During September and October 2008, the beam trawlers Carhelmar and Lady T Emiel carried out the sixth in a series of FSP surveys of Western Channel sole and plaice. Similar FSP surveys were carried out during the months August–October of 2003–2007, and all aimed at demonstrating trends in distribution, abundance and age composition of sole and plaice, and providing information on bycatch species. The survey design was simplified from previous years' with the smaller, 2 × 4 m beam trawler Carhelmar now surveying both the western and eastern study areas. This implied no change in survey design for the west, but previously the east had been surveyed by the larger Lady T Emiel (2 × 12 m beams). The survey was further limited to 45 western and 45 eastern 'core' stations, for which consistent data were available for all previous years. In addition to those, Lady T Emiel still sampled 28 of the 45 eastern prime stations about a month separate from when the same stations had been sampled by Carhelmar. There was evidence that the Lady T Emiel and Carhelmar have highly similar sole catchabilities and fairly similar plaice catchabilities, provided that catch rates are quantified as the number of fish caught h–1 m–1 beam length. This was indicated by close correspondence in plaice and especially sole catch rates and length distributions obtained during the 2008 Lady T Emiel and eastern Carhelmar surveys. This result provides encouragement for continuing to use this FSP time-series as one of the tuning indices in the ICES Western Channel plaice stock assessment, as was done in 2007 and 2008 (ICES 2007, 2008).

Catch rates of sole in the western area were less than in previous years, and those in the east slightly down on the previous year; nevertheless there was a very broad age distribution of sole. The catch rates of plaice in both the western and eastern areas were lower than in 2007 and considerably lower than throughout the years 2003–2006. Relatively large numbers of small (<25 cm) monkfish were taken, especially in the west. Cod were only caught in small numbers that were comparable with 2007, but were much less scarce than during the 2003–2006 surveys.

The age distribution for sole was broad (with ages of fish >20 years recorded in all survey survey legs), and that for plaice much narrower, with just 1 fish >10 year recorded. The relative age compositions of both sole and plaice were broadly similar to those in the commercial fishery landings, as reported by ICES, 2008. The trends in sole and plaice spawning-stock-biomass (SSB) from the FSP surveys were similar to the recent, steadily declining trends demonstrated by the ICES assessment, especially if based on the eastern FSP surveys alone; the SSB trend based on the western FSP survey is suggestive of a steeper decline in both species than provided by the formal assessment.

See http://www.cefas.co.uk/data/fisheries-science-partnership-(fsp)/reports.aspx for the full report.

WD 8: Trends in abundance of cod, haddock and whiting from UK Fisheries Science Partnership roundfish surveys of the Irish Sea. Mike Armstrong, Shaun Doran, Guy Pasco and Peter Randall CEFAS, Lowestoft

This report presents the results of the sixth in a series of FSP surveys of cod, haddock and whiting in the Irish Sea that commenced in spring 2004, and evaluates the time-series of data on catch-rates, distribution and age composition.

See http://www.cefas.co.uk/data/fisheries-science-partnership-(fsp)/reports.aspx for the full report.

WD 9: NFFO Annual Fisheries Reports. Paul Trebilcock and Nathan de Rozarieux Cornish FPO/Seafood Cornwall Training Ltd

This working document is the first of its kind submitted by any fishing industry organization to the WGCSE. The objective of the document is to feed information on recent developments on the ground in the fisheries to the WG and policy-makers in a more structured way. The report consists of a Annual Fisheries Reports (AFRs) from seven defined métiers; Over 24 m Beamer, Under 24 m Beamer, Over 15 m Trawlers, Under 15 m Trawlers, Over 15 m Netters, Under 15 m Netters, Under 10 m Multi-purpose. The AFR reports followed a consistent format and included information from the industry under the following headings:

1.1.1 Fleet profile

1.1.2 Technological developments:

1.1.3 Stock abundance-Patterns and Trends

- i) Seasonal changes
- ii) Spatial changes
- iii) Changes in age structure of population/stock availability
- iv) Market price changes

1.1.4 Impact of management measures on fishing patterns/areas fished

1.1.5 Economic features and trends

1.1.6 Sentinel skippers comments/views/issues

The WG very much welcomed this report and found it very informative and useful. It would encourage the development and expansion of the scheme. From an assessment and scientific advisory perspective these reports will become of more use to ICES over several years and also if they can be expanded to other countries through NWWRAC. It would be very useful if, in consultation with scientists, the métiers in the AFR are made consistent with those sampled under the DCF and with information provided to the WG. This is particularly important for stocks where commercial cpue or lpue data are used in the assessment. The AFRs also highlight the need for ICES to take account mixed fisheries and ecosystem considerations in the assessment and management of stocks and fisheries in the WGCSE area. WGCSE would point out that many of the species and stocks discussed in the AFR are not assessed by WGCSE and some are considered by other ICES expert groups (e.g. WGHMM, WGCEPH, WGNEW, etc.). The AFR may also serve as an important input to future benchmark assessments where new data from industry can be considered and some assessment assumptions can be explored.

WD10: *Nephrops* catches from the Spanish Porcupine Survey. Francisco Velasco, IEO, Santander

This document provided data and information on *Nephrops* catches on the Spanish Porcupine survey. This was a very important source of fishery-independent information for this stock and has been used in Section 7.6

WD11: Results of Russian Research and Fishery of Demersal Fish on the Rockall Bank in 2008. V.N. Khlivnoy, PINRO, Murmansk

In 2008, Russian research and fisheries for demersal fish on the Rockall Bank were continued. During research activities new data on biology and fisheries that may contribute to increase knowledge of biology, peculiarities of distribution and abundance dynamics of haddock (*Melanogrammus aeglefinus*) and other demersal fish was obtained. The objective of the present paper is to summarize Russian data on biology and fisheries collected in 2008, prepare materials for the stock assessment and evaluate prospects of haddock fishery at Rockall. These results were relevant to Section 4.3.

WD12: Update on the UWTV Survey on the Aran, Galway Bay and Slyne Head *Nephrops* Grounds. Colm Lordan and Jennifer Doyle, Marine Institute, Galway, Ireland

The *Nephrops* fishery 'at the back of the Aran Islands' is the mainstay of the Ros a Mhíl fleet. Sustaining this valuable fishery would be at the heart of any management plan for fisheries in the area. In 2008 the seventh in a series of annual UWTV survey was complete and the results of that survey together with a synthesis and analysis of the results is presented. A geostatistical analysis indicates that burrow densities and abundances have fluctuated considerably in space and time. The highest densities occurred in 2004 and the lowest densities in 2008. The 2008 survey demonstrates a decrease in burrow density to the lowest observed. Using the survey directly for assessment and management has been discussed at WKNEPHTV, 2007 and at SGNEP, 2009.This stock was a focus at the benchmark workshop on *Nephrops* assessment held in Aberdeen WKNEPH, 2009. There appears to a negative relationship between abundance and landings in autumn and a positive relationship between observed densities and landings the following spring. There is some concern about the stock given the most recent survey abundance observed to date. The time-series is short and to date survey estimates have fluctuated across a large dynamic range. These results were used in Section 7.5.

WD13: Update on the UWTV Survey on the Irish Sea *Nephrops* Grounds. Colm Lordan, Jennifer Doyle Marine Institute, Galway, Ireland and Richard Briggs, AFBI, Belfast

This survey is carried out in cooperation with Marine Institute (Ireland) and AFBI (Northern Ireland) and is in its sixth year. A revision of the count data for the early years 2003 and 2004 is also presented where the initial high burrow estimates were checked and a drift in burrow identification was detected as detailed in SGNEPS 2009. The results of the survey were used Section 6.5.

WD14: Update on the UWTV Survey on the Celtic Sea *Nephrops* Grounds. Colm Lordan and Jennifer Doyle Marine Institute, Galway, Ireland

This is the third in a time-series of UWTV surveys on the 'Smalls grounds'. The 2006 survey covered the distinct mud patches of the Smalls Grounds and also indicator stations on the Labadie Bank, Nymphe Bank and Seven Heads, whereas the 2007 and 2008 survey covered the Smalls Grounds only due to poor weather and time constraints. This report details the results of the surveys on the Smalls Grounds only to date. Data for assessment of *Nephrops* in this area has been rather sparse in the past. The main source of significant new information on this stock comes from the fishery-independent UWTV survey initiated by Ireland in 2006. This survey indicates that burrow density in 2008 increased slightly from that observed in 2007. Because the Celtic Sea survey covers only part of the *Nephrops* meta-population in the Celtic Sea there is significant biomass outside the surveyed area. An approach to estimate catch options including biomass outside the survey area needs to be developed. Improved spatially explicit data such as that presented in WD 1 of WGCSE 2009 will help in this regard. The results of the surveys are relevant to Section 7.7.

WD15: Haddock in the Celtic Sea and West of Ireland Analysis of the catch numbers-at-age and yield-per-recruit. Hans Gerritsen, Marine Institute, Galway, Ireland

This WD formed the basis for Section 7.4.

WD 16: Plaice VIIbc: Analysis of the catch numbers-at-age and yield-per-recruit. Hans Gerritsen, Marine Institute, Galway, Ireland

This WD formed the basis for Section 7.9.

WD17: Plaice VIIjk: Analysis of the catch numbers-at-age and yield-per-recruit. Hans Gerritsen, Marine Institute, Galway, Ireland

This WD formed the basis for Section 7.11.

WD18: Sole VIIbc: Analysis of the catch numbers-at-age and yield-per-recruit. Hans Gerritsen, Marine Institute, Galway, Ireland

This WD formed the basis for Section 7.12.

WD19: Sole VIIjk: Analysis of the catch numbers-at-age and yield-per-recruit. Hans Gerritsen, Marine Institute, Galway, Ireland

This WD formed the basis for Section 7.14.

WDs20–32: A summary of the Irish fishery and sampling of Anglerfish VI, Cod VIa, Cod VIIe–k, Cod VIIa, Haddock VIa, Haddock VIb, Haddock VIIb–k, Haddock VIIa, Megrim VI, Plaice VIIa, Plaice VIIfg, Whiting VIIe–k and Whiting VIIa in 2008. S. Beattie, M. Blaszkowski, R. Bunn, S. Davie, J. Doyle, D. Fee, R. Fitzgerald, K. Foley, H. Gerritsen, O. Hanniffy, I. Hehir, D. Hoare, M. McAuliffe, K. McCann, H. McCormick, S. J. Moore, G. Ní Chonchuir, S. O' Connor, T. Rapp, N. Slattery, D. Stokes, M. Sullivan and F. Woods. Marine Institute, Galway, Ireland

These 13 WDs summarized the Irish fisheries the results of sampling for WGCSE stocks in 2008. The data were used under the relevant stock sections.

WDs 33–48: Annual Data File for Cod VIIa, Plaice VIIa, Sole VIIa, Whiting VIIa, Plaice VIIe, Sole VIIe, Cod VIIe–k, Haddock VIIe–k, Whiting VIIe–k, Plaice VIIfg, Sole VIIfg, Plaice VIIh–k, Sole VIIh–k. I. D. Holmes and D. Brown, CEFAS, Lowestoft

These 16 WDs summarized the UK E&W fisheries the results of sampling for WGCSE stocks in 2008. The data were used under the relevant stock sections.

2 Data and Methods

A discussion of historical data available is discussed in Section 2.1 to 2.5 of WGNSDS 2008 and Section 1.3 of WGSSDS 2008 (ICES, 2008a,b). There have been no substantive changes to available data or work up methodologies this year. The methods employed by the WG are described in each stock annex and Sections 2.6 to 2.11 of WGNSDS 2008 and Section 1.4 of WGSSDS 2008 (ICES, 2008a,b).

Biological sampling levels by country and stock are summarised in Table 2.1. The sampling levels for 2008 are, in general, similar to those in 2007. Deficiencies in sampling (if any) are discussed in the relevant stock section.

2.1 References

ICES. 2010. Report of the Working Group on the Assessment of Northern Shelf Demersal Stock (WGNSDS), 15–21 May 2008, Copenhagen, Denmark. ICES CM 2008/ACOM:08. 756 pp.

ICES. 2010. Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks (WGSSDS), 26 June–5 July 2007, ICES Headquarters, Copenhagen. ICES CM 2007/ACFM:28. 675 pp.

Table 2.1. Biological sampling levels by stock and country.

Table 2.1 Biological sampling levels by stock and country		Cod					Whiting				Nephrops									Plaice					Sole					Haddock				Megrim		Anglerfish			
		VIa	VIb	VIIa	VIIb,c	VIIe–k	VIIb,c	VIIe–k	VIa	VIIa	FU11	FU12	FU13	FU14	FU15	FU16	FU17	FU19	FU 20-22	VIIa	VIIb,c	VIIe	VIIf,g	VII h-k	VIIa	VIIb,c	VIIe	VIIf,g	VII h-k	VIIb–k	VIa	VIb	VIIa	VIa	VIb	IIa	IVa &	VIa	VIb
Belgium	No. lengths (landings)																			10,437			1,520		14,771			10,491											
	No. ages (landings)																			451			591		887			840											
	No. samples (landings)*																			(10)			7		(10)			7											
	No. lengths (discards)																																						
	No. ages (discards)																																						
	No. samples (discards)'																																						
E & W (UK)	No. lengths (landings)			1,003		8,929								5,250						11,731		24,561	10,767		5,718		13,107												
	No. ages (landings)			482		1,359														1,690		2,411	951		700		2,173												
	No. samples (landings)*			17		186								23						79		209	90		52		125												
	No. lengths (discards)			5		314				2,119				9,477						51,317		10,476			0		8,223						11						
	No. ages (discards)			0						*0*															0								0						
	No. samples (discards)'			26		144				26				31						76		486			26		486						26						
Northern Ireland	No. lengths (landings)	25		8,331						225					14,748																451		8,336						
	No. ages (landings)	1		447																													594						
	No. samples (landings)*			151						2					127																4		90						
	No. lengths (discards)			52						8,168					5,265																		2,267						
	No. ages (discards)																																						
	No. samples (discards)'			43						43					127																		43						
France	No. lengths (landings)					13,134		7,308											12,139											3,487									
	No. ages (landings)					1,268		1,399																						1,094									
	No. samples (landings)*					68		24											73											13									
	No. lengths (discards)					5,329		305																						694									
	No. ages (discards)					0		0																						0									
	No. samples (discards)'					27		6																						2									
Spain	No. lengths (landings)															769																							
	No. ages (landings)																																						
	No. samples (landings)*															2																							
	No. lengths (discards)																																						
	No. ages (discards)																																						
	No. samples (discards)'																																						
Ireland	No. lengths (landings)	147	34	3,515	313	6,361	1,706	17,268	2,156	11,553										11,553	1,551	0	11,671	2,328	5,037	577	0	5,690	1,788	18,690	3,480	3,305	3,759	299	157			791	457
	No. ages (landings)	171	0	566	284	1,503	520	2,096	41	467										467	407	0	558	452	372	47	0	0	479	2,885	886	646	754	409	450			201	178
	No. samples (landings)*	5	1	73	21/17	157/70	29/18	78/129	12	81										81/18	13	0	95/24	19/27	49	15/2	0	54	19/14	104/202	24	21	56	13	6			10	6
	No. lengths (discards)	29		28	0	85	718	1,983	184	2,179										1,082	118	0	501	239	54	11	0	15	19	3,283	804	3,217	1,546	444	196			133	145
	No. ages (discards)	0		12	0	31	278	459	39	369										369	114	0	176	112	43	0	0	6	11	871	137	71	354	173	35			62	34
	No. samples (discards)*	9		18	19	38	19	38	9	18										21	19	0	19	19	18	19	0	19	19	57	9	2	18	9	1			9	1
	No. lengths (catches)														26,104	5,970	13,645	12,311	15,533																				
	No. ages (catches)																																						
	No. samples (catches)*														65	6	37	18	43																				
UK Scotland	No. lengths (landings)	1,214							2,902		19,925	25,055	23,809																		7,293	3,346		1,971			11436[IV]	3,413	
	No. ages (landings)	307							601																						1,290	556		152			1528[IV]	426	
	No. samples (landings)*										38	43	33																										
	No. lengths (discards)	852							1,231		4,317	4,882	6,776																		966			273			123[IV]	4	
	No. ages (discards)	558							256		7	7	10																		370			0			0	0	
	No. samples (discards)'	15							15																						15			15			55	15	
Norway	No. lengths (landings)		362																													1,931				2,118	701		306
	No. ages (landings)																															258							
	No. samples (landings)*		27																													42				274	138		48
	No. lengths (discards)																																		1,025				
	No. ages (discards)																																						
	No. samples (discards)'																																		28				
Russian Federatio	No. lengths (landings)																															22,362							
	No. ages (landings)																															630							
	No. samples (landings)*																															5							
	No. lengths (discards)																																						
	No. ages (discards)																																						
	No. samples (discards)'																																						
Denmark	No. lengths (landings)																																				2,911		
	No. ages (landings)																																				43		
	No. samples (landings)*																																						
	No. lengths (discards)																																				169		
	No. ages (discards)																																						
	No. samples (discards)'																																				9		

3 West of Scotland

3.1 West of Scotland area overview

3.1.1 Description of fisheries

The demersal fisheries in Subarea VI are predominantly conducted by otter trawlers fishing for prawns (*Nephrops*); cod, haddock, hake, saithe, and whiting (gadoids); anglerfish and megrim. Other species including lemon sole, plaice, witch, red mullet, halibut, turbot and pollack form a proportionally small but valuable part of the catch. Trawlers may target a particular species assemblage in particular areas, but invariably catch some mixture of species. Generally one can consider there to be:

- an inshore fishery targeting prawns (with smaller catches of gadoids);
- a shelf fishery for the gadoids;
- a fishery close to the shelf edge targeting anglerfish and megrim;
- a fishery at Rockall targeting haddock on the bank (<200 m) and anglerfish on the slope (>200 m).

With the exception of the inshore *Nephrops* fleets, these fisheries may operate in both Sub-areas VI and IV.

The inshore *Nephrops* fisheries

The *Nephrops* fisheries are well defined by the soft muddy substrata which are fished throughout the year, with the highest landings usually made in spring and summer. In the Minch (FU 11 and 12) fisheries are predominantly exploited by *Nephrops* trawlers using single rig gear with a 70 mm mesh, although about 15% of landings are currently made by creel vessels, an activity which has increased in recent years. Vessels usually have a trip duration of one day, sailing to shoot before dawn, and carrying out 3–4 hauls of 4 hours per day. In all, about 135 trawlers contribute to the landings, 75% of which are local. Mean engine power is around 200 kW, and mean vessel length is around 15 m. Most vessels were built between the 1960s and 1980s. The major landing ports are Ullapool, Gairloch, Oban, Mallaig and Stornoway. The minimum landing size for *Nephrops* in the Minch is 20 mm CL, and less than 0.5% of the animals are landed under size. Discarding takes place at sea, and landings are made by category for whole animals (small, medium and large) and as tails. The main bycatch species is haddock, although whiting (in the south) and Norway pout also feature significantly in discards. Vessels usually have a trip duration of one day in winter, but up to six days in summer.

The Firth of Clyde *Nephrops* fishery is predominantly exploited by a dedicated *Nephrops* trawler fleet of approximately 120 vessels, with less than 2–3 % of the landings made by creel vessels. The 90 resident Clyde trawlers make about 90% of the *Nephrops* landings. The regular fleet is comprised of Scottish vessels, but some catches are taken by Northern Ireland and Republic of Ireland vessels. The major landing ports are Troon, Campbeltown, Girvan and Tarbert, but smaller landings are also made at Carradale, Largs and Rothsay. Fishing with mobile gear is prohibited within the Firth of Clyde over weekends, and with vessels >70 feet (about 21 m) in length, so the trawler fleet that fishes the Firth of Clyde mostly consists of vessels between 10 and 20 m in length (mean overall length 14 m), with a mean engine power of 185 kW. Almost half the fleet was built during the 1960s, with less than 20% built after 1979. Most vessels use single otter trawls with a 70 mm mesh codend, but just under a third of *Nephrops* landings are taken by vessels using twin-rig trawls with an 80 mm mesh codend. Only a small fish bycatch is made in the Firth of Clyde, with whiting and cod being the most important species. The composition of the bycatch and discards varies within the Firth of Clyde, with more flatfish (common and long rough dab), echinoderms and crustaceans (other than *Nephrops*) caught in the North, whereas more roundfish (particularly whiting) are caught in the South. These differences reflect the different habitats and fish communities in the area.

The fleet exploiting the Sound of Jura is different from the Firth of Clyde, with vessels tending to be slightly smaller but more powerful. Most landings are taken by Scottish vessels (which are virtually all local to the area) with a very small proportion taken by boats from the rest of the UK. The local trawler fleet consists of vessels between 9 and 16 m in length, and with a mean engine power of 185 kW.

The gadoid shelf fishery

The fisheries on the shelf (<200 m) are exploited throughout the year, with the highest landings usually made in spring. Since 1976, effort by Scottish heavy trawlers and seiners has decreased. Light trawler effort has declined rapidly since 1997 after a long-term increasing trend. In recent years there have been several changes to the Scottish fleet, either directly or indirectly prompted by measures designed to conserve vulnerable whitefish stocks, particularly cod. The most important of these measures in recent years have been the two successive decommissioning schemes in 2001–2002 and 2000–2004, under which 165 vessels were removed from the [total Scottish] fleet.

These fisheries are now predominantly exploited by trawlers using single trawls with 120 mm mesh (since 2009), although pair trawling, twin trawling and seine nets are also used. Recent increases in the price of fuel have led to a reduction in twin trawling and renewed interest in seine netting. Vessels usually have a trip duration of several days, and carrying out 1–2 hauls of 8 hours per day. In all, about 120 trawlers from the west of Scotland contribute to the fishery but Ireland, Northern Ireland, England, France, Spain and Germany also participate in these fisheries. The major Scottish landing ports are, in order of [2007] landings, Peterhead, Lerwick, Fraserburgh, Aberdeen, Scrabster, Ullapool, Kinlochbervie, Mallaig and Lochinver. Discarding takes place at sea, and is a result of either captures below minimum landing size or fish over quota in a mixed fishery.

Irish fishing activity in terms of kW.days has declined in VIa in recent years and during spring 2007 a significant fishery for shoaling cod in the Celtic Sea prompted the larger, newer boats to switch their efforts away from VIa. An Irish decommissioning round during 2005 is also thought to have removed the few remaining Irish vessels that traditionally target cod on the Cape grounds of Division VIa.

The shelf edge fishery

A fishery for anglerfish in Subarea VI occurs largely in Division VIa with the UK and France being the most important exploiters, followed by Ireland. Landings from Rockall (Division VIb) are generally less than 1000 t with the UK taking on average around 50% of the total. The Scottish fishery for anglerfish in Division VIa comprises two main fleets targeting mixed round-fish. The Scottish Light Trawl Fleet (<27 m) takes around 60% of landings and the Scottish Heavy Trawl Fleet (>27 m) over 20%. The development of a directed fishery for anglerfish has led to considerable changes in the way the Scottish fleet operates. Part of this is a change in the distribution of fishing effort; the development of a directed fishery having led to effort shifting away from traditional round-fish fisheries in inshore areas to more offshore areas and deeper waters. The expansion in area and depth range fished has been accompanied by the development of specific trawls and vessels to exploit the stock. There has been an almost linear increase in landings from Division VIa since the start of the directed fishery until 1996 which has been followed more recently by a very severe decline, indicating the previous increase was almost certainly due only to the expansion and increase in efficiency of the fishery. More recent declines in landings (2002–2004) may have been as a consequence of restrictive TACs.

The Irish fleet which takes around 15–20% of the total Division VIa landings is a light trawl fleet targeting anglerfish, hake, megrim and other gadoids on the Stanton Bank and on the slope northwest of Ireland. This fleet uses a mesh size of 80 mm or greater. Since 1996 there has been an increase in the number of vessels using twin rigs in this fleet. There have also been changes to the fleet composition since 2000, with around ten vessels decommissioned and four new vessels joining the fleet.

The French vessels catching anglerfish may be targeting saithe and other demersal species or fishing in deep water for roundnose grenadier, blue ling or orange roughy. Spanish gillnetters and longliners, many of them operating under the UK flag, work along the shelf edge targeting anglerfish, hake and ling but occasionally moving into deeper water to fish or deep-water sharks.

The Rockall fishery

At Rockall, there is a targeted fishery for haddock by Russian Scottish, Irish trawlers. The Rockall haddock fishery changed markedly in 1999 when a revision of the EU EEZ placed the southwestern part of the Rockall plateau in international waters. This has opened opportunities for other nations, notably Russia, to exploit the fishery in this area. The Russian fleet started fishing operations in international waters at Rockall in 1999. The Russian haddock fishery uses bottom trawls with codend mesh size of 40–100 mm (mainly 40–70 mm) and retains haddock of all length classes in the catch. This fishery targets concentrations of haddock mainly during spring and the beginning of summer.

Prior to 1999, the UK and Ireland fisheries had been principally summer fisheries but in more recent years the Scottish and Irish fishery was conducted throughout the year with the peak in April–May. The Scottish fleet operating in VIb consists mainly of large otter trawlers (>27 m) targeting haddock and anglerfish. Their activity depends on weather and the availability of haddock quota in VIb.

The Irish fleet otter trawl in Division VIb take anglerfish as a bycatch in the haddock fishery on the Rockall Bank. The fleet targeting haddock uses 100 mm mesh and twin rig trawls. Occasionally Irish-Spanish flag vessels target anglerfish, witch and megrim with 80 mm mesh on the slope in VIb. Discarding practices of these vessels are not known although discarding of anglerfish from the fleet targeting haddock in Division VIb is not thought to be significant (Anon, 2001). The fleet composition changed in 2001. Four vessels have recently been decommissioned and two new vessels have joined the fleet that targets haddock. In 2006 and 2007, the effort of the Irish fleet operating at Rockall has increased with the increase in Rockall haddock TAC. Following a number of years of reduced Irish fishing activity at Rockall, at least 10 vessels (>24 m, 1000 hp+) are reported to have shifted from deeper water to the mixed fishery in VIb.

There are some indications that, because of a general decline in catches by the Scottish and Irish fleets in Division VIa, there is an increasing focus in the Rockall fishery in Division VIb. The fishery at Rockall also seems particularly attractive given the lack of effort restrictions in this area.

Other fisheries

Under Council Regulation No. 51/2006 the use of gillnets has been banned outside 200 m depth. WGFTFB2006 report that this has greatly reduced effort at depths greater than 200 m in VIa. The measure was aimed to protect monkfish and deep-water shark.

In addition to these demersal trawl fisheries, a deep-water gillnet fleet continues to operate on the continental slopes to the West of the British Isles, North of Shetland, at Rockall and the Hatton Bank. These vessels, though mostly based in Spain, are registered in the UK, Germany and other countries outside the EU such as Panama. The fishery is conducted in depths greater than 200 m, with the main target species being anglerfish and deep-water sharks. Gear loss and discarding of damaged catch are thought to be substantial in this fishery. Until recently these fisheries have not been well documented or understood and have been largely unregulated, with little or no information on catch composition, discards and a high degree of suspected misreporting. In recent years, there have been around 16 vessels participating in the fishery, 12 UK registered and 4 German registered.

In response to the concerns with these gillnet fisheries for deep-water sharks and anglerfish in Subarea VI, the EC banned the setting of gillnets in waters greater than 200 m in 2006 (Council Regulation 51/2006). However, this regulation was reviewed in July 2006 and a new regulation put in place which is a permanent ban, but allows a derogation for entangling nets in waters less than 600 m, not exceeding 100 km in total length with a maximum soak time of 72 hours. (The relevant regulation can be found in EC Regulation No 40/2008 Annex III, article 8 and this also applies to Division IVa in 2008). NEAFC have also introduced an indefinite ban. In addition, in 2007 the EU funded a ghost net retrieval programme, DEEPCLEAN (coordinated by the Marine Institute, Ireland) aiming to maximize the recovery of lost or abandoned gillnets and quantify the scale and biological consequences.

Some inshore vessels on the west coast of Scotland turn to scallop dredging when *Nephrops* catches or prices drop, although the scope for this has been limited in recent years with ASP and PSP closures of the scallop fishery in some areas. A seasonal sprat fishery often develops in the south Minch in November and December, which is targeted by vessels of all sizes (including those that usually target *Nephrops*).

3.1.2 Regulations and their effects

TAC regulations

The Regulations specifying Total Allowable Catches (TAC) by species and management area for stocks assessed by WGCSE to the west of Scotland are as follows:

	Council Regulation (EC) No:	2848 / 2000	2555 / 2001	2341 / 2002	2287 / 2003	27 / 2005	51 / 2006	41 / 2006	40 / 2008	43/2009
Stock	Management Area	2001 TAC	2002 TAC	2003 TAC	2004 TAC	2005 TAC	2006 TAC	2007 TAC	2008 TAC	2009 TAC
Cod	Vb α, VI, XII, XIV	3700	4600	1808	848	721	613	490	402	302
Megrim	Vb α, VI, XII, XIV	4360	4360	4360	3600	2880	2880	2880	2592	2799
Anglerfish	IIa α, IV α	14 130	10 500	7000	7000	10 314	10 314	11 345	11 345	
	Vb α, VI, XII, XIV	6400	4770	3180	3180	4686	4686	5155	5155	5567
Haddock	Vb, VI α, XII, XIV	13 900	14 100	8675	~	~	~	~		
	Vb, VIa	~	~	~	6503	7600		7200	6120	3516
	VIb α, XII, XIV	~	~	~	702	702	597	4615	6916	5879
Whiting	Vb α, VI, XII, XIV	4000	3500	2000	1600	1600	1360	1020	765	574
Nephrops	VI, Vb α	11 340	11 340	11 340	11 300	12 700	17 675	19 885	19 885	18 891

Effort Regulations

The Long Term Management Plan for Cod introduced in February 2009 Council Regulation (EC) 1342/2008 (see Section 9 for detailed specification) has resulted in a new effort allocation system and replaced the previous days and sea regulations (e.g. EC 40/2008) that limited effort for trawls and seines in the Irish Sea and West of Scotland (and other "cod recovery" areas). The earlier days-at-sea scheme was based on providing a maximum amount of days permissible depending on area and mesh size. Although this regulation reduced the overall effort expended by vessels using mesh sizes greater than 100 mm, the days-at-sea cap was not considered to have limited the effort of vessels using gears less than 100 mm. This is because of the relatively high allocations for this fleet segment and the movement into other ICES divisions. In contrast, EC 1342/2008 provides individual member states with an effort allocation based on the actual amount of effort expended within VIa from a defined reference period. The uptake of kW days by gear grouping is now regulated by individual member states whereas in the earlier days-at-sea system, the number of days permissible by gear grouping was allocated as part of the annual TAC and quota regulations and included derogations for a wide range of gears. The application of the new harvest control rule stipulates that if cod stocks are considered to be below minimum spawning stock levels, then fishing mortality should be reduced by 25%. In 2009 this resulted in a reduction in effort allocation for VIa of 25%. Both the earlier days-at-sea scheme and the current kW days system have resulted in a switching of effort away from VIa and into other areas not covered by 1342/2008 e.g. Rockall and the Celtic Sea.

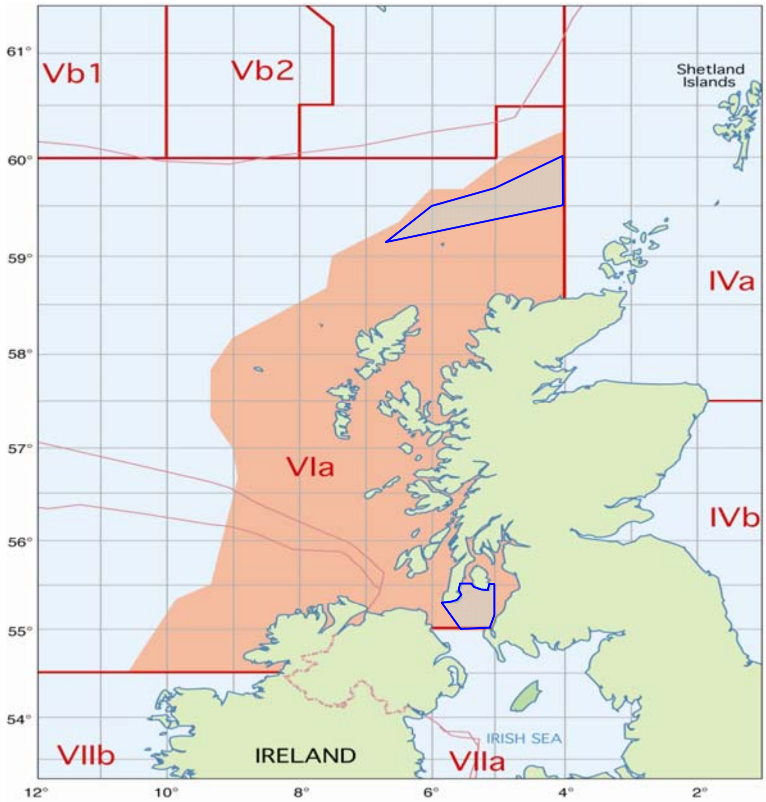


Figure 3.1.1 West of Scotland management line: fshing activity within the shaded area is prohibited until 31 December 2009 with a number of permitted derogations. Areas with blue borders indicate the positions of the "windsock" closure (north of 59°) and the Clyde closure (just north of 55°, west of 5°)

Although the regulation is likely to have resulted in some degree of effort displacement, the provisions of Article 13 of 1342/2008 allow member states to recoup all or part of the effort reductions applied in 43/2009. Various national programmes have been enacted in 2008 and 2009 that aim to reduce cod catches through a range of measures including spatial and temporal avoidance plans and technical measures.

In 2008 the Scottish administration introduced the Conservation Credit Scheme The principle of this two part scheme involves credits (in terms of additional time at sea) in return for the adoption of, and adherence to, measures which reduce mortality on cod and lead to a reduction in discard numbers. The initial, basic scheme was implemented from the beginning of February 2008 provides incentives (by way of additional effort allocations) in return for observance of Real Time Closures (RTC), observance of a one net rule, adoption of more selective gears, agreeing to participate in additional gear trials and participation in an enhanced observer scheme. UK and Irish authorities have recently submitted applications to the EC with proposals to reduce cod catches. It is premature to state what the likely impact of these initiatives will be on cod and other species. It is important to note that if fully implemented as intended, these measures could result in significant reductions in cod catches through 2009.

Other measures

Emergency measures were enacted in 2001 for the west of Scotland, consisting of area closures from 6 March–30 April, in an attempt to maximize cod egg production. These measures were retained into 2003 and subsequent years. A new closed area (often termed the windsock) was implemented to the west of Scotland in 2004 under Council Regulation (EC) No 2287/2003 and has remained in force since. Both the Clyde closed area and the windsock are shown in Figure 3.1.1.

STECF (2007) evaluated the effectiveness of the windsock closure and concluded "*any effect on the primary objective of allowing as many cod to spawn in 2001 cannot be disentangled from other causes of changes in SSB, recruitment or F. However, estimates of $F_{2\text{-}5}$ decreased and SSB increased in 2001 and 2002, while recruitment decreased in 2001, but increased in 2002 (ICES 2003). Research vessel indices during the spawning season did indicate an increase in SSB in the northern part of VIa in 2001 relative to previous years (Holmes et al., in review). However, SSB subsequently fell in the following years and is now at very low levels. The closure seems to have little effect on the demersal fish community. No effect was detected for cod or any of the other main commercial stocks. The closure may have affected some non-commercial species since a highly positive effect was observed for some species, e.g. lesser spotted dogfish.*"

3.1.3 Changes in fishing technology and fishing patterns

During 2009, a significant change in the regulations affecting fisheries in VIa has been introduced. Annex III, article 6.1 (EC 43/2009) introduced further restrictions on fishing for cod, haddock and whiting in ICES zones VI. This prohibited the use of all fishing gear inside 200 m until 31 December 2009. Anecdotal information from the industry and WGFTFB (2009) suggests that this regulation has had an impact on fleet behaviour since their introduction. There are a number of derogations to this article and for the main demersal trawl fisheries for finfish and *Nephrops*, this has resulted in the introduction of measures to increase gear selectivity. The derogations are as follows:

- Inshore static nets fixed with stakes, scallop dredges, mussel dredges, draft nets and beach-seines, pots and creels within the specified areas and time periods, provided that: no fish other than salmon, shellfish and crustacea are retained on board, landed or brought ashore.
- Fishing activities using nets of mesh size less than 55 mm, provided that:
    - (i) no net of mesh size greater than or equal to 55 mm is carried on board; and
    - (ii) no fish other than herring, mackerel, pilchard/sardines, sardinelles, horse mackerel, sprat, blue whiting and argentines are retained on board.
- Trawling for *Nephrops* trawling provided that:
    - (i) the fishing gear used incorporates a sorting (Swedish) grid or a square-mesh panel as described in Appendix 5 to this Annex;
    - (ii) no less than 30% of the retained catch by weight is made up of *Nephrops;*
    - (iii) no more than 10% of the retained catch by weight is composed of any mixture of cod, haddock and/or whiting; and
    - (iv) the fishing gear is constructed with a minimum mesh-size of 80 mm.
- Fishing with trawls, demersal seines or similar gears provided that:
    - (i) all nets on board the vessel are constructed with a minimum mesh-size of 120 mm for vessels more than 15 metres overall length and of 110 mm for all other vessels;

(ii) no more than 30% of the retained catch by weight is comprised of any mixture of cod, haddock and/or whiting;

(iii) where the catch retained on board comprises less than 90% saithe the fishing gear used incorporates a square-mesh panel of 120 mm for vessels >15 m;

(iv) where the overall length of the vessel is less than or equal to 15 m, regardless of the quantity of saithe a square mesh panel of 110 mm.

For the Irish fleet operating in the southern part of VIa (Stanton bank), qualitative observations suggest that increase in mesh size has reduced activity in the area, and has encouraged activity towards other areas. This is largely as a consequence of the loss of flatfish species such as megrim and black sole. Similarly, Scottish industry sources contend that the regulations have encouraged activity towards targeting anglerfish. Until logbook and VMS data from 2009 is available, it is not possible to quantify the extent of this effort displacement. Given that the West of Scotland management line dissects individual statistical rectangles, integrated logbook and VMS analysis is required to quantify both the potential effort displacement and changes in landings composition.

The Irish Sea Fisheries Board (BIM) has recently completed selectivity trials to quantify the codend selectivity of the newly regulated mesh sizes. These trials highlight significant increases in L50 for a range of species including haddock, hake and whiting with L50’s of 38, 47 and 41cm respectively with the 120 mm mesh with a 120 mm square mesh panel combination.

3.1.4 Impacts of fisheries on the ecosystems

As well as the current poor state of many north and western fish stocks, particular environmental problems caused by fisheries in this area include:

- Bycatch of fulmars on longlines. There have been only a few studies in this area, and no definitive catch rate is known, however an annual catch of 10 000+ has been estimated.
- Bycatch and discards in demersal fisheries are high. For example, the *Nephrops* fishery discards large amounts of juvenile haddock and whiting. Juvenile cod are also discarded from other demersal fisheries. The loss of these juvenile fish will be a serious impediment to future stock rebuilding, although conversely many seabirds are thought to thrive on discards.
- Damage to the Darwin Mounds, a globally unique site holding the cold-water coral *Lophelia pertusa*. Although located at 1000 m depth some 150 km NW of the Outer Hebrides, these are susceptible to damage by trawling. In 2003, the Darwin Mounds were given emergency protection through the CFP which banned demersal fishing. This protection was made permanent in August 2004.
- Damage to areas around Rockall containing coral, such as the Empress of Britain Bank, Logachev mounds and Northwest Rockall closures.
- Seamount habitats and deep-sea fisheries. Seamounts are underwater mountains rising over 1000 m. As a consequence of strong localized currents and upwellings, they are hot spots of marine biodiversity often with large numbers sharks, marine mammals and seabirds. They are also important areas for deep-sea fisheries. Concern regarding overexploitation of long-lived, slow growing, late maturing species such as the orange roughy

is increasing. The Hebridean Terrace Seamount is thought to be inhabited by the main component of the spawning stock for orange roughy. In addition, trawling impacts on the benthic communities which include deep-water coral species. OSPAR have placed seamounts on their list of threatened habitats that require conservation. No moves, however, are currently being made by the European Union to protect seamounts.

3.2 Cod in Subarea VIa

Cod in Division VIa is included in the revised EU long-term management plan for cod stocks and the fisheries exploiting those stocks (Council Regulation (EC) 1342/2008). An update assessment was conducted this year by the WG.

ICES Advice applicable to 2008

Exploitation boundaries in relation to existing management plans

The management plan is not explicit about the level of reduction in the catch when the stock is below $\mathbf{B}_{lim}$. Furthermore, because of the uncertainty in the level of fishing mortality, ICES is not in a position to give quantitative forecasts. Previous simulations demonstrate that fishing should be closed for 3 years in order to bring SSB above $\mathbf{B}_{lim}$.

Exploitation boundaries in relation to precautionary limits

Given the very low SSB estimates, the high total mortality and low recruitment in this stock, ICES advises zero catch of cod in 2008.

Conclusion on exploitation boundaries

As the recovery plan for this stock is considered to be consistent with the precautionary approach only when the fishery is closed for an initial period, and as this is congruent with the advice in relation to precautionary limits, ICES advises a zero catch of cod in 2008.

ICES Advice applicable to 2009

Exploitation boundaries in relation to existing management plans

The management plan is not explicit about the level of reduction in the catch when the stock is below B_{lim}. Furthermore, as a consequence of the uncertainty in the level of fishing mortality, ICES is not in a position to give quantitative forecasts. Simulations conducted in 2006 demonstrated that fishing should be closed for 3 years in order to bring SSB above B_{lim}.

Exploitation boundaries in relation to precautionary considerations

Given the low SSB and low recruitments in recent years, it is not possible to identify any non-zero catch which would be compatible with the precautionary approach.

3.2.1 General

Stock definition and the management unit

General information about the stock can be found in the stock annex and an overview of the fisheries West of Scotland can be found in Section 3.1. The assessment unit is VIa but a TAC is set for ICES Areas Vb (EC waters), VI, XII and XIV. The 2008 and 2009 TACs for cod in the management unit were 402 t and 302 t respectively. For 2009, however, the amount that may be taken in ICES Areas VIa and Vb (EC waters) is explicitly stated as 240 t.

Management applicable to 2008 and 2009

The minimum landing size of cod in the human consumption fishery in this area is 35 cm.

Technical measures applicable to the West of Scotland, including those associated with the cod recovery plan in force in 2008 (Council Regulation No. 423/2004) and in the new cod long-term management plan in force in 2009 (Council Regulation No. 1342/2008), are described in Section 3.1.

The following table summarizes ICES management advice and EU management applied for cod in Division VIa during 2001–2008:

Year	Catches corresponding to ICES advice (t)	Basis	TAC for Vb (EC), VI, XII, XIV (t)	TAC for Vb (EC) and VIa	% change in F associated with TAC1
2001	-	Lowest possible F, recovery plan	3700	-	-50%
2002	-	Recovery plan or lowest possible F	4600	-	-10%
2003	-	Closure	1808	-	-60%
2004	-	Closure	848	-	-80%
2005	-	Closure	721	-	(no assessment)
2006	-	Closure	613	-	(relative trends assessment only)
2007	-	Closure	490	-	>-80%
2008	-	Closure	402	-	>-80%
2009	-	Closure	302	240	>-80% (TAC=302t)

[1]**Based on *F*-multipliers from forecast tables.**

The fishery in 2008

Cod is believed to be no longer targeted in any fisheries now operating in ICES Division VIa. Quota uptake in 2008 by the UK fleet was however exactly 100%, (data from UK government taking into account quota swaps). The table of official catch statistics is given in Table 3.2.1. Comparing the totals provided by nations to the TAC overall the TAC has been overshot.

Because of restrictive TACs, seasonal/spatial closures of the fishery, and effort restrictions based on bycatch composition the probability of misreporting and under reporting of cod in the past is considered to have been high. From 2006 the Registration of Buyers and Sellers legislation in the UK and Sales Notes management system in Ireland are considered to have reduced to low or negligible levels under reporting (see Section 3.1). Misreporting, however, is still believed to take place in the UK. Area misreporting will, for example, see cod caught in VIa declared as taken from the Faroe region or ICES Area IVa. The Buyers and Sellers legislation introduced in 2006 is also believed responsible for a significant increase in discards starting in 2006. Since 2006, the estimated weight of discards has greatly exceed landings (Table 3.2.2), and discarding has taken place over all age groups (Tables 3.2.6 and 3.2.7 and Figure 3.2.1). Numbers discarded have been relatively high from the 2005 year class at-age 1 in 2006 through to age 3 in 2008 (Table 3.2.6).

Tables and figures of total effort by the fleets operating in Division VIa can be found in Section 3.1 (Section 16 last year).

3.2.2 Data

An overview of the data provided and used by the WG is provided in the following text table:

	Commercial Data				Survey Data			
	Landings		Discards		Cpue at-age			
	No. at-age	Wght. at-age	No. at-age	Wght. at-age	ScoGFSQ1	ScoGFSQ4	IreGFS	IRGFS
Available	1978–2008 Ages : 1–7+	1978–2008 Ages : 1–7+	1978–2008 Ages : 1–7+	1978–2008 Ages : 1–7+	1985–2009 Ages : 1–7	1996–2008 Ages : 0-8	1993–2002 Ages : 0–3	2003–2008 Ages : 0–3
Used	1978–1994 Ages : 1–7+	1978–2008 Ages : 1–7+	1978–1994 Ages : 1–7+	1978–2008 Ages : 1–7+	1985–2009 Ages : 1–6	NOT USED	NOT USED	NOT USED

A plot of log catch curve gradient derived from commercial catch data is shown in Figure 3.2.2. The trend in gradients over time appear fairly consistent between the age ranges considered (2–5, 2–4 and 3–5) except for the most recent (2004) cohort. The implication from the figure is of an increasing rate of mortality for cohorts spawned during the 1990s but a considerable reduction in mortality for the 2002, 2003 and 2004 cohorts. Landings and discard data numbers-at-age are, however, only included in the assessment up to 1994 because of concerns over deteriorating quality of landings data.

Annual mean weights-at-age in landings, discards and catch are given in Tables 3.2.5, 3.2.7 and 3.2.9. Weights-at-age for the stock are still required to obtain biomass estimates and so the full series of stock weights are used. Figure 3.2.1 shows the mean weights-at-age in the landings and discards. There is no evidence of a trend in weight-at-age for ages 1 and 2 for VIa cod landings, but some evidence of a gradual long-term decline at-age 3 and above.

Raised discard numbers-at-age are given in Table 3.2.6. Increased discards from 2006 are considered an indicator of the combined effect of restrictive quotas and new regulation. The age distribution of discards in 2007 and 2008, however, also provide supporting evidence of a 2005 year class larger than the recent average. A consequence of the current assessment model configuration is that the change in discarding practices from 2006 as demonstrated in Tables 3.2.2 and 3.2.6 have no influence on the final assessment. The likely reduction in unallocated landings from 2006 suggest a future benchmark should consider re-instating commercial data from 2006 but there are still concerns about area misreporting and an assessment of the scale of misreporting needs to be completed before a benchmark.

All available survey data are given in Table 3.2.3, with the data used in the assessment highlighted in bold. Survey descriptions are given in the stock annex. Figure 3.2.3 shows cpue (at lengths >23 cm) by ICES statistical rectangle from 2008 for the ScoGFSQ4 and IRGFS surveys and from 2009 for the ScoGFSQ1 survey. Figure 3.2.4 shows log catch curves for the ScoGFSQ1 survey. It demonstrates a strong "hook" at the younger ages, with abundance-at-age two often higher than at-age one. The index of the 2005 year class has, however; also increased from age 2 to age 3 and the survey's ability to track recent cohorts is poor.

Values for natural mortality (0.2 for all ages and years) and the proportion of fish mature-at-age are unchanged from the last meeting. The proportion of F and M acting before spawning is set to zero.

A study by the sea mammal research unit (SMRU) on seal predation has indicated that seal predation on cod probably constitutes significant natural mortality over and above values assumed in the assessment. A working document looking at the significance of seal predation to perceptions of the VIa cod stock was submitted to WGNSDS 2008.

A plot of log catch curve gradient derived from the ScoGFSQ1 data is shown in Figure 3.2.5. For cohorts after 1995 index values of zero have sometimes been recorded at-age five. For the age ranges considered (2–5, 2–4 and 3–5) this means the slope has not always been fitted to data from all the ages indicated. There is little consistancy in results between age ranges chosen and this appears to worsen after the 1995 or 1996 cohort. The series for ages 2–5 seems more stable than the others in this later period. Overall, information on mortality trends from the survey-series appears weak.

3.2.3 Historical stock development

This update assessment uses a TSA run as outlined in the stock annex.

Model settings and input parameter settings for the final run are given in Table 3.2.10 and final parameter estimates from the TSA run are given in Table 3.2.11, alongside final run estimates for VIa cod from previous WGs. Standardised prediction errors at-age from the update assessment run (which can be interpreted as residuals) are shown in Figure 3.2.7 (landings), Figure 3.2.8 (discards) and Figure 3.2.9 (ScoGFSQ1). Errors within ±2 are considered reasonable. No prediction errors against the 2009 survey data fall outside ±2 such that no data points for this year were downweighted.

It is important to note that the assessment is based on survey estimates of mortality with corresponding population abundance. While the assumed natural mortality rate (M=0.2) is excluded from the estimates of 'fishing mortality', unallocated removals from the stock as a result of the fishery or other sources are not and are therefore also included in the estimates of 'fishing mortality' used in the forecast. The WG consider the mortality outputs from TSA not to represent F at-age but rather estimated total mortality that cannot be accounted for by the standard value used for natural mortality. These mortality estimates are here referred to as 'Z-0.2'. For management purposes, however, this combined mortality would still need to fall below the level of Flim, as higher levels of mortality over and above M are considered to have led to stock decline in the early 1980s.

Table 3.2.12 gives the TSA population numbers-at-age and Table 3.2.13 gives their associated standard errors. Estimated Z-0.2 at-age is given in Table 3.2.14 and standard errors on the log of this mortality are given in Table 3.2.15. Full summary output is given in Table 3.2.16.

A summary plot for this run is shown in Figure 3.2.6. The disparity between the estimated total catch compared with the supplied commercial data is clear. There was a reduction of this disparity in 2006 and 2007 but it has increased again in 2008 (see also Figure 3.2.15). There is a noticeable long-term downward trend in recruitment although the value for 2006 is the highest value since 1997. SSB rose steeply in 2007 and the estimate for 2008 is a little above that for 2007 but is still well below B_{lim}. Mean Z-0.2 is above F_{lim} and comparable to values since 1995.

Retrospectives for the final assessment run are shown in Figure 3.2.10. This figure also shows lines at ± 2 se (approximate 95% confidence limits) around the run using all years of data. Retrospective bias is small with respect to SSB. With respect to recruitment the run terminating in 2006 sits on the lower confidence limit whereas that terminating in 2005 falls just outside this limit. Higher levels of Z-0.2 from the run terminating in 2005 appear untypically high but fall within the confidence limits for this metric. The confidence interval for mean Z-0.2 is wide, reflecting uncertainty in estimation of mean Z-0.2 when that estimation is based on the age structure present in survey data.

The TSA estimated stock–recruit relationship is shown in Figure 3.2.11. It includes the data point of the 1986 year class which from inspection of Figure 3.2.11 appears an outlier.

Comparison with last year's assessment

Compared with last year's assessment SSB in 2007 has been revised down from 6276 t to 5836 t while the estimate of mean Z-0.2 has risen from 0.79 to 0.82. The estimate of recruitment in 2007 is revised up from 2.4 million to 2.7 million. The estimate of SSB in 2008 from this update assessment is 6488 t with an s.e. of 858 t. The short-term forecast from last year's assessment predicted SSB in 2008 at 7470 t which is slightly greater than one s.e. difference from the update assessment. Figure 3.2.10 shows these revisions represent comparatively small retrospective adjustments.

Section 15 reveals a comparison of SSB, recruitment-at-age one and mean F (2–5) estimates produced by final run assessments between this year's assessment and assessments going back to 2001.

3.2.4 Short-term stock projections

A short-term projection was made using WGFRANSW following the procedure outlined in the stock annex.

Estimating recruiting year-class abundance

The recruitment values (000 fish) used in the forecast are given in the following table:

YEAR	TSA	STF
2009	5435 (ScoGFSQ1)	5435 (ScoGFSQ1)
2010	6204 (Ricker)	5145 (GM 98-07)
2011		5145 (GM 98-07)

Three-year means of the Z-0.2 estimates were taken to represent status quo mortality. At previous assessment meetings the status quo mortality was used in the intermediate and TAC years. The cod long-term management plan introduced in 2009 (Council Regulation No. 1342/2008, article 6, paragraph 4), however, directs that forecasts "assume that in the year prior to the year of application of the TAC the stock is fished with an adjustment in fishing mortality equal to the reduction in maximum allowable fishing effort that applies in that year." Fishing effort (days-at-sea) and TAC were both reduced by 25% in 2009 compared with 2008. Although not considered a measure of F the status quo Z-0.2 was reduced by 25% for the intermediate-year in the forecast (2009). The management options table from this first run demonstrated SSB to be below B_{lim} at the start of 2010. Following article 6, paragraph 2(a) of the new cod management plan status quo Z-0.2 was reduced by a further 25% for 2010 with the aim of producing more representative detailed tables.

Input data to the short-term projection is displayed in Table 3.2.17. Management options from the forecast are demonstrated in Table 3.2.18 and detailed tables of catch numbers-at-age are demonstrated in Table 3.2.19.

A plot of the short-term forecast is shown in Figure 3.2.12. Results from sensitivity analysis from this forecast are shown in Figure 3.2.13 and probability profiles in Figure 3.2.14. It is emphasized again that the outputs from the forecasting software include figures labeled as "H-cons" do not refer to the human consumption fishery but in the present application refer to all removals over and above the losses as a result of the assumed natural mortality rate of M=0.2. These values will include estimates of unallocated fishery removals that may be as a consequence of misreporting and mixing of cod stocks across management boundaries, or additional natural mortality not encompassed by the standard value of M=0.2. The WG recommends that these forecasts are not used to determine a future TAC using the procedure specified in Article 7 of the new long-term management plan for cod, as it is not possible to determine figures for unallocated fishery removals to deduct from the forecasted total removals to calculate the TAC for 2010.

Estimates of SSB corresponding to the different levels of the Z-0.2 mortality should, however, remain appropriate. From Table 3.2.18 it can be seen that even with removals in 2010 reduced to zero SSB is not predicted to reach B_{lim} by 2011.

3.2.5 Medium-term stock projections

Medium-term predictions are not being made for VIa cod at this WG. It was felt that recruitment cannot be assumed to conform to historical patterns as the stock is at a historic low.

3.2.6 Biological reference points

ICES has defined the following PA reference points:

Reference point	Technical basis
Bpa=22 000 t	Previously set at 25 000 t, which was considered a level at which good recruitment is probable. This has since been reduced to 22 000 t because of an extended period of stock decline.
Blim=14 000 t	Smoothed estimate of Bloss (as estimated in 1998).
Fpa=0.6	Consistent with Bpa.
Flim=0.8	F values above 0.8 led to stock decline in the early 1980s.

A figure of yield-per-recruit is given in Figure 3.2.16. Input data are as for the short-term forecast (Table 3.2.17). The corresponding reference points are:

	Z-0.2	Yield/R	SSB/R
	Ages 2–5		
Average last 3 years	0.85	0.83	1.13
Fmax	0.21	1.49	7.60
F0.1	0.14	1.41	10.86
Fmed	0.74	0.91	1.42

The precautionary approach plot for this stock is given in Figure 3.2.17. It demonstrates clearly how the stock has moved and remained in the zone indicating reduced reproductive capacity and (substituting Z-0.2 for F) unsustainable removals.

3.2.7 Management plans

Cod in VIa is included in Council Regulation No. 1342/2008 establishing a long-term plan for cod stocks and fisheries exploiting those stocks. The plan and its evaluation by ICES are discussed in Section 9.

3.2.8 Uncertainties and bias in assessment and forecast

Landings

Since the early 1990s the most significant problem with assessment of this stock is with commercial data. Incorrect reporting of landings-species and quantity-is known to have occurred and directly affects the perception of the stock.

Effort

Commercial effort data for Division VIa from the Scottish fleets is considered very uncertain and was not used in the assessment.

Discards

In the current set-up used for this assessment discard information is removed for the same years for which landings data are removed. The increase in discards at-ages one and two since 2006 is not therefore able to influence the fit of discard parameters. Furthermore, the TSA model for VIa cod is formulated to only consider discards at-ages one and two. Discards have also been recorded at older ages since 2006 and if this continues in future years, re-inclusion of discard data would probably require modification of the model to fit discard proportions across more ages.

Available discard estimates are calculated mainly from the Scottish sampling programme. The method used is to sample on a stratified basis then raise by some auxiliary variable to, initially, total strata discards, and ultimately international discards. These estimates are prone to bias. At WGNSDS 2004 a new method of raising discard data was introduced (WD 2), using the same raw data, and which will reduce estimation bias. The method is being applied and tested on data from both the Northern Shelf and North Sea regions before the resulting revised data are released to assessment working groups. Data using the new method was therefore not available for this year's assessment.

Surveys

The survey used for this assessment changed vessel and tow duration in 1999. Although a correction has been made based on comparative tows, there will be an additional variance associated with this correction factor which will affect the survey index. The current spatial aggregation of the survey (weighted arithmetic mean) can result in hauls catching large numbers of fish having a strong influence on index values (as was the case in the ScoGFSQ1 in 2008). This in turn can cause a 'noisy' set of indices that can lead to high prediction errors from TSA (and it is standard practice when using TSA to down weight data points that cause high prediction errors). The current weighting of strata (weighting by number of valid hauls) is also not consistent between years leading to further increase in the overall estimation of survey variance by TSA. Ways of compiling the survey that can better incorporate extreme values, including new post stratification and strata weightings, are currently under investigation and are proposed for consideration at a future data compilation workshop.

Biological factors

Assumptions on mean weight-at-length and mean maturity-at-age have remained unchanged for a long period. However, biological responses of cod in VIa as a localized species to high exploitation and low population numbers are so far unknown to the Working Group. Estimates of high predation consumption of cod relative to total-stock biomass have raised concerns that natural mortality of cod at younger ages may be significantly greater than the standard value of 0.2 currently assumed and will have changed significantly over the period of the historical assessment.

Forecasts

Short-term forecasts are sensitive to the estimation of status quo mean fishing mortality. The WG considers mortality estimates arising from an assessment heavily or wholly based on survey data are poorly estimated and therefore noisy and sensitive to survey catchability. In addition, for VIa cod only one survey series has been considered sufficiently long and self-consistent for use in assessment.

Natural mortality on cod at some or all ages is considered to have become greater than can be accommodated by the standard natural mortality figure of M=0.2. It is also possibly subject to a persistent upward trend. As a consequence, mortality outputs from TSA (or any model reliant on survey data) are not considered to represent a fishing mortality F at-age for recent years in the time-series but rather estimates, (referred to here as 'Z-0.2'), of total mortality that cannot be accounted for by the standard value used for natural mortality. It is not possible to determine the proportion of the mortality caused by fishing and therefore not possible to partition F into landings and discard F. Until a better estimate of natural mortality can be determined short-term forecasts are only appropriate to considering the SSB corresponding to the different levels of the Z-0.2 mortality.

3.2.9 Recommendation for next Benchmark

PROBLEM	SOLUTION	EXPERTISE NECESSARY	SUGGESTED TIME
Misreporting of landings. Unknown level prevents adjustment of reported catch and inclusion in assessment.	Analysis of VMS data compared with landings declarations to estimate the degree of area misreporting.	Requires someone familiar with VMS analysis (plus provision of trip specific landings declarations).	Work possible in 2009.
Bias in discard estimates	Adoption of new discard raising methodology.	New discard raising methodology being developed as part of a PhD project.	PhD unlikely to be finished before 2012.
Inappropriate modelling of discards within TSA model	Revision of TSA to allow fitting of a discard ogive for years when sufficient ages are present in the discards.	Requires someone familiar with FORTRAN and preferably TSA routines.	Work scheduled for 2009.

PROBLEM	SOLUTION	EXPERTISE NECESSARY	SUGGESTED TIME
Variance and bias in survey index	Adoption of new aggregation methods to form final indices from haul by haul data, (combinations of new post stratification, weighting of strata and/or adoption of statistical approaches such as fitting of GAM or delta distribution models).	Work being undertaken as a Marine Scotland Science research project.	Project due for completion in 2010.
	Inclusion of additional surveys (ScoQ4GFS and IRGFS). ScoGFSQ4 indices to be formed in same manner as ScoGFSQ1 after conclusion of above project.		Comparison with existing assessment setup (single survey) possible in 2010 (after conclusion of above project).
			Charter surveys funded for 2009.
	Addition of new survey effort and/or revision of survey design.		Revised/augmented survey possible from 2010.
Uncertainty in natural mortality (level and trend) because of unquantified predation from large and increasing seal population.	Revision of TSA to allow inclusion of different fleets, (this in turn allows estimates of age specific consumption of cod by seals to be input as if from an additional fleet).	Requires someone familiar with FORTRAN and preferably TSA routines.	Method for estimating age specific consumption of cod by seals presented at 2008 ICES ASC. Work to adjust TSA scheduled for 2009.

3.2.10 Management considerations

Survey information demonstrates that the total removal of cod in Division VIa may have been underestimated in the past decade relative to earlier periods. In an attempt to remove bias in the assessment a catch-at-age model was used that ignored landings and discard data from 1995 onwards, relying on survey data for this later period. It is, however, considered that mortality estimates arising from an assessment heavily or wholly based on survey data are poorly estimated and therefore noisy and sensitive to survey catchability. In contrast, historical trends in spawning biomass and recruitment appear to be robust measures of stock dynamics.

The fishery is managed by a combination of TAC, area closures, technical measures and effort restrictions. These do not seem to have been effective in controlling catches. Despite considerable reductions in fishing effort over the past decade, the stock structure is still truncated with few older fish present.

Although the UK 'Buyers and Sellers' and Irish 'Sales Notes' legislation is considered to have reduced underreporting from 2006, discard data reveals increased discards-at-ages one and two and a change in discard practices such that fish are discarded at older ages. This suggests the legislation has controlled landings rather than catch. There are also reports of continued area misreporting. The ScoGFSQ1 survey data indicated the 2005 year class to be the biggest within the last decade. Both discards at higher ages and area misreporting reduce the potential of the 2005 year class to contribute to increases in SSB. It is important good observer coverage is conducted in Division VIa to record discard trends in future and that work is done to estimate area misreporting (comparing declared landings to VMS data).

Cod is taken in mixed demersal fisheries, and in Division VIa is now regarded as a bycatch species. To greatly reduce cod catch would likely result in having to greatly reduce harvesting of other stocks such as haddock, whiting and anglerfish.

The EU cod long-term management plan, (Council Regulation No. 1342/2008) is complemented by a system of fishing effort limitation. The effort baselines introduced for 2009 effectively give vessels with gears using mesh sizes of 70–89 mm and 90–99 mm, and with landings compositions with a small percentage of cod, between two and three times greater days-at-sea than vessels using gears with mesh sizes of 100–119 mm or ≥120 mm. Such differences in previous effort regulations effectively encouraged vessel operators to change fisheries, particularly to *Nephrops* trawling. The landings composition restrictions do not restrict discards. It is important the bycatch from the *Nephrops* fleet is closely monitored (including discard observations).

Article 7 (paragraph 1) of the current management plan requires TACs to be calculated after removal of quantities of discards and fish corresponding to other sources of cod mortality caused by fishing. The current assessment of VIa cod is considered to estimate a mortality that is a combination of mortality from fishing and natural mortality not accounted for by the standard long-term input value. As such mortality from landings, discards and other causes as a consequence of fishing cannot be defined.

A report by the Sea Mammal Research Unit (SMRU, 2006) gives estimates of cod consumed by grey seals to the west of Scotland and although highly uncertain, the estimates suggest predation mortality on cod is greater than can be accommodated by the standard value of natural mortality used for gadoid species in ICES Division VIa. It has not been possible using an update assessment to quantify the level of mortality caused by seal predation. This is proposed for a benchmark assessment, (see Section 3.2.9). The mean fishing mortality reference points for VIa cod were determined under the assumption of M=0.2. The values of mean Z-0.2 from the current assessment are estimates of mortality over and above M i.e. mortality from fishing plus non fishing mortality which cannot be encompassed within the standard value for natural mortality. For management purposes this combined mortality would still need to fall below the level of F_{lim}, as higher levels of mortality over and above M are considered to have led to stock decline.

Table 3.2.1. Cod in Division VIa. Official catch statistics in 1985–2008, as reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	48	88	33	44	28	-	6	-	22	1	2	+	11	1	+	+	2	+						
Denmark	-	-	4	1	3	2	2	3	2	+	4	2	-	-	+	-	-	-						
Faroe Islands	-	-	-	11	26	-	-	-	-	-	-	-	-	-	-	-	-	-		2	0	0.8	12	1
France	7,411	5,096	5,044	7,669	3,640	2,220	2,503	1,957	3,047	2,488	2,533	2,253	956	714*	842*	236	391	208	172	91	107	100.7	92	79.91
Germany	66	53	12	25	281	586	60	5	94	100	18	63	5	6	8	6	4	+	+			2	2	1
Ireland	2,564	1,704	2,442	2,551	1,642	1,200	761	761	645	825	1,054	1,286	708	478	223	357	319	210	120	34	27.9	18	70	58.2
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-					
Norway	204	174	77	186	207	150	40	171	72	51	61	137	36	36	79	114*	40*	88	45	10	17	30	30	65
Spain	28	-	-	-	85	-	-	-	-	-	16	+	6	42	45	14	3	11	3					
UK (E., W., N.I.)	260	160	444	230	278	230	511	577	524	419	450	457	779	474	381	280	138	195	79	46	25		21	
UK (Scotland)	8,032	4,251	11,143	8,465	9,236	7,389	6,751	5,543	6,069	5,247	5,522	5,382	4,489	3,919	2,711	2,057	1,544	1,519	879	413	243		260	
UK																						332.1		231.4
Total landings	**18,613**	**11,526**	**19,199**	**19,182**	**15,426**	**11,777**	**10,634**	**9,017**	**10,475**	**9,131**	**9,660**	**9,580**	**6,992**	**5,671**	**4,289**	**2,767**	**2,439**	**2,231**	**1,298**	**596**	**419.9**	**483.6**	**487**	**435.51**

*** Preliminary.**

Table 3.2.2. Cod in Division VIa. Landings, discards and catch estimates 1978–2008, as used by the WG. Values are totals for fish over the ages 1 to 7+. Values for 2007 have been revised compared with last year's assessment.

Year	Landings	Discards	Catch
1978	13521	3678	17199
1979	16087	54	16141
1980	17879	996	18875
1981	23866	520	24386
1982	21510	1652	23162
1983	21305	2026	23331
1984	21271	635	21906
1985	18608	8812	27420
1986	11820	1201	13022
1987	18975	8767	27742
1988	20413	1217	21629
1989	17171	2833	20004
1990	12176	326	12503
1991	10926	917	11843
1992	9086	2897	11983
1993	10315	192	10507
1994	8929	186	9115
1995	9438	257	9696
1996	9425	87	9513
1997	7033	354	7387
1998	5714	423	6137
1999	4201	98	4298
2000	2977	607	3584
2001	2347	224	2571
2002	2242	169	2412
2003	1241	49	1291
2004	540	75	615
2005	479	57	535
2006	463	478	940
2007	525	2104	2629
2008	451	909	1360

Table 3.2.3. Cod in Division VIa. Survey data made available to the WG. Data used in update run are highlighted in bold. For ScoGFSQ1, numbers are standardized to catch-rate per 10 hours.

ScoGFSQ1	Scottish west coast groundfish survey							
1985	2008							
1	1	0	0.25					
1	7							
10	**1.5**	**23.7**	**8.6**	**13.6**	**3.9**	**2.5**	1.2	1985
10	**1.5**	**6.9**	**26.8**	**5.6**	**7.3**	**2.5**	1.9	1986
10	**57.4**	**16.2**	**15.3**	**22.8**	**3.0**	**2.8**	0.0	1987
10	**0.0**	**64.9**	**14.2**	**3.4**	**2.1**	**0.7**	0.2	1988
10	**4.5**	**7.2**	**45.1**	**8.6**	**1.9**	**0.5**	0.8	1989
10	**2.0**	**24.6**	**4.1**	**14.7**	**4.2**	**1.6**	0.8	1990
10	**4.8**	**5.4**	**17.4**	**5.2**	**13.4**	**2.8**	0.5	1991
10	**7.3**	**11.5**	**5.4**	**7.6**	**3.4**	**2.3**	0.5	1992
10	**1.7**	**38.2**	**12.7**	**1.7**	**1.4**	**1.1**	0.0	1993
10	**13.6**	**14.7**	**25.1**	**5.8**	**1.0**	**0.0**	0.0	1994
10	**6.4**	**23.8**	**14.0**	**16.5**	**1.2**	**1.9**	0.7	1995
10	**2.8**	**20.9**	**24.1**	**4.1**	**2.8**	**1.3**	0.0	1996
10	**11.1**	**7.7**	**11.6**	**7.9**	**4.2**	**4.7**	1.0	1997
10	**2.8**	**30.9**	**5.3**	**8.7**	**3.7**	**0.6**	2.0	1998
10	**1.5**	**8.2**	**8.2**	**1.4**	**3.2**	**0.5**	0.5	1999
10	**13.3**	**5.4**	**6.9**	**1.3**	**0.0**	**0.4**	0.0	2000
10	**2.7**	**18.4**	**5.7**	**13.2**	**19.5**	**1.1**	1.6	2001
10	**5.3**	**4.3**	**10.6**	**2.6**	**0.5**	**3.0**	0.0	2002
10	**2.7**	**16.7**	**2.0**	**4.7**	**1.8**	**0.7**	0.4	2003
10	**5.7**	**3.0**	**5.6**	**2.3**	**1.7**	**0.0**	0.0	2004
10	**1.3**	**1.5**	**1.2**	**0**	**0**	**0.4**	0	2005
10	**2.2**	**1.9**	**1.1**	**0.3**	**0**	**0**	0.3	2006
10	**2.1**	**18.8**	**3.4**	**1.2**	**0**	**0.6**	0	2007
10	**0.8**	**2.1**	**44.2**	**6.3**	**0.8**	**0**	0	2008
10	**1.8**	**2.6**	**2.3**	**0.4**	**0**	**0**	0	2009

Table 3.2.3 cont. Cod in Division VIa. Survey data made available to the WG. For IreGFS, effort is given as minutes towed, numbers are in units.

IreGFS		Irish groundfish survey		
1993	2002			
1	1	0.75	0.79	
0	3			
1849	0.0	312.0	49.0	13.0
1610	20.0	999.0	56.0	13.0
1826	78.0	169.0	142.0	69.0
1765	0.0	214.0	89.0	18.0
1581	6.0	565.0	31.0	10.0
1639	0.0	83.0	53.0	6.0
1564	0.0	24.0	14.0	3.0
1556	0.0	124.0	4.0	1.0
755	3.0	82.0	28.0	2.0
798	0.0	50.6	2.2	1.2

Table 3.3 cont. Cod in Division VIa. Survey data made available to the WG. For ScoGFSQ4, numbers are standardized to catch-rate per 10 hours. "+" indicates value less than 0.5 after standardizing.

ScoGFSQ4	Quarter 4 Scottish groundfish survey								
1996	2008								
1	1	0.75	1.00						
0	8								
10	0	1	14	5	3	1	0	0	0
10	1	11	2	1	1	1	0	0	0
10	+	15	9	1	0	0	0	0	0
10	2	4	6	9	1	0	0	0	0
10	0	16	3	0	0	0	0	0	0
10	1	2	9	1	1	0	0	0	0
10	1	10	3	7	1	0	0	0	0
10	1	2	11	3	1	0	0	0	0
10	0	5	4	0	+	0	0	0	0
10	+	2	3	0	1	+	0	0	0
10	0	17	6	1	1	0	0	0	0
10	0	12.0	20.0	1.3	0.6	0	0.3	0	0
10	2	8	5	7	1	0	0	0	0

Table 3.2.3 cont. Cod in Division VIa. Survey data made available to the WG. For IRGFS, numbers are standardized to catch rate per hour.

IRGFS	Irish West Coast groundfish				
2003	2008				
1	1	0.79	0.92		
0	4				
1127	0	10	11	0	0
1200	0	24	10	1	0
960	63	13	7	0	2
1510	0	95	12	0	0
1173	0	219	31	8	3
1135	0	23	24	4	0

Table 3.2.4. Cod in Division VIa. Landings-at-age (thousands). Values for 2007 have been revised compared with last year's assessment.

	Age						
Year	1	2	3	4	5	6	7+
1966	384	2883	629	999	825	78	52
1967	261	2571	3705	670	442	264	67
1968	333	1364	3289	1838	215	171	151
1969	64	1974	1332	1943	759	149	170
1970	256	1176	1638	571	476	153	74
1971	254	1903	550	841	240	201	95
1972	735	2891	1591	409	501	108	110
1973	1015	1524	1442	583	161	193	104
1974	843	2318	778	1068	288	72	102
1975	1207	1898	1187	533	325	90	35
1976	970	3682	1467	638	256	215	56
1977	1265	1314	1639	624	269	87	79
1978	723	1761	999	695	286	97	75
1979	929	1612	2125	682	342	134	69
1980	1195	3294	2001	796	191	77	37
1981	461	7016	3220	904	182	29	20
1982	1827	1673	3206	1189	367	111	33
1983	2335	4515	1118	1400	468	148	60
1984	2143	2360	2564	448	555	185	59
1985	1355	5069	1269	1091	140	167	79
1986	792	1486	2055	411	191	40	30
1987	7873	4837	988	905	137	56	26
1988	1008	8336	2193	278	210	39	20
1989	2017	1082	3858	709	113	69	33
1990	513	4024	432	924	170	23	11
1991	1518	1728	1805	188	266	70	23
1992	1407	1868	575	720	69	58	24
1993	328	3596	1050	131	183	24	36
1994	942	1207	1545	280	56	51	20
1995	753	2750	700	630	70	15	11
1996	341	2331	1210	247	204	31	13
1997	1414	1067	989	281	66	62	7
1998	310	3318	293	174	57	16	9
1999	132	884	1047	64	48	24	9
2000	765	532	211	231	15	12	13
2001	96	1241	155	63	52	3	4
2002	337	340	522	41	13	14	4
2003	62	516	85	107	6	2	1
2004	44	92	85	11	26	2	1
2005	31	121	43	37	7	6	0.5
2006	17	91	72	21	13	2	1
2007	5	165	62	33	3	3	2
2008	0.07	27	88	16	10	1	2

Table 3.2.5. Cod in Division VIa. Mean weight-at-age in landings (kg).

	AGE						
Year	1	2	3	4	5	6	7+
1966	0.730	1.466	3.474	5.240	4.868	8.711	9.250
1967	0.681	1.470	2.906	4.560	6.116	7.394	8.058
1968	0.745	1.776	2.766	4.721	6.304	7.510	8.278
1969	0.860	1.284	2.821	4.259	6.169	6.374	7.928
1970	0.595	0.955	2.533	4.678	6.016	7.120	8.190
1971	0.674	1.046	2.536	4.167	6.023	6.835	8.100
1972	0.609	1.192	2.586	4.417	6.226	7.585	8.538
1973	0.597	1.181	2.784	4.601	5.625	7.049	8.611
1974	0.611	1.103	2.834	4.750	6.144	7.729	9.339
1975	0.603	1.369	3.078	5.302	6.846	8.572	10.328
1976	0.616	1.397	3.161	5.005	6.290	8.017	9.001
1977	0.629	1.160	2.605	4.715	6.269	7.525	9.511
1978	0.630	1.373	3.389	5.262	7.096	8.686	9.857
1979	0.693	1.373	2.828	4.853	6.433	7.784	9.636
1980	0.624	1.375	3.002	5.277	7.422	8.251	9.331
1981	0.550	1.166	2.839	4.923	7.518	9.314	10.328
1982	0.692	1.468	2.737	4.749	6.113	7.227	9.856
1983	0.583	1.265	2.995	4.398	6.305	8.084	9.744
1984	0.735	1.402	3.168	5.375	6.601	8.606	10.350
1985	0.628	1.183	2.597	4.892	6.872	8.344	9.766
1986	0.710	1.211	2.785	4.655	6.336	8.283	9.441
1987	0.531	1.312	2.783	4.574	6.161	7.989	10.062
1988	0.806	1.182	2.886	5.145	6.993	8.204	9.803
1989	0.704	1.298	2.425	4.737	7.027	7.520	9.594
1990	0.613	1.275	2.815	4.314	7.021	9.027	11.671
1991	0.640	1.095	2.618	4.346	6.475	8.134	10.076
1992	0.686	1.293	2.607	4.268	6.190	7.844	10.598
1993	0.775	1.316	2.940	4.646	6.244	7.802	8.409
1994	0.644	1.292	2.899	4.710	6.389	8.423	8.409
1995	0.606	1.148	2.857	4.956	6.771	8.539	9.505
1996	0.667	1.221	2.738	5.056	6.892	8.088	10.759
1997	0.595	1.210	2.571	4.805	6.952	7.821	9.630
1998	0.605	1.061	2.264	4.506	6.104	8.017	9.612
1999	0.691	1.039	2.194	4.688	6.486	8.252	9.439
2000	0.689	1.261	2.457	4.126	6.666	7.917	8.392
2001	0.654	0.988	2.679	4.568	5.860	7.741	9.386
2002	0.668	1.140	2.330	4.841	6.175	7.192	9.548
2003	0.671	1.016	2.312	3.854	6.220	8.075	8.839
2004	0.609	1.027	2.194	4.396	6.003	8.258	9.678
2005	0.776	1.172	2.624	4.118	4.908	6.753	10.240
2006	0.656	1.169	2.236	3.822	6.172	7.796	11.1
2007	0.476	0.976	2.512	4.285	6.491	7.733	8.810
2008	0.557	1.195	2.943	4.775	6.329	7.957	8.471

Table 3.2.6. Cod in Division VIa. Discard dataset from Scottish and Irish sampling programmes, ages 1–7, years 1978–2008. Data from 1978–2001 raised from Scottish sampling only; later data raised from Scottish sampling and Irish sampling when available (2004 and 2005 to date). Values for 2007 have been revised compared with last year's assessment.

A) Discards-at-age (thousands)							
	Age						
Year	1	2	3	4	5	6	7
1978	8904	1203	0	0	0	0	0
1979	11	119	0	0	0	0	0
1980	2758	0	0	0	0	0	0
1981	289	1475	0	0	0	0	0
1982	5264	2	0	0	0	0	0
1983	7371	1005	0	0	0	0	0
1984	2117	10	0	0	0	0	0
1985	43508	3122	0	0	0	0	0
1986	4483	10	0	0	0	0	0
1987	52582	159	0	0	0	0	0
1988	714	3256	0	0	0	0	0
1989	8443	25	0	0	0	0	0
1990	1835	158	0	0	0	0	0
1991	3255	319	0	0	0	0	0
1992	12498	143	2	0	0	0	0
1993	595	51	0	0	0	0	0
1994	773	2	0	0	0	0	0
1995	1111	126	0	0	0	0	0
1996	233	86	0	0	0	0	0
1997	1074	27	0	0	0	0	0
1998	472	837	3	0	0	0	0
1999	283	16	0	0	0	0	0
2000	2081	53	0	0	0	0	0
2001	216	373	0	0	0	0	0
2002	508	32	0	0	0	0	0
2003	77	38	8	0	0	0	0
2004	232	21	0	0	0	0	0
2005	108	20	0	0	0	0	0
2006	1242	48	25	2	3	1	0.1
2007	627	1651	56	42	3	3	0
2008	89	133	368	1	0	0	0

Table 3.2.7. Cod in Division VIa. Discard dataset from Scottish and Irish sampling programmes, ages 1–7, years 1978–2006. Data from 1978–2001 raised from Scottish sampling only; later data raised from Scottish sampling and Irish sampling when available (2004 and 2005 to date).

B) MEAN WEIGHT-AT-AGE IN DISCARDS (KG)

	Age						
Year	1	2	3	4	5	6	7
1978	0.37	0.321	0	0	0	0	0
1979	0.276	0.43	0	0	0	0	0
1980	0.361	0	0	0	0	0	0
1981	0.135	0.326	0	0	0	0	0
1982	0.314	0.392	0	0	0	0	0
1983	0.223	0.374	0	0	0	0	0
1984	0.298	0.435	0	0	0	0	0
1985	0.178	0.346	0	0	0	0	0
1986	0.267	0.305	0	0	0	0	0
1987	0.166	0.37	0	0	0	0	0
1988	0.296	0.283	0	0	0	0	0
1989	0.332	0.59	0	0	0	0	0
1990	0.132	0.454	0	0	0	0	0
1991	0.245	0.351	0	0	0	0	0
1992	0.22	1.03	2.382	0	0	0	0
1993	0.239	0.812	3.723	0	0	0	0
1994	0.24	0.365	0	0	0	0	0
1995	0.203	0.256	0	0	0	0	0
1996	0.226	0.389	0	0	0	0	0
1997	0.321	0.328	0	0	0	0	0
1998	0.23	0.367	0.59	0	0	0	0
1999	0.294	0.299	0	0	0	0	0
2000	0.28	0.421	0	0	0	0	0
2001	0.248	0.417	0	0	0	0	0
2002	0.263	1.021	0	0	0	0	0
2003	0.272	0.57	0.39	0	0	0	0
2004	0.258	0.581	0	0	0	0	0
2005	0.285	0.501	0	0	0	0	0
2006	0.259	1.291	2.649	3.499	6.24	5.581	11.122
2007	0.198	0.940	3.016	4.453	5.018	10.627	0
2008	0.220	0.976	2.046	4.047	7.937	0	0

Table 3.2.8. Cod in Division VIa. Total catch-at-age (thousands). Values for 2007 have been revised compared with last year's assessment.

	Age						
Year	1	2	3	4	5	6	7+
1978	9627	2965	999	695	286	97	75
1979	940	1731	2125	682	342	134	69
1980	3953	3294	2001	796	191	77	37
1981	749	8491	3220	904	182	29	20
1982	7091	1676	3206	1189	367	111	33
1983	9706	5520	1118	1400	468	148	60
1984	4260	2371	2564	448	555	185	59
1985	44863	8191	1269	1091	140	167	79
1986	5275	1495	2055	411	191	40	30
1987	60456	4996	988	905	137	56	26
1988	1722	11592	2193	278	210	39	20
1989	10459	1107	3858	709	113	69	33
1990	2348	4182	432	924	170	23	11
1991	4773	2047	1805	188	266	70	23
1992	13905	2011	577	720	69	58	24
1993	923	3647	1050	131	183	24	36
1994	1715	1209	1545	280	56	51	20
1995	1864	2877	700	630	70	15	11
1996	574	2417	1210	247	204	31	13
1997	2488	1094	989	281	66	62	7
1998	783	4155	296	174	57	16	9
1999	415	900	1047	64	48	24	9
2000	2846	585	211	231	15	12	13
2001	312	1614	155	63	52	3	4
2002	845	372	522	41	13	14	4
2003	139	554	93	107	6	2	1
2004	267	113	85	11	26	2	1
2005	139	141	43	37	7	6	0.5
2006	1259	139	97	23	15	2	1
2007	632	1816	118	75	5	7	2
2008	89	160	456	18	10	1	2

Table 3.2.9. Cod in Division VIa. Mean weight-at-age (kg) in total catch.

	AGE						
Year	1	2	3	4	5	6	7+
1978	0.389	0.946	3.389	5.262	7.096	8.686	9.857
1979	0.688	1.308	2.828	4.853	6.433	7.784	9.636
1980	0.440	1.375	3.002	5.277	7.422	8.251	9.331
1981	0.390	1.020	2.839	4.923	7.518	9.314	10.328
1982	0.411	1.467	2.737	4.749	6.113	7.227	9.856
1983	0.310	1.103	2.995	4.398	6.305	8.084	9.744
1984	0.518	1.398	3.168	5.375	6.601	8.606	10.350
1985	0.191	0.864	2.597	4.892	6.872	8.344	9.766
1986	0.334	1.205	2.785	4.655	6.336	8.283	9.441
1987	0.213	1.282	2.783	4.574	6.161	7.989	10.062
1988	0.595	0.929	2.886	5.145	6.993	8.204	9.803
1989	0.404	1.282	2.425	4.737	7.027	7.520	9.594
1990	0.237	1.244	2.815	4.314	7.021	9.027	11.671
1991	0.371	0.979	2.618	4.346	6.475	8.134	10.076
1992	0.267	1.274	2.606	4.268	6.190	7.844	10.598
1993	0.430	1.309	2.940	4.646	6.244	7.802	8.409
1994	0.462	1.291	2.899	4.710	6.389	8.423	8.409
1995	0.365	1.109	2.857	4.956	6.771	8.539	9.505
1996	0.487	1.191	2.738	5.056	6.892	8.088	10.759
1997	0.477	1.188	2.571	4.805	6.952	7.821	9.630
1998	0.379	0.921	2.248	4.506	6.104	8.017	9.612
1999	0.420	1.025	2.194	4.688	6.486	8.252	9.439
2000	0.390	1.186	2.457	4.126	6.666	7.917	8.392
2001	0.372	0.856	2.679	4.568	5.860	7.741	9.386
2002	0.424	1.130	2.330	4.841	6.175	7.192	9.548
2003	0.450	0.986	2.15	3.854	6.220	8.075	8.839
2004	0.314	0.945	2.194	4.396	6.003	8.258	9.678
2005	0.395	1.078	2.624	4.118	4.908	6.753	10.240
2006	0.264	1.211	2.341	3.797	6.184	7.031	11.103
2007	0.200	0.943	2.752	4.380	5.729	9.166	8.810
2008	0.220	1.013	2.219	4.731	6.371	7.957	8.471

Table 3.2.10. Cod in Division VIa. TSA parameter settings for the assessment run.

PARAMETER	SETTING	JUSTIFICATION
Age of full selection.	am = 4	Based on inspection of previous XSA runs.
Multipliers on variance matrices of measurements.	Blandings(a) = 2 for ages 6, 7+ Bsurvey(a) = 2 for age 1, 5, 6	Allows extra measurement variability for poorly sampled ages.
Multipliers on variances for fishing mortality estimates.	H(1) = 4	Allows for more variable fishing mortalities for age 1 fish.
Downweighting of particular data points (implemented by multiplying the relevant q by 9)	Landings: age 2 in 1981 and 1987, age 7 in 1989. Discards: age 1 in 1985 and 1992, age 2 in 1998. Survey: age 1 in 2000, age 2 in 1993, age 6 in 1995. Ages 4, 5, 6 in 2001 (the latter are from a single large haul, 24 fish > 75 cm in 30 mins.). Age 3 in 2008 (large haul near 4W line)	Large values indicated by exploratory prediction error plots.
Discards	Discards are allowed to evolve over time constrained by a trend. Ages 1 and 2 are modelled independently.	
Recruitment.	Modelled by a Ricker model, with numbers-at-age 1 assumed to be independent and normally distributed with mean η1 S exp(−η2 S), where S is the spawning-stock biomass at the start of the previous year. To allow recruitment variability to increase with mean recruitment, a constant coefficient of variation is assumed.	
Large year classes.	The 1986 year class was large, and recruitment-at-age 1 in 1987 is not well modelled by the Ricker recruitment model. Instead, N(1, 1980) is taken to be normally distributed with mean 5η1 S exp(−η2 S). The factor of 5 was chosen by comparing maximum recruitment to median recruitment from 1966–1996 for VIa cod, haddock, and whiting in turn using previous XSA runs. The coefficient of variation is again assumed to be constant.	

Table 3.2.11. Cod in Division VIa. TSA parameter estimates for 2002–2004, 2006–2008 assessments and final assessment presented this year. No final assessment using TSA was conducted in 2005. Run 3 from 2004 used a similar approach to this year's assessment.

Parameter	Notation	Description	2002 WG	2003 WG	2004 WG	2006 WG	2007 WG	2008 WG	2009WG
					Run3				
Initial fishing mortality	F (1, 1978)	Fishing mortality-at-age a in year y	0.03	0.64	0.64	0.6378	0.6337	0.6366	0.6373
	F (2, 1978)		0.25	0.62	0.57	0.5333	0.5889	0.5803	0.5797
	F (4, 1978)		0.67	0.82	0.66	0.5743	0.6879	0.5888	0.5886
Survey selectivities	Φ(1)	Survey selectivity-at-age a	0.83	0.33	0.47	0.6275	0.5425	0.4746	0.4809
	Φ(2)		4.41	1.98	3.19	3.5857	3.7292	3.2855	3.3317
	Φ(4)		18.28	10.65	14.92	15.9096	14.1997	14.0472	13.7891
Fishing mortality standard deviations	σF	Transitory changes in overall fishing mortality	0.10	0.04	0.07	0.0947	0.0741	0.0846	0.0850
	σU	Persistent changes in selection (age effect in F)	0.10	0.06	0.03	0.0242	0.0507	0.00	0.00
	σV	Transitory changes in the year effect in fishing mortality	0.00	0.07	0.10	0.0844	0.0984	0.1120	0.1117
	σY	Persistent changes in the year effect in fishing mortality	0.16	0.07	0.00	0.0425	0.00	0.00	0.00
Survey catchability standard deviations	σΩ	Transitory changes in survey catchability	0.24	0.00	0.00	0.1224	0.2374	0.2276	0.2498
	σβ	Persistent changes in survey catchability	0.00	0.45	0.00 (f)	0.00 (f)	0.00 (f)	0.00 (f)	0.00(f)

PARAMETER	NOTATION	DESCRIPTION	2002 WG	2003 WG	2004 WG	2006 WG	2007 WG	2008 WG	2009WG
Measurement standard deviations	σlandings	Standard error of landings-at-age data	0.12	0.13	0.10	0.0935	0.0891	0.0892	0.0889
	σdiscards	Standard error of discards-at-age data	n/a	0.94	1.42	1.2669	1.367	1.3756	1.3681
	σsurvey	Standard error of survey data	0.36	0.56	0.35	0.3887	0.364	0.3875	0.3930
Discards	σlogit p	Transitory trends in discarding	n/a	0.30	0.00	0.00	0.00	0.00	0.00
	σpersistent	Persistent trends in discarding	n/a	0.16	0.68	0.5735	0.6742	0.7032	0.6959
	η1	Ricker parameter (slope at the origin)	0.82	0.62	0.80	0.6584	0.7882	0.9634	0.8913
Recruitment	η2	Ricker parameter (curve dome occurs at 1/η2)	0.03	0.003	0.01	0.0049	0.0124	0.0203	0.0177
	cvrec	Coefficient of variation of recruitment data	0.36	0.56	0.49	0.4184	0.5116	0.5627	0.5530

Table 3.2.12. Cod in Division VIa. TSA population numbers-at-age (millions).

	Age						
Year	1	2	3	4	5	6	7+
1978	20.3834	9.4816	2.58	1.4111	0.5267	0.1598	0.1296
1979	28.2475	10.1453	4.2371	1.1236	0.5256	0.1851	0.0992
1980	31.2485	13.7737	4.3553	1.3366	0.2788	0.1199	0.0595
1981	10.4731	16.4374	6.1989	1.8084	0.4944	0.0998	0.0651
1982	25.6588	5.1018	6.8456	2.3838	0.6813	0.192	0.0599
1983	15.5709	12.0438	2.1619	2.5867	0.8553	0.24	0.0893
1984	24.0151	6.0912	4.549	0.7556	0.8464	0.2789	0.1029
1985	12.3426	12.0925	2.2199	1.4568	0.2282	0.2289	0.1116
1986	19.0478	4.2339	3.8708	0.6894	0.3243	0.0635	0.0787
1987	59.9898	9.8768	1.7474	1.3607	0.2272	0.1024	0.0468
1988	6.0594	16.8979	3.6537	0.5501	0.3546	0.0667	0.0423
1989	19.595	2.477	5.4809	1.1622	0.1863	0.1073	0.0348
1990	6.3376	8.7682	0.9413	1.4908	0.3403	0.0556	0.0404
1991	11.0872	2.9295	3.4148	0.3638	0.4806	0.121	0.0349
1992	17.0816	4.5201	0.9594	1.1366	0.1241	0.1474	0.0477
1993	6.9902	8.1252	1.8195	0.3041	0.3391	0.0417	0.0662
1994	14.6727	3.2374	3.2566	0.6021	0.1082	0.1119	0.0365
1995	12.2695	7.2902	1.4381	1.2815	0.2253	0.0397	0.0549
1996	4.8575	5.7714	2.9589	0.5271	0.4477	0.078	0.0327
1997	17.1842	2.0334	2.2395	1.0197	0.1753	0.1505	0.0366
1998	8.5604	7.842	0.7621	0.772	0.3292	0.0572	0.0612
1999	4.8335	3.8195	2.9689	0.2534	0.248	0.1052	0.038
2000	10.0142	2.0693	1.4683	1.0133	0.0811	0.0797	0.0461
2001	3.2344	4.6239	0.819	0.5262	0.3447	0.0274	0.0425
2002	8.6733	1.3022	1.7469	0.2758	0.1683	0.1135	0.0226
2003	1.8655	3.8881	0.4813	0.5893	0.0885	0.0543	0.044
2004	3.968	0.6298	1.4164	0.1588	0.1837	0.0272	0.0308
2005	5.3396	1.4309	0.1875	0.4474	0.0466	0.0559	0.0176
2006	10.397	2.3236	0.4636	0.0471	0.134	0.0137	0.0221
2007	2.7188	4.8041	0.9176	0.1611	0.0154	0.0446	0.0119
2008	3.3142	1.2433	1.9361	0.3348	0.0547	0.0053	0.0193
2009*	5.4348	1.4736	0.4807	0.6507	0.1082	0.0174	0.0079
2010*	4.4357	2.4657	0.5752	0.1684	0.2131	0.0356	0.0083
GM(78–08)	10.1615	4.7272	1.9106	0.6681	0.2256	0.0778	0.0453

***2009 and 2010 values are TSA-derived projections of population numbers.**

Table 3.2.13. Cod in Division VIa. Standard errors on TSA population numbers-at-age (millions).

	AGE						
Year	1	2	3	4	5	6	7+
1978	2.896	0.5356	0.123	0.0844	0.0514	0.0302	0.0222
1979	2.1681	0.546	0.1764	0.0605	0.0452	0.0311	0.0194
1980	2.5862	0.7773	0.2308	0.097	0.0315	0.0274	0.0199
1981	1.1813	1.2151	0.3363	0.1001	0.0376	0.014	0.0128
1982	2.1932	0.3647	0.3835	0.135	0.0383	0.0149	0.0046
1983	1.6137	0.8974	0.1165	0.1644	0.0652	0.0247	0.009
1984	1.76	0.5355	0.2839	0.051	0.0717	0.0354	0.0136
1985	1.4803	0.8016	0.1499	0.1134	0.0232	0.0377	0.0188
1986	1.4668	0.3301	0.2378	0.0524	0.0411	0.0116	0.0176
1987	9.7326	0.656	0.1015	0.0957	0.0219	0.0191	0.0092
1988	1.102	1.5896	0.1917	0.0374	0.0355	0.011	0.0088
1989	2.0097	0.1831	0.4706	0.0757	0.0142	0.0158	0.0065
1990	1.1302	0.4907	0.0527	0.1311	0.0286	0.0071	0.0068
1991	1.5311	0.2186	0.195	0.0198	0.0424	0.0132	0.004
1992	1.5692	0.3132	0.0693	0.0763	0.0088	0.019	0.0063
1993	0.953	0.4937	0.1257	0.0252	0.0323	0.0047	0.0082
1994	2.6652	0.3414	0.2903	0.068	0.0112	0.0169	0.0047
1995	2.7757	1.4216	0.2177	0.1893	0.0402	0.007	0.01
1996	1.9336	1.2663	0.5964	0.0924	0.079	0.0161	0.0062
1997	3.756	0.7901	0.5167	0.2336	0.0362	0.0313	0.0081
1998	2.4221	1.7271	0.3062	0.1942	0.0876	0.0144	0.0149
1999	1.8074	1.07	0.7028	0.1085	0.071	0.0329	0.0102
2000	2.6563	0.7335	0.4213	0.2585	0.0369	0.0258	0.0144
2001	1.38	1.1546	0.2769	0.1541	0.0901	0.0126	0.0125
2002	2.2273	0.5177	0.4586	0.0979	0.0554	0.0328	0.0074
2003	1.1997	0.9724	0.1906	0.1686	0.0337	0.0198	0.0136
2004	1.593	0.4092	0.3776	0.0656	0.0598	0.012	0.0101
2005	1.132	0.5951	0.1417	0.1334	0.0222	0.0213	0.0064
2006	1.5417	0.4288	0.2098	0.0455	0.0447	0.0075	0.0086
2007	0.8517	0.6716	0.1612	0.0703	0.0147	0.0151	0.0044
2008	1.3022	0.3624	0.3148	0.0573	0.0234	0.0049	0.0061
2009*	2.533	0.5928	0.1436	0.1379	0.0235	0.0082	0.003
2010*	2.5499	1.1983	0.2378	0.0537	0.053	0.0091	0.0033
GM(78–08)	1.8132	0.6215	0.2295	0.0891	0.0360	0.0164	0.0094

***2009 and 2010 values are standard errors on TSA-derived projections of population numbers.**

Table 3.2.14. Cod in Division VIa. TSA estimates for mortality-at-age.

	Age						
Year	1	2	3	4	5	6	7+
1978	0.5141	0.6134	0.6343	0.7584	0.7861	0.7861	0.7814
1979	0.5491	0.7003	0.8686	1.0002	0.9728	0.9609	0.9455
1980	0.4496	0.6329	0.6802	0.7773	0.7966	0.7766	0.7691
1981	0.4725	0.6692	0.7564	0.7515	0.6796	0.7238	0.7347
1982	0.585	0.6611	0.7648	0.8212	0.8418	0.835	0.841
1983	0.6708	0.75	0.841	0.9	0.9059	0.9415	0.9517
1984	0.5521	0.753	0.8855	0.955	1.0208	0.9763	0.9518
1985	0.7724	0.9089	0.929	1.1396	1.0213	1.1012	1.0833
1986	0.4817	0.6772	0.8187	0.8905	0.8893	0.8835	0.8578
1987	0.7971	0.8046	0.9269	1.0706	1.0004	1.0046	1.003
1988	0.632	0.7795	0.9296	0.8815	0.9612	0.9387	0.9239
1989	0.6075	0.7571	0.9669	1.0051	0.9974	1.0201	1.0045
1990	0.5561	0.7358	0.75	0.9087	0.8339	0.8175	0.8066
1991	0.6789	0.8611	0.8901	0.8759	0.9624	0.9732	0.9893
1992	0.5383	0.7099	0.9083	0.9931	0.8902	0.8756	0.8977
1993	0.5728	0.7143	0.8981	0.8332	0.9052	0.889	0.8823
1994	0.4995	0.6082	0.7315	0.7823	0.8025	0.7893	0.8047
1995	0.5552	0.7016	0.8037	0.8518	0.8612	0.8628	0.8637
1996	0.6025	0.7412	0.8586	0.9006	0.8905	0.905	0.906
1997	0.586	0.7495	0.8592	0.9241	0.9149	0.9121	0.9163
1998	0.6023	0.759	0.8728	0.9283	0.9311	0.9284	0.9281
1999	0.6115	0.7537	0.8703	0.9313	0.9298	0.9284	0.9276
2000	0.573	0.725	0.8267	0.8752	0.8849	0.887	0.8864
2001	0.6197	0.7597	0.8709	0.9305	0.9115	0.9248	0.9256
2002	0.5986	0.757	0.8726	0.9271	0.9256	0.9216	0.9251
2003	0.6397	0.7827	0.888	0.952	0.9551	0.9494	0.9497
2004	0.6723	0.7998	0.9211	0.9798	0.9725	0.9751	0.9732
2005	0.6345	0.8226	0.9408	0.998	0.9945	0.9893	0.989
2006	0.5269	0.7243	0.8539	0.913	0.8988	0.9002	0.8992
2007	0.5802	0.709	0.7916	0.8823	0.8846	0.8757	0.8762
2008	0.6079	0.7563	0.8844	0.9274	0.9365	0.9336	0.9317
2009*	0.5904	0.7408	0.849	0.9163	0.9127	0.9125	0.9112
2010*	0.5837	0.7317	0.8402	0.9002	0.9002	0.9002	0.9002
GM(78–08)	0.5869	0.7352	0.8445	0.9078	0.9051	0.9058	0.9041

***Estimates for 2009 and 2010 are TSA projections.**

Table 3.2.15. Cod in Division VIa. Standard errors of TSA estimates for log mortality-at-age.

	Age						
Year	1	2	3	4	5	6	7+
1978	0.194	0.0985	0.0635	0.0641	0.0771	0.0917	0.0929
1979	0.2023	0.1007	0.0579	0.0566	0.0684	0.0876	0.0906
1980	0.1999	0.0995	0.0629	0.0639	0.0688	0.0883	0.0915
1981	0.2069	0.0889	0.06	0.0626	0.0743	0.0909	0.0942
1982	0.2005	0.0931	0.0632	0.0652	0.0792	0.0914	0.0989
1983	0.1788	0.085	0.0601	0.0625	0.0746	0.0889	0.0938
1984	0.1968	0.0941	0.0615	0.0634	0.0711	0.0883	0.0937
1985	0.1852	0.0775	0.0629	0.0593	0.0751	0.0853	0.0916
1986	0.2093	0.092	0.0635	0.0661	0.0737	0.0935	0.0916
1987	0.1776	0.0912	0.0594	0.0598	0.0783	0.0899	0.0954
1988	0.206	0.0759	0.0575	0.0649	0.0713	0.095	0.0964
1989	0.1888	0.0845	0.0639	0.0609	0.0737	0.0864	0.0976
1990	0.2025	0.0709	0.0644	0.0657	0.0743	0.0914	0.0934
1991	0.1947	0.0687	0.061	0.0634	0.0703	0.0878	0.0956
1992	0.1919	0.0765	0.0637	0.0646	0.0793	0.0885	0.096
1993	0.2051	0.0835	0.0755	0.0768	0.0863	0.0998	0.0977
1994	0.2168	0.1202	0.1128	0.1164	0.1227	0.1232	0.1234
1995	0.2344	0.1419	0.1369	0.1371	0.1378	0.1386	0.1386
1996	0.2352	0.1417	0.1367	0.137	0.1376	0.1383	0.1384
1997	0.2314	0.144	0.1377	0.1376	0.1383	0.139	0.1391
1998	0.235	0.142	0.1389	0.1376	0.1383	0.139	0.139
1999	0.2356	0.1445	0.1384	0.1391	0.139	0.1397	0.1398
2000	0.2355	0.1455	0.1407	0.1399	0.1406	0.1406	0.1407
2001	0.2344	0.1429	0.1388	0.1377	0.1384	0.1392	0.1392
2002	0.2325	0.1443	0.1378	0.1383	0.1386	0.1392	0.1393
2003	0.2342	0.1418	0.1394	0.1376	0.1383	0.139	0.139
2004	0.2279	0.1438	0.1366	0.1375	0.1379	0.1386	0.1386
2005	0.2349	0.144	0.1398	0.1381	0.139	0.1396	0.1397
2006	0.2368	0.1462	0.1405	0.1402	0.1401	0.1408	0.1409
2007	0.2357	0.145	0.1406	0.1401	0.1404	0.1407	0.1408
2008	0.2385	0.1466	0.1401	0.1404	0.1406	0.1411	0.1411
2009*	0.2427	0.1494	0.1445	0.1432	0.1433	0.1433	0.1434
2010*	0.2432	0.1497	0.1449	0.1437	0.1437	0.1437	0.1437
GM(78–08)	0.2132	0.1095	0.0913	0.0922	0.1004	0.1110	0.1136

***Estimates for 2009 and 2010 are standard errors of TSA projections of log *F*.**

Table 3.2.16. Cod in Division VIa. TSA summary table. "Obs." denotes sum-of-products of numbers and mean weights-at-age, not reported caught, landed and discarded weight. * Estimates for 2009, 2010 are TSA projections.

YEAR	LANDINGS (000 TONNES)			DISCARDS (000 TONNES)			TOTAL CATCH (000 TONNES)			MEAN Z-0.2 (2–5)		SSB (000 TONNES)		TSB (000 TONNES)		RECRUITMENT-AT-AGE 1 (MILLIONS)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1978	13.5205	13.2202	0.57	3.6808	3.2732	0.8153	17.2013	17.2641	1.1594	0.6981	0.031	26.0115	0.7542	39.481	1.506	20.3834	2.896
1979	16.0887	15.7211	0.6444	0.0541	4.0765	0.7343	16.1427	26.5038	1.9673	0.8855	0.0348	28.4369	0.7788	55.9254	1.9346	28.2475	2.1681
1980	17.8789	17.2693	0.78	0.9958	3.3826	0.8209	18.8747	23.9056	1.66	0.7217	0.0318	31.7602	1.0737	56.4458	1.9777	31.2485	2.5862
1981	23.8646	22.18	1.3599	0.5198	0.9759	0.2991	24.3843	24.2284	1.4422	0.7142	0.0304	38.0752	1.2365	52.6732	1.8276	10.4731	1.1813
1982	21.5108	23.0713	1.0134	1.6539	2.4145	0.7307	23.1647	25.8198	1.5123	0.7722	0.0348	37.4673	1.1833	54.2371	1.7123	25.6588	2.1932
1983	21.3052	20.9233	0.9002	2.0195	1.6187	0.4635	23.3247	22.72	1.251	0.8492	0.0349	32.0549	1.069	44.1577	1.5283	15.5709	1.6137
1984	21.2717	19.8631	0.9523	0.6355	2.5338	0.6437	21.9071	24.3172	1.5506	0.9036	0.0381	29.9342	1.1219	48.4737	1.7883	24.0151	1.76
1985	18.6071	17.6169	0.7931	8.8246	1.2935	0.3576	27.4317	17.3564	1.0064	0.9997	0.0398	22.0854	0.8791	30.2722	1.1648	12.3426	1.4803
1986	11.8201	11.5524	0.6334	1.1998	1.6609	0.4038	13.0199	13.5851	0.8869	0.8189	0.036	18.4574	0.749	28.7691	1.0712	19.0478	1.4668
1987	18.9705	18.1505	0.9499	8.7876	3.8985	1.3836	27.7581	20.9336	2.0915	0.9506	0.0405	19.6788	0.7273	39.2472	2.4075	59.9898	9.7326
1988	20.4133	18.6443	1.2617	1.133	0.8411	0.2944	21.5462	18.6963	1.3705	0.888	0.0349	23.5077	0.9962	36.1252	1.8273	6.0594	1.102
1989	17.1693	15.0516	1.0025	2.818	2.1173	0.6509	19.9873	17.0757	1.3193	0.9316	0.0384	21.0362	1.0946	32.332	1.5604	19.595	2.0097
1990	12.1755	11.9277	0.6213	0.3141	0.3733	0.1326	12.4896	12.3516	0.7392	0.8071	0.0329	17.7448	0.7085	24.8534	0.9531	6.3376	1.1302
1991	10.9267	10.8041	0.513	0.9095	0.8867	0.3172	11.8362	11.6099	0.7399	0.8974	0.0345	15.2082	0.5675	21.9456	0.8962	11.0872	1.5311
1992	9.0862	8.8834	0.4167	2.9024	1.3097	0.3589	11.9886	9.9196	0.6118	0.8754	0.0379	12.4262	0.4886	20.1045	0.7831	17.0816	1.5692
1993	10.3142	10.405	0.4414	0.1846	0.7183	0.2197	10.4988	11.4635	0.6148	0.8377	0.0463	14.5442	0.6129	23.4007	1.0322	6.9902	0.953
1994	8.9279	9.1028	0.4277	0.1863	1.0801	0.3548	9.1142	11.0618	0.8083	0.7311	0.0687	15.0678	1.0722	25.172	1.8779	14.6727	2.6652
1995	9.4385	10.8415	1.6199	0.258	0.855	0.3078	9.6965	12.1833	1.82	0.8046	0.0925	16.4737	1.9003	25.4161	2.862	12.2695	2.7757
1996	9.4267	11.382	1.8851	0.086	0.4373	0.2258	9.5127	12.2415	2.0533	0.8477	0.0972	17.2754	2.2675	24.08	3.2012	4.8575	1.9336
1997	7.0336	9.106	1.7867	0.3537	1.8812	0.7448	7.3872	11.7788	2.1463	0.8619	0.0999	13.8563	2.1612	24.0141	3.3791	17.1842	3.756
1998	5.7139	8.7618	1.7481	0.4175	0.7554	0.3414	6.1314	9.4247	1.764	0.8728	0.101	11.7646	1.8692	18.7141	2.8043	8.5604	2.4221
1999	4.201	7.779	1.6028	0.0879	0.5257	0.287	4.2889	8.4762	1.7037	0.8713	0.1018	11.6631	2.003	16.4875	2.7241	4.8335	1.8074
2000	2.9771	6.5772	1.5036	0.6049	0.954	0.4523	3.582	7.6672	1.5468	0.8279	0.098	10.1178	1.8203	15.7045	2.5629	10.0142	2.6563
2001	2.347	6.2224	1.2894	0.2093	0.3337	0.2095	2.5563	6.4052	1.2945	0.8681	0.1007	8.9787	1.5099	12.3902	2.0565	3.2344	1.38
2002	2.2426	5.1543	1.2888	0.1662	0.8182	0.4031	2.4089	6.3046	1.3291	0.8706	0.1012	7.6718	1.4199	12.6285	2.13	8.6733	2.2273
2003	1.2411	4.617	1.037	0.0458	0.243	0.2061	1.2869	4.8952	1.0946	0.8945	0.1036	6.531	1.1775	9.3546	1.7507	1.8655	1.1997

Table 3.2.16 (cont). Cod in Division VIa. TSA summary table. "Obs." denotes sum-of-products of numbers and mean weights-at-age, not reported caught, landed and discarded weight. * Estimates for 2009, 2010 are TSA projections.

Year	Landings (000 tonnes)			Discards (000 tonnes)			Total catch (000 tonnes)			Mean Z-0.2 (2–5)		SSB (000 tonnes)		TSB (000 tonnes)		Recruitment-at-age 1 (millions)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
2004	0.5402	3.5446	0.9212	0.0718	0.3924	0.2504	0.612	3.914	0.9487	0.9183	0.1059	5.3059	1.0828	7.273	1.4841	3.968	1.593
2005	0.5114	2.9187	0.9813	0.0406	0.5652	0.2921	0.552	3.5047	0.8809	0.939	0.1097	3.8542	0.9214	6.7714	1.3597	5.3396	1.132
2006	0.4545	2.8957	1.0787	0.4777	0.9167	0.4566	0.9323	3.6404	0.7309	0.8475	0.1005	3.6935	0.7533	7.9445	1.1578	10.397	1.5417
2007	0.5242	3.9769	0.7381	2.0833	0.2951	0.3082	2.6076	4.3014	0.7004	0.8169	0.0967	5.8356	0.774	8.9091	1.0937	2.7188	0.8517
2008	0.4501	5.0864	0.8805	0.9084	0.2853	0.1849	1.3585	4.4276	0.7159	0.8761	0.1041	6.4875	0.8583	8.4238	1.1336	3.3142	1.3022
2009*	NA	3.6334	0.8594	NA	0.4578	0.3062	NA	3.8929	0.7623	0.8547	0.1046	5.4845	0.9544	7.6363	1.4	5.4348	2.533
2010*	NA	3.4967	1.0067	NA	0.4055	0.3217	NA	3.6815	0.9384	0.8431	0.1035	4.9411	1.1448	7.3999	1.8612	4.4357	2.5499
Min	0.4501	2.8957	0.4167	0.0406	0.2430	0.1326	0.5520	3.5047	0.6118	0.6981	0.0304	3.6935	0.4886	6.7714	0.7831	1.8655	0.8517
GM	5.9923	9.6991	0.9360	0.5175	0.9868	0.3819	7.3165	11.0442	1.1851	0.8487	0.0584	14.3045	1.0593	22.2699	1.6654	10.1615	1.8132
AM	10.3533	11.3952	1.0207	1.3752	1.3456	0.4404	11.7285	13.1606	1.2729	0.8516	0.0664	17.1937	1.1494	26.8299	1.7919	13.7429	2.0844
Max	23.8646	23.0713	1.8851	8.8246	4.0765	1.3836	27.7581	26.5038	2.1463	0.9997	0.1097	38.0752	2.2675	56.4458	3.3791	59.9898	9.7326

Table 3.2.17. Cod in Division VIa. Inputs to short-term predictions from TSA run. Mean weights assumed from final 3 years. Note: Text is presented as it was output from WGFRANSW but data referred to as that for the human consumption fishery should be regarded as that for removals in addition to the assumed value of natural mortality.

```
Table_____Cod,VIa
 input data for catch forecast and linear sensitivity analysis


 Label     Value     CV     Label     Value     CV

 Number at-age              Weight in the stock
 N1         5434   0.47     WS1        0.23   0.14
 N2         1473   0.40     WS2        1.06   0.13
 N3          480   0.30     WS3        2.44   0.12
 N4          650   0.21     WS4        4.30   0.11
 N5          108   0.22     WS5        6.09   0.05
 N6           17   0.47     WS6        8.05   0.13
 N7            7   0.38     WS7        9.46   0.15

 H.cons selectivity         Weight in the HC catch
 sH1        0.57   0.07     WH1        0.23   0.14
 sH2        0.73   0.03     WH2        1.06   0.13
 sH3        0.84   0.06     WH3        2.44   0.12
 sH4        0.91   0.03     WH4        4.30   0.11
 sH5        0.91   0.03     WH5        6.09   0.05
 sH6        0.90   0.03     WH6        8.05   0.13
 sH7        0.90   0.03     WH7        9.46   0.15

 Natural mortality          Proportion mature
 M1         0.20   0.10     MT1        0.00   0.10
 M2         0.20   0.10     MT2        0.52   0.10
 M3         0.20   0.10     MT3        0.86   0.10
 M4         0.20   0.10     MT4        1.00   0.10
 M5         0.20   0.10     MT5        1.00   0.00
 M6         0.20   0.10     MT6        1.00   0.00
 M7         0.20   0.10     MT7        1.00   0.00

 Relative effort            Year effect for natural mortality
 in HC fishery
 HF09       0.75   0.05     K09        1.00   0.10
 HF10       0.56   0.05     K10        1.00   0.10
 HF11       1.00   0.05     K11        1.00   0.10

 Recruitment in 2010 and 2011
 R10        5144   0.60
 R11        5144   0.60



 Proportion of F before spawning = .00
 Proportion of M before spawning = .00
```

Stock numbers in 2009 are TSA survivors.

Table 3.2.18. Cod in Division VIa. Results of short-term forecasts from TSA run. Management options. Note: Text is presented as it was output from WGFRANSW but data referred to as that for the human consumption fishery should be regarded as that for removals in addition to the assumed value of natural mortality.

Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year							
	2009	2010						
Mean F Ages								
H.cons 2 to 5	0.64	0.00	0.17	0.34	0.51	0.68	0.85	1.02
Effort relative to 2008								
H.cons	0.75	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Biomass								
Total 1 January	7.64	8.94	8.94	8.94	8.94	8.94	8.94	8.94
SSB at spawning time	5.49	6.06	6.06	6.06	6.06	6.06	6.06	6.06
Catch weight (,000t)								
H.cons	3.16	0.00	1.19	2.20	3.07	3.82	4.46	5.01
Biomass in year.... 2011								
Total 1 January		17.11	14.92	13.04	11.43	10.04	8.84	7.81
SSB at spawning time		12.99	11.15	9.57	8.22	7.06	6.07	5.22

	Year							
	2009	2010						
Effort relative to 2008								
H.cons	0.75	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.16	0.21	0.21	0.21	0.21	0.21	0.21	0.21
SSB at spawning time	0.16	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Catch weight								
H.cons	0.15	0.00	0.23	0.21	0.20	0.20	0.20	0.20
Biomass in year 2011								
Total 1 January		0.24	0.25	0.25	0.25	0.25	0.25	0.26
SSB at spawning time		0.24	0.24	0.25	0.25	0.25	0.25	0.26

Table 3.2.19: Cod in Division VIa. Results of short-term forecasts from TSA run. Detailed tables. Note: Text is presented as it was output from WGFRANSW but data referred to as that for the human consumption fishery should be regarded as that for removals in addition to the assumed value of natural mortality.

```
           Detailed forecast tables.


 Forecast for year 2009
 F multiplier H.cons=0.75

       Populations     Catch number
 +----+-----------+   +--------+-------+
 | Age| Stock No. |   | H.Cons |  Total|
 +----+-----------+   +--------+-------+
 |   1|       5435|   |    1731|   1731|
 |   2|       1474|   |     568|    568|
 |   3|        481|   |     206|    206|
 |   4|        651|   |     295|    295|
 |   5|        108|   |      49|     49|
 |   6|         17|   |       8|      8|
 |   7|          8|   |       4|      4|
 +----+-----------+   +--------+-------+
 |  Wt|          8|   |       3|      3|
 +----+-----------+   +--------+-------+


 Forecast for year 2010
 F multiplier H.cons=0.56

       Populations     Catch number
 +----+-----------+   +--------+-------+
 | Age| Stock No. |   | H.Cons |  Total|
 +----+-----------+   +--------+-------+
 |   1|       5145|   |    1291|   1291|
 |   2|       2897|   |     891|    891|
 |   3|        698|   |     241|    241|
 |   4|        209|   |      77|     77|
 |   5|        270|   |      99|     99|
 |   6|         45|   |      16|     16|
 |   7|         11|   |       4|      4|
 +----+-----------+   +--------+-------+
 |  Wt|          9|   |       3|      3|
 +----+-----------+   +--------+-------+
```

Table 4.2.1. Cod in Division VIb (Rockall). Official catch statistics.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Faroe Islands	18	-	1	-	31	5	-	-	-	1	-	-
France	9	17	5	7	2	-	-	-	-	-	-	-
Germany	-	3	-	-	3	-	-	126	2	-	-	-
Ireland	-	-	-	-	-	-	400	236	235	472	280	477
Norway	373	202	95	130	195	148	119	312	199	199	120	92
Portugal	-	-	-	-	-	-	-	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	-	-	-	-
Spain	241	1200	1219	808	1345	-	64	70	-	-	-	2
UK (E. & W. and N.I.)	161	114	93	69	56	131	8	23	26	103	25	90
UK (Scotland)	221	437	187	284	254	265	758	829	714	322	236	370
Total	**1,023**	**1,973**	**1,600**	**1,298**	**1,886**	**549**	**1,349**	**1,596**	**1,176**	**1,097**	**661**	**1,031**

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Faroe Islands	-	-	-	-	n/a	n/a	n/a				
France	-	-	-	-	+	+*	1			0.08	
Germany	10	22	3	11	1	-	-				
Ireland	436	153	227	148	119	40	18	11	7	12	22.7
Norway	91	55*	51*	85*	152*	89	28	25	23	7	7
Portugal	-	5	-	-	-	-	-				
Russia	-	-	-	-	7	26	-				
Spain	5	1	6	4	3	1		6			
UK (E. & W. and N.I.)	23	20	32	22	4	2	2	3			
UK (Scotland)	210	706	341	389	286	176	67	57	45	43	
UK											28.7
Total	**775**	**962**	**660**	**659**	**572**	**334**	**115**	**102**	**75**	**62**	**58.4**

Country	2007	2008*
Faroe Islands	-	
France	-	
Germany	-	
Ireland	24	40.7
Norway	12	11
Portugal	-	
Russia	-	
Spain	-	
UK (E. & W. and N.I.)		
UK (Scotland)	26	
UK		41.3
Total	**62**	**93.0**

*** Preliminary.**

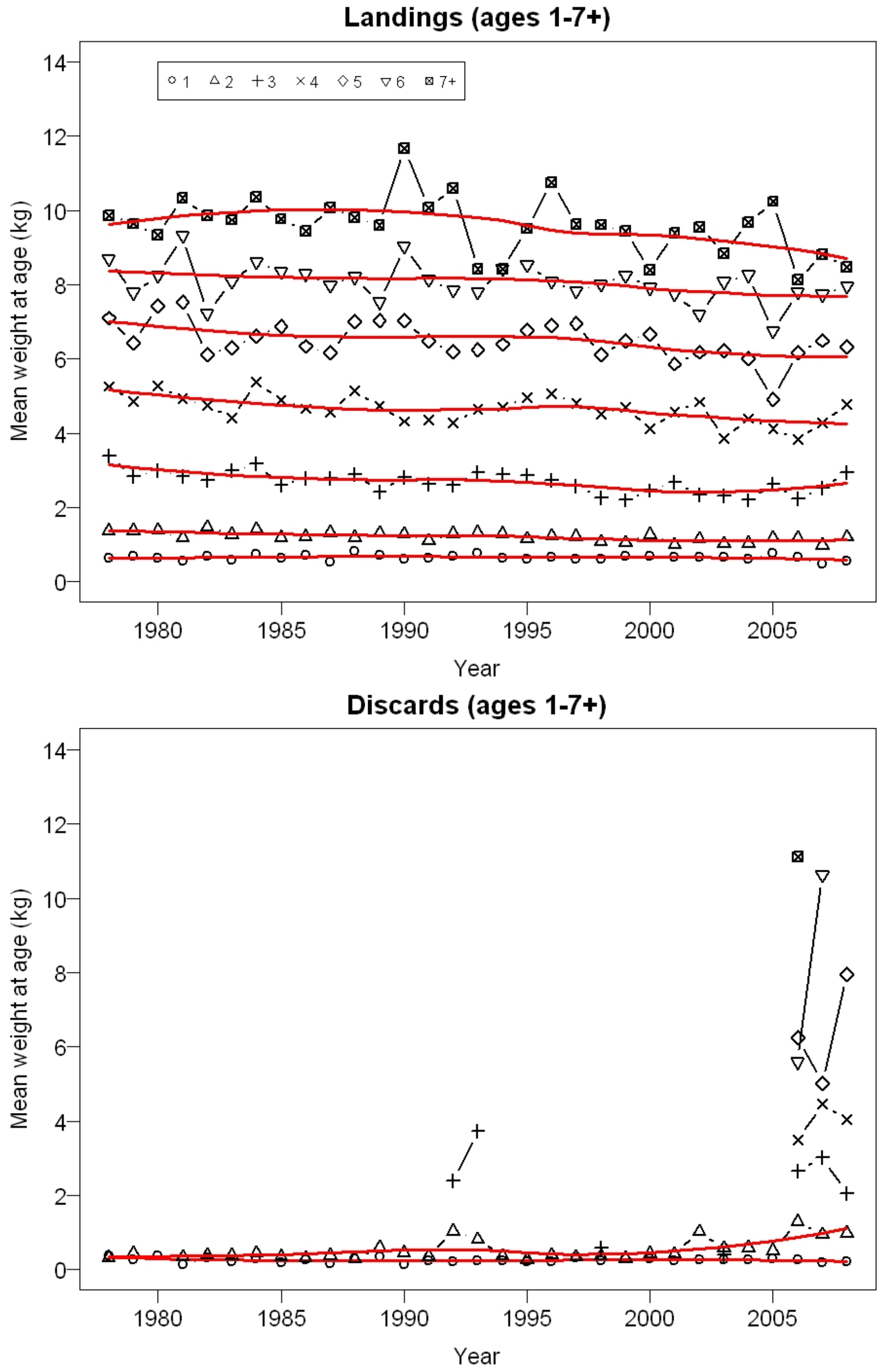


Figure 3.2.1. Cod in Division VIa. Mean weights-at-age in landings and discards. A loess smooth has been fitted to the data at each age, with a span including three quarters of the data points.

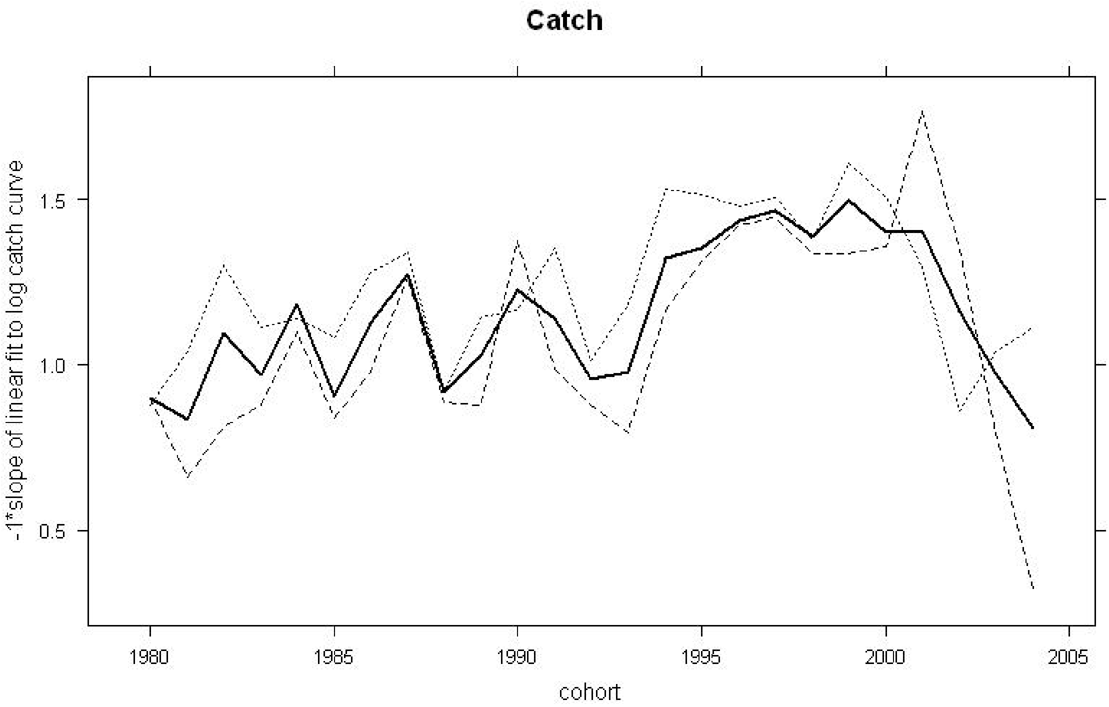


Figure 3.2.2. Cod in Division VIa. Log catch curve gradient plot using WG commercial catch-at-age data. Solid line shows time-series of gradient of linear fit to curve over the age range 2–5, dashed line over the ages 2–4 and dotted line over the ages 3–5. An increasing value indicates increasing mortality.

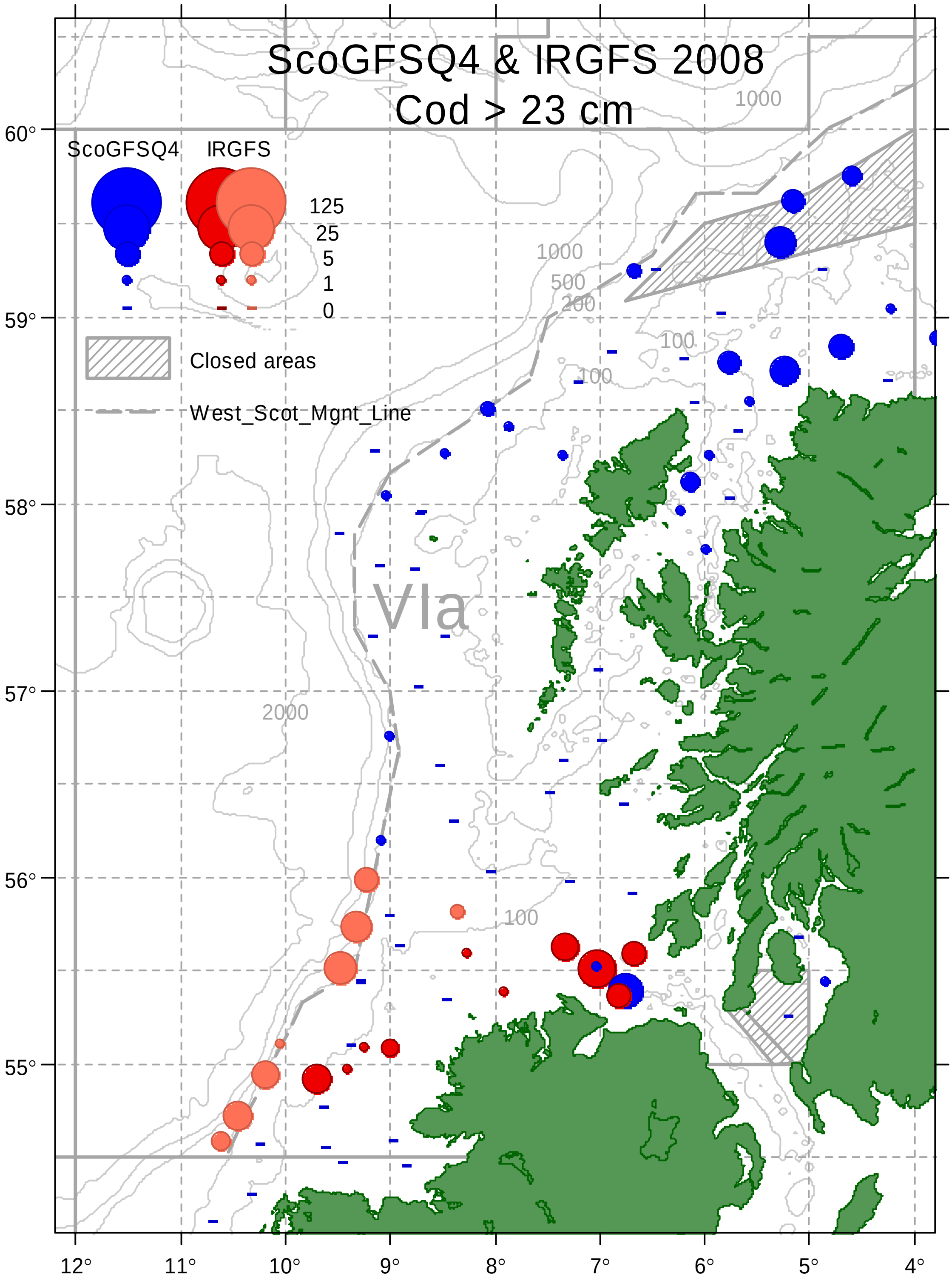


Figure 3.2.3. Cod in Division VIa. Cpue numbers for fish greater than 23 cm length (proxy for age 1+) by ICES statistical rectangle resulting from quarter four surveys. Scottish quarter four groundfish survey (ScoGFSQ4) and Irish groundfish survey (IRGFS). Numbers are standardized to 30 minutes towing. Hauls from shelf slope in Irish survey (coloured orange) are not included in IRGFS.

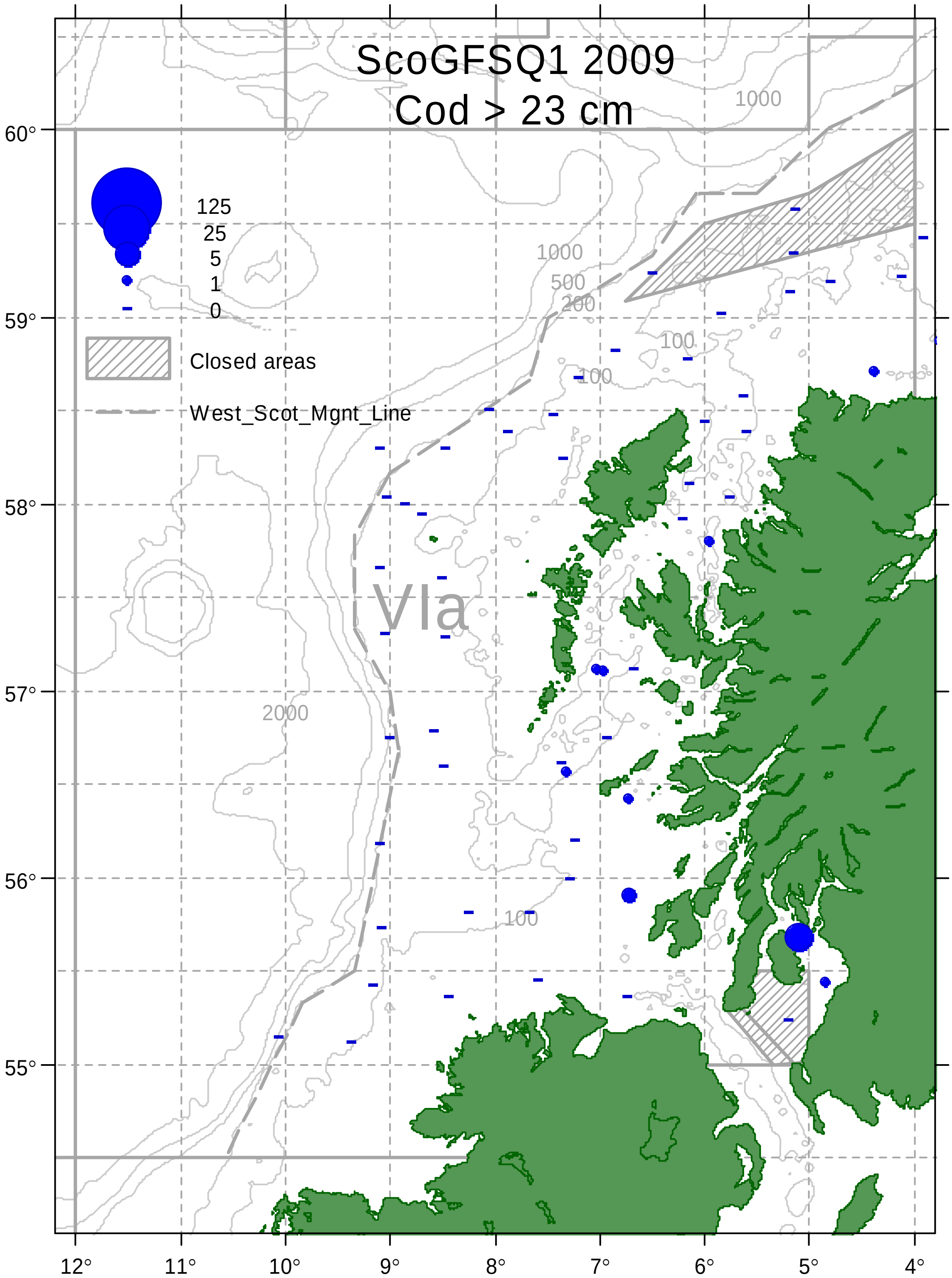


Figure 3.2.3. cont. Cod in Division VIa. Cpue numbers for fish greater than 23 cm length (proxy for age 1+) by ICES statistical rectangle resulting from Scottish quarter one survey (ScoGFSQ1). Numbers are standardized to 30 minutes towing.

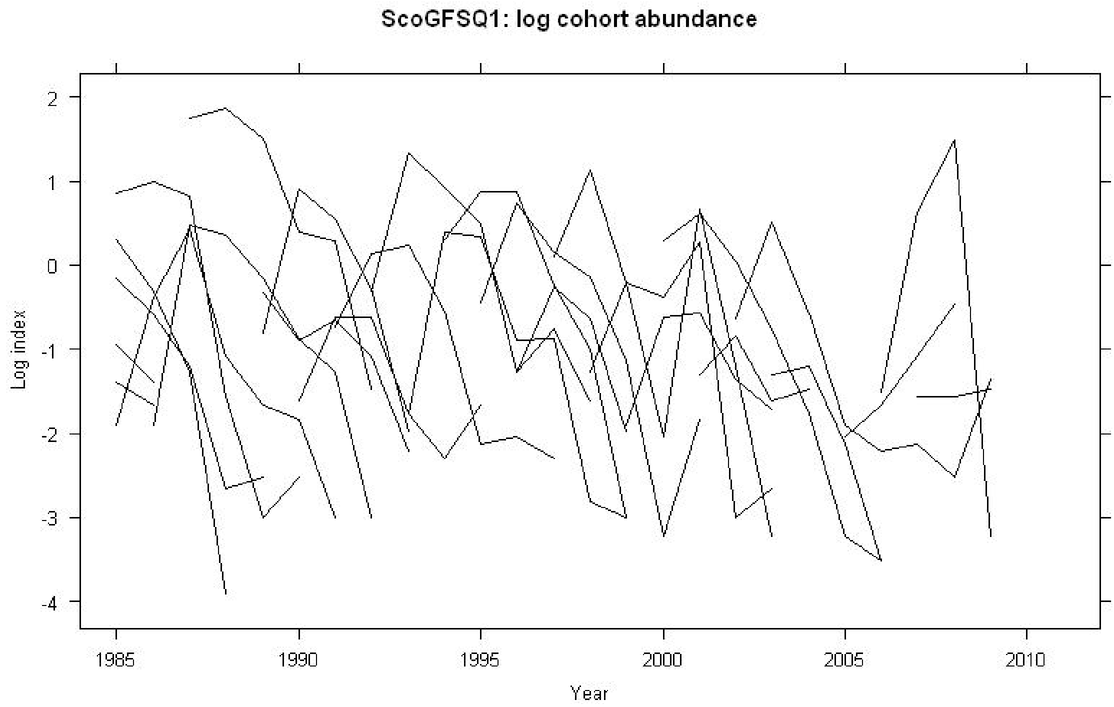


Figure 3.2.4. Cod in Division VIa. Log catch curves from Scottish quarter one groundfish survey (ScoGFSQ1); ages 1–6.

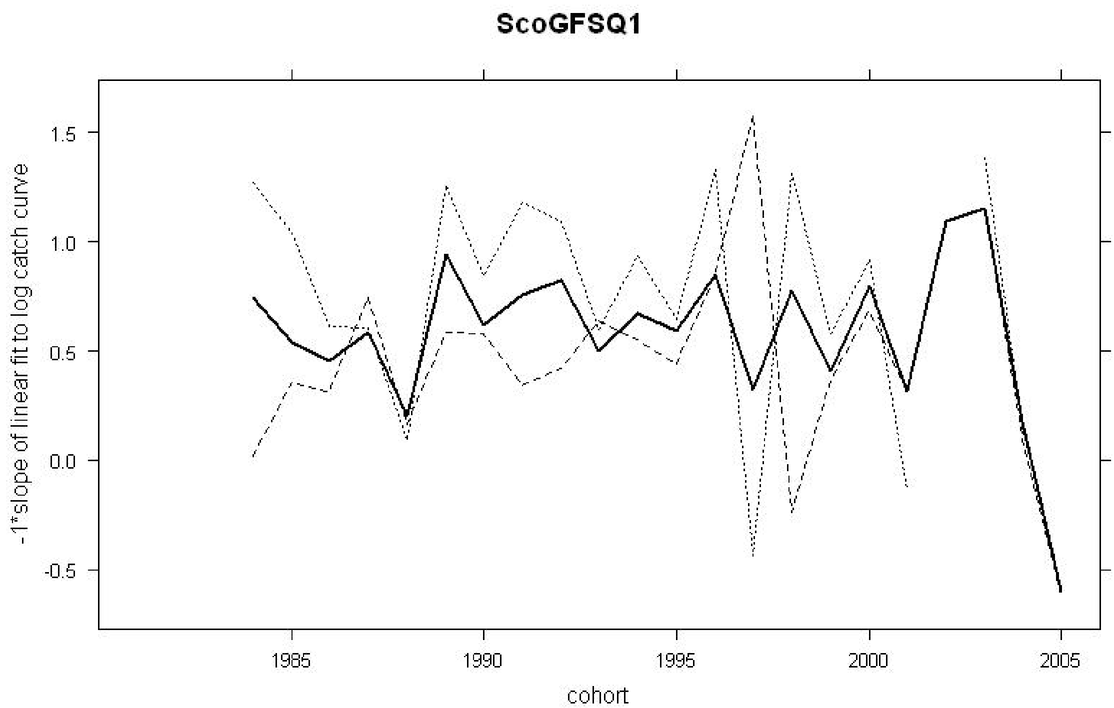


Figure 3.2.5. Cod in Division VIa. Log catch curve gradient plot using ScoGFSQ1 index data. Solid line shows time-series of gradient of linear fit to curve over the age range 2–5, dashed line over the ages 2–4 and dotted line over the ages 3–5. An increasing value indicates increasing mortality.

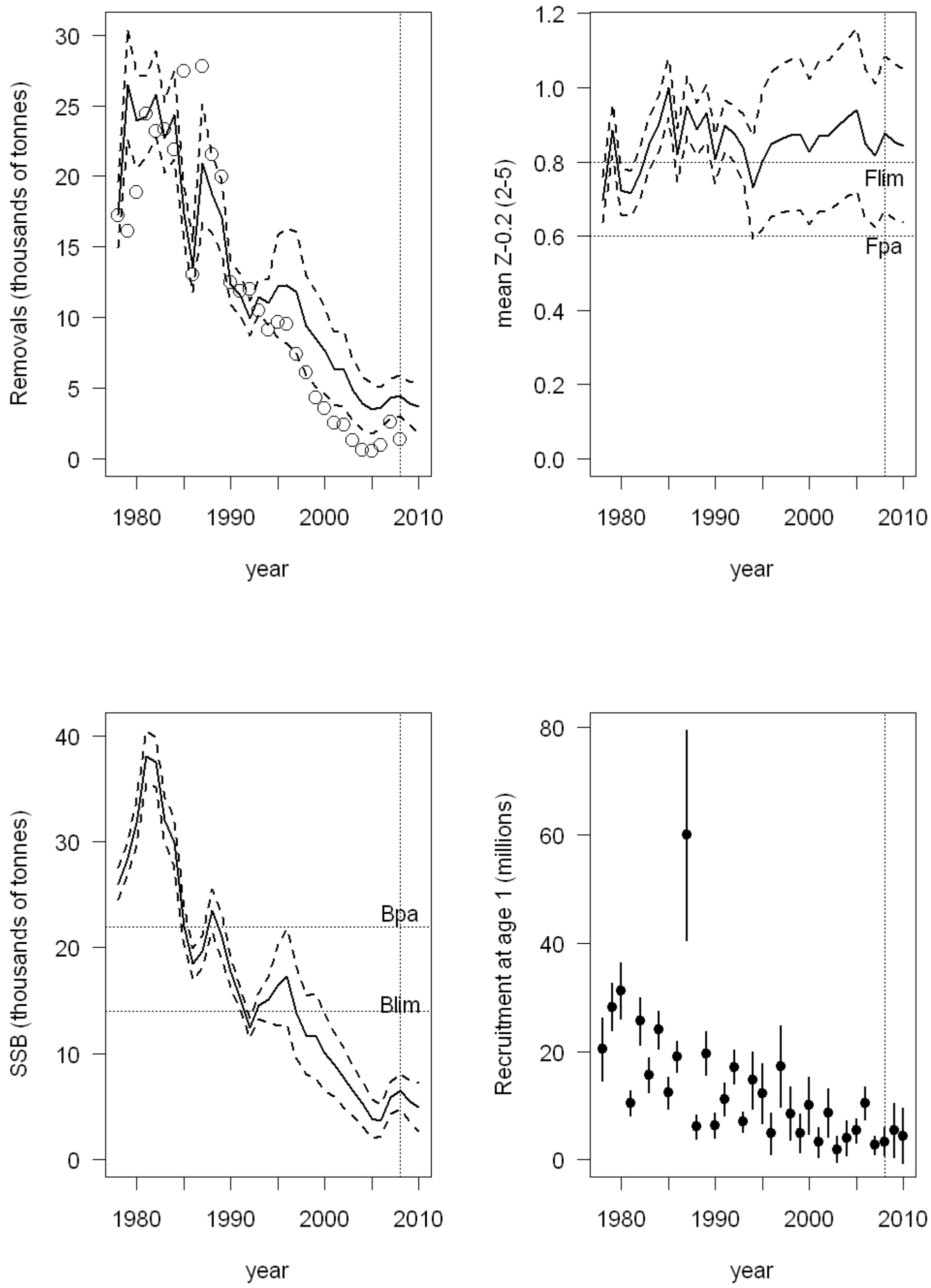


Figure 3.2.6. Cod in Division VIa. Summary plot of TSA update run. (landings and discard data excluded from 1995 onward). Solid line in top left frame indicates removals resulting from mortality over and above M=0.2; open circles represent reported catch. Solid line in top right frame indicates mortality over and above M=0.2. Dashed lines show ± 2 s.e. (approx 95% confidence interval).

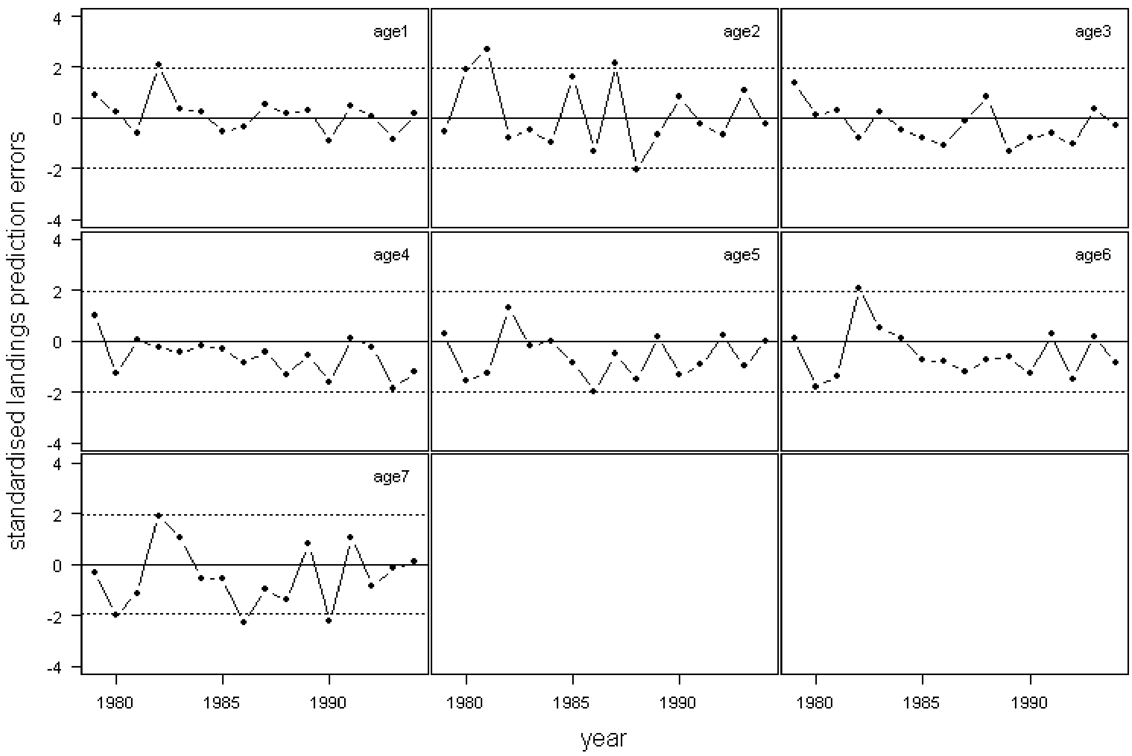


Figure 3.2.7. Cod in Division VIa. TSA final run. Standardised prediction errors-at-age plots for landings.

Figure 3.2.8. Cod in Division VIa. TSA final run. Standardised prediction errors-at-age plots for discards.

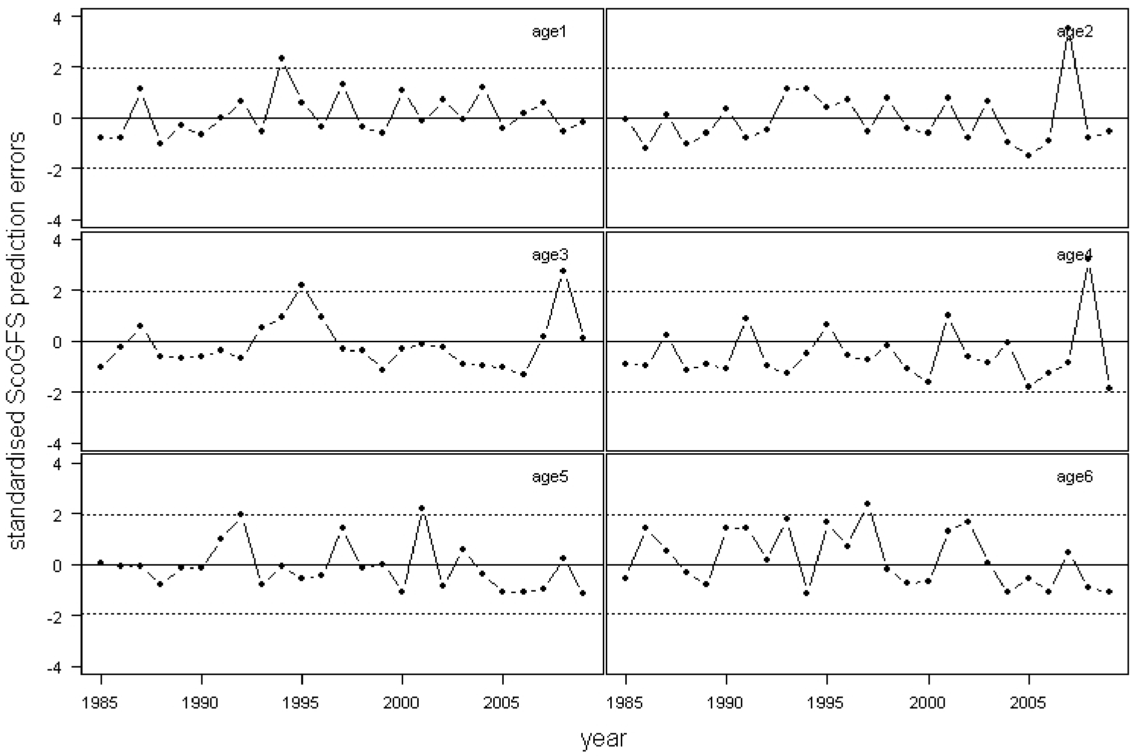


Figure 3.2.9. Cod in Division VIa. TSA run. Standardised prediction errors-at-age plots for ScoGFSQ1.

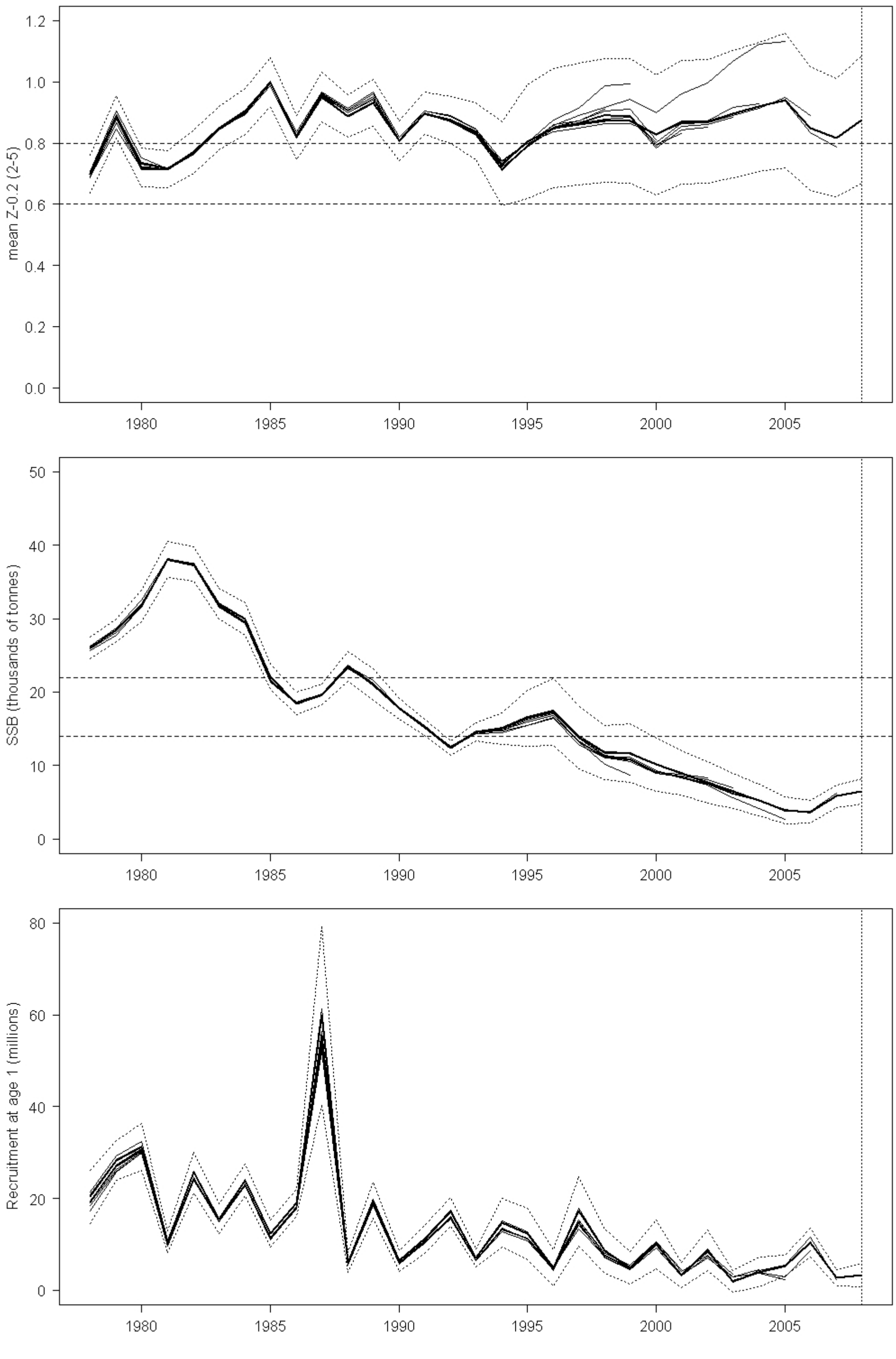


Figure 3.2.10. Cod in Division VIa. Retrospective plots of TSA run. Biological reference points are given by dashed lines. Confidence intervals for the run using all years of data are shown by dotted lines.

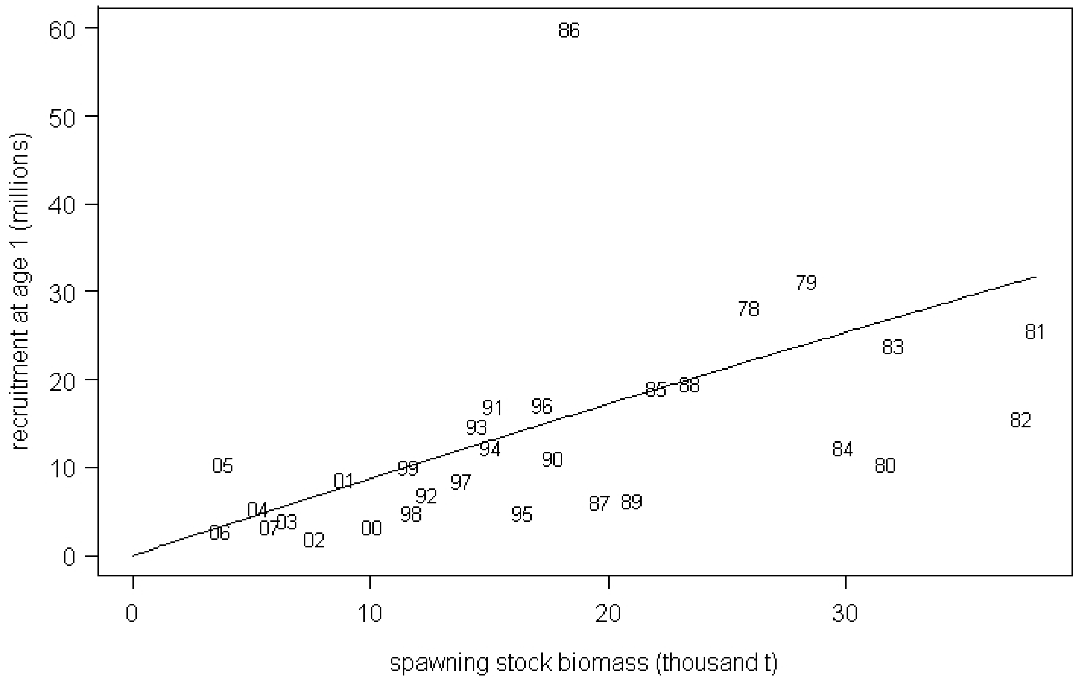


Figure 3.2.11. Cod in Division VIa. TSA final run. Stock-recruit relationship.

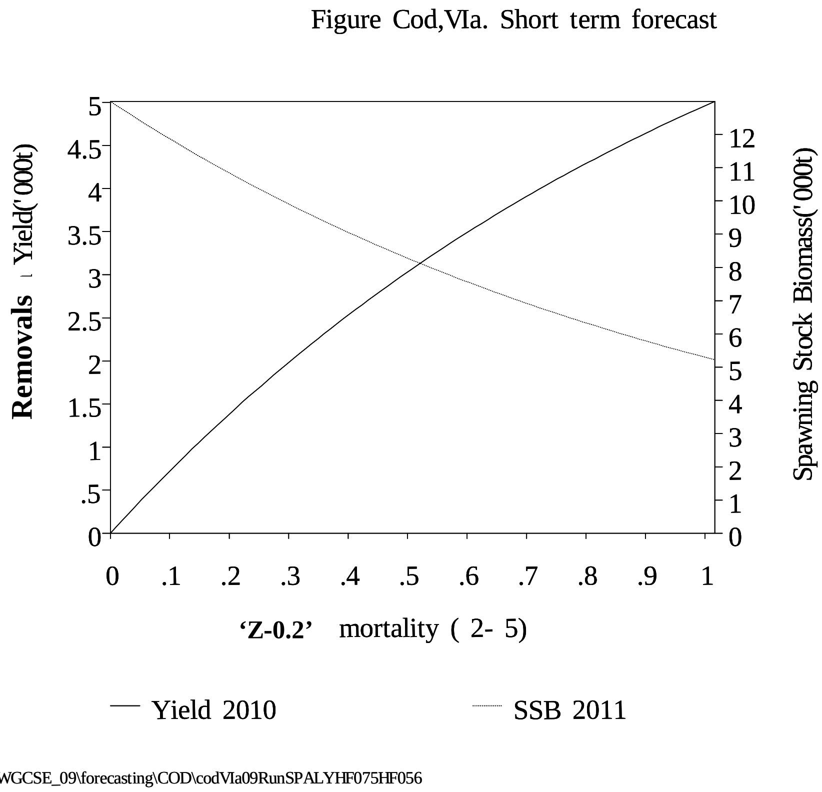
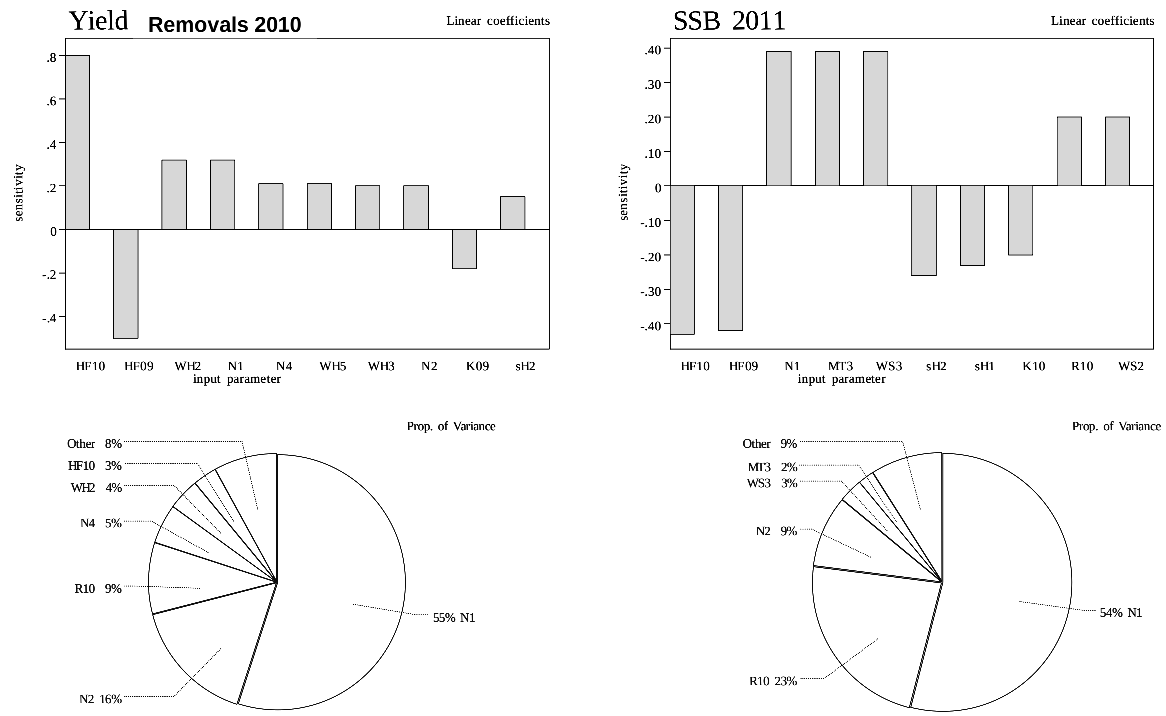


Figure 3.2.12. Cod in Division VIa. Short term forecast. Figure shows mortality from all sources that is over and above M=0.2 and associated removals.

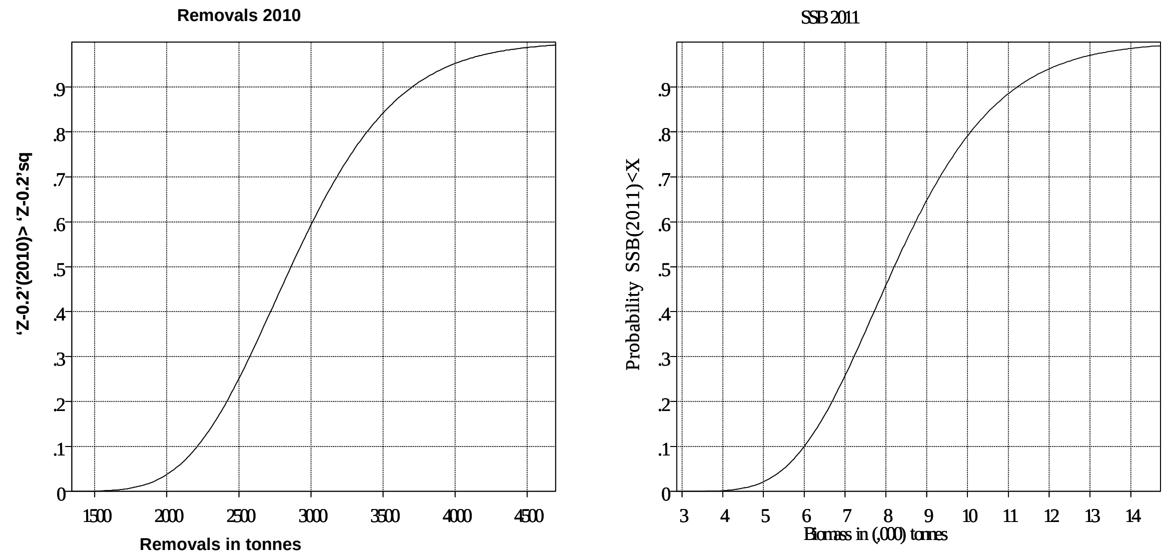
Figure Cod,VIa. Sensitivity analysis of short term forecast.



Data from file:C:\Work\WGCSE\WGCSE_09\forecasting\COD\codVIa09RunSPALYHF075HF056

Figure 3.2.13. Cod in Division VIa. Sensitivity analysis of short-term forecast. Removals are associated with mortality from all sources over and above M=0.2.

Figure Cod,VIa. Probability profiles for short term forecast.



Data from file:C:\Work\WGCSE\WGCSE_09\forecasting\COD\codVIa09RunSPALYHF075HF056

Figure 3.2.14. Cod in Division VIa. Probability profiles for short-term forecast. Removals are associated with mortality from all sources over and above M=0.2.

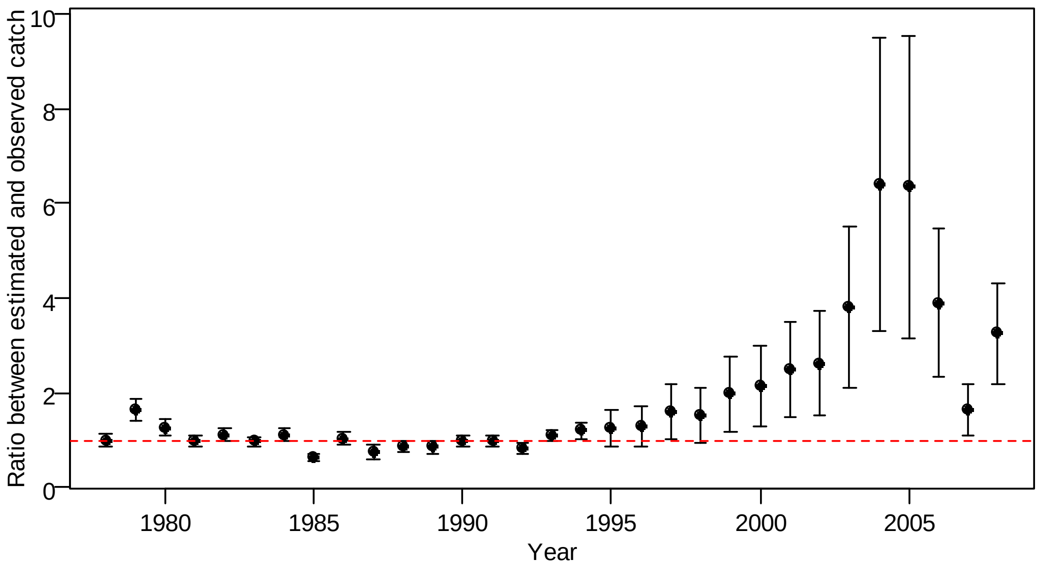


Figure 3.2.15. Cod in Division VIa. Ratio of estimated to observed catch using TSA. Bars show ± 2 s.e. TSA excludes catch data from 1995 to 2008 inclusive. The 'catch' resulting from TSA is considered removals from both fishing and natural mortality over and above M=0.2.

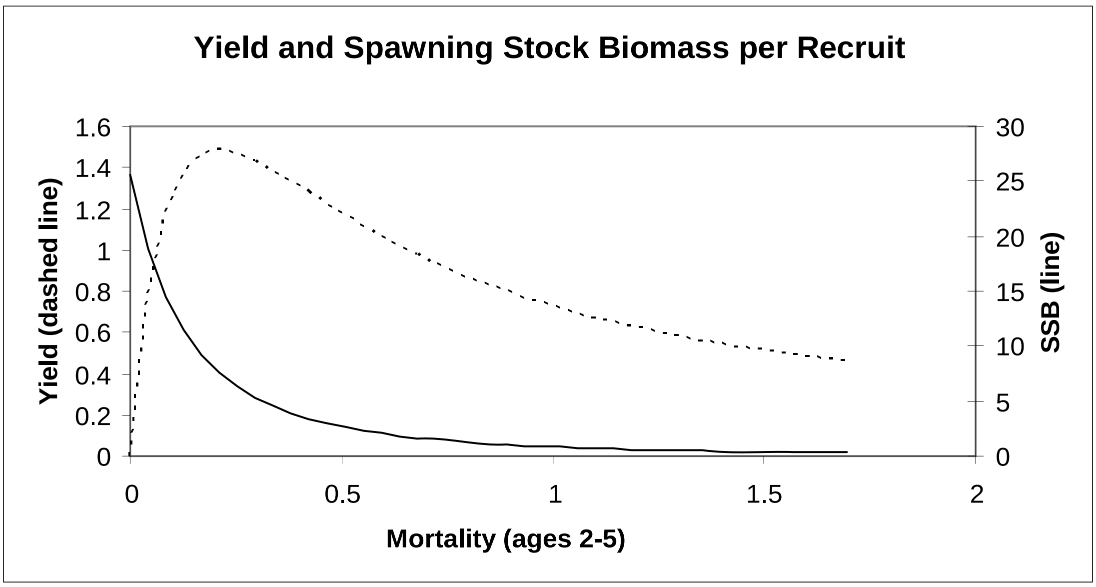


Figure 3.2.16. Cod in Division VIa. Yield and biomass-per-recruit. Mortality is all mortality over and above the fixed natural mortality value of 0.2 (referred to as 'Z-0.2').

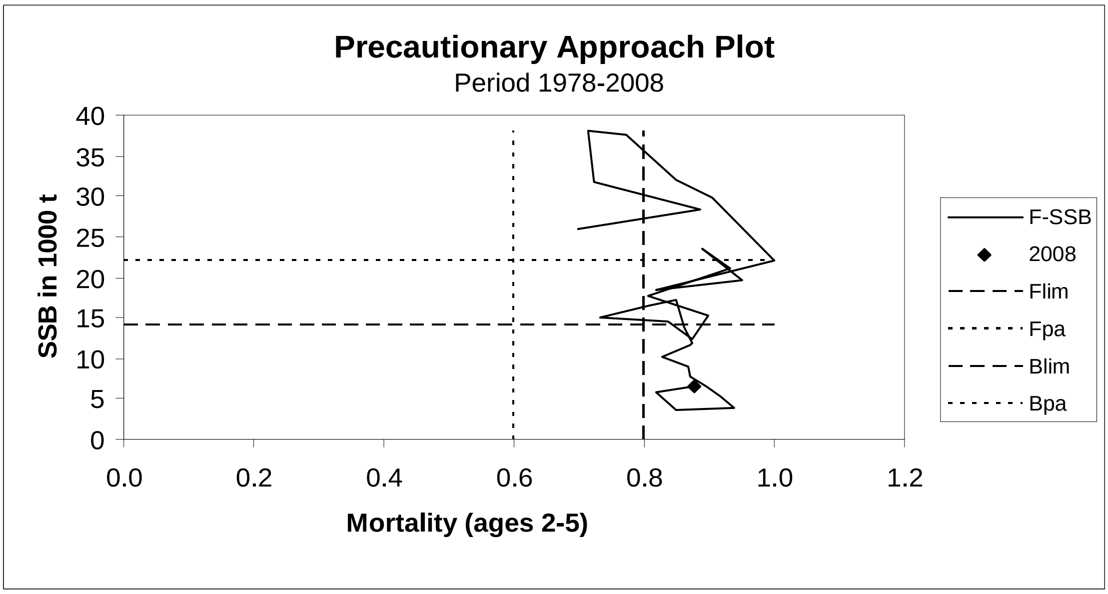


Figure 3.2.17. Cod in Division VIa. Precautionary approach plot. Mortality is all mortality over and above the fixed natural mortality value of 0.2 (referred to as 'Z-0.2').

3.3 Haddock in Division VIa

Type of assessment in 2009

The stock assessment of haddock in VIa for 2009 is an update using the same procedure as in 2008. This used the Time-Series Analysis (TSA) assessment model and tuning data from two Scottish Groundfish surveys.

ICES advice applicable to 2008

The form of ICES' advice changed in 2003 to take more account of the mixed nature of the fisheries exploiting haddock. Management of haddock since then has been considered as part of wider concerns in the Celtic Sea and West of Scotland ecosystem.

The advice relating to the single-stock exploitation boundary for 2008 was:

"Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects:

Candidates for reference points which are consistent with taking high long-term yields and achieving a low risk of depleting the productive potential to the stock may be identified in the range of F0.1–F_{max}. The estimate for F_{max} is uncertain, but the current fishing mortality is likely to be higher. There will be no gain to the long-term yield by having fishing mortalities above F_{max}. Fishing at such lower mortalities would lead to higher SSB and, therefore, lower risks of fishing outside precautionary limits.

Exploitation boundaries in relation to precautionary limits.

In order to maintain SSB above B_{pa} in 2009, ICES recommends a reduction in fishing mortality to less than 0.18. This corresponds to total catches (including discards and unallocated catches) of less than 4200 t in 2008."

ICES advice applicable to 2009

The advice relating to the single-species exploitation boundary for 2009 was:

"Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects:

The current fishing mortality (2007) is estimated to be 0.56, which is above the rate expected to lead to high long-term yields and low risk of stock depletion.

Exploitation boundaries in relation to precautionary limits:

Even in the absence of fishing the stock is not expected to be rebuilt to B_{pa}."

3.3.1 General

Stock description and management units

A TAC relating to this stock is in place for ICES management Areas Vb and VIa and the assessment is carried out using data from VIa. The basis for the stock assessment area is described in the stock annex.

The agreed minimum landing size for haddock in Division VIa is 30 cm. There is no formal management plan in place. Further regulations implemented for the west of Scotland, including, for example, technical measures associated with cod and the UK Registration of Buyers and Sellers regulation, are described in the overview section for this management area (Section 3.1.)

The following table summarizes ICES management advice and the EC management applied for haddock in Division VIa during 2004–2009:

Year	Predicted catch corresp. to Single-Stock Exploitation Boundaries	Basis	TAC for Vb (EC), and VIa	% change in F associated with TAC[1]	2009 WG estimate of landings
2004	12.2	Fpa	6.50	-50%	3.20
2005	7.6	0.75 * Fpa	7.60	-30%	3.15
2006	8.0	0.7 * Fpa	7.81	+3%	5.72
2007	7.2	0.87 * Fpa	7.20	-8%	3.70
2008	4.2	SSB>Bpa in 2009	6.12	-50%	2.80
2009	0	F=0	3.52	-43%	NA

Values are thousand tonnes. [1]Based on *F*-multipliers from forecast tables. NA = not applicable.

Fishery in 2008

Official (reported) landings for each country participating in the fishery are given in Table 3.3.1. Note that data for 2008 landings are preliminary pending final submissions. Vessels operating in the fishery are mainly Scottish and Irish and the amount of quota allocated to different countries reflects this.

Uptake of quota is given here and is calculated from the official landings as a proportion of the EC allocated quota for each country. No country took up its full allocated quota in 2008 and in some cases the proportion of uptake was low. Discards data that are reported are dealt with in the following section (see below).

Country	TAC 2008	Official landings*	% uptake of quota
Belgium	7	0	0%
Germany	9	1	11%
France	366	85	23%
Ireland	995	879	88%
UK	4743	1769	37%
EC	6120	2734	45%

Values of TAC (Total Allowable Catch) and landings are in tonnes.

*** The official landings provided to ICES for 2008 are preliminary at time of writing in 2009.**

3.3.2 Data

An overview of the data that have been provided to the WG is given in Section 2. The reliability of catch data for VIa haddock has been a concern for several years, as a consequence of issues such as misreporting or underreporting and associated unaccounted discarding. It has not been possible to quantify the extent of these unallocated removals, leading to the use at the 2007 meeting of a modified TSA assessment method which did not use catch data after 1994. Recent changes in regulations and fleet behaviour are likely to have improved the quality of catch data, which is now thought to be more representative of the true catch.

Landings

Landings, as reported to ICES and made available as official statistics, and as estimated by the WG are provided in Table 3.3.1. Data are received by the stock coordinator in electronic format. In previous years commercial data have been collated by FRS Aberdeen (now Marine Scotland-Science) using a suite of VAX programs as described in Kunzlik (WD5 WGNSDS 2007). These are now obsolete, and in the continued absence of a functional version of the InterCatch system, data for 2007 and 2008 were collated by the marine laboratory, Marine Scotland via a spreadsheet system. This was a tractable simplification of the VAX system which used data aggregated on a national level, rather than a fleet level.

Catch-at-age data

Total catch-at-age data are given in Table 3.3.2., while catch-at-age data and mean weights-at-age for each catch component (landings and discards) are given in Tables 3.3.3–3.3.7. The full available year and age range are given for completeness: however, it should be noted that commercial catch data preceding 1978 are not used in the assessment, as the split of total catch into landings and discards was hypothetical prior to that time. The countries that provide data are listed in Table 2.2, and sampling levels are demonstrated in Table 2.3.

Discards

WG estimates of discards are based on data collected in the Scottish and Irish discard programmes; raised by weighted average to the level of the total international discards (Table 3.3.4.). For 2008 discard data were available from Scotland and Ireland. Previously, discard age compositions from Scottish sampling were applied to the unsampled fleets but for 2008 both Scottish and Irish discard data were used for that purpose. The revision of the Irish discard data to accommodate a new raising procedure and the provision of a time-series will require that the overall time-series of discard estimates is recalculated. Work is also underway to revise the Scottish discard estimates with an aim to reduce bias and increase precision. A working document presented at WGNSDS 2004 set out the methodology of this ongoing work (ICES, 2004).

Biological

Weights-at-age

The weights-at-age for this stock are generated by applying a fixed weight–length relationship with observations on fish length: for this purpose a combination of Scottish and Irish weight–length relationships were used, depending on data availability. This procedure gives an approximation only to weights-at-age, and does not incorporate effects such as changes in condition. The estimated weights-at-age for the total catch in Division VIa are given in Table 3.3.5. These are calculated as weighted averages of the corresponding weights-at-age in landings and discards: the latter are given in Tables 3.3.6.and 3.3.7. Weights-at-age in the stock are assumed to be equal to the weights-at-age in the total catch, in the absence of a sufficiently long time-series of survey-based weight measurements. The weights-at-age time-series are also plotted in Figures 3.3.1–3.3.3. Mean weights-at-age of haddock have declined considerably in landings (and, by extension, catch and stock) for fish aged 5 and older over the last ~20 years. Weights-at-age in discards have remained more constant. Most of the discarded fish are younger than age 4. There was a difference between haddock mean weights-at-age 1 in the Irish (351 g) and Scottish (275 g) landings data from 2008. On further inspection it was found that the Irish data had been based on very few measurements of fish weight from 2008. For the assessment, it was decided to use the Scottish landings data for age 1 as this was based on a larger sample of fish that had been sampled throughout the year and hence was considered to be more representative of the annual mean weight for this age class.

Natural mortality and maturity

Natural mortality was assumed to be 0.2 for all ages and years. Maturity was assumed to be as follows: Age 1: 0% mature; age 2: 57% mature; age 3: all mature. Details can be found in the stock annex. Proportions of *F* and *M* before spawning were both set to 0.0, in order to generate abundance (and hence SSB) estimates dated to January 1st.

Surveys

Research vessel surveys

Four research-vessel survey-series are available for the assessment of haddock in Division VIa (see Table 3.3.8).

The Reports of the 2006 meeting of the WG (ICES WGNSDS 2006) and the 2007 meeting of the IBTS WG (ICES IBTSWG 2007) explored the available survey data in detail. Both ScoGFS Q1 and Q4 were first accepted for use in the 2006 assessment, and this practice has been continued this year. The IreGFS series was not considered further because of problems with internal consistency (ICES WGNSDS 2006), whereas the new IRGFS series has six years of data and cannot yet be considered for tuning purposes.

All survey-series available for tuning the assessment are given in Table 3.3.8, with the data that were used in the final assessment indicated. Plots of the spatial distribution of the ScoGFS Q1 and Q4 survey mean catch rates per ICES statistical rectangle by age class are given in the stock annexe.

Commercial cpue

Commercial catch-effort series

There has been a general decline in effort directed at haddock in VIa. Landings-per-unit effort have also declined, although there was a rise in lpue during 2000–2003 as a result of the strong 1999 year-class recruiting in 2000. Commercial effort data are given in the stock annex and are currently not used in the stock assessment.

3.3.3 Historical stock development

Final update assessment

The model used for this assessment is TSA, with data from two research vessel surveys and catch data excluded after 1994. The model is run using a custom made Fortran 90 programme (see stock annex).

The assessment in 2009 was an update, using TSA. The following table summarizes data ranges used.

DATA	2009 ASSESSMENT
Catch data	Years: 1978–1994 Ages: 1–8+
Survey: ScoGFS Q1	Years: 1985–2009 Ages 1–7
Survey: ScoGFS Q4	Years: 1996–2008 Ages 1–7
Survey: IreGFS	Not used

Standardised prediction errors are given in Figures 3.3.5 (landings), 3.3.6 (discards), 3.3.7 (ScoGFS Q1) and 3.3.8 (ScoGFS Q4). Although some outliers remain, none are large enough to invalidate the model fit and there are no time-trends in recent years. A notable prediction error occurred in the ScoGFS Q4 in 2007 at-age 2 (the 2005 year class). This was as a consequence of a large index value in this survey year at that age (which was common to many hauls): $q_{catch}(age=2,\ year=2007)$ was inflated to decrease the influence of this extreme value (an adjustment recommended in Fryer 2001 which has been applied previously to several age/year data points). A prediction error from the ScoGFS Q1 in 2009 (age 4) was also down weighted according to the same procedure. Parameter estimates from TSA are demonstrated in Table 3.3.9. Outputs from the TSA assessment are shown in Figures 3.3.10.–3.3.14.

The TSA stock–recruit plot is presented in Figure 3.3.9. Estimated and observed discard rates (proportions-at-age) are shown in Figure 3.3.10. Discard model fits are good for the years 1978–1994 when discard data are included in the estimation. Agreement remains close until 2002, when the values begin to diverge (note that the "estimated" discard ogive is actually fixed after 1994, as there are no new discard data included in the model after that year). Although the overall discard estimates are close to observations in 2008 (see Figure 3.3.4) Figure 3.3.10 suggests that the discarding pattern by age in 2008 is still somewhat different from the model, but improved from some previous years (e.g. 2006).

Comparison with previous assessments

The results of retrospective analyses are summarized in Figure 3.3.11. There is little bias in these plots. Most retrospective bias is thought to be caused by mismatch between catch and survey data (ICES-WGMG 2007), and as only survey data are used in the TSA model after 1994 the absence of strong retrospective patterns is not surprising. However, there are some deviations in SSB estimates during the early to mid-1990s, and this corresponds to the period when neither survey was able to track year-class strength well. The estimates from this year's assessment are reasonably consistent with those from recent years.

Recruitment estimates

The TSA assessment provides estimates of recruitment for the forecast years 2009 and 2010. The value for 2009 (that is, the 2008 year class at-age 1) is based largely on the ScoGFS Q1 datum for that year (along with a degree of time-series smoothing), and as it is based on observations it is appropriate to use it in the forecast. The value for 2010 (that is, the 2009 year class at-age 1) is not generated directly by data, but rather the underlying Ricker stock–recruit model that is included by TSA (Figure 3.3.9) as part of the overall model fit. Recruitment estimates based on TSA forecasts were used for 2008 as well as for 2007. As with the assessment of last year, a long-term (1978–2008) geometric mean was used for subsequent years. The recruitment values used in the forecast are given in the following table:

YEAR	TSA	GM (78–08)
2009	29 644 (~ ScoGFS)	
2010	111 075 (Ricker)	
2011	-	91 033

Figure 3.3.12 demonstrates the close agreement between the TSA-generated recruitment estimates, and the indices from the two surveys. The plot also illustrates the available forecast recruitment options.

State of the stock

The state of the stock is summarized in Figure 3.3.4 and Table 3.3.14.

The final estimates for the stock in 2008 are:

$F_{(2\text{-}6)}$ = 0.46

SSB = 30, 436 t

Based on the most recent estimates of SSB in 2009 (20 271 tonnes, <B_{lim}) ICES classifies the stock as being at risk of reduced reproductive capacity.

Based on the most recent estimate of fishing mortality in 2008 (0.46, <F_{pa}) ICES classifies the stock as at risk of being harvested sustainably. The reader is reminded that the most recent estimates of F are uncertain and that the mean F for the last three years (2006–2008) is 0.51 (>F_{pa}).

Summary plots from the final assessment are given in Figure 3.3.4, while corresponding estimates and standard errors are presented in Tables 3.3.10 and 3.3.11 (population abundance), Tables 3.3.12 and 3.3.13 (fishing mortality), and Table 3.3.14 (stock summary). Mean $F_{2\text{-}6}$ is estimated to have fluctuated just above F_{pa} (0.5) during 2003–2006 and has fallen to below 0.5 in 2007–2008. A sequence of low recruitments has led to a fall in SSB. Estimated and observed catches diverged considerably from 1995 onwards, indicating considerable amounts of unaccounted mortality. However, total observed catch in 2006 and 2007 was back within the bounds of error of the estimated catch. This may indicate a beneficial effect of management regulations and changes in fleet behaviour since 2006.

3.3.4 Short-term projections

The time-series of estimated fishing mortality-at-age is shown in Figure 3.3.13, along with the mean F over ages 2–6. As with last year a three-year mean fishing-mortality selection pattern was used in the forecast. Figure 3.3.14 compares a simple three-year mean, the most recent estimate (2008), and TSA-generated selection patterns. The WG did not consider what discard proportion to use in the forecast. As highlighted above, the assessment is survey-based from 1995 onwards and estimates total **removals** from that year to the present. It is not possible to subsequently partition estimated removals back into landings, discards, and other sources of mortality, because it is not known what proportion of the difference between observed and estimated removals is as a consequence of fishing. It is also likely (in any case) that changes in regulations and fishing practices in Division VIa will alter discarding practice. The forecasts presented in this Section are therefore intended to be used as forecasts of total **removals**, rather than landings for direct TAC advice purposes. This is an unavoidable consequence of series of recent years of poor-quality commercial catch data.

The final key issue for the forecast is that of weights-at-age, and in particular, the slow growth observed in recent year classes. Figure 3.3.15 demonstrates this with linear models fitted to cohort-based mean weights-at-age data. A number of recent year classes appear to be growing more slowly than has been the case in the more distant past. As per last year, linear models were used as the basis for predictions for those cohorts with sufficient data (Table 3.3.15).

The short-term forecast programme used in this assessment (WGFRANSW from the MLA suite) cannot account for changing *F* within a forecast, so for this purpose a three year mean of *F* is used (mean F 2006–2008 = 0.51). Table 3.3.16 presents the inputs to the short-term forecast. Outputs from the forecast are given in Tables 3.3.17 (management options) and 3.3.18 (detailed tables), and Figures 3.3.16 (sensitivity analysis), 3.3.17 (probability profiles) and 3.3.18 (short-term forecast).

It is worth reiterating that this year's forecast for haddock in Division VIa is based on an assessment principally driven by survey data since 1995. Because of this, it is not possible to partition estimated removals into landings, discards, and other sources of mortality. It is therefore not possible to adjust TACs directly for catch options. However, the WG concludes that the current downwards trend in SSB and continued low recruitment are informative indicators for management advice.

At the *status quo* rate of removals, and given assumptions about growth and recruitment, the most recent estimate of SSB (2009) is below B_{lim} and is forecast to remain below B_{lim} in 2010 and 2011, even in the absence of fishing mortality. This is a consequence of a declining SSB and a series of poor recruitments which have failed to arrest the stock's decline. Anecdotal evidence and fishery observations suggest that regulations and changes in fishing patterns in 2008 might result in a reduction of fishing mortality, there is no means of evaluating how individual measures might contribute to reductions in mortality. F is below F_{pa} in 2008 (0.46), although the estimates are uncertain. The three year mean of F (2006–2008), which stands at 0.51, is just above F_{pa} (0.50).

It must be emphasized that the forecast given in this section is a projection of removals, *not* landings. Care therefore needs to be taken when interpreting the forecast in the context of management advice for the purposes of setting quotas. In the absence of any indications of a strong incoming year class, it is inevitable that SSB will continue to decline in the short term. However, as mentioned above, the rate of that decline may be less than suggested in this forecast.

Yield-per-recruit

Yield-per-recruit analysis resulted in the following estimates.

Yield and spawning biomass per Recruit F-reference points (2008):

	Fish Mort	Yield/R	SSB/R
	Ages 2–6		
Average last 3 years	0.51	0.19	0.43
Fmax	0.39	0.19	0.54
F0.1	0.19	0.17	0.96
Fmed	0.52	0.19	0.41

3.3.5 3.3.5 Medium-term forecasts

Stochastic medium-term projections were not produced for this stock. The reliance of the fishery on intermittent large year classes, and the fluid nature of the fishery and related management, make the usefulness of medium-term projections questionable in any case.

3.3.6 3.3.6 Biological reference points

B_{pa} is set at 30 000 tonnes and is defined as B_{lim}*1.4. B_{lim} is defined as the lowest observed SSB, considered to be 22 000 tonnes when the current reference points were established in 1998. F_{pa} is 0.5 on the technical basis of a high probability of avoiding SSB falling below B_{pa} in the long term. F_{lim} is not defined. In the 2007 ACFM report, F_{max} was estimated at 0.44 and $F_{0.1}$ was 0.2.

3.3.7 Management plans

There is no management plan currently in place for this stock, although one is in the process of being formulated. Any advice for haddock needs to take account of corresponding advice for cod and other mixed-fishery considerations.

3.3.8 Uncertainties and bias in assessment and forecast

Quality of the assessment

Landings and discards

Quotas for haddock in Division VIa appear to have started to become restrictive in or around 1995. Anecdotal evidence suggests that these and other strict management measures led to increasing unreliability of landings data from the commercial fleets prosecuting the fishery from 1995 to 2005. The approach taken in this WG is to assess the stock using a modified TSA model which does not include catch data from 1995 onwards, and which thus models removals rather than catches.

Effort

Following detailed analyses of models using the available commercial catch data (ICES WGNSDS 2004) and because of concerns of unaccounted mortality and the unreliability of commercial catch data, the commercial cpue or lpue data cannot be used to improve the TSA assessment. Furthermore, work at a recent demersal stocks WG indicated that hyperstability of catches when stocks are at low levels may reduce the usefulness of commercial effort data (ICES WGNSSK 2000). The assessment is therefore primarily survey-based.

Surveys

A survey-based assessment can only be as good as the surveys on which it is based. The Scottish roundfish survey-series appear to have good internal consistency and to track cohorts well, with the exception of a period during the mid-1990s. Concerns remain over the apparent differences in catchability of young fish between the Scottish and Irish components of IBTS (ICES-IBTSWG 2007). Any survey is likely to become less reliable when stock abundance declines, and this issue needs to be revisited in the near future for haddock and many other stocks.

Weights-at-age

In this assessment, simple linear growth models have been fitted to cohort weights-at-age data and used to generate weights-at-age in the forecast. These models fit reasonably well, but this approach is quite simplistic and may be missing important nuances in growth characteristics such as variable growth within a cohort.

Model formulation

Models such as the modified TSA used this year, based largely on survey data, are becoming the *de facto* standard in several ICES assessments for which problems exist with commercial catch data (see this report, and also ICES-WGNSSK 2006). Other examples include BADAPT and SURBA. While these are essential to address data problems, it needs to be borne in mind that there are two main problems with such approaches. First, survey data are based on far fewer samples, and are therefore more variable than catch data. It is therefore likely that precision is sacrificed (to a certain extent) to reduce bias. Second, a survey-based assessment estimates removals from the stock and total mortality, rather than landings and fishing mortality, and is therefore more difficult to use as the basis of quota advice than corresponding catch-based approaches.

3.3.9 Recommendations for next benchmark

Review of last year's assessment

The following comments relate to the review of the 2008 assessment of VIa haddock and a benchmark assessment is needed in order to deal with them in detail:

General comments

"The application of modified TSA assessment method in the light of unknown levels of mis- or underreporting and unaccounted discard pattern is the advantage of the method as the unreliable catch data after 1994 were not used in the assessment. Changes in fishery exploitation pattern (shift in use of gear) seems to have affected catch-at-age composition as it is evident that numbers-of-age 2 in catch-at-age matrix (Table 4.1.13) is drastically higher than all the other age groups in 2007 catch. Due to changes in fisheries practice adaptation in data collection sampling schemes shall be considered.

The usage of weights-at-age by applying fixed weight–length relationship to observations on fish length enables tracking changes in fish condition taking into account that both weight-at-age in the total catch is equal to weight-at-age in the stock. Changes in fish condition might be evident in case of abundant year classes which are usually characterized by slower growth rate. It will be of great interest to incorporate weight-at-age in the stock from survey-based weight measurements when WG considers the time-series-sufficiently long.

Technical comments

Improvements for next year:

- *adapt sampling schemes to changes in fishing behaviour observed in 2006 and 2007,*
- *apply in the assessment weight-at-age in the stock from observed survey based weight measurements when the dataseries is considered to be long enough,*
- *it is not explained neither in the Report nor in the Stock Annex why the direct weight measurements are not used.*

Things that need update before ADG:

None.

Conclusions

RG agrees with WG on stock."

Below, some potential avenues of endeavour for the next benchmark meeting are proposed. All aspects are considered important and the proposed time frame would be to work on these in 2011–2012. Work on developing management plan is also important.

Landings and discards

There should be an analysis of precision and bias of catch-at-age data. This would need to be done in order to consider how or whether to re-include commercial catch data in the assessment. Measures such as the UK Registration of Buyers and Sellers legislation may have improved the reliability of commercial landings data for the last three years. Although it is not appropriate to simply add these data to the model at the end of the time-series, the survey-based estimates do indicate that the discrepancy between observed and estimated removals has fallen in 2006, 2007 and 2008; furthermore the actual catches in 2006 and 2007 were within the bounds of error of the estimated catch.

Effort

A VMS-based analysis of lpue could help to address the concern that currently commercial cpue or lpue data cannot be used in the assessment. With the increased requirement for vessels to operate with VMS it is likely that the quality of effort data will improve. This will lead to improved time-series of effort data in future but still leaves the uncertainties regarding the earlier years in the time-series.

Surveys

As the time-series lengthens, an analysis of the new IreGFS should take place in order to check the quality and consistency of this survey for tuning purposes and hence decide on its inclusion in the assessment.

Weights-at-age

The growth characteristics of this haddock stock are very variable, and seem to be strongly driven by cohort effects rather than year effects: that is, early life-history events determine the subsequent growth potential to each cohort. Work is underway at Marine Scotland (Aberdeen) and elsewhere to develop improved models of growth, and it is hoped that these will improve stock forecasts in future. Consideration of using stock weights from the survey, instead of the estimated weights-at-age could be addressed at a benchmark assessment.

Other modelling

Growth modelling could help with forecasts of mean weights-at-age. It may also be of interest to use bioeconomic models to address questions to do with feedbacks between quota, its uptake and strong drivers of fishers' behaviour, for example, fuel price.

3.3.10 Management considerations

Management decisions will need to consider changes in fishing behaviour, for example, reallocation of effort and responses to gear measures and ongoing management plans for other stocks. There appears to have been substantial reductions in effort associated with larger mesh sizes (120 mm+) away from the traditional gadoid fishery in Division VIa and redirected to the *Nephrops* fishery in Division IVa (principally, the Fladen Ground). There may also be redistribution of effort from VIa to VIb (Rockall) and to outside the "cod management" line defined in the cod management plan (Council Regulation (EC) No. 1342/2008). This line follows the 200 m depth contour. Trials of paired gear (both seine and trawl) at Rockall have been carried out by some Scottish skippers. This may lead to a considerable increase in effective effort at Rockall, especially given the lack of effort restrictions in that fishery. Special attention needs to be given to considering the sporadic nature of haddock recruitment, and how to manage periods of low recruitment interspersed with large, occasional pulses. More generally, management of haddock in Division VIa is becoming the subject of an empirical evaluation of the type carried out in 2006 for North Sea haddock (ICES-WGNSSK 2006). This should lead to a management plan for haddock in VIa.

Table 3.3.1. Haddock in Division VIa. Nominal landings, as officially reported to ICES and estimated by the WG.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008[1]
Belgium	8	9	-	9	1	7	1	-	1	3	2	2	1	2	-	-	+	-	-	-	-
Denmark	+	+	+	+	-	1	-	1	1	-	-	-	-	-	-	+	-				-
Faroe Is.	-	13	-	1	-	-	-	-	-	-	-	-	-	-	-	-	4	-	1	2	-
France	3001	1335[2]	863[2]	761[2]	761	1132	753	671	445	270	394	788	282	160	151	183	173	273	291	211	85
Germany	4	4	15	1	2	9	19	14	2	1	1	2	1	1	+	-	-	1	7	-	1
Ireland	2731	2171	773	710	700	911	746	1406	1399	1447	1352	1054	677	744	672	497	194	152	526	759	879
Norway	54	74	46	12	72	40	7	13	16	21	28	18	70	32	30	23	4	21	17	16	28
Spain	-	-	-	-	-	-	-	1	-	-	2	4	-	4	4	5	-	47	44	5	-
UK (E&W)3	114	235	164	137	132	155	254	322	448	493	458	315	199	201	237	107	93	42	19	193	-
UK (N. Ire)	35								...	...	…	...	…	…	…	…	…	…	…	…	-
UK (Scot.)	15 151	19 940	10 964	8434	5263	10 423	7421	10 367	10 790	10 352	12 125	8630	5933	5886	5988	4582	2909	2025	4928	2587	-
UK (total)																				-	1769
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Total reported	21 098	23 781	12 825	10 065	6932	12 678	9201	12 794	13 102	12 587	14 360	10 813	7163	7030	7082	5397	3378	2561	5833	3773	2762
WG estimates	21 136	16 688	10 135	10 557	11 350	19 060	14 243	12 368	13 453	12 874	14 401	10 430	6952	6731	7097	5334	3199	3148	5723	3702	2801

[1]Preliminary.

[2]Includes Divisions Vb(EC) and VIb.

[3]1989–2005 N. Ireland included with England and Wales.

n/a = Not available.

WG estimates refer to the sum-of-products of landings and weights-at-age provided to the WG, rather than the estimated removals produced in the final assessment.

Table 3.3.2. Haddock in Division VIa. Total catch-at-age numbers (000s). Values used in the final assessment are boxed.

Year	Age 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	451	1059	1341	72461	6816	294	274	174	11	6	6	0	0	0	0	0	24
1966	5953	1595	529	1113	47431	1926	64	32	57	0	0	0	0	0	0	0	57
1967	40122	19185	19332	951	265	24979	400	9	14	4	0	0	0	0	0	0	19
1968	27	129418	38393	3079	356	681	14063	727	43	9	0	0	0	0	0	0	52
1969	2742	84	160706	10260	1434	268	379	4576	191	9	0	0	0	0	0	0	200
1970	17189	6317	519	95114	2770	173	89	145	585	13	2	0	0	0	0	0	600
1971	6604	71481	3915	3328	79966	545	127	7	20	175	16	0	0	0	0	0	212
1972	14215	20713	85141	2718	2336	53823	504	50	19	0	67	0	0	0	0	0	86
1973	19589	47387	16907	19477	258	1222	33193	150	32	6	125	0	0	0	0	0	163
1974	63698	68837	11562	10757	6317	83	447	11463	104	34	31	0	1	4	0	0	174
1975	6849	179349	34957	3339	3350	1882	95	98	3454	72	8	0	0	0	0	0	3534
1976	4227	24337	72330	15224	1588	1491	868	21	7	1103	4	0	5	0	0	0	1119
1977	4552	13109	3468	35948	5705	680	495	308	28	11	259	5	0	0	0	0	304
1978	57	**15942**	**2095**	**971**	**24357**	**2938**	**351**	**247**	338	7	17	211	3	0	0	0	**575**
1979	5697	**70070**	**17282**	**1865**	**470**	**9863**	**833**	**114**	145	28	3	1	42	1	0	0	**221**
1980	13	**22729**	**21927**	**5636**	**922**	**143**	**3082**	**229**	22	5	21	3	0	4	0	0	**54**
1981	764	**251**	**83911**	**20697**	**1768**	**194**	**39**	**822**	39	14	2	2	1	0	1	0	**60**
1982	136	**15492**	**5019**	**73676**	**8167**	**898**	**108**	**272**	288	31	12	1	0	0	0	0	**332**
1983	2084	**14524**	**20233**	**6040**	**36122**	**3398**	**597**	**41**	194	195	40	15	0	0	0	0	**444**
1984	269	**98976**	**8626**	**12910**	**6242**	**22790**	**2449**	**371**	43	44	73	3	0	0	0	0	**162**
1985	155	**22820**	**78922**	**4667**	**4184**	**1789**	**11189**	**964**	84	4	8	56	4	0	0	1	**157**
1986	2979	**8127**	**11235**	**45367**	**1823**	**916**	**449**	**2611**	344	38	7	15	1	3	0	0	**409**
1987	1498	**89021**	**16824**	**10150**	**23857**	**1452**	**1116**	**642**	1818	326	20	15	9	3	12	0	**2203**
1988	7582	**10007**	**58414**	**7598**	**4185**	**9255**	**428**	**235**	177	935	45	3	1	3	2	0	**1167**
1989	3773	**5010**	**3420**	**25724**	**2755**	**1556**	**3634**	**255**	84	87	437	56	1	1	0	0	**666**
1990	437	**37247**	**5856**	**1884**	**12158**	**871**	**279**	**519**	48	22	12	2	0	0	0	0	**85**
1991	8921	**36924**	**21991**	**1259**	**834**	**5132**	**412**	**283**	410	24	11	5	6	0	0	1	**457**
1992	4332	**51840**	**18971**	**11331**	**565**	**236**	**1577**	**157**	37	108	25	0	0	0	0	0	**169**
1993	2196	**43659**	**60785**	**20763**	**4669**	**306**	**219**	**915**	70	107	44	25	1	2	0	0	**250**
1994	2843	**19484**	**32638**	**21527**	**5671**	**1579**	**76**	**175**	237	17	16	9	1	0	0	0	**279**
1995	7692	17580	15759	23599	6865	1472	387	34	111	90	2	0	0	0	0	0	203
1996	10249	33344	39812	6641	10225	3663	1007	324	23	40	12	4	0	0	0	0	80
1997	2984	23843	10507	21550	2178	2668	870	259	59	1	7	1	0	0	0	0	67
1998	2058	11421	18001	8032	15116	1352	1036	377	124	45	2	4	1	0	0	0	175
1999	6898	6179	18055	11569	3004	4919	579	452	96	12	2	1	2	1	0	0	115
2000	5709	50142	6642	8596	4213	1055	1104	205	133	21	1	0	0	0	0	0	156
2001	11818	11023	33496	2432	3666	1521	533	314	65	25	11	0	3	0	0	0	104
2002	1362	16427	12394	32248	833	714	549	238	144	18	9	0	0	0	0	0	172
2003	3861	6972	5592	6848	12830	222	209	70	34	12	10	0	0	0	0	0	56
2004	2727	15159	6506	2384	3839	6706	286	101	26	6	2	2	0	0	0	0	37
2005	3965	7190	6202	3700	2116	2669	2704	57	42	5	1	1	0	0	0	0	48
2006	817	16031	4831	3844	3801	3109	2731	2750	33	26	5	0	0	1	0	0	65
2007	257	1777	15850	2897	1725	2428	811	904	478	6	0	0	0	0	0	0	485
2008	1840	2409	2330	4421	587	609	868	255	185	122	0	0	0	0	0	0	307

Table 3.3.3. Haddock in Division VIa. Landings-at-age numbers (000s). Values used in the final assessment are boxed.

Year \ Age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	0	33	463	60967	6753	294	274	174	11	6	6	0	0	0	0	0	24
1966	0	58	175	1082	46902	1926	64	32	57	0	0	0	0	0	0	0	57
1967	0	595	6136	782	262	24979	400	9	14	4	0	0	0	0	0	0	19
1968	0	3665	12439	2573	354	681	14063	727	43	9	0	0	0	0	0	0	52
1969	0	3	45819	8766	1423	268	379	4576	191	9	0	0	0	0	0	0	200
1970	0	169	170	78402	2747	173	89	145	585	13	2	0	0	0	0	0	600
1971	0	1925	1149	2665	78909	545	127	7	20	175	16	0	0	0	0	0	212
1972	0	576	26700	2225	2312	53823	504	50	19	0	67	0	0	0	0	0	86
1973	0	1252	5301	16109	256	1222	33193	150	32	6	125	0	0	0	0	0	163
1974	0	1706	3318	8625	6261	83	447	11463	104	34	31	0	1	4	0	0	174
1975	0	4629	10534	2735	3315	1882	95	98	3454	72	8	0	0	0	0	0	3534
1976	0	745	22563	12358	1571	1491	868	21	7	1103	4	0	5	0	0	0	1119
1977	0	451	1317	29456	5645	680	495	308	28	11	259	5	0	0	0	0	304
1978	0	**1030**	**1006**	**813**	**23620**	**2912**	**344**	**247**	338	7	17	211	3	0	0	0	**575**
1979	0	**2068**	**10448**	**1761**	**468**	**9810**	**833**	**114**	145	28	3	1	42	1	0	0	**221**
1980	0	**2505**	**12871**	**5341**	**915**	**143**	**3082**	**229**	22	5	21	3	0	4	0	0	**54**
1981	0	**200**	**20553**	**15695**	**1768**	**194**	**39**	**822**	39	14	2	2	1	0	1	0	**60**
1982	0	**250**	**1342**	**46283**	**8004**	**898**	**108**	**272**	288	31	12	1	0	0	0	0	**332**
1983	0	**568**	**4917**	**4585**	**34659**	**3387**	**597**	**41**	194	195	40	15	0	0	0	0	**444**
1984	0	**3341**	**4386**	**10754**	**5959**	**20352**	**2449**	**371**	43	44	73	3	0	0	0	0	**162**
1985	0	**939**	**19434**	**4437**	**4112**	**1782**	**11031**	**964**	84	4	8	56	4	0	0	1	**157**
1986	0	**603**	**4812**	**26770**	**1823**	**916**	**449**	**2611**	344	38	7	15	1	3	0	0	**409**
1987	0	**4254**	**7388**	**9206**	**23551**	**1452**	**1116**	**642**	1818	326	20	15	9	3	12	0	**2203**
1988	0	**847**	**20687**	**6873**	**4091**	**9205**	**428**	**235**	177	935	45	3	1	3	2	0	**1167**
1989	0	**927**	**1414**	**18417**	**2744**	**1556**	**3633**	**255**	84	87	437	56	1	1	0	0	**666**
1990	0	**787**	**3198**	**1342**	**9450**	**848**	**279**	**519**	48	22	12	2	0	0	0	0	**85**
1991	0	**2145**	**10578**	**1217**	**834**	**5131**	**412**	**283**	410	24	11	5	6	0	0	1	**457**
1992	0	**691**	**10194**	**10010**	**553**	**236**	**1575**	**157**	37	108	25	0	0	0	0	0	**169**
1993	0	**745**	**15008**	**15975**	**4594**	**290**	**219**	**910**	70	107	44	25	1	2	0	0	**250**
1994	0	**1017**	**6326**	**15037**	**5240**	**1484**	**76**	**175**	237	17	16	9	1	0	0	0	**279**
1995	0	540	3669	12774	6483	1472	387	34	111	90	2	0	0	0	0	0	203
1996	0	437	9457	4968	8626	3622	1007	324	23	40	12	4	0	0	0	0	80
1997	0	883	2831	16921	2125	2638	870	259	59	1	7	1	0	0	0	0	67
1998	0	1345	7129	5675	13387	1352	1036	377	124	45	2	4	1	0	0	0	175
1999	0	346	5501	7159	2960	4864	493	452	96	12	2	1	2	1	0	0	115
2000	0	759	2507	5864	3841	1054	1090	205	133	21	1	0	0	0	0	0	156
2001	0	245	8535	1822	3523	1393	533	314	65	25	11	0	3	0	0	0	104
2002	0	177	1227	13557	691	707	549	199	144	18	9	0	0	0	0	0	172
2003	0	21	1029	2150	8809	221	206	69	34	11	10	0	0	0	0	0	55
2004	0	14	245	804	1819	4071	286	100	26	6	2	2	0	0	0	0	37
2005	0	7	287	792	1252	1212	2018	57	42	5	1	1	0	0	0	0	48
2006	0	67	567	1513	2300	2504	2259	2192	33	26	5	0	0	1	0	0	65
2007	0	34	842	1121	1429	2394	778	855	478	6	0	0	0	0	0	0	485
2008	0	21	297	2718	546	584	752	254	161	122	0	0	0	0	0	0	283

Table 3.3.4. Haddock in Division VIa. Discards-at-age numbers (000s). Values used in the final assessment are boxed.

Year	Age 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	451	1026	877	11494	63	0	0	0	0	0	0	0	0	0	0	0	0
1966	5953	1537	354	31	529	0	0	0	0	0	0	0	0	0	0	0	0
1967	40122	18590	13196	169	3	0	0	0	0	0	0	0	0	0	0	0	0
1968	27	125753	25954	506	3	0	0	0	0	0	0	0	0	0	0	0	0
1969	2742	81	114887	1493	11	0	0	0	0	0	0	0	0	0	0	0	0
1970	17189	6148	348	16712	23	0	0	0	0	0	0	0	0	0	0	0	0
1971	6604	69556	2766	663	1057	0	0	0	0	0	0	0	0	0	0	0	0
1972	14215	20137	58442	494	24	0	0	0	0	0	0	0	0	0	0	0	0
1973	19589	46135	11607	3368	2	0	0	0	0	0	0	0	0	0	0	0	0
1974	63698	67131	8244	2132	56	0	0	0	0	0	0	0	0	0	0	0	0
1975	6849	174721	24423	604	35	0	0	0	0	0	0	0	0	0	0	0	0
1976	4227	23593	49767	2866	17	0	0	0	0	0	0	0	0	0	0	0	0
1977	4552	12658	2152	6492	59	0	0	0	0	0	0	0	0	0	0	0	0
1978	55	**14911**	**1090**	**157**	**738**	**27**	**7**	**0**	0	0	0	0	0	0	0	0	**0**
1979	5697	**68002**	**6833**	**104**	**2**	**53**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1980	13	**20224**	**9057**	**295**	**7**	**0**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1981	764	**51**	**63359**	**5002**	**0**	**0**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1982	136	**15241**	**3678**	**27393**	**163**	**0**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1983	2084	**13957**	**15316**	**1456**	**1464**	**12**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1984	269	**95634**	**4240**	**2156**	**284**	**2438**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1985	155	**21882**	**59488**	**231**	**71**	**6**	**159**	**0**	0	0	0	0	0	0	0	0	**0**
1986	2979	**7524**	**6423**	**18597**	**0**	**0**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1987	1498	**84767**	**9436**	**944**	**306**	**0**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1988	7582	**9160**	**37727**	**725**	**95**	**49**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1989	3773	**4083**	**2007**	**7308**	**11**	**0**	**1**	**0**	0	0	0	0	0	0	0	0	**0**
1990	437	**36460**	**2658**	**542**	**2708**	**23**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1991	8921	**34779**	**11413**	**42**	**0**	**1**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1992	4331	**51148**	**8776**	**1322**	**12**	**0**	**2**	**0**	0	0	0	0	0	0	0	0	**0**
1993	2196	**42914**	**45777**	**4787**	**74**	**16**	**0**	**5**	0	0	0	0	0	0	0	0	**0**
1994	2843	**18467**	**26312**	**6490**	**432**	**94**	**0**	**0**	0	0	0	0	0	0	0	0	**0**
1995	7692	17040	12090	10825	382	0	0	0	0	0	0	0	0	0	0	0	0
1996	10249	32907	30354	1674	1599	41	0	0	0	0	0	0	0	0	0	0	0
1997	2984	22961	7676	4629	53	30	0	0	0	0	0	0	0	0	0	0	0
1998	2058	10075	10872	2357	1728	0	0	0	0	0	0	0	0	0	0	0	0
1999	6898	5834	12554	4410	44	54	86	0	0	0	0	0	0	0	0	0	0
2000	5709	49383	4136	2731	372	1	14	0	0	0	0	0	0	0	0	0	0
2001	11818	10778	24961	611	143	128	0	0	0	0	0	0	0	0	0	0	0
2002	1362	16250	11168	18692	142	8	0	39	0	0	0	0	0	0	0	0	0
2003	3861	6951	4564	4697	4021	2	2	1	0	0	0	0	0	0	0	0	0
2004	2727	15146	6261	1580	2021	2635	0	1	0	0	0	0	0	0	0	0	0
2005	3965	7184	5915	2908	864	1457	686	0	1	0	0	0	0	0	0	0	1
2006	817	15964	4263	2331	1501	605	471	557	0	0	0	0	0	0	0	0	0
2007	257	1743	15008	1775	296	34	33	48	0	0	0	0	0	0	0	0	0
2008	1840	2388	2033	1703	41	25	116	1	24	0	0	0	0	0	0	0	24

Table 3.3.5. Haddock in Division VIa. Weights-at-age (kg) in total catch. Values used in the final assessment are boxed.

Year	Age 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	0.040	0.160	0.242	0.412	0.692	0.916	1.041	1.249	1.517	1.920	1.833	0.000	0.000	0.000	0.000	0.000	1.713
1966	0.040	0.162	0.251	0.555	0.572	1.041	1.125	1.325	1.522	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.522
1967	0.040	0.160	0.266	0.569	0.573	0.667	1.177	1.844	1.611	2.355	0.000	0.000	0.000	0.000	0.000	0.000	1.786
1968	0.040	0.159	0.264	0.567	0.823	0.731	0.811	1.430	1.903	2.516	0.000	0.000	0.000	0.000	0.000	0.000	2.005
1969	0.040	0.158	0.243	0.526	0.916	1.042	1.024	0.999	1.569	2.065	0.000	0.000	0.000	0.000	0.000	0.000	1.590
1970	0.040	0.161	0.230	0.368	0.812	1.283	1.262	1.043	1.342	1.791	1.213	0.000	0.000	0.000	0.000	0.000	1.352
1971	0.040	0.160	0.248	0.341	0.546	1.040	1.313	1.651	1.426	1.466	2.042	0.000	0.000	0.000	0.000	0.000	1.506
1972	0.040	0.160	0.249	0.380	0.530	0.546	0.984	1.499	1.538	0.000	1.551	0.000	0.000	0.000	0.000	0.000	1.548
1973	0.040	0.159	0.251	0.384	0.597	0.512	0.571	1.185	1.706	2.202	1.520	0.000	0.000	0.000	0.000	0.000	1.581
1974	0.040	0.159	0.248	0.368	0.527	0.764	0.685	0.798	1.142	1.319	1.229	0.000	0.833	0.890	0.000	0.000	1.183
1975	0.040	0.159	0.260	0.428	0.581	0.832	1.027	1.001	1.009	1.190	2.523	0.000	0.000	0.000	0.000	0.000	1.016
1976	0.040	0.159	0.256	0.459	0.592	0.831	1.095	1.585	1.084	1.243	1.806	0.000	1.679	0.000	0.000	0.000	1.246
1977	0.040	0.161	0.274	0.406	0.684	0.800	1.128	1.337	1.117	1.394	1.339	1.593	0.000	0.000	0.000	0.000	1.325
1978	0.068	0.134	0.278	0.388	0.516	0.827	1.045	1.152	1.399	2.126	1.376	1.208	1.627	0.000	0.000	0.000	1.338
1979	0.032	0.182	0.325	0.457	0.730	0.777	1.040	1.491	1.944	1.735	1.569	1.781	1.119	1.590	0.000	0.000	1.754
1980	0.077	0.134	0.319	0.572	0.719	0.998	0.985	1.143	1.565	1.632	1.879	2.862	0.000	1.482	0.000	0.000	1.747
1981	0.082	0.252	0.245	0.467	0.887	0.975	1.376	1.294	1.347	1.366	1.314	1.785	1.587	0.000	1.677	0.000	1.379
1982	0.038	0.157	0.273	0.376	0.746	1.126	1.539	1.549	1.514	1.738	2.068	1.543	0.000	0.000	0.000	0.000	1.555
1983	0.050	0.178	0.282	0.461	0.557	1.002	1.370	1.716	1.558	1.556	1.555	1.999	0.000	0.000	0.000	0.000	1.572
1984	0.059	0.149	0.319	0.456	0.688	0.667	1.087	1.392	2.075	1.882	1.417	1.864	0.000	0.000	0.000	0.000	1.724
1985	0.019	0.138	0.268	0.486	0.636	0.802	0.868	1.272	1.277	1.695	2.014	2.152	2.741	0.000	0.000	4.141	1.694
1986	0.064	0.182	0.270	0.362	0.637	0.903	1.115	1.043	1.418	1.517	1.832	1.925	1.504	2.635	0.000	0.000	1.463
1987	0.028	0.168	0.270	0.418	0.566	0.880	1.105	1.250	1.147	1.149	1.851	2.774	3.040	2.828	2.664	0.000	1.182
1988	0.085	0.170	0.254	0.444	0.562	0.704	1.027	1.280	1.279	0.879	1.618	0.990	3.424	3.994	4.150	0.000	0.984
1989	0.052	0.226	0.301	0.402	0.625	0.749	0.894	1.115	1.465	1.357	0.949	1.388	2.807	3.008	0.000	0.429	1.110
1990	0.073	0.112	0.355	0.445	0.534	0.891	1.108	1.280	1.823	1.682	2.288	1.964	2.506	0.000	0.000	0.000	1.860
1991	0.058	0.184	0.297	0.547	0.618	0.678	0.931	1.053	1.091	1.755	3.290	2.170	1.343	0.000	0.000	2.869	1.201
1992	0.050	0.133	0.321	0.437	0.766	0.892	0.932	1.407	1.493	1.564	2.180	0.000	0.000	0.000	0.000	0.000	1.639
1993	0.037	0.108	0.277	0.458	0.650	0.861	0.898	1.022	1.514	1.210	1.578	2.304	1.800	2.405	0.000	0.000	1.483
1994	0.031	0.169	0.253	0.405	0.611	0.698	0.929	0.959	0.909	1.243	1.319	1.961	2.430	0.000	0.000	0.000	0.992
1995	0.030	0.149	0.274	0.354	0.553	0.833	0.978	1.322	1.059	0.940	1.953	1.996	2.492	0.000	0.000	0.000	1.020
1996	0.047	0.128	0.243	0.404	0.462	0.645	0.750	0.754	1.122	1.163	1.046	1.141	0.000	3.167	0.000	0.000	1.137
1997	0.048	0.153	0.263	0.394	0.614	0.730	0.925	1.057	0.921	2.024	1.630	2.252	0.000	3.033	0.000	0.000	1.020
1998	0.089	0.164	0.283	0.382	0.502	0.689	0.802	0.951	1.006	1.064	2.488	2.585	3.322	2.591	0.000	0.000	1.077
1999	0.035	0.172	0.255	0.365	0.494	0.611	0.729	0.840	1.067	1.465	1.465	3.246	1.993	2.954	2.829	0.000	1.172
2000	0.053	0.127	0.270	0.361	0.447	0.572	0.719	0.840	0.749	1.186	1.262	0.000	2.168	0.000	0.000	0.000	0.813
2001	0.050	0.112	0.242	0.403	0.432	0.514	0.657	0.808	1.029	0.975	1.089	3.361	0.597	0.000	0.000	0.000	1.015
2002	0.048	0.118	0.208	0.307	0.521	0.606	0.632	0.636	0.810	1.995	0.916	0.000	2.698	0.000	0.000	0.000	0.939
2003	0.036	0.124	0.239	0.282	0.382	0.652	0.648	0.908	0.945	1.232	1.393	2.682	0.000	0.000	0.000	0.000	1.086
2004	0.033	0.112	0.189	0.290	0.313	0.373	0.541	0.715	0.782	0.853	1.396	3.976	0.000	0.000	0.000	0.000	0.988
2005	0.053	0.103	0.198	0.295	0.451	0.429	0.525	1.163	0.916	1.467	2.084	3.491	2.275	0.000	0.000	0.000	1.018
2006	0.024	0.155	0.254	0.326	0.388	0.471	0.496	0.563	1.242	1.182	1.682	2.675	0.000	3.889	5.471	0.000	1.294
2007	0.060	0.115	0.219	0.331	0.404	0.456	0.550	0.593	0.682	0.825	2.160	2.270	0.000	0.000	0.000	0.000	0.685
2008	0.022	0.113	0.245	0.367	0.492	0.570	0.619	0.708	0.770	0.911	2.494	2.109	0.000	0.000	0.000	0.000	0.827

Table 3.3.6. Haddock in Division VIa. Weights-at-age (kg) in landings. Values used in the final assessment are boxed.

Year	Age 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	0.000	0.273	0.295	0.440	0.695	0.916	1.041	1.249	1.517	1.920	1.833	0.000	0.000	0.000	0.000	0.000	1.713
1966	0.000	0.315	0.324	0.563	0.575	1.041	1.125	1.325	1.522	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.522
1967	0.000	0.285	0.374	0.635	0.576	0.667	1.177	1.844	1.611	2.355	0.000	0.000	0.000	0.000	0.000	0.000	1.786
1968	0.000	0.259	0.367	0.627	0.827	0.731	0.811	1.430	1.903	2.516	0.000	0.000	0.000	0.000	0.000	0.000	2.005
1969	0.000	0.199	0.314	0.570	0.921	1.042	1.024	0.999	1.569	2.065	0.000	0.000	0.000	0.000	0.000	0.000	1.590
1970	0.000	0.348	0.261	0.389	0.817	1.283	1.262	1.043	1.342	1.791	1.213	0.000	0.000	0.000	0.000	0.000	1.352
1971	0.000	0.295	0.328	0.360	0.549	1.040	1.313	1.651	1.426	1.466	2.042	0.000	0.000	0.000	0.000	0.000	1.506
1972	0.000	0.285	0.325	0.406	0.532	0.546	0.984	1.499	1.538	0.000	1.551	0.000	0.000	0.000	0.000	0.000	1.548
1973	0.000	0.259	0.329	0.408	0.599	0.512	0.571	1.185	1.706	2.202	1.520	0.000	0.000	0.000	0.000	0.000	1.581
1974	0.000	0.264	0.328	0.393	0.530	0.764	0.685	0.798	1.142	1.319	1.229	0.000	0.833	0.890	0.000	0.000	1.183
1975	0.000	0.277	0.365	0.465	0.585	0.832	1.027	1.001	1.009	1.190	2.523	0.000	0.000	0.000	0.000	0.000	1.016
1976	0.000	0.251	0.345	0.504	0.596	0.831	1.095	1.585	1.084	1.243	1.806	0.000	1.679	0.000	0.000	0.000	1.246
1977	0.000	0.307	0.370	0.437	0.689	0.800	1.128	1.337	1.117	1.394	1.339	1.593	0.000	0.000	0.000	0.000	1.325
1978	0.000	0.257	0.353	0.419	0.524	0.832	1.060	1.152	1.399	2.126	1.376	1.208	1.627	0.000	0.000	0.000	1.338
1979	0.000	0.269	0.386	0.467	0.732	0.779	1.040	1.491	1.944	1.735	1.569	1.781	1.119	1.590	0.000	0.000	1.754
1980	0.000	0.251	0.373	0.587	0.722	0.998	0.985	1.143	1.565	1.632	1.879	2.862	0.000	1.482	0.000	0.000	1.747
1981	0.000	0.289	0.357	0.502	0.887	0.975	1.376	1.294	1.347	1.366	1.314	1.785	1.587	0.000	1.677	0.000	1.379
1982	0.000	0.285	0.369	0.452	0.754	1.126	1.539	1.549	1.514	1.738	2.068	1.543	0.000	0.000	0.000	0.000	1.555
1983	0.000	0.479	0.424	0.518	0.568	1.004	1.370	1.716	1.558	1.556	1.555	1.999	0.000	0.000	0.000	0.000	1.572
1984	0.000	0.273	0.388	0.486	0.705	0.713	1.087	1.392	2.075	1.882	1.417	1.864	0.000	0.000	0.000	0.000	1.724
1985	0.000	0.283	0.346	0.494	0.641	0.803	0.875	1.272	1.277	1.695	2.014	2.152	2.741	0.000	0.000	4.141	1.694
1986	0.000	0.294	0.373	0.440	0.637	0.903	1.115	1.043	1.418	1.517	1.832	1.925	1.504	2.635	0.000	0.000	1.463
1987	0.000	0.276	0.337	0.435	0.570	0.880	1.105	1.250	1.147	1.149	1.851	2.774	3.040	2.828	2.664	0.000	1.182
1988	0.000	0.310	0.338	0.462	0.567	0.706	1.027	1.280	1.279	0.879	1.618	0.990	3.424	3.994	4.150	0.000	0.984
1989	0.000	0.372	0.406	0.468	0.625	0.749	0.894	1.115	1.462	1.357	0.948	1.388	2.807	3.008	0.000	0.429	1.109
1990	0.000	0.335	0.443	0.532	0.618	0.908	1.108	1.280	1.823	1.682	2.288	1.964	2.506	0.000	0.000	0.000	1.860
1991	0.000	0.287	0.382	0.556	0.618	0.678	0.931	1.053	1.091	1.755	3.290	2.170	1.343	0.000	0.000	2.869	1.201
1992	0.000	0.310	0.384	0.461	0.777	0.892	0.932	1.407	1.493	1.564	2.180	0.000	0.000	0.000	0.000	0.000	1.639
1993	0.000	0.313	0.395	0.509	0.655	0.889	0.898	1.026	1.514	1.210	1.578	2.304	1.800	2.405	0.000	0.000	1.483
1994	0.000	0.280	0.352	0.454	0.633	0.723	0.929	0.959	0.909	1.243	1.319	1.961	2.430	0.000	0.000	0.000	0.992
1995	0.000	0.293	0.375	0.415	0.567	0.833	0.978	1.322	1.059	0.940	1.953	1.996	2.492	0.000	0.000	0.000	1.020
1996	0.000	0.285	0.363	0.445	0.492	0.649	0.750	0.754	1.122	1.163	1.046	1.141	0.000	3.167	0.000	0.000	1.137
1997	0.000	0.275	0.365	0.425	0.621	0.735	0.925	1.057	0.921	2.024	1.630	2.252	0.000	3.033	0.000	0.000	1.020
1998	0.000	0.265	0.331	0.416	0.524	0.689	0.802	0.951	1.006	1.064	2.488	2.585	3.322	2.591	0.000	0.000	1.077
1999	0.000	0.313	0.353	0.420	0.496	0.614	0.820	0.840	1.067	1.465	1.465	3.246	1.993	2.954	2.829	0.000	1.172
2000	0.000	0.265	0.347	0.410	0.465	0.572	0.724	0.840	0.749	1.186	1.262	0.000	2.168	0.000	0.000	0.000	0.813
2001	0.000	0.243	0.332	0.457	0.439	0.538	0.657	0.808	1.029	0.975	1.089	3.361	0.597	0.000	0.000	0.000	1.015
2002	0.000	0.254	0.321	0.383	0.566	0.608	0.632	0.691	0.810	1.995	0.916	0.000	2.698	0.000	0.000	0.000	0.939
2003	0.000	0.240	0.311	0.389	0.428	0.654	0.651	0.917	0.946	1.253	1.395	2.682	0.000	0.000	0.000	0.000	1.091
2004	0.000	0.253	0.329	0.394	0.391	0.448	0.541	0.718	0.782	0.853	1.396	3.976	0.000	0.000	0.000	0.000	0.988
2005	0.000	0.270	0.358	0.415	0.542	0.596	0.594	1.167	0.921	1.467	2.084	3.491	2.275	0.000	0.000	0.000	1.023
2006	0.000	0.291	0.348	0.392	0.437	0.508	0.527	0.621	1.242	1.182	1.682	2.675	0.000	3.889	5.471	0.000	1.294
2007	0.000	0.248	0.357	0.398	0.423	0.458	0.558	0.605	0.682	0.825	2.160	2.270	0.000	0.000	0.000	0.000	0.685
2008	0.000	0.275	0.378	0.418	0.505	0.578	0.666	0.709	0.823	0.911	2.494	2.109	2.966	0.000	0.000	0.000	0.862

Table 3.3.7. Haddock in Division VIa. Weights-at-age (kg) in discards. Values used in the final assessment are boxed.

	Age																
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1966	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1967	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1968	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1969	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1970	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1971	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1972	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1973	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1974	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1975	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1976	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1977	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.059	**0.125**	**0.208**	**0.231**	**0.259**	**0.265**	**0.308**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1979	0.032	**0.180**	**0.230**	**0.272**	**0.266**	**0.303**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1980	0.077	**0.120**	**0.243**	**0.287**	**0.334**	**0.000**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1981	0.082	**0.106**	**0.209**	**0.360**	**0.000**	**0.000**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1982	0.038	**0.155**	**0.238**	**0.247**	**0.363**	**0.000**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1983	0.050	**0.165**	**0.237**	**0.283**	**0.298**	**0.536**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1984	0.059	**0.145**	**0.248**	**0.303**	**0.331**	**0.278**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1985	0.019	**0.132**	**0.242**	**0.326**	**0.362**	**0.423**	**0.353**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1986	0.064	**0.173**	**0.193**	**0.248**	**0.000**	**0.000**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1987	0.028	**0.163**	**0.218**	**0.247**	**0.281**	**0.000**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1988	0.085	**0.157**	**0.208**	**0.279**	**0.331**	**0.341**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1989	0.052	**0.193**	**0.226**	**0.237**	**0.491**	**0.961**	**1.423**	**0.000**	2.572	0.000	3.048	0.000	0.000	0.000	0.000	0.000	**2.810**
1990	0.073	**0.108**	**0.250**	**0.228**	**0.242**	**0.268**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1991	0.058	**0.178**	**0.218**	**0.278**	**0.000**	**0.263**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1992	0.050	**0.130**	**0.247**	**0.258**	**0.242**	**0.000**	**0.947**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1993	0.037	**0.105**	**0.238**	**0.287**	**0.382**	**0.348**	**0.000**	**0.430**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1994	0.031	**0.163**	**0.229**	**0.291**	**0.337**	**0.304**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1995	0.030	**0.144**	**0.243**	**0.281**	**0.310**	**0.000**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1996	0.047	**0.126**	**0.206**	**0.282**	**0.300**	**0.317**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1997	0.048	**0.148**	**0.226**	**0.283**	**0.340**	**0.317**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1998	0.089	**0.151**	**0.251**	**0.298**	**0.337**	**0.000**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
1999	0.035	**0.163**	**0.213**	**0.276**	**0.318**	**0.311**	**0.206**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2000	0.053	**0.125**	**0.223**	**0.257**	**0.259**	**0.625**	**0.337**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2001	0.050	**0.109**	**0.211**	**0.243**	**0.254**	**0.245**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2002	0.048	**0.117**	**0.196**	**0.253**	**0.305**	**0.456**	**0.000**	**0.358**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2003	0.036	**0.123**	**0.223**	**0.233**	**0.282**	**0.462**	**0.439**	**0.496**	0.591	0.432	0.689	0.000	0.000	0.000	0.000	0.000	**0.493**
2004	0.033	**0.112**	**0.183**	**0.237**	**0.242**	**0.256**	**0.000**	**0.411**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2005	0.053	**0.103**	**0.190**	**0.262**	**0.320**	**0.290**	**0.322**	**0.416**	0.493	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.493**
2006	0.024	**0.154**	**0.241**	**0.284**	**0.313**	**0.318**	**0.348**	**0.336**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2007	0.060	**0.113**	**0.211**	**0.288**	**0.314**	**0.336**	**0.368**	**0.373**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2008	0.022	**0.112**	**0.226**	**0.287**	**0.322**	**0.389**	**0.312**	**0.458**	0.419	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.419**

Table 3.3.8. Haddock in Division VIa. Available research-vessels survey data. Values used in the final assessment are boxed.

ScoGFS Q1

Year	Age 1	2	3	4	5	6	7	8
1985	1104	4085	68	80	141	388	27	1
1986	753	1669	1877	17	14	47	90	5
1987	5518	446	460	690	25	34	25	67
1988	571	3610	303	112	246	10	4	8
1989	178	488	1701	98	49	69	5	1
1990	2577	87	54	296	26	6	36	3
1991	1591	1763	92	25	184	9	4	15
1992	3618	1193	321	12	13	28	6	1
1993	5371	5922	675	167	0	2	18	2
1994	1151	2300	787	126	39	3	1	8
1995	7112	1074	1697	485	65	30	10	4
1996	4401	3742	315	456	125	20	11	3
1997	4262	2018	1915	147	151	53	2	1
1998	5034	2720	616	562	40	64	19	7
1999	941	2989	687	168	128	15	11	2
2000	7936	553	440	97	13	20	1	3
2001	3421	5762	143	146	34	16	6	1
2002	2339	3246	5293	56	70	24	9	3
2003	2650	1696	1449	1874	23	34	18	4
2004	1397	2765	869	1199	609	11	3	5
2005	573	633	1402	351	512	402	5	3
2006	633	892	539	397	156	170	51	2
2007	99	2019	296	121	192	82	89	65
2008	86	113	1094	98	84	71	13	15
2009	42	113	147	1445	29	43	63	7

ScoGFS Q4

Year	Age 0	1	2	3	4	5	6	7
1996	2907	761	656	70	137	57	24	6
1997	3713	1359	282	151	25	26	14	4
1998	399	1640	486	148	137	17	33	5
1999	4670	366	574	267	92	68	11	18
2000	2959	4231	147	191	59	25	5	3
2001	3083	2219	3563	48	138	22	12	2
2002	2943	1709	1770	2841	34	50	24	8
2003	293	2023	965	1470	639	28	17	3
2004	542	574	1068	410	649	524	5	9
2005	286	419	409	410	223	309	87	1
2006	19	543	233	162	281	79	100	40
2007	125	69	1392	109	128	90	48	45
2008	14	117	78	835	74	94	63	29

IreGFS

Year	Effort (hours)	Age 0	1	2	3	4	5	6	7	8
1993	2130	143	2493	5691	1606	693	29	112	56	35
1994	1865	76	1237	3538	3303	367	187	13	18	66
1995	2026	967	3104	1149	4152	1663	187	149	29	14
1996	2008	192	2536	3688	2155	627	254	126	45	24
1997	1879	2900	8289	636	532	375	294	45	8	3
1998	1936	96	1098	1538	1353	192	84	75	15	49
1999	1914	7985	1028	1967	1530	679	237	118	25	34
2000	1878	1454	8865	569	691	484	183	32	30	0
2001	965	1951	2728	3548	136	187	151	36	4	0
2002	796	6618	2541	2768	1788	67	90	32	5	2

IRGFS

Year	Effort (hours)	Age 0	1	2	3	4	5	6	7	8	9	10
2003	1127	207	7588	2382	839	355	22	30	7	0	3	2
2004	1200	86	2163	3322	1281	941	957	60	10	21	0	0
2005	960	233	1160	767	778	315	87	3	0	0	1	0
2006	1510	313	207	1027	381	1337	543	130	59	0	0	0
2007	1173	320	979	1049	346	689	101	64	69	1	0	0
2008	1135	76	2052	562	645	74	196	169	31	14	0	0

Table 3.3.9. Haddock in Division VIa. TSA parameter estimates from this year's assessment, along with those from previous assessments for comparison. * = fixed parameter.

Parameter	Notation	Description	2003	2004	2005	2006	2007	2008	2009
Initial fishing mortality	F (1, 1978)	Fishing mortality at age a in year y	0.42	0.28	0.26	0.23	0.25	0.40	0.40
	F (2, 1978)		0.67	0.5	0.51	0.50	0.56	0.71	0.70
	F (4, 1978)		0.53	0.51	0.51	0.51	0.52	0.56	0.57
Survey selectivities ScoGFS Q1	$\Phi(1)$	ScoGFS Q1 survey selectivity at age a	3.99	2.25	2.35	2.49	2.58	2.60	2.58
	$\Phi(2)$		4.84	2.71	2.45	2.55	3.01	3.07	3.01
	$\Phi(4)$		2.1	1.51	2.11	2.19	2.04	1.92	1.94
Survey selectivities ScoGFS Q4	$\Phi(1)$	ScoGFS Q4 survey selectivity at age a	-	-	-	1.99	1.62	1.77	1.75
	$\Phi(2)$		-	-	-	1.99	1.76	1.88	1.84
	$\Phi(4)$		-	-	-	2.25	2.39	2.61	2.64
Fishing mortality standard deviations	σF	Transitory changes in overall F	0.00	0.11	0.10	0.10	0.12	0.20	0.20
	σU	Persistent changes in selection (age effect in F)	0.05	0.04	0.01	0.00	0.09	0.03	0.03
	σV	Transitory changes in the year effect in F	0.27	0.23	0.22	0.23	0.23	0.33	0.35
	σY	Persistent changes in the year effect in F	0.00	0.14	0.09	0.09	0.07	0.00	0.00
Survey catchability standard deviations	$\sigma\Omega 1$	Transitory changes in ScoGFS Q1 catchability	0.00	0.08	0.18	0.30	0.19	0.12	0.12
	$\sigma\beta 1$	Persistent changes in ScoGFS Q1 catchability	0.14	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
	$\sigma\Omega 2$	Transitory changes in ScoGFS Q4 catchability	-	-	-		0.16	0.20	0.19
	$\sigma\beta 2$	Persistent changes in ScoGFS Q4 catchability	-	-	-		0.00*	0.00*	0.00*
Measurement coefficients of variation	cv landings	Coefficent of variation of landings-at-age data	0.22	0.25	0.23	0.20	0.20	0.24	0.25
	cv discards	Coefficent of variation of discards-at-age data	0.51	0.43	0.45	0.42	0.41	0.54	0.54
	cv survey	Coefficent of variation of ScoGFS Q1 survey data	0.40	0.34	0.53	0.57	0.33	0.35	0.36
	cv survey	Coefficent of variation of ScoGFS Q4 survey data	-	-	-	0.57	0.22	0.34	0.35
Discard curve parameters	σP	Transitory changes in overall discard proportion	0.50	0.19	0.20	0.19	0.18	0.20	0.20
	$\sigma\alpha 1$	Transitory changes in discard-ogive intercept	0.00	0.15	0.02	0.00	0.14	0.00	0.00
	$\sigma\nu 1$	Persistent changes in discard-ogive intercept	0.26	0.21	0.22	0.21	0.32	0.26	0.25
	$\sigma\alpha 2$	Transitory changes in discard-ogive slope	0.34	0.01	0.03	0.21	0.23	0.22	0.23
	$\sigma\nu 2$	Persistent changes in discard-ogive slope	0.02	0.61	0.43	0.23	0.002	0.000	0.000
Trend parameters	$\theta\nu 1$	Trend parameter for discard-ogive intercept	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
	$\theta\nu 2$	Trend parameter for discard-ogive slope	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
Recruitment	$\eta 1$	Ricker parameter (slope at the origin)	9.10	9.63	9.71	9.73	9.06	11.35	11.08
	$\eta 2$	Ricker parameter (curve dome occurs at $1/\eta 2$)	0.33	0.29	0.31	0.29	0.30	0.35	0.35
	cv rec	Coefficent of variation of recruitment curve	0.52	0.89	0.89	0.90	0.62	0.60	0.61

Table 3.3.10. Haddock in Division VIa. Estimates of population abundance (in thousands) from the final TSA run.

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	74505	7971	2425	61370	4577	631	477	1033
1979	155672	45006	4059	1064	23613	1520	232	571
1980	487012	88288	17705	1608	402	8168	469	259
1981	67093	326205	45783	7078	603	177	3277	272
1982	70688	45263	195531	22367	3373	295	92	1682
1983	46013	47972	27029	105261	11066	1695	146	883
1984	319590	26619	25386	13146	50272	5275	790	485
1985	73298	191213	11409	9277	5256	21280	2075	499
1986	59878	42571	96173	4999	3841	2408	8506	1102
1987	246364	39555	23606	49655	2510	1996	1303	4921
1988	20122	138560	15231	8297	17322	813	591	2142
1989	17729	9922	60449	5540	2864	5990	299	979
1990	95590	8769	4093	23876	1958	912	1891	401
1991	128823	57950	3262	1795	9969	817	399	968
1992	180907	71292	24006	1257	702	3560	310	504
1993	178335	118952	35994	10349	539	328	1546	363
1994	65251	111520	47668	11821	3526	168	94	606
1995	233025	36252	58687	21404	4808	1482	72	291
1996	125557	143212	17961	27247	8864	2153	626	154
1997	156005	69194	63849	7239	9925	3095	876	280
1998	170944	86330	28765	23584	2470	3597	904	349
1999	33498	89726	35066	10645	6418	901	1410	367
2000	511212	17781	34910	12724	3508	1517	324	648
2001	193674	276488	6410	10667	3539	1062	291	257
2002	116674	129608	151127	3052	4219	1474	467	203
2003	147128	80693	81710	90428	1519	2100	824	341
2004	60394	96577	42000	43992	33910	497	741	277
2005	39396	38755	54045	21825	22222	14966	168	436
2006	120057	24219	20179	24944	8968	9680	4258	207
2007	16566	75003	12631	10094	10151	3934	4087	1706
2008	6562	10951	45216	6507	4951	4483	1935	2557
2009*	29644	4369	6434	26234	2931	2539	2111	2204
2010*	111075	18242	2274	3123	10426	1136	1004	1708

***Estimates for 2009 and 2010 are TSA forecasts.**

Table 3.3.11. Haddock in Division VIa. Standard errors of estimates of population abundance (in thousands) from the final TSA run.

	Age							
Year	1	2	3	4	5	6	7	8+
1978	8182	722	302	430	1139	214	146	338
1979	16377	4406	336	147	2353	596	126	204
1980	44664	8984	2414	200	83	1408	333	135
1981	6126	29431	5589	1233	122	53	859	207
1982	7972	4038	18646	2990	655	74	33	514
1983	6216	5564	2348	10144	1510	358	45	283
1984	49930	3692	2896	966	4348	663	167	126
1985	8897	21295	1451	1161	557	2241	399	106
1986	7000	4632	10251	533	441	348	1499	243
1987	35424	4242	2830	5329	248	220	218	858
1988	4551	16336	1564	1058	2026	105	137	427
1989	4176	1513	6900	641	404	882	59	224
1990	11800	1682	577	3091	277	190	473	129
1991	13939	7143	532	218	1263	126	95	237
1992	18340	6886	3084	182	86	587	67	124
1993	20196	12672	3492	1322	68	44	301	75
1994	13587	14385	5379	1294	426	18	20	124
1995	30413	7929	8739	3311	713	237	15	72
1996	22995	22779	4050	4985	1736	332	119	44
1997	24102	12963	11524	1335	1751	530	113	47
1998	22937	14327	5184	4153	402	446	146	58
1999	11356	15378	6370	1809	1419	125	189	65
2000	107850	5849	7714	2509	666	482	44	94
2001	26565	50350	1789	2255	600	168	79	64
2002	19144	15859	23876	511	652	152	54	36
2003	17770	12265	9718	13582	232	274	66	40
2004	11338	12451	6004	5531	4720	94	102	52
2005	11378	6495	7395	3040	2785	2225	25	52
2006	14104	5404	2885	4033	1320	1325	655	39
2007	3469	8134	2500	1478	1649	490	446	210
2008	4377	1505	5594	1196	668	633	189	301
2009*	37624	2763	843	3709	560	367	224	269
2010*	67421	23108	1456	751	3261	382	315	495

***Estimates for 2009 and 2010 are TSA forecasts.**

Table 3.3.12. Haddock in Division VIa. Estimates of fishing mortality from the final TSA run.

Year	Age 1	2	3	4	5	6	7	8+
1978	0.281	0.369	0.623	0.767	0.773	0.738	0.709	0.725
1979	0.367	0.702	0.726	0.766	0.824	0.791	0.808	0.803
1980	0.207	0.457	0.607	0.726	0.589	0.644	0.642	0.621
1981	0.196	0.325	0.498	0.491	0.498	0.456	0.507	0.493
1982	0.184	0.314	0.411	0.501	0.483	0.503	0.519	0.489
1983	0.343	0.439	0.372	0.455	0.491	0.514	0.503	0.546
1984	0.314	0.619	0.790	0.708	0.632	0.727	0.747	0.709
1985	0.342	0.487	0.625	0.679	0.580	0.716	0.652	0.628
1986	0.209	0.389	0.461	0.458	0.422	0.408	0.463	0.468
1987	0.375	0.744	0.842	0.851	0.914	1.016	0.880	0.861
1988	0.423	0.629	0.811	0.858	0.862	0.796	0.809	0.832
1989	0.417	0.617	0.715	0.825	0.898	0.928	0.950	0.916
1990	0.297	0.701	0.625	0.674	0.674	0.625	0.663	0.661
1991	0.384	0.671	0.718	0.739	0.824	0.768	0.841	0.781
1992	0.209	0.461	0.642	0.646	0.553	0.629	0.616	0.589
1993	0.270	0.694	0.892	0.865	0.847	1.005	0.916	0.942
1994	0.389	0.430	0.588	0.686	0.655	0.642	0.705	0.667
1995	0.288	0.496	0.568	0.683	0.607	0.662	0.654	0.658
1996	0.395	0.608	0.706	0.813	0.852	0.700	0.825	0.805
1997	0.396	0.689	0.804	0.865	0.789	1.031	1.030	0.922
1998	0.444	0.702	0.793	1.098	0.797	0.738	1.068	0.926
1999	0.400	0.734	0.818	0.946	1.138	0.834	0.780	0.943
2000	0.413	0.810	0.985	1.101	1.004	1.398	1.086	1.139
2001	0.204	0.416	0.578	0.726	0.618	0.622	0.887	0.699
2002	0.168	0.261	0.323	0.499	0.498	0.381	0.480	0.462
2003	0.235	0.474	0.411	0.744	0.922	0.846	1.444	0.838
2004	0.243	0.383	0.453	0.476	0.618	0.886	0.650	0.645
2005	0.299	0.451	0.581	0.692	0.638	1.058	1.049	0.814
2006	0.267	0.458	0.490	0.700	0.613	0.661	0.763	0.697
2007	0.227	0.307	0.480	0.514	0.626	0.518	0.643	0.582
2008	0.212	0.346	0.344	0.597	0.467	0.553	0.486	0.532
2009*	0.286	0.453	0.523	0.723	0.748	0.728	0.721	0.732
2010*	0.295	0.480	0.562	0.775	0.775	0.775	0.775	0.775

***Estimates for 2009 and 2010 are TSA forecasts.**

Table 3.3.13. Haddock in Division VIa. Standard errors of estimates of log fishing mortality from the final TSA run.

Year	Age 1	2	3	4	5	6	7	8+
1978	0.252	0.172	0.168	0.145	0.169	0.204	0.221	0.214
1979	0.234	0.158	0.144	0.167	0.154	0.188	0.221	0.215
1980	0.278	0.177	0.177	0.162	0.191	0.176	0.221	0.225
1981	0.276	0.196	0.171	0.177	0.188	0.215	0.214	0.231
1982	0.266	0.183	0.169	0.168	0.180	0.202	0.235	0.213
1983	0.230	0.165	0.173	0.159	0.172	0.189	0.224	0.212
1984	0.362	0.162	0.139	0.131	0.144	0.184	0.214	0.220
1985	0.244	0.172	0.166	0.155	0.169	0.176	0.216	0.223
1986	0.269	0.176	0.166	0.169	0.177	0.193	0.213	0.224
1987	0.256	0.140	0.143	0.133	0.134	0.175	0.212	0.197
1988	0.264	0.159	0.136	0.143	0.144	0.180	0.215	0.204
1989	0.272	0.176	0.155	0.145	0.153	0.167	0.217	0.211
1990	0.253	0.166	0.174	0.161	0.166	0.186	0.211	0.221
1991	0.239	0.162	0.168	0.151	0.153	0.182	0.217	0.209
1992	0.263	0.167	0.162	0.163	0.170	0.183	0.220	0.218
1993	0.259	0.147	0.128	0.139	0.144	0.184	0.203	0.219
1994	0.278	0.213	0.195	0.174	0.183	0.225	0.247	0.242
1995	0.483	0.349	0.330	0.316	0.320	0.318	0.339	0.339
1996	0.448	0.299	0.307	0.285	0.280	0.285	0.286	0.311
1997	0.409	0.268	0.250	0.241	0.234	0.236	0.212	0.278
1998	0.425	0.284	0.276	0.252	0.256	0.260	0.257	0.295
1999	0.483	0.312	0.305	0.292	0.288	0.286	0.258	0.312
2000	0.457	0.299	0.267	0.260	0.263	0.264	0.218	0.292
2001	0.466	0.321	0.311	0.289	0.297	0.287	0.282	0.315
2002	0.493	0.333	0.329	0.310	0.306	0.301	0.260	0.321
2003	0.428	0.270	0.264	0.224	0.221	0.215	0.182	0.270
2004	0.491	0.323	0.317	0.294	0.287	0.275	0.267	0.313
2005	0.475	0.298	0.277	0.232	0.233	0.203	0.218	0.278
2006	0.492	0.330	0.311	0.268	0.266	0.258	0.264	0.303
2007	0.486	0.320	0.307	0.266	0.257	0.254	0.218	0.294
2008	0.492	0.344	0.332	0.294	0.295	0.275	0.232	0.311
2009*	0.555	0.422	0.417	0.404	0.402	0.401	0.403	0.404
2010*	0.562	0.431	0.427	0.415	0.415	0.415	0.415	0.415

***Estimates for 2009 and 2010 are TSA forecasts.**

Table 3.3.14. Haddock in Division VIa. Stock summary from final TSA run. "Obs." denotes the SOP of numbers and mean weights-at-age, rather than the reported caught, landed and discarded yield. "Pred." are TSA estimates, and "SE" denotes standard errors. *Estimates for 2009 and 2010 are TSA projections.

Year	Landings (tonnes)			Discards (tonnes)			Total catches (tonnes)			Mean F(2-6)		SSB (tonnes)		TSB (tonnes)		Recruitment (000s at age 1)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1978	17178	19573	1768	2327	2404	592	19505	21902	1921	0.654	0.065	40244	1126	51144	1585	74505	8182
1979	14820	16330	1796	13857	10160	2279	28678	26907	3143	0.762	0.069	32209	2251	66915	4097	155672	16377
1980	12759	13922	1695	4715	13993	3301	17474	29419	4392	0.605	0.062	36775	2747	114371	7205	487012	44664
1981	18233	20594	2892	15048	13786	3214	33281	34805	5105	0.453	0.052	78739	5224	130026	8170	67093	6126
1982	29635	31215	4679	10063	6642	1412	39698	35786	4837	0.442	0.048	104220	7525	120639	7657	70688	7972
1983	29405	30118	3893	6787	5288	1018	36192	35057	4140	0.454	0.046	93883	6132	107866	6332	46013	6216
1984	30012	30739	2792	16343	13447	4877	46355	43308	6107	0.695	0.058	66624	3551	117999	8472	319590	49930
1985	24393	24352	2493	17444	13767	3094	41837	37587	4652	0.617	0.059	66770	4173	98904	6575	73298	8897
1986	19561	20275	2700	7153	4543	953	26714	23486	2945	0.428	0.044	61121	4372	76962	4775	59878	7000
1987	27012	29583	2979	16193	13743	3770	43205	43420	5176	0.874	0.070	55933	3731	102017	7344	246364	35424
1988	21136	21599	2259	9536	8938	2122	30672	30423	3689	0.791	0.066	47390	3139	65946	4852	20122	4551
1989	16688	18598	2424	2981	2682	691	19669	20617	2603	0.796	0.071	38402	3083	43693	3332	17729	4176
1990	10135	11011	1585	5387	3014	760	15522	13086	1752	0.660	0.065	22273	1975	34396	2524	95590	11800
1991	10557	10173	1136	8691	9919	2153	19248	20633	2821	0.744	0.069	21800	1638	52944	3743	128823	13939
1992	11350	9957	1210	9163	8337	1567	20513	18973	2305	0.586	0.058	29695	2063	63476	3888	180907	18340
1993	19060	18666	1947	16811	14907	2519	35871	33394	3410	0.861	0.074	44856	2931	78370	5006	178335	20196
1994	14243	13897	1597	11098	11117	2334	25342	24834	3098	0.600	0.082	45896	3607	69055	5795	65251	13587
1995	12368	16655	4923	8552	11566	4308	20920	27513	7993	0.603	0.168	44082	5098	82972	7831	233025	30413
1996	13453	18953	5686	11364	14695	4583	24817	33210	8926	0.736	0.177	47685	6195	78749	9255	125557	22995
1997	12874	21786	5829	6470	14475	4387	19344	36601	8518	0.835	0.163	51348	6829	83009	9178	156005	24102
1998	14401	18389	5042	5535	17096	5203	19936	36260	8836	0.826	0.179	42557	5269	81159	8317	170944	22937
1999	10430	15879	5085	4891	9874	3485	15321	25831	7033	0.894	0.221	37321	5031	52926	7151	33498	11356
2000	6952	14179	4505	7899	22049	10379	14851	35737	12549	1.060	0.229	24932	4310	91980	15463	511212	107850
2001	6731	11347	5515	6657	17485	6601	13389	28948	9637	0.592	0.146	48314	7794	98752	13758	193674	26565
2002	7097	15037	5971	8880	8353	3395	15977	21210	6438	0.393	0.102	67458	8294	92894	9528	116674	19144
2003	5334	29575	7210	4104	9975	3358	9438	35840	7264	0.680	0.124	72080	7070	98528	8073	147128	17770
2004	3199	19038	5669	4380	6157	2362	7579	21237	5590	0.563	0.138	50013	4825	64613	5871	60394	11338
2005	3148	24586	5691	3546	4338	1902	6694	23628	4906	0.684	0.130	48178	4669	55538	5214	39396	11378
2006	5723	13448	3666	5161	5955	2392	10884	18023	4703	0.585	0.134	31461	3518	52659	4760	120057	14104
2007	3735	8708	2559	4009	3606	1424	7745	11556	2787	0.489	0.107	27996	2530	36967	3144	16566	3469
2008	2792	8779	2601	1285	1525	923	4077	9895	2594	0.462	0.113	30436	2888	32335	3003	6562	4377
2009*	NA	9413	2782	NA	1377	1266	NA	10300	3220	0.635	0.227	20271	2086	24511	5416	29644	37624
2010*	NA	5813	2231	NA	4345	2990	NA	9783	4263	0.673	0.248	12658	4243	28738	10713	111075	67421
Min	3148	8708		2327	2404		6694	11556		0.393		21800		34396		16566	
GM	12073	17850		7407	8684		20169	26989		0.646		45737		74532		99373	
AM	14387	18939		8502	10077		22889	28308		0.665		49342		78849		140367	
Max	30012	31215		17444	22049		46355	43420		1.060		104220		130026		511212	

Table 3.3.15. Haddock in Division VIa. Mean weights-at-age in total catches (or stock) and forecasted weights-at-age in 2008. Forecasts in this table are based on either of simple three-year means or linear model projections: those that were used in the forecasts are shaded and boxed: simple three year means were used for the younger ages (1–2) and linear model projections for the older ages (3–8+). The weights for the 1999 year class are highlighted in red.

	Age							
Year	1	2	3	4	5	6	7	8+
1999	0.172	0.255	0.365	0.494	0.611	0.729	0.840	1.172
2000	**0.127**	0.270	0.361	0.447	0.572	0.719	0.840	0.813
2001	0.112	**0.242**	0.403	0.432	0.514	0.657	0.808	1.015
2002	0.118	0.208	**0.307**	0.521	0.606	0.632	0.636	0.939
2003	0.124	0.239	0.282	**0.382**	0.652	0.648	0.908	1.086
2004	0.112	0.189	0.290	0.313	**0.373**	0.541	0.715	0.988
2005	0.103	0.198	0.295	0.451	0.429	**0.525**	1.163	1.018
2006	0.155	0.254	0.326	0.388	0.471	0.496	**0.563**	1.294
2007	0.115	0.219	0.331	0.404	0.456	0.550	0.593	**0.685**
2008	0.113	0.245	0.367	0.492	0.570	0.619	0.708	0.827
arithmetic mean 2009	**0.128**	**0.239**	0.341	0.428	0.499	0.555	0.621	0.935
linear model 2009			**0.375**	**0.460**	**0.606**	**0.659**	**0.682**	**0.771**
yr class in 2009	2008	2007	2006	2005	2004	2003	2002	2001
CV	0.184	0.076	0.060	0.122	0.103	0.093	0.112	0.413

Table 3.3.16. Haddock in Division VIa. Inputs to short-term forecasts.

Label	Value	CV	Label	Value	CV
Number at age			**Stock weight**		
N1	29644	1.27	WS1	0.128	0.18
N2	4369	0.63	WS2	0.239	0.08
N3	6434	0.13	WS3	0.375	0.06
N4	26234	0.14	WS4	0.460	0.12
N5	2931	0.19	WS5	0.606	0.10
N6	2539	0.14	WS6	0.659	0.09
N7	2111	0.11	WS7	0.682	0.11
N8	2204	0.12	WS8	0.771	0.41
Removals selectivity			**Removals weights**		
sH1	0.235	0.12	WH1	0.128	0.18
sH2	0.371	0.21	WH2	0.239	0.08
sH3	0.438	0.19	WH3	0.375	0.06
sH4	0.604	0.15	WH4	0.460	0.12
sH5	0.569	0.15	WH5	0.606	0.10
sH6	0.577	0.13	WH6	0.659	0.09
sH7	0.631	0.22	WH7	0.682	0.11
sH8	0.604	0.14	WH8	0.771	0.41
Natural mortality			**Prop.mature.**		
M1	0.2	0.1	MT1	0	0.1
M2	0.2	0.1	MT2	0.57	0.1
M3	0.2	0.1	MT3	1	0.1
M4	0.2	0.1	MT4	1	0
M5	0.2	0.1	MT5	1	0
M6	0.2	0.1	MT6	1	0
M7	0.2	0.1	MT7	1	0
M8	0.2	0.1	MT8	1	0
Relative effort			**Year effect for M**		
'HF08'	1	0.08	'K08'	1	0.1
'HF09'	1	0.08	'K09'	1	0.1
'HF10'	1	0.08	'K10'	1	0.1
Recruitment					
'R10'	111075	0.6062			
'R11'	91033	1.35			
Prop. F before spawning	0				
Prop. M before spawning	0				

Stock numbers in 2009 are TSA survivors.

Table 3.3.17. Haddock in Division VIa. Results of short-term forecasts: management options.

	Year 2009	2010						
Mean F Ages								
H.cons 2 to 6	0.51	0.00	0.10	0.20	0.31	0.41	0.51	0.61
Effort relative to 2008								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Biomass								
Total 1 January	25.9	31.6	31.6	31.6	31.6	31.6	31.6	31.6
SSB at spawning time	21.7	15.4	15.4	15.4	15.4	15.4	15.4	15.4
Catch weight (,000t)								
H.cons	9.50	0.00	2.14	4.11	5.91	7.57	9.09	10.49
Biomass in year.... 2011								
Total 1 January		50.9	48.3	45.8	43.5	41.4	39.5	37.7
SSB at spawning time		29.9	27.7	25.6	23.8	22.0	20.5	19.0

	Year 2009	2010						
Effort relative to 2008								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.21	0.34	0.34	0.34	0.34	0.34	0.34	0.34
SSB at spawning time	0.12	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Catch weight								
H.cons	0.17	0.00	0.47	0.33	0.30	0.29	0.28	0.28
Biomass in year.... 2011								
Total 1 January		0.43	0.45	0.46	0.47	0.49	0.50	0.51
SSB at spawning time		0.36	0.37	0.38	0.38	0.39	0.40	0.40

Table 3.3.18. Haddock in Division VIa. Results of short-term forecasts: detailed tables.

Forecast for year 2009
F multiplier H.cons=1.00

	Populations	Catch number	
Age	Stock No.	H.Cons	Total
1	29644	5655	5655
2	4369	1234	1234
3	6434	2084	2084
4	26234	10884	10884
5	2931	1163	1163
6	2539	1019	1019
7	2111	904	904
8	2204	914	914
Wt	26	9	9

Forecast for year 2010
F multiplier H.cons=1.00

	Populations	Catch number	
Age	Stock No.	H.Cons	Total
1	111075	21190	21190
2	19182	5417	5417
3	2469	800	800
4	3399	1410	1410
5	11745	4660	4660
6	1359	545	545
7	1167	500	500
8	1907	791	791
Wt	32	9	9

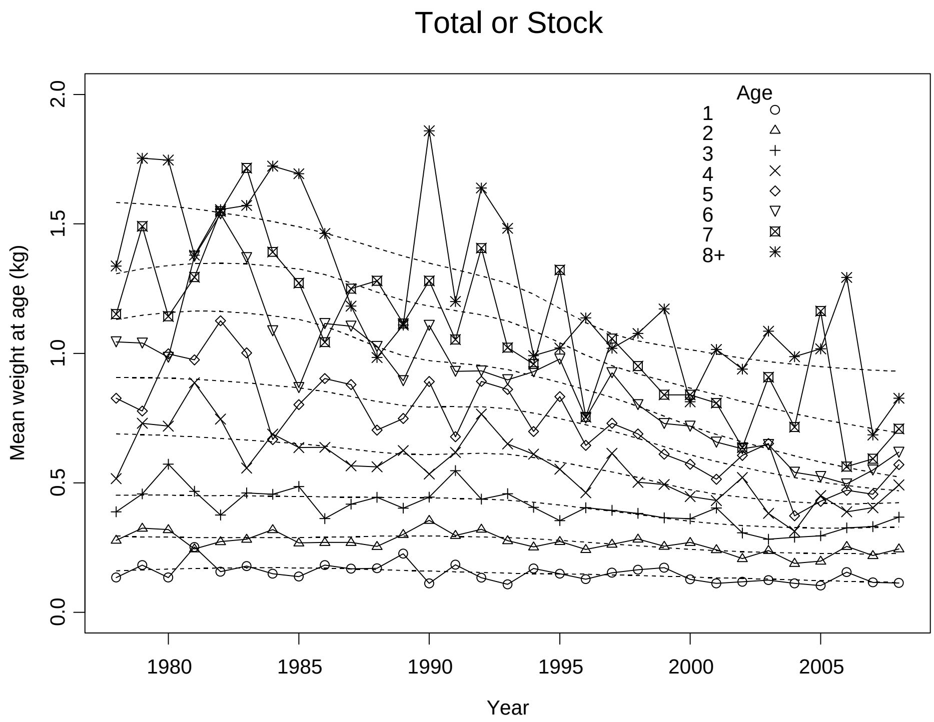


Figure 3.3.1. Haddock in Division VIa. Mean weights-at-age (kg) in total catch (also used for stock weights). Dotted lines show loess smoothers fitted through each time-series at-age. For clarity, only ages 1–8+ are shown here.

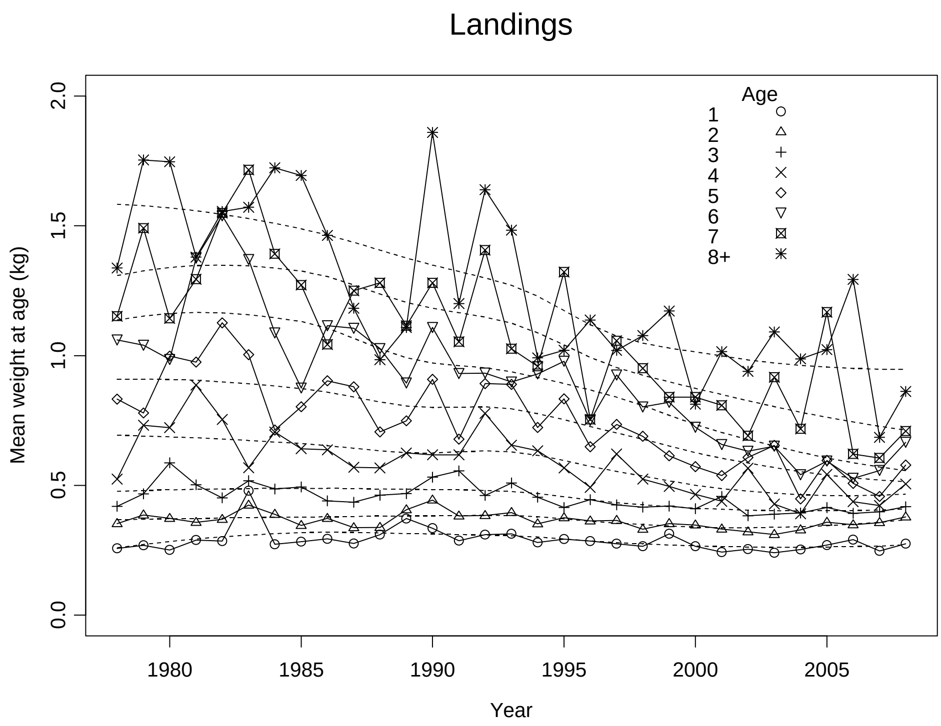


Figure 3.3.2. Haddock in Division VIa. Mean weights-at-age (kg) in landings. Dotted lines show loess smoothers fitted through each time-series at-age. For clarity, only ages 1–8+ are shown here.

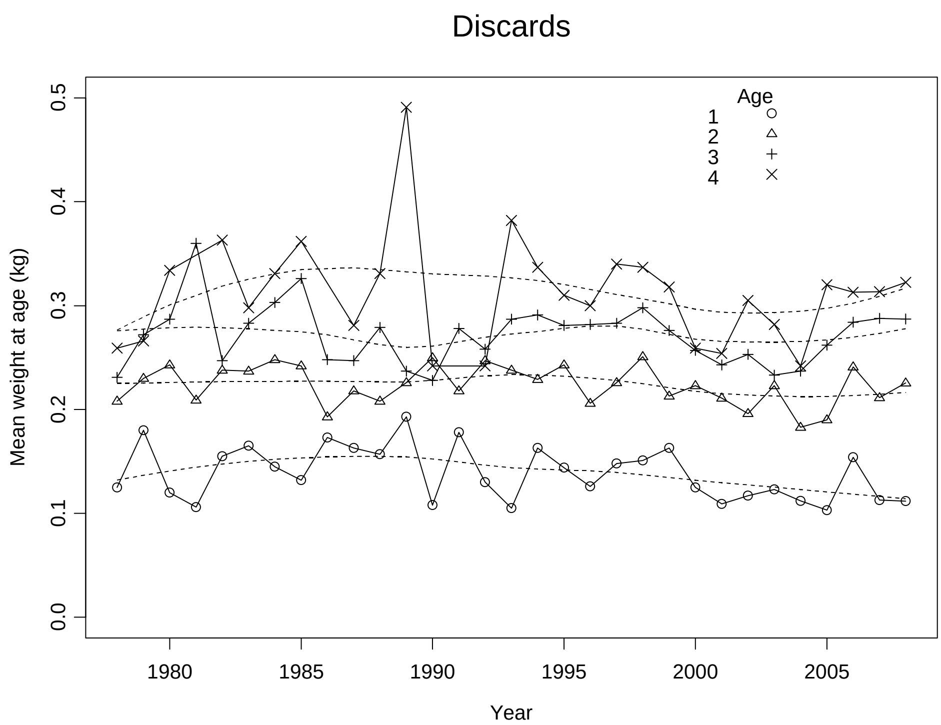


Figure 3.3.3. Haddock in Division VIa. Mean weights-at-age (kg) in discards. Dotted lines show loess smoothers fitted through each time-series at-age. For clarity, only ages 1–4 are shown here.

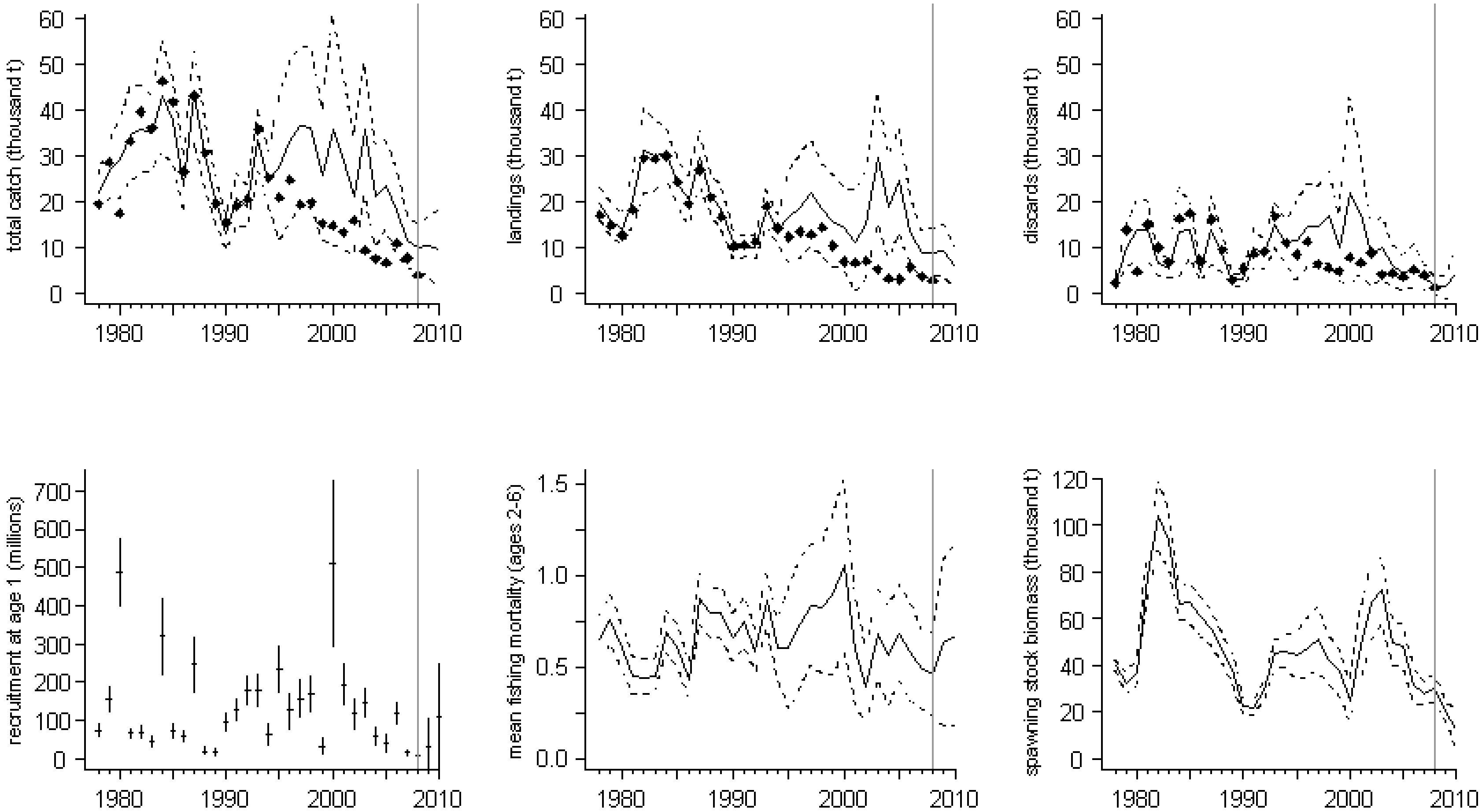


Figure 3.3.4. Haddock in Division VIa. TSA stock summaries from the final run (catch data not included from 1995 onwards). Estimates are plotted with approximate point wise 95% confidence bounds. Dots indicate observed values for catch, landings and discards. The vertical line in each plot delineates the last year of the historical assessment (2008): estimates to the right of these lines are TSA-based forecasts.

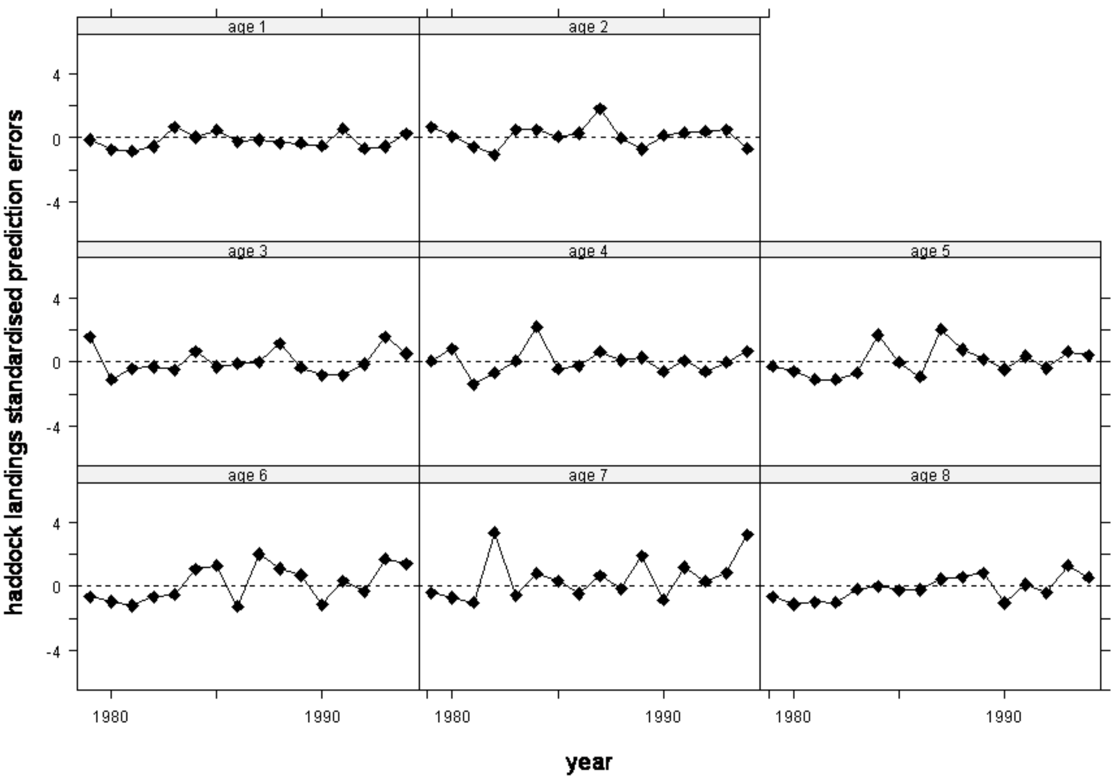


Figure 3.3.5. Haddock in Division VIa. Standardised landings prediction errors from the final TSA run.

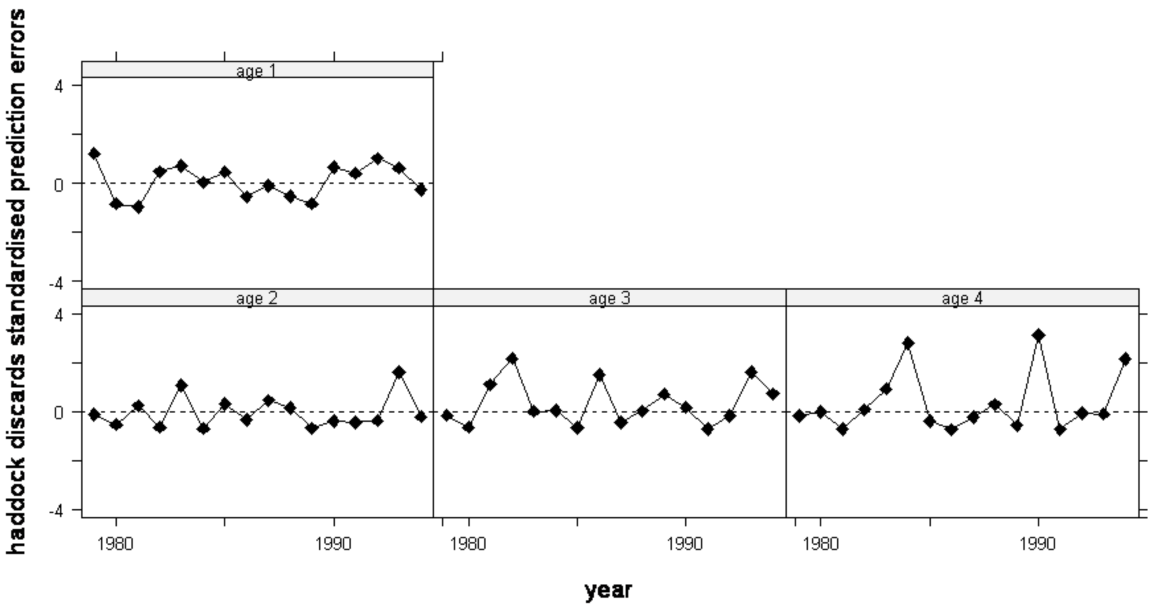


Figure 3.3.6. Haddock in Division VIa. Standardised discards prediction errors from the final TSA run.

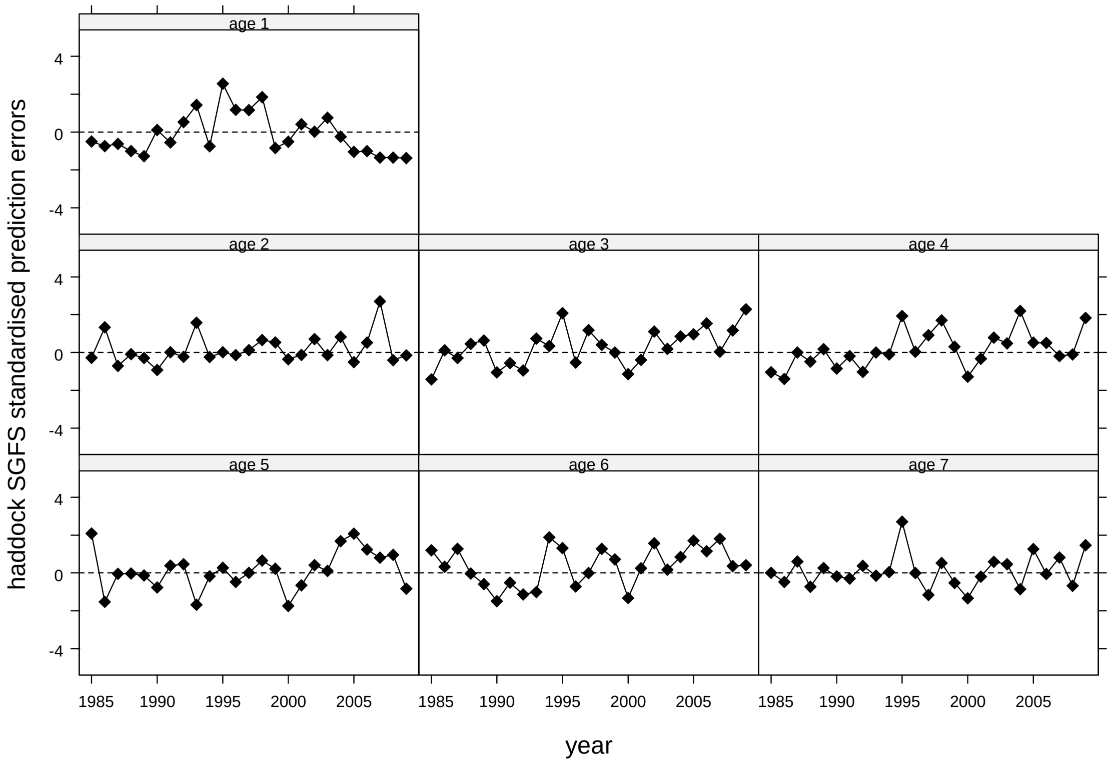


Figure 3.3.7. Haddock in Division VIa. Standardised ScoGFS Q1 prediction errors from the final TSA run.

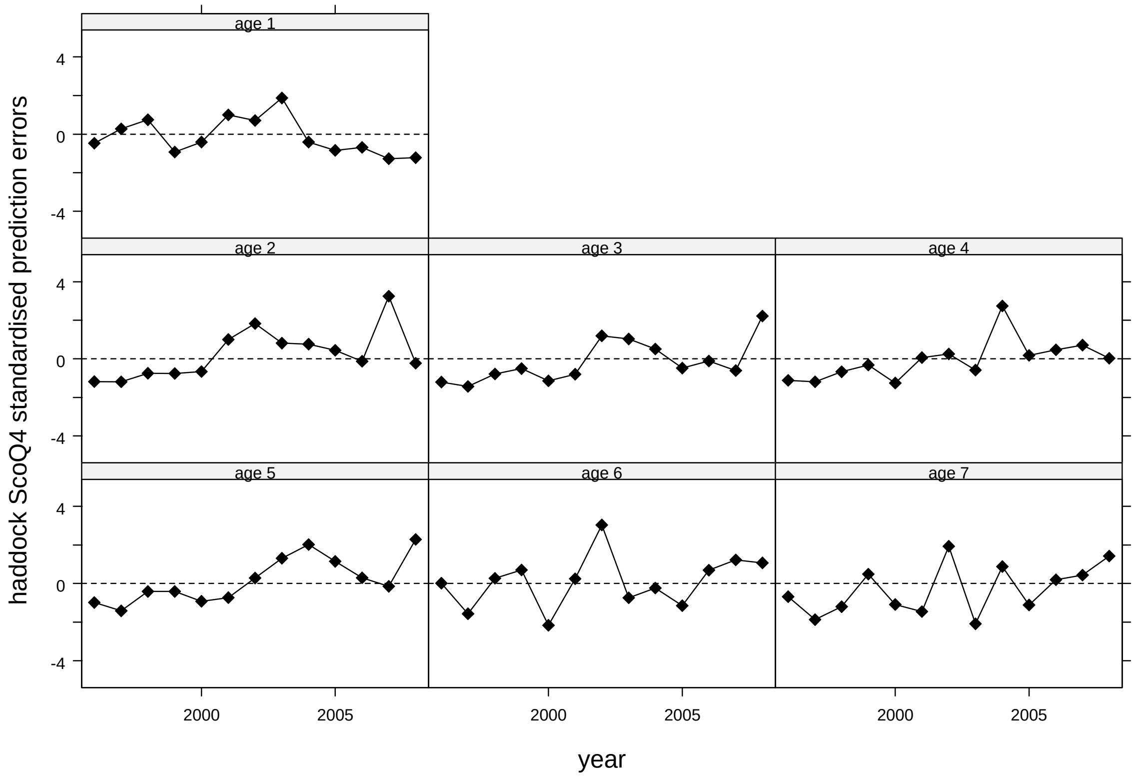


Figure 3.3.8. Haddock in Division VIa. Standardised ScoGFS Q4 prediction errors from the final TSA run.

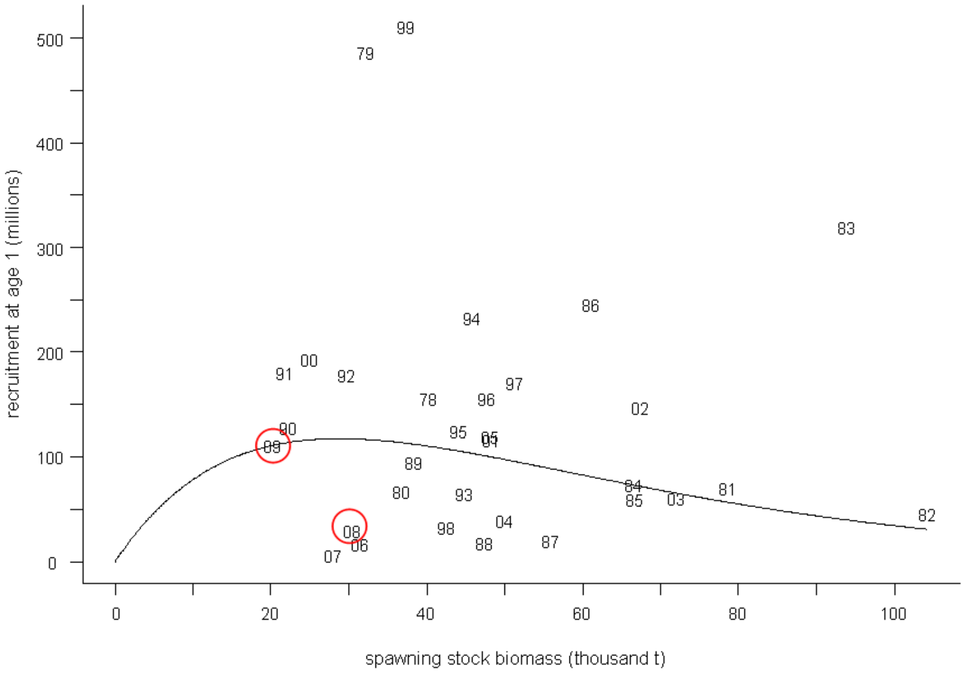


Figure 3.3.9. Haddock in Division VIa. Stock-recruit plot from the final TSA run, points labelled as year classes. Predicted recruitments are circled: for the 2008 year class recruiting in 2009 (using ScoGFS Q1 data); and the 2009 year class recruiting in 2010 (based on the underlying Ricker model).

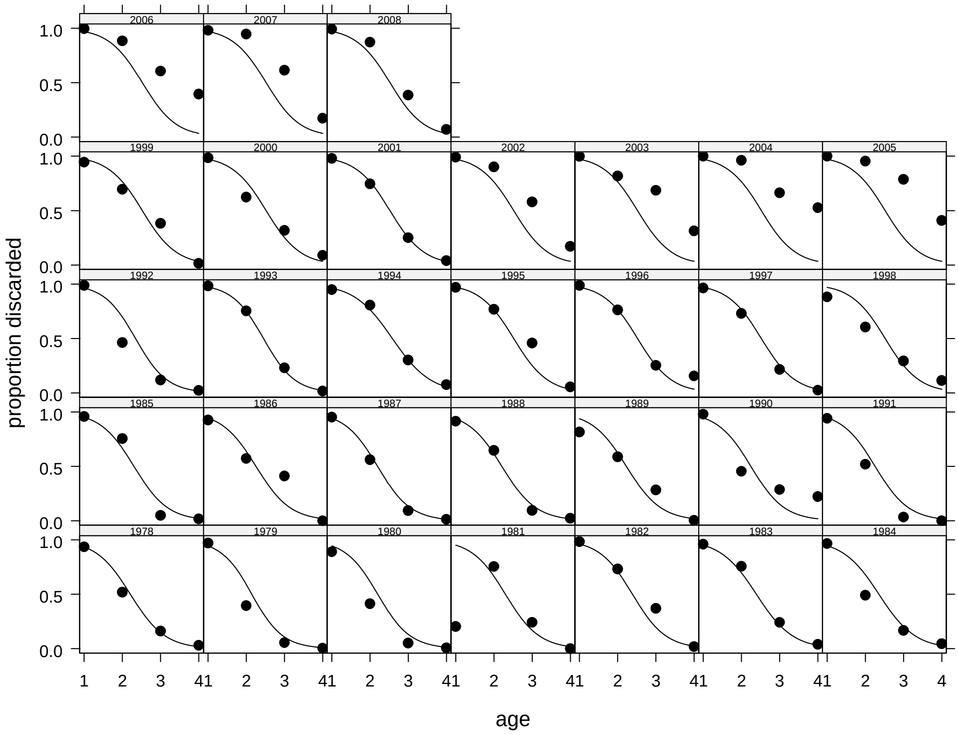


Figure 3.3.10. Haddock in Division VIa. Fitted (lines) and observed (dots) discard proportions-at-age from the final TSA run.

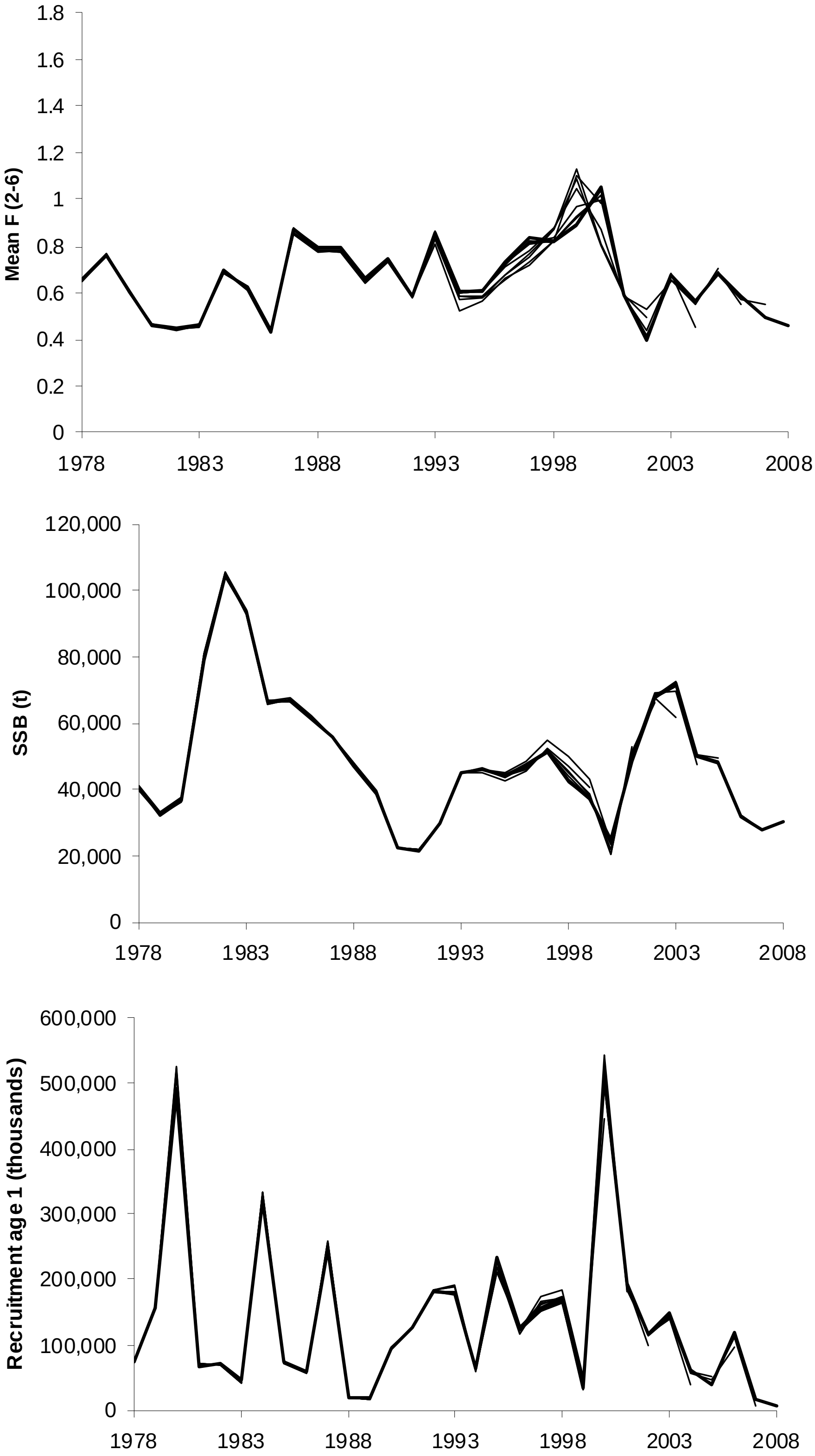


Figure 3.3.11. Haddock in Division VIa. Estimates of Mean F_{2-6}, SSB and recruitment from retrospective TSA runs.

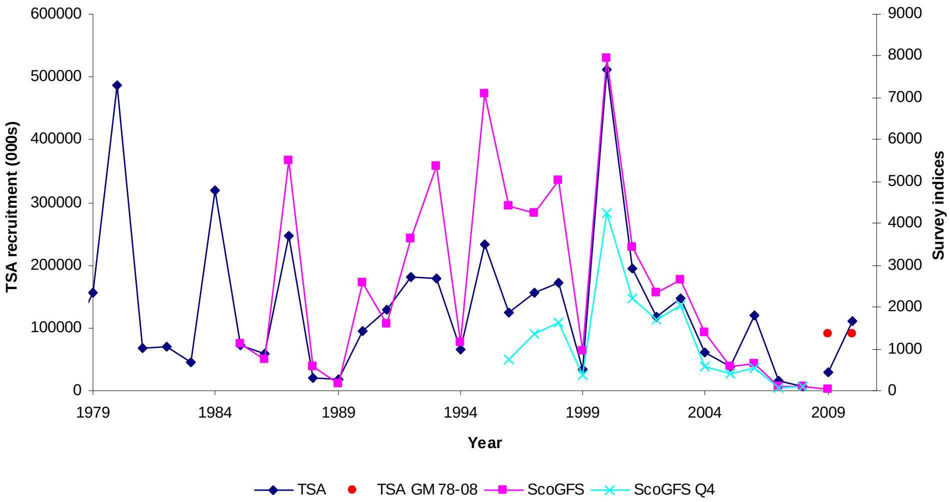


Figure 3.3.12. Haddock in Division VIa. Time-series of recruitment-at-age 1 from the final TSA assessment, along with the long-term (1978–2008) geometric mean and the age-1 indices from the Q1 and Q4 ScoGFS survey series.

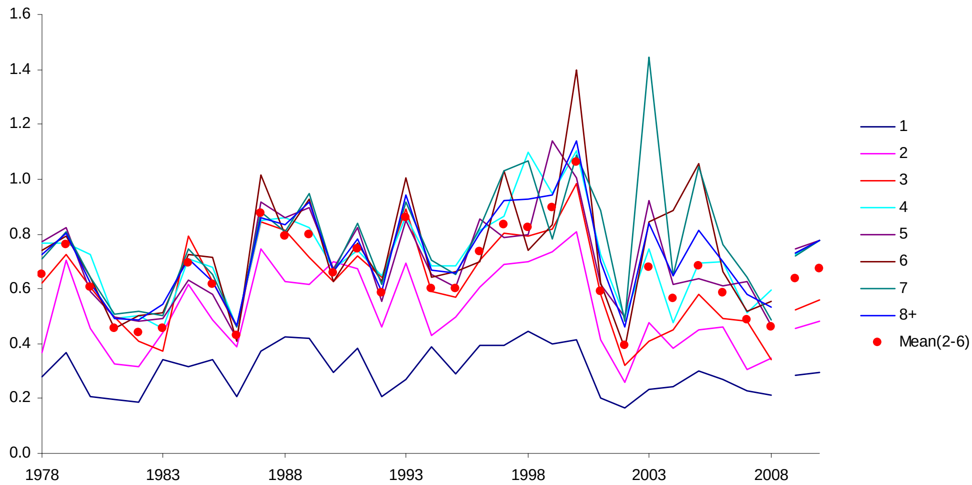


Figure 3.3.13. Haddock in Division VIa. Time-series of estimated fishing mortality-at-age, along with the mean over ages 2–6. Values for 2009 and 2010 are TSA-generated forecasts.

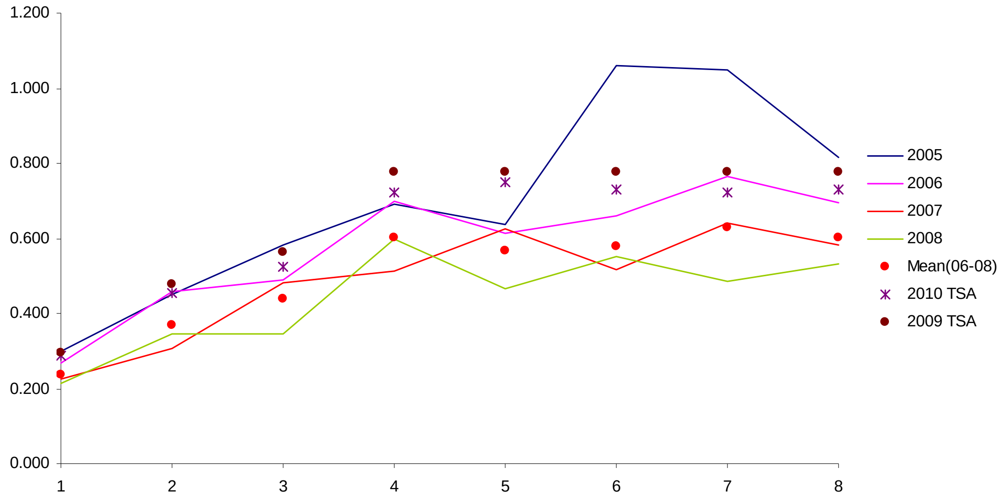


Figure 3.3.14. Haddock in Division VIa. Candidates for fishing mortality-at-age in short-term forecasts. Lines labelled 2005, 2006, 2007 and 2008 indicate the TSA estimates for those years. Points marked 2009 TSA and 2010 TSA show the TSA-generated forecast values from the final assessment.

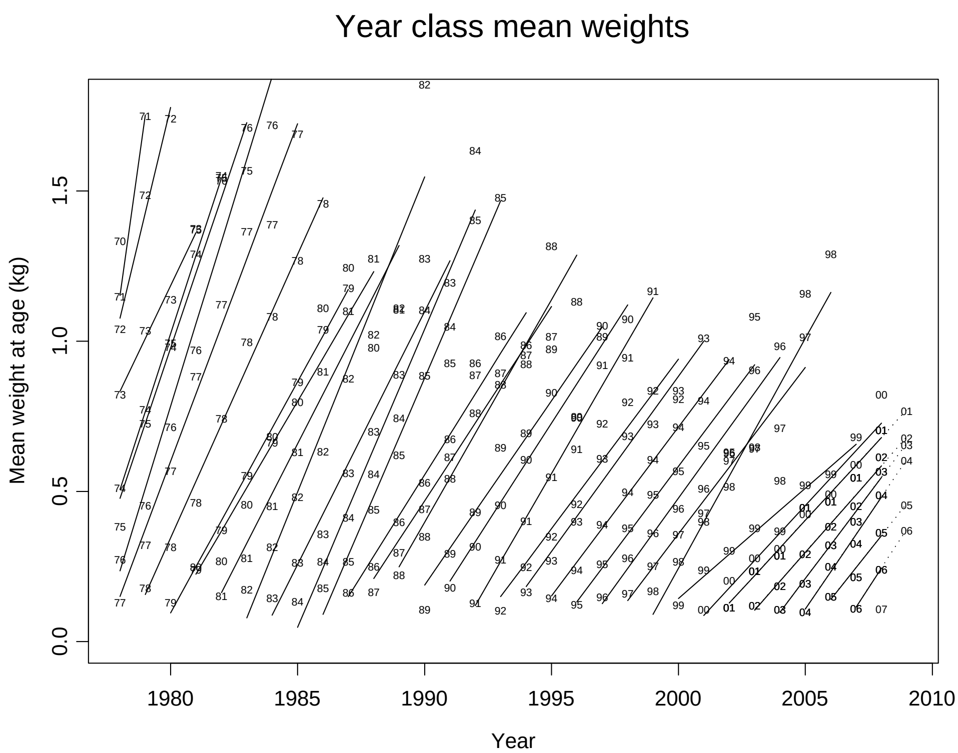


Figure 3.3.15. Haddock in Division VIa. Mean weights-at-age (kg) in total catch (or stock), tracked by year class with a linear model fit. Predicted weights in 2009 based on linear model fits indicated with the dotted lines.

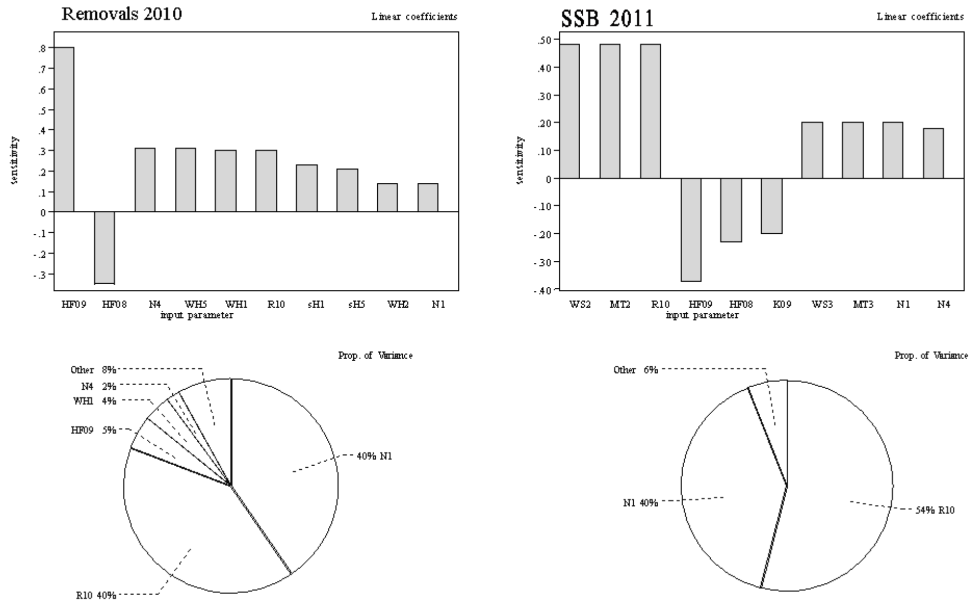


Figure 3.3.16. Haddock in Division VIa. Sensitivity analysis of short-term forecast.

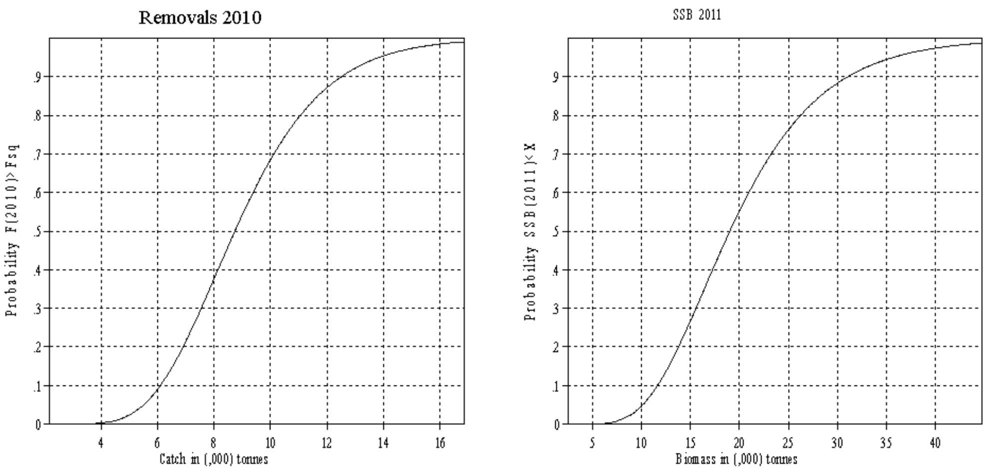


Figure 3.3.17. Haddock in Division VIa. Probability profiles for short-term forecast.

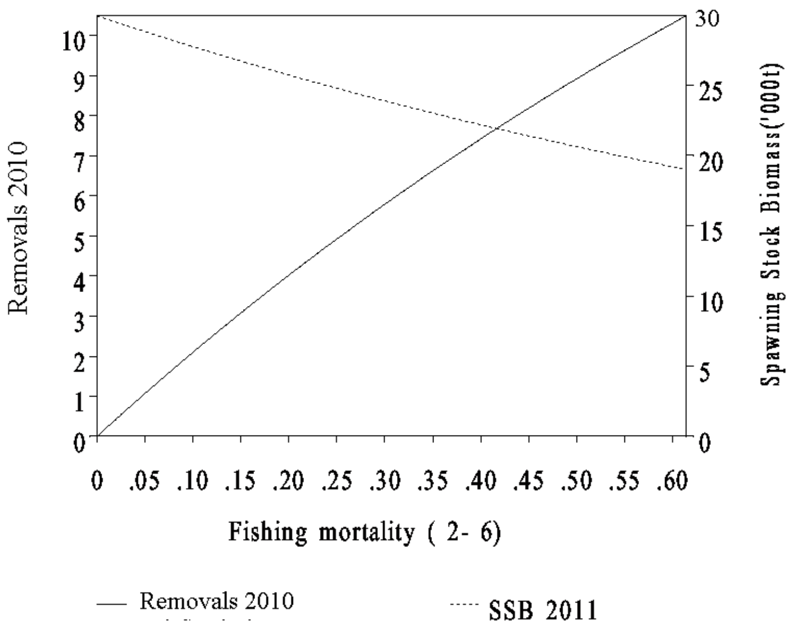


Figure 3.3.18. Haddock in Division VIa. Summary of short-term forecast.

3.4 Whiting in Subarea VIa

As agreed at this year's meeting of ACOM, no advice will be provided for whiting in Division VIa this year. Therefore, no assessment or data analysis are conducted this year and only input data tables and text describing the fishery and input data have been updated.

ICES advice applicable to 2008 and 2009

In 2006, the ICES advice for 2007 for single-stock exploitation boundaries was as follows:

Exploitation boundaries in relation to precautionary limits

"Given that SSB is estimated at the lowest observed level and total mortality at the highest level over the time period, catches in 2007 should be reduced to the lowest possible level."

The advice given since then has been the same (see Table below).

3.4.1 General

Stock description

General information is now located in the stock annex and also Section 2.1.

Management applicable to 2008 and 2009

The following table summarizes ICES advice and actual management applicable for whiting in Division VIa during 2001–2009:

Year	Single species exploitation (tonnes)	Basis for single species	TAC for Vb, VI, XII, XIV (tonnes)	% change in F associated with TAC[1]
2001	< 4200	Reduce F below F_{pa}	4000	-40%
2002	< 2000	SSB > B_{pa} in short term	3500	-40%
2003	-	SSB > B_{pa} in short term	2000	-60%
2004	-	SSB > B_{pa} in 2005	1600	(no assessment)
2005	-	-	1600	(assessment in relative trends only)
2006	-	-	1360	(assessment in relative trends only)
2007	0	Reduce catches to lowest possible level	1020	(assessment in relative trends only)
2008	0	Reduce catches to lowest possible level	765	
2009	0	Reduce catches to lowest possible level	574	

[1]**Based on *F*-multipliers from forecast tables.**

The minimum landing size for whiting in Division VIa is 27cm.

The fishery in 2008

A description of the fisheries on the west of Scotland is given in Section 3.1 above.

Tables and figures of total effort to 2006 by the fleets operating in Division VIa can be found in Section 16 of the report of WGNSDS 2007.

Anecdotal information from the fishing industry suggests that the number of vessels targeting whiting continues to be very low. The quota uptake of UK vessels in 2008 (taking into account all swaps that were made) was approximately 75% (compared with 49% in 2007). Total landings in 2008 were 441 t, down slightly from 2007 (Table 3.4.1.1). These are above the lowest recorded landings of 2005, but continue to be below the long-term average.

The total estimated international catch of ages 1–7+ (including discards) in 2008 was 617 t of which approximately 174 t were discards (Table 3.4.1.2). An additional 16 t of 0-gp fish were also estimated to be discarded. The total weight of discards in 2008 was the lowest in the time-series and less than half of the value estimated for 2007. The catch in 2008 is estimated to be 617 t, lower than that in 2007, and is by far the lowest in the time-series.

Mandatory introduction of larger square mesh panels for the *Nephrops* fleet in 2008 may be partially responsible for the reductions. Discarding is expected to decline further following the mandatory increase in mesh size to 120 mm for vessels fishing in the mixed demersal fishery in 2009.

3.4.2 Data

Landings

There have been concerns that the quality of landings data is deteriorating, giving a possible reason for the different stock dynamics implied by the commercial fleet and the annual survey (ScoGFS) in recent years, (see Section 5.1.6.1.3 in the 2005 WG report). The introduction of UK and Irish legislation requiring registration of all fish buyers and sellers (See section 1.7) may mean that the reported landings from 2006 onwards are more representative of actual landings.

Details on nations which supply data are given in Table 2.2. Sampling levels are demonstrated in Table 2.3. Age distributions were estimated from market samples. Annual numbers-at-age in the landings are given in Table 3.4.2.1.Annual mean weights-at-age in the landings are given in Table 3.4.2.2 and shown in Figure 3.4.2.1.

Discards

Annual numbers-at-age in the discards are given in Table 3.4.2.3. Annual mean weights-at-age in the discards are given in Table 3.4.2.4 and shown in Figure 3.4.2.2.

This year, WG estimates of discards are based on data collected in the Irish and Scottish discard programme (raised by weighted average to the level of the total international discards). Discard age compositions from Scottish and Irish samples have been applied to unsampled fleets. Work is underway to revise the Scottish discard estimates with an aim to reduce bias and increase precision. Such revisions are particularly important for the estimation of total catch for this stock which has very high discards across a wide age range. A working document set out the methodology of this work at the 2004 meeting of WGNSDS (Fryer and Millar, 2004).

Commercial catch-effort data

Four commercial catch-effort dataseries were available to the WG including:

- Scottish light trawlers (ScoLTR): ages 1–7, years 1965–2005;
- Scottish seiners (ScoSEI): ages 1–6, years 1965–2005;

- Scottish Nephrops trawlers (ScoNTR): ages 1–6, years 1965–2005;
- Irish Otter Trawlers (IreOTB); ages1–7, years 1995-2005.

However, given the problems with non-mandatory effort reporting in the UK (described further in the report of WGNSSK for 2000, ICES CM 2001/ACFM:07), these cpue series have not been used for a number years and are not presented in the report. They are retained in the stock annex.

Surveys

Four research survey indices for whiting in VIa were also available:

- Scottish west coast groundfish survey (ScoGFSQ1): ages 1–7, years 1985-2009;
- Irish west coast groundfish survey (IreGFS): ages 0–5, year 1993-2002;
- Scottish fourth-quarter west coast groundfish survey (ScoGFSQ4): ages 0–8, years 1996–2008;
- Irish groundfish survey (IRGFS): ages 0–6; years 2003–2008.

For the Scottish surveys, a new vessel and gear were used from 1999. The catch rates as presented are corrected for the change in vessel and gear. The basis for the correction is comparative trawl haul data (Zuur *et al.*, 2001). The Irish quarter four survey was discontinued in 2003 and has been replaced by a new survey. The replacement survey (IRGFS) has been running for six years. The Scottish quarter four survey was presented for the first time to WGNSDS 2005.

The survey-series are described in the report of the 2009 IBTSWG and also in the Stock Annex. For all survey-series, the oldest age given represents a true age, rather than a plus group. The survey indices are displayed in Table 3.4.2.5. The sum of the Scottish fourth-quarter west coast groundfish survey indices is the second lowest in the time-series; and the sum of the Scottish first-quarter west coast groundfish survey indices is the third lowest in the time-series, although the latter was higher than last years' all time low. These data do not indicate any change in the status of the stock. The spatial distribution of cpue from the two Scottish surveys in 2008 has been provided in the stock annex.

Biological data

Annual numbers-at-age in the total catch are given in Table 3.4.2.6. Annual mean weights-at-age in the total catch are given in Table 3.4.2.7. As in previous meetings, the catch mean weights-at-age were also used as stock mean weights-at-age (see stock annex).

Values for natural mortality (0.2 for all ages, and years) and the proportion of fish mature at-age (knife-edged at-age 2 for all years) are unchanged from the last meeting. As last year, the proportion mature before spawning and the proportion fished before spawning are both set to be zero.

3.4.3 Historical stock development

No assessment has been presented in 2009 and a discussion of management considerations can be found in the report of WGNSDS 2007. There are therefore no projections.

3.4.4 Biological reference points

ICES considers that B_{lim} is 16 000 t and B_{pa} be set at 22 000 t. ICES proposes that F_{lim} is 1.0 and F_{pa} be set at 0.6.

3.4.5 Uncertainties and bias in the assessment and forecast

There is currently no assessment for this stock. Long-term information on the historical yield and catch composition all indicate that the present stock size is low. A survey-based assessment carried out in 2007, covering the more recent period, indicated that the stock was at its lowest level over this time period; total mortality was at the highest level over the time period. The sum of the Scottish fourth-quarter west coast groundfish survey indices is the second lowest in the time-series; and the sum of the Scottish first-quarter west coast groundfish survey indices is the third lowest in the time-series, although the latter was higher than last years' all time low. These data (Table 3.4.2.5) do not, therefore, indicate any change in the status of the stock, although this should be checked periodically with a survey based assessment.

Table 3.4.1.1. Nominal landings (t) of WHITING in Division VIa, 1989–2008, as officially reported to ICES.

COUNTRY	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*
Belgium	1	-	+	-	+	+	+	-	1	1	+	-	-	-	-	+	-	-	-	-
Denmark	1	+	3	1	1	+	+	+	+	-	-	-	-	-	+	+	-	-	-	-
Faroe Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+
France	199 [1,2]	180	352 [1,2]	105	149	191	362	202	108	82	300	48	52	21	11	6	9	7	1	3
Germany	+	+	+	1	1	+	-	+	-	-	+	-	-	-	-	-	-	+	1	-
Ireland	1,315	977	1,200	1,377	1,192	1,213	1,448	1,182	977	952	1,121	793	764	577	568	356	172	196	56	69
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	1	-	1	2	+	-	2	-	-	-	-	-	-	-
UK (E, W and NI)	44	50	218	196	184	233	204	237	453	251	210	104	71	73	35	13	5	2	1	-
UK (Scot.)	6,109	4,819	5,135	4,330	5,224	4,149	4,263	5,021	4,638	3,369	3,046	2,258	1,654	1,064	751	444	103	178	424	-
UK (total)																				369
Total landings	7,669	6,026	6,908	6,010	6,751	5,786	6278	6642	6178	4657	4677	3203	2543	1735	1365	819	289	383	484	441

*** Preliminary.**

1989–2008 N. Ireland included with England and Wales.

Table 3.4.1.2. Whiting in Division VIa. Annual weight and numbers caught, years 1978–2008.

YEAR	WEIGHT (TONNES)			NUMBERS (THOUSANDS)		
	Total	Human consumption	Discards	Total	Human consumption	Discards
1978	20452	14677	5775	93932	54369	39563
1979	20163	17081	3082	77794	61393	16401
1980	15108	12816	2292	57131	44562	12569
1981	16439	12203	4236	72113	46067	26046
1982	20064	13871	6193	87481	47883	39598
1983	21980	15970	6010	79114	49359	29755
1984	24118	16458	7660	125708	50218	75490
1985	23560	12893	10667	124683	43166	81517
1986	13413	8454	4959	64495	31273	33222
1987	18666	11544	7122	103485	41221	62264
1988	23136	11352	11784	141314	40681	100633
1989	11599	7531	4068	54633	26876	27757
1990	10036	5643	4393	42927	19201	23726
1991	12006	6660	5346	63112	25103	38009
1992	15396	6004	9392	86903	22266	64637
1993	15373	6872	8501	68351	23246	45105
1994	14771	5901	8870	87881	20060	67821
1995	13657	6076	7581	77932	18763	59169
1996	14058	7156	6902	71396	22329	49067
1997	11192	6285	4907	50459	19250	31209
1998	10476	4631	5845	56583	14387	42196
1999	7734	4613	3121	38260	15970	22290
2000	9715	3010	6705	78815	10118	68697
2001	4850	2438	2412	20802	8477	12325
2002	3829	1709	2120	25179	5765	19414
2003	2936	1356	1580	15403	4124	11279
2004	3437	811	2626	21749	2571	19178
2005	1239	341	898	6154	1051	5103
2006	1326	380	946	12988	1049	11939
2007	849	484	365	4879	1145	3734
2008	617	443	174	3085	1232	1853
Min	617	341	174	3085	1049	1853
GM	8812	4584	3731	45443	15128	26869
AM	12329	7279	5049	61766	24941	36825
Max	24118	17081	11784	141314	61393	100633

Table 3.4.2.5. Whiting in Division VIa. Available catch-effort and survey tuning series.

SCOLTR: Scottish Light Trawl - Effort in hours – Numbers-at-age (thousands)							
1965	2005						
1	1	0	1				
1	7						
37387	2011.623	469.253	3512.923	393.473	14.925	5.445	0.909
40538	1036.117	926.485	162.985	5508.27	333.46	32.68	6.196
80916	2539.797	4967.604	1637.023	101.256	2456.915	133.979	12.466
65348	1931.014	3404.448	1868.458	677.298	51.295	844.125	58.939
106856	46.897	8823.442	2211.584	578.006	278.879	28.188	516.892
129741	94.958	5275.823	8514.611	712.848	143.241	35.554	3.428
137728	1566.57	4472.064	1026.561	9818.08	337.772	63.477	25.237
154288	13450.885	4637.042	1716.159	334.786	5435.152	309.86	29.756
93992	4613.649	12778.492	680.372	148.997	42.975	478.522	39.083
88651	7452.711	15917.02	1773.837	159.241	17.112	6.477	78.812
132353	10597.964	6684.991	10431.537	837.283	79.71	12.155	2.811
139225	10858.324	15481.895	3550.826	5483.438	412.525	13.045	4.668
143574	18222.115	4276.619	5983.177	773.244	1126.782	74.579	1.916
127387	9805.191	5887.935	1561.61	1814.903	127.832	244.126	3.76
99803	1846.163	9530.148	2446.896	368.018	290.896	31.887	57.01
121211	1856.938	4385.272	4359.469	1052.873	170.989	172.29	10.997
165002	983.137	13544.1	4617.56	1330.75	504.711	152.752	62.619
135280	8248.806	2593.129	10934.792	1899.759	316.934	74.891	62.409
112332	4809.036	4322.894	2548.597	8292.216	1696.241	253.9	54.475
132217	29865.064	4084.418	2582.188	1149.781	5206.862	592.972	221.473
142815	9243.535	11577.551	2515.313	663.96	360.662	917.939	82.73
126533	3187.288	6006.487	2693.592	621.738	98.497	50.635	93.945
131720	12328.429	6004.925	2767.12	1229.144	147.776	43.178	32.132
158191	5358.52	15325.219	2988.119	1334.433	316.668	46.956	2.997
217443	3161.234	1640.767	5226.339	1473.139	434.728	129.89	14.252
169667	4110.42	4152.38	972.043	1380.502	386.872	51.478	6.092
209901	7018.52	2968.053	3981.784	336.752	423.153	73.429	5.829
189288	9761.596	6548.587	1727.049	2100.437	113.974	102.439	10.66
189925	2623.886	10105.623	4392.988	1169.932	1701.769	51.678	46.841
174879	3251.43	6503.608	5363.793	1739.967	333.927	291.821	13.881
175631	1775.509	5661.947	5310.813	1995.375	569.453	114.177	107.935
214159	2738.034	8043.865	4647.63	2543.265	833.461	213.15	24.196
179605	3107.284	3973.701	5098.515	1858.52	532.696	95.153	39.379
142457	3997.939	3171.019	2547.76	2327.54	654.589	149.808	79.812
98993	559.916	3273.961	1709.217	814.593	793.265	122.037	34.883
76157	4363.101	2324.771	2202.561	627.094	169.833	201.883	8.678
35698	575.281	2603.626	1358.595	783.414	117.804	37.996	5.442
15174	389.652	848.153	1566.132	374.617	166.509	16.845	5.038
9357	565.293	207.507	273.115	578.307	100.052	41.916	0.206
7116	1769.901	1215.938	242.922	199.9	221.001	27.997	3.138
3063	217.522	400.094	268.966	23.085	27.158	14.318	2.462

cont) Whiting in VIa. Available catch-effort and survey tuning series.

SCOSEI: Scottish Seine - Effort in hours – Numbers-at-age (thousands)						
1965	2005					
1	1	0	1			
1	6					
153103	8570.938	4534.63	19453.707	1412.984	62.399	15.334
156511	2872.249	12671.39	1491.149	13027.566	736.15	68.22
158208	7058.77	23604.969	5804.573	363.182	5528.921	304.951
150094	11817.932	14128.65	4897.227	1409.535	134.705	1651.222
140718	1314.237	19167.426	4024.433	1038.908	420.643	45.006
95629	979.255	2065.056	9177.95	815.703	176.987	51.144
98748	3280.938	6459.36	2466.983	14808.06	484.003	73.488
70741	20563.777	7286.501	1143.727	588.902	3139.349	112.588
59596	16428.303	16410.354	1995.231	373.15	97.243	886.47
56448	8764.309	28089.33	3578.12	289.184	22.105	9.317
56420	15931.473	9161.576	13093.543	585.337	37.682	9.127
57090	7559.305	30718.529	6226.15	4887.683	283.504	18.081
41920	14522.98	4873.693	6783.85	584.118	1035.664	43.296
33599	9880.994	4708.252	812.33	1086.089	65.835	152.233
38465	3779.036	13497.126	3739.924	473.079	392.189	16.481
38700	2222.899	3686.353	4277.55	1081.223	273.049	118.803
37208	789.787	9229.84	3128.155	1025.456	426.614	90.387
36689	1146.222	1977.49	9664.041	1183.655	229.857	68.248
38080	3803.96	3110.436	1942.945	5805.497	1181.95	138.395
29561	3965.733	2170.117	1220.296	382.107	2024.552	218.843
26365	18813.885	6473.455	1248.851	327.561	171.234	557.447
19960	1423.965	4902.12	1815.778	359.211	53.845	24.911
26332	8664.831	3706.126	2068.674	916.903	142.281	19.137
21383	7392.194	8210.657	1658.022	1078.674	218.449	22.005
39350	2182.008	1845.431	4488.746	1282.547	272.354	186.923
27664	2699.332	2964.297	687.892	940.682	279.68	34.508
25787	4160.412	2318.718	3285.513	305.785	290.789	53.282
20273	7513.958	5370.645	1341.721	1622.613	102.037	101.204
24315	1509.725	6046.03	2291.531	675.422	789.292	22.916
21305	1725.208	3310.909	2498.717	701.186	108.245	140.133
21950	721.806	2616.333	2260.832	970.329	298.966	83.208
15205	1270.19	2353.781	1371.875	819.771	297.3	67.732
11449	1096.1	1273.361	1933.262	696.409	187.498	33.748
11166	4251.142	1659.104	1010.394	614.297	265.65	62.355
8638	823.21	2152.386	706.708	294.599	179.097	43.194
6431	2601.077	887.944	755.637	152.896	66.565	19.536
5893	728.924	1007.442	454.373	240.788	40.285	22.082
3817	335.558	583.357	482.121	132.428	40.991	2.935
2370	3130.339	260.924	133.135	290.007	34.543	8.6
1173	7323.289	758.611	165.379	83.46	77.222	2.096
476	676.408	225.196	143.246	10.154	15.355	3.048

(cont) Whiting in VIa. Available catch-effort and survey tuning series.

SCONTR: Scottish Nephrops Trawl - Effort in hours – Numbers-at-age (thousands)						
1965	2005					
1	1	0	1			
1	6					
101975	1659.715	453.604	1101.02	102.448	4.875	0.947
116972	613.623	951.561	154.546	785.807	44.575	4.319
135811	1788.967	2002.916	444.377	15.668	322.969	18.182
166713	1761.346	1850.07	637.399	159.199	12.641	190.783
155131	736.536	2706.572	437.098	155.072	44.263	4.378
144704	439.172	645.419	1379.363	127.922	31.719	12.912
127638	1072.488	444.198	235.897	1405.7	60.499	10.787
185397	3744.591	1908.742	232.266	70.731	730.108	46.028
186342	3462.89	5445.012	486.932	168.428	24.824	351.356
186342	1933.55	5427.964	650.405	87.286	11.605	3.757
203053	5916.971	2730.363	2846.712	319.449	35.425	9.045
224347	4061.224	4343.339	893.637	1142.92	125.278	3.601
196403	3573.612	1393.724	1431.401	168.241	289.689	17.117
219562	6053.242	2596.492	417.688	570.766	110.339	108.757
273713	659.614	3413.303	934.795	207.461	216.936	38.758
254147	1439.22	1529.161	1377.826	281.539	44.696	46.021
286461	1090.91	5250.686	1199.303	430.934	105.108	20.647
288902	2882.413	422	2552.725	439.981	95.697	55.05
293396	2702.936	1289.896	464.524	1258.148	205.504	48.013
312947	15763.118	731.211	414.638	132.72	870.58	84.641
384215	14885.186	3109.454	505.209	225.601	91.132	274.925
368971	2231.072	1259.03	707.734	246.405	8.838	22.587
395355	12048.819	1562.25	799.307	375.73	43.994	3.069
397682	19926.506	12751.985	539.705	138.471	31.741	1.001
379169	9854.602	485.161	443.582	152.424	71.883	13.451
390391	7434.593	1407.942	58.831	63.502	8.758	1.297
414817	13745.576	1280.079	294.651	27.112	43.958	5.263
391325	15245.132	3122.017	453.21	211.635	19.575	30.04
406753	6063.665	2833.312	611.27	159.111	112.856	2.336
380688	22785.318	4821.332	2174.707	613.104	18.004	26.177
333756	14759.284	5645.468	494.013	362.773	33.499	45.261
345007	14700.369	1316.965	633.638	192.741	44.427	25.493
354884	7854.017	1893.631	387.294	176.713	17.444	1.276
350882	13268.769	1926.434	620.474	116.935	63.417	3.41
337585	7208.116	1905.577	475.713	92.945	80.71	24.242
332659	31208.406	934.503	360.23	101.447	28.855	11.379
305743	1743.097	1271.809	189.3	80.436	14.844	15.496
258169	7281.766	1291.392	483.271	29.948	8.517	0.753
255729	4468.485	586.213	191.646	197.557	41.643	3.198
232356	3881.27	1310.954	239.992	157.625	102.126	6.493
220936	1738.881	829.542	258.178	41.47	16.707	7.849

(cont) Whiting in VIa. Available catch-effort and survey tuning series. For ScoGFSQ1, numbers are standardized to catch-rate per 10 hours. "+" indicates value less than 0.5 after standardizing. For IreGFS, effort is given as minutes towed, numbers are in units.

	SCOGFSQ1: Scottish Groundfish Sruvey - Effort in hours – Numbers-at-age							
	Effort	Age						
Year	(hours)	1	2	3	4	5	6	7
1985	10	3140	1792	380	85	23	156	18
1986	10	1456	1526	403	68	10	9	10
1987	10	6938	1054	584	143	36	2	1
1988	10	567	3469	653	189	42	5	1
1989	10	910	505	586	237	48	3	0
1990	10	1818	572	122	216	61	4	1
1991	10	3203	277	298	22	39	9	1
1992	10	4777	1597	410	517	56	18	0
1993	10	5532	6829	644	91	30	11	2
1994	10	6614	2443	1487	174	56	15	6
1995	10	5598	2831	1160	370	70	17	32
1996	10	9384	2238	635	341	135	30	5
1997	10	5663	2444	1531	355	102	17	4
1998	10	9851	1352	294	195	50	14	1
1999	10	6125	4952	489	103	16	1	0.4
2000	10	12862	471	152	34	10	11	0
2001	10	4653	1954	242	41	8	1	1
2002	10	5542	1028	964	86	15	1	1
2003	10	6934	746	436	300	32	2	4
2004	10	5888	1566	189	131	44	9	1
2005	10	1308	723	183	35	8	11	2
2006	10	1441	466	282	77	0.3	3	0.6
2007	10	614	522	127	75	16	3	2
2008	10	593	127	77	26	8	3	0
2009	10	906	387	103	105	20	9	7

	IR-WCGFS : Irish West Coast GFS (VIa) - Effort (min. towed) - Whiting number-at-age						
	Effort	Age					
Year	(min)	0	1	2	3	4	5
1993	2130	14403	32643	11419	1464	231	13
1994	1865	264	11969	4817	2812	78	57
1995	2026	34584	5609	6406	734	186	80
1996	2008	376	7457	3551	374	232	5
1997	1879	1550	13865	8207	1022	524	50
1998	1936	1829	4077	3361	663	121	5
1999	1914	3337	3059	1965	322	11	12
2000	1878	682	10102	2126	109	109	4
2001	965	1118	5201	2903	149	70	3
2002	796	594	8247	9348	820	280	0

IRGFS: Irish groundfish survey - effort in minutes – numbers-at-age								
	Effort	Age						
Year	(min)	0	1	2	3	4	5	6
2003	1127	1101	12886	2894	512	290	102	1
2004	1200	6924	3114	1312	104	35	16	1
2005	960	910	2228	1126	91	5	4	0
2006	1510	99	1055	921	214	27	3	0
2007	1173	138	1989	2380	722	169	251	122
2008	1135	24	4342	1328	573	243	123	36

IreOTB : Irish otter trawl - Effort in hours – numbers-at-age (thousands)								
1995	2005							
1	1	0	1					
1	7							
56335	222	298	530	461	92	28	98	
60709	165	531	670	281	175	33	12	
62698	99	358	515	282	339	133	89	
57403	51	1092	552	312	186	218	232	
53192	98	315	437	266	198	109	123	
46913	50	131	188	303	158	76	65	
48358	14	304	144	101	126	100	44	
37231	31	162	388	27	65	97	47	
39803	90	294	604	492	131	30	0	
35140	33	387	266	245	200	28	21	
30941	23	159	188	78	41	19	2	

(cont). Whiting in VIa. Available catch-effort and survey tuning series. For ScoGFSQ4, numbers are standardized to catch-rate per 10 hours. "+" indicates value less than 0.5 after standardizing.

SCOGFSQ4 : QUARTER FOUR SCOTTISH GROUNDFISH SURVEY - EFFORT IN HOURS – NUMBERS-AT-AGE										
	Effort	Age								
Year	(hours)	0	1	2	3	4	5	6	7	8
1996	10	5154	1908	1116	570	188	51	6	1	0
1997	10	8001	2869	951	323	160	46	12	1	0
1998	10	1852	2713	1124	149	100	20	1	0	+
1999	10	8203	2338	582	141	33	24	1	1	0
2000	10	4434	4055	789	160	9	7	1	0	0
2001	10	9615	1957	1420	155	40	12	2	0	0
2002	10	14658	1591	621	479	30	9	5	0	0
2003	10	9932	3446	567	338	83	27	4	0	0
2004	10	5923	1758	940	83	57	62	1	0	0
2005	10	2297	308	318	76	9	4	0.9	0.7	0
2006	10	415	296	140	101	35	8	3	0.5	0
2007	10	1894	434	326	99	83	48	0.6	0	0
2008	10	2297	208	78	110	28	24	4	0	+

Table 3.4.2.2. Whiting in Division VIa. Landings-at-age (thousands).

	1	2	3	4	5	6	7+
1965	6938	6085	43530	4803	388	103	22
1966	1685	10544	2229	28185	1861	186	52
1967	5169	26023	10619	697	14574	789	143
1968	7265	16484	9239	3656	324	5036	368
1969	873	25174	8644	2566	1206	118	2333
1970	730	6423	28065	3241	670	214	550
1971	2387	8617	4122	34784	1338	240	223
1972	16777	12028	4013	1363	14796	793	148
1973	14078	36142	5592	1461	357	4292	310
1974	9083	51036	10049	1166	180	52	849
1975	14917	16778	36318	2819	281	57	245
1976	8500	46421	15757	17423	1508	66	57
1977	16120	13376	25144	3127	4719	292	24
1978	17670	18175	6682	9400	941	1433	68
1979	6334	34221	13282	3407	3488	276	384
1980	11650	11378	14860	4155	1244	1085	190
1981	3593	24395	11297	4611	1518	452	201
1982	2991	5783	29094	6821	2043	803	348
1983	3418	7094	8040	22757	6070	1439	540
1984	7209	12765	8221	4387	14825	1953	858
1985	4139	19520	8574	3351	1997	4764	822
1986	2674	14824	9770	2653	532	291	529
1987	6430	13935	13988	5442	837	330	259
1988	1842	20587	9638	6168	1949	290	207
1989	2529	5887	11889	4767	1266	468	71
1990	3203	8028	2393	4009	1326	204	37
1991	3294	8826	10046	1208	1391	286	51
1992	2695	9440	4473	4782	396	373	106
1993	1051	10179	6293	2673	2738	163	147
1994	909	4889	9158	3607	712	715	69
1995	215	4322	6516	5654	1397	376	282
1996	990	5410	7675	5052	2461	583	157
1997	877	3658	8514	4316	1441	338	106
1998	840	3504	4277	3698	1442	338	288
1999	1013	6131	4546	2040	1774	355	112
2000	484	2952	4211	1570	485	328	89
2001	461	3271	2630	1567	401	131	16
2002	62	1624	3018	799	227	23	13
2003	170	710	1111	1673	347	111	2
2004	54	724	543	521	622	78	29
2005	28	276	455	140	99	45	7
2006	82	139	369	260	61	113	24
2007	187	168	255	326	132	27	50
2008	6	265	394	336	152	55	24

Table 3.4.2.3. Whiting in Division VIa. Discards-at-age (thousands).

	1	2	3	4	5	6	7+
1965	17205	4968	11437	531	14	2	0
1966	4322	8946	515	3317	79	3	0
1967	12237	20791	2674	84	629	12	1
1968	16394	12612	2137	377	13	82	3
1969	1983	20494	2093	292	51	2	26
1970	1776	6704	7494	382	33	4	0
1971	5505	6719	969	3906	57	4	1
1972	39192	8930	850	152	610	14	1
1973	30521	26995	1225	147	14	77	2
1974	23101	40590	2362	123	7	1	7
1975	37295	13541	8485	310	12	1	0
1976	24891	35812	3360	1940	63	1	0
1977	48148	8675	5432	301	212	5	0
1978	27942	10505	889	206	1	20	0
1979	3450	10722	1619	533	76	0	0
1980	2376	6172	3206	651	156	9	0
1981	1017	22014	2763	148	101	4	0
1982	17837	4577	15938	1189	55	1	0
1983	15069	8173	1964	4271	176	102	0
1984	68241	3951	1085	572	1577	59	4
1985	59783	17426	3134	663	61	446	3
1986	10459	20085	2491	117	6	2	61
1987	46876	13689	1518	180	1	0	0
1988	46421	51395	2472	292	54	0	0
1989	17778	3660	5796	401	111	11	0
1990	16406	5791	860	571	95	3	0
1991	30355	2874	4432	173	140	36	0
1992	46463	15041	2224	908	0	0	0
1993	14618	22281	5966	921	1317	0	2
1994	39697	18403	7775	1634	183	125	4
1995	28557	20921	8483	961	246	0	0
1996	28620	14617	4398	1395	18	1	18
1997	18182	9037	3431	466	93	0	0
1998	31183	7304	2418	991	184	51	64
1999	13623	7256	933	369	79	29	0
2000	63789	3556	1206	117	15	14	0
2001	5514	5861	738	208	4	0	0
2002	14166	3235	1749	130	124	8	1
2003	9331	1107	427	371	34	7	2
2004	14667	3557	536	305	107	4	2
2005	2923	1578	534	37	19	7	4
2006	9784	852	1000	256	36	11	2
2007	995	1077	308	64	4	3	0
2008	806	638	142	162	51	41	0

Table 3.4.2.1. Whiting in Division VIa. Total catch-at-age (thousands).

	1	2	3	4	5	6	7+
1965	24143	11054	54967	5334	402	105	22
1966	6007	19490	2744	31502	1940	189	53
1967	17406	46814	13293	781	15204	801	144
1968	23659	29096	11376	4034	337	5118	372
1969	2856	45668	10737	2858	1257	120	2358
1970	2506	13128	35559	3623	703	218	550
1971	7891	15336	5090	38690	1395	245	224
1972	55969	20958	4863	1514	15406	807	149
1973	44599	63137	6817	1608	371	4369	313
1974	32185	91625	12412	1289	188	53	856
1975	52213	30319	44804	3129	293	58	245
1976	33392	82233	19117	19363	1571	67	57
1977	64268	22051	30576	3428	4931	297	24
1978	45612	28680	7571	9606	942	1452	68
1979	9784	44943	14901	3940	3565	276	384
1980	14026	17551	18065	4806	1400	1093	190
1981	4610	46409	14060	4758	1618	456	201
1982	20829	10360	45032	8010	2098	804	348
1983	18487	15266	10004	27029	6246	1541	540
1984	75450	16716	9306	4959	16403	2011	863
1985	63922	36946	11708	4014	2058	5210	825
1986	13133	34909	12260	2770	539	293	591
1987	53305	27624	15506	5621	839	330	259
1988	48263	71982	12110	6460	2002	290	207
1989	20307	9547	17685	5168	1377	479	71
1990	19609	13819	3252	4580	1421	208	37
1991	33648	11700	14478	1381	1531	322	51
1992	49158	24481	6697	5691	396	373	106
1993	15669	32460	12259	3594	4055	163	149
1994	40606	23292	16933	5241	896	840	73
1995	28772	25243	14999	6615	1643	377	283
1996	29611	20027	12073	6447	2479	584	175
1997	19059	12695	11946	4782	1534	338	106
1998	32023	10808	6695	4689	1626	389	352
1999	14636	13387	5479	2408	1853	384	112
2000	64273	6508	5417	1687	500	343	89
2001	5975	9132	3368	1775	405	131	17
2002	14228	4859	4767	929	351	32	13
2003	9501	1817	1538	2044	381	119	4
2004	14721	4281	1079	825	730	82	31
2005	2951	1854	988	178	118	53	11
2006	9865	991	1369	516	97	124	26
2007	1182	1245	563	390	136	29	50
2008	812	903	536	498	203	96	24

Table 5 3.4.2. Whiting in Division VIa. Landings weights-at-age (kg).

	1	2	3	4	5	6	7+
1965	0.218	0.249	0.308	0.452	1.208	0.72	0.778
1966	0.238	0.243	0.325	0.374	0.61	0.72	0.828
1967	0.204	0.24	0.319	0.424	0.412	0.639	0.821
1968	0.206	0.263	0.366	0.444	0.554	0.538	0.735
1969	0.178	0.223	0.335	0.5	0.57	0.649	0.63
1970	0.205	0.203	0.274	0.382	0.519	0.619	0.683
1971	0.209	0.247	0.276	0.316	0.426	0.551	0.712
1972	0.211	0.258	0.345	0.368	0.426	0.494	0.638
1973	0.196	0.235	0.362	0.479	0.485	0.532	0.666
1974	0.193	0.215	0.317	0.444	0.591	0.641	0.584
1975	0.209	0.245	0.305	0.471	0.651	0.615	0.717
1976	0.201	0.242	0.309	0.361	0.497	0.687	0.856
1977	0.2	0.244	0.296	0.392	0.431	0.629	0.819
1978	0.199	0.235	0.286	0.389	0.516	0.549	0.612
1979	0.218	0.232	0.306	0.404	0.536	0.678	0.693
1980	0.172	0.242	0.33	0.42	0.492	0.595	0.817
1981	0.192	0.228	0.289	0.382	0.409	0.409	0.547
1982	0.184	0.22	0.276	0.352	0.505	0.513	0.526
1983	0.216	0.249	0.28	0.34	0.409	0.494	0.51
1984	0.216	0.259	0.313	0.371	0.412	0.458	0.458
1985	0.185	0.238	0.306	0.402	0.43	0.461	0.538
1986	0.174	0.236	0.294	0.365	0.468	0.482	0.499
1987	0.188	0.237	0.304	0.373	0.511	0.52	0.576
1988	0.176	0.215	0.301	0.4	0.483	0.567	0.6
1989	0.171	0.22	0.279	0.348	0.459	0.425	0.555
1990	0.225	0.251	0.324	0.359	0.417	0.582	0.543
1991	0.199	0.22	0.291	0.354	0.391	0.442	0.761
1992	0.193	0.23	0.288	0.349	0.388	0.397	0.51
1993	0.186	0.242	0.314	0.361	0.412	0.452	0.474
1994	0.161	0.217	0.29	0.371	0.451	0.482	0.483
1995	0.19	0.225	0.296	0.381	0.469	0.473	0.528
1996	0.195	0.245	0.288	0.365	0.483	0.526	0.569
1997	0.198	0.245	0.297	0.384	0.522	0.629	0.661
1998	0.215	0.236	0.301	0.364	0.438	0.5	0.646
1999	0.181	0.225	0.28	0.365	0.44	0.524	0.594
2000	0.205	0.241	0.298	0.336	0.419	0.488	0.617
2001	0.173	0.234	0.303	0.37	0.395	0.376	0.595
2002	0.213	0.257	0.304	0.363	0.464	0.65	0.707
2003	0.228	0.264	0.309	0.362	0.374	0.436	0.717
2004	0.193	0.251	0.295	0.345	0.382	0.403	0.342
2005	0.189	0.261	0.313	0.378	0.44	0.482	0.356
2006	0.221	0.292	0.319	0.394	0.455	0.528	0.567
2007	0.215	0.280	0.349	0.418	0.498	0.598	0.660
2008	0.274	0.245	0.322	0.384	0.514	0.530	0.653

Table 3.4.2.4. Whiting in Division VIa. Discard weights-at-age (kg).

	1	2	3	4	5	6	7+
1965	0.122	0.177	0.213	0.249	0.287	0.303	0.287
1966	0.122	0.178	0.212	0.248	0.29	0.297	0.286
1967	0.122	0.178	0.213	0.248	0.29	0.295	0.289
1968	0.128	0.179	0.213	0.249	0.291	0.298	0.287
1969	0.121	0.178	0.214	0.249	0.29	0.295	0.285
1970	0.121	0.175	0.213	0.249	0.29	0.299	0.284
1971	0.12	0.177	0.211	0.248	0.29	0.299	0.284
1972	0.121	0.177	0.213	0.248	0.289	0.301	0.281
1973	0.123	0.176	0.215	0.252	0.288	0.301	0.285
1974	0.119	0.177	0.214	0.25	0.285	0.299	0.288
1975	0.119	0.176	0.213	0.25	0.286	0.301	0.278
1976	0.116	0.177	0.213	0.249	0.288	0.3	0.28
1977	0.118	0.177	0.214	0.249	0.289	0.299	0.282
1978	0.135	0.167	0.199	0.288	0.32	0.238	0
1979	0.173	0.188	0.208	0.215	0.281	0	0
1980	0.14	0.179	0.208	0.22	0.271	0.386	0
1981	0.108	0.16	0.195	0.298	0.286	0.295	0
1982	0.096	0.18	0.209	0.243	0.283	0.44	0
1983	0.141	0.186	0.228	0.237	0.267	0.267	0
1984	0.087	0.199	0.246	0.26	0.259	0.303	0.227
1985	0.102	0.191	0.237	0.286	0.326	0.312	0.316
1986	0.092	0.17	0.196	0.245	0.258	0.33	0.263
1987	0.085	0.182	0.233	0.249	0.225	0	0
1988	0.076	0.143	0.203	0.227	0.262	0	0
1989	0.099	0.177	0.205	0.209	0.294	0.305	0
1990	0.124	0.171	0.214	0.219	0.237	0.264	0
1991	0.085	0.169	0.205	0.223	0.226	0.281	0
1992	0.109	0.173	0.219	0.227	0	0	0
1993	0.118	0.197	0.225	0.242	0.256	0	0.436
1994	0.087	0.157	0.22	0.283	0.297	0.253	0.299
1995	0.075	0.154	0.189	0.246	0.278	0.597	0.493
1996	0.095	0.18	0.203	0.229	0.302	0.421	0.26
1997	0.112	0.182	0.221	0.235	0.243	0.422	0.819
1998	0.098	0.179	0.225	0.254	0.282	0.264	0.245
1999	0.077	0.168	0.217	0.205	0.266	0.268	0
2000	0.075	0.164	0.203	0.233	0.282	0.25	0
2001	0.094	0.154	0.196	0.203	0.381	0	0
2002	0.073	0.162	0.212	0.245	0.24	0.295	0.276
2003	0.077	0.177	0.231	0.242	0.213	0.3	0.278
2004	0.086	0.186	0.236	0.246	0.304	0.349	0.314
2005	0.088	0.149	0.223	0.214	0.315	0.292	0.373
2006	0.046	0.197	0.235	0.295	0.322	0.518	0.362
2007	0.059	0.159	0.225	0.226	0.334	0.794	0.266
2008	0.075	0.211	0.286	0.301	0.397	0.222	0.304

Table 3.4.2.7. Whiting in Division VIa. Total catch weights-at-age (kg).

	1	2	3	4	5	6	7+
1965	0.15	0.217	0.288	0.432	1.177	0.712	0.776
1966	0.155	0.213	0.304	0.361	0.597	0.713	0.824
1967	0.146	0.212	0.298	0.405	0.407	0.634	0.817
1968	0.152	0.227	0.337	0.426	0.544	0.534	0.731
1969	0.138	0.203	0.311	0.474	0.559	0.643	0.626
1970	0.145	0.189	0.261	0.368	0.508	0.613	0.683
1971	0.147	0.216	0.264	0.309	0.42	0.547	0.71
1972	0.148	0.223	0.322	0.356	0.421	0.491	0.636
1973	0.146	0.21	0.336	0.458	0.477	0.528	0.663
1974	0.14	0.198	0.297	0.426	0.579	0.636	0.581
1975	0.145	0.214	0.288	0.449	0.636	0.61	0.717
1976	0.138	0.214	0.292	0.35	0.489	0.679	0.854
1977	0.139	0.218	0.281	0.379	0.425	0.624	0.816
1978	0.16	0.21	0.276	0.387	0.516	0.545	0.612
1979	0.202	0.222	0.295	0.378	0.531	0.678	0.693
1980	0.167	0.22	0.308	0.393	0.467	0.593	0.817
1981	0.173	0.196	0.271	0.379	0.401	0.408	0.547
1982	0.109	0.202	0.252	0.336	0.499	0.513	0.526
1983	0.155	0.215	0.27	0.324	0.405	0.479	0.51
1984	0.099	0.245	0.305	0.358	0.397	0.453	0.457
1985	0.107	0.216	0.288	0.383	0.427	0.448	0.537
1986	0.109	0.198	0.274	0.36	0.466	0.481	0.474
1987	0.097	0.21	0.297	0.369	0.51	0.52	0.576
1988	0.08	0.164	0.281	0.392	0.477	0.567	0.6
1989	0.108	0.204	0.255	0.337	0.446	0.422	0.555
1990	0.14	0.217	0.295	0.342	0.405	0.577	0.543
1991	0.096	0.207	0.265	0.338	0.376	0.424	0.761
1992	0.114	0.195	0.265	0.33	0.388	0.397	0.51
1993	0.123	0.211	0.271	0.331	0.361	0.452	0.474
1994	0.089	0.17	0.258	0.344	0.419	0.448	0.474
1995	0.076	0.166	0.235	0.361	0.44	0.473	0.528
1996	0.098	0.198	0.257	0.336	0.482	0.526	0.537
1997	0.116	0.2	0.275	0.369	0.505	0.629	0.661
1998	0.101	0.197	0.274	0.341	0.42	0.469	0.573
1999	0.084	0.194	0.269	0.34	0.433	0.504	0.593
2000	0.076	0.199	0.277	0.329	0.415	0.478	0.617
2001	0.1	0.183	0.28	0.35	0.395	0.376	0.589
2002	0.074	0.194	0.27	0.346	0.385	0.554	0.685
2003	0.08	0.211	0.287	0.34	0.36	0.427	0.526
2004	0.086	0.197	0.266	0.308	0.371	0.4	0.34
2005	0.089	0.166	0.264	0.344	0.42	0.455	0.362
2006	0.047	0.21	0.258	0.345	0.406	0.527	0.551
2007	0.084	0.175	0.281	0.387	0.494	0.616	0.659
2008	0.076	0.221	0.312	0.357	0.484	0.397	0.649

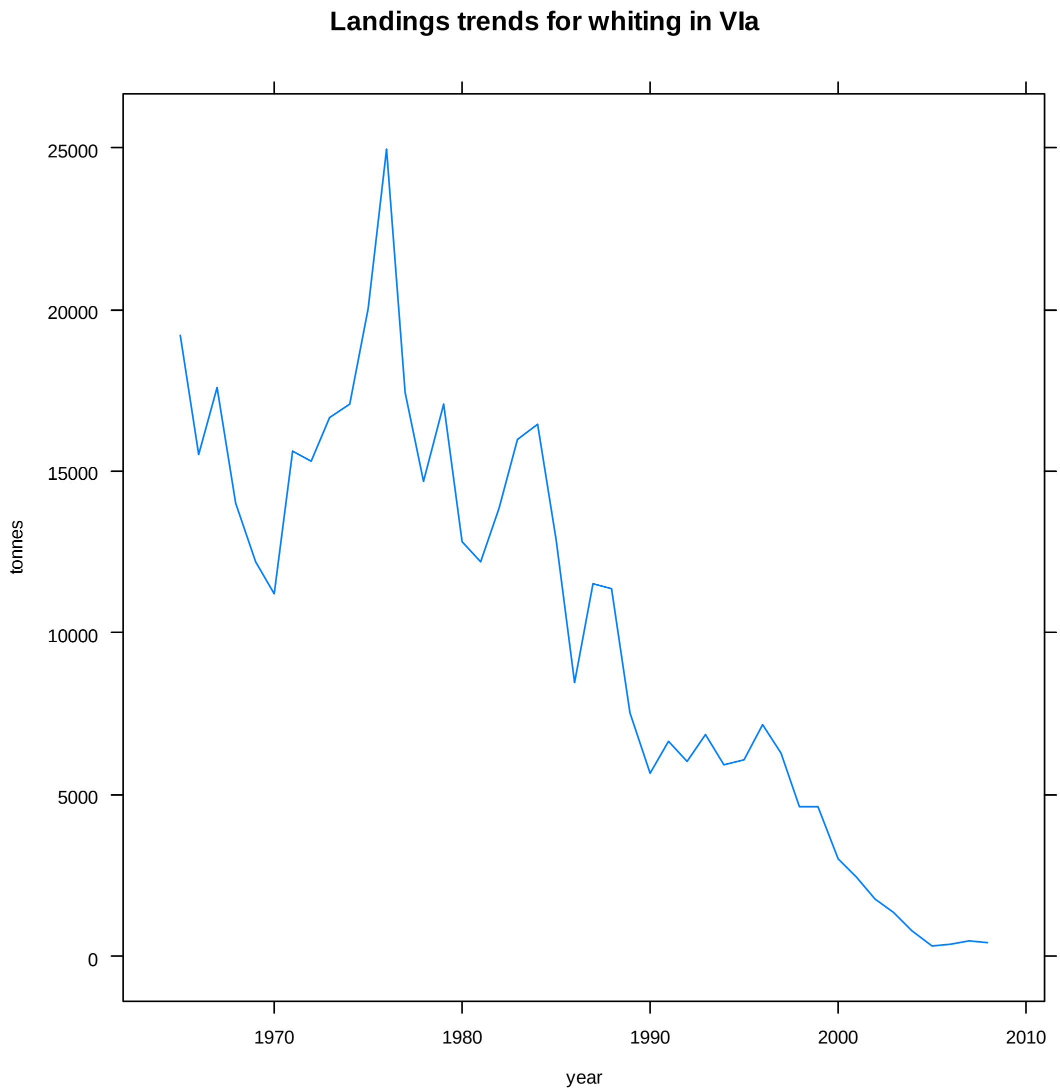


Figure 3.4.2.1. Landings (t) of Whiting in Division VIa, as officially reported to ICES.

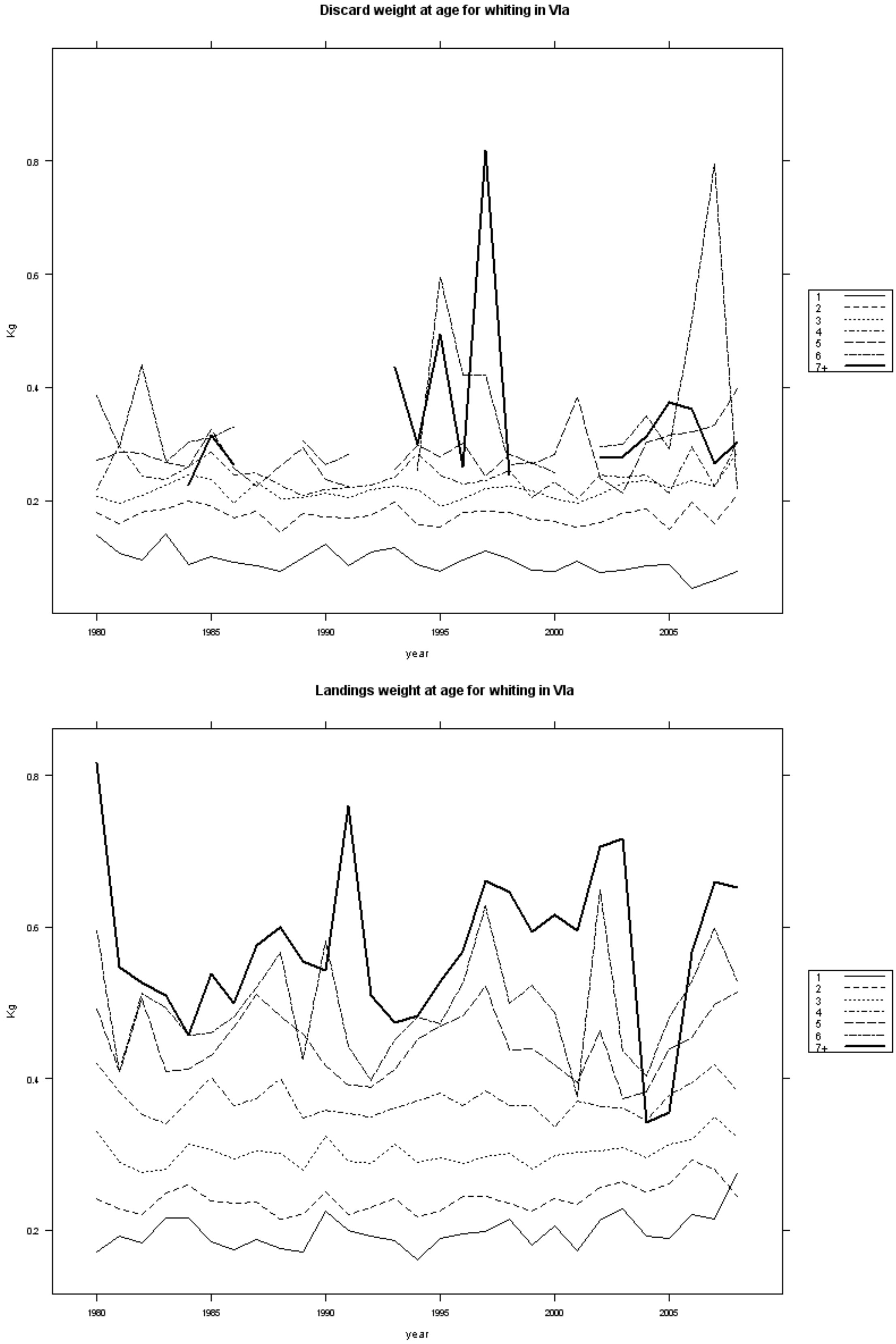


Figure 3.4.2.2. Whiting in Division VIa. Mean weights-at-age in the landings and discards.

3.5 North Minch

Type of assessment in 2009.

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG and described in Section 3.5.

ICES advice applicable to 2007 and 2008

"The effort in this fishery should not be allowed to increase relative to the past three years. In addition to the ceiling on effort ICES advises that the exploitation ratio in this stock should be no more than 15%, until such time that more reliable catch information becomes available. This corresponds to landings of less than 3200 t for North Minch"

ICES advice applicable to 2009

"The current fishery appears sustainable. Therefore, ICES recommends that *Nephrops* fisheries should not be allowed to increase relative to the past two years (2006–2007). This corresponds to landings of no more than 4100 tonnes for the North Minch stock."

3.5.1 General

Management is by TAC is at the ICES Subarea level as described at the beginning of Section 3.5.

The fishery in 2007 and 2008

The fishery in 2008 was generally similar to previous years with a fleet of mainly smaller trawlers working 1–4 day trips from the main ports of Lochinver, Ullapool, Stornaway and Gairloch. The largest part of the North Minch fleets continued to be based at Stornaway, made up of mostly smaller vessels, currently 10 single rigged trawlers and four multi-rigged trawlers. Although several vessels have been sold or left the fleet in recent years, the remainder have continued to fish the same pattern as always, most trawlers landing daily or every second day. The reported effort by *Nephrops* trawlers in the North Minch was slightly down in 2008 compared with the previous two years, but continues to be conducted throughout the year, with slightly more reported effort in the second quarter, consistent with the previous five years.

Little if any marketable fish bycatch was reported by the boats fishing in the North Minch, this was confirmed during *Nephrops* discard observer trips on board North Minch boats.

As a consequence of bad fishing and poor weather over summer, some local boats left the North Minch after July to fish in the Moray Firth squid fishery, or down to the South Minch depending on catch rates and the weather. Anecdotal reports suggest the squid fishery was less profitable this year than it has been in the previous two years.

Further general information on the fishery can be found in the stock annex.

3.5.2 Data

Commercial catch and effort data

Official catch statistics (landings) reported to ICES are demonstrated in Table 3.5.2; these relate to the whole of VIa and VIb of which the North Minch is a part. Landings for FU 11 provided through national laboratories are presented in Table 3.5.5. Landings from this fishery are only reported from Scotland. A variety of gear types make landings of *Nephrops*. Total reported landings in 2008 were 3799 tonnes, consisting of 3242 tonnes landed by trawlers and 557 tonnes landed by creel vessels. These figures for total landings represent a decrease on the 2007 and 2006 landings. Landings from creel vessels have risen since the mid 1990s, and have been at a stable level since then.

Reported effort by all Scottish *Nephrops* trawlers has revealed a decreasing trend since 1999, although has risen slightly in the past three years due apparently as a result of increased multi trawl effort. (Figures 3.5.3 and 3.5.4).

There are concerns over the accuracy of the effort data (hours fished) for this stock as that logbook field is not mandatory. Further details can be found in the report of the 2000 WGNSSK (ICES, 2001). It is recommended that effort in this fishery is given in days fished rather than hours next year, as this is thought to be more reliable. The introduction of the "buyers and sellers" regulations in the UK in 2006 has led to increased reliability in the reported landings. The elevated lpue observed since 2006 is linked to this improved reporting rather than a sudden change in stock abundance.

Males consistently make the largest contribution to the landings this is because of their larger size (Figure 3.5.4). The sex ratio in numbers fluctuates between 50–60% males. This is likely to be as a consequence of the varying seasonal pattern in the fishery and associated relative catchability (as a result of different burrow emergence behaviour) of male and female *Nephrops*.

Discards

Discarding of undersized and unwanted *Nephrops* occurs in this fishery, and quarterly discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 1999 (Table 3.5.10). Discarding rates average around 18% by number in this FU. In 2008, discard rates were estimated to be lower than average at just over 11% by number.

It is likely that some *Nephrops* survive the discarding process, an estimate of 25% survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population.

Length compositions

Length compositions of landings and discards are obtained during monthly market sampling and quarterly on-board observer sampling respectively. Quarterly landings and discards-at-length data were available from Scotland and these sampling levels are displayed in Table 3.5.4. Although assessments based on detailed catch analysis are not currently possible, examination of length compositions can provide a preliminary indication of exploitation effects.

Figure 3.5.5 shows a series of annual length frequency distributions for the period 2000 to 2008. Catch (removals) length compositions are demonstrated for each sex along with the mean size for both. In both sexes the mean sizes have been fairly stable over time, although males appear to demonstrate a slight increase in mean length in the past few years. Examination of the tails of the distributions above 35 mm (the length beyond which the effects of recruitment pulses and discarding are considered to be negligible) demonstrates no evidence of reductions in relative numbers of larger animals.

The observation of relatively stable length compositions is further confirmed in the series of mean sizes of larger *Nephrops* (>35 mm) in the landings shown in Figure 3.5.3 and Table 3.5.6. This parameter might be expected to reduce in size if overexploitation were taking place but there is no evidence of this. The mean size of smaller animals (<35 mm) in the catch (and landings) is also quite stable through time.

Mean weight in the landings is shown in Figure 3.5.6 and Table 3.5.9, and this demonstrates some fluctuation but no systematic changes over the time-series.

Natural mortality, maturity-at-age and other biological parameters

Biological parameter values are included in the Stock Annex.

Research vessel data

Underwater TV surveys using a stratified random approach are available for this stock since 1994 (missing surveys in 1995 and 1997). Underwater television surveys of *Nephrops* burrow number and distribution, reduce the problems associated with traditional trawl surveys that arise from variability of burrow emergence of *Nephrops*.

The numbers of valid stations used in the final analysis in each year are demonstrated in Table 3.5.8. On average, 39 stations have been considered valid each year, then raised to the estimated area of the ground available for *Nephrops*-1775 km^2.

3.5.3 Data Analysis

Exploratory analyses of survey data

The UWTV survey work-up method employed on the Scottish surveys assumes that the width of the viewed transect is the entire lower edge of the TV screen on which the burrows are counted. This can be calculated from the TV camera parameters and the position of the camera in relation to the seabed. Although the camera has been changed a number of times since the start of the survey, the manufacturer has remained the same and efforts have been made to ensure that the camera parameters (lens properties) remained constant. However, in 2008, it came to light that a number of changes had been made to the housing of the glass front of the camera which meant that the field of view of the camera had actually changed (a number of times) with the actual field of view being less than that calculated from the assumed camera parameters.

A re-working of the UWTV survey abundances for Division VIa were presented to the *Nephrops* benchmark workshop (WKNEPH) in 2009 (ICES, 2009) and further details of the technical changes to the camera can be found in the report of that workshop. The revised abundance estimates for FU11 from 1999 onwards are presented here for the first time and are slightly higher than the previous values as a result of the field of view being smaller than previously calculated. (Because of inconsistent file formats, pre-1999 survey data could not be reworked ahead of this WG).

Table 3.5.7 demonstrates the basic analysis for the three most recent TV surveys conducted in FU11. The Table includes estimates of abundance and variability of each of the strata adopted in the stratified random approach.

Figure 3.5.7 shows the distribution of stations in recent TV surveys (2003–2008), with the size of the symbol reflecting the *Nephrops* burrow density. Abundance is generally higher in the soft and intermediate sediments located to the southwest and northeast of the ground in 2008, however in previous years there has also been large abundances found on the coarser sediment type in the northeast of the ground which are not apparent this year. Table 3.5.8 and Figure 3.5.8 show the time-series estimated abundance for the TV surveys, with 95% confidence intervals on annual estimates.

VMS plots have revealed fishing effort extends outside the present survey area for FU11, which would imply an underestimate of stock biomass in this area (WKNEPH, 2009). Further work needs to be done on this problem as the VMS data becomes more available.

The review of the use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WKNEPH (ICES, 2009). A number of potential biases were highlighted including those as a consequence of edge effects, species burrow misidentification and burrow occupancy. The cumulative bias correction factor estimated for FU11 was 1.33 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 33%.

3.5.4 Final assessment

The underwater TV survey is presented as the best available information on the North Minch *Nephrops* stock. This survey provides a fishery-independent estimate of *Nephrops* abundance. The details of the 2008 survey is displayed in Table 3.5.7 and compared with the 2006 and 2007 outcomes. At present it is not possible to extract any length or age structure information from the survey and it therefore only provides information on abundance over the area of the survey.

The 2008 TV survey data presented at this meeting demonstrates that the 2008 abundance declined slightly although confidence limits overlap for the past two years. Abundance estimates have decreased by 40% from the high levels estimated between 2003 and 2007. Despite the large change in survey abundance there is no detectable change in the mean length information from the fishery that might suggest weaker recent recruitment.

The TV survey results reported here do not cover the sea loch areas adjacent to the main South Minch grounds and should therefore be considered underestimates of the overall biomass. The sea lochs support a significant but unknown part of the creel fishery.

3.5.5 Historical stock trends

The TV survey estimates of abundance for *Nephrops* in the North Minch suggests that historically the population was increasing until 2007 after which there was a steep decline to current levels. The 2008 estimate (848 million individuals) is close to the average of the time-series. The bias adjusted abundance estimates from 1999–2008 (the period over which the survey estimates have been revised) are displayed in Table 3.5.10.

Table 3.5.10 also displays the estimated harvest ratios over this period. These range from 12–32%. (Note: the estimated harvest ratios prior to 2006 may not be representative of actual harvest ratios as a consequence of underreporting of landings).

3.5.6 Recruitment estimates

Recruitment estimates from surveys are not available for this FU.

3.5.7 Short-term forecasts

A prediction of landings for 2010 was made for the North Minch Functional Unit using the approach agreed at the Benchmark Workshop and outlined in the introductory section to this chapter (Section 3.5). The percentage of the dead removals that are discarded was calculated as 19.9 % (based on the 2005–2007 average) and this value is used in the provision of landings options for 2010. The Table below reveals landings predictions at various harvest ratios, including those equivalent to fishing at $F_{0.1}$, F_{max} and the harvest ratio in 2008. The harvest ratios equivalent to $F_{0.1}$and F_{max} are significantly lower than those previously presented as a consequence of a revision of the assumptions regarding the size range of *Nephrops* inhabiting the burrows observed in the TV survey.

The inputs to the landings forecast were as follows:

Mean weight in landings (06-08) = 21.6 gl;

Percentage of dead removals discarded (2005-2007) = 19.9 %

Survey bias = 1.33.

	Harvest rate	Survey Index (adjusted)	Implied fishery Retained number	Implied fishery Landings (tonnes)
	0.0%	638	0	0
	5.0%	638	26	552
	8.0%	638	41	883
F0.1	8.8%	638	45	972
	10.0%	638	51	1104
	15.0%	638	77	1656
Fmax	15.4%	638	79	1700
	20.0%	638	102	2208
F2008	26.0%	638	133	2871
TAC decrease of 15%	31.6%	638	161	3485
TAC increase of 15%	42.7%	638	218	4715

3.5.8 Reference points

Precautionary approach biological reference points have not been determined for *Nephrops* stocks. Long term harvest reference points ($F_{0.1}$, and F_{max}) were estimate as described in 3.5 and WKNEPH 2009.

3.5.9 Uncertainties and bias in assessment and forecast

There are several key uncertainties and bias sources in the method proposed (these are discussed further in WKNEPH 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007, WKNEPHBID 2008, SGNEPS 2009). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that was more accurate but no more precise (WKNEPH 2009). The survey estimates themselves are fairly precisely estimated. Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates.

Underwater TV surveys have been conducted for this stock since 1994, with a continual annual series available since 1998. The number of valid stations in the survey has remained relatively stable throughout the time period. Confidence intervals around the abundance estimates are quite small for this functional unit. The final estimate is bias corrected and used deterministically although the 95% confidence bounds are +-15%.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. For FU11 deterministic estimates of the mean weight in the landings and discard rates have been used. Historical data suggest parameters have been variable in the past (Tables 3.5.9 and 3.5.10). In future years the uncertainty in these key parameters should be estimated.

The length and sex composition of the landings data is considered to be well sampled. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in this fishery since 1990, and is considered to represent the fishery adequately.

There are concerns over the accuracy of historical landings and effort data prior to 2006 when Buyers and Sellers was introduced and the reliability began to improve.

The TV survey results reported here do not cover the sea loch areas adjacent to the main North Minch grounds and should therefore be considered underestimates of the overall biomass. The sea lochs support a significant but unknown part of the creel fishery.

VMS data has also revealed that fishing occurs out with the TV survey area and this needs to be investigated further over the next year.

TV observations indicate that the stock has been decreased suddenly between 2006 and 2007. There is currently no significant rise in the mean size of catches below 35 mm which would indicate a drop in recruitment has occurred.

3.5.10 Management considerations

ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level and management at the Functional Unit level could provide the controls to ensure that catch opportunities and effort were compatible and in line with the scale of the resource.

Creel fishing takes place in this area but overall effort by this fleet in creel numbers is not known and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the North Minch and STECF estimates that discards of whiting and haddock are high in VIa generally. It is important that efforts are made to ensure that unwanted bycatch is kept to a minimum in this fishery. Current efforts to reduce discards and unwanted bycatches of cod under the Scottish Conservation Credits scheme and Cod Long term plan include the implementation of larger meshed square meshed panels (110 mm) and real time closures to avoid cod.

The implementation of buyers and sellers legislation in the UK in 2006 is improving the reliability of fishery statistics but the transition period is accompanied in some cases by large changes in landings which produce significant changes in the lpue and cpue series that cannot be completely attributed to changes in stock. Until a sufficient time-series of reliable data has built up, use of fishery catch and effort data in the assessment process should be avoided.

Table 3.5.1. *Nephrops* Functional Units and descriptions by statistical rectangle.

Functional Unit	Stock	Division	ICES Rectangles
11	North Minch	VIa	44–46 E3–E4
12	South Minch	VIa	41–43 E2–E4
13	Clyde	VIa	39–40 E4–E5
14	Irish Sea East	VIIa	35–38E6; 38E5
15	Irish Sea West	VIIa	36E3; 35–37 E4–E5; 38E4

Table 3.5.2. Nominal catch (tonnes) of *Nephrops* in Divisions VIa and VIb, 1980–2008, as officially reported to ICES. There are no Functional Units in ICES Division VIb but occasional small landings are made.

VIa Official Landings

	France	Ireland	Spain	UK - (Eng+Wales+N.Irl.)	UK - Scotland	UK	TOTAL
1980	5	1	-	-	7,422	-	7,428
1981	5	26	-	-	9,519	-	9,550
1982	1	1	-	1	9,000	-	9,003
1983	1	1	-	11	10,706	-	10,719
1984	3	6	-	12	11,778	-	11,799
1985	1	1	28	9	12,449	-	12,488
1986	8	20	5	13	11,283	-	11,329
1987	6	128	11	15	11,203	-	11,363
1988	1	11	7	62	12,649	-	12,730
1989	-	9	2	25	10,949	-	10,985
1990	-	10	4	35	10,042	-	10,091
1991	-	1	-	37	10,458	-	10,496
1992	-	10	-	56	10,783	-	10,849
1993	-	7	-	191	11,178	-	11,376
1994	3	6	-	290	11,047	-	11,346
1995	4	9	3	346	12,527	-	12,889
1996	-	8	1	176	10,929	-	11,114
1997	-	5	15	133	11,104	-	11,257
1998	-	25	18	202	10,949	-	11,194
1999	.	136	40	256	11,078	-	11,510
2000	1	130	69	137	10,667	-	11,004
2001	9	115	30	139	10,568	-	10,861
2002	-	117	18	152	10,225	-	10,512
2003	-	145	12	81	10,450	-	10,688
2004	-	150	6	267	9,941	-	10,364
2005	-	153	17	153	7,616	-	7,939
2006	-	133	1	255	13,432	-	13,821
2007	-	155	-	2,088	14,120	-	16,363
2008*	-	56	-	-	-	15,152	15,208

*** figures are provisional.**

VIb Official Landings

	France	Germany	Ireland	Spain	UK - (Eng+Wales+N.Irl.)	UK - Scotland	TOTAL
1980	-	.	-	-	.	-	0
1981	-	.	-	-	.	-	0
1982	-	.	-	-	.	-	0
1983	-	.	-	-	.	-	0
1984	-	.	-	-	.	-	0
1985	-	.	-	-	.	-	0
1986	-	.	-	8	.	-	8
1987	-	.	-	18	11	-	29
1988	-	.	-	27	4	-	31
1989	-	.	-	14	-	-	14
1990	-	.	-	10	1	-	11
1991	-	-	-	30	-	-	30
1992	-	-	-	2	4	1	7
1993	-	-	-	2	6	9	17
1994	-	-	-	5	16	5	26
1995	1	-	-	2	26	1	30
1996	-	6	-	5	65	5	81
1997	-	-	1	3	88	23	115
1998	-	-	1	6	46	7	60
1999	.	-	-	5	2	5	12
2000	2	-	8	3	4	4	21
2001	1	-	1	14	2	7	25
2002	1	-	-	7	3	7	18
2003	-	-	1	5	6	18	30
2004	-	-	-	2	7	13	22
2005	3	-	1	1	5	7	17
2006	-	-	-	-	1	3	4
2007	-	-	-	2	.	.	2
2008*	-	-	-	-	-	-	0

*** figures are provisional.**

Table 3.5.3. ***Nephrops*****, Total** ***Nephrops*** **landings (tonnes) by Functional Unit plus Other rectangles, 1981–2008.**

YEAR	FU11	FU12	FU13	OTHER	TOTAL
1981	2861	3651	2968	39	9519
1982	2799	3552	2623	27	9001
1983	3196	3412	4077	34	10 719
1984	4144	4300	3310	36	11 790
1985	4061	4008	4285	104	12 458
1986	3382	3484	4341	89	11 296
1987	4083	3891	3007	257	11 238
1988	4035	4473	3665	529	12 702
1989	3205	4745	2812	212	10 974
1990	2544	4430	2912	182	10 068
1991	2792	4442	3038	255	10 527
1992	3560	4237	2805	248	10 849
1993	3192	4455	3342	344	11 332
1994	3616	4415	2629	441	11 101
1995	3656	4680	3989	460	12 785
1996	2871	3995	4060	239	11 165
1997	3046	4345	3618	243	11 252
1998	2441	3730	4843	157	11 171
1999	3257	4051	3752	438	11 498
2000	3246	3952	3419	421	11 038
2001	3259	3992	3182	420	10 853
2002	3440	3305	3383	397	10 525
2003	3268	3879	3171	433	10 751
2004	3135	3868	3025	403	10 431
2005	2984	3841	3423	254	10 502
2006	4160	4554	4778	241	13 733
2007	3968	5451	6656	259	16 334
2008*	3799	5347	5921	161	15 228

*** provisional.**

Table 3.5.4. ***Nephrops*****. Sampling levels all areas.**

IMS DATA ONLY	2007	2008
No. *Nephrops* Samples	126	119
No. *Nephrops* measured	11 9262	68 309
Discard data only	2007	2008
No. *Nephrops* Samples	22	24
No. Marketable *Nephrops* measured		45 251
No. Discards Measured	14 630	15 975

Table 3.5.5. ***Nephrops*****, North Minch (FU11), Nominal Landings of** ***Nephrops*****, 1981–2008.**

	UK Scotland			
Year	*Nephrops* trawl	Other trawl	Creel	Total
1981	2320	170	371	2861
1982	2323	105	371	2799
1983	2784	95	317	3196
1984	3449	161	534	4144
1985	3236	117	708	4061
1986	2642	203	537	3382
1987	3458	143	482	4083
1988	3449	149	437	4035
1989	2603	112	490	3205
1990	1941	134	469	2544
1991	2228	125	439	2792
1992	2978	150	432	3560
1993	2699	85	408	3192
1994	2916	246	454	3616
1995	2940	184	532	3656
1996	2355	147	369	2871
1997	2553	102	391	3046
1998	2023	67	351	2441
1999	2791	56	410	3257
2000	2695	28	523	3246
2001	2651	41	567	3259
2002	2775	79	586	3440
2003	2607	44	617	3268
2004	2400	25	710	3135
2005	2267	18	699	2984
2006	3446	17	697	4160
2007	3362	16	590	3968
2008	3230	12	557	3799

*** provisional na = not available**

**** There are no landings by other countries from this FU**

Table 3.5.6. *Nephrops*, North Minch (FU 11): Mean sizes (CL mm) above and below 35 mm of male and female *Nephrops* in Scottish catches and landings, 1981–2008.

	CATCHES		LANDINGS			
	< 35 mm CL		< 35 mm CL		> 35 mm CL	
YEAR	Males	Females	Males	Females	Males	Females
1981	30.2	29.3	30.6	30.2	39.2	37.6
1982	29.8	28.6	30.1	29.0	39.8	37.4
1983	29.0	27.6	29.1	27.5	40.0	37.8
1984	28.5	28.0	28.5	28.1	39.2	37.4
1985	27.9	27.5	27.9	27.5	40.0	37.5
1986	29.5	28.4	29.7	28.6	39.1	37.6
1987	29.6	29.0	29.9	29.6	39.8	37.9
1988	29.9	29.5	30.3	30.1	38.9	38.0
1989	29.0	29.0	29.2	29.2	40.1	38.9
1990	29.3	28.6	29.8	28.9	39.1	38.1
1991	30.3	29.1	30.6	29.5	39.4	39.1
1992	29.3	28.0	29.7	28.3	39.6	38.3
1993	29.4	27.9	29.5	28.0	38.7	38.3
1994	28.1	27.0	29.4	28.3	39.5	38.8
1995	27.7	27.7	28.6	29.0	40.0	38.2
1996	29.5	29.4	30.2	30.2	40.0	38.7
1997	29.1	28.4	29.9	28.8	39.4	38.0
1998	29.8	28.8	30.6	29.3	39.6	38.4
1999	28.9	28.2	30.1	29.1	39.4	37.5
2000	29.9	28.6	30.4	29.0	39.4	37.8
2001	29.4	28.1	30.3	28.8	39.8	38.2
2002	29.2	28.4	30.4	29.5	39.7	38.3
2003	29.0	28.3	30.3	29.6	39.2	37.8
2004	29.6	28.9	30.4	29.5	40.3	38.8
2005	28.4	27.8	30.1	30.0	39.4	37.8
2006	29.0	27.4	30.5	28.9	39.1	38.2
2007	30.0	28.3	30.0	28.2	40.3	38.7
2008	29.6	28.3	30.1	28.8	40.0	38.5

*** provisional na = not available**

Table 3.5.7. *Nephrops*, North Minch (FU11): Results by stratum of the 2006–2008 TV surveys. Note that stratification was based on a series of arbitrary rectangles. Zero stations were surveyed in area W in 2006 because of submarine activity, and an average of the whole area was applied to the mud in this area.

Stratum	Area (km²)	Number of Stations	Mean burrow density (no./m²)	Observed variance	Abundance (millions)	Stratum variance	Proportion of total variance
			2006 TV survey				
U	656	14	0.79	0.08	515	2600	0.184
V	425	10	0.78	0.43	332	7756	0.549
W	563	0	0.90	0.27	505	2877	0.203
X	131	6	1.30	0.32	171	907	0.064
Total	1775	30			1522	14141	1
			2007 TV survey				
U	656	14	0.58	0.13	380	3843	0.419
V	425	9	0.74	0.11	316	2302	0.251
W	563	9	0.27	0.01	150	2678	0.292
X	131	4	1.00	0.02	131	351	0.038
Total	1775	36			977	9174	1
			2008 TV survey				
U	656	13	0.36	0.05	233	1511	0.255
V	425	10	0.59	0.05	250	827	0.140
W	563	13	0.40	0.14	225	3511	0.592
X	131	5	1.07	0.02	140	78	0.013
Total	1775	41			848	5927	1

Table 3.5.8. ***Nephrops*****, North Minch (FU11): Revise results of the 1994–2008 TV surveys. Abundance estimates are not revised prior to 1999.**

Year	Number of valid stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1994	41	0.38	665	99
1995		No survey		
1996	38	0.25	439	62
1997		No survey		
1998	38	0.41	728	103
1999	36	0.32	565	104
2000	39	0.41	725	80
2001	56	0.39	691	75
2002	37	0.49	876	149
2003	41	0.64	1131	209
2004	38	0.62	1107	165
2005	41	0.64	1142	168
2006	30	0.86	1522	238
2007	36	0.55	977	192
2008	41	0.48	849	154

Table 3.5.9. ***Nephrops*****, North Minch (FU11–13): Mean weight in the landings.**

Year	FU 11	FU 12	FU 13
1990	21.31	19.90	24.21
1991	25.28	21.65	20.57
1992	21.58	24.01	25.08
1993	20.70	21.16	29.40
1994	23.38	24.88	25.22
1995	22.16	21.87	19.14
1996	26.62	23.02	21.60
1997	21.62	23.28	24.14
1998	23.57	22.09	18.04
1999	21.49	23.60	16.74
2000	22.77	24.81	19.54
2001	23.15	21.44	19.06
2002	23.03	23.60	15.82
2003	22.86	24.48	18.59
2004	21.45	24.02	18.30
2005	23.62	23.53	17.46
2006	21.97	23.15	18.66
2007	21.68	21.43	18.53
2008	21.15	21.41	16.05
Mean (06-08)	**22.60**	**22.81**	**20.32**

Table 3.5.10. *Nephrops*, North Minch (FU11): Adjusted TV survey abundance, landings, discard rate (proportion by number) and estimated harvest rate.

	Adjusted survey (millions)	Landings (tonnes)	Discard rate (%)	Harvest ratio*
1999	484	3257	0.18	0.32
2000	711	3246	0.08	0.17
2001	666	3259	0.13	0.19
2002	815	3440	0.19	0.18
2003	1068	3268	0.21	0.13
2004	1067	3135	0.14	0.12
2005	939	2984	0.35	0.14
2006	1075	4160	0.31	0.19
2007	736	3968	0.08	0.23
2008	638	3799	0.11	0.26

***harvest rates previous to 2006 are unreliable.**

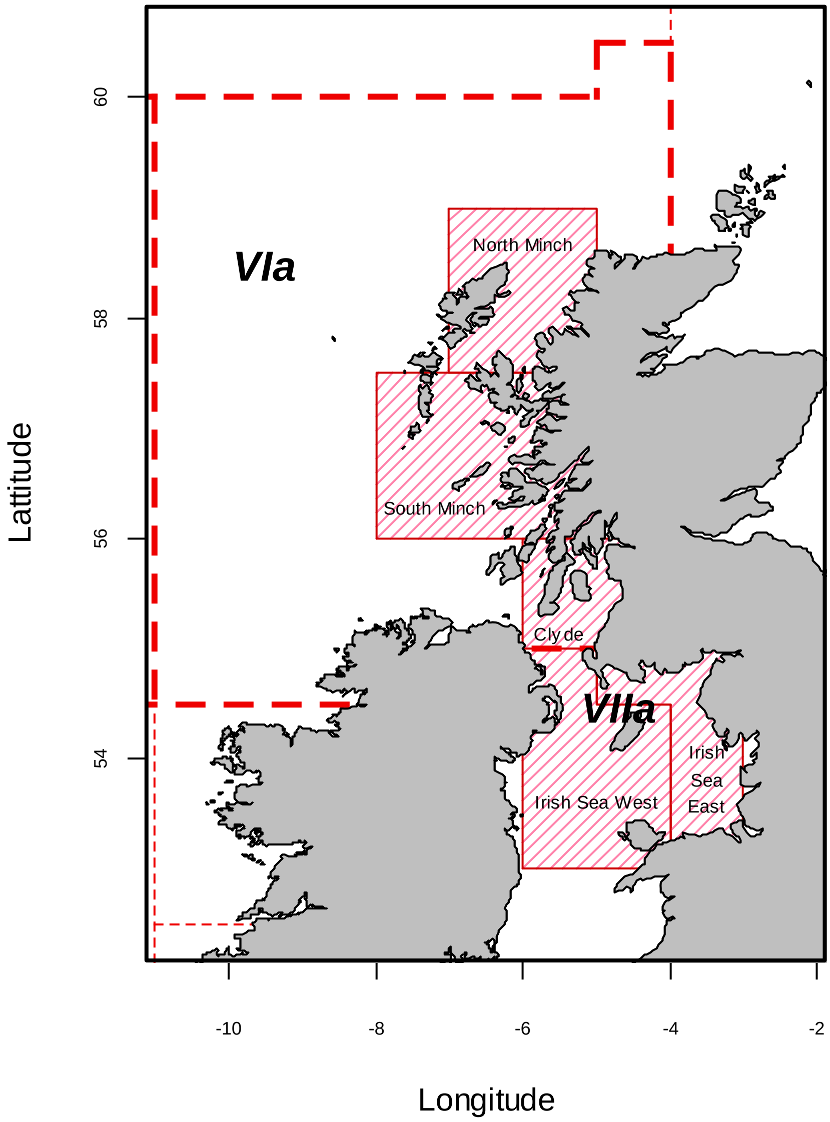


Figure 3.5.1. *Nephrops* Functional Units in VIa and VIIa.

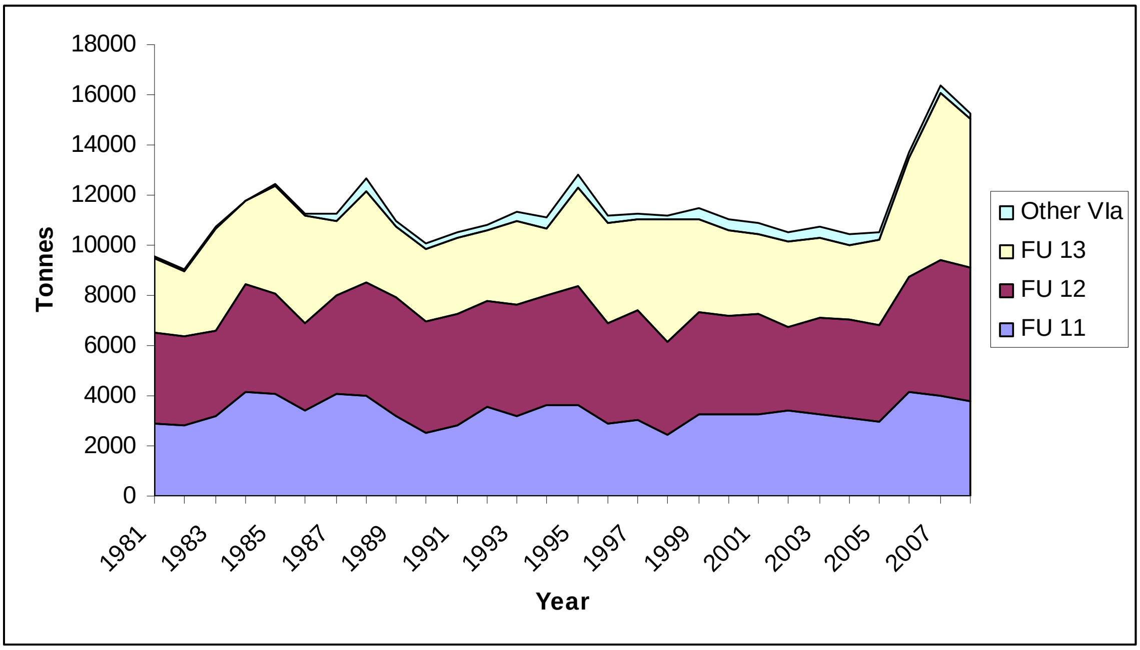


Figure 3.5.2. *Nephrops* in Division VIa. Landing (thousands tonnes) by FU and Other rectangles.

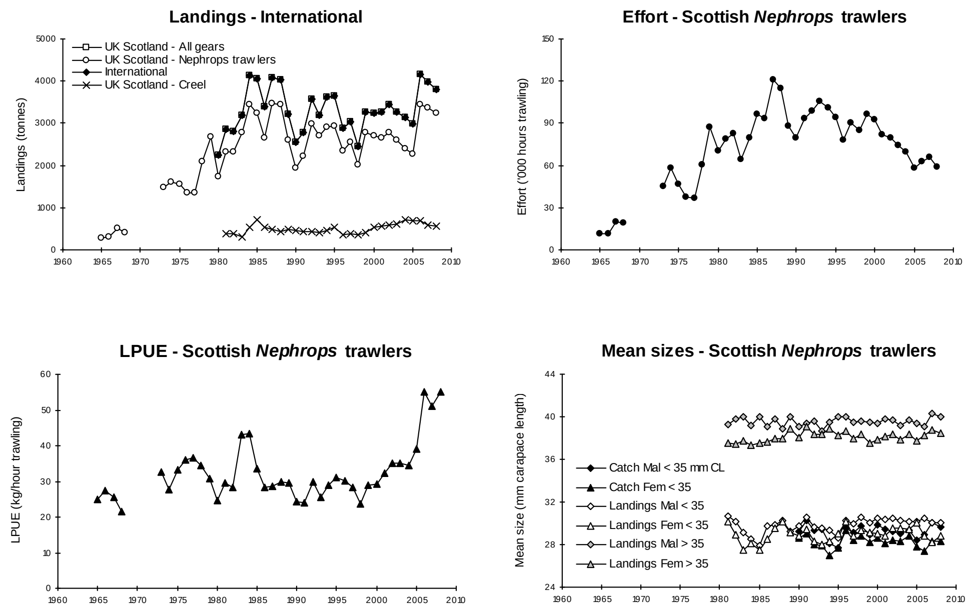


Figure 3.5.3. *Nephrops*, North Minch (FU11), Long term landings, effort, lpue and mean sizes.

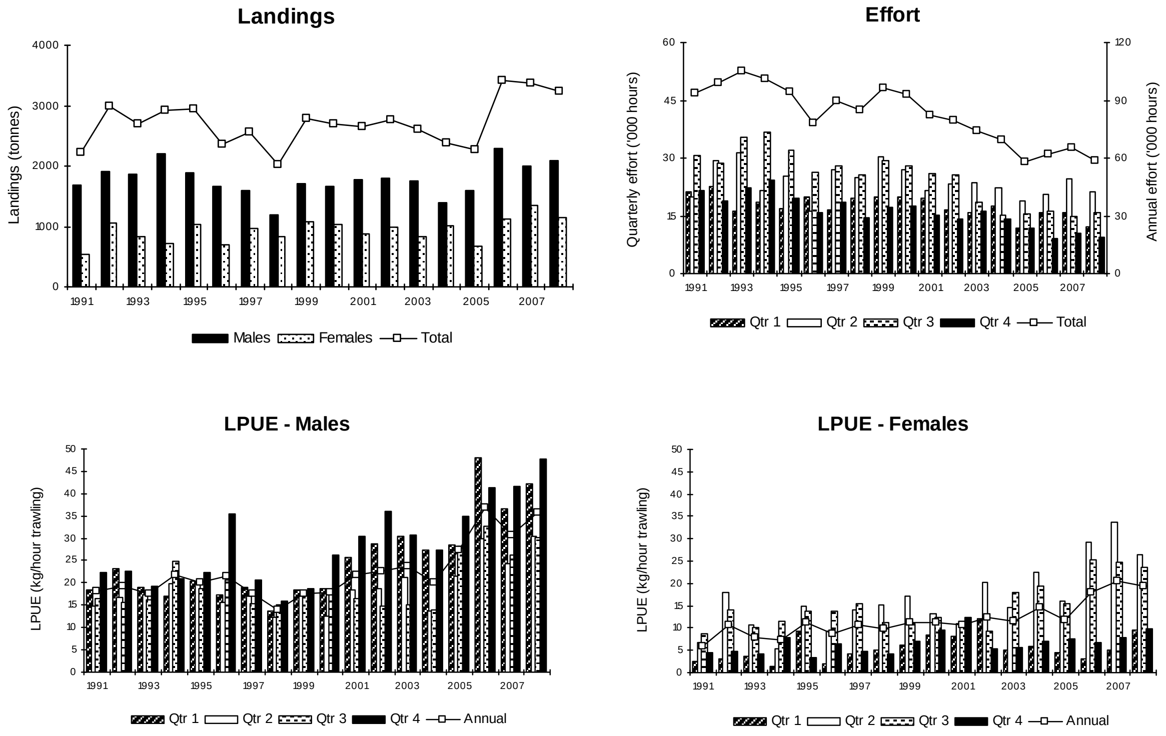


Figure 3.5.4. ***Nephrops*****, North Minch (FU11), Landings, effort and lpues by quarter and sex from Scottish *Nephrops* trawlers.**

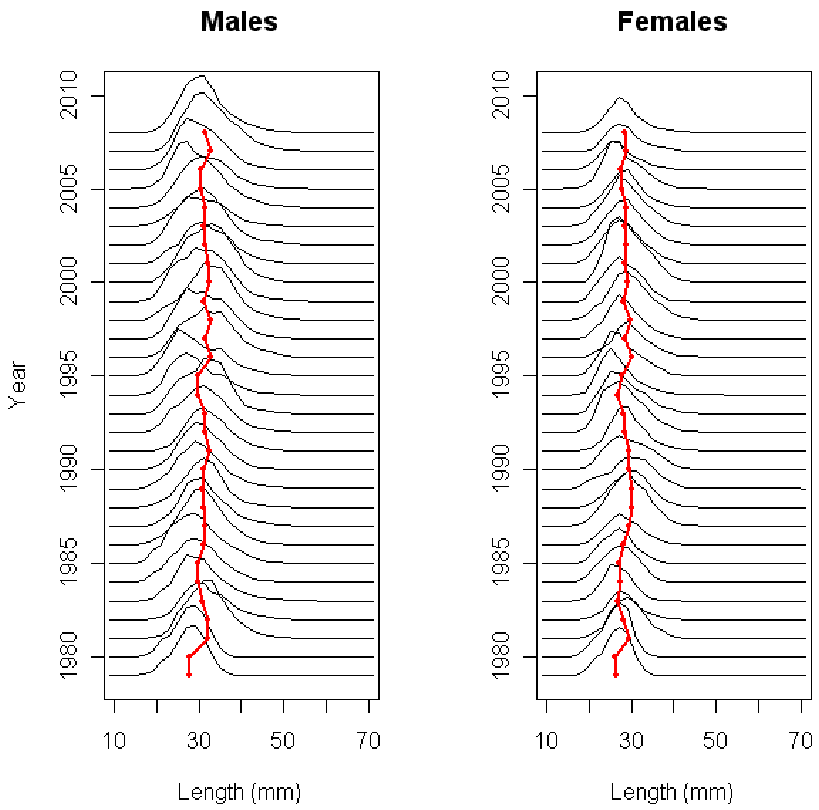


Figure 3.5.5. ***Nephrops*****, North Minch (FU11), Catch length frequency distribution and mean sizes (red line) for** ***Nephrops*** **in the North Minch, 1979–2008.**

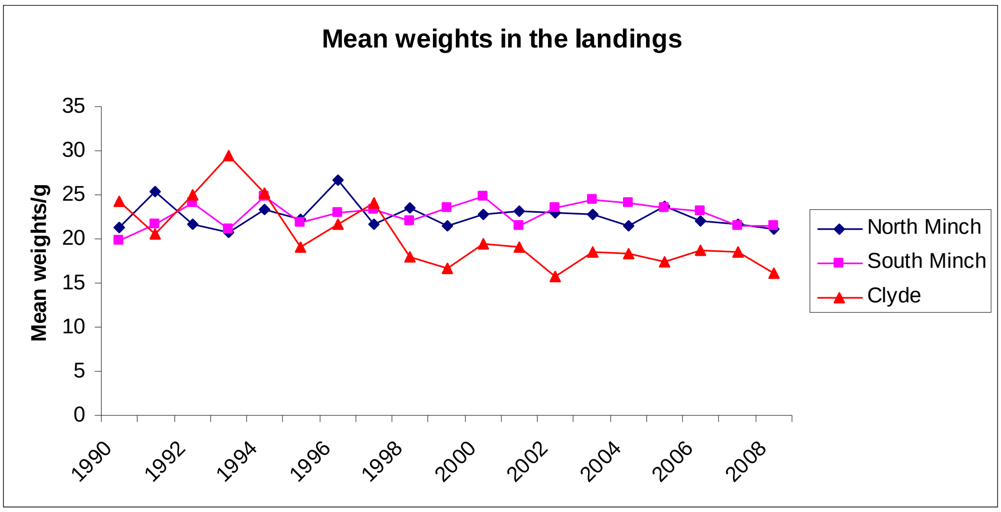


Figure 3.5.6. ***Nephrops*****, (FU11–13), individual mean weight in the landings from 1990–2008 (from Scottish market sampling data).**

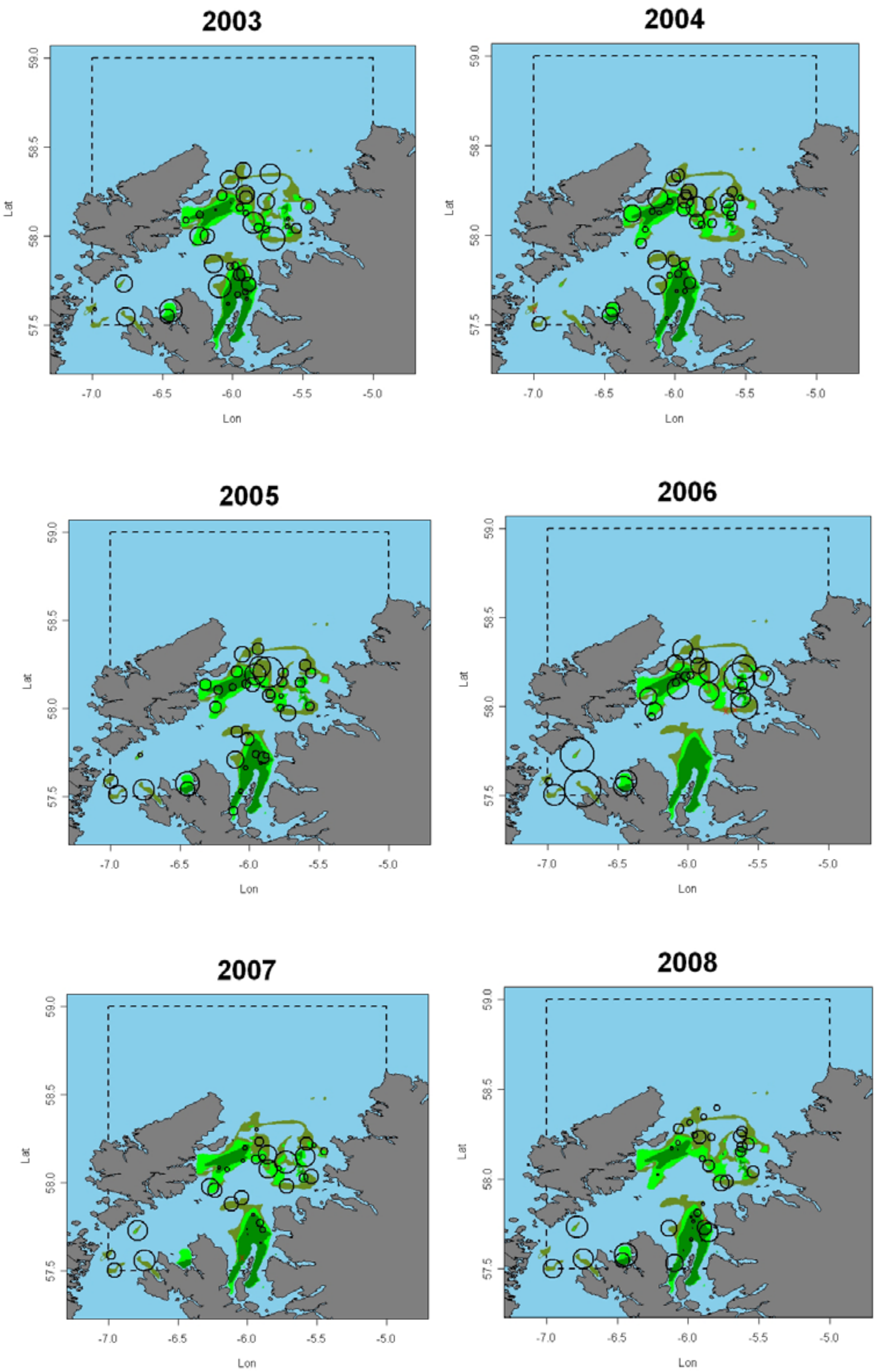


Figure 3.5.7. ***Nephrops*, North Minch (FU11), TV survey station distribution and relative density, 2003–2008. Shaded green and brown areas represent areas of suitable sediment for *Nephrops*. Bubbles in these figures are all scaled the same. Red crosses represent zero observations.**

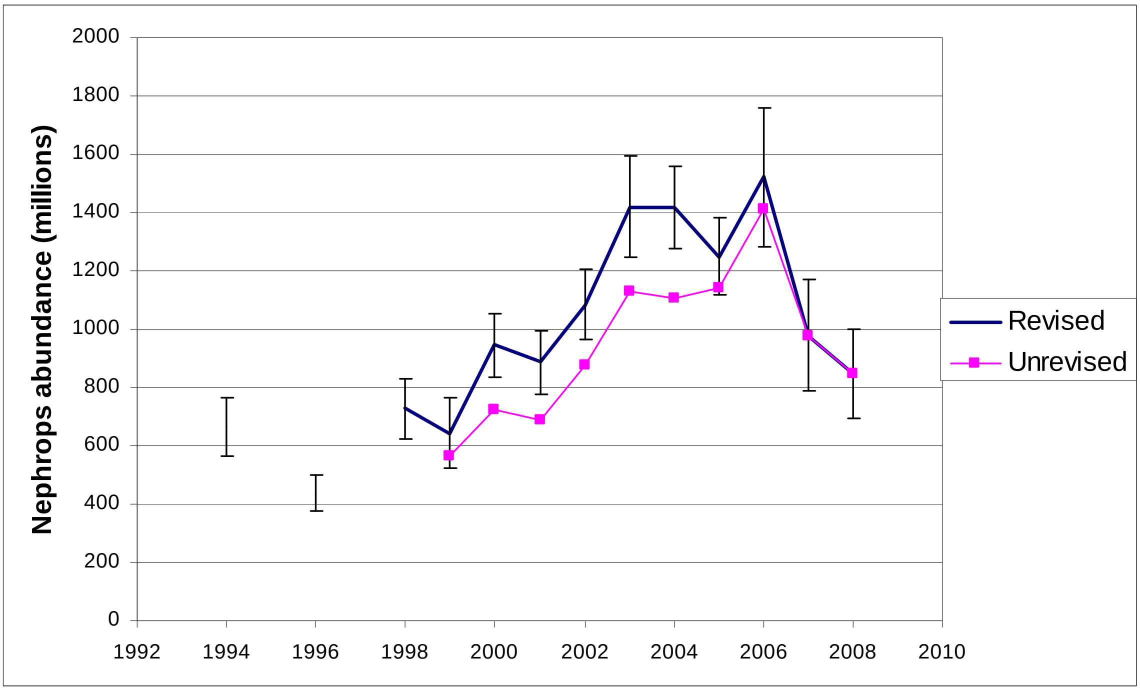


Figure 3.5.8. ***Nephrops*, North Minch (FU11), Time-series of revised TV survey abundance estimates (not adjusted for bias), with 95% confidence intervals, 1994–2008 (no survey 1995 and 1997) and non-revised time-series of abundance.**

3.6 South Minch

Type of assessment in 2009

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG and described in Section 3.5.

ICES advice applicable to 2007 and 2008

"The effort in this fishery should not be allowed to increase relative to the past three years. In addition to the ceiling on effort ICES advises that the exploitation ratio in this stock should be no more than 15%, until such time that more reliable catch information becomes available. This corresponds to landings of less than 7200 t for the South Minch"

ICES advice applicable to 2009

"The current fishery appears sustainable. Therefore, ICES recommends that *Nephrops* fisheries should not be allowed to increase relative to the past two years (2006–2007). This corresponds to landings of no more than 5000 tonnes for the South Minch stock."

3.6.1 General

Management applicable to this stock is included in management for Division VIa as a whole, and is described in Section 3.5.

The fishery in 2007 and 2008

Two distinct fleets continued to operate in the South Minch during 2008, landing into the two main ports of Oban and Mallaig. Inshore, a large fleet of smaller vessels including creel boats operated throughout the year, while some larger twin riggers fished slightly further afield. 90% of boats are thought to fish for *Nephrops* at some time. Most of the trawlers in the inshore fleet are less than 15 m in length. Trips were typically of 1–3 days usually operating within about 2 hours steaming distance. Some boats which have switched to twin rigging are now single rig fishing again as a consequence of high fuel prices. The large number of local boats is supplemented in number by nomadic boats and boats from the east coast arriving throughout the year. Between July and November local inshore boats moved round to the Moray Firth for the seasonal squid fishery; this was reported to be smaller in 2008 compared with 2007. During winter fishing activity is severely reduced in the South Minch as a result of the weather and small boats are often restricted to fishing in the sheltered sea-lochs.

3.6.2 Data available

Commercial catch and effort data

Official catch statistics (landings) reported to ICES are demonstrated in Table 3.5.2. These relate to the whole of VIa of which the South Minch is a part (Figure 3.5.1). Landings for FU12 provided through national laboratories are presented in Table 3.6.2, broken down by country and by gear type. Landings from this fishery are predominantly reported from Scotland, with low levels reported from the rest of the UK in the mid 1990s, and low levels more recently reported for Ireland. Total international reported landings in 2008 was 5346 tonnes, consisting of 4437 tonnes landed by trawlers and 895 tonnes landed by creel vessels. These estimates for total landings demonstrate a substantial increase from the lower levels previous to 2006. This is probably as a consequence of the increased catching opportunities in the last two years and to the introduction of the "buyers and sellers" regulations in the UK in 2006 which have increased the reliability of landings information. Landings from creel vessels have remained relatively stable over the last four years, at the highest level in the time-series.

Reported effort by all Scottish *Nephrops* trawlers reveals an increasing trend reaching a peak in the early 1990s since then there has been a declining trend with some fluctuations (Figures 3.6.1 and 3.6.2).

There are concerns over the accuracy of the effort data (hours fished) for this stock as that logbook field is not mandatory. Further details can be found in the report of the 2000 WGNSSK (ICES, 2001). The introduction of the "buyers and sellers" regulations in the UK in 2006 however, have led to increased reliability in the reported landings. The elevated lpue observed since 2006 is linked to this improved reporting rather than a sudden change in stock abundance.

Males consistently make the largest contribution to the landings. This is likely to be because of the varying seasonal pattern in the fishery and associated relative catchability (as a result of different burrow emergence behaviour) of male and female *Nephrops.*

Discards

Discarding of undersized and unwanted *Nephrops* occurs in this fishery, and quarterly discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 1990. Discarding rates average around 21% by number in this FU. There was a large decline in the discard rate in 2007 and in 2008, discard rates were estimated to be lower than average at just over 12% by number.

It is likely that some *Nephrops* survive the discarding process, an estimate of 25% survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population.

Length compositions

Length compositions of landings and discards are obtained during monthly market sampling and quarterly on-board observer sampling respectively. Quarterly landings and discards-at-length data were available from Scotland and these sampling levels are demonstrated in Table 3.5.4. Although assessments based on detailed catch analysis are not currently possible, examination of length compositions can provide a preliminary indication of exploitation effects.

Figure 3.6.3 shows a series of annual length frequency distributions for the period 1979 to 2008. Catch (removals) length compositions are demonstrated for each sex along with the mean size for both. In both sexes the mean sizes have been fairly stable over time. Examination of the tails of the distributions above 35 mm (the length beyond which the effects of recruitment pulses and discarding are considered to be negligible) reveals no evidence of reductions in relative numbers of larger animals.

The observation of relatively stable length compositions is further confirmed in the series of mean sizes of larger *Nephrops* (>35 mm) in the landings shown in Figure 3.6.1 and Table 3.6.2. This parameter might be expected to reduce in size if overexploitation were taking place but there is no evidence of this. The mean size of smaller animals (<35 mm) in the catch (and landings) is also quite stable through time although there has been a decrease in recent years, particularly in females which may be associated with increased recruitment (that has led to increased densities observed on the UWTV survey in this area (see below)).

Mean weight in the landings is shown in Figure 3.5.6 and Table 3.5.9 and this demonstrates some fluctuation but no systematic changes over the time-series.

Natural mortality, maturity-at-age and other biological parameters

Biological parameter values are included in the Stock Annex.

Research vessel data

Underwater TV surveys using a stratified random approach are available for this stock since 1995. Underwater television surveys of *Nephrops* burrow number and distribution reduce the problems associated with traditional trawl surveys that arise from variability of burrow emergence of *Nephrops*.

The numbers of valid stations used in the final analysis in each year are demonstrated in Table 3.6.4. On average, 35 stations have been considered valid each year, then raised to a stock area of 5072 km^2. In 2008 station numbers were lower than in previous years, as a result of trouble at sea with rocks and creels around planned stations, bad weather and leisure craft activity. This also meant that only one station was surveyed in the mud sediment type. This sediment type area accounts for less than 10% of the total.

3.6.3 Data analysis

Exploratory analyses of survey data

The UWTV survey work-up method employed on the Scottish surveys assumes that the width of the viewed transect is the entire lower edge of the TV screen on which the burrows are counted. This can be calculated from the TV camera parameters and the position of the camera in relation to the seabed. Although the camera has been changed a number of times since the start of the survey, the manufacturer has remained the same and efforts have been made to ensure that the camera parameters (lens properties) remained constant. However, in 2008, it came to light that a number of changes had been made to the housing of the glass front of the camera which meant that the field of view of the camera had actually changed (a number of times) with the actual field of view being less than that calculated from the assumed camera parameters.

A re-working of the UWTV survey abundances for Division VIa were presented to the *Nephrops* benchmark workshop (WKNEPH) in 2009 (ICES, 2009) and further details of the technical changes to the camera can be found in the report of that workshop. The revised abundance estimates for FU12 from 1999 onwards are presented here for the first time and are slightly higher than the previous values as a result of the field of view being smaller than previously calculated. (As a result of inconsistent file formats, pre-1999 survey data could not be reworked ahead of this WG).

Table 3.6.3 demonstrates the basic analysis for the three most recent TV surveys conducted in FU12. The Table includes estimates of abundance and variability of each of the strata adopted in the stratified random approach. Because of the fact only one station was surveyed in the mud sediment type, it was not possible to calculate a sample variance for this area in the usual way, which allows the calculation of confidence intervals. Instead an average of the three most recent years was taken.

Figure 3.6.4 shows the distribution of stations in recent TV surveys (2003–2008), with the size of the symbol reflecting the *Nephrops* burrow density. Abundance appears to be well distributed throughout the different sediment types in the South Minch. Table 3.6.4 and Figure 3.6.5 show the time-series estimated abundance for the TV surveys, with 95% confidence intervals on annual estimates.

The review of the use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WKNEPH (ICES, 2009). A number of potential biases were highlighted including those as a result of edge effects, species burrow misidentification and burrow occupancy. The cumulative bias correction factor estimated for FU12 was 1.32 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 32%.

3.6.4 Final assessment

The underwater TV survey is presented as the best available information on the South Minch *Nephrops* stock. This survey provides a fishery-independent estimate of *Nephrops* abundance. The details of the 2008 survey is demonstrated in Table 3.6.4 and compared with the 2006 and 2007 outcomes. At present it is not possible to extract any length or age structure information from the survey and it therefore only provides information on abundance over the area of the survey.

The 2008 TV survey data presented at this meeting demonstrates that the abundance has increased in 2008, however not back to the levels seen in 2006. Confidence limits are quite large for this FU.

Mean size in the catch of individuals < 35 mm has decreased for females and to a lesser extent, males, in recent years which may be interpreted as an increase in recruitment which would be in agreement with the increased number of burrows estimated from recent TV surveys.

The TV survey results reported here do not cover the sea loch areas adjacent to the main South Minch grounds and should therefore be considered underestimates of the overall biomass. The sea lochs support an unknown but significant part of the creel fishery.

3.6.5 Historical stock trends

The TV survey estimates of abundance for *Nephrops* in the South Minch demonstrate that the population increased substantially between the late 1990s and 2003 but has declined again since then. The 2008 estimate (2123 million individuals) is close to the average of the time-series. The bias adjusted abundance estimates from 1999–2008 (the period over which the survey estimates have been revised) is demonstrated in Table 3.6.5.

Table 3.6.5 also demonstrates the estimated harvest ratios over this period. These range from 6–22% over this period. (Note: the estimated harvest ratios prior to 2006 are may not be representative of actual harvest ratios as a result of underreporting of landings).

3.6.6 Recruitment estimates

Recruitment estimates from surveys are not available for this FU.

3.6.7 Short-term forecasts

A prediction of landings for 2010 was made for the South Minch Functional Unit using the approach agreed at the Benchmark Workshop and outlined in the introductory section to this chapter (Section 3.5). The percentage of the dead removals that are discarded was calculated as 16.7% (based on the 2005–2007 average) and this value is used in the provision of landings options for 2010. The Table below demonstrates landings predictions at various harvest ratios, including those equivalent to fishing at $F_{0.1}$, F_{max} and the harvest ratio in 2008. The harvest ratios equivalent to $F_{0.1}$and F_{max} are significantly lower than those previously presented because of a revision of the assumptions regarding the size range of *Nephrops* inhabiting the burrows observed in the TV survey.

The inputs to the landings forecast were as follows:

Mean weight in landings (06-08) = 22.0 g

Percentage of dead removals discarded (2005–2007) = 16.7 %

Survey bias = 1.32.

	Harvest rate	Survey Index (adjusted)	Implied fishery: Retained number	Implied fishery: Landings (tonnes)
	0.0%	1608	0	0
	5.0%	1608	67	1474
	8.0%	1608	107	2358
F0.1	9.6%	1608	129	2829
	10.0%	1608	134	2947
F2008	14.0%	1608	188	4126
TAC decrease of 15%	14.4%	1608	193	4250
	15.0%	1608	201	4421
Fmax	16.0%	1608	214	4715
TAC increase of 15%	19.5%	1608	261	5750
	20.0%	1608	268	5894

3.6.8 Biological reference points

Precautionary approach biological reference points have not been determined for *Nephrops* stocks. Long-term harvest reference points ($F_{0.1}$, and F_{max}) were estimated as described in 3.5 and WKNEPH 2009.

3.6.9 Uncertainties and bias in assessment and forecast

There are several key uncertainties and bias sources in the method proposed (these are discussed further in WKNEPH 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that was more accurate but no more precise (WKNEPH 2009). Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates.

The number of valid stations in the survey has remained relatively stable throughout the time period. Confidence intervals around the abundance estimates are on average greater during the most recent years, when abundance estimates have been slightly higher. The overlap of confidence intervals makes it difficult to determine which population changes are significant. The final estimate is bias corrected and used deterministically although the 95% confidence bounds are +-26%.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. For FU12 deterministic estimates of the mean weight in the landings and discard rates have been used. Historical data suggest parameters have been variable in the past (Tables 3.5.9 and 3.6.5). In future years the uncertainty in these key parameters should be estimated.

The length and sex composition of the landings data is considered to be well sampled. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in this fishery since 1990, and is considered to represent the fishery adequately.

There are concerns over the accuracy of historical landings and effort data prior to 2006 when Buyers and Sellers was introduced and the reliability began to improve.

The TV survey results reported here do not cover the sea loch areas adjacent to the main South Minch grounds and should therefore be considered underestimates of the overall biomass. The sea lochs support a significant but unknown part of the creel fishery.

3.6.10 Management considerations

ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level. Management at the Functional Unit level could confer controls to ensure effort and catch were in line the scale of the resource.

Creel fishing takes place in this area but overall effort for creel numbers is not known and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the South Minch and STECF estimates that discards of whiting and haddock are high in VIa generally. It is important that efforts are made to ensure that unwanted bycatch is kept to a minimum in this fishery. Current efforts to reduce discards and unwanted bycatches of cod under the Scottish Conservation Credits scheme and cod long-term plan include the implementation of larger meshed square meshed panels (110 mm) and real time closures to avoid cod.

The implementation of buyers and sellers legislation in the UK in 2006 is improving the reliability of fishery statistics but the transition period is accompanied in some cases by large changes in landings which produce significant changes in the lpue and cpue series that cannot be completely attributed to changes in stock. Until a sufficient time-series of reliable data has built up, use of fishery catch and effort data in the assessment process should be avoided.

Table 3.6.1. ***Nephrops*****, South Minch (FU12), Nominal Landings of** ***Nephrops*****, 1981–2008, as officially reported.**

	UK Scotland						
Year	*Nephrops* trawl	Other trawl	Creel	Sub-total	Other UK	Ireland	Total
1981	2965	254	432	3651	0	0	3651
1982	2925	207	420	3552	0	0	3552
1983	2595	361	456	3412	0	0	3412
1984	3228	478	594	4300	0	0	4300
1985	3096	424	488	4008	0	0	4008
1986	2694	288	502	3484	0	0	3484
1987	2927	418	546	3891	0	0	3891
1988	3544	364	555	4463	10	0	4473
1989	3846	338	561	4745	0	0	4745
1990	3732	262	436	4430	0	0	4430
1991	3597	341	503	4441	1	0	4442
1992	3479	208	549	4236	1	0	4237
1993	3608	193	649	4450	5	0	4455
1994	3743	265	404	4412	3	0	4415
1995	3442	716	508	4666	14	0	4680
1996	3107	419	468	3994	1	0	3995
1997	3519	331	492	4342	3	1	4345
1998	2851	340	538	3729	0	0	3730
1999	3165	359	513	4037	0	14	4051
2000	2939	312	699	3950	0	2	3952
2001	2823	393	767	3983	0	9	3992
2002	2234	315	742	3291	0	14	3305
2003	2812	203	858	3873	0	6	3879
2004	2865	104	880	3849	0	19	3868
2005	2810	46	953	3809	1	31	3841
2006	3569	19	922	4510	9	35	4554
2007	4436	8	958	5402	19	30	5451
2008	4432	5	895	5332	2	13	5347

provisional na = not available.

Table 3.6.2. *Nephrops*, South Minch (FU12): Mean sizes (CL mm) above and below 35 mm of male and female *Nephrops* in Scottish catches and landings, 1981–2008.

	Catches		Landings			
	< 35 mm CL		< 35 mm CL		> 35 mm CL	
Year	Males	Females	Males	Females	Males	Females
1981	28.2	26.4	29.6	27.5	41.5	38.0
1982	27.8	27.1	28.7	28.8	41.7	41.3
1983	28.6	26.5	29.3	27.6	39.5	37.6
1984	27.9	26.3	28.4	27.0	39.8	38.0
1985	27.9	27.5	28.6	28.5	40.0	37.6
1986	28.4	27.9	29.3	28.9	39.5	37.3
1987	28.3	26.6	29.2	28.1	39.8	37.6
1988	29.3	27.7	30.4	29.7	39.5	38.6
1989	28.6	28.1	29.8	29.4	39.5	38.4
1990	28.0	27.5	29.3	29.0	39.4	38.5
1991	29.4	27.5	29.9	27.9	39.0	38.5
1992	29.6	28.6	31.0	29.8	39.5	38.0
1993	29.0	27.8	30.0	28.5	39.5	38.0
1994	29.8	28.0	30.8	29.2	39.3	38.1
1995	29.5	28.2	30.0	28.4	39.4	38.0
1996	28.9	28.5	30.4	29.8	39.9	38.1
1997	29.3	28.7	30.6	29.6	39.8	37.8
1998	28.6	27.6	30.4	28.7	39.1	38.0
1999	28.6	27.7	30.0	29.5	39.4	38.3
2000	28.9	28.3	30.9	30.0	39.7	38.5
2001	27.7	27.3	29.7	28.8	39.6	38.1
2002	29.1	27.8	30.4	29.0	39.5	38.8
2003	29.0	28.1	30.4	29.5	39.8	38.4
2004	28.8	28.1	30.1	29.8	39.5	38.8
2005	28.1	27.8	30.4	29.5	39.8	38.6
2006	29.2	28.0	30.5	28.8	39.5	38.1
2007	29.7	28.2	29.9	28.2	40.0	38.3
2008	28.6	27.5	29.4	28.5	39.6	38.1

*** provisional   na = not available.**

Table 3.6.3. ***Nephrops*** **South Minch (FU12). Results by stratum of the 2006–2008 TV surveys. Note that stratification was based on a series of sediment strata.**

Stratum	Area (km²)	Number of Stations	Mean burrow density (no./m²)	Observed variance	Abundance (millions)	Stratum variance	Proportion of total variance
			2006 TV survey				
M	303	2	0.50	0.10	152	4446	0.033
SM	2741	18	0.57	0.28	1561	114 860	0.842
MS	2028	16	0.35	0.07	716	17 047	0.125
Total	5072	36			2428	136 353	1
			2007 TV Survey				
M	303	3	0.21	0.01	65	372	0.008
SM	2741	15	0.30	0.07	822	33 184	0.727
MS	2028	21	0.24	0.06	490	12 092	0.265
Total	5072	39			1377	45 647	1
			2008 TV Survey				
M	303	1	0.58	0.05	176	4593	0.037
SM	2741	18	0.45	0.19	1227	78 145	0.636
MS	2028	14	0.36	0.14	720	40 157	0.327
Total	5072	33			2123	122 895	1

Table 3.6.4. ***Nephrops*****, South Minch (FU12): Revised results of the 1995–2008 TV surveys. Abundance estimates are not revised prior to 1999.**

Year	Stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1995	33	0.30	1520	331
1996	21	0.38	1945	700
1997	36	0.28	1434	244
1998	38	0.38	1916	306
1999	37	0.23	1146	275
2000	41	0.37	1851	332
2001	47	0.44	2228	512
2002	31	0.42	2114	671
2003	25	0.42	2121	721
2004	38	0.50	2543	457
2005	33	0.50	2529	763
2006	36	0.48	2428	739
2007	39	0.27	1377	427
2008	33	0.42	2123	701

Table 3.6.5. ***Nephrops*****, South Minch (FU12): Adjusted TV survey abundance, landings, discard rate proportion by number) and estimated harvest rate.**

	Adjusted survey (millions)	Landings (tonnes)	Discard rate (%)	Harvest ratio*
1999	1085	4051	0.16	0.15
2000	1854	3952	0.20	0.08
2001	2037	3992	0.30	0.09
2002	1899	3305	0.19	0.07
2003	2157	3879	0.23	0.07
2004	2558	3868	0.26	0.06
2005	2208	3841	0.29	0.07
2006	1846	4554	0.28	0.11
2007	1016	5451	0.08	0.22
2008	1608	5347	0.12	0.14

***harvest rates previous to 2006 are unreliable.**

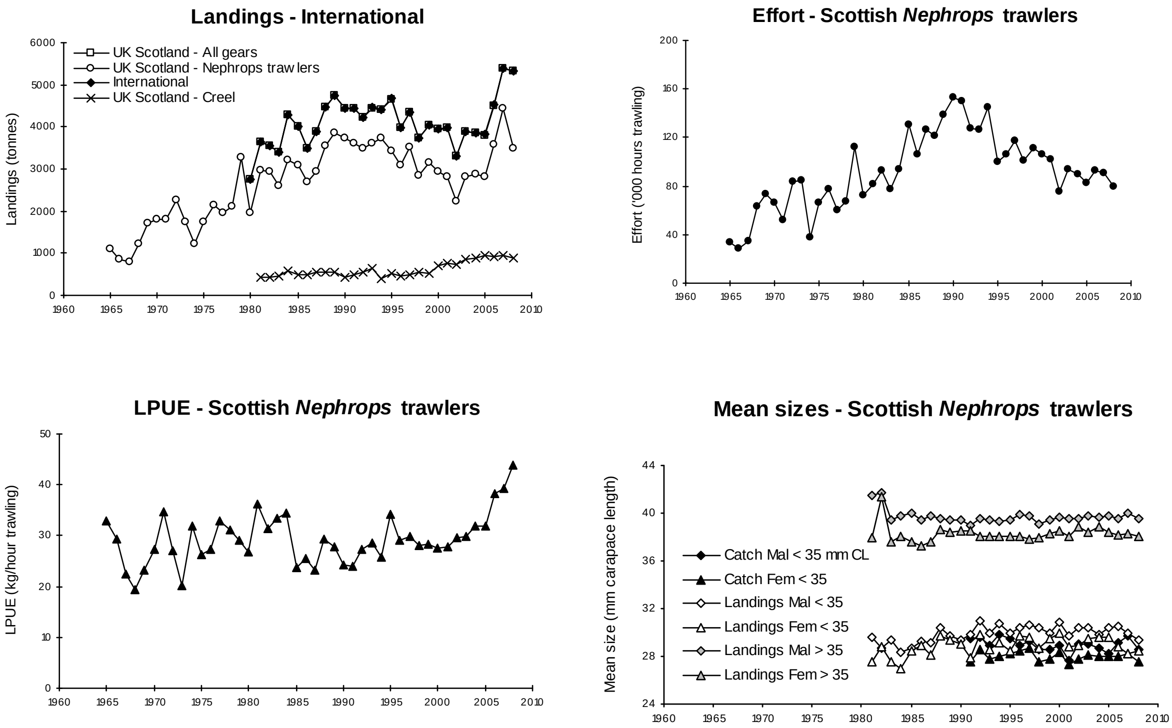


Figure 3.6.1. ***Nephrops,*** **South Minch (FU12), Long-term landings, effort, lpue and mean sizes.**

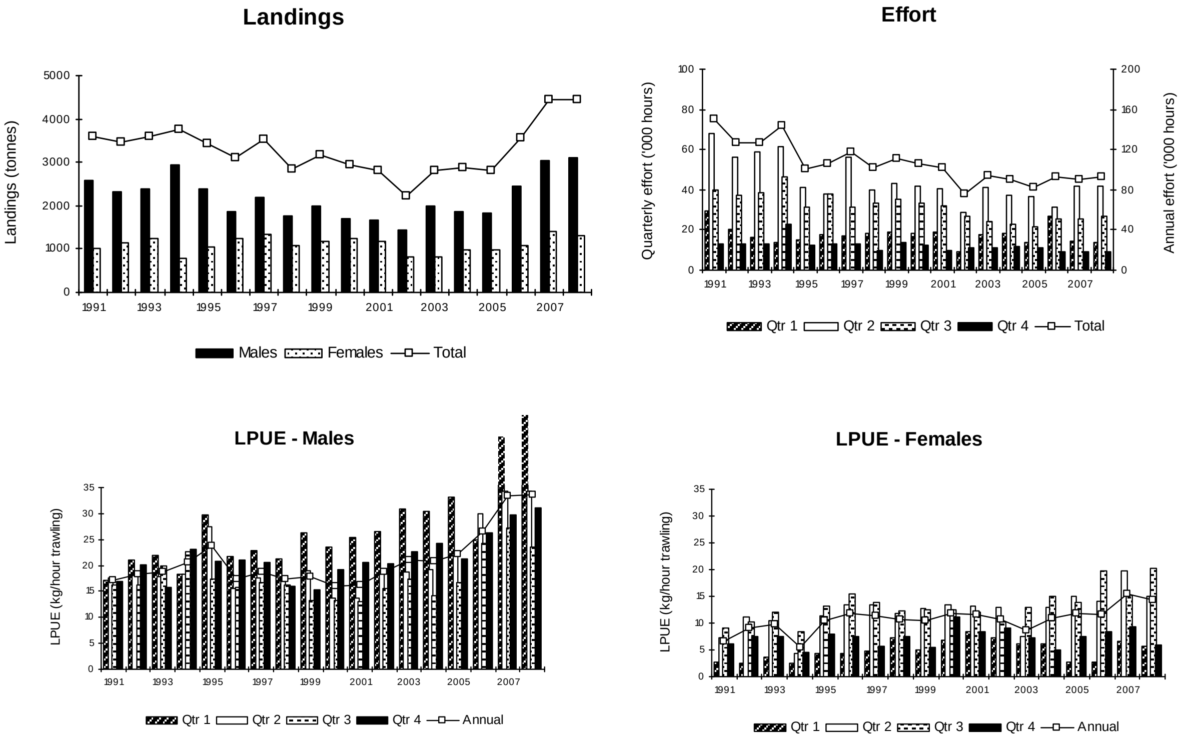


Figure 3.6.2. ***Nephrops*****, South Minch (FU12), Landings, effort and lpues by quarter and sex from Scottish** ***Nephrops*** **trawlers.**

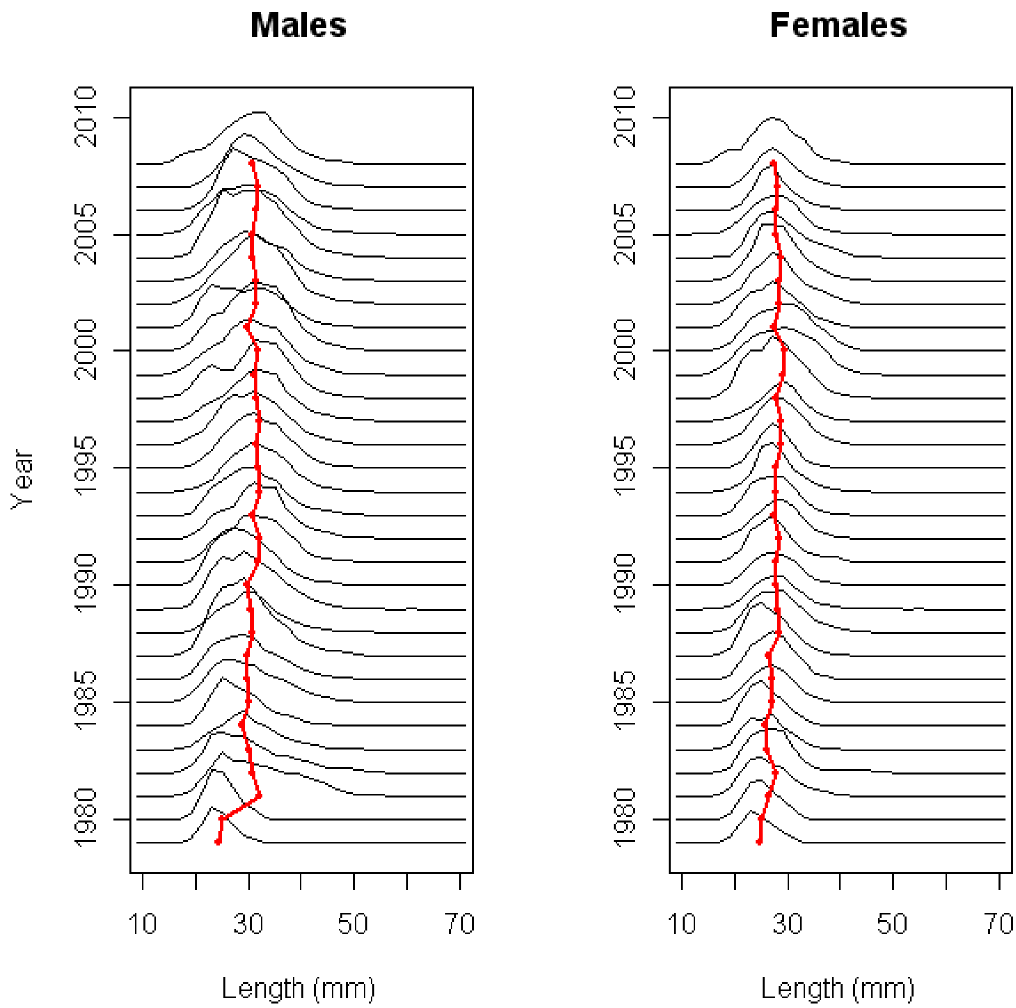


Figure 3.6.3. ***Nephrops.*** **South Minch (FU12). Catch length frequency distribution and mean sizes (red line) for *Nephrops* in the South Minch, 1979–2008.**

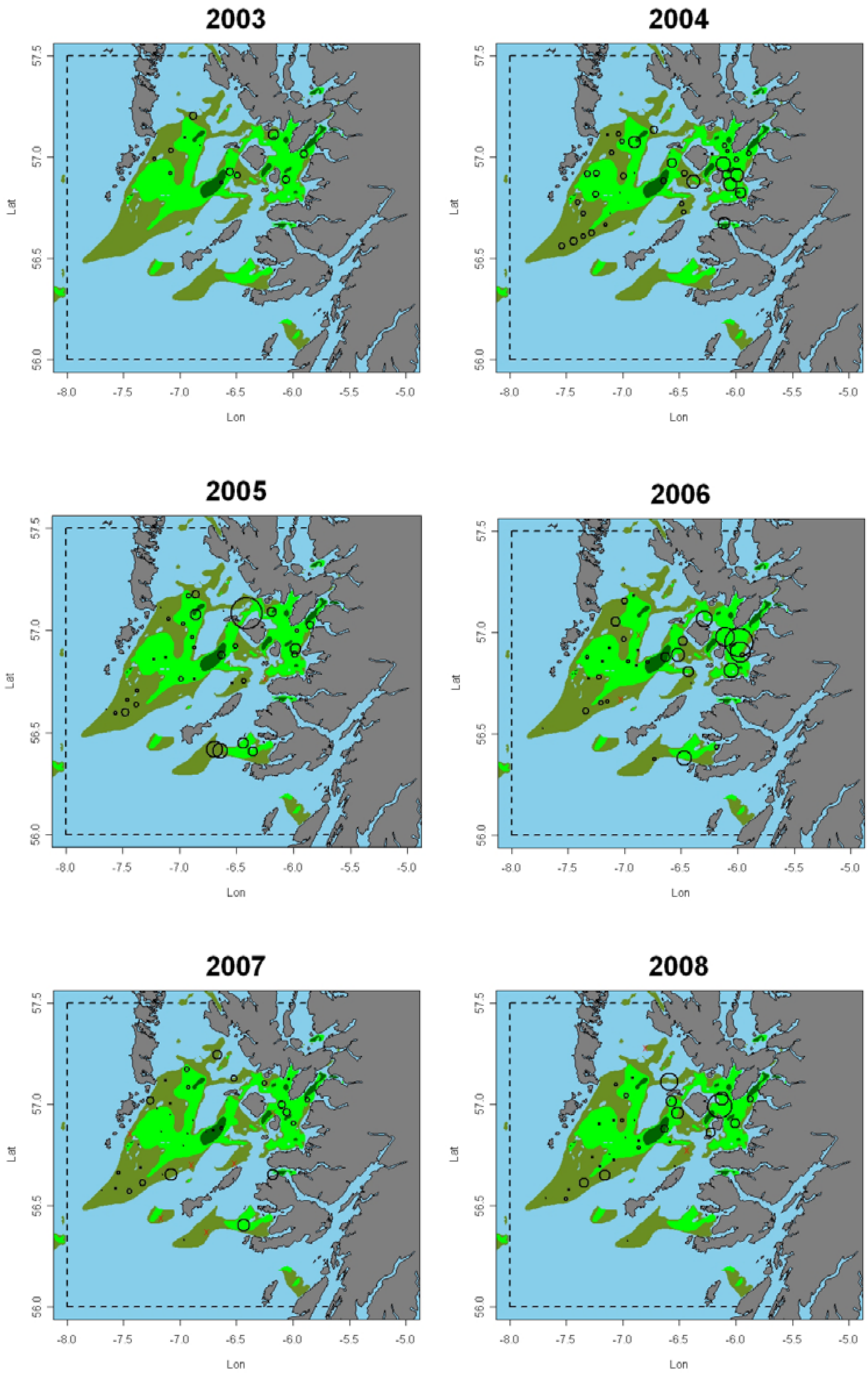


Figure 3.6.4. ***Nephrops*****, South Minch (FU12), TV survey station distribution and relative density, 2003–2008. Shaded green and brown areas represent areas of suitable sediment for *Nephrops*. Bubbles in this figure are all scaled the same. Red crosses represent zero observations.**

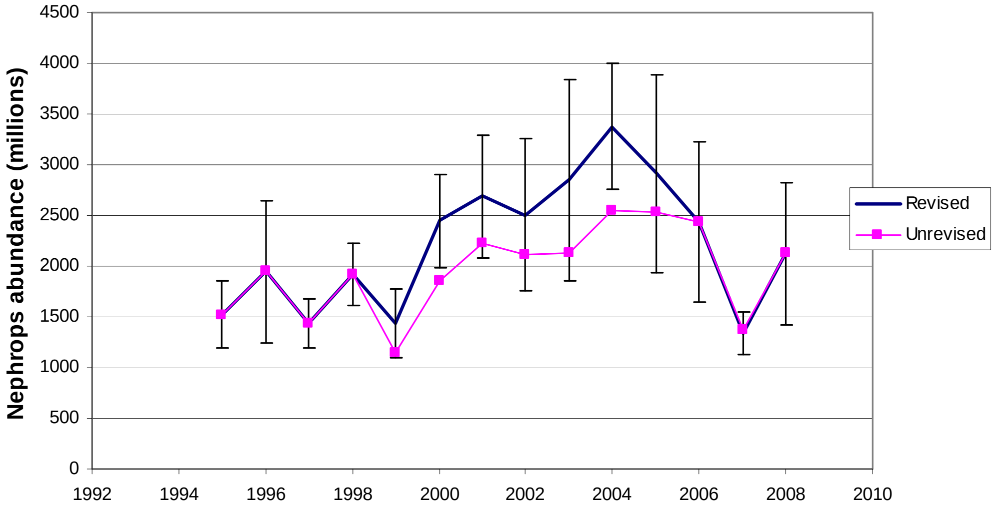


Figure 3.6.5. ***Nephrops*****, South Minch (FU12), Time-series of revised TV survey abundance estimates, with 95% confidence intervals, 1995–2008 and unrevised series of abundance.**

3.7 Firth of Clyde

Type of assessment in 2009

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG and described in Section 3.5.

ICES advice applicable to 2007 and 2008

"The effort in this fishery should not be allowed to increase relative to the past three years. In addition to the ceiling on effort ICES advises that the exploitation ratio in this stock should be no more than 15%, until such time that more reliable catch information becomes available. This corresponds to landings of less than 3800 t for the Firth of Clyde stock."

ICES advice applicable to 2009

"The current fishery appears sustainable. Therefore, ICES recommends that the *Nephrops* fisheries should not be allowed to increase relative to the past two years (2006–2007). This corresponds to landings of no more than 5700 tonnes for the Firth of Clyde stock."

3.7.1 General

Management applicable to this stock is included in management for Division VIa as a whole, and is described in Section 3.5.

The fishery in 2007 and 2008

Around 35 trawlers ranging from 9.9 m to 20 m operated in the Clyde during 2008. A mixture of 70 mm and 80 mm single rig and 80 mm twin-rig was fished. The most significant landings were made at the main Clyde landing ports of Troon, Girvan, Largs on the East side of the Clyde and Campbelltown, Tarbert, and Carradale on the west side of the Clyde. Almost all of the Clyde *Nephrops* fleet fish daily trips. Fishing in the Clyde was generally steady through the year although there is a dip in catches during April and May. In common with other years a small bycatch of fish was taken in the Clyde consisting mainly of cod, hake and whiting.

A few Northern Irish boats fish the Clyde at varying times of the year fishing mainly for tails, these boats land mainly into Campbeltown though often make landings into Troon depending on where the boats are fishing.

Mobile gear is banned in the Inshore Clyde from Friday night to Sunday night as are vessels greater than 21 m in length. An increasing number of creel boats operate in the Clyde. Creeling activity often takes place during the weekend when the trawlers cannot fish as a consequence of the ban. Only about a third of creelers operated throughout the year, the rest prosecuted a summer fishery.

3.7.2 Data available

Commercial catch and effort data

Official catch statistics (landings) reported to ICES are demonstrated in Table 3.5.1. These relate to the whole of VIa of which the Firth of Clyde is a part. Landings statistics for FU13 provided through national laboratories are presented in Table 3.7.1, broken down by country and by gear type. Landings from this fishery are predominantly reported from Scotland, although the remainder of the UK also contributes, and landings from Northern Ireland form the main part of this. Landings from England, Wales and Northern Ireland contributed about 7% of the total in 2008. Total international reported landings in 2008 decreased from 2007, and consisted of 5737 tonnes landed by trawlers (Scottish and other UK) and 182 tonnes landed by creel vessels. Creel landings have increased in the most recent years but remain at a low level compared with other methods and to the creel fisheries elsewhere on the west coast of Scotland.

Reported effort by all Scottish *Nephrops* trawlers demonstrates an increasing trend reaching a peak in the mid 1990s. However, reported effort by all Scottish *Nephrops* trawlers has demonstrated a substantial decrease between 1999 and 2004. Thereafter effort has started to increase again. (Figures 3.7.1 and 3.7.2).

There are concerns over the accuracy of the effort data (hours fished) for this stock as that logbook field is not mandatory. Further details can be found in the report of the 2000 WGNSSK (ICES, 2001). The introduction of the "buyers and sellers" regulations in the UK in 2006 however, have led to increased reliability in the reported landings. The elevated lpue observed since 2006 is linked to this improved reporting rather than a sudden change in stock abundance.

Males consistently make the largest contribution to the landings, although the sex ratio does seem to vary. This is likely to be because of the varying seasonal pattern in the fishery and associated relative catchability (as a result of different burrow emergence behaviour) of male and female *Nephrops* (Figure 3.7.2).

Discards

Discarding of undersized and unwanted *Nephrops* occurs in this fishery, and quarterly discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 1990. Discarding rates are high and variable in this FU and average around 30% by number in this FU (Table 3.7.5). In 2008, discard rates were estimated to be slightly higher than average at just over 32% by number. Discards in 2006 were estimated to have been relatively low figure possibly as a result of reduced recruitment.

It is likely that some *Nephrops* survive the discarding process, an estimate of 25% survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population.

Length compositions

Length compositions of landings and discards are obtained during monthly market sampling and quarterly on-board observer sampling respectively. Quarterly landings and discards-at-length data were available from Scotland and these sampling levels are demonstrated in Table 3.5.4. Although assessments based on detailed catch analysis are not currently possible, examination of length compositions can provide a preliminary indication of exploitation effects.

Figure 3.7.3 shows a series of annual length frequency distributions for the period 1979 to 2008. Catch (removals) length compositions are demonstrated for each sex along with the mean size for both. In both sexes the mean sizes have been fairly stable over time. Examination of the tails of the distributions above 35 mm (the length beyond which the effects of recruitment pulses and discarding are considered to be negligible) displays no evidence of reductions in relative numbers of larger animals.

The observation of relatively stable length compositions is further confirmed in the series of mean sizes of larger *Nephrops* (>35 mm) in the landings shown in Figure 3.7.1 and Table 3.7.2. This parameter might be expected to reduce in size if overexploitation were taking place but there is no evidence of this. The mean size of smaller animals (<35 mm) in the catch (and landings) has fluctuated through time, in the most recent year the mean size of females in the catch below 35 mm has decreased quite markedly, suggesting possible good recruitment.

Mean weight in the landings is shown in Figure 3.5.6 and Table 3.5.9. Mean weight fluctuated considerably in the 1990s but it has been less variable at a low level since then.

Natural mortality, maturity-at-age and other biological parameters

Biological parameter values are included in the Stock Annex.

Research vessel data

Underwater TV surveys using a stratified random approach are available for this stock since 1995. Underwater television surveys of *Nephrops* burrow number and distribution, reduce the problems associated with traditional trawl surveys that arise from variability of burrow emergence of *Nephrops*.

The numbers of valid stations used in the final analysis in each year are demonstrated in Table 3.7.4. On average, 37 stations have been considered valid each year, then raised to the estimated area of the ground available for *Nephrops*-2000 km^2.

3.7.3 Data analyses

Exploratory analyses of survey data

The UWTV survey work-up method employed on the Scottish surveys assumes that the width of the viewed transect is the entire lower edge of the TV screen on which the burrows are counted. This can be calculated from the TV camera parameters and the position of the camera in relation to the seabed. Although the camera has been changed a number of times since the start of the survey, the manufacturer has remained the same and efforts have been made to ensure that the camera parameters (lens properties) remained constant. However, in 2008, it came to light that a number of changes had been made to the housing of the glass front of the camera which meant that the field of view of the camera had actually changed (a number of times) with the actual field of view being less than that calculated from the assumed camera parameters.

A re-working of the UWTV survey abundances for Division VIa were presented to the *Nephrops* benchmark workshop (WKNEPH) in 2009 (ICES, 2009) and further details of the technical changes to the camera can be found in the Report of that Workshop. The revised abundance estimates for FU13 from 1999 onwards are presented here for the first time and are slightly higher than the previous values as a result of the field of view being smaller than previously calculated. (Because of inconsistent file formats, pre-1999 survey data could not be reworked ahead of this WG).

Table 3.7.3 demonstrates the basic analysis for the three most recent TV surveys conducted in FU13. The Table includes estimates of abundance and variability of each of the strata adopted in the stratified random approach. The areas of all sediment types (mud, muddy sand and sandy mud) in this region are very similar and as such the number of stations surveyed in each sediment type are similar also.

Figure 3.7.4 shows the distribution of stations in recent TV surveys (2003–2008), with the size of the symbol reflecting the *Nephrops* burrow density. Table 3.7.4 and Figure

3.7.5 show the time-series estimated abundance for the TV surveys, with 95% confidence intervals on annual estimates.

The review of the use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WKNEPH (ICES, 2009). A number of potential biases were highlighted including those as a consequence of edge effects, species burrow misidentification and burrow occupancy. The cumulative bias correction factor estimated for FU13 was 1.19 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 19%.

3.7.4 Final assessment

The underwater TV survey is presented as the best available information on the stocks of *Nephrops* in FU13. The survey in the Clyde component provides a fishery-independent estimate of *Nephrops* abundance. The details of the 2008 survey are demonstrated in Table 13.7.3 and compared with the 2006 and 2007 outcome. At present it is not possible to extract any length or age structure information from the survey and it therefore only provides information on abundance over the area of the survey.

The 2008 TV survey data presented at this meeting demonstrates that the abundance has risen in 2008, to close to the levels seen in 2006. A large drop was seen in 2007. Confidence limits are quite high for this stock especially in the most recent years, but those from 2007 do not overlap with the two adjacent years.

The TV survey results reported here do not cover the sea loch areas adjacent to the main Clyde grounds and should therefore be considered underestimates of the overall biomass. The sea lochs support a significant but unknown part of the creel fishery, although creel landings remain at a low level in the Clyde compared with the other areas on the West Coast.

3.7.5 Historical stock trends

The TV survey estimates of abundance for *Nephrops* in the Firth of Clyde demonstrate an increasing trend until 2007 at which time it suffered a 33% decline. The 2008 estimate (2105 million individuals) represents an increase in abundance numbers back to a similar level to those observed in 2003–2006. The bias adjusted abundance estimates from 1999–2008 (the period over which the survey estimates have been revised) is demonstrated in Table 3.7.5.

Table 3.7.5 also demonstrates the estimated harvest ratios over this period. These range from 12–36% over this period. (Note: the estimated harvest ratios prior to 2006 may not be representative of actual harvest ratios due to underreporting of landings).

3.7.6 Recruitment estimates

Recruitment estimates from surveys are not available for this FU.

3.7.7 Short-term forecasts

A prediction of landings for 2010 was made for the North Minch Functional Unit using the approach agreed at the Benchmark Workshop and outlined in the introductory section to this chapter (Section 3.1). The percentage of the dead removals that are discarded was calculated as 18.6 % (based on the 2005–2007 average) and this value is used in the provision of landings options for 2010. The Table below displays landings predictions at various harvest ratios, including those equivalent to fishing at $F_{0.1}$, F_{max} and the harvest ratio in 2008. The harvest ratios equivalent to $F_{0.1}$and F_{max} are significantly lower than those previously presented because of a revision of the assumptions regarding the size range of *Nephrops* inhabiting the burrows observed in the TV survey.

The inputs to the landings forecast were as follows:

Mean weight in landings (06–08) = 17.74 g

Percentage of dead removals discarded (2005–2007) = 18.6%

Survey bias = 1.19.

	Harvest rate	Survey Index (adjusted)	Implied fishery: Retained number	Implied fishery: Landings (tonnes)
	0.0%	1768	0	0
	5.0%	1768	72	1277
	8.0%	1768	115	2043
F0.1	8.7%	1768	125	2221
	10.0%	1768	144	2553
	15.0%	1768	216	3830
Fmax	15.1%	1768	217	3855
TAC decrease of 15%	19.0%	1768	273	4845
	20.0%	1768	288	5106
TAC increase of 15%	25.7%	1768	370	6555
F2008	27.0%	1768	389	6894

3.7.8 Biological reference points

Precautionary approach biological reference points have not been determined for *Nephrops* stocks. Long-term harvest reference points ($F_{0.1}$, and F_{max}) were estimated as described in 3.5 and WKNEPH 2009.

3.7.9 Uncertainties and bias in assessment and forecast

There are several key uncertainties and bias sources in the method proposed (these are discussed further in WKNEPH 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007, WKNEPHBID 2008, SGNEPS 2009). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that was more accurate but no more precise (WKNEPH 2009). Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates.

Underwater TV surveys have been conducted for this stock every year since 1995. The number of valid stations in the survey has remained relatively stable throughout the time period. Confidence intervals around the abundance estimates are stable throughout the series. The final estimate is bias corrected and used deterministically although the 95% confidence bounds are +-16%.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. For FU13 deterministic estimates of the mean weight in the landings and discard rates have been used. Historical data suggest parameters have been variable in the past (Tables 3.5.9 and 3.6.5). In future years the uncertainty in these key parameters should be estimated.

The length and sex composition of the landings data is considered to be well sampled. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in this fishery since 1990, and is considered to represent the fishery adequately.

There are concerns over the accuracy of historical landings and effort data and because of this the final assessment adopted is independent of official statistics.

The TV survey results reported here do not cover the sea loch areas adjacent to the main Clyde grounds and should therefore be considered underestimates of the overall biomass. The sea lochs support a significant but unknown part of the creel fishery, although creel landings remain at a low level in the Clyde relative to other areas on the West Coast.

3.7.10 Management considerations

ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level. Management at the Functional Unit level could confer controls to ensure effort and catch were in line with the scale of the resource.

Creel fishing takes place in part of this area although the relative scale of the fishery is smaller than in the Minches. Overall effort for creel numbers is not known and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the Firth of Clyde and STECF estimates that discards of whiting and haddock are high in VIa generally. It is important that efforts are made to ensure that unwanted bycatch is kept to a minimum in this fishery. Current efforts to reduce discards and unwanted bycatches of cod under the Scottish Conservation credits scheme and cod long-term plan, include the implementation of larger meshed square meshed panels (110 mm). A seasonal closure (early spring) in the southwest part of the Firth of Clyde is in place to protect spawning cod although *Nephrops* vessels are derogated to fish in those parts where mud sediments are distributed.

The implementation of buyers and sellers legislation in the UK in 2006 is improving the reliability of fishery statistics but the transition period is accompanied in some cases by large changes in landings which produce significant changes in the lpue and cpue series that cannot be completely attributed to changes in stock. Until a sufficient time-series of reliable data has built up, use of fishery catch and effort data in the assessment process should be avoided.

3.8 Other *Nephrops* populations within Division VIa

Nephrops fisheries also take place outside the Functional Units in Subdivision VIa, although they represent only 1% of the reported landings (Table 3.5.3). The main areas of activity are the Stanton Bank (to the west of the South Minch, Figure 13.5.1) and areas of suitable sediment along the shelf edge and slope to the west of the Hebrides.

3.8.1 Stanton Bank

Underwater TV surveys were not conducted in Stanton Bank in 2008.

3.8.2 Shelf edge west of Scotland

Marine Scotland Science has taken the opportunity of using the Scotia deep-water surveys conducted in 2000, 2002 and 2004 to conduct preliminary underwater TV work on the *Nephrops* populations along the shelf edge. These TV runs are carried out during the night (when the vessel is not required for fishing). It is hoped that this can continue as an annual survey.

To date, successful survey runs have been conducted to a depth of 635 m, observing *Nephrops* burrows at a range of locations along the shelf edge and slope. Observed densities have been very low (average 0.04 m^{-2}) compared with shelf stocks on the west coast and in the North Sea (typically 0.2–0.9 m^{-2}), although the animals on the shelf edge are considerably larger than those found on the shelf. Forecasts of landings based on TV surveys were not attempted for this area.

Table 3.7.1. ***Nephrops,*** **Firth of Clyde (FU13), Nominal Landings of** ***Nephrops*****, 1981–2008, as officially reported.**

Year	UK Scotland				Other UK	Total **
	Nephrops trawl	Other trawl	Creel	Sub-total		
1981	2498	404	66	2968	0	2968
1982	2373	171	79	2623	0	2623
1983	3890	120	53	4063	14	4077
1984	3069	154	77	3300	10	3310
1985	3921	293	64	4278	7	4285
1986	4074	175	79	4328	13	4341
1987	2859	80	65	3004	3	3007
1988	3507	108	43	3658	7	3665
1989	2577	184	35	2796	16	2812
1990	2732	122	24	2878	34	2912
1991	2845	145	25	3015	23	3038
1992	2532	246	10	2788	17	2805
1993	3199	110	5	3314	28	3342
1994	2503	49	28	2580	49	2629
1995	3767	132	26	3925	64	3989
1996	3880	111	27	4018	42	4060
1997	3486	44	25	3555	63	3618
1998	4539	81	40	4660	183	4843
1999	3475	29	38	3542	210	3752
2000	3143	63	76	3282	137	3419
2001	2889	67	94	3050	132	3182
2002	3074	53	105	3232	151	3383
2003	2954	20	117	3091	80	3171
2004	2659	18	90	2767	258	3025
2005	3166	14	95	3275	148	3423
2006	4356	0	178	4534	244	4778
2007	6069	0	221	6290	366	6656
2008	5321	0	182	5503	416	5919

*** provisional   ** Total also includes Rep. of Ireland.**

Table 3.7.2. *Nephrops*, Firth of Clyde (FU13): Mean sizes (CL mm) above and below 35 mm of male and female *Nephrops* in Scottish catches and landings, 1981–2008.

	CATCHES		LANDINGS			
	< 35 mm CL		< 35 mm CL		> 35 mm CL	
YEAR	Males	Females	Males	Females	Males	Females
1981	28.4	27.3	30.2	29.3	40.3	39.3
1982	28.2	26.4	29.9	29.0	39.9	40.1
1983	27.9	26.7	29.3	28.5	40.8	39.5
1984	27.0	25.9	28.0	26.8	40.9	39.6
1985	27.1	26.1	28.1	27.2	39.8	39.3
1986	27.1	26.0	27.9	27.1	40.5	39.0
1987	28.5	26.5	29.6	28.3	39.4	40.0
1988	28.1	27.0	30.6	29.5	41.2	40.1
1989	26.9	26.9	30.2	30.0	41.6	39.8
1990	27.4	26.2	30.4	29.5	40.1	39.8
1991	28.6	27.1	29.2	28.2	39.3	40.3
1992	29.6	28.8	30.1	29.2	39.9	41.1
1993	29.6	29.7	31.4	30.9	40.4	39.9
1994	26.4	27.0	29.4	29.4	40.8	39.2
1995	27.2	25.8	28.7	27.6	40.3	39.8
1996	28.8	28.0	30.0	29.1	38.6	40.4
1997	27.9	26.9	30.0	29.2	40.0	40.3
1998	25.9	25.2	28.4	27.9	38.9	39.1
1999	26.5	25.3	28.5	27.3	39.0	39.5
2000	28.3	27.7	29.3	28.6	38.7	39.1
2001	27.4	26.8	29.5	28.7	39.0	39.6
2002	27.5	25.6	28.4	26.4	39.0	39.4
2003	27.2	25.9	29.1	27.9	39.2	38.6
2004	27.1	26.5	28.4	27.6	39.2	39.5
2005	28.0	26.7	29.2	27.9	38.7	38.1
2006	28.7	27.1	29.0	27.3	40.0	38.7
2007	27.0	26.7	29.1	29.2	39.1	38.6
2008	27.2	25.2	28.6	26.6	39.1	38.2

*** provisional   na = not available.**

Table 3.7.3. ***Nephrops,*** **Firth of Clyde (FU13): Results by stratum of the 2006–2008 TV surveys. Note that stratification was based on a series of sediment strata.**

Stratum	Area (km²)	Number of Stations	Mean burrow density (no./m²)	Observed variance	Abundance (millions)	Stratum variance	Proportion of total variance
			2006 TV survey				
M	717	16	1.09	0.11	779	3688	0.158
SM	699	16	0.91	0.21	636	6973	0.298
MS	665	11	1.19	0.32	788	12720	0.544
Total	2080	43			2203	23381	1
			2007 TV survey				
M	717	12	0.70	0.07	502	2798	0.159
SM	699	11	0.62	0.17	431	7724	0.439
MS	665	17	0.82	0.27	547	7066	0.402
Total	2080	40			1480	17588	1
			2008 TV survey				
M	717	15	0.88	0.21	629	7345	0.173
SM	699	11	0.90	0.55	628	24502	0.575
MS	665	12	1.28	0.29	848	10732	0.252
Total	2080	38			2105	42579	1

Table 3.7.4. ***Nephrops*****, Firth of Clyde (FU13): Revised results of the 1995–2008 TV surveys. Abundance estimates are not revised prior to 1999.**

	Stations	Mean density	Abundance	95% confidence interval
Year		burrows/m²	millions	millions
1995	29	0.33	689	210
1996	38	0.54	1113	288
1997	31	0.68	1426	312
1998	38	0.720	1502	254
1999	39	0.532	1107	344
2000	40	0.807	1679	293
2001	39	0.850	1768	319
2002	36	0.899	1870	343
2003	37	1.039	2162	347
2004	32	1.127	2344	437
2005	44	1.121	2331	342
2006	43	1.050	2203	306
2007	40	0.705	1480	265
2008	38	1.012	2105	413

Table 3.7.5. *Nephrops*, Firth of Clyde (FU13): Adjusted TV survey abundance, landings, discard rate (proportion by number) and estimated harvest rate.

	Adjusted survey (millions)	Landings (tonnes)	Discard rate (%)	Harvest ratio*
1999	930	3752	0.30	0.28
2000	1411	3419	0.22	0.14
2001	1485	3182	0.34	0.14
2002	1571	3383	0.20	0.15
2003	1817	3171	0.45	0.14
2004	1970	3025	0.52	0.14
2005	1959	3423	0.27	0.12
2006	1851	4778	0.07	0.14
2007	1233	6656	0.30	0.36
2008	1768	5921	0.32	0.27

*** harvest rates previous to 2006 are unreliable.**

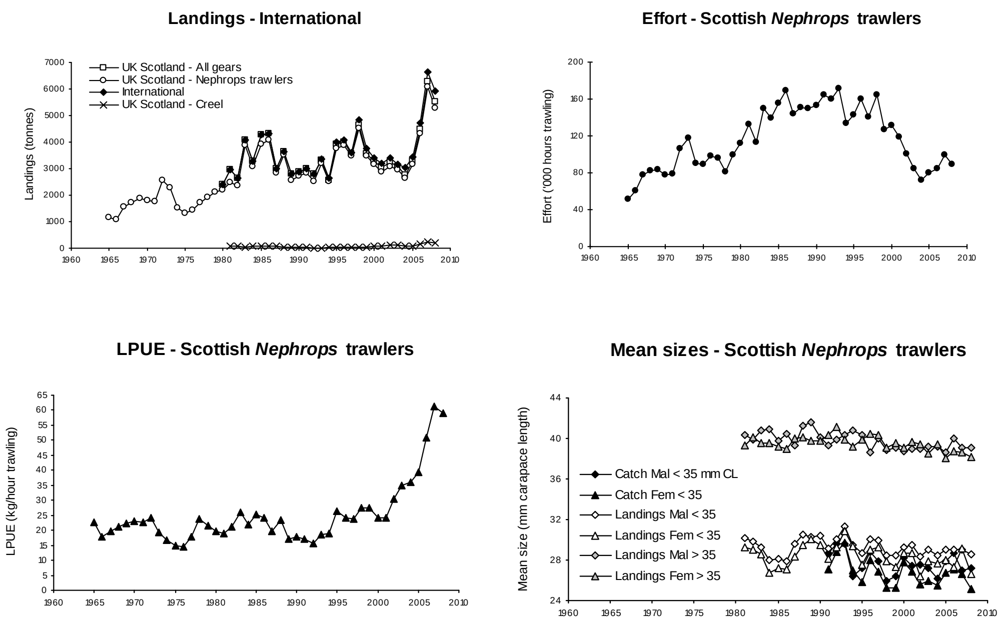


Figure 3.7.1. *Nephrops*, Firth of Clyde (FU13), Long term landings, effort, lpue and mean sizes.

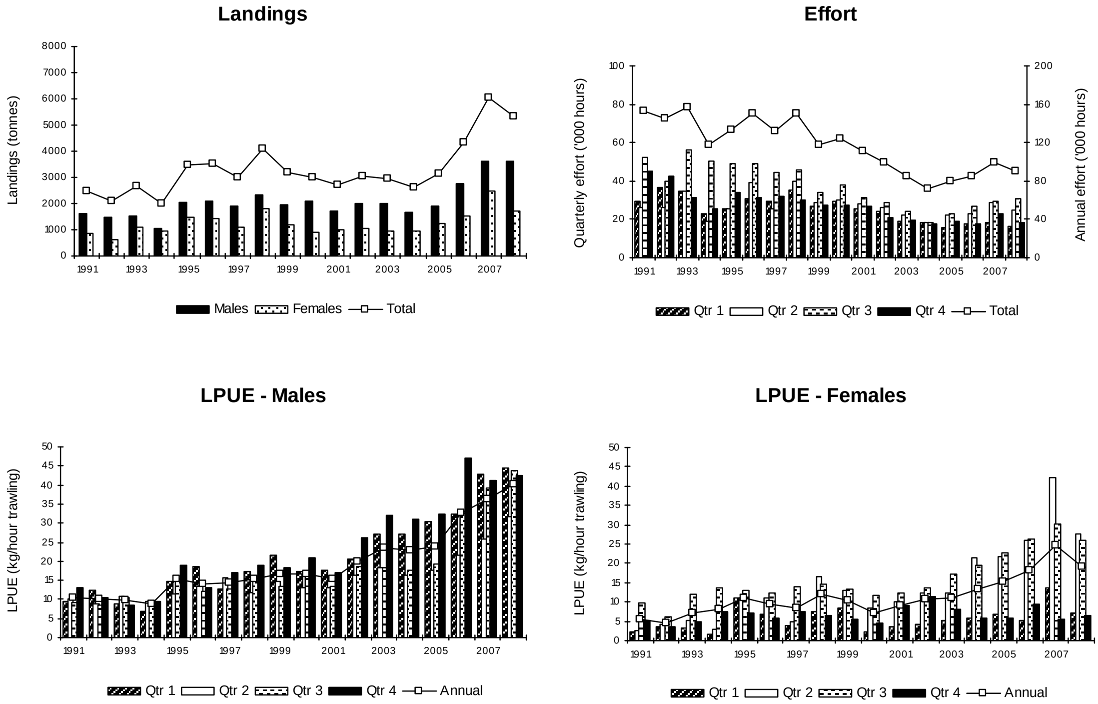


Figure 3.7.2. ***Nephrops*, Firth of Clyde (FU13), Landings, effort and lpues by quarter and sex from Scottish *Nephrops* trawlers.**

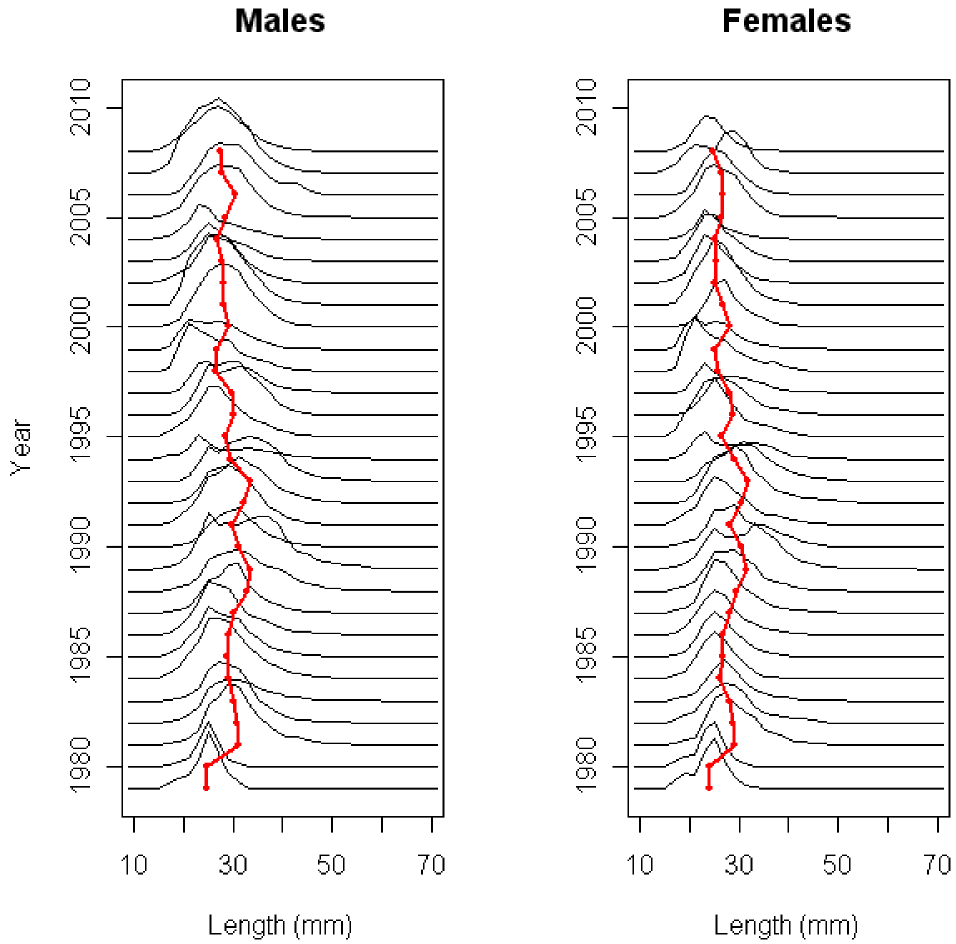


Figure 3.7.3. ***Nephrops,*** **Firth of Clyde (FU13), Catch length frequency distribution and mean sizes (red line) for** ***Nephrops*** **in the Firth of Clyde, 1979–2008.**

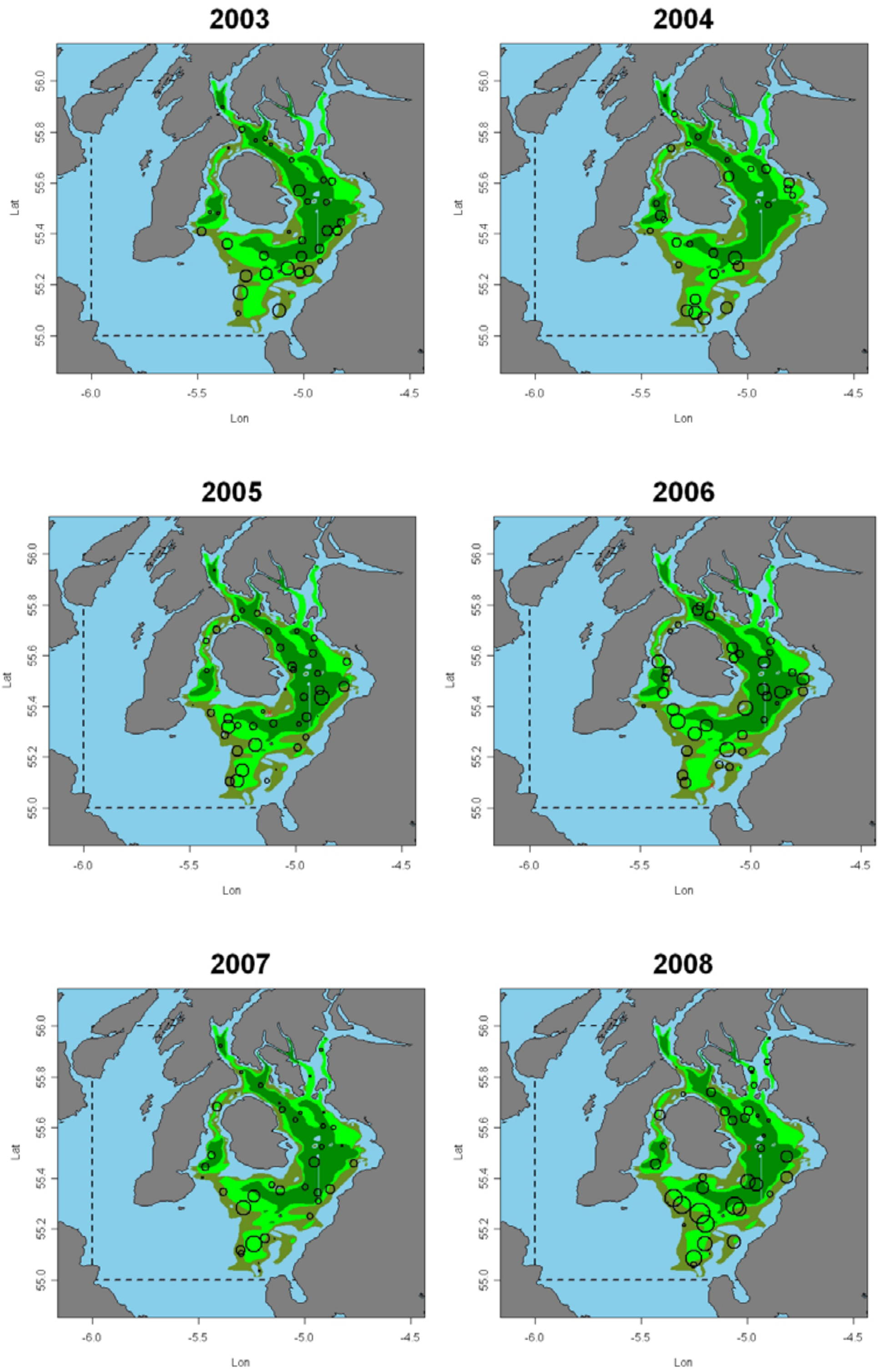


Figure 3.7.4. ***Nephrops*****, Firth of Clyde (FU13), TV survey station distribution and relative density, 2003–2008. Shaded green and brown areas represent areas of suitable sediment for *Nephrops*. Bubbles scaled the same. Red crosses represent zero observations.**

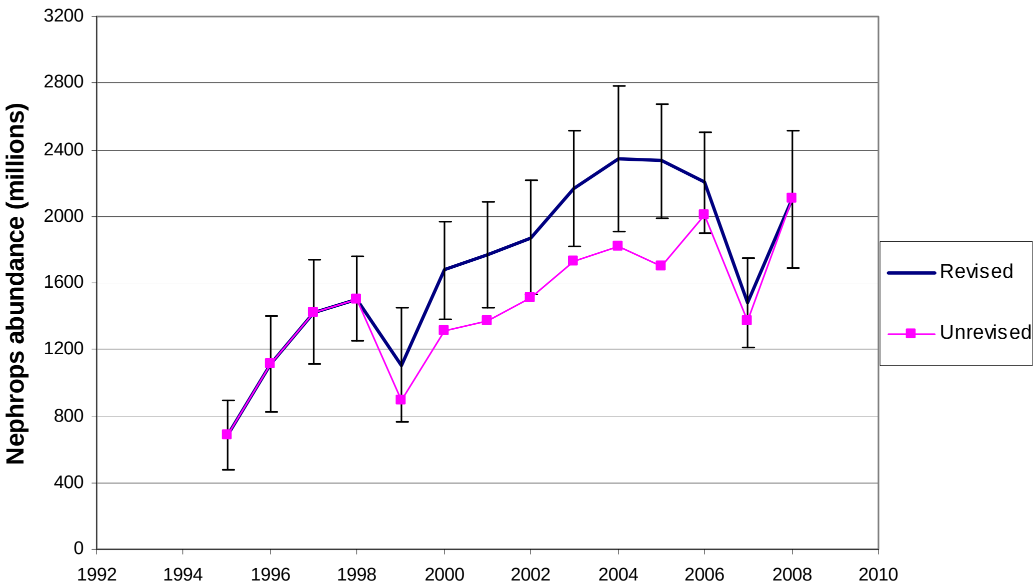


Figure 3.7.5. ***Nephrops*, Firth of Clyde (FU13), Time-series of revised TV survey abundance estimates, with 95% confidence intervals, 1995–2008, and unrevised TV abundance.**

4 Rockall Area

4.1 Area overview

Description of fisheries

The demersal fisheries in Division VIb are predominantly conducted by large otter trawlers fishing for haddock, monkfish, saithe, cod, megrim, whiting, and squids, mainly in a mixed fishery. The majority of vessels are trawlers from Scotland, the Russian Federation and Ireland, which are targeted at haddock. The importance of Scottish seiners has been declining in recent years as many of these vessels have switched to pair seining or have been decommissioned.

Apart from otter trawl fishery, there is a longline fishery, targeting mainly ling and tusk. There is also a significant directed fishery with pelagic trawls for blue whiting in the area.

Over the past decade there have been significant changes in the fleets fishing at Rockall, which were accompanied by changes in the spatial and temporal distribution of their effort. There are also possible misreporting of landings, considerable discarding and highgrading in this fishery. The Russian fleet has accounted for the majority of haddock catches in the recent years. However, since 2007, the highest catches were taken by the Scottish fleet, accounting for roughly a half of the total haddock catch on the Rockall Bank.

Vessels from the Russian Federation have fished for haddock and other demersal species at Rockall since 1999 when part of the Bank was designated as being in international waters. The Russian haddock fishery takes place in the international part of the Rockall Bank. It uses bottom trawls with codend mesh size of 40–100 mm (mainly 40–70 mm) and retains haddock of all length classes in the catch. This fishery targets concentrations of haddock mainly during spring and the beginning of summer.

The larger Scottish and Irish trawlers fish for haddock at Rockall when opportunities arise for good catches from this stock. The Scottish and Irish fisheries are conducted throughout the year. A considerable proportion of EU landings over the past few years have been taken in the international waters. High catch rates attract effort into the Rockall area, especially given the lack of effort restrictions in the area.

Norwegian vessels, mainly longliners, have been operating on the Rockall Bank for many years, but on a considerably smaller scale than the Russian and EU fleets.

Regulations and their effects

The fishery in the EU waters is regulated through TAC allocations by the European Commission. The fishery in international waters is regulated by agreements within the framework of the NEAFC and is not subject to TAC.

Currently, there is one closed area at Rockall to protect juvenile haddock (Rockall Haddock Box), which is partly located in the EU waters and partly in international waters. In addition, there are four closed areas to protect cold-water corals (North West Rockall, Logachev Mounds, West Rockall Mounds and Empress of British Banks). They were established and are subject to regulation by the NEAFC.

Changes in fishing technology and fishing patterns

There have been no significant changes in fishing technology on the Rockall Bank over the past few years.

Impacts of fisheries on the ecosystems

Fisheries on the Rockall Bank pose a threat to the sensitive bottom fauna such as cold-water corals.

4.2 Cod in Division VIb

Officially reported catches are displayed in Table 4.2.1. No analytical assessment of this stock has been carried out.

Table 4.2.1. Cod in Division VIb (Rockall). Official catch statistics.

COUNTRY	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Faroe Islands	18	-	1	-	31	5	-	-	-	1	-	-
France	9	17	5	7	2	-	-	-	-	-	-	-
Germany	-	3	-	-	3	-	-	126	2	-	-	-
Ireland	-	-	-	-	-	-	400	236	235	472	280	477
Norway	373	202	95	130	195	148	119	312	199	199	120	92
Portugal	-	-	-	-	-	-	-	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	-	-	-	-
Spain	241	1200	1219	808	1345	-	64	70	-	-	-	2
UK (E. & W. and N.I.)	161	114	93	69	56	131	8	23	26	103	25	90
UK (Scotland)	221	437	187	284	254	265	758	829	714	322	236	370
Total	1023	1973	1600	1298	1886	549	1349	1596	1176	1097	661	1031

COUNTRY	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Faroe Islands	-	-	-	-	n/a	n/a	n/a				
France	-	-	-	-	+	+*	1			0.08	
Germany	10	22	3	11	1	-	-				
Ireland	436	153	227	148	119	40	18	11	7	12	22.7
Norway	91	55*	51*	85*	152*	89	28	25	23	7	7
Portugal	-	5	-	-	-	-	-				
Russia	-	-	-	-	7	26	-				
Spain	5	1	6	4	3	1		6			
UK (E. & W. and N.I.)	23	20	32	22	4	2	2	3			
UK (Scotland)	210	706	341	389	286	176	67	57	45	43	
UK											28.7
Total	775	962	660	659	572	334	115	102	75	62	58.4

COUNTRY	2007	2008*
Faroe Islands	-	
France	-	
Germany	-	
Ireland	24	40.7
Norway	12	11
Portugal	-	
Russia	-	
Spain	-	
UK (E. & W. and N.I.)		
UK (Scotland)	26	
UK		41.3
Total	62	93.0

*** Preliminary.**

4.3 Haddock in Division VIb (Rockall)

Type of assessment in 2009: Update assessment

The assessment of the haddock stock in Division VIb is based on catch-at-age and one survey index (Scottish Groundfish Survey) and conducted using the XSA method. Discarding occurs in part of the fishery and has been estimated and used in the assessment. In 2005, WGNSDS, on the recommendation of RGNSDS, adopted a new assessment approach, which allows modelling of the total catch (including discards) of the Irish, Scottish and Russian fleets (for details see Stock Annex). The same approach has been used in the annual assessment since 2005. The current assessment is an update of the last year assessment.

ICES advice applicable to 2008

The ICES advice for 2008 for single-stock exploitation boundaries was as follows:

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

"There is no gain in yield by having a target above $F_{0.1}$ (0.18)."

Exploitation boundaries in relation to precautionary limits

"Fishing mortality should be less than F_{pa}, corresponding to catches less than 10 640 t in 2008."

ICES advice applicable to 2009

The ICES advice for 2009 for single-stock exploitation boundaries was as follows:

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

"Fishing mortality around $F_{0.1}$ (0.21) can be considered as a candidate target reference point consistent with taking high long-term yields and achieving a low risk of depleting the productive potential (< 5%). The present fishing mortality (0.25) is above the candidate reference point."

Exploitation boundaries in relation to precautionary limits

"Fishing mortality should be less than F_{pa}, corresponding to total catches less than 9740 t in 2009. Landings should be less than 6470 t in 2009."

Conclusion on exploitation boundaries

"In the present situation with a stock that is well above B_{pa} and fishing mortality below F_{pa} there is little gain to the long-term yield by increasing fishing mortality above current levels. ICES therefore recommends limiting catches to 6490 t in 2009 and landings to 4330 t."

4.3.1 General

Stock description and management units

The haddock stock at Rockall is an entirely separate stock from that on the continental shelf of the British Isles (Chuksin and Gerber, 1976; Shestov, 1977; Blacker, 1982, Newton *et al*., 2008). Since 2004, the EU TAC for haddock in VIb has been included with Divisions XII and XIV. For details of the earlier management units see Stock Annex.

Management applicable to 2008 and 2009

The EU TAC for VIb, XII and XIV was set at 6916 t in 2008 (a 50% increase compared with TAC for 2007) and at 5879 t in 2009 (a 15% reduction compared with TAC for 2008).

The ICES advice, agreed TAC for EU waters, and WG estimates of landings are summarized below. All values are in tonnes.

YEAR	CATCHES CORRESPONDING TO ICES ADVICE (VIB)	BASIS	AGREED TAC	WG LANDINGS
2002	< 1300	Reduce F below 0.2	1300[a]	3336
2003	-	Lowest possible F	702[a]	6242
2004	-	Lowest possible F	702[b]	6445
2005	-	Lowest possible F	702[b]	5179
2006	-	Lowest possible F	597[b]	2765
2007	< 7100	Reduce F below Fpa	4615[b]	3349
2008	< 10 640[c]	Keep F below Fpa	6916[b]	4221
2009	< 4300[d]	No long-term gains in increasing F	5879[b]	

[a] TAC was set for Divisions VIa and VIb (plus Vb1, XII and XIV) combined with restrictions on quantity that can be taken in Vb and VIa. The quantity displayed here is the total area TAC minus the maximum amount which is allowed to be taken from Vb and VIa.

[b] In 2004, the EU TAC for Division VI was split and the VIb TAC for haddock was included with XII and XIV. This value is the TAC for VIb, XII and XIV.

[c] Total catch, including landings and discards.

[d] Only landings.

The minimum landing size of haddock taken by EU vessels at Rockall is 30 cm. There is no minimum landing size for haddock taken by non-EU vessels in international waters.

In order to protect the prerecruit stock, the International Waters component of the statistical rectangle 42D5 has been closed for fishing since 2001 and its EU component, since 2002 (see Stock Annex). The protected area (the whole rectangle) is referred to as Rockall Haddock Box. In order to protect cold water corals, three further areas (North West Rockall, Logachev Mounds and West Rockall Mounds) are closed between January 2007 and December 2009 (see Stock Annex). A new area to protect cold water corals (Empress of British Banks) was established by the NEAFC in 2007.

Fishery in 2008

Nominal landings for 2008 and previous years as reported to ICES are given in Table 4.3.1.

Russian fishery in 2008

In 2008, the Russian haddock fishery commenced in March with a trawler of tonnage class 9 (see WD11). The catches were dominated by haddock (on average, 90% of catch weight). The daily catch in March amounted to 3–17 t including 2–14 t of haddock (Tables 4.3.2 and 4.3.3).

In April, two trawlers of tonnage class 9 and three trawlers of tonnage class 8 conducted fishing activities. The efficiency of fishing increased (Table 4.3.2), and the daily catch varied from 7 to 45 t. In May, fishing conditions deteriorated and the vessels left the fishing ground.

Fishing activities were resumed at the end of September and continued till the end of November. During that period 1–2 trawlers of tonnage class 9 conducted fishing for haddock (Table 4.3.2). Haddock accounted for 80–90% of the catch (Table 4.3.3).

During the whole fishing period, the Russian fleet operated in the international waters at depths between 200 and 400 m. Trawls with the minimum mesh size of 40–90 mm were used.

The total catch obtained by the Russian fleet at Rockall in 2008 using bottom trawls amounted to 1775 t of fish, of which haddock made up 1666 t (Table 3). In addition, about 3 t of haddock was caught by longliners. In the Russian fishery for haddock, the following species were bycaught: saithe (*Pollachius virens*), anglerfish (*Lophius piscatorius*), witch (*Glyptocephalus cynoglossus*), long rough dab (*Hippoglossus platessoides*) and grey gurnard (*Eutrigla gurnardus*).

Compared with the previous years, the haddock fishery lasted longer and, for the first time, it was conducted in autumn.

Scottish fishery in 2008

The number of Scottish vessels fishing for haddock and the number of trips made to Rockall declined substantially from 2000 onwards (WD6 to WGNSDS 2004). In 2006, there were 13 Scottish vessels fishing in the area. This declining trend was reversed with 22 vessels in 2007 and 28 vessels in 2008.

The officially reported effort has varied over the past few years. It decreased in 2007 (by 50% compared with 2006) and in 2008 (by one third compared with 2007). It is not known to what extent this reflects changes in targeting haddock. Total Scottish demersal landings in VIb in 2008 are estimated to be 2975 t, of which 1779 t were haddock. The latter was an 8% increase compared with the haddock catch in 2007 (Table 4.3.1). Other important target species included anglerfish (*Lophius* spp.), saithe and ling.

The UK landings and effort data include a small number of English vessels landing from VIb (most likely deep-water vessels) which slightly increased the reported hours fished in VIb, but not necessarily with a corresponding increase in the landings of haddock.

Irish fishery in 2008

The landings of haddock from VIb increased considerably in 2007 and 2008, largely as a consequence of increased quota allocations. Landings totalling 721 t were reported from Irish otter trawlers in 2008 (over a twofold increase from 336 t in 2007; Table 4.3.1). Most landings and effort were reported for Quarter 2 (Table 4.3.5). The recent trend of increasing effort has continued in line with the available quota.

Norwegian fishery in 2008

The Norwegian demersal fleet fishing on the Rockall Bank consisted mainly of longliners and targeted mainly ling and tusk (1021 and 190 t, respectively, in 2008). Haddock constituted the bycatch in this fishery. All catch of haddock was taken in Quarter 3. In 2008, Norwegian landings of haddock amounted to 36 t, which was less than 84 t recorded in 2007 and 123 t in 2006, but within the catch range for the period 2001–2005 (32–70 t).

4.3.2 Data

Landings

Nominal landings as reported to ICES are given in Table 4.3.1, along with Working Group estimates of total estimated landings. Reported international landings of Rockall haddock in 1991–2005 varied between 4000 and 6000 t, except for 2001–2002, when they decreased down to about 2300–3000 t. In 2006, they were also low at 2760 t, but increased slightly to 3348 in 2007 and to 4221 t in 2008.

Revisions to official catch statistics for previous years are also displayed in Table 4.3.1.

Anecdotal evidence suggests that misreporting of haddock from Rockall have occurred historically (which may have led to discrepancies in assessment), but a quantitative estimation of the degree of misreporting is not possible.

Age composition and mean weight-at-age of Scottish and Irish landings were obtained from port sampling.

Age composition and mean weight-at-age of Russian landings were obtained by observers on board commercial fishing vessels. In 2002, there was no sampling of the Russian catch and therefore the length composition for that year had to be estimated (for estimation details, see Stock Annex).

Observer data from commercial vessels are also available for Norwegian landings for 2006–2008.

Discards

The haddock catch estimated by landings is underestimated as a result of unaccounted for discarding of small individuals in the Scottish and Irish fisheries in most years. Therefore, the assessment of the stock is done based on the total catch (including discards). On Russian vessels, the whole catch of haddock is kept on board and therefore, total catch is equivalent to landings.

Haddock discards on board Scottish and Irish vessels were in some years determined directly, whereas in other years, indirect estimates of discards were done (for details of the estimation of discards see Stock Annex).

The analysis of the discard data collected by Scottish scientists in 1999 and 2001 indicated that only a relatively small proportion of fish taken aboard is landed (Figure 4.3.1). The direct estimates from the Scottish trawlers in 1985, 1999 and 2001 demonstrated a larger proportion of discards of small haddock: from 12 to 75% by weight (Table 4.3.6) and up to 80–90% of catch abundance. Discard trips in 1995, 1997, 1998, 2000 and 2001 revealed that discarding by Irish fishing vessels also reaches considerable values (Table 4.3.7).

Discard data were also obtained by Irish scientists from discard trips in 2007 and 2008. They revealed that 52 and 87% of the catch in numbers, respectively, was discarded. The range of discarded sizes was 19–43 cm (mean 30 cm).

The proportion of fish discarded from Scottish and Irish catches at different sizes may be determined and modelled using a logistic curve. Calculations where the discard curve was applied agree well with the results of size composition measurements from Scottish vessels in 1999 and 2001 and from the combined 1995–2002 Irish discard trips (see Stock Annex).

Russian vessels retain all haddock and therefore there is no need to calculate discards (see Stock Annex).

Anecdotal information from the Scottish industry suggests that discards of were be considerably lower at Rockall in 2008 compared with previous years.

Biological

There was no change in biological parameters compared with the 2008 assessment (see Stock Annex).

Surveys

There is only one abundance index available for VPA assessment of this stock from the Scottish survey (Figure 4.3.2, Table 4.3.8). The survey is conducted on about 40 standard trawl stations. However, the survey area varied along with the number of stations in different years (see Stock Annex).

The Russian trawl-acoustic survey conducted in 2005 provided information on the stock size and biomass of the haddock stock, both in the EU zone and in international waters. The acoustic survey yielded a biomass estimate of 60 000 t and an abundance estimate of 225.9 million (for the details see Stock Annex). No such survey has been conducted in subsequent years.

Commercial cpue

Commercial cpue series are available for Scottish trawlers, light trawlers, seiners, Irish otter trawlers and Russian trawlers fishing in Division VIb. The effort data for these five fleets are shown in Figure 4.3.3 and Table 4.3.9. Commercial cpue series for the different fleets are shown in Figure 4.3.4.

In 2005–2007, the Russian effort in bottom fishery (in hours and number of vessels/days) decreased because of economic reasons. The effort in 2008 increased slightly compared with 2007. Haddock catches varied accordingly with the changes in fishing effort. In 2006–2007, cpue in the Russian haddock fishery (mainly with trawlers of tonnage class 10) increased compared with previous years. In 2008, with trawlers of class 8 and 9 only, cpue was still high (on average, 12.2 t per fishing day for trawlers of class 9), but lower than in 2007 (on average, 16.9 t per fishing day for a trawler of class 10). In the period of the targeted fishery (April–May), the mean catch of haddock per hour trawling by a trawler of tonnage class 9 was 0.86 t (in 2007, it was 0.88 t for a trawler of class 10) (Figure 4.3.4). The dynamics of catch per unit of effort for this type of vessels agrees well with year-to-year variations in total biomass of haddock (Figure 4.3.5).

The effort data from the Scottish fleets are known to be unreliable as a result of changes in the practices of effort recording and non-mandatory effort reporting (see the report of WGNSSK 2000, CM 2001/ACFM:07, for further details). It is unknown what proportion of Scottish and Irish effort was applied directly to the haddock fishery. The apparent effort increase may just be the result of more exact reporting of effort as a result of VMS, but another suggestion is that it arises from restrictive 'days at sea' in other areas (Via and IV). Working at Rockall keeps 'days at sea' elsewhere intact (the years in question do correspond to the introduction of the days at sea legislation) and it is possible that vessels are either working extra days in VIb or they are simply reporting extra days from VIb. Despite the uncertainty about the fishing effort, the lpue for the Scottish fleet increased considerably in 2007 and 2008 compared with previous years (Figure 4.3.4).

The Irish otter trawl effort series indicated low values between 2002 and 2005 with the lowest value in 2004. In 2006–2008, the effort increased considerably (Figure 4.3.3). The lpue demonstrated an increase in 2007 and 2008 (Figure 4.3.4).

The WG decided that the commercial cpue and lpue data, which do not include discards and have not been corrected for changes in fishing power despite known changes in vessel size, engine power, fish-finding technology and net design, were unsuitable for catch-at-age tuning.

Other relevant data

The Irish Fisheries Board (BIM) and the Marine Institute recently conducted a collaborative series of surveys to assess the length structure of haddock at various locations on the Rockall Bank and tested the selectivity of a number of codend configurations, which are typically used by the Irish fleets.

In 2008, the selectivity of gears with different mesh sizes was also investigated at Rockall by Russian scientists.

4.3.3 Historical stock development

Model used:

The assessment is based on catch-at-age data and one survey index (Scottish Groundfish Survey) and conducted using the XSA method.

Software used:

The same software was used as in the last year's assessment (XSA from Lowestoft suite of VPA programs).

Model Options chosen:

Settings for the final XSA assessment did not change compared with the previous assessment (see Stock Annex) and were as follows:

Assessment model: XSA

Tuning indices: one survey index (SCOGFS)

Time-series weights: none

Catchability dependent for ages < 4

Regression type: C

Q plateau: 5

Shrinkage stand. error: 1.0

Shrinkage age-year: 4 years, 3 ages

Minimum stand. error: 0.3

Plus group: 7+

Fbar: 2–5

Input data types and characteristics:

There were no changes in data types and characteristics compared with the previous assessment:

Year range: 1991–2008

Age range: 1–7+

For tunning data the following year and age ranges were used:

Year range: 1991–2008

Age range: 1–6

Data screening

Figures 4.3.6 and 4.3.7 and Table 4.3.10 show landings, discards and total catch by number and weight. Landings, discards and total catch-at-age by number are displayed in Tables 4.3.11–4.3.13.

Mean weights-at-age in total catch, landings, discards and stock are displayed in Tables 4.3.14–4.3.17. The mean weights-at-age in the stock are assumed to be the same as the catch weights. The temporal dynamics of haddock mean weights-at-age in the total catch (including discards) and in the stock are shown in Figure 4.3.8. Mean weights-at-age in total catch increased in 2008 following their decrease in 2007. This increase was observed both in the Scottish landings and in the Russian catches.

The landings of haddock aged 1 were not large and it was hard to consider the catch of fish in this age group. The results from Scottish and Irish investigations demonstrated that the abundance in discards exceeded that of landings. Discarded fish are, primarily, haddock aged 1–2 (see Tables 4.3.1 and 4.3.2 in Stock Annex). Figures of log catch by age demonstrate that these values are much less variable when discards are included (Figures 4.3.9–4.3.14). Data on catches, landings and discards-at-age are given in Tables 4.3.11–4.3.13.

The Scottish trawl survey was the only survey index available to the Working Group. Plots of log cpue by age, year and year class are shown in Figures 4.3.15–4.3.17.

Comparative scatterplots of log index-at-age are shown in Figure 4.3.18b. The survey demonstrates relatively good internal consistency in tracking year-class strength through time.

A SURBA 3.0 run was carried out to analyse the survey data. Previous working groups have concluded that the first three years of the survey should not be used in assessments and that age 0 data were a poor indicator of year-class strength. Here, the runs were actually conducted using the survey data from 1991 onwards to be consistent with the period over which the catch-at-age assessment could be run (the settings: lambda = 1.0, reference age = 3). A summary of the results and residuals is shown in Figure 4.2.18. SSB reveals a declining trend since 1995 but increasing in 2003–2004. The estimates of the temporal component of F are very noisy, but indicates a steep decline since 2000. Retrospective analysis demonstrated consistent estimation of SSB and F (2–5) (Figure 4.3.18a).

Comparative scatterplots of log index at-age are shown in Figure 4.3.18b. The survey demonstrates relatively good internal consistency in tracking year-class strength through time.

Final update assessment

The diagnostics file of the final XSA run is given in Table 4.3.18. Adjusted survey cpue against XSA population estimates are shown in Figure 4.3.19. The analysis of residuals and retrospective analysis (Figures 4.3.20–4.3.22) reveals that applying the chosen parameters for XSA (as done in 2005–2008 assessments) improves the residual and retrospective patterns compared with other exploratory settings. However, there are still some trends apparent in the log-catchability residuals. The results of retrospective analysis conducted at the Working Group in 2002 and 2003 indicated that using shrinkage values of more than 0.5 improved the retrospective curves and demonstrated convergence. In this year's analysis, only 15 years data were available for the retrospective analysis, but a good year-to-year consistency was obtained. Dynamics of fishing mortality-at-age are presented in Figure 4.3.23. The final XSA results are given in Tables 4.3.19–4.3.21. The final XSA and SURBA results are compared in Figure 4.3.24. The SURBA estimates are more variable, but there is a good overall consistency between estimates by the two methods.

Summary plots from the final XSA assessment are shown in Figure 4.3.25.

Comparison with previous assessments

XSA was conducted with the same basic assumptions and setup as last year's assessment. Perceptions of the stock have not changed. Figure 4.3.22 shows, for a comparison, SSB, recruitment-at-age 1 and mean F (2–5) estimates in the present assessment and assessments going back to 2001. The estimates from this year's assessment are reasonably consistent with the assessments carried out in previous years. Estimates of fishing mortality for 2007 have been revised upwards by 7%, and SSB has been revised downwards by 9% (Figure 4.3.26).

State of the stock

Based on this year's estimate of SSB and fishing mortality in 2008, the stock can be considered as having full reproductive capacity and that it is harvested sustainably. Spawning biomass has generally increased in recent years as a result of the 2001 and 2005 year classes. SSB has been above B_{pa} since 2003. Fishing mortality was above F_{pa} throughout most of the time-series but declined in 2005 and has remained below F_{pa} since then.

4.3.4 Short-term projections

Estimating year-class abundance

The abundance index for age 0 in the 2008 survey was low (Figure 4.3.27). VPA abundance for age 1 has been highly correlated with age 0 indices over most of the time-series (from 1993 onwards, Figure 4.3.28). The recruitment (age 1) in 2009 was therefore estimated using RCT3 regression (Shepherd, 1997) relating survey indices to stock abundance.

For forecasting recruitment (age 1) in 2010 and thereafter, a geometric mean was used for 1991–2006.

The input data for the short-term forecast can be found in Table 4.3.22. Status quo fishing mortality is taken as the 3-year mean of the values over the period 2006–2008. Three year mean values were also used for stock weights and catch weights.

For forecasting discards and landings, the proportion of discards/landings-at-age in 1999–2008 was used, (Tables 4.3.11–4.3.13, Figure 4.3.29). The results obtained from the forecast (including discards) are given in Tables 4.3.23–4.3.24. Short-term forecast is also shown in Figure 4.3.30.

The sensitivity analysis of forecast is shown in Figures 4.2.31–4.2.32. There is a small probability of SSB in 2011 being below B_{pa} and F_{sq}.

Stock numbers of recruits and their source for recent year classes used in predictions and the relative (%) contributions to landings and SSB (by weight) of these year classes are presented in Table 4.3.25.

4.3.5 Medium-term projection

Medium term projections were conducted using the MAR-Lab software. There appears to be little or no relationship between spawning biomass and recruitment levels at-age 1 and no attempt to fit a stock recruitment relationship with these data has been made. Particularly high discard rates result in very poor estimation of the both the overall level and the interannual variability of recruitment. Significant year-to-year fluctuations of recruit abundance are noticed, at that, the link between adult haddock biomass and abundance of survived fingerlings and yearlings is absent. In the years when biomass is maximal poor year classes are often observed. So, in 2001, when the stock was the lowest for recent years, one of the most abundant year classes appeared. Strong year classes appear on average once in a 4–5 year period, although the available time-series is relatively short. At F_{sq} = 0.23 and F_{pa} = 0.4, there is less than 5% probability of SSB falling below B_{pa} in the long term (See Figures 4.3.33–4.3.34).

4.3.6 Biological reference points

Precautionary approach reference points

Biological reference points for this stock are given below:

B_{lim}: 6000 t (lowest observed SSB)

B_{pa}: 9000 t (B_{loss} × 1.4)

F_{pa}: 0.4 (by analogy with other haddock stocks).

Figure 4.3.35 shows the stock in 2008 to be above B_{pa} and below F_{pa}.

Yield-per-recruit analysis

The stock–recruitment scatterplot is shown in Figure 4.3.36. Yield-per-recruit results, long-term yield and SSB (conditional on the current exploitation pattern) are shown in Figure 4.3.37. Status quo F (0.23) is approximately 43% lower than F_{max} (0.40) and 28% greater than $F_{0.1}$ (0.18).

4.3.7 Management plans

There is a need for an internationally agreed management plan. This would require a management strategy evaluation to identify an appropriate F_{MSY} target. Such a plan should involve extensive collaboration between stakeholders, scientists and management authorities in both the design and the monitoring of conservation measures. Management measures in the haddock fishery could be a combined application of TAC and limits of fishing efforts and should include effective control and enforcement measures.

4.3.8 Uncertainties and bias in assessment and forecast

The WG considers that the long-term trends in the XSA assessment and survey biomass estimates/indices are probably indicative of the general stock trends. However, F is considered to be poorly estimated as a consequence of the following sources of uncertainty in the current assessment:

1) The method of estimating discards from survey data, although considered appropriate, is likely to be the main source of error.

2) There are concerns over the accuracy of landings statistics from Rockall in earlier years.

3) Historically, there is poor agreement between survey and XSA estimates of population numbers during some periods. This may be related to potential inaccuracies in the landings statistics.

4) In 1999 the gear and tow duration were changed on the Scottish survey. There were no calibrations done to assess possible impacts on catchability for this survey.

5) The XSA assessment demonstrates trends in catchability, even if reduced by weak shrinkage.

6) The XSA assessment diagnostics give quite large standard errors on survivors' estimates (0.3–0.4) and there are often quite different values given by ScoGFS, F-shrinkage and P-shrinkage.

The WG considers that a longer series of more accurate landings, discards (for non-Russian fleets) and survey data will be necessary to overcome these deficiencies.

There are concerns about the ability to forecast future catches and landings given substantial changes in national composition of the fleets operating at Rockall. A substantial change in TAC may lead to big changes in discarding practices. The Working Group previously presented forecast for total catch. However, with increased EU catches with discards, this approach is no longer considered appropriate. The present forecast predicts future catches disaggregated into landings and discard components.

The WG makes the following reservations about the forecast:

1) The future fleet composition at Rockall is very uncertain.

2) Discard proportion has varied considerably over time (Figure 4.3.29). However, no major changes in the pattern of discards-at-age have been observed since 1999. Therefore, average proportions for 1999–2008 were used and it is assumed that these values will also apply for 2009–2011.

4.3.9 Recommendation for next Benchmark

The main conclusion of WGCSE is that and time-series of improved landings and discard data are needed before progress can be made towards the next benchmark assessment of this stock.

Because the survey covers only part of the currently known distribution area of haddock, it is necessary to use other available survey data for the assessment of this stock.

No time frame for the next benchmark could be proposed at this stage.

4.3.10 Management considerations

Fishing mortality levels have historically been high. The fishing mortality has decreased for small individuals (age 1 and 2) since 2001. Survey-based indices of SSB indicate that the stock was at a historical low in 2002, but have increased since.

The short-term forecast was presented disaggregated this year. The basis for this forecast is uncertain. Future management of Rockall haddock should consider the dynamic nature of fleets and fishing practices.

In 2004, an ICES Expert Group met to deal with a request for advice from the EU and Russia concerning Rockall haddock management plans. They concluded that the lack of alternative assessment approaches precluded the identification of potential alternative limits to exploitation that may be useful to long-term management. In addressing this term of reference the Expert Group considered alternative approaches to management.

The Expert Group acknowledged that the Precautionary Approach requires that management be implemented in data poor situations. The Expert Group considered that the principles of the Precautionary Approach may have application to Rockall haddock provided the implementation considers the particular biology of the target species and the way it is exploited. For Rockall haddock the Expert Group considered that the fishing mortality should not be allowed to expand. Adoption of a TAC may actually allow increased fishing mortality if the stock is declining or there is significant unreported catch. Moreover, application of TACs implies that there is a simple relationship between a recorded landing of a species and the effort exerted on that species. Such an assumption is unlikely to be true for Rockall haddock. Furthermore, there are ways of evading TACs including misreporting, highgrading and discarding. For Rockall haddock these may occur to a large extent because of the remote nature of the fishery and the processing of catches at sea by some fleets. The Expert Group concluded that effort regulation rather than TACs may be a better means of controlling fishing mortality on Rockall haddock in the long term but that TAC regulation could be used in future if more objective and accurate biological and fishery information are routinely provided (ICES CM 2004/ACFM:33). In circumstances where population is dominated by small individuals and differences in length of older and younger age groups are not great, the effectiveness of using selective properties of trawl gear is very low. Comparison of the discard practices of the national fleets operating at Rockall indicate that an increase of minimum mesh size (as was the case in 1991) does not result in considerable reduction of the proportion of small individuals in catches, however catch rates are decreased. ACFM 2007 was unable to forecast discards and include them in TAC, and as a result, there were no recommendations on allowable landings. ACOM 2008 recommended applying TAC to landings only.

In the opinion of ACOM 2008, it would be beneficial to develop and introduce into fisheries practice measures aimed at preventing discards of haddock. Elaboration of such measures complies with recommendations under the UNGA Resolutions. Chapter VIII, item 60 of the UNGA Resolution 61/105 urges States, regional and subregional management organizations and arrangements and other relevant international organizations that have not done so to take action to reduce or eliminate fish discards and post-harvest losses, including juvenile fish (UNGA Resolution 61/105, 2007).

In 2004–2008, the analytical methods of stock estimation were improved, the new data on biology and distribution were obtained, a trawl acoustic survey was carried out and the biomass of haddock from the Rockall Bank was estimated. The results from these investigations allow us to draw the following conclusions:

1) As a consequence of the appearance of above-average year classes in 2000–2001, the haddock stock has increased over the past few years. This is corroborated by Russian fishery statistics, biological research data, analytical calculations and Trawl Acoustic Survey in March 2005.
2) The 2005 year class is also a strong one. It has grown to a catchable size and will enhance the fishable stock over the next few years.
3) It would be beneficial to conduct the groundfish/trawl-acoustic survey annually. An annual trawl survey covering the whole of the distributional area may improve the assessment of the stock status.

4) Discarding and the use of small-mesh gear have historically resulted in significant mortality of small haddock.

5) Regulation measures applied for haddock fishery encourage discards. Changes in the level of fishing mortality will not improve the situation as it will still be difficult to present forecasts both for discards and landings, and consequently for fishing mortality rates. Furthermore, there are ways of evading recommended fishing mortality including misreporting, high-grading and discarding.

6) It would be beneficial to develop and introduce into fisheries practice measures aimed at preventing discards of undersized haddock.

7) General management issues aimed at maintaining a healthy stock of Rockall haddock, such as changes in landing size, changes in mesh size, use of square mesh and headline panels, licenses to fishing and closed areas, are currently being discussed through ongoing negotiations between EU and the Russian Federation.

References

Blacker R.W. 1982. Rockall and its fishery. Laboratory Leaflet, Lowestoft. No 55. 23 pp.

Chuksin, Yu. V. and Gerber, E. M. 1976. Soviet fishery in the Rockall and Porcupine areas. Zaprybpromrazvedka. Kaliningrad, 8 pp.

Newton, A. W., Peach, K. J., Coull, K. A., Gault, M. and Needle, C. L. 2008. Rockall and the Scottish haddock fishery. Fisheries research, 94: 133–140.

Shestov, V. P. 1977. Rockall haddock. Fishery biological resources of the North Atlantic and adjacent seas of the Arctic Ocean. Moscow, pp.344–346.

Table 4.3.1. Nominal catch (tonnes) of haddock in Division VIb, 1990–2008, as officially reported to ICES.

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008[1]
Faroe Islands	-	-	-	-	-	-	-	-	-	-	n/a	n/a	-	-	-	-	2	2	16
France	…[2]	…[2]	…[2]	…[2]	…[2]	…[2]	-	-	-		5	2	-	1	-	-	-	-	-
Iceland	-	-	-	-	-	-	-	-	-	167	-	-	-	-	-	-	-	-	-
Ireland	620	640	571	692	956	677	747	895	704	1,021	824	357	206	169	19	105	41	338	721
Norway	38	69	47	68	75	29	24	24	40	61	152	70	49	60	32	33	123	84	36
Portugal	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Russian Federation	-	-	-	-	-	-	-	-	-	458	2154	630	1630	4237	5844	4708	2154	1282	1669
Spain	178	187	51	-	-	28	1	22	21	25	47	51	7	19	-	-	5	-	-
UK (E, W and NI)	238	165	74	308	169	318	293	165	561	288	36	-	-	56	-	-	-	-	-
UK (Scotland)	7139	4792	3777	3045	2535	4439	5753	4114	3768	3970	2470	1205	1145[3]	1607	411[3]	332[3]	440[3]	1643[3]	1779[3]
Total	8213	5853	4520	4113	3735	5491	6818	5220	5098	5990	5688	2315	3037	6148	6306	5178	2765	3349	4221
Unallocated catch	-4329	-198	800	671	1998	-379	-543	-591	-599	-851	-357	-279	299	94	139	1	0	0	0
WG estimate	3884	5655	5320	4784	5733	5112	6275	4629	4499	5139	5331[4]	2036[4]	3336[4]	6242[4]	6445	5179	2765	3349	4221

[1]Preliminary.

[2]Included in Division VIa.

[3]Includes Scotland, England, Wales and NI landings.

[4]includes the total Russian catch.

n/a = not available.

Table 4.3.2. Details of Russian fleet operations in fishery for the haddock on the Rockall Bank (Division VIb) in 2008 (preliminary data).

Month	Tonnage class	Number of vessel/days	Catch of haddock, tonnes	
			Total	Catch per hour
March	9	10	83	0.58
April	9	37	568	0.91
	8	32	148	0.30
May	9	5	50	0.57
	8	29	147	0.29
September	9	4	59	0.81
October	9	33	361	0.60
November	9	14	250	0.87
Total			1666	

Table 4.3.3. Species composition of Russian catch (t) taken with bottom trawls on the Rockall Bank (Division VIb) in 2008 (preliminary data).

Fish species	March	April	May	June	July	August	September	October	November	Total
Haddock	83	716	197		3		59	361	250	1669
Saithe	1	20	3		4	1	1	16	4	50
Anglerfish	3	6	1	1	1		2	13	8	35
Long rough dab		1						1	1	3
Witch	1	2			5	2	1	8	4	23
Other					1			1		2
Total	88	745	2021	1	14	3	63	400	267	1782

Table 4.3.4. Details of UK fleet operations in fishery for the haddock on the Rockall Bank (Division VIb) in 2008 (preliminary data).

			Catch in tonnes	
Month	Country	Gear type	Total	Catch per vessel/day
February	Scotland	OTB	7.4	2.5
	England and Wales	OTB	0.3	0.3
March	Scotland	OTB	239.9	30.0
	Scotland	OTT	13.5	13.5
April	Scotland	OTB	576.8	30.4
	Scotland	PTB	37.7	18.8
May	Scotland	OTB	174.6	14.6
	Scotland	PTB	22.9	11.4
	Northern Ireland	SSC	14.8	14.8
June	Scotland	OTB	102.8	5.4
	Scotland	OTT	13.6	6.8
July	Scotland	OTB	136.6	8.0
	Scotland	OTT	23.8	7.9
August	Scotland	OTB	125.8	18.0
	Scotland	OTT	19.5	19.5
September	Scotland	OTB	219.0	21.9
October	Scotland	OTB	35.4	11.8
November	Scotland	OTB	10.6	5.3
December	Scotland	OTB	3.6	3.6
Total			1779	

OTB – bottom otter trawl, OTT – otter twin trawl, PTB – bottom pair trawl, SSC – Scottish seines.

Table 4.3.5. Details of Irish fleet operations in fishery for the haddock on the Rockall Bank (Division VIb) in 2008 (preliminary data).

Time interval	Catch in tonnes	Effort in hours
1st Quarter	36	730
2nd Quarter	441	5341
3rd Quarter	140	2915
4th Quarter	104	755
Total	721	9740

Table 4.3.6. Details of Scottish discard trips in the Rockall area (Newton *et al.*, 2003).

Trip no.	Date	Gear	No. of hauls	Hours fished	% (by weight) haddock landed of catch	% (by weight) discarded of haddock
1	May 85	Heavy Trawl	20	89.08	74	17.3
2	Jun 85	Heavy Trawl	28	127.17	74	18.6
3	Jun 99	Heavy Trawl	21	110.83	41	74.9
4	Apr 01	Heavy Trawl	11	47.33	96	12.4
5	Jun 01	Heavy Trawl	35	163.58	58	47.5
6	Aug 01	Heavy Trawl	26	130.08	31	69.7

Table 4.3.7. Landings and Discards haddock estimates at Rockall from discard observer trips conducted aboard Irish vessels between 1995 and 2001, and from an observer trip aboard the MFV (February–March 2000). (ICES CM 2004/ACFM:33).

	FAT/ KBG/ 00/4	FAT/ KBG/ 01/12	FAT/ KBG/ 95/1	FAT/ KBG/ 95/2	FAT/ KBG/ 97/7	FAT/ KBG/ 97/8	FAT/ KBG/ 98/4	Feb 2000	Discard rate
Landing	3021	942	12727	6893	14258	25866	23805	4400	
Discards	1864	926	1146	1893	6625	17926	3687	6200	
% discarded	38.16	49.57	8.26	21.54	31.72	40.90	13.40	58.49	27%

Table 4.3.8. Haddock in VIb. Tuning data available for Scottish groundfish survey in September.

```
Haddock WGNSDS 2008 Rockall
101
SCOGFS (Numbers per 10 hours fishing at Rockall)
 1991 2008
 1 1 0.66 0.75
 0 6
```

1	14 458	16 398	4431	683	315	228	37	64	3
1	20 336	44 912	14 631	6135	647	127	200	4	32
1	15 220	37 959	15 689	3716	1104	183	38	73	21
1	23 474	13 287	11 399	4314	696	203	30	12	4
1	16 293	16 971	6648	5993	1935	483	200	1	6
1	33 578	19 420	5903	1940	1317	325	69	6	1
1	28 897	10 693	2384	538	292	281	71	9	1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	10 178	9969	2410	708	279	172	90	64	32
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	31 813	7455	521	284	154	39	14	12	14
1	11 704	20 925	2464	173	105	65	20	10	15
1	2526	10 114	10 927	1656	138	97	100	26	6
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	24 452	4082	920	1506	2107	231	33	13	7
1	3570	18 715	2562	256	1402	1694	349	16	6
1	558	2671	6019	570	254	516	367	28	-1
1	84	222	378	3401	1217	371	164	76	82

Table 4.3.9. Details of Scottish and Irish effort (in hours) in 1985–2008 (preliminary data).

	Scottish fleet			Irish fleet
Year	SCOTRL*	SCOLTR*	SCOSEI*	IROTB*
1985	8421	3081	1677	
1986	7465	4783	507	
1987	8786	9737	402	
1988	12 450	5521	261	
1989	10 161	11 946	1411	
1990	3249	5335	4552	
1991	2995	11 464	6733	
1992	2402	9623	3948	
1993	1632	11 540	1756	
1994	2305	15 543	399	
1995	1789	13 517	1383	9142
1996	1627	17 324	952	7219
1997	563	16 096	1061	7169
1998	1332	12 263	456	7461
1999	11 336	9424	456	8680
2000	12 951	8586	80	9883
2001	7838	1037	42	7244
2002	8304	1100	0	2626
2003	15 000	500	50	4618
2004	15 200	300	50	2070
2005	7788	32	0	2693
2006	9990	231	0	5903
2007	4534	319	44	6589
2008	2497	1016	82	9740

SCOTRL* – Scottish Heavy Trawl, SCOLTR* – Scottish Light Trawl, SCOSEI* – Scottish Seine, IROTB* – Irish bottom otter trawl.

Table 4.3.10. Haddock in VIb International landings, discards and total catch.

	Num (*1000)			Weight, tonnes		
Year	Landings	Discards	Total Catch[1]	Landings	Discards	Total Catch[1]
1991	12302	65832	78134	5656	13228	18884
1992	11418	55964	67383	5321	11871	17192
1993	8767	44656	53423	4781	9853	14634
1994	11400	46628	58028	5732	11023	16755
1995	11784	35467	47251	5587	9168	14756
1996	14066	41506	55572	7072	9356	16428
1997	9965	26980	36945	5167	5894	11061
1998	9034	47831	56865	4986	10862	15848
1999	12930	52881	65811	5356	11062	16418
2000	15999	26033	42031	5444	6609	12053
2001	5361	9222	14583	2123	1535	3658
2002	11167	21899	33066	3117	4152	7270
2003	24409	25087	49496	5969	5521	11490
2004	22705	3989	26694	6437	883	7321
2005	19505	1877	21382	5191	505	5696
2006	9605	1667	11272	2756	386	3142
2007	8936	12261	21197	3348	2242	5590
2008	10209	7603	17812	4221	2100	6320

[1] Landings and discards.

Table 4.3.11. Haddock in VIb. International catch (landings and discards) numbers-(*10^3) at-age.

Run title : HADDOCK LANDISC 2008 ROCKALL

At 15/05/2009 16:55

Catch numbers at age Numbers*10**-3

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE									
1	21186	16084	11178	8170	2749	12096	9957	14224	17282
2	33847	24711	19375	20623	9831	18811	10535	19807	21949
3	15189	18584	15494	17868	21584	10911	5388	10173	12203
4	5341	5361	4938	8209	9756	9612	4098	4763	5499
5	1704	1761	1617	2449	2464	3299	5002	3740	3419
6	346	676	461	476	787	751	1758	2767	2684
+gp	522	206	359	232	79	92	206	1391	2776
0 TOTALNUM	78134	67383	53423	58028	47251	55572	36945	56865	65811

Catch numbers at age Numbers*10**-3

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE									
1	8222	7667	13363	6576	932	1061	2880	1491	476
2	12581	1961	11119	23606	4112	3723	1475	9829	2207
3	10697	1815	4536	14559	10282	7420	1626	3605	11437
4	4917	1018	2445	2063	9212	8124	2414	1503	1291
5	2050	1038	898	1285	1386	753	2291	2213	507
6	1498	484	260	925	296	109	436	1816	964
+gp	2066	601	444	483	474	193	151	741	930
0 TOTALNUM	42031	14583	33066	49496	26694	21382	11273	21197	17812

Table 4.3.12. Haddock in VIb. International landings numbers-(*10³) at-age.

Run title : HADDOCK LANDISC 2008 ROCKALL

At 15/05/2009 16:55

Landings numbers at age Numbers*10**-3

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE									
1	87	86	28	30	1	2	0	4	245
2	6807	3642	1919	1160	146	5149	319	392	2600
3	3011	5624	4740	5299	5205	1861	2102	1815	2994
4	1344	964	1157	3665	4791	4149	2155	1340	1972
5	558	580	489	1040	1319	2347	3658	1898	1228
6	32	364	144	66	279	473	1540	2284	1600
+gp	464	160	290	141	43	85	192	1301	2291
0 TOTALNUM	12302	11418	8767	11400	11784	14066	9965	9034	12930

Landings numbers at age Numbers*10**-3

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE									
1	33	399	657	920	197	887	2344	31	17
2	3445	941	2983	8103	1765	2835	768	1220	749
3	5081	1232	3998	11001	9502	6866	1290	2709	6191
4	3006	752	2111	1846	9119	7913	2356	1074	1164
5	1295	988	809	1188	1364	725	2269	1539	479
6	1176	470	217	878	286	98	428	1623	761
+gp	1963	579	392	475	472	182	150	740	848
0 TOTALNUM	15999	5361	11167	24409	22705	19505	9605	8936	10209

Table 4.3.13. Haddock in VIb. International discards numbers-(*10³) at-age.

Run title : HADDOCK DISC 2008 ROCKALL

At 15/05/2009 16:55

Discard numbers at age Numbers*10**-3

YEAR	1991	1992	1993	1994	**1995***	1996	**1997***	1998	**1999***
AGE									
1	21099	15998	11151	8140	**2748**	12094	**9957**	14220	**17037**
2	27040	21069	17456	19464	**9685**	13662	**10216**	19415	**19348**
3	12178	12961	10755	12570	**16379**	9051	**3286**	8357	**9209**
4	3998	4397	3781	4545	**4965**	5463	**1944**	3423	**3526**
5	1146	1181	1128	1409	**1145**	952	**1344**	1842	**2191**
6	313	312	317	410	**508**	278	**218**	483	**1084**
+gp	58	46	69	91	**36**	7	**15**	91	**485**
0 TOTALNUM	65832	55964	44656	46628	**35467**	41506	**26980**	47831	**52881**

Discard numbers at age Numbers*10**-3

YEAR	2000	**2001***	2002	2003	2004	2005	2006	2007	2008
AGE									
1	8189	**7268**	12706	5655	735	174	536	1459	458
2	9136	**1019**	8136	15503	2346	888	707	8610	1458
3	5616	**583**	539	3558	781	554	336	896	5246
4	1912	**266**	334	217	93	210	58	429	128
5	755	**50**	89	97	22	28	22	674	28
6	322	**15**	43	48	10	11	8	193	203
+gp	103	**21**	51	8	2	11	1	0	82
0 TOTALNUM	26033	**9222**	21899	25087	3989	1877	1667	12261	7603

*** data calculated using estimates from discard observer trips.**

Table 4.3.14. Haddock in VIb. International catch (landings and discards) weights-at-age (kg).

	1	2	3	4	5	6	7
1991	0.142	0.240	0.291	0.378	0.469	0.414	0.679
1992	0.133	0.239	0.318	0.362	0.423	0.567	0.844
1993	0.137	0.238	0.334	0.400	0.493	0.503	0.874
1994	0.153	0.233	0.319	0.420	0.469	0.477	0.721
1995	0.118	0.222	0.309	0.401	0.501	0.460	0.843
1996	0.136	0.278	0.314	0.395	0.553	0.575	0.763
1997	0.136	0.240	0.322	0.382	0.512	0.634	0.944
1998	0.141	0.250	0.308	0.354	0.436	0.546	0.662
1999	0.138	0.208	0.272	0.334	0.379	0.483	0.618
2000	0.189	0.250	0.267	0.321	0.382	0.451	0.707
2001	0.133	0.257	0.320	0.416	0.432	0.521	0.713
2002	0.135	0.239	0.237	0.325	0.509	0.580	0.753
2003	0.153	0.203	0.256	0.350	0.384	0.424	0.753
2004	0.147	0.198	0.244	0.294	0.444	0.609	0.753
2005	0.114	0.197	0.235	0.311	0.459	0.600	0.806
2006	0.093	0.198	0.245	0.329	0.441	0.595	0.787
2007	0.114	0.186	0.266	0.296	0.387	0.497	0.569
2008	0.199	0.241	0.291	0.437	0.571	0.669	0.932

Table 4.3.15. Haddock in VIb. International landings weights-at-age (kg).

	1	2	3	4	5	6	7
1991	0.302	0.402	0.444	0.592	0.724	0.963	0.704
1992	0.136	0.366	0.455	0.658	0.612	0.759	0.954
1993	0.305	0.402	0.503	0.701	0.830	0.820	0.972
1994	0.314	0.356	0.452	0.558	0.638	1.224	0.890
1995	0.377	0.311	0.414	0.479	0.640	0.699	1.236
1996	0.327	0.436	0.501	0.487	0.627	0.709	0.783
1997	-	0.315	0.401	0.444	0.564	0.661	0.973
1998	0.256	0.344	0.494	0.517	0.542	0.591	0.678
1999	0.274	0.338	0.390	0.440	0.505	0.601	0.665
2000	0.272	0.404	0.379	0.407	0.473	0.513	0.740
2001	0.274	0.426	0.383	0.518	0.426	0.518	0.677
2002	0.240	0.422	0.416	0.541	0.565	0.649	0.818
2003	0.100	0.164	0.246	0.351	0.388	0.423	0.758
2004	0.142	0.172	0.241	0.293	0.446	0.617	0.754
2005	0.103	0.184	0.230	0.310	0.461	0.614	0.824
2006	0.084	0.167	0.223	0.327	0.440	0.598	0.789
2007	0.096	0.238	0.275	0.322	0.450	0.523	0.570
2008	0.125	0.197	0.302	0.444	0.583	0.752	0.984

Table 4.3.16. Haddock in VIb. International discards weights-at-age (kg).

	1	2	3	4	5	6	7
1991	0.142	0.199	0.253	0.306	0.345	0.358	0.478
1992	0.133	0.217	0.258	0.298	0.330	0.342	0.464
1993	0.137	0.220	0.260	0.307	0.346	0.359	0.462
1994	0.153	0.226	0.263	0.308	0.345	0.356	0.458
1995	0.118	0.220	0.276	0.325	0.341	0.329	0.379
1996	0.136	0.218	0.276	0.326	0.370	0.348	0.524
1997	0.136	0.238	0.272	0.312	0.372	0.442	0.568
1998	0.141	0.248	0.267	0.291	0.327	0.336	0.436
1999	0.139	0.212	0.255	0.288	0.313	0.318	0.410
2000	0.189	0.267	0.289	0.311	0.330	0.334	0.462
2001	0.135	0.247	0.294	0.344	0.412	0.440	0.495
2002	0.137	0.254	0.308	0.335	0.398	0.338	0.367
2003	0.161	0.223	0.287	0.342	0.337	0.440	0.510
2004	0.148	0.218	0.282	0.343	0.324	0.371	0.469
2005	0.171	0.240	0.298	0.357	0.387	0.473	0.506
2006	0.132	0.233	0.334	0.420	0.495	0.435	0.435
2007	0.115	0.179	0.239	0.232	0.244	0.280	0.406
2008	0.202	0.264	0.279	0.370	0.351	0.358	0.392

Table 4.3.17. Haddock VIb. Stock weights-at-age (kg).

	1	2	3	4	5	6	7
1991	0.142	0.240	0.291	0.378	0.469	0.414	0.679
1992	0.133	0.239	0.318	0.362	0.423	0.567	0.844
1993	0.137	0.238	0.334	0.400	0.493	0.503	0.874
1994	0.153	0.233	0.319	0.420	0.469	0.477	0.721
1995	0.118	0.222	0.309	0.401	0.501	0.460	0.843
1996	0.136	0.278	0.314	0.395	0.553	0.575	0.763
1997	0.136	0.240	0.322	0.382	0.512	0.634	0.944
1998	0.141	0.250	0.308	0.354	0.436	0.546	0.662
1999	0.138	0.208	0.272	0.334	0.379	0.483	0.618
2000	0.189	0.250	0.267	0.321	0.382	0.451	0.707
2001	0.133	0.257	0.320	0.416	0.432	0.521	0.713
2002	0.135	0.239	0.237	0.325	0.509	0.580	0.753
2003	0.153	0.203	0.256	0.350	0.384	0.424	0.753
2004	0.147	0.198	0.244	0.294	0.444	0.609	0.753
2005	0.114	0.197	0.235	0.311	0.459	0.600	0.806
2006	0.093	0.198	0.245	0.329	0.441	0.595	0.787
2007	0.114	0.186	0.266	0.296	0.387	0.497	0.569
2008	0.199	0.241	0.291	0.437	0.571	0.669	0.932

Table 4.3.18. XSA diagnostics in assessment of Haddock in VIb.

Lowestoft VPA Version 3.1

14/05/2009 23:18

Extended Survivors Analysis

HADDOCK LANDISC 2004 ROCKALL

CPUE data from file had6b.tun

Catch data for 18 years. 1991 to 2008. Ages 1 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SCOGFS	1991	2008	0	6	0.66	0.75

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 4

Regression type = C
Minimum of 10 points used for regression
Survivor estimates shrunk to the population mean for ages < 4

Catchability independent of age for ages >= 5

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 4 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.000

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 27 iterations

1

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0.495	0.389	0.114	0.148	0.171	0.05	0.036	0.047	0.068	0.036
2	0.739	0.842	0.149	0.241	0.421	0.154	0.288	0.065	0.223	0.135
3	0.895	1.055	0.265	0.604	0.571	0.327	0.456	0.196	0.224	0.439
4	0.942	1.247	0.245	0.692	0.618	0.905	0.466	0.261	0.28	0.116
5	0.862	1.247	1.021	0.356	1.023	1.211	0.159	0.229	0.406	0.143
6	1.35	1.317	1.257	0.785	0.772	0.696	0.257	0.13	0.286	0.31

Table 4.3.18. cont.

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
1999	4.89E+04	4.64E+04	2.28E+04	9.96E+03	6.54E+03	4.00E+03
2000	2.82E+04	2.44E+04	1.81E+04	7.62E+03	3.18E+03	2.26E+03
2001	7.86E+04	1.57E+04	8.62E+03	5.17E+03	1.79E+03	7.48E+02
2002	1.07E+05	5.75E+04	1.11E+04	5.41E+03	3.31E+03	5.29E+02
2003	4.62E+04	7.59E+04	3.70E+04	4.95E+03	2.22E+03	1.90E+03
2004	2.11E+04	3.19E+04	4.08E+04	1.71E+04	2.18E+03	6.53E+02
2005	3.28E+04	1.65E+04	2.24E+04	2.41E+04	5.66E+03	5.32E+02
2006	6.95E+04	2.59E+04	1.01E+04	1.16E+04	1.24E+04	3.96E+03
2007	2.52E+04	5.43E+04	1.99E+04	6.81E+03	7.33E+03	8.06E+03
2008	1.50E+04	1.93E+04	3.56E+04	1.30E+04	4.21E+03	4.00E+03

Estimated population abundance at 1st Jan 2009

0.00E+00	1.18E+04	1.38E+04	1.88E+04	9.48E+03	2.99E+03

Taper weighted geometric mean of the VPA populations:

5.48E+04	4.25E+04	2.49E+04	1.13E+04	4.77E+03	1.84E+03

Standard error of the weighted Log(VPA populations) :

0.614	0.5579	0.5206	0.5023	0.5785	0.8564

Log catchability residuals.

Fleet : SCOGFS

Age	1991	1992	1993	1994	1995	1996	1997	1998
1	-0.33	0.15	-0.06	0	0.2	0.32	-0.14	99.99
2	-0.41	0.34	0.26	-0.1	0.2	0.28	-0.12	99.99
3	-0.29	0.46	0.21	0.05	-0.02	-0.02	-0.35	99.99
4	-0.13	0.65	0.5	0.22	0.87	0.08	-1.09	99.99
5	-0.19	0.16	0.59	-0.44	0.92	0.03	-0.64	99.99
6	0.04	0.21	-0.03	-0.13	0.12	-0.16	-0.38	99.99

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0.32	99.99	-0.43	-0.22	0.27	99.99	0.12	0.13	0.18	-0.54
2	-0.1	99.99	-0.06	-0.49	0.09	99.99	0.25	0.26	0.03	-0.45
3	-0.05	99.99	0.27	-0.1	-0.24	99.99	0.18	0.04	-0.24	0.1
4	-0.27	99.99	-0.7	-0.81	-0.5	99.99	0.54	0.71	-0.45	0.36
5	-0.35	99.99	-0.43	-1	0.27	99.99	-0.41	0.85	0.31	0.35
6	-0.17	99.99	-0.42	-0.05	0.28	99.99	0.08	0.34	-0.21	-0.3

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	4	5	6
Mean Log	-2.5042	-2.5355	-2.5355
S.E(Log q)	0.6139	0.5577	0.2367

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	0.5	3.889	6.31	0.82	15	0.29	-1.55
2	0.53	3.535	6.12	0.82	15	0.29	-2.14
3	0.48	4.63	6.49	0.86	15	0.23	-2.5

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	0.61	2.434	5.18	0.75	15	0.32	-2.5
5	0.95	0.185	2.82	0.53	15	0.55	-2.54
6	1	-0.036	2.57	0.93	15	0.24	-2.59

Table 4.3.18. cont.

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2007

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	6902	0.372	0	0	1	0.623	0.06
P shrinka	42483	0.56				0.287	0.01
F shrinka	8341	1				0.089	0.05

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
11830	0.3	0.69	3	2.333	0.036

Age 2 Catchability dependent on age and year class strength

Year class = 2006

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	12347	0.226	0.314	1.39	2	0.778	0.15
P shrinka	24922	0.52				0.174	0.077
F shrinka	9935	1				0.047	0.183

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
13814	0.2	0.23	4	1.151	0.135

Age 3 Catchability dependent on age and year class strength

Year class = 2005

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	20467	0.175	0.027	0.15	3	0.787	0.409
P shrinka	11273	0.5				0.17	0.651
F shrinka	29326	1				0.043	0.302

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
18780	0.17	0.13	5	0.774	0.439

Table 4.3.18 cont.

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2004

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	10126	0.168	0.13	0.77	4	0.961	0.109
F shrinka	1889	1				0.039	0.482

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
9483	0.17	0.2	5	1.198	0.116

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2003

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	3310	0.2	0.132	0.66	4	0.935	0.13
F shrinka	698	1				0.065	0.505

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
2991	0.2	0.23	5	1.15	0.143

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 2002

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	2352	0.187	0.161	0.86	5	0.938	0.316
F shrinka	3313	1				0.062	0.234

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
2402	0.19	0.14	6	0.777	0.31

Table 4.3.19. Haddock in VIb. Fishing mortality-at-age.

Run title : HADDOCK LANDISC 2004 ROCKALL

At 14/05/2009 23:18

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1991	1992	1993	1994	1995	1996	1997	1998
AGE								
1	0.2398	0.1772	0.1069	0.1411	0.0507	0.2406	0.1665	0.2447
2	0.602	0.4878	0.3358	0.2935	0.2519	0.5703	0.3416	0.58
3	0.8967	0.807	0.6568	0.5968	0.5728	0.4916	0.3133	0.6545
4	0.9351	0.9826	0.5155	0.9188	0.7862	0.5456	0.3443	0.5062
5	0.427	0.976	0.9567	0.5251	0.8034	0.6804	0.6185	0.6126
6	0.6386	0.2983	0.7532	0.8591	0.3163	0.6142	1.0065	0.864
+gp	0.6386	0.2983	0.7532	0.8591	0.3163	0.6142	1.0065	0.864
0 FBAR 2- 5	0.7152	0.8133	0.6162	0.5836	0.6036	0.572	0.4044	0.5883

Table 8 Fishing mortality (F) at age

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	FBAR **-**
AGE											
1	0.4948	0.3886	0.114	0.1478	0.171	0.05	0.0364	0.0469	0.0675	0.0357	0.05
2	0.7395	0.8422	0.1488	0.2407	0.4211	0.1537	0.2876	0.065	0.2231	0.135	0.1411
3	0.8953	1.0548	0.2651	0.6043	0.5712	0.3265	0.456	0.1957	0.2237	0.4389	0.2861
4	0.9419	1.2473	0.2452	0.692	0.6182	0.9048	0.4662	0.2608	0.2797	0.1162	0.2189
5	0.8622	1.247	1.0209	0.3559	1.0226	1.2111	0.1588	0.2289	0.4059	0.1426	0.2591
6	1.3502	1.317	1.2573	0.7847	0.7722	0.6961	0.2566	0.1298	0.2864	0.3098	0.242
+gp	1.3502	1.317	1.2573	0.7847	0.7722	0.6961	0.2566	0.1298	0.2864	0.3098	
0 FBAR 2- 5	0.8597	1.0978	0.42	0.4732	0.6583	0.649	0.3421	0.1876	0.2831	0.2082	

Table 4.3.20. Haddock in VIb. Stock number-(*10³)at-age.

Run title : HADDOCK LANDISC 2004 ROCKALL

At 14/05/2009 23:18

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1991	1992	1993	1994	1995	1996	1997	1998
AGE								
1	109822	109475	121807	68625	61462	62510	71753	72409
2	82705	70745	75077	89612	48793	47833	40233	49737
3	28353	37087	35562	43937	54708	31053	22141	23408
4	9717	9469	13548	15096	19805	25260	15551	13253
5	5419	3123	2902	6625	4931	7387	11984	9024
6	809	2895	964	913	3208	1808	3063	5286
+gp	1207	877	740	439	319	219	353	2616
0 TOTAL	238032	233672	250600	225247	193227	176070	165080	175732

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	GMST 91-**	AMST 91-**
AGE													
1	48935	28223	78644	107485	46226	21139	32812	69525	25233	14974	0	62353	69428
2	46413	24427	15668	57451	75910	31897	16463	25904	54317	19310	11830	43949	49929
3	22800	18140	8615	11053	36976	40790	22395	10110	19874	35577	13814	24721	27946
4	9960	7625	5172	5411	4945	17100	24092	11621	6806	13009	18780	11531	12977
5	6540	3179	1793	3314	2218	2182	5665	12375	7331	4213	9483	4684	5541
6	4004	2261	748	529	1901	653	532	3957	8059	4000	2991	1598	2096
+gp	4045	3048	908	889	978	1031	937	1367	3265	3833	4704		
0 TOTAL	142697	86903	111548	186133	169153	114791	102897	134860	124885	94916	61602		

Table 4.3.21. Haddock in VIb. Summary table.

Run title : HADDOCK LANDISC 2004 ROCKALL

At 14/05/2009 23:18

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RE Age 1	TOTALB	TOTSPE	LANDIN	YIELD/SS	FBAR 2- 5
1991	109822	51064	15620	5655	0.362	0.7152
1992	109475	50392	18924	5320	0.2811	0.8133
1993	121807	54415	19859	4784	0.2409	0.6162
1994	68625	55594	24215	5733	0.2368	0.5836
1995	61462	47147	29062	5587	0.1923	0.6036
1996	62510	46819	25020	7075	0.2828	0.572
1997	71753	40896	21481	5166	0.2405	0.4044
1998	72409	43097	20454	4984	0.2437	0.5883
1999	48935	32848	16441	5221	0.3175	0.8597
2000	28223	23121	11680	4558	0.3902	1.0978
2001	78644	21206	6720	1918	0.2854	0.42
2002	107485	35283	7041	2571	0.3651	0.4732
2003	46226	36073	13590	5961	0.4386	0.6583
2004	21139	26546	17123	6400	0.3738	0.649
2005	32812	23421	16430	5191	0.316	0.3421
2006	69525	26783	15188	2759	0.1817	0.1876
2007	25233	28981	16001	3348	0.2092	0.2831
2008	14974	32325	24692	4205	0.1703	0.2082
Arith. Mean	63948	37556	17752	4802	0.2849	0.5598
0 Units	(Thousar	(Tonnes)	(Tonnes	(Tonnes)		

Table 4.3.22. Haddock in VIb. Input data for short-term forecast.

MFDP version 1a
Run: 2009
Time and date: 22:45 18,05,09
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

2009

Age	N	M	Mat	PF	PM	SWt
1	9710	0.2	0	0	0	0.135
2	11830	0.2	0	0	0	0.209
3	13814	0.2	1	0	0	0.268
4	18780	0.2	1	0	0	0.354
5	9483	0.2	1	0	0	0.466
6	2991	0.2	1	0	0	0.587
7	4704	0.2	1	0	0	0.752

Catch

Age	Sel	CWt	DSel	DCWt
1	0.0109	0.101	0.0391	0.15
2	0.0516	0.201	0.0895	0.225
3	0.1995	0.267	0.0866	0.284
4	0.1756	0.364	0.0433	0.341
5	0.2162	0.491	0.0428	0.363
6	0.2097	0.624	0.0323	0.358
7	0.2287	0.781	0.0132	0.411

2010

Age	N	M	Mat	PF	PM	SWt
1	62353	0.2	0	0	0	0.135
2	.	0.2	0	0	0	0.209
3	.	0.2	1	0	0	0.268
4	.	0.2	1	0	0	0.354
5	.	0.2	1	0	0	0.466
6	.	0.2	1	0	0	0.587
7	.	0.2	1	0	0	0.752

Catch

Age	Sel	CWt	DSel	DCWt
1	0.0109	0.101	0.0391	0.15
2	0.0516	0.201	0.0895	0.225
3	0.1995	0.267	0.0866	0.284
4	0.1756	0.364	0.0433	0.341
5	0.2162	0.491	0.0428	0.363
6	0.2097	0.624	0.0323	0.358
7	0.2287	0.781	0.0132	0.411

2011

Age	N	M	Mat	PF	PM	SWt
1	62353	0.2	0	0	0	0.135
2	.	0.2	0	0	0	0.209
3	.	0.2	1	0	0	0.268
4	.	0.2	1	0	0	0.354
5	.	0.2	1	0	0	0.466
6	.	0.2	1	0	0	0.587
7	.	0.2	1	0	0	0.752

Catch

Age	Sel	CWt	DSel	DCWt
1	0.0109	0.101	0.0391	0.15
2	0.0516	0.201	0.0895	0.225
3	0.1995	0.267	0.0866	0.284
4	0.1756	0.364	0.0433	0.341
5	0.2162	0.491	0.0428	0.363
6	0.2097	0.624	0.0323	0.358
7	0.2287	0.781	0.0132	0.411

Input units are thousands and kg - output in tonnes

Table 4.3.23. Haddock in VIb. Short-term forecast.

MFDP version 1a
Run: 2009
Time and date: 22:45 18,05,09
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

2009

		Catch	Landings		Discards	
Biomass	SSB	FMult	FBar	Yield	FBar	Yield
23846	20062	1	0.1607	3480	0.0656	915

2010							2011	
		Catch	Landings		Discards			
Biomass	SSB	FMult	FBar	Yield	FBar	Yield	Biomass	SSB
28253	18255	0	0	0	0	0	39097	20010
.	18255	0.2	0.0321	729	0.0131	203	38053	19072
.	18255	0.4	0.0643	1424	0.0262	399	37054	18178
.	18255	0.6	0.0964	2088	0.0393	589	36099	17327
.	18255	0.8	0.1286	2721	0.0524	773	35186	16517
.	18255	1	0.1607	3325	0.0656	951	34313	15746
.	18255	1.2	0.1929	3902	0.0787	1123	33477	15011
.	18255	1.4	0.225	4452	0.0918	1290	32678	14312
.	18255	1.6	0.2572	4977	0.1049	1451	31912	13646
.	18255	1.8	0.2893	5479	0.118	1608	31180	13011
.	18255	2	0.3215	5957	0.1311	1760	30479	12407
.	18255	2.2	0.3536	6414	0.1442	1908	29807	11831
.	18255	2.4	0.3857	6851	0.1573	2051	29164	11283
.	18255	2.6	0.4179	7268	0.1704	2190	28547	10761
.	18255	2.8	0.45	7666	0.1835	2326	27957	10263
.	18255	3	0.4822	8046	0.1967	2457	27390	9789
.	18255	3.2	0.5143	8409	0.2098	2585	26848	9338
.	18255	3.4	0.5465	8756	0.2229	2709	26327	8908
.	18255	3.6	0.5786	9088	0.236	2829	25828	8498
.	18255	3.8	0.6108	9405	0.2491	2947	25349	8108
.	18255	4	0.6429	9708	0.2622	3061	24889	7736

Input units are thousands and kg - output in tonnes

Table 4.2.24. Haddock in VIb. Detailed short-term forecast output.

MFDP version 1a
Run: 2009
Time and date: 22:45 18,05,09
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

Year:	2009	F multiplier	1	Fleet1 HCF	0.1607	Fleet1 DFb	0.0656						
	Catch												
Age	F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)	
1	0.0109	94	9	0.0391	336	50	9710	1311	0	0	0	0	
2	0.0516	517	104	0.0895	897	202	11830	2472	0	0	0	0	
3	0.1995	2183	583	0.0866	947	269	13814	3702	13814	3702	13814	3702	
4	0.1756	2694	981	0.0433	664	227	18780	6648	18780	6648	18780	6648	
5	0.2162	1644	807	0.0428	325	118	9483	4419	9483	4419	9483	4419	
6	0.2097	507	316	0.0323	78	28	2991	1756	2991	1756	2991	1756	
7	0.2287	870	679	0.0132	50	21	4704	3537	4704	3537	4704	3537	
Total		8508	3480		3299	915	71312	23846	49772	20062	49772	20062	

Year:	2010	F multiplier	2	Fleet1 HCF	0.3215	Fleet1 DFb	0.1311					
	Catch											
Age	F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0218	1174	119	0.0782	4213	632	62353	8418	0	0	0	0
2	0.1032	619	124	0.179	1074	242	7562	1580	0	0	0	0
3	0.399	2338	624	0.1732	1015	288	8411	2254	8411	2254	8411	2254
4	0.3512	2206	803	0.0866	544	185	8496	3008	8496	3008	8496	3008
5	0.4324	3811	1871	0.0856	754	274	12353	5756	12353	5756	12353	5756
6	0.4194	1820	1136	0.0646	280	100	5992	3518	5992	3518	5992	3518
7	0.4574	1639	1280	0.0264	95	39	4946	3720	4946	3720	4946	3720
Total		13608	5957		7975	1760	110114	28253	40199	18255	40199	18255

Year:	2011	F multiplier	2	Fleet1 HCF	0.3215	Fleet1 DFb	0.1311					
	Catch											
Age	F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0218	1174	119	0.0782	4213	632	62353	8418	0	0	0	0
2	0.1032	3782	760	0.179	6560	1476	46192	9654	0	0	0	0
3	0.399	1298	347	0.1732	563	160	4669	1251	4669	1251	4669	1251
4	0.3512	1009	367	0.0866	249	85	3886	1376	3886	1376	3886	1376
5	0.4324	1385	680	0.0856	274	100	4490	2092	4490	2092	4490	2092
6	0.4194	1830	1142	0.0646	282	101	6025	3537	6025	3537	6025	3537
7	0.4574	1829	1428	0.0264	106	43	5520	4151	5520	4151	5520	4151
Total		12308	4843		12247	2597	133135	30479	24590	12407	24590	12407

Input units are thousands and kg - output in tonnes

Table 4.3.25. Haddock VIb. Stock numbers of recruits and their source for recent year classes used in predictions and the relative (%) contributions to landings and SSB (by weight) of these year classes.

Year-class			2005	2006	2007	2008	2009
Stock No. (thousands) of 1 year-olds			69525	25233	14974	9710	62353
Source			XSA	XSA	XSA	RCT3	GM91-06
Status Quo F:							
% in	2009	landings	28.2	16.8	3.0	0.3	-
% in	2010	landings	31.6	13.3	10.7	2.0	1.8
% in	2009	SSB	33.1	18.5	0.0	0.0	-
% in	2010	SSB	31.5	16.5	12.3	0.0	0.0
% in	2011	SSB	29.1	16.5	11.6	9.2	0.0

GM : geometric mean recruitment

Haddock V|b : Year-class % contribution to

a) 2010 landings **b) 2011 SSB**

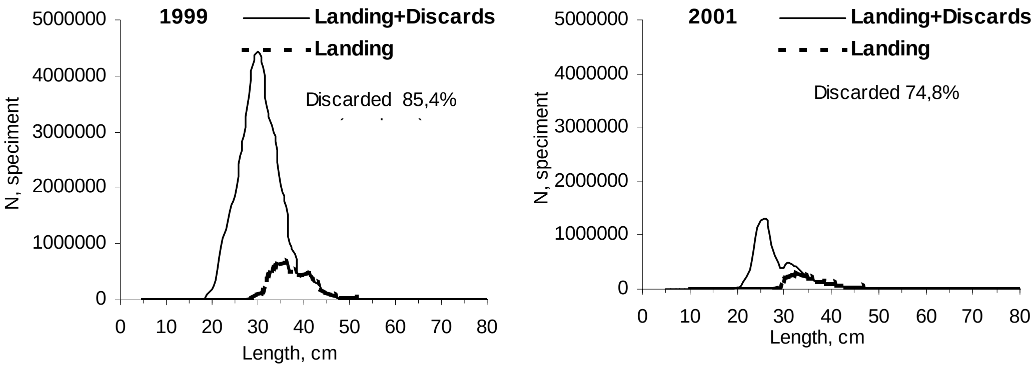


Figure 4.3.1. Length distribution and quantity of haddock lifted on board and landings by Scottish trawlers in 1999 and 2001 (unpublished data, Newton, 2004).

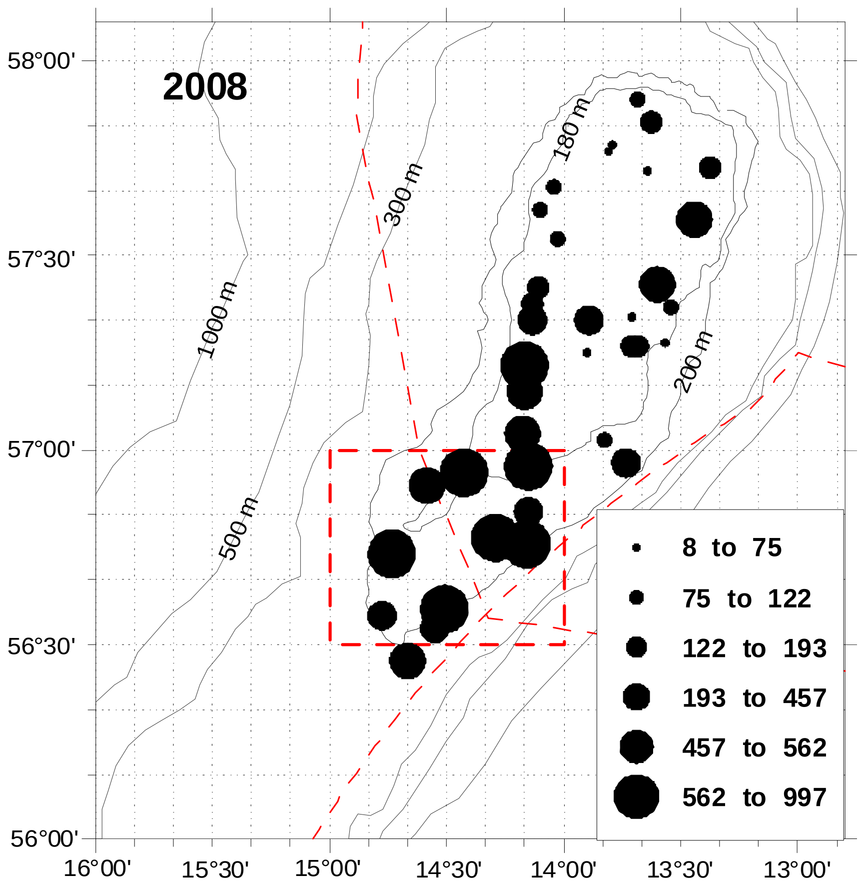


Figure 4.3.2. Distribution of haddock (catch per 30 minutes) on the Rockall Bank in 2008 from the Scottish trawl survey.

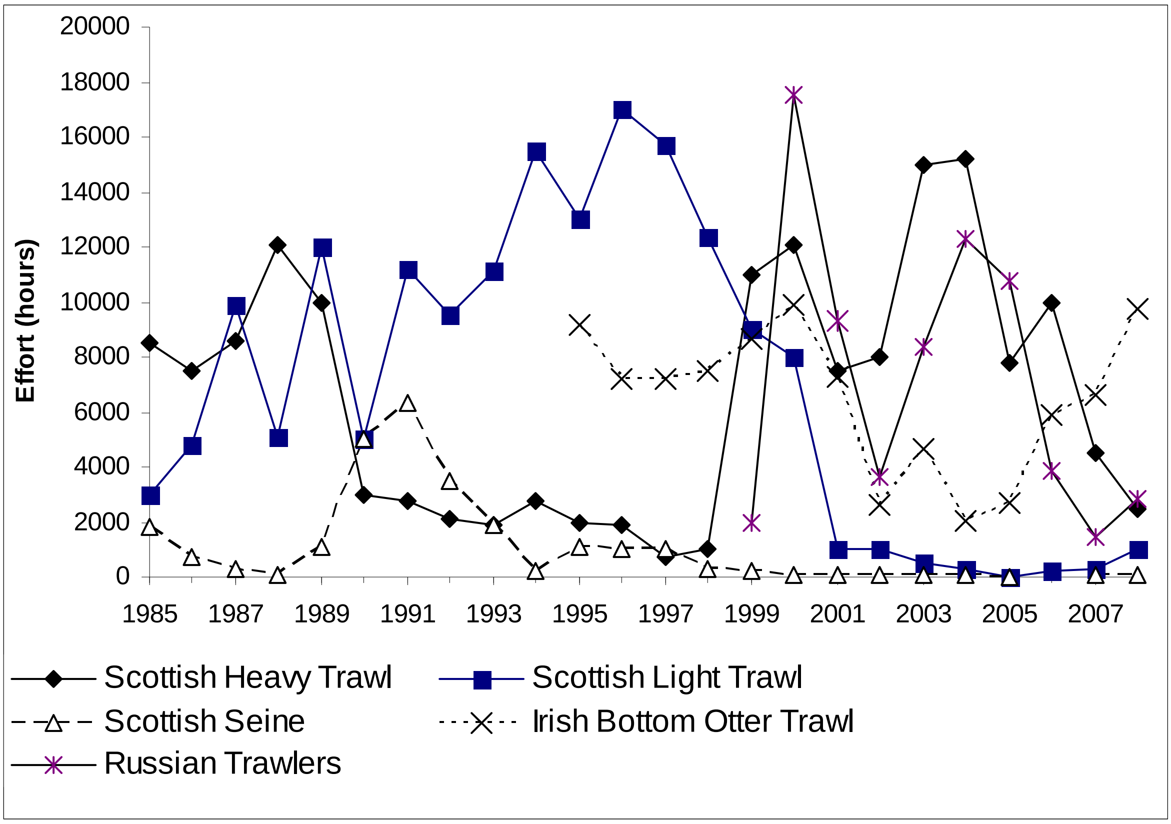


Figure 4.3.3. Rockall haddock in VIb. Scottish, Irish and Russian effort in 1985–2008.

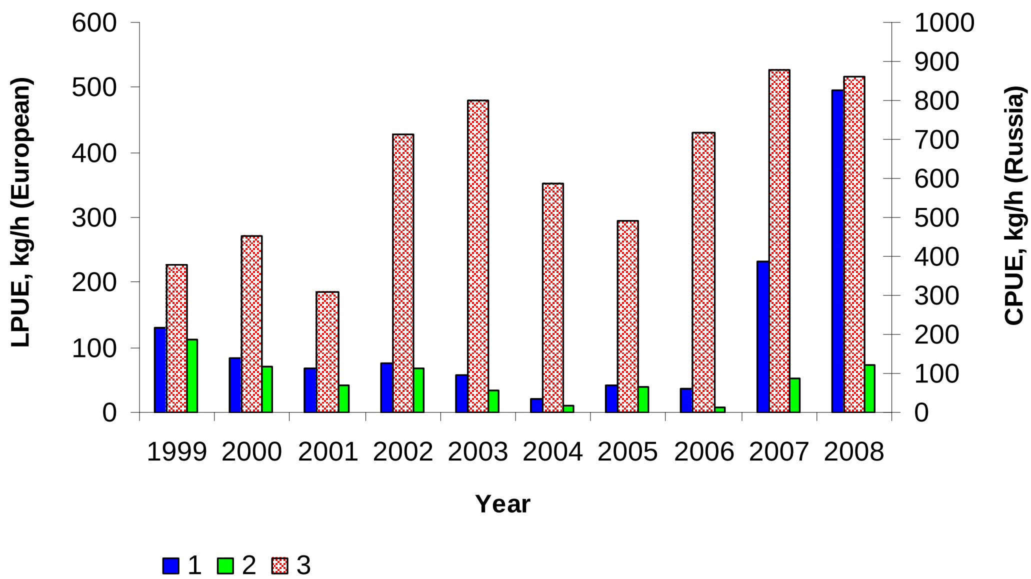


Figure 4.3.4. Lpue and cpue of the fleets fishing for Rockall haddock. Note that Scottish and Irish effort data are not reliable because reporting is not mandatory.

1 – Scottish lpue (all gears).

2 – Irish trawlers lpue.

3 – Cpue of Russian trawlers (BMRT type, tonnage class 10 in 1999–2007, and tonnage class 9 in 2008).

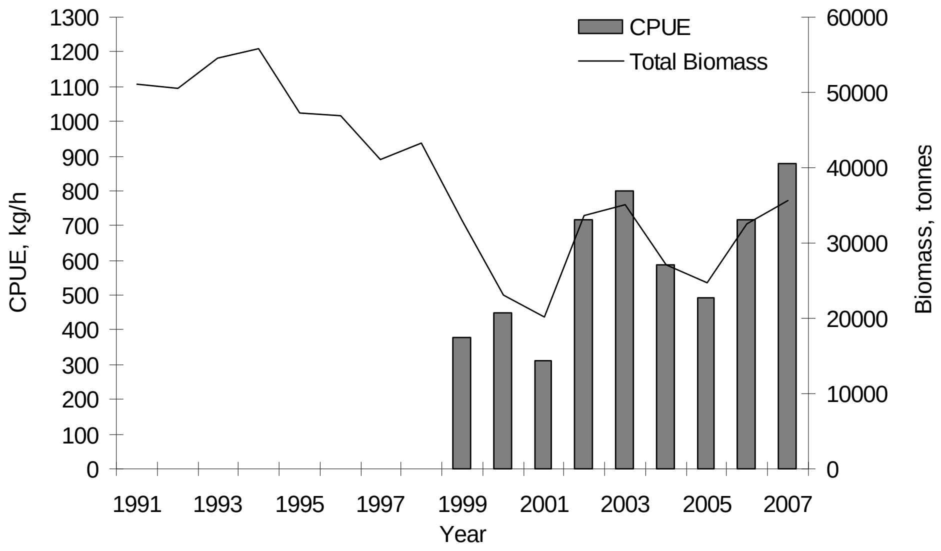


Figure 4.3.5. Dynamics of haddock total biomass (ICES, 2008a; ICES, 2008b) and directed fishing efficiency (t per a trawling hour) for tonnage class 10 vessels in 1999–2007.

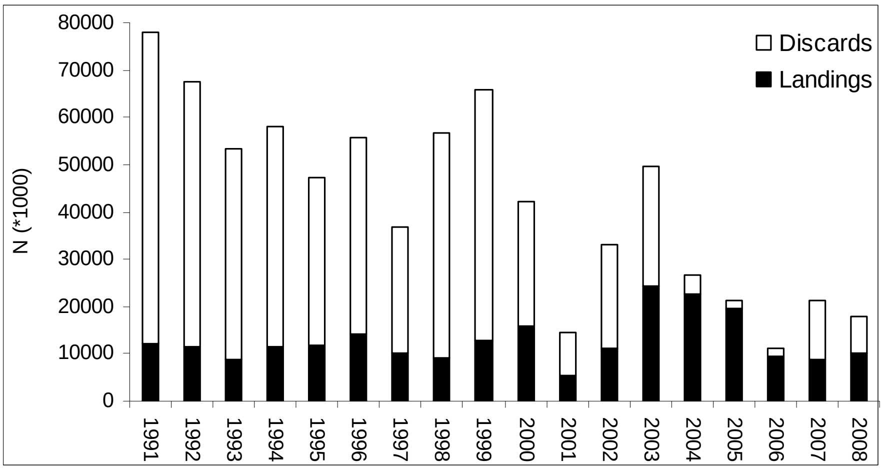


Figure 4.3.6. Total landings and discards of Rockall haddock ('000 individuals).

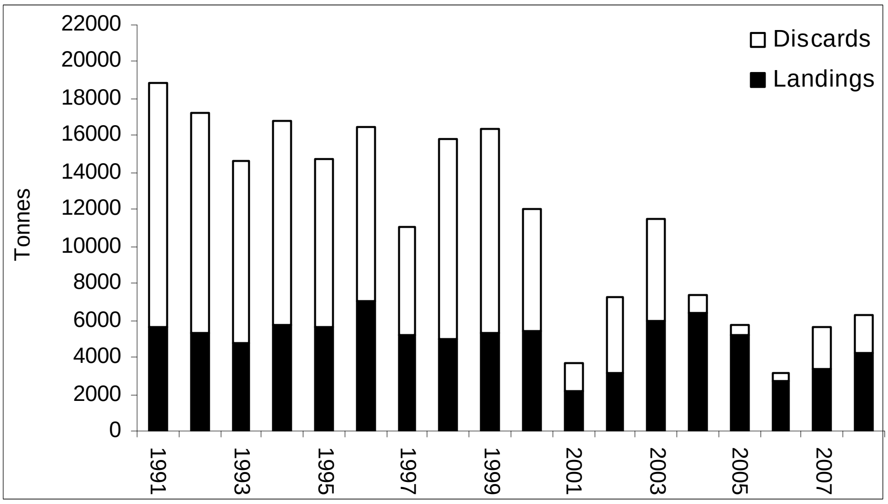


Figure 4.3.7. Total landings and discards of Rockall haddock (tonnes).

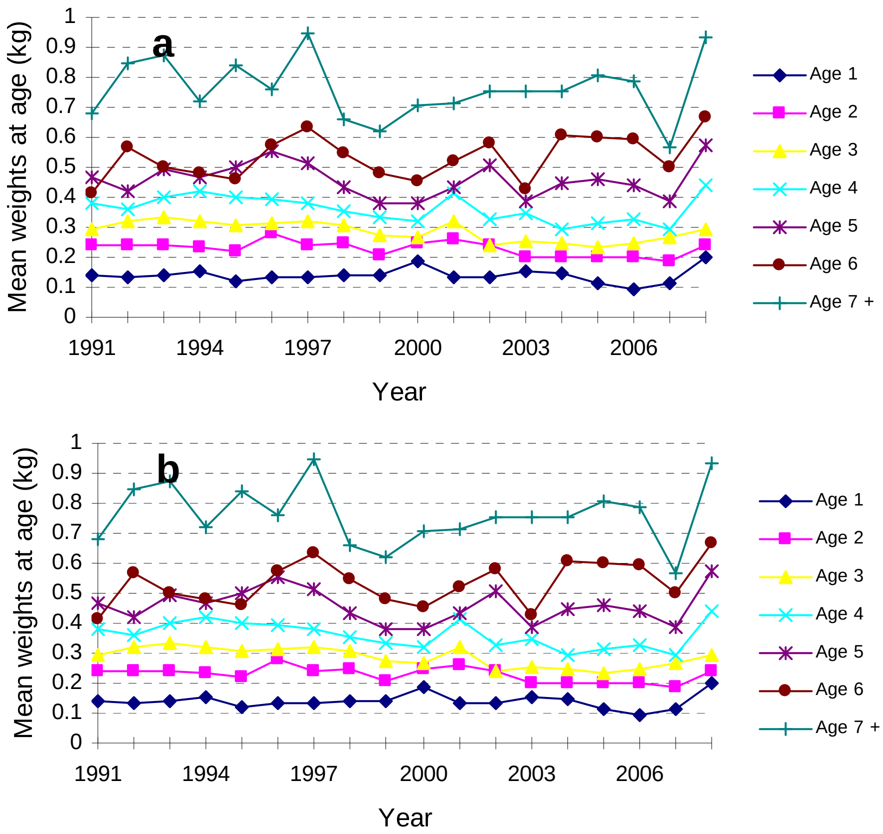


Figure 4.3.8. Haddock in VIb. Mean weights-at-age a) in catch and b) in stock.

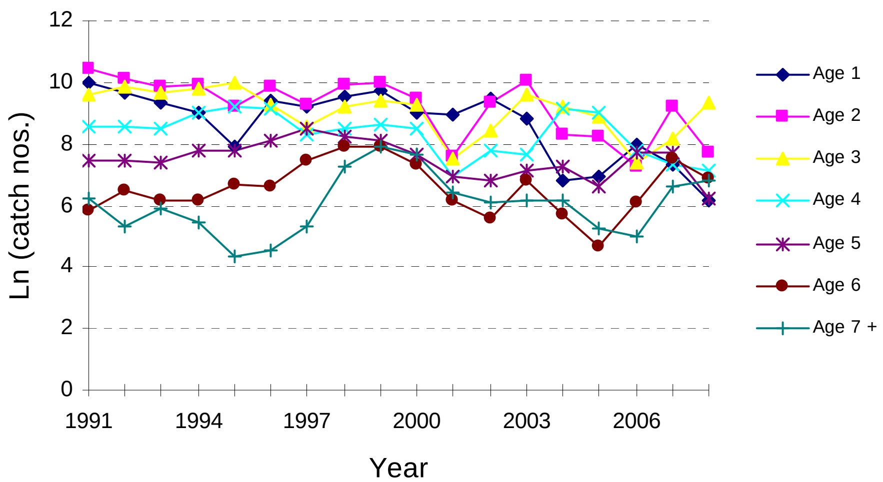


Figure 4.3.9. Haddock in VIb. Log catch-(with discards in numbers)at-age by year.

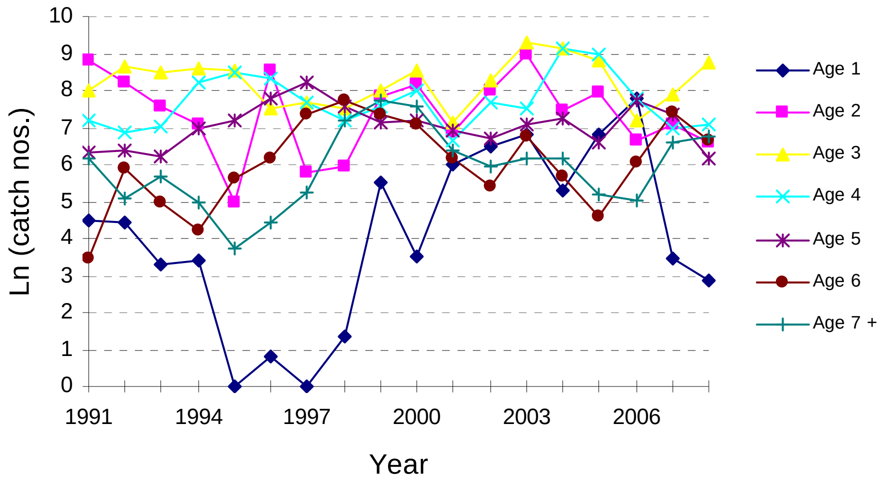


Figure 4.3.10. Haddock in VIb. Log landings-(in numbers)at-age by year.

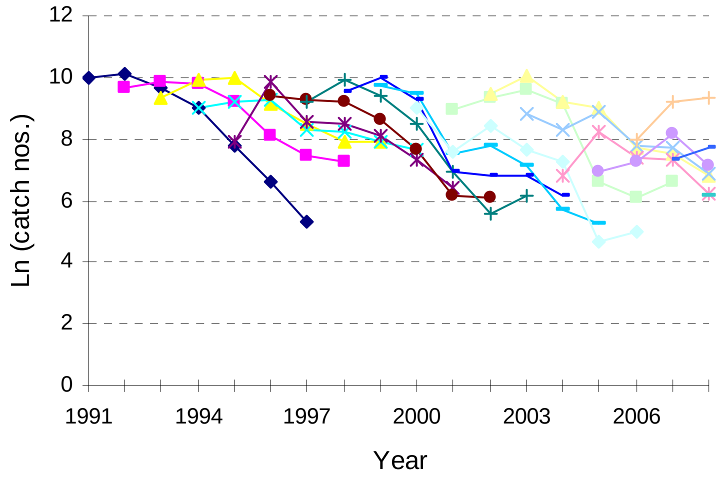


Figure 4.3.11. Haddock in VIb. Log catch-(with discards, in numbers)at-age by year class.

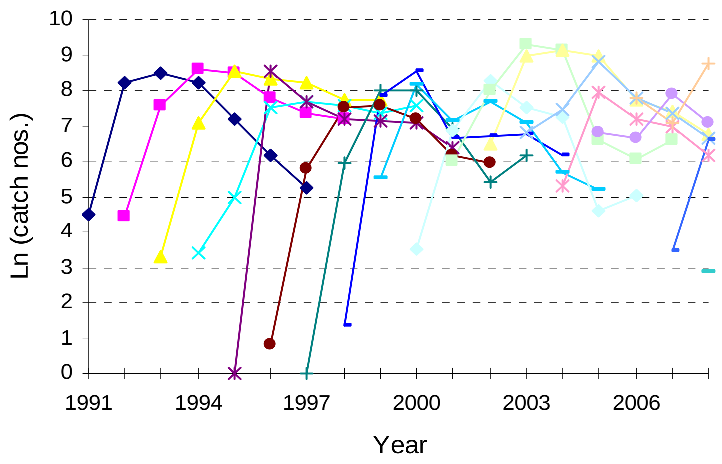


Figure 4.3.12. Haddock in VIb. Log landings-(without registered discards, in numbers)at-age by year class.

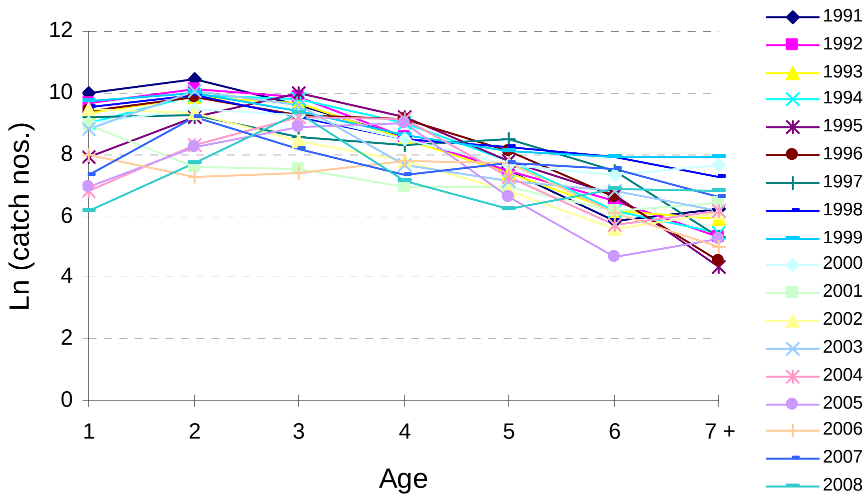


Figure 4.3.13. Haddock in VIb. Catch curves (with registered discards).

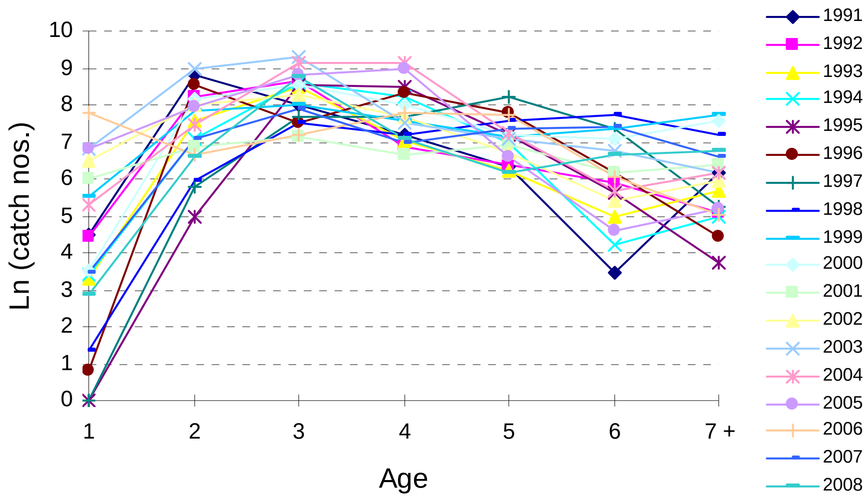


Figure 4.3.14. Haddock in VIb. Catch curves (landings without registered discards).

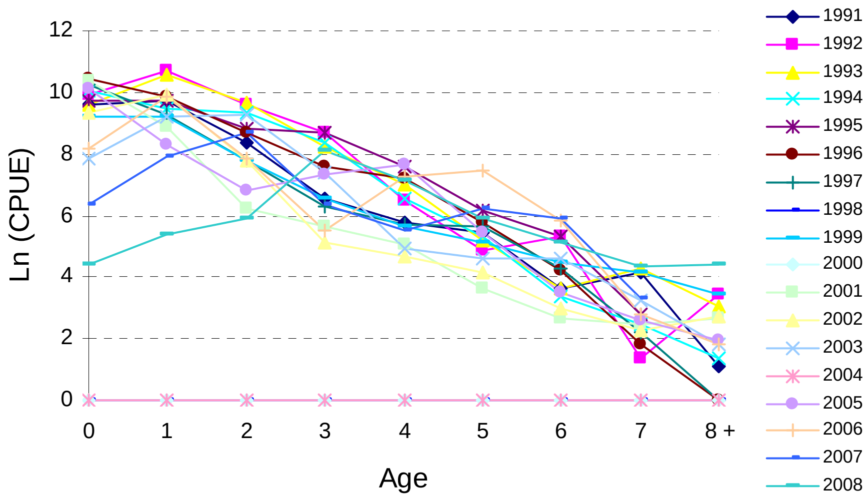


Figure 4.3.15. Haddock in VIb. Log survey cpue at-age by year.

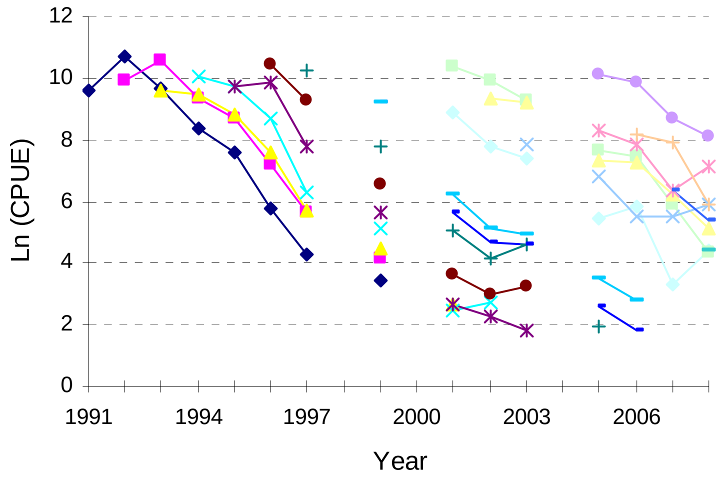


Figure 4.3.16. Haddock in VIb. Log survey cpue by year class.

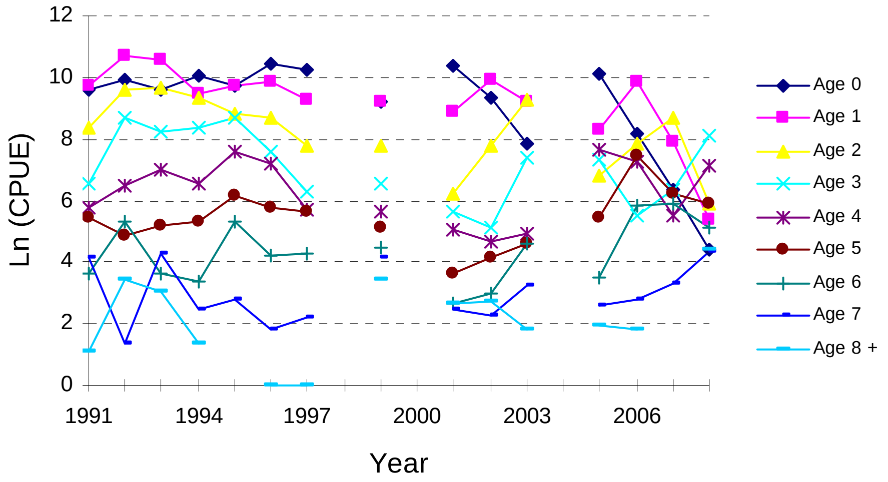


Figure 4.3.17. Haddock in VIb. Log survey cpue at-age.

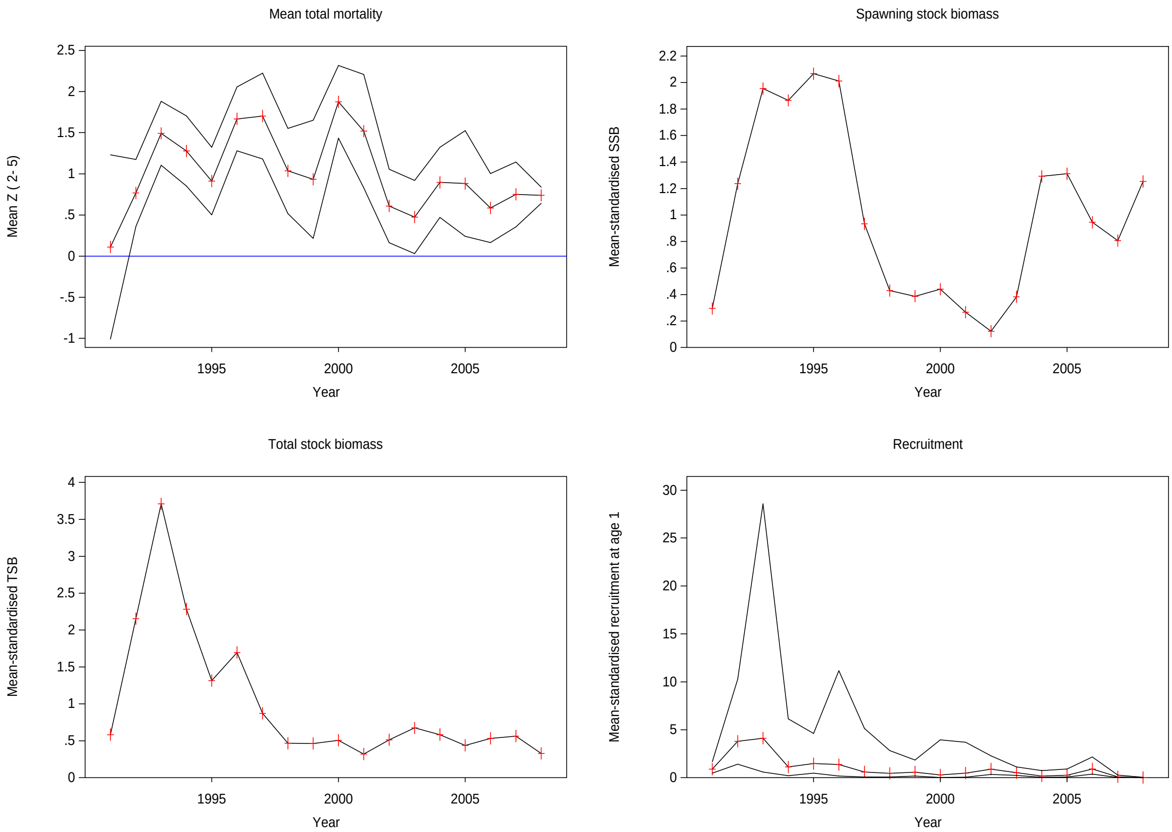


Figure 4.3.18. SURBA analysis for Rockall haddock.

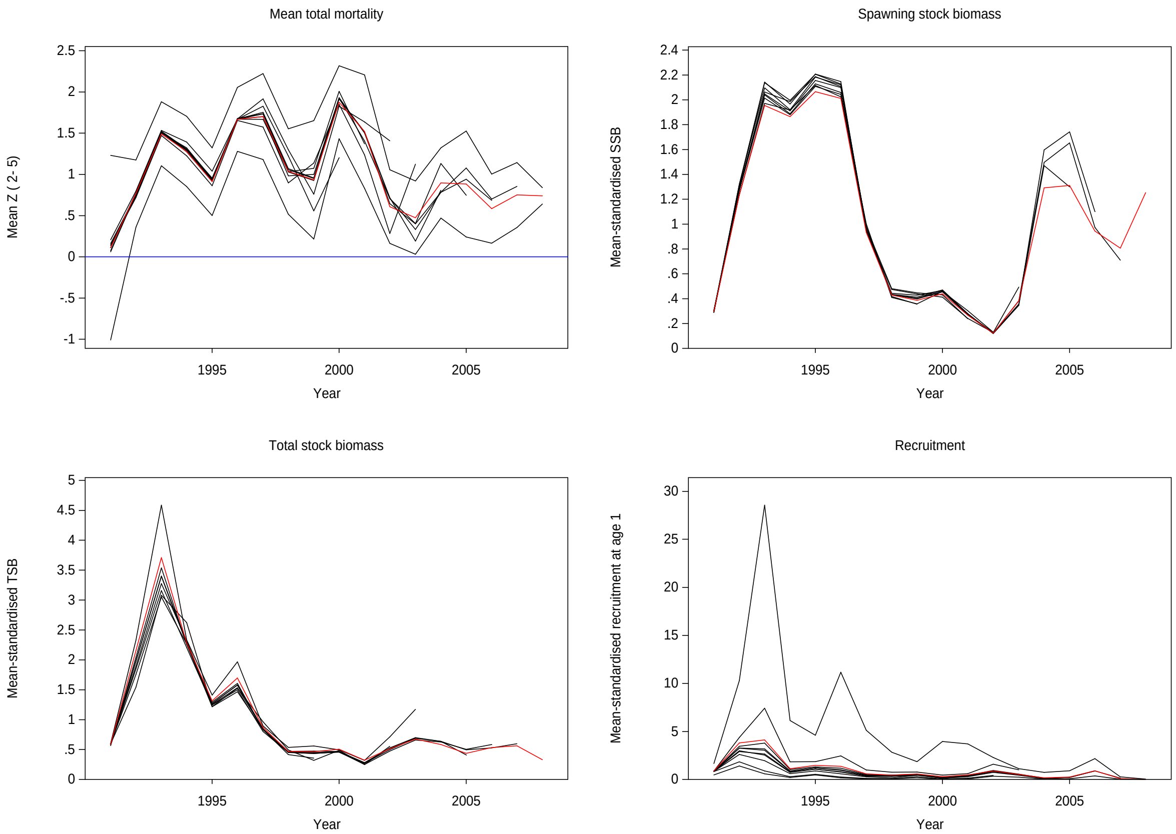


Figure 4.3.18a. SURBA analysis for Rockall haddock. Retrospective plots.

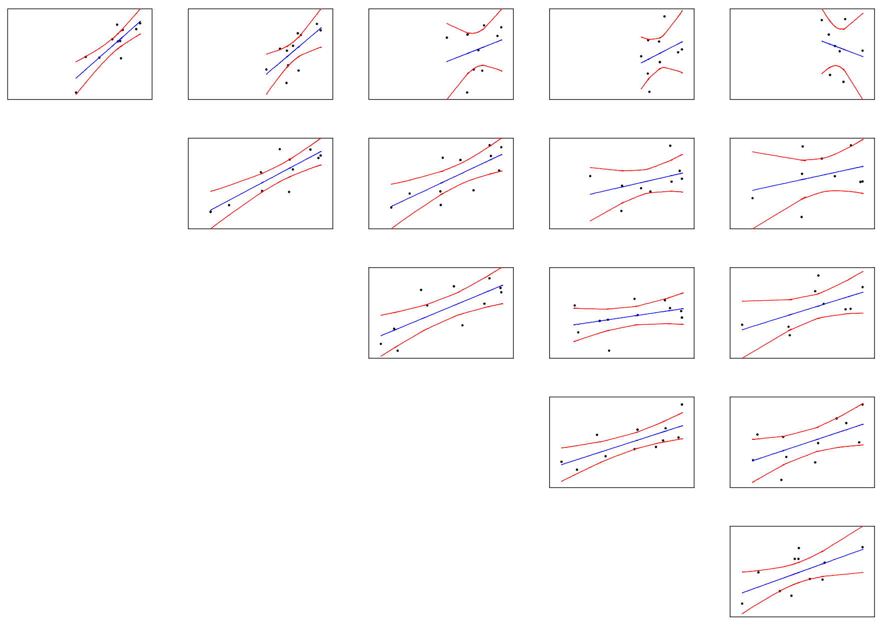


Figure 4.3.18b. SURBA analysis for Rockall haddock. Pairwise plots of age.

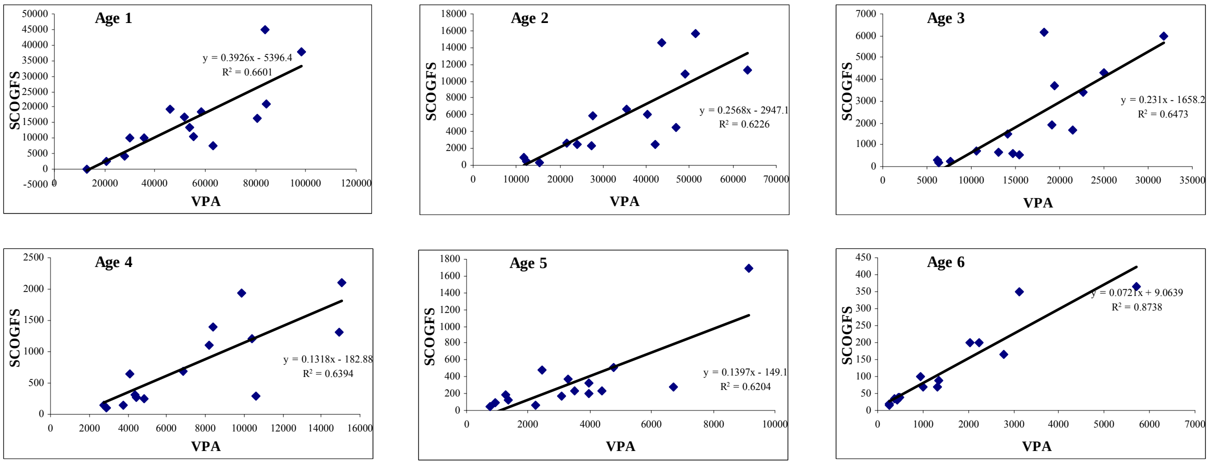


Figure 4.3.19. Haddock in VIb. Scottish groundfish survey adjusted cpue values from the final XSA run plotted against VPA numbers (shrinkage 1.0) at-age. Catchability dependent on stock size at-ages < 4.

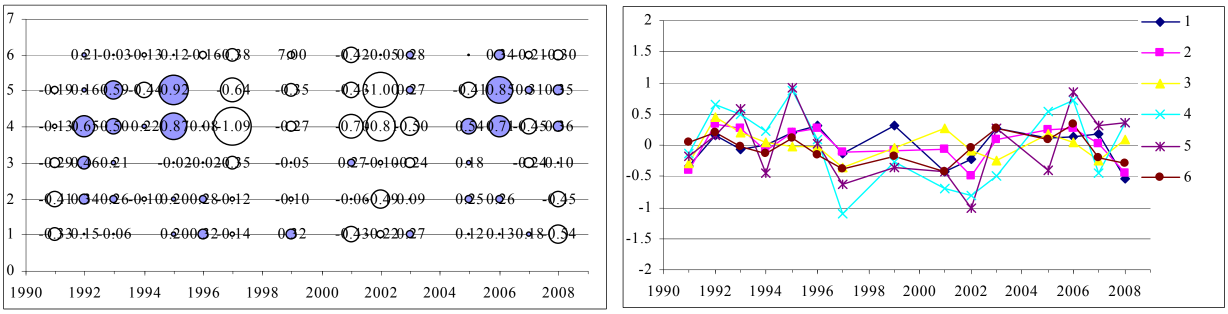


Figure 4.3.20. Haddock in VIb. Log catchability residual plots (shrinkage 1.0). Final XSA: catchability dependent on stock size at-ages < 4.

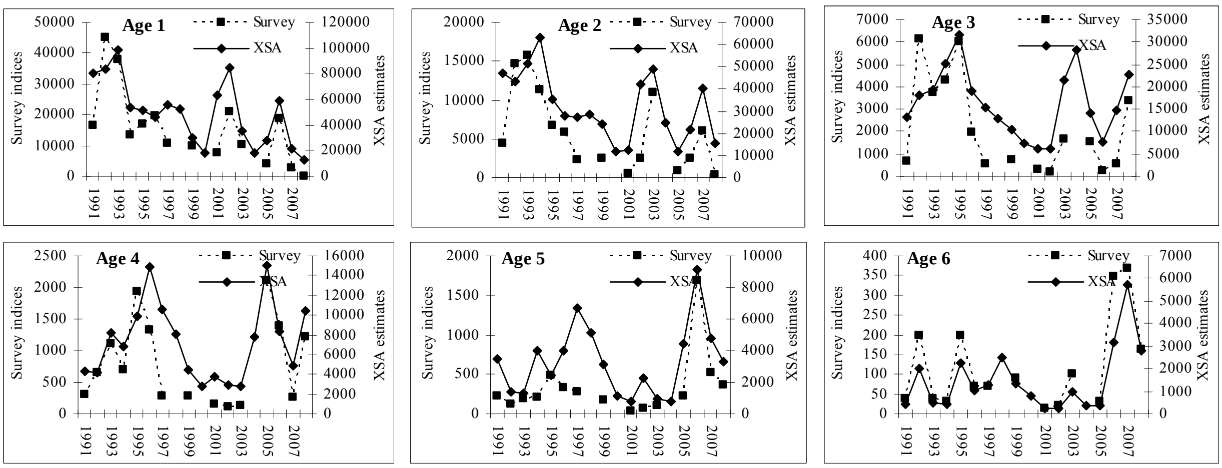


Figure 4.3.21. Haddock in VIb. Survey indices and XSA estimates (shrinkage 1.0) at-age. Final XSA: catchability dependent on stock size at-ages < 4.

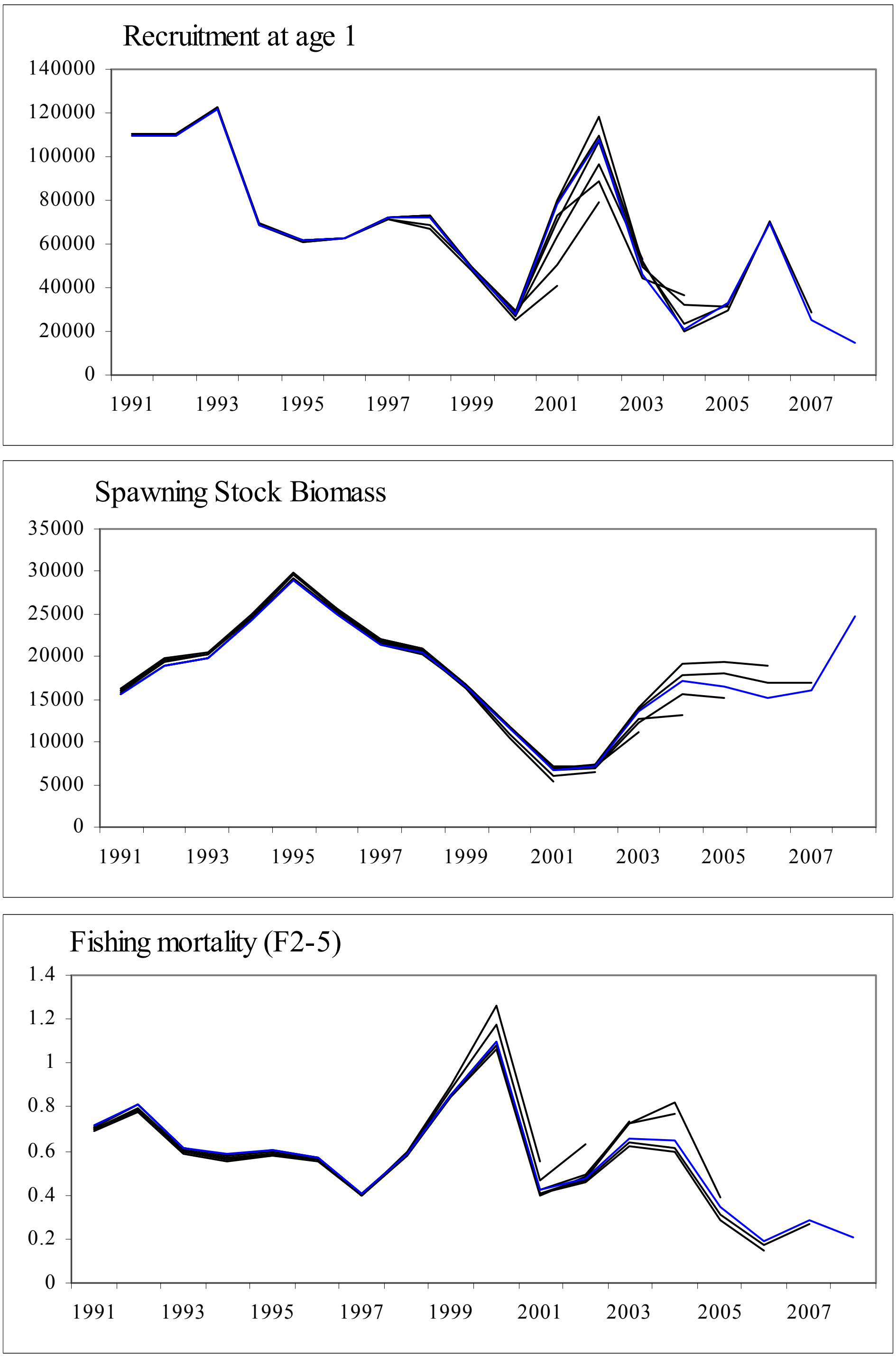


Figure 4.3.22. Haddock in VIb. Retrospective analyses (F shrinkage 1.0).

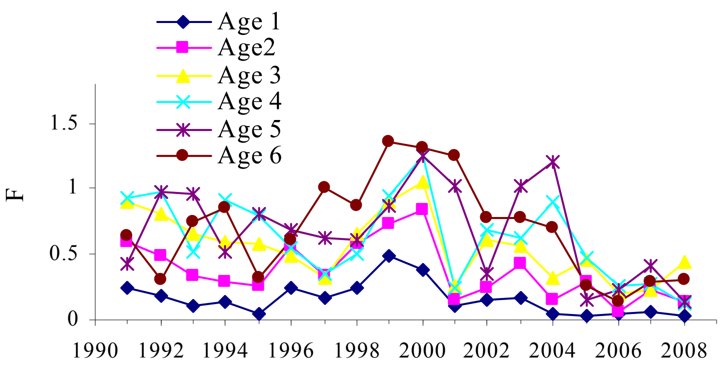


Figure 4.3.23. Haddock in VIb. F at-age (F shrinkage 1.0).

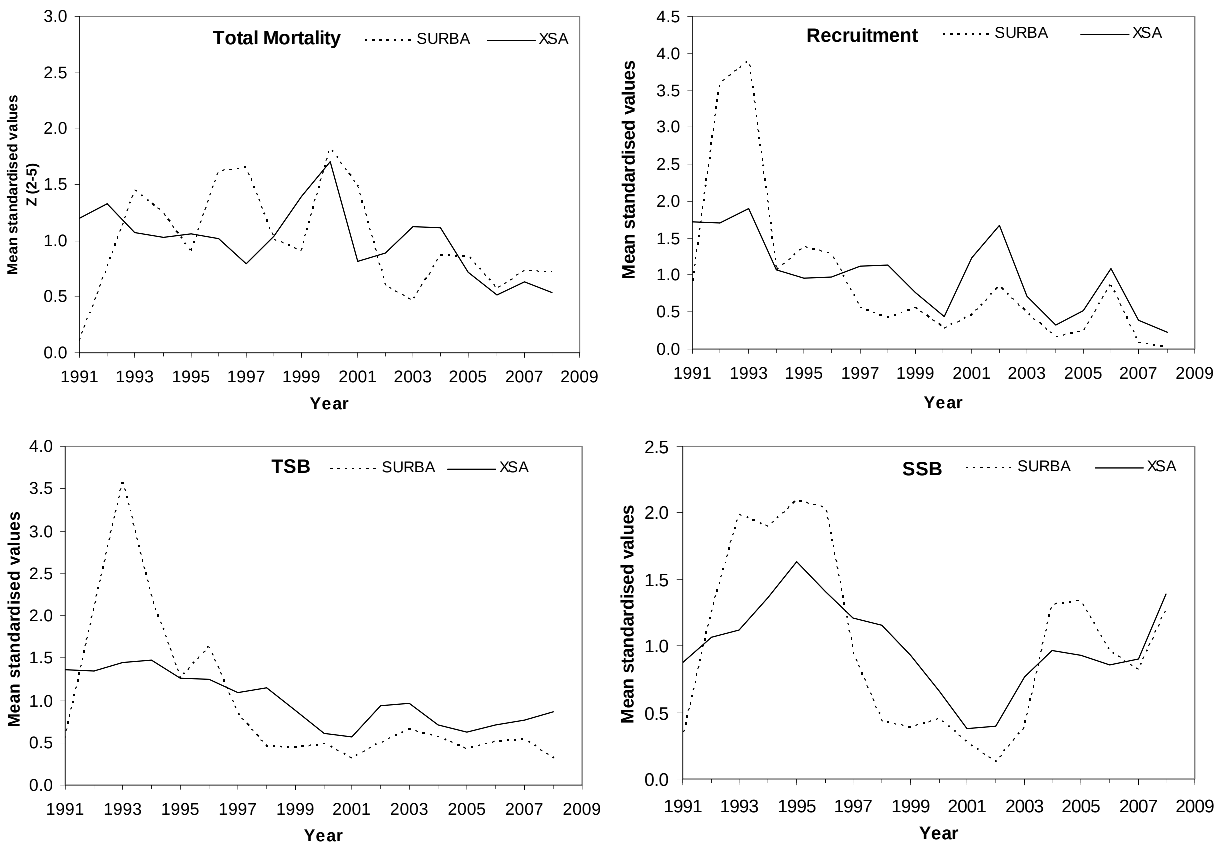


Figure 4.3.24. Haddock in VIb. XSA and SURBA analysis.

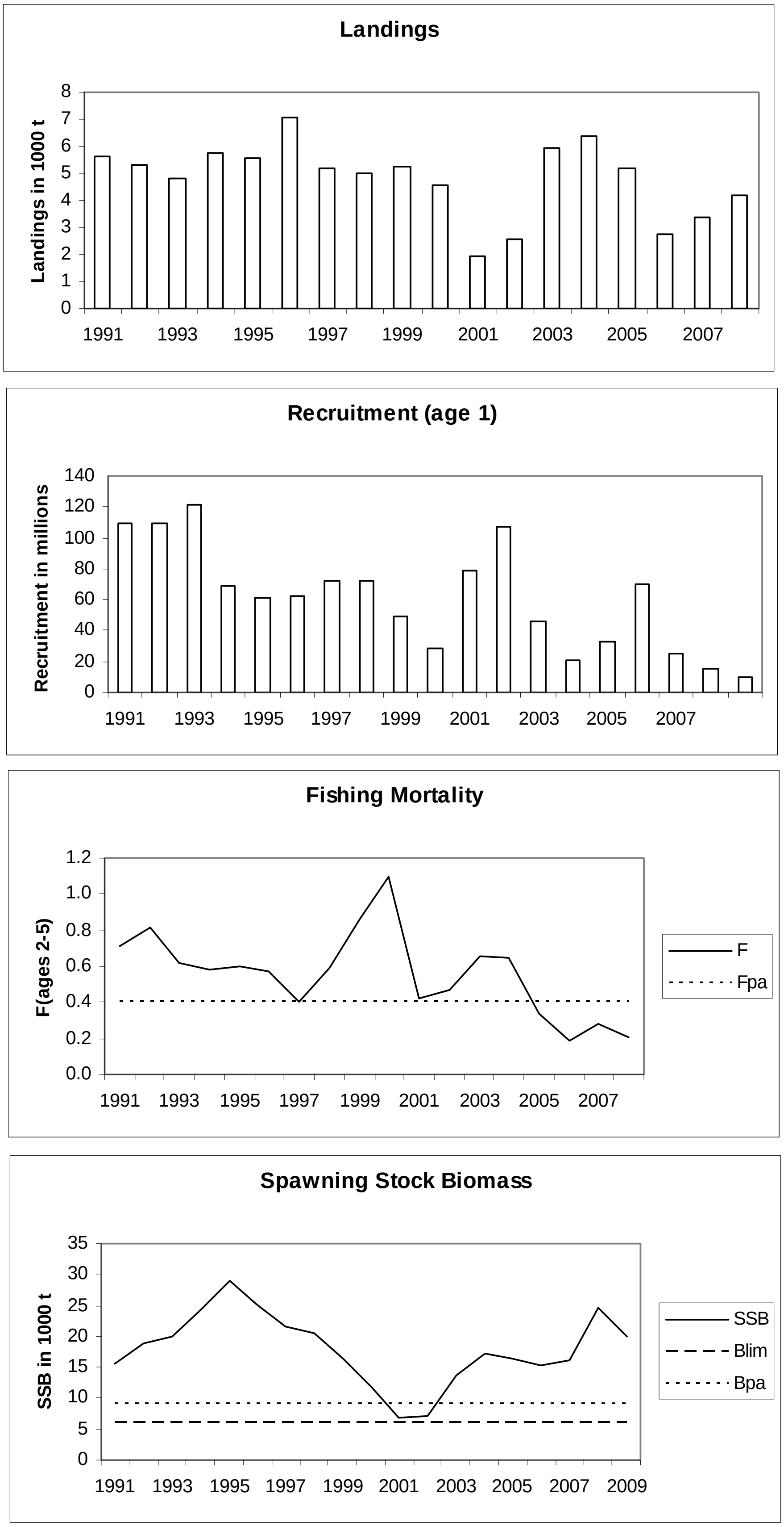


Figure 4.3.25. Haddock in VIb. Summary plots.

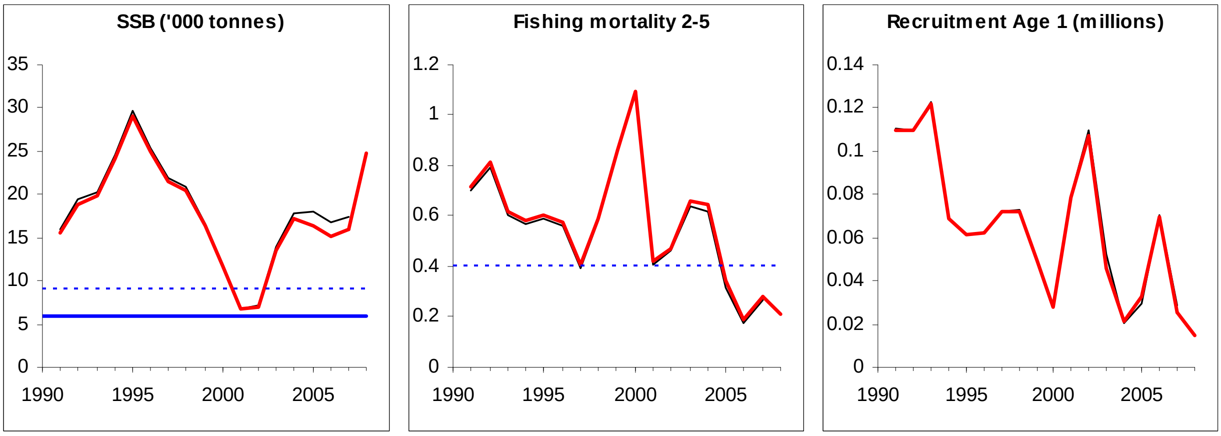


Figure 4.3.26. Haddock in VIb. Comparison of the current assessment (in red) with the previous one (in black).

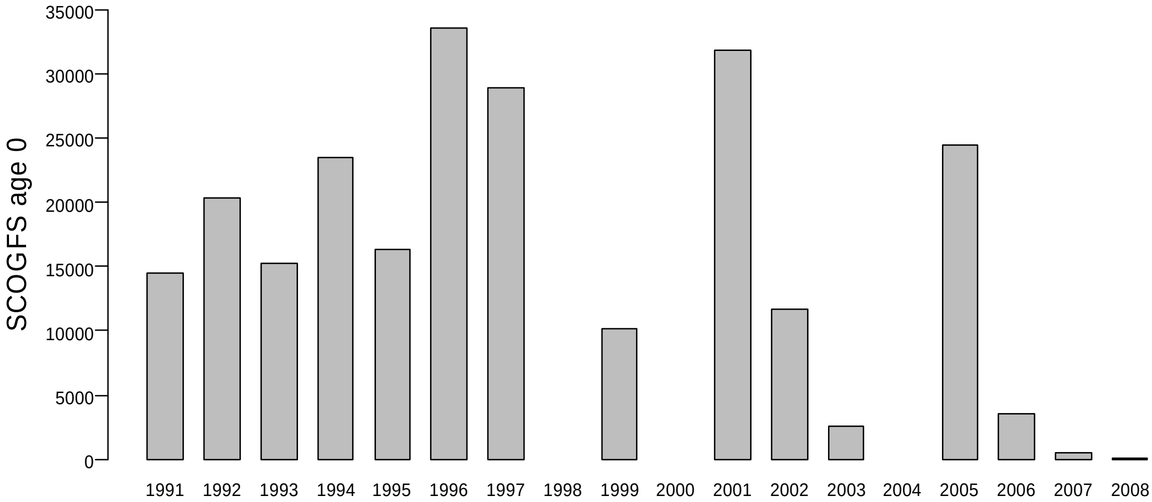


Figure 4.3.27. Haddock in VIb. Scottish Groundfish survey indices of haddock at-age 0.

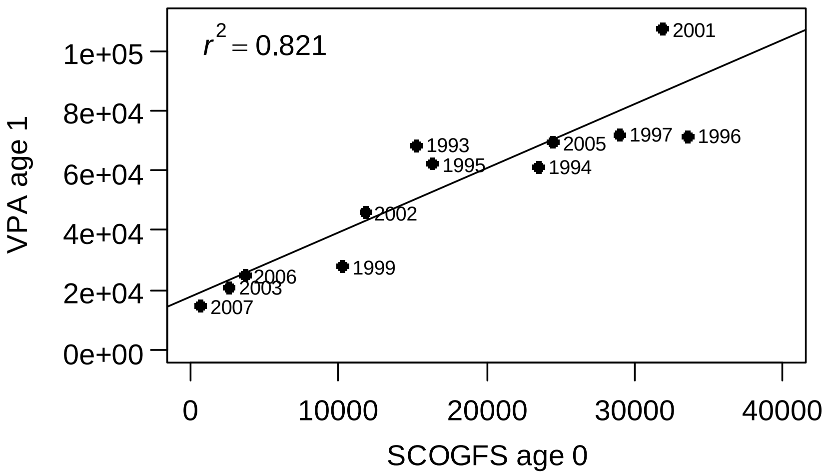


Figure 4.3.28. Haddock in VIb. VPA numbers-at-age 1 from XSA plotted against Scottish Ground-fish survey indices of haddock at-age 0.

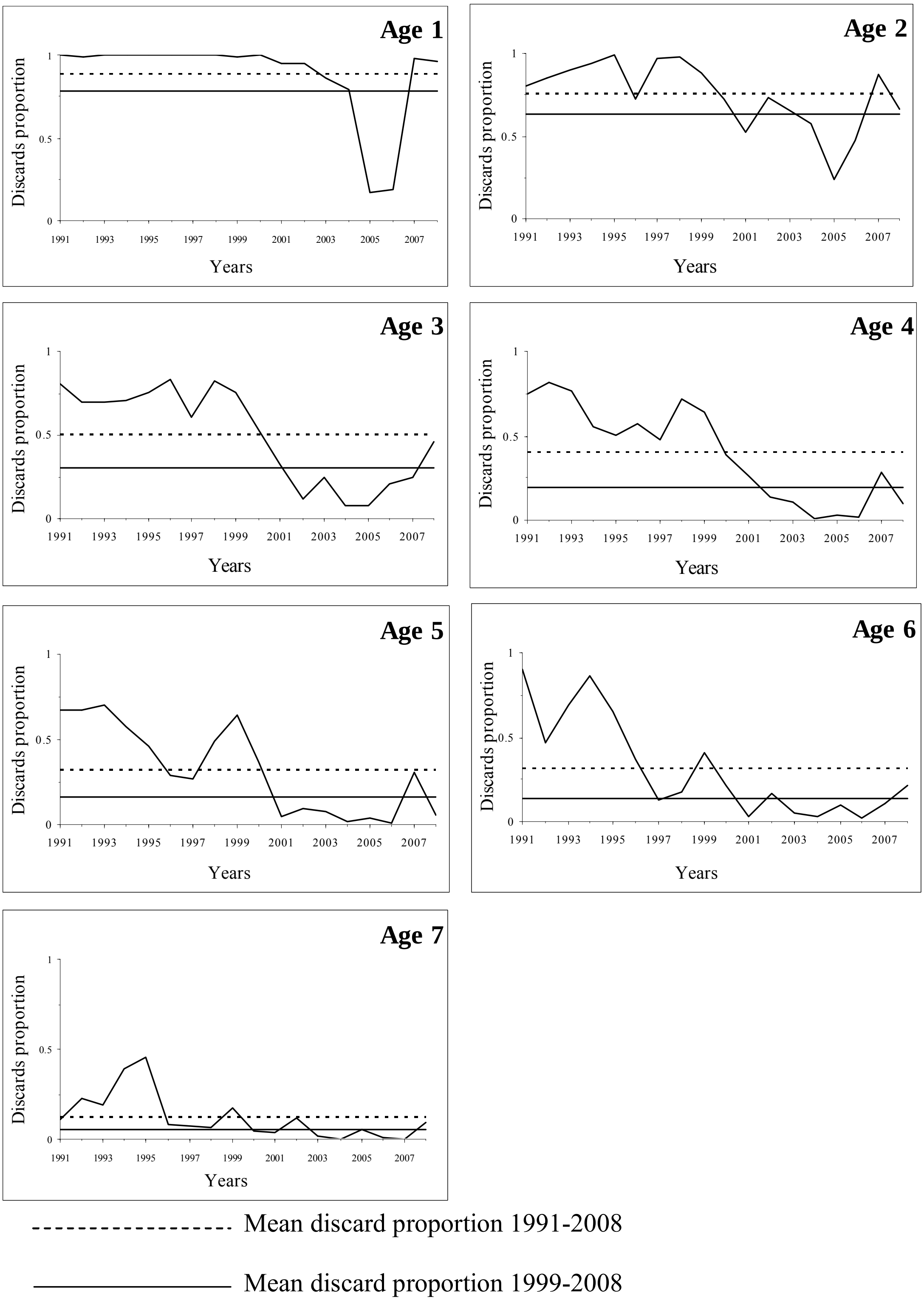


Figure 4.3.29. Haddock in Division VI b. Discard proportion-at-age by year and mean discard proportion at-age for two periods, 1991–2008 and 1999–2008.

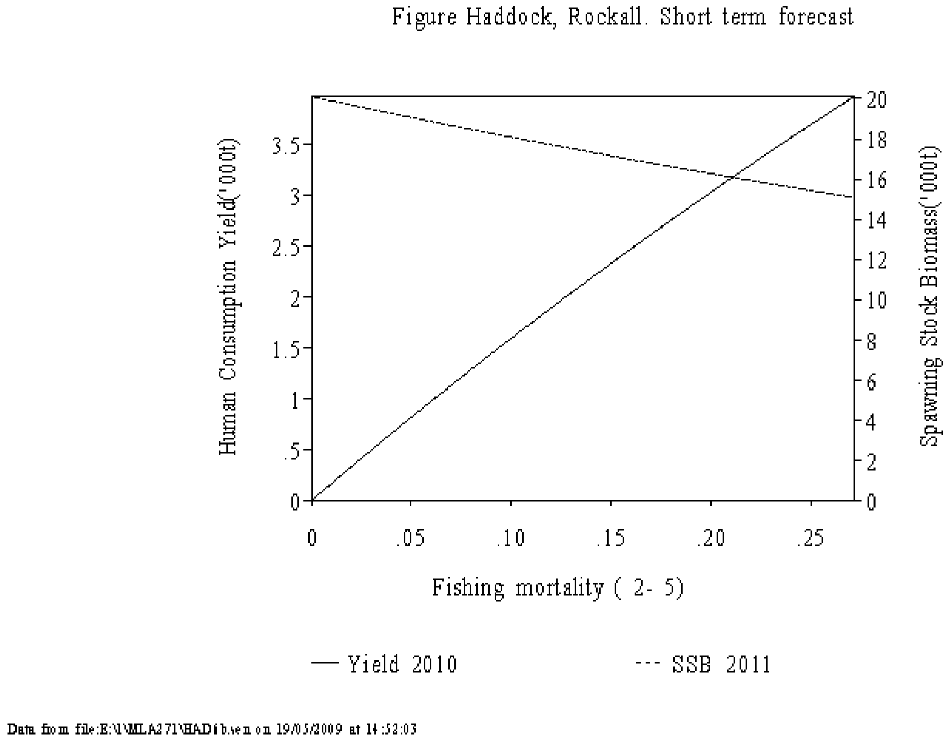


Figure 4.3.30. Haddock in VIb. Short-term forecast.

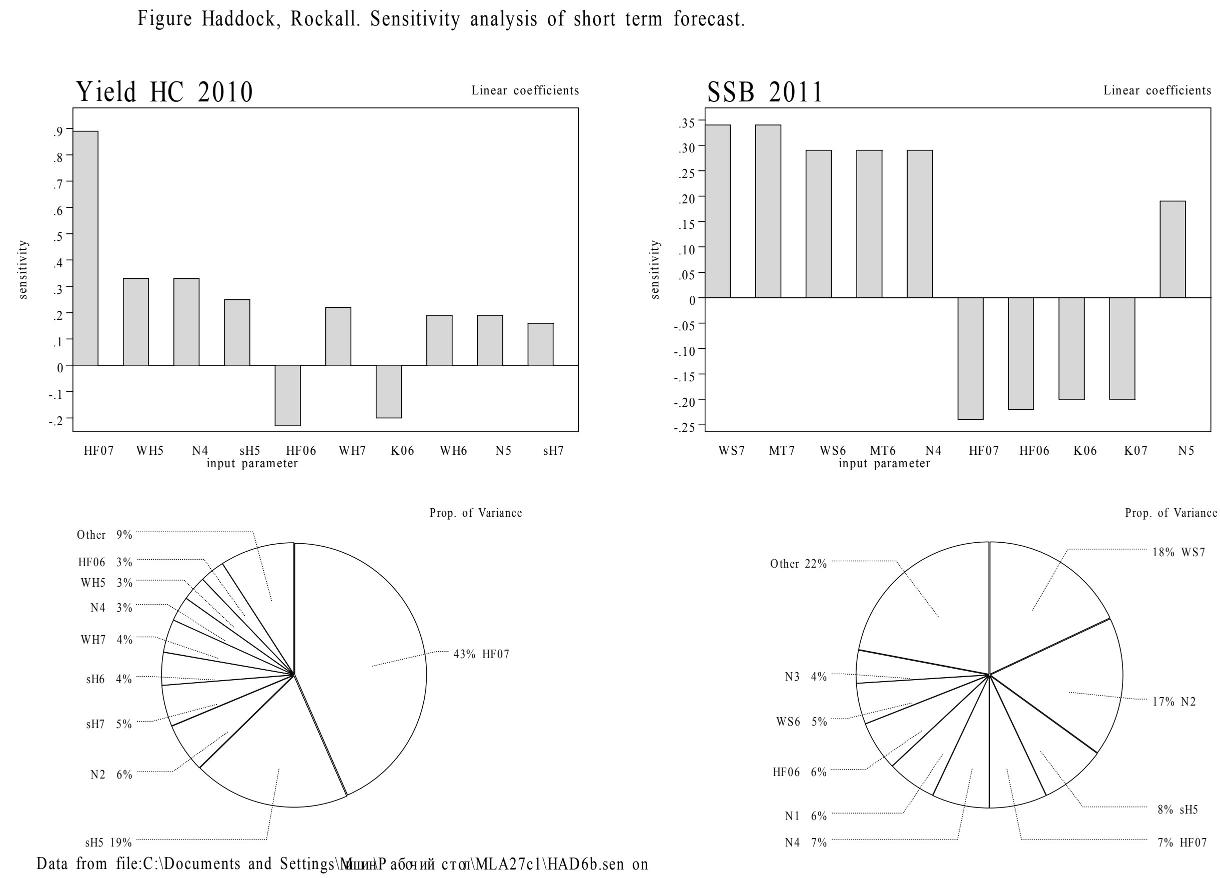


Figure 4.3.31. Haddock in VIb. Delta plots from selectivity analysis.

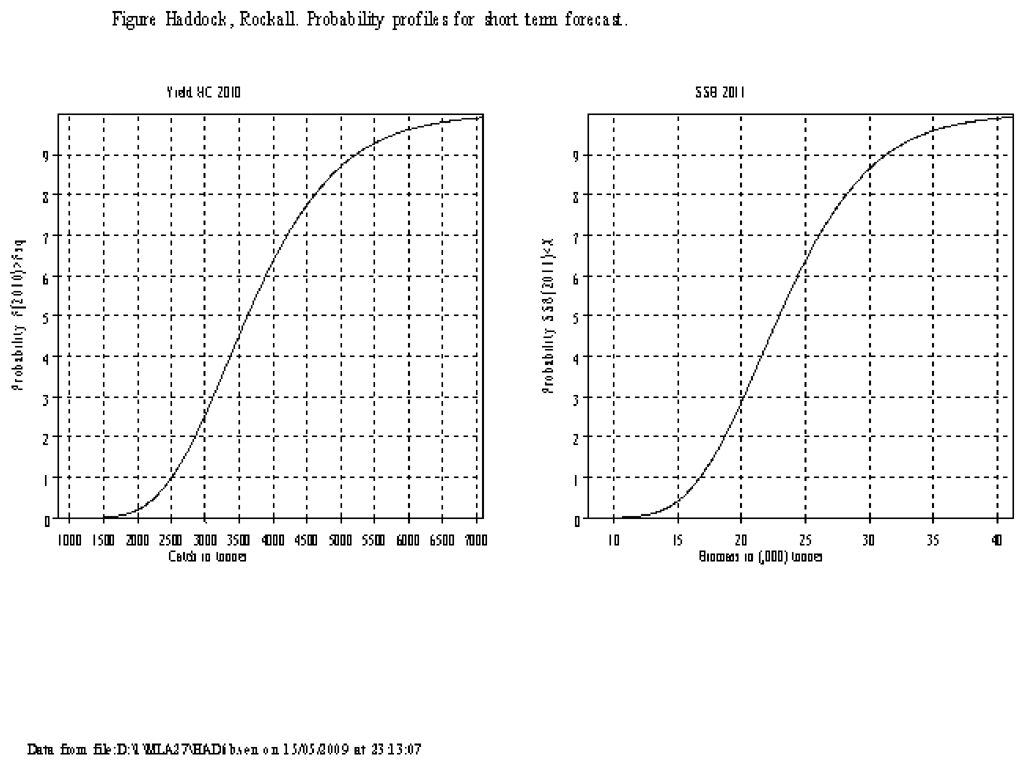


Figure 4.3.32. Haddock in VIb. Probability plots for yield in 2009 and SSB in 2010.

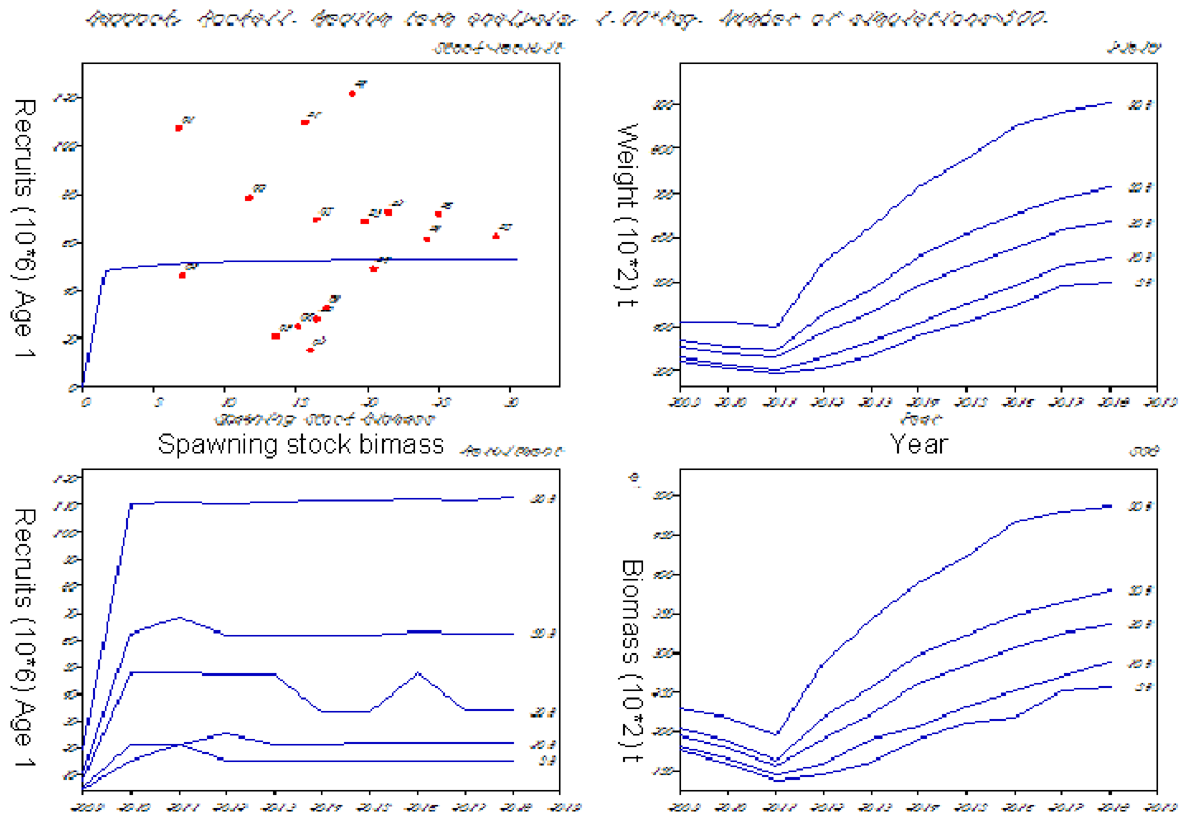


Figure 4.3.33. Haddock VIb. Medium-term analysis.

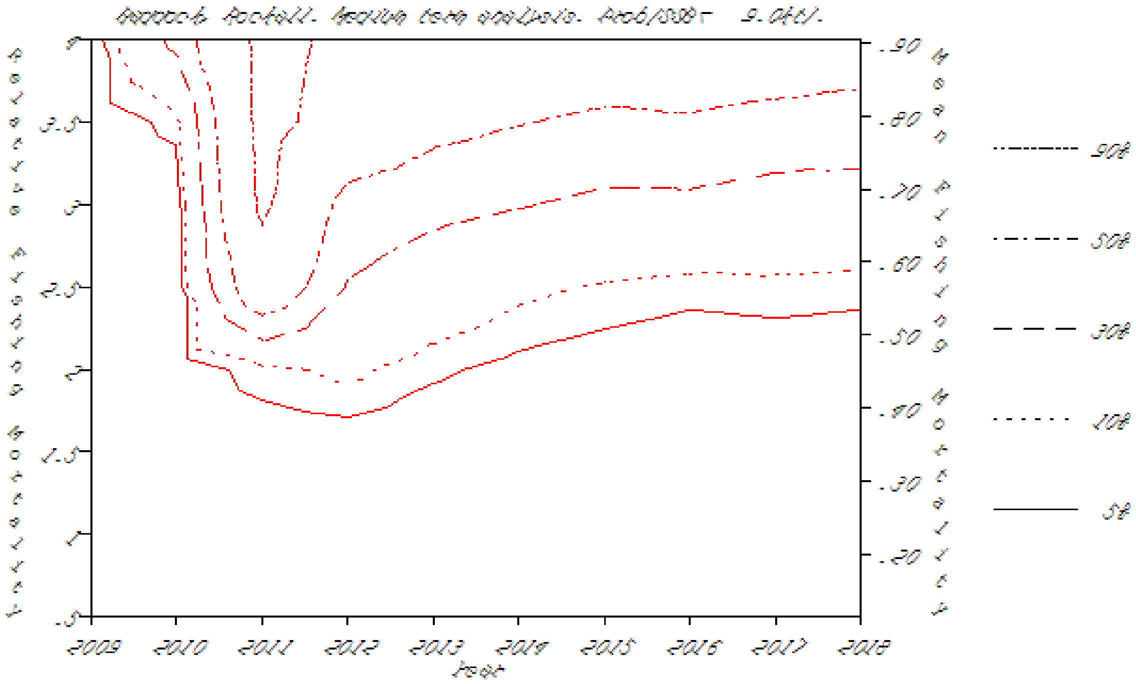


Figure 4.3.34. Haddock VIb. Medium-term analysis.

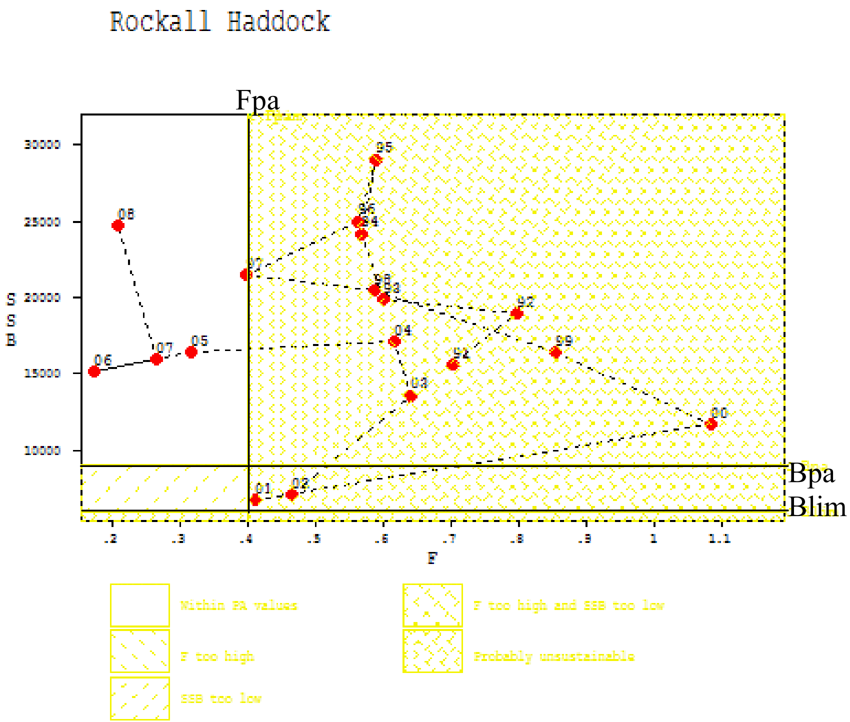


Figure 4.3.35. Haddock in VIb. Biological reference points.

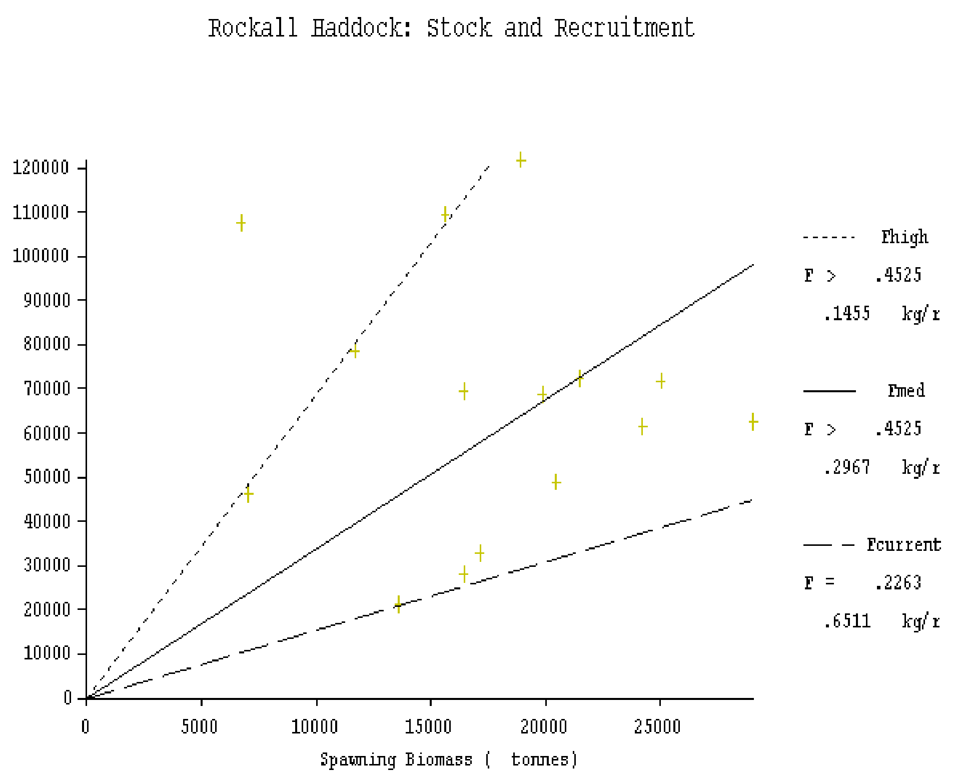


Figure 4.3.36. Haddock in VIb. SSB and recruitment.

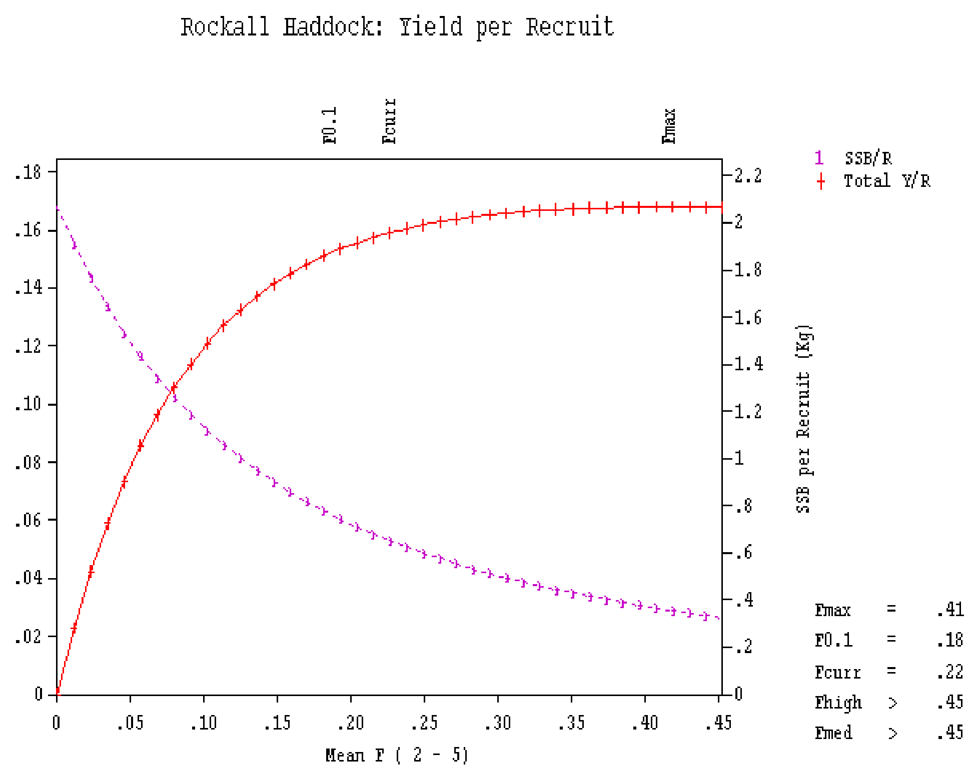


Figure 4.3.37. Haddock in VIb. Yield-per-recruit.

5 Northern Shelf Area

5.1 Northern Shelf Area overview

5.1.1 Description of fisheries

UK (Scottish) vessels account for 43% of the reported anglerfish landings from the Northern Shelf area. The Danish and Norwegian fleets are the next most important exploiters of this stock in the North Sea while Irish and French vessels take a significant proportion of the landings from the West of Scotland. A brief description of the recent anglerfish fisheries on the northern shelf is given by country below:

The Scottish fishery

The main fleets catching anglerfish in Scotland consist of mixed demersal trawl fisheries operating along the shelf edge in both Divisions VIa and IVa and a more inshore *Nephrops* fishery in which anglerfish is an important bycatch. There is also a fleet operating in VIb which consists of larger trawlers targeting haddock and anglerfish at Rockall. Fishing activity of the mixed demersal trawlers at Rockall has increased in 2007, but no other significant changes in fleet behaviour are known to have occurred in 2007. A general description of recent changes in the fishery can now be found in the stock annex.

The Irish Fishery

The landings of anglerfish by Irish vessels in VIa are mainly taken by the otter trawl fleet. Reported landings in 2007 were mainly taken on the slope in the southern part of VIa with some landings also reported from the Stanton Bank area. Fishing activity in terms of kW days has declined in VIa in recent years due to reduced quotas and effort allocations. Following a number of years of minimal Irish fishing activity at Rockall, at least 10 vessels (>24 m, 1000 hp+) are reported to have shifted from deeper water to the mixed fishery in VIb in 2008. These vessels have some bycatches of anglerfish in what is primarily a haddock directed fishery.

The Danish Fishery

The geographical distribution of the Danish fishery for anglerfish in 2007 is shown in Figure 6.1.2. This figure (quantity of landings by ICES rectangle) is based on logbook records. The majority of Danish anglerfish landings are taken in the northeastern North Sea, in the part constituting the Norwegian Deeps, situated in the Norwegian EEZ of the North Sea. Other important fishing areas for anglerfish are the Fladen Ground (also in IVa) and in the Skagerrak (IIIa). Landings by fishery are shown in Figure 6.1.3. No significant changes are in evidence in 2007 and a general description of the fisheries can be found in the Stock Annex.

The Norwegian fishery for Anglerfish in the North Sea

This overview is based on Norwegian sale slips data. The majority of the Norwegian anglerfish landings from Division IVa are taken in the directed, coastal, gillnetting fishery (Figure 6.1.4). The remaining 30–40% of the Norwegian landings from IVa is mostly taken as bycatch in different trawl fisheries. A similar pattern is found for Skagerrak (IIIa) (Table 6.1.6). The third quarter has in recent years been the most important season for the directed fishery, while the second quarter seems to be more important for other gears.

Other fisheries

French demersal trawlers also take a considerable proportion of the total landings from the West of Scotland area. The vessels catching anglerfish may be targeting saithe and other demersal species or fishing in deep water for roundnose grenadier, blue ling or orange roughy. It is not known to what extent the increased restrictions to deep-water fisheries have affected the French fishery for anglerfish. No details were available on French fisheries in 2007 or 2008.

In addition to these demersal trawl fisheries, a deep-water gillnet fleet continues to operate on the continental slopes to the West of the British Isles, North of Shetland, at Rockall and the Hatton Bank. These vessels, though mostly based in Spain, are registered in the UK, Germany and other countries outside the EU such as Panama. The fishery is conducted in depths greater than 200 m, with the main target species being anglerfish and deep-water sharks. Gear loss and discarding of damaged catch are thought to be substantial in this fishery. Until recently these fisheries have not been well documented or understood and have been largely unregulated, with little or no information on catch composition, discards and a high degree of suspected misreporting (Hareide *et al*., 2006). In recent years, there have been around 16 vessels participating in the fishery, 12 UK registered and four German registered.

5.1.2 Regulations and their effects

In response to the concerns with gillnet fisheries for deep-water sharks and anglerfish in Subarea VI, the EC banned the setting of gillnets in waters greater than 200 m in 2006 (Council Regulation 51/2006). However, this regulation was reviewed in July 2006 and a new regulation put in place which is a permanent ban, but allows a derogation for entangling nets in waters less than 600 m, not exceeding 100 km in total length with a maximum soak time of 72 hours. (The relevant regulation can be found in EC Regulation No 40/2008 Annex III, article 8 and this also applies to Division IVa in 2008). NEAFC have also introduced an indefinite ban.

5.1.3 Changes in fishing technology and fishing patterns

The draft report of the 2008 WG on Fish Technology and Fish Behaviour also highlights several issues relating to recent (2008) changes in fishing technology and fleet behaviour which are relevant to the Northern Shelf anglerfish fishery. These include a number of measures with the aim of reducing cod mortality such as real-time closures which could imply a greater effort on anglerfish. However, there are reported changes in fleet behaviour which may have resulted in a reduction in effort in VIa (and increases in IVa and VIb), including a shift of Scottish vessels to the North Sea *Nephrops* fishery and further effort increases in the Irish fleet fishing at Rockall. Additionally, there is reported to be a general shift from twin to single trawl, driven by rising fuel costs which may result in a decrease in lpue.

5.2 Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Division IIa, IIIa, Subarea IV and VI

The WGNSDS considered the stock structure of anglerfish on a wider European scale in 2004, and found no conclusive evidence to indicate an extension of the stock area northwards to include Division IIa. However, for the purposes of reporting, anglerfish in IIa is treated in a separate section (5.2.2) from anglerfish on the northern shelf (Division IIIa, Subarea IV and VI, Section 5.2.1), but the advice refers to both.

5.2.1 Anglerfish in Division IIIa, Subarea IV and VI

There has been no assessment of the anglerfish stock on the northern shelf since 2003. Recent ACFM review groups have highlighted the generally poor data for this stock and the need to continue with the recently instigated data collection schemes (both survey and commercial data) in order to obtain time-series of sufficient length. Since 2005, an annual science- industry partnership survey has been conducted by the Scottish, and in some years, Irish institutes: updates to these survey data are presented this year, along with updates to catch and effort data where available.

ICES advice applicable to 2008 and 2009

The ICES advice for 2008 (Single Stock Exploitation Boundaries) was as follows, and applied to Subarea VI, Subarea IV, Division IIIa and also Division IIa:

"The available information is inadequate to evaluate spawning stock or fishing mortality relative to precautionary reference points. The effort in fisheries that catch anglerfish should not be allowed to increase and the fishery must be accompanied by mandatory programmes to collect catch and effort data on both target and bycatch fish."

The ICES advice for 2009 (Single Stock Exploitation Boundaries) was as follows:

The new data available for this stock do not change the perception of the stock and do not give reason to change the advice from 2007. The advice for the fishery in 2009 is therefore the same as the advice given in 2007 for the 2008 fishery: The effort in fisheries that catch anglerfish should not be allowed to increase and the fishery must be accompanied by mandatory programmes to collect catch and effort data on both target and bycatch fish.

In addition, ICES offers the following considerations: Following ICES suggestions in 2005 a number of initiatives were instigated covering anglerfish in Division IVa and Subarea VI:

- dedicated Scottish and Irish scientific anglerfish surveys which are coordinated to involve the use of both research vessels and commercial fishing vessels;
- a Scottish tallybook scheme (linked to a longer time-series of personal diaries);
- increased observer coverage (short-term initiative in 2006).

Data are currently being gathered, with improvements to both industry-related data and surveys covering Subarea VI and part of the North Sea. There are currently 3 years of survey-derived absolute abundance estimates and 2 complete years of Scottish tallybook data providing commercial catch data.

Mixed fisheries advice for all relevant areas can be found in Section 1.7.

General

Stock description and management units

For the purposes of this section, the anglerfish stock on the Northern Shelf is considered to occur in Divisions IIa, IIIa (Skagerrak and Kattegat), Subarea IV (the North Sea) and Subarea VI (West of Scotland plus Rockall). Anglerfish in the North Sea and Skagerrak/Kattegat were considered by this Working Group for the first time in 1999. In 2004, the WG was asked to consider the stock structure of anglerfish on a wider Northern European scale and despite a lack of conclusive evidence to indicate a single-stock, anglerfish in IIa was included in the ToR at subsequent WG meetings.

Management of Northern Shelf anglerfish is based on separate TACs for the North Sea area and West of Scotland area. The following table summarizes ICES advice and actual management applicable for Northern Shelf anglerfish during 2003–2008.

			West of Scotland			North Sea		
Year	Single stock exploitation boundary	Basis	TAC[4)]	% change in F associated with TAC	WG landings	TAC[5)]	% change in F associated with TAC	WG landings
2003	<6700[1)]	Reduce F below Fpa	3180	49% reduction	4126	7000	49% reduction	8268
2004	<8800[2)]	Reduce F below Fpa[2)]	3180	48% reduction	3296	7000	48% reduction	9027
2005	-	No effort increase[2)]	4686	-	n/a	10 314	-	n/a
2006	-	No effort increase[2)]	4686	-	n/a	10 314	-	n/a
2007	-	No effort increase[2)]	5155	-	n/a	11 345	-	n/a
2008	-	No effort increase[3)]	5155	-		11 345	-	
2009	-	No effort increase[3)]	5567	-		11 345	-	

All values in tonnes.

[1)] Advice for Division IIIa, Subarea IV and Subarea VIa combined.

[2)] Advice for Division IIIa, Subarea IV and Subarea VI combined.

[3)] Advice for Division IIa, Division IIIa, Subarea IV and Subarea VI combined.

[4)] TAC applies to Vb(EC), VI, XII and XIV.

[5)] TAC applies to IIa and IV (EC)

Although there is no minimum landing size for this species, there is an EU minimum weight of 500 g for marketing purposes (EC Regulation 2406/96).

An additional quota of 1550 t is also available for EU vessels fishing in the Norwegian zone of Subarea IV in 2009.

The fishery in 2008

A description of the fisheries on the northern shelf is given in Section 5.1 above.

UK (Scottish) vessels account for 43% of the reported anglerfish landings from the Northern Shelf area. The Danish and Norwegian fleets are the next most important exploiters of this stock in the North Sea while Irish and French vessels take a significant proportion of the landings from the West of Scotland.

The official landings by area are given in Table 5.2.1 and the breakdown by country in Tables 5.2.2–4. In 2008, total [officially reported] landings (16 342 t) were slightly lower than in 2007 (16 430). This was largely as a result of a reduction in [officially reported] landings in Division VIa by France and Ireland (Table 5.2.2). In both of the latter cases this was associated with a reduction in activity; and in the latter case two French vessels were decommissioned.

Total officially reported landings of anglerfish from the Northern Shelf are shown in Figure 5.2.1. During the 1970s landings were fairly stable at around 9000 t, but from about 1983 they increased steadily to a peak of over 35 000 t in 1996, then declined rapidly during the following 5 years. However, any subsequent declines in reported landings may have been as a result of restrictive TACs and are not necessarily representative of actual landings. The overall trend in landings is driven by the landings from the Northern North Sea and West of Scotland. Together these two areas account on average for approximately 80% of the total landings over 1973–2007.

Uptake of EC quota, based on the officially reported landings was as follows:

	TAC	Landings	Uptake (%)	TAC			Landings	Uptake (%)
	VI1	VI		IV (Norwegian)	IIa & IV	IIa & IV (total)	IIa & IV (total)	
Belgium	200	0	0	47	401	448	185	41
Denmark				1189	884	2073	1306	63
Germany	228	147	64	19	432	451	366	81
Spain	214	0	0					
France	2462	1828	74		82	82	39	48
Ireland	557	371	67					
Netherlands	193	0	0	17	303	320	0	0
Sweden					10	10	72	723
UK (total)	1713	1726	101	278	9233	9511	9042	95
Total	5567	4072	73	1550	11 345	12 895	11 010	85

[1]TAC applies to Vb(EC), VI, XII and XIV.

Catches in Division IIIa are not regulated: Table 5.2.4 demonstrates the official landings which came to in all 482 t in 2008. The landings by fleet for Scotland, Denmark and Norway are given in Figures 5.2.2–5.2.4. The Irish fleet is dominated by demersal trawlers and so it is not demonstrated here.

Data

Landings

The TACs for both the West of Scotland and North Sea areas were reduced substantially in 2003 and 2004, and at previous WGs it has been highlighted that these reductions would likely imply an increased incentive to misreport landings and increase discarding unless fishing effort was reduced accordingly (Section 6.4.6, ICES WGNSDS 2003). Anecdotal information from the fishery in 2003 to 2005 appeared to suggest that the TACs were particularly restrictive in these years. The official statistics for these years are, therefore, likely to be particularly unrepresentative of actual landings. The introduction of UK and Irish legislation requiring registration of all fish buyers and sellers (See Section 1.7) may mean that the total reported landings from 2006 onwards are more representative of actual total landings.

In the meantime, collation of an international landings-at-age dataset is being hampered by the different approaches to age determination by the institutes which could provide these data. It has been proposed to ICES PGCCDBS that this be addressed at an anglerfish ageing workshop to be held in 2009/10.

The absence of a TAC for Subarea IV prior to 1999 means that before 1999, landings in excess of the TAC in other areas were likely to be misreported into the North Sea. In 1999, a precautionary TAC was introduced for North Sea anglerfish, but unfortunately for current and future reporting purposes, the TAC was set in accord with recent catch levels from the North Sea which includes a substantial amount misreported from Subarea VI. The area misreporting practices have thus become institutionalised and the statistical rectangles immediately east of the 4°W boundary (E6 squares) have accounted for a disproportionate part of the combined VIa/North Sea catches of anglerfish. The Working Group historically (prior to 2005) provided estimates of the actual Division VIa landings by adjusting the reported data for Division VIa to include a proportion of the landings declared from Division IVa in the E6 ICES statistical rectangles. Details of how the correction has been applied are given in the Stock Annex. Scottish officially reported landings adjusted for area misreporting are displayed along with landings from Ireland, Denmark and France in Figure 5.2.5. As a consequence of ongoing technical problems associated with changes to the Scottish Executive database and lack of landings data provided to the Working Group by some of the major nations exploiting the fishery, WG estimates of the actual Division VIa and IVa landings have not been calculated for recent years (2005–2008).

The corrected spatial distribution of anglerfish landings by the Scottish fleet reveals a typical pattern, with most landings being taken from the area around Shetland and also the area to the west of Scotland close to the shelf edge. Some landings, associated with the *Nephrops* fishery, are taken from the Fladen ground in the middle of the northern North Sea. Relatively few landings were taken from Rockall. The spatial distribution of Danish landings displays the typical pattern of higher landings around the Norwegian deeps. The Irish fishery in 2008 landed principally from the west coast of Ireland and in the south of Division Via, with some landings from Rockall.

Consideration should be given in future to examining the distribution of landings combined with vessel monitoring system (VMS) data, perhaps using a kilowatt fishing hours metric to produce spatial distributions of lpue.

Commercial catch-effort data

Scotland

Reliable effort data (in terms of hours fished) are not available from the Scottish trawl fleets because of changes in the practices of effort recording and non-mandatory recording of hours fished in recent years. Further details can be found in Section B4 of the Stock Annex and the Report of the 2000 WGNSSK (ICES, 2001). Effort data in terms of days fished are available from official logbooks and these data are presented by gear in the report of WGNSDS 2007. However, given the uncertainties associated with the official landings from the recent past, no attempt has been made to use these data to calculate an lpue series and they have not been updated this year.

Attempts have recently been made to obtain more reliable data on catch and effort from the Scottish anglerfish fishery. In 2005, an analysis of data collated from the personal diaries of Scottish skippers operating across the Northern Shelf was presented to this WG (ICES, 2006 and Bailey *et al*., 2004). Following recommendations made by ACFM that this data collection scheme should be continued and extended, in 2006, Marine Scotland Science (in consultation with the fishing industry) established a monkfish tallybook project. A fuller description and analysis of these data can be found in the WGNSDS 2008 report and Dobby *et al*., 2008. However, at present there are problems in the scheme in terms of falling participation levels (4 vessels in 2008): this is unlikely to give a representative picture of the fishery and so updates of these data are not included.

Ireland

Trends in official landings, effort in hours fished and kWdays (which are believed to be a more accurate indicator of effort than hours fished) from the Irish otter trawl fleets (OTB) operating in Division VIa and VIb are shown in Table 5.2.7 and Figure 5.2.6. This fleet is responsible for the majority of the landings from the south of Division VIa. Landings and effort data from the other fleets (1995–2006) are available in the Stock Annex. The Irish lpues from logbooks are shown in Figure 5.2.6. The time-series demonstrate increasing trends in (particularly) Division VIa in recent years with a slight tailing off in 2008. However, it is not clear whether such trends are indicative of stock trends as such increases in lpue could also be because of increases in efficiency and changes in reporting practices.

Denmark

Danish logbook data for anglerfish landings and corresponding effort by main fishery in the North Sea and IIIA for the period 1996–2008 are shown in Table 5.2.5. Figure 5.2.7 and Table 5.2.8 show the fluctuations in lpue for anglerfish in mixed demersal fisheries and the shrimp fishery (small-meshed). Of particular relevance is the series for the mixed demersal trawl fisheries in the North Sea including *Nephrops* trawls as these are where most anglerfish is taken (Table 5.2.5). Note the upwards trend, especially from 2003 to 2004 for all fisheries and the subsequent stabilization in lpue. A time-series corrected for increase in fishing power for the shrimp trawl lpue indicates a recent rise form rather lower levels than that inferred previously (Figure 5.2.7). The recorded overall effort seems to have declined in recent years (Table 5.2.5 B). However, this decline in nominal effort may also have been accompanied by 'technological creep'.

Anecdotal information from Danish fishers suggests that this apparent levelling off in lpue is because of the TAC constraints on the Danish fishery in the Norwegian EEZ since 2005, which was not in evidence in previous years. Although catch rates are not declining, the TAC constraints and possible technological creep currently render it problematic to use these logbook based lpues as indicators of stock abundance.

Norway

Available logbook data from Norwegian trawlers have been examined for the possibility of establishing a cpue time-series for anglerfish. However, several problems were encountered in the dataset, and it is still considered insufficient for providing any reliable information on trends in stock abundance.

Six gillnetters have been included in a self-sampling scheme established along the Norwegian coast within IVa and IIIa. Detailed information about effort and catch will be provided through this scheme, and will potentially be valuable in future assessments of anglerfish in this area.

Other countries

No effort data were available for the Spanish and French fleets operating in Subarea VI.

Research vessel surveys

At previous meetings of this WG it has been concluded that the traditional groundfish surveys are ineffective at catching anglerfish and do not provide a reliable indication of stock size. As a result of this conclusion, and the urgent requirement for fishery-independent data, Marine Scotland Science, began a new joint science/industry survey in 2005. This is a targeted anglerfish survey using commercial gear. In 2006 and 2007, Ireland also participated extending the anglerfish survey to cover the remaining part of VIa (from $54^{0}30'$ to $56^{0}39'$) and into ICES areas VIIb,c,j. Further details of the survey including information on design, sampling, gear and vessel were recently considered by ICES WKAGME and are available in the 2009 report of that group.

Results from previous surveys, as described in previous working group reports, did not consider certain biases. In addition to reporting the results of the 2008 surveys, new abundance and biomass estimates are now provided for the 2005–2007 surveys (summarized in Figure 5.2.8 and Table 5.2.9). The estimates presented this year, represent the best available knowledge to date from the four surveys carried out (2005–2008) and as such they evaluate the following factors:

1) herding of anglerfish by the trawl doors and sweeps;
2) escapes of fish under the trawl footrope;
3) anglerfish abundance and biomass in the southern part of Area VI not covered in 2008;
4) visual counts of anglerfish in areas closed to trawling at Rockall;

The estimates currently do not take account of the following:

1) areas in the central and southern North Sea (eastern part of ICES Division IVa and all of IVb and IVc);
2) areas inaccessible to the trawl in Division VIa.

Methods to account for these factors are under development.

The 2008 survey took place in April: the sample locations for (n = 167) are illustrated in Figure 5.2.9 as the number density (number per square kilometre) and weight density (kilograms per square kilometre) of anglerfish. The highest densities of anglerfish occurred close to the 200 m contour in the northern and western areas, including the northern North Sea (particularly by weight). Very high densities were found on the east coast of the Rockall plateau. The results of the survey are presented in Table 5.2.9. The total estimate for the whole northern shelf in 2008 was 54 080 t. The Relative Standard Errors for the Scottish components (without taking into account of footrope escapes) were 9.1% and 10.6% for abundance and biomass respectively. Applying these to the current biomass estimates give 95% confidence limits of 42 615–65 545 tonnes for the Northern shelf. The incomplete survey in ICES Area IV still gave a larger biomass of 29 723 t than the largely complete survey estimate in ICES Area VI of 24 356 t. The estimates-at-age (Figure 5.2.10) indicate that despite corrections for catchability, which largely affect the smaller, younger fish, there is still an issue with catchability which is unaccounted for. It should also be noted that ageing of anglerfish is still uncertain and an ageing workshop to address this has been planned for 2009/10. The time-series estimates indicate an increase in total biomass over the four year time period (Table 5.2.9 and Figure 5.2.11).

The estimates of abundance of anglerfish from the surveys from 2005–2008 are in line with previous attempts to quantify their abundance (ICSE 2004, Figure 5.2.11). There are still several factors which make the survey estimates likely to be underestimates or minimum estimates. First, although experiments have been carried out to estimate escapes from under the footrope, and a model applied to account for this component of catchability, the estimates of younger anglerfish (ages 0–3) still look to be underestimated (Figure 4). This could be as a result of either a net selectivity issue, or an availability [to the trawl] issue, as it is known that younger fish occur in shallower water (Hislop *et al*., 2001). Methods to compensate for these additional catchability and availability factors are being considered by modelling cohort mortality (catch curves): an abundance-at-age matrix can then be presented and used in some form of survey based assessment. Second, the area considered was not complete. Although only a small part of ICES Area VI was missed (white areas in Figure 5.2.8), quite a large part of ICES Area IV was not surveyed (Figures 5.2.8 and 5.2.9). Although repeated requests have been made to countries with an interest in the anglerfish fishery to consider participating, no other countries have done so, with the exception of the Irish who participated in 2006 and 2007. The problem is, therefore, being tackled by an examination of data from the International Bottom Trawl survey. If a relationship can be found between the IBTS survey data and the data from the anglerfish survey where they overlap, then abundance estimates in the southern North Sea could be derived by interpolation where there is only IBTS data. These methods are currently under development (see ICES WKAGME 2009).

Historical stock development

There has been no assessment of this stock since the length based assessment presented in ICES 2004. This indicated a total stock size of approximately 35 000 t in 2003.

The estimates of abundance of anglerfish from the surveys from 2005–2008 are in line with these previous attempts to quantify their abundance. There are still several factors which make the survey estimates likely to be underestimates or minimum estimates.

Short-term projections

In the absence of an age based assessment, there are no short-term projections for this stock.

The European Commission's position on Managing Fish Stocks without Catch Option Tables, sets out a possible new approach concerning the setting of TACs in cases where scientific advice on an appropriate catch level is provided, but a quantified stock assessment calculation is not available, usually for reasons of uncertain data quality. In its "Policy Statement" Communication the Commission set out its approach to setting TACs where "the state of the stock is not known precisely and STECF advises on an appropriate catch level". In such cases, the Commission proposed to "aim to set the TAC according to STECF advice but not to change the TAC by more than 15%". This rule was used by the Commission when making its annual TAC proposal for 2009.

Anglerfish will come under this "Category 6" grouping of stocks in 2009. The following Table displays the outcome of applying the Commission's rules for Category 6 based on the survey data from 2008 compared with the outcome (actual TAC in 2009).

	Biomass change					
	Mean (05–06)	Mean (07–08)	% change	TAC 2008	TAC 2009	Actual TAC 2009
Area IV (partial)	20 530	29 150	42%	12 955	14 898	12 895
Area VI	19 489	22 097	13%	5155	5155	5567

In terms of setting the TAC for 2010, this could be based, according to similar principles, on the 2009 survey which has recently been completed: the data from the 2009 survey should be considered along with other ICES' survey updates later on in the year

Medium-term projection

There are no medium-term projections for this stock.

Biological reference points

	Type	Value	Technical basis
Precautionary approach	Blim	Not defined	There is currently no biological basis for defining Blim
	Bpa	Not defined	
	Flim	Not defined	There is currently no biological basis for defining Flim
	Fpa	0.30	F35%SPR = 0.30. This fishing mortality corresponds to 35% of the unfished SSB/R. It is considered to be an approximation of FMSY.
Targets	Fy	Not defined	

(unchanged since 1998).

Management plans

There is no management plan for this stock.

Uncertainties and bias in assessment and forecast

This WG has previously attempted assessments of the anglerfish stock(s) within its remit using a number of different approaches. As yet none have proven entirely satisfactory. The catch-at-length analysis used in previous years appears to have addressed a number of the suspected problems with the data as a result of the rapid development of the fishery, and has also provided a satisfactory fit to the catch-at-length distribution data. However, since 2003, the WG has been unable to present an analytic assessment because of the lack of reliable fishery and insufficient survey information (i.e. only a 3-year time-series), and in addition it is not known to what extent the dynamic pool assumptions of the traditional assessment model are valid for anglerfish.

Commercial data

For a number of years the WG has expressed concerns over the quality of the commercial catch-at-length data because of:

- Accuracy of landings statistics because of species and area misreporting;
- Lack of information on total catch and catch composition of gillnetters operating on the continental slope to the northwest of the British Isles (See the Stock annex for further details of this fishery).

However, the introduction of legislation on buyers and sellers registration in the UK and Ireland in 2006 may mean that the reported landings for 2006 onwards are more reliable.

The recent Scottish tallybook scheme has been implemented as part of a long-term approach to provide better information on the fishery. Although the time-series of data is currently short, the scheme has the potential to deliver relatively extensive information on spatial and depth distribution of catch rates provided that participation remains high. In addition to total catch rate information, the fishers are also asked to provide information on landings by size category, discards, catches of mature females and bycatches of other species.

Survey data

In addition to obtaining estimates of abundance from swept-area methods (and in future a time-series of data for use in survey based assessments), a visual count method is being developed at Marine Scotland Science to provide alternative estimates of anglerfish density. It is also anticipated that the new Scottish-Irish science/industry survey will provide further useful information on the biology and stock structure of anglerfish. So far, in all 48 live anglerfish have been tagged with data storage tags on the Marine Scotland Science surveys which if and when recovered will provide information on the vertical migration, depth distribution and temperature regime of individuals (although there have been no tag returns to date). Tagging carried out on the Irish survey (800 ribbon tags) should also provide information on movement of anglerfish.

In 2006, Ireland extended the survey area to include the more southerly regions of the Northern Shelf stock of anglerfish area not covered by the Scottish survey. However the participation of other nations in a collaborative survey to include coverage of waters in the east and south of the North Sea would also be valuable.

Biological information

In light of the current studies, knowledge of the distribution of anglerfish on the Northern Shelf has improved. However, the biology of anglerfish is still not well understood and it has been highlighted at previous WGNSDS meetings that some of the basic biological parameters used in the assessments should be regarded as quite uncertain. Recent studies by Laurenson *et al.*, 2005 have obtained similar growth parameters and maturity ogives to those previously used. A further discussion of the biology can be found in the Stock Annex.

In addition, ageing has not been validated and should still be regarded as uncertain. An ageing workshop is due to be carried out in 2009/10.

Stock Structure

Currently, anglerfish on the Northern Shelf are split into Subarea VI (including Vb(EC), XII and XIV) and the North Sea (and IIa (EC)) for management purposes. However, genetic studies have found no evidence of separate stocks over these 2 regions (including Rockall) and particle-tracking studies have indicated interchange of larvae between the two areas (Hislop *et al*., 2001). So, at previous WGs, assessments have been made for the whole Northern Shelf area combined. In fact, both microsatellite DNA analysis (O'Sullivan *et al*., 2005) and particle tracking studies carried out as part of EC 98/096 (Anon, 2001) also suggested that anglerfish from further south (Sub-area VII) could also be part of the same stock.

Following the recent expansion of the anglerfish fishery in ICES Divisions IIa and V, in 2004 the WG group was asked to consider the stock structure on the wider Northern European scale (Section 16 of the WGNSDS 2004 report). It was concluded that there was currently insufficient information to conclusively define new stock areas for assessment and further coordinated work is still required. Given the request to also assess anglerfish in Division IIa and that there may be an extension to include ICES Division V in the near future, the likely spatial disaggregation of the stock (drift of larvae and possible migration of mature fish back into deeper water) means that any assessment model would need to be spatially structured, possibly supported by assessments for each of the stock units separately. Given the problems with data quality associated with Northern Shelf anglerfish, the WG wishes to highlight fundamentals required for a wider area assessment:

- Accurate information on the spatial distribution of catch and effort;
- Data on movement and migration of mature and immature individuals; and,
- An internationally coordinated, dedicated anglerfish survey over the wider Northern European area to include waters further east. Currently the Scottish-Irish survey provides a biomass estimate for the whole of VIa, but there is only partial coverage of the North Sea. The survey should be expanded to cover the entire distribution of the stock and this would require the participation of other nations.

Recommendations for the next benchmark

ICES has previously advised a two-stage approach for management of the anglerfish fishery. The first stage was to substantially improve the quality and quantity of data collected in the fishery while maintaining exploitation at its current level. It has stated that this was expected to take at least five years to establish useable time-series. The second stage would then be to use these data to examine alternative management approaches and harvest control rules. The data collection stage of this process is currently ongoing.

The biological data associated with the anglerfish surveys should be evaluated and compared with existing estimates of (e.g. maturity-at-age, growth rates, length distributions, sex ratios and species compositions). There are still uncertainties about the validity of age readings of anglerfish: this will be addressed by an age determination workshop. Depending on the outcome of this workshop, the catch-at-age data should then be evaluated for use in any assessment.

Irrespective of any ageing concerns, the survey estimates have underestimated the younger ages. This is despite the recent incorporation of a correction to account for escapes of small fish under the footrope of the survey trawl, which clearly has not accounted for all small fish. Some developments of the latter bias correction are still possible; however, it seems likely that a survey based assessment model could also be developed to determine the absolute abundance of the total population.

The approach developed recently for the use of the *Nephrops* TV surveys should be considered for anglerfish. In order for this to take place, however, a fully raised international catch-at-length dataset would be required and this should be prepared well in advance of any benchmark. Institutes should be approached as soon as possible to start preparing such datasets from previous years and so that appropriate raising procedures can be developed. The particular requirements for anglerfish will also need to be considered where the approach might differ from the *Nephrops* situation.

A number of recommendations were made at ICES WKAGME for the improvement of the anglerfish surveys and these can be addressed in the coming year well in advance of the benchmark. These include: improving the survey design in the light of previous estimates of density (allocation of samples to strata); providing estimates for the two species separately so that they may be incorporated separately in any assessment model (for cohort tracking for example); incorporating better procedures for [the few] missing ages; accounting for areas not surveyed in the North Sea using IBTS data; and improving the estimates of footrope escapes.

Finally, it should be emphasized that, to date, efforts to extrapolate estimates of abundance into areas that have not been surveyed (southern North Sea and Subarea IIIa) have not proved particularly successful. Additional participation of nations with an interest in this fishery should be encouraged before the next benchmark. In 2009 only Scotland and Ireland participated in this survey.

5.2.2 Anglerfish in Division IIa

The WGNSDS considered the stock structure on a wider European scale in 2004, and found no conclusive evidence to indicate an extension of the stock area northwards to include Division IIa. Anglerfish in IIa is therefore treated in this separate chapter.

Type of assessment in 2009

No assessment was performed.

ICES advice applicable to 2008 and 2009

The ICES advice for 2008 and 2009 (Single Stock Exploitation Boundaries) was as follows, and applies to Subarea VI, Subarea IV, Division IIIa and Division IIa:

"The available information is inadequate to evaluate spawning stock or fishing mortality relative to precautionary reference points. The effort in fisheries that catch anglerfish should not be allowed to increase and the fishery must be accompanied by mandatory programmes to collect catch and effort data on both target and bycatch fish."

General

Stock description and management units

The WGNSDS considered the stock structure on a wider European scale in 2004, and found no conclusive evidence to indicate an extension of the stock area northwards to include Division IIa. Anglerfish in IIa is therefore treated in this separate chapter.

Fishery in 2008

There has been an expansion of the fishery in recent years. This is largely because of a northward expansion of the Norwegian gillnet fishery. The official landings from the areas north of 64° account for approximately 55% of the total figure for Division IIa in 2007 and 2008. Norway is by far the largest exploiter of the IIa fishery accounting for over 95% of official landings. UK is now the next most important exploiter in this area, with landings of approximately 2.5% of the total reported to ICES (Table 5.2.10). The coastal gillnetting accounts for 85–90% of the landings, while 4–6% is taken as bycatch in different offshore gillnet fisheries (Table 5.2.11).

No TAC is given for Division IIa, Norwegian waters. Catches of anglerfish in Division IIa, EC waters are taken as a part of the TAC for Subarea IV. The Norwegian fishery is regulated through:

- A prohibition against targeting anglerfish with other fishing gear than 360 mm gillnets. A discard ban on anglerfish regardless of size.

- A maximum of 10% bycatch of anglerfish in the shrimp trawl fishery, maximum 25% bycatch of anglerfish in the trawl and Danish seine fishery.
- 48 hours maximum soak time in the gillnet fishery.
- A maximum of 500 gillnets (each net being 27.5 m) per vessel.
- A closure of the gillnet fishery from 1 March to 20 May. This closure period was expanded to 20 December to 20 May in the areas north of N 65° in 2008 and this area was expanded southwards to N 64 ° in 2009.

Data

Landings

The official landings for each country are demonstrated in Table 5.2.10. Landings in 2008 as reported to ICES for the total Division IIa were 4148 t, which is 400 t lower than the year before. No information suggests that the official landing figures from Norway give a biased estimate of the actual landings.

Discards

The absence of a TAC in Norwegian waters probably reduces the incentive to under-report landings. Anecdotal evidence from the industry suggests that a small percentage of the catch (not marketable) might be discarded. This happens when the soaking time is too long, mostly as a result of bad weather.

Biological

Length distributions are available from the directed gillnetting during the period 1992–2008, but data are lacking 1997–2001 (Figure 5.2.12). The length data indicates a decrease in mean length of 15–20 cm occurring during the period without length samples. The mean length has increased somewhat during the last five years, but is still below the level seen during the 1990s (Figure 5.2.13). One third of the anglerfish measured during the 1990s were above 100 cm, this proportion was between 1–6% for the early 2000s and 14–16 % for in 2006–2008. For 2005–2008, some length data from anglerfish caught as bycatch in other fisheries are presented in Figure 5.2.14.

Surveys

Anglerfish appears in demersal trawl surveys along the Norwegian shelf, but in very small numbers. There has been a change in the surveys, going from single species-to multispecies surveys, during recent years. The procedures for data collection on anglerfish have varied and, at present, no time-series from surveys in Division IIa yields reliable information on the abundance of anglerfish.

Commercial cpue

Reliable effort data are not available from the Norwegian gillnetters as a result of non-mandatory effort recording. In late 2005, ten gillnetters were included in a self-sampling scheme established along the Norwegian coast within Division IIa. Detailed information about effort and catch is provided through this scheme, and will potentially be valuable in future assessments of anglerfish in this area.

Historical stock development

Anglerfish in Div IIa have never been assessed quantitatively and it is not possible to describe the historical stock development.

Management considerations

The WG notes the apparent changes in size composition in anglerfish caught in the gillnet fishery. If the selectivity in the gillnets has been stable, this could be interpreted as an altering of the size spectrum in the stock. As the information on trends in effort is lacking for the main fishery, it remains unclear whether the increased landings last year might reflect an increased abundance in the area. Time-series on effort and catch-by-length should be established to facilitate future analytical assessments of this stock. The possibility of establishing a survey, similar to the one being carried out for the Northern Shelf area, should also be considered for Division IIa.

References

Hislop, J. R. G., Gallego, A., Heath, M. R., Kennedy, F. M., Reeves, S. A., and Wright, P. J. 2001. A synthesis of the early life history of the anglerfish, Lophius piscatorius (Linnaeus, 1758) in northern British waters. ICES Journal of Marine Science 58:70–86.

ICES 2004. Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks. *ICES CM 2004/**ACFM:0**1.* 558 pp.

Table 5.2.1. Anglerfish on the Northern Shelf (IIIa, IV and VI). Total official landings by area (tonnes).

	IIIA	IVA	IVB	IVC	VIA	VIB	TOTAL
1973	140	2085	575	41	9221	127	12189
1974	202	2737	1171	39	3217	435	7801
1975	291	2887	1864	59	3122	76	8299
1976	641	3624	1252	49	3383	72	9021
1977	643	3264	1278	54	3457	78	8774
1978	509	3111	1260	72	3117	103	8172
1979	687	2972	1578	112	2745	29	8123
1980	652	3450	1374	175	2634	200	8485
1981	549	2472	752	132	1387	331	5623
1982	529	2214	654	99	3154	454	7104
1983	506	2465	1540	181	3417	433	8542
1984	568	3874	1803	188	3935	707	11075
1985	578	4569	1798	77	4043	1013	12078
1986	524	5594	1762	47	3090	1326	12343
1987	589	7705	1768	66	3955	1294	15377
1988	347	7737	2061	95	6003	1730	17973
1989	334	7868	2121	86	5729	313	16451
1990	570	8387	2177	34	5615	822	17605
1991	595	9235	2522	26	5061	923	18362
1992	938	10209	3053	39	5479	1089	20807
1993	843	12309	3144	66	5553	681	22596
1994	811	14505	3445	210	5273	777	25021
1995	823	17891	2627	402	6354	830	28927
1996	702	25176	1847	304	6408	602	35039
1997	776	23425	2172	160	5330	899	32762
1998	626	16857	2088	78	4506	900	25055
1999	660	13326	1517	24	4284	1401	21212
2000	602	12338	1617	31	3311	1074	18973
2001	621	12861	1832	21	2660	1309	19304
2002	667	11048	1244	21	2280	718	15978
2003	478	8523	847	20	2493	643	13004
2004	519	8987	851	15	2453	671	13496
2005	458	8424	688	5	3019	958	13552
2006	423	10338	685	3	2785	916	15150
2007	433	10632	749	4	3352	1260	16430
2008	482	11029	711	5	2972	1144	16342
Min	140	2085	575	3	1387	29	5623
Max	938	25176	3445	402	9221	1730	35039
Average	564	8726	1623	84	4022	732	15751

Table 5.2.2. Anglerfish in Subarea VI. Nominal landings (t) as officially reported to ICES.

Anglerfish in Division VIa (West of Scotland)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*
Belgium	3	2	9	6	5	-	5	2	-	-	+	+	-	+	-	-	-	-
Denmark	1	3	4	5	10	4	1	2	1	+	+	.	+	+	-	-	-	-
Faroe Is.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	3	2	1
France	1,910	2,308	2,467	2,382	2,648	2,899	2,058	1,634	1,814	1,132	943	739	1,212	1,191	1,392	1,314	1763	1519
Germany	1	2	60	67	77	35	72	137	50	39	11	3	27	39	39	1	-	54
Ireland	250	403	428	303	720	717	625	749	617	515	475	304	322	219	356	392	470	295
Netherlands	-	-	-	-	-	-	27	1	-	-	-	-	-	-	-	-	-	-
Norway	6	14	8	6	4	4	1	3	1	3	2	1	+	+	1	1	1	2
Spain	7	11	8	1	37	33	63	86	53	82	70	101	196	110	82	76	3	-
UK(E,WandNI)	270	351	223	370	320	201	156	119	60	44	40	32	31	30	20	24	42	…
UK(Scot.)	2,613	2,385	2,346	2,133	2533	2,515	2,322	1,773	1,688	1,496	1,119	1,100	705	862	1,127	974	1,071	…
UK (total)																		1,101
Total	5,061	5,479	5,553	5,273	6,354	6,408	5,330	4,506	4,284	3,311	2,660	2,280	2,493	2,453	3,019	2,785	3,352	2,972
Unallocated	296	2,638	3,816	2,766	5,112	11,148	7,506	5,234	3,799	3,114	2,068	1,882	985	1,938				
As used by WG	5,357	8,117	9,369	8,039	11,466	17,556	12,836	9,740	8,083	6,425	4,728	4,162	3,478	4,391				

***Preliminary. [1]Includes VIb.**

Table 5.2.2. contd. Anglerfish in Subarea VI. Nominal landings (t) as officially reported to ICES.

Anglerfish in Division VIb (Rockall)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*
Estonia	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	
Faroe Is.	-	2	-	-	-	15	4	2	2	-	1	-	-	-	-	-	-	1
France	-	-	29	-	-	-	1	1	…[1]	48	192	43	191	175	293	224	327	309
Germany	-	-	103	73	83	78	177	132	144	119	67	35	64	66	77	72	222	93
Ireland	272	417	96	135	133	90	139	130	75	81	134	51	26	13	35	53	70	76
Norway	18	10	17	24	14	11	4	6	5	11	5	3	6	5	4	6	7	5
Portugal	-	-	-	-	-	-	-	+	429	20	18	8	4	19	63	-	-	-
Russia	-	-	-	-	-	-	-	-	-	-	1	-	-	2	4	1	1	35
Spain	333	263	178	214	296	196	171	252	291	149	327	128	59	43	34	36	12	-
UK(E,WandNI)	99	173	76	50	105	144	247	188	111	272	197	133	133	54	93	46	146	…
UK(Scot)	201	224	182	281	199	68	156	189	344	374	367	317	160	294	355	478	475	…
UK (total)																		625
Total	923	1089	681	777	830	602	899	900	1401	1074	1309	718	643	671	958	916	1260	1144
Unallocated									-9	17	-178	-47	145	121				
As used by WG	923	1,089	681	777	830	602	899	900	1392	1091	1131	671	788	792				

***Preliminary. [1]Included in VIa.**

Total Anglerfish in Subarea VI (West of Scotland and Rockall)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*
Total official	5,984	6,568	6,234	6,050	7,184	7,010	6,229	5,406	5,685	4,385	3,969	2,998	3,136	3,124	3,977	3,701	4,612	4,116
Total ICES	6,280	9,206	10,050	8,816	12,296	18,158	13,735	10,640	9,475	7,516	5,859	4,833	4,266	5,183				

***Preliminary.**

Table 5.2.3. Nominal landings (t) of anglerfish in the North Sea, as officially reported to ICES.

Northern North Sea (IVa)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*
Belgium	2	9	3	3	2	8	4	1	5	12	-	8	1	-	-	-	-	-
Denmark	1,245	1265	946	1,157	732	1,239	1,155	1,024	1,128	1,087	1,289	1,308	1,523	1,538	1,379	1,311	961	1,069
Faroes	1	-	10	18	20	-	15	10	6	.	2	+	3	11	22	2	+	-
France	124	151	69	28	18	7	7	3*	181*	8	9	8	8	8	4	7	13	36
Germany	71	68	100	84	613	292	601	873	454	182	95	95	65	20	84	173	186	344
Netherlands	23	44	78	38	13	25	12	-	15	12	3	8	9	38	13	14	14	-
Norway	587	635	1,224	1,318	657	821	672	954	1,219	1,182	1,212	928	769	999	880	1,005	831	860
Sweden	14	7	7	7	2	1	2	8	8	78	44	56	8	6	5	5	20	63
UK(E, WandNI)	129	143	160	169	176	439	2,174	668	781	218	183	98	104	83	34	99	303	…
UK (Scotland)	7,039	7,887	9,712	11,683	15,658	22,344	18,783	13,319	9,710	9,559	10,024	8,539	6,033	6,284	6,003	7,722	8304	…
UK (total)																		8,657
Total	9,235	10,209	12,309	14,505	17,891	25,176	23,425	16,857	13,326	12,338	12,861	11,048	8,523	8,987	8,424	10,338	10,632	11,029

*** Preliminary. [1]Includes IVb,c.**

Table 5.2.3. continued. Nominal landings (t) of anglerfish in the North Sea as officially reported to ICES.

Central North Sea (IVb)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*
Belgium	357	538	558	713	579	287	336	371	270	449	579	435	180	260	207	138	179	181
Denmark	345	421	347	350	295	225	334	432	368	260	251	255	191	274	237	276	173	237
Faroes	-	-	2	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-
France	-	1	-	2	-	-	-	-*	…1*	-	-	-	-	+	-	-	-	-
Germany	4	2	13	15	10	9	18	19	9	14	9	17	11	11	9	14	12	22
Ireland													1	-	-	-	-	-
Netherlands	285	356	467	510	335	159	237	223	141	141	123	62	42	25	31	33	61	-
Norway	17	4	3	11	15	29	6	13	17	9	15	10	12	22	16	14	24	15
Sweden	-	-	-	3	2	1	3	3	4	3	2	9	2	1	4	4	6	9
UK(E, WandNI)	669	998	1,285	1,277	919	662	664	603	364	423	475	236	167	120	96	108	122	…
UK (Scotland)	845	733	469	564	472	475	574	424	344	318	378	210	241	138	88	98	172	…
UK (total)																		247
Total	2,522	3,053	3,144	3,445	2,627	1,847	2,172	2,088	1,517	1,617	1,832	1,244	847	851	688	685	749	711

*** Preliminary. [1]Included in IVa.**

Table 5.2.3. continued. Nominal landings (t) of anglerfish in the North Sea as officially reported to ICES.

Southern North Sea (IVc)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*
Belgium	13	12	34	37	26	28	17	17	11	15	15	16	9	5	4	3	3	4
Denmark	2	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	-	
France	-	-	-	-	-	-	-	10	-	+	-	+	-	-	-	-	-	+
Germany	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	-	-	-
Netherlands	5	10	14	20	15	17	11	15	10	15	6	5	1	-	1	-	1	-
Norway	-	-	-	-	+	-	-	-	+	-	+	-	-	-	-	-	-	-
UK(E&WandNI)	6	17	18	136	361	256	131	36	3	1	-	-	10	3	-	-	-	…
UK (Scotland)	-	-	-	17	-	3	1	+	+	+	-	-	-	7	-	-	-	…
UK (Total)																		+
Total	26	39	66	210	402	304	160	78	24	31	21	21	20	15	5	3	4	5

*** Preliminary. [1]Included in IVa.**

Total North Sea

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*
Total	11,783	13,301	15,519	18,162	20,920	27,327	25,757	19,023	14,867	13,986	14,714	12,313	9,390	9,853	9,117	11,026	11,385	11,745
WG estimate	10,566	11,728	13,078	15,432	15,794	16,240	18,217	14,027	11,719	11,564	12,677	10,334	8,273	9,027				
Unallocated	-1,217	-1,573	-2,441	-2,730	-5,126	-11,087	-7,540	-4,996	-3,148	-2,422	-2,037	-1,979	-1,117	-826				

*** Preliminary.**

Table 5.2.4. Nominal landings (t) of Anglerfish in Division IIIa, 1991–2007, as officially reported to ICES.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*
Belgium	15	48	34	21	35	-	-	-	-	-	-	-	-	-	-	-	-	-
Denmark	493	658	565	459	312	367	550	415	362	377	375	369	215	311	274	227	255	289
Germany	-	-	1	-	-	1	1	1	2	1	-	1	-	1	1	2	1	1
Netherlands							-	-	-	-	-	.	3	4	4	3	1	-
Norway	64	170	154	263	440	309	186	177	260	197	200	242	189	130	100	137	132	144
Sweden	23	62	89	68	36	25	39	33	36	27	46	55	71	73	79	54	44	48
Total	595	938	843	811	823	702	776	626	660	602	621	667	478	519	458	423	433	482

***Preliminary.**

Table 5.2.5. Total Danish Anglerfish landings (tons) and effort (days fishing) by fishery.

A. Landings by fishery (from logbook data).

YEAR	NORTH SEA						NORTH SEA	IIIA			TONS			IIIA	IIIA & IV
	Other gear	Beam trawls	dem trawl	Neph trawl	ind trawl	Shrimp trawl	total	Other gear	Beam trawls	dem trawl	Neph trawl	ind trawl	Shrimp trawl	total	total)
1999	75	116	1106	39	84	76	1496	82	41	121	105	1	12	362	1858
2000	52	88	1066	16	68	56	1347	61	47	116	140	0	13	377	1724
2001	52	18	1343	7	67	53	1540	44	18	86	211	4	11	375	1915
2002	41	59	1269	86	53	55	1563	35	41	116	162	1	15	371	1934
2003	28	40	1508	59	30	42	1707	27	4	27	147	1	10	217	1924
2004	57	45	1525	91	42	50	1809	31	13	40	189	0	37	311	2120
2005	14	48	1412	96	26	17	1612	18	5	104	136	0	9	272	1884
2006	9	8	1454	96	10	9	1587	10	1	107	105	0	3	227	1814
2007	11	24	1020	67	10	2	1134	15	10	123	97	0	9	255	1389
2008	18	33	1160	86	2	8	1306	27	8	91	145	0	17	288	1594

B. Effort by fishery (from logbook data).

YEAR	TOTAL DANISH EFFORT IN IV (DAYS)						NORTH SEA	TOTAL DANISH EFFORT IN IIIA (DAYS)						IIIA	IIIA & IV
	Other gear	Beam trawls	dem trawl	Neph trawl	ind trawl	Shrimp trawl	total	Other gear	Beam trawls	dem trawl	Neph trawl	ind trawl	Shrimp trawl	total	total
1999	748	687	5084	428	1043	1200	9190	419	321	987	1555	15	160	3456	12646
2000	695	787	6297	285	808	1102	9974	316	410	962	2173	5	227	4092	14066
2001	780	250	8164	182	1039	1137	11552	315	267	775	2916	31	219	4522	16074
2002	676	537	7415	741	1155	1025	11548	297	356	1054	2570	18	210	4505	16053
2003	309	445	7917	711	528	810	10720	174	62	328	1983	7	188	2742	13462
2004	522	419	6212	448	517	606	8725	309	165	211	2638	3	135	3462	12186
2005	166	401	6075	443	240	263	7589	141	92	517	1991	3	154	2898	10487
2006	174	96	5912	543	125	154	7004	99	43	539	1403	2	52	2139	9143
2007	108	191	3805	361	106	36	4607	117	139	744	1244	0	181	2424	7031
2008	189	191	3978	469	38	104	4968	185	51	690	2031	1	397	3356	8325

Table 5.2.6. Anglerfish in IV and IIIa. Norwegian landings (tonnes) by fishery in 2005–2007 and preliminary data from 2008.

Fleet	2005 Div IIIa	2005 Div IIV	2006 Div IIIa	2006 Div IVa	2007 Div IIIa	2007 Div IVa	2008 Div IIIa	2008 Div IVa
Coastal gillnetting	61	526	103	696	87	574	97	554
Offshore gillnetting	1	16	+	19	+	32	+	24
Coastal shrimp trawling	22	50	25	46	26	36	27	35
Offshore dem trawling	5	102	+	142	8	154	12	206
Offshore shrimp trawling	3	68	5	66	8	39	7	32
Other gears	7	119	3	36	3	24	+	24
Total	100	880	137	1,005	132	860	144	875

Table 5.2.7. Anglerfish in Subarea VI. Landings, effort and lpue from the Irish OTB fleet.

YEAR	HOURS (VIA)	KW.DAYS (VIA)	HOURS VIB)	KW.DAYS (VIB)	LANDINGS (VIA)	LANDINGS (VLB)	LPUE (VIA_HOURS)	LPUE (VIA KW.DAYS)	LPUE (VIB_HOURS)	LPUE (VIB KW.DAYS)
1995	56863	1408312	9029	599053	655	114	11.52	0.47	12.63	0.019
1996	60960	1388902	7219	469212	624	74	10.24	0.45	10.25	0.022
1997	63159	1462368	7169	377836	587	93	9.29	0.40	12.97	0.025
1998	57398	1343782	7337	403310	558	99	9.72	0.42	13.49	0.024
1999	54075	1348480	8680	437920	449	64	8.30	0.33	7.37	0.019
2000	52847	1325585	9883	613229	410	62	7.76	0.31	6.27	0.013
2001	47224	1320179	7232	593467	315	93	6.67	0.24	12.86	0.011
2002	35016	1007965	2626	217918	276	41	7.88	0.27	15.61	0.036
2003	39211	1536279	4543	478464	314	26	8.01	0.20	5.72	0.017
2004	35217	1279049	2234	205349	210	13	5.96	0.16	5.82	0.029
2005	30748	1075974	3844	216991	351	35	11.42	0.33	9.11	0.053
2006	28014	1031169	5903	464965	386	53	13.78	0.37	8.98	0.030
2007	25373	911973	6589	548392	467	69	18.41	0.51	10.47	0.034
2008	17327	630615	9740	n/a	295	78	17.03	0.47	8.01	n/a

Landings in tonnes.

Lpue estimates on '000 hours fished or '000 kw.days.

Table 5.2.8. Danish lpue (Kg/day) for anglerfish. Official logbook records and for shrimp trawl adjusted for increasing fishing power (technological creep).

Year	North sea (IV) & Skagerrak (IIIa)		North sea (IV) & Skagerrak (IIIa)		
	LPUE, nominal (unadjusted)		Relative LPUE, nominal (unadjusted)		Relative LPUE, adjusted for increasing fishing power
	Dem. Trawl + Neph trawl	Shrimp trawl	Dem. Trawl + Neph trawl	Shrimp trawl	Shrimp trawl
1996	176.1	91.0	1.03	1.49	2.82
1997	170.6	61.0	1.00	1.00	1.00
1998	176.6	59.4	1.03	0.97	1.27
1999	163.5	62.3	0.96	1.02	0.95
2000	132.2	49.0	0.77	0.80	0.73
2001	131.7	45.3	0.77	0.74	0.67
2002	135.3	54.5	0.79	0.89	0.62
2003	156.4	49.4	0.92	0.81	0.47
2004	194.3	75.4	1.14	1.24	0.54
2005	188.3	55.4	1.10	0.91	0.24
2006	205.6	54.4	1.20	0.89	0.09
2007	208.1	45.0	1.22	0.74	0.09
2008	202.5	42.6	1.19	0.70	0.20

Table 5.2.9. Abundance (millions of individuals) and biomass (tonnes) estimates from the 2005–2008 anglerfish surveys.

	Abundance (millions)				Biomass (tonnes)			
Stratum	2005	2006	2007	2008	2005	2006	2007	2008
Survey Total	26.117	25.921	23.884	22.262	37,160	37,599	45,164	50,568
Irish area VI	2.9	2.878	2.652	2.472	2,389	2,418	2,904	3,251
Rockall visual	0.048	0.073	0.073	0.063	212	259	343	260
AreaIV (partial)	14.196	13.601	15.608	12.62	19,060	21,999	28,575	29,724
AreaVIa	12.822	12.097	6.859	8.253	14,753	11,600	9,310	15,045
AreaVIb	2.048	3.174	4.141	3.924	5,948	6,676	10,527	9,311
AreaVI	14.87	15.27	11.000	12.177	20,701	18,276	19,836	24,357
Northern Shelf (partial)	29.065	28.871	26.609	24.796	39,761	40,275	48,411	54,080

Table 5.2.10. Nominal catch (t) of Anglerfish in Division IIa, 1993–2007, as officially reported to ICES.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*
Denmark	+	+	+	+	+	+	+	+	2	+	-	1	-	-	-	-
Faroes	+	+	+	+	+	+	+	-	1	1	2	5	11	4	7	4
France	-	-	-	-	-	-	+	-	-	-	-	-	-	1	-	4
Germany	2	3	1	4	20	53	4	17	65	59	55	70	55	-	-	-
Norway	3,044	1,026	526	893	576	1,488	1,731	2,952	3,552	2,000	2,404	2,906	2,649	4,253	4,455	4,000
Portugal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Russia	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Sweden	-	-	-	+	+	+	+	+	+	-	-	-	-	-	-	-
UK (total)	1	2	74	15	5	7	6	30	2	10	15	18	19	86	115	138
Total	3,047	1,031	601	912	601	1,548	1,741	2,999	3,622	2,070	2,476	2,999	2,672	4,341	4,577	4,147

***Preliminary**

Table 5.2.11. Anglerfish in IIa. Norwegian landings (tonnes) by fishery in 2005–2007 and preliminary data for 2008.

Fleet	2005	2006	2007	2008
Coastal gillnetting	2,301	3,723	4,039	3,573
Offshore gillnetting	115	261	204	240
Offshore dem trawling	77	71	52	26
Coastal Danish seine	54	54	63	75
Other gears	102	144	98	84
Total	2,649	4,253	4,456	3,998

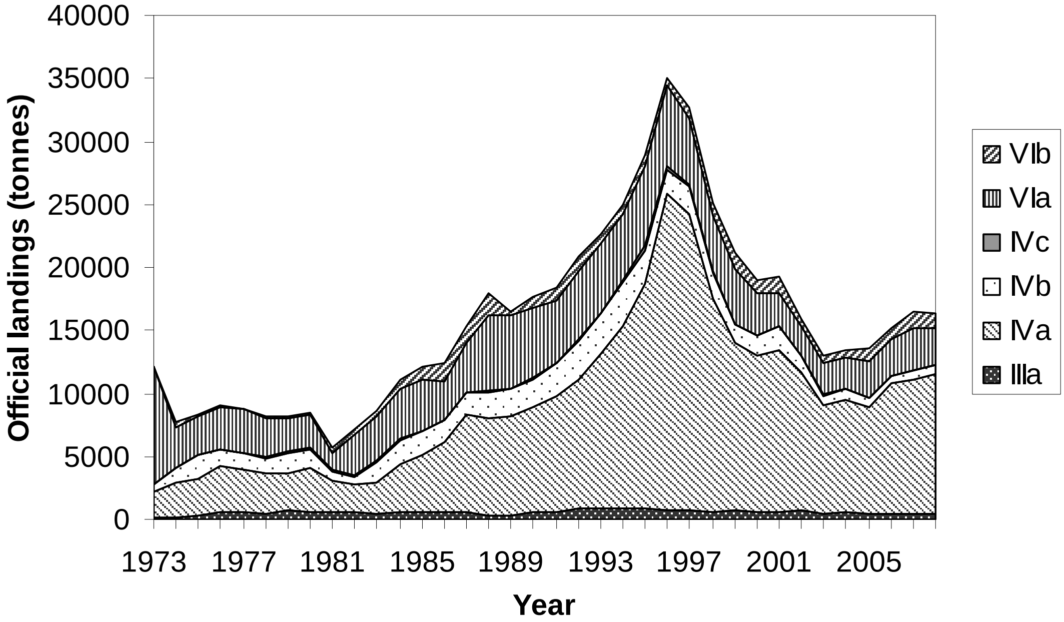
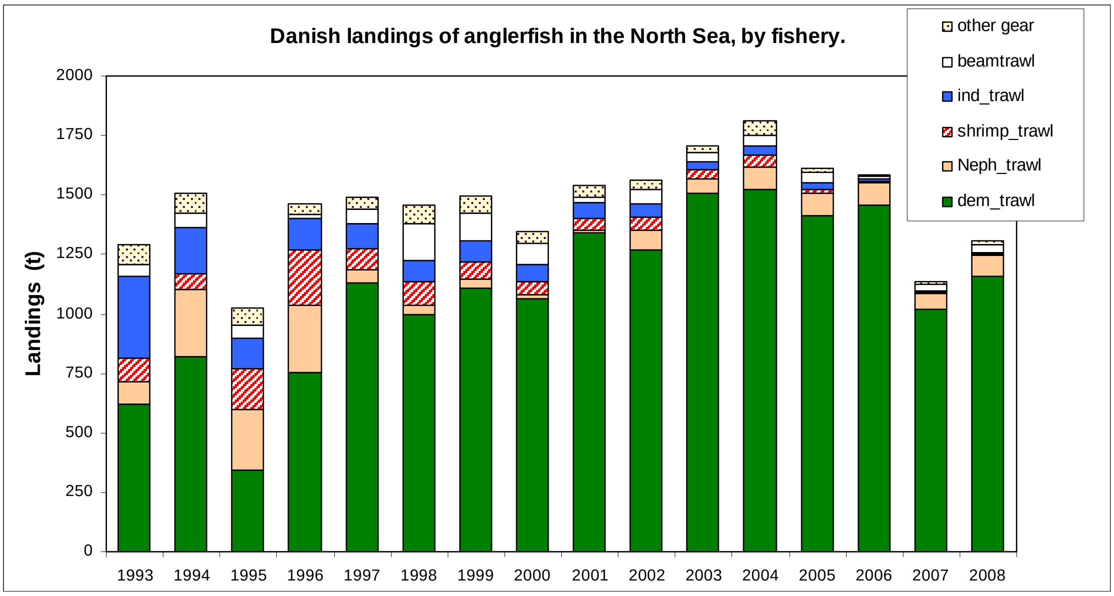


Figure 5.2.1. Northern Shelf anglerfish. Officially reported landings by ICES area.



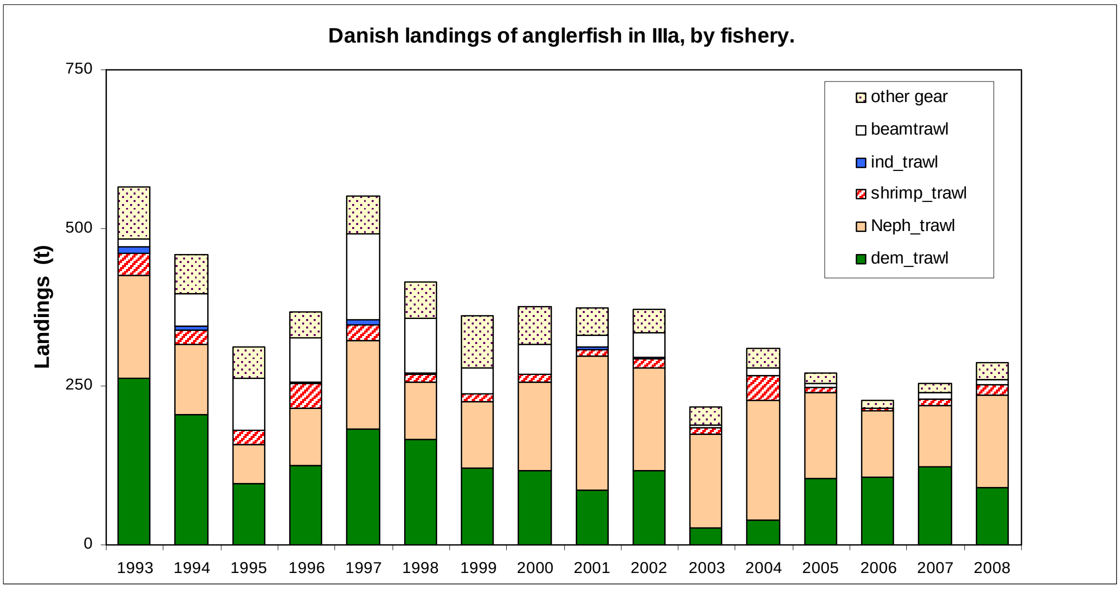


Figure 5.2.2. Danish landings of Anglerfish by fishery in the North Sea (top) and Division IIIa (bottom).

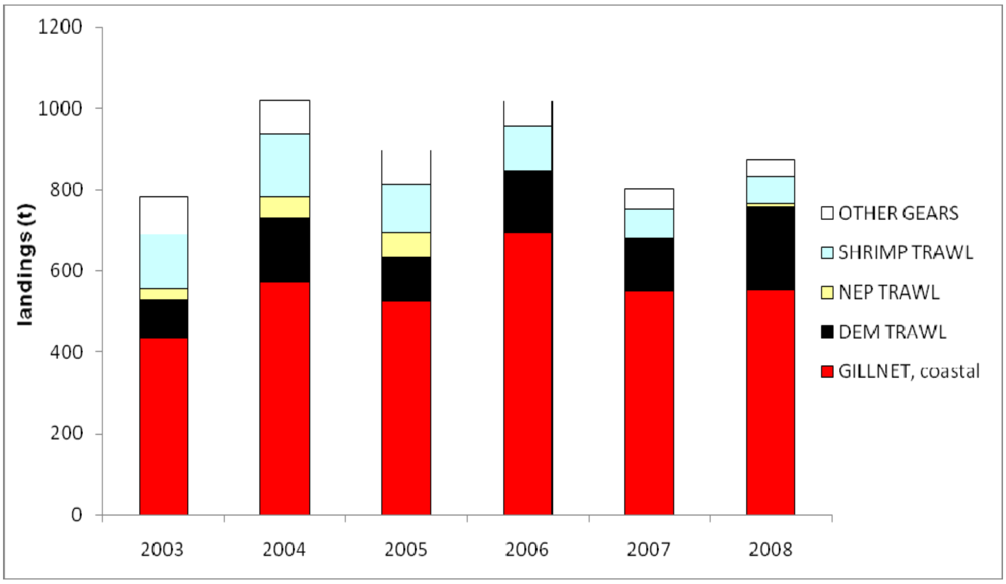


Figure 5.2.3. Anglerfish in Division IVa. Norwegian landings by fleet from 2003–2008.

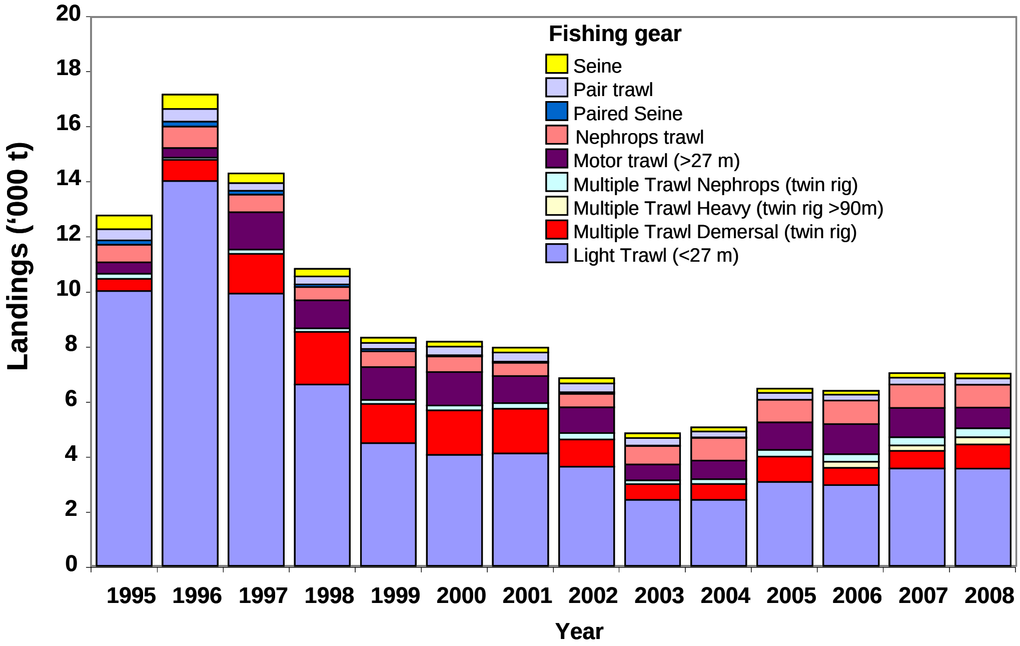


Figure 5.2.4. Anglerfish in Divisions IVa, and VI. Scottish landings by fleet 1993–2008.

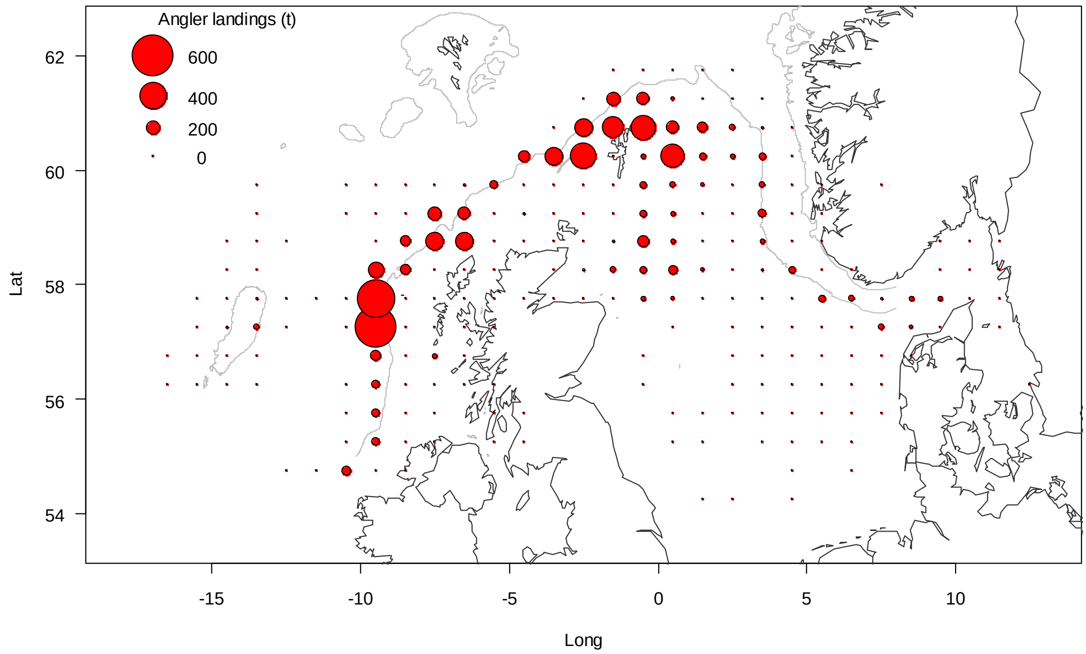


Figure 5.2.5. Northern Shelf anglerfish. Distribution of officially reported landings for 2008 from Scotland, Ireland, Denmark and France. The circles are centred on each ICES rectangle and the area of each circle is proportional to the landings in tonnes (according to the legend).

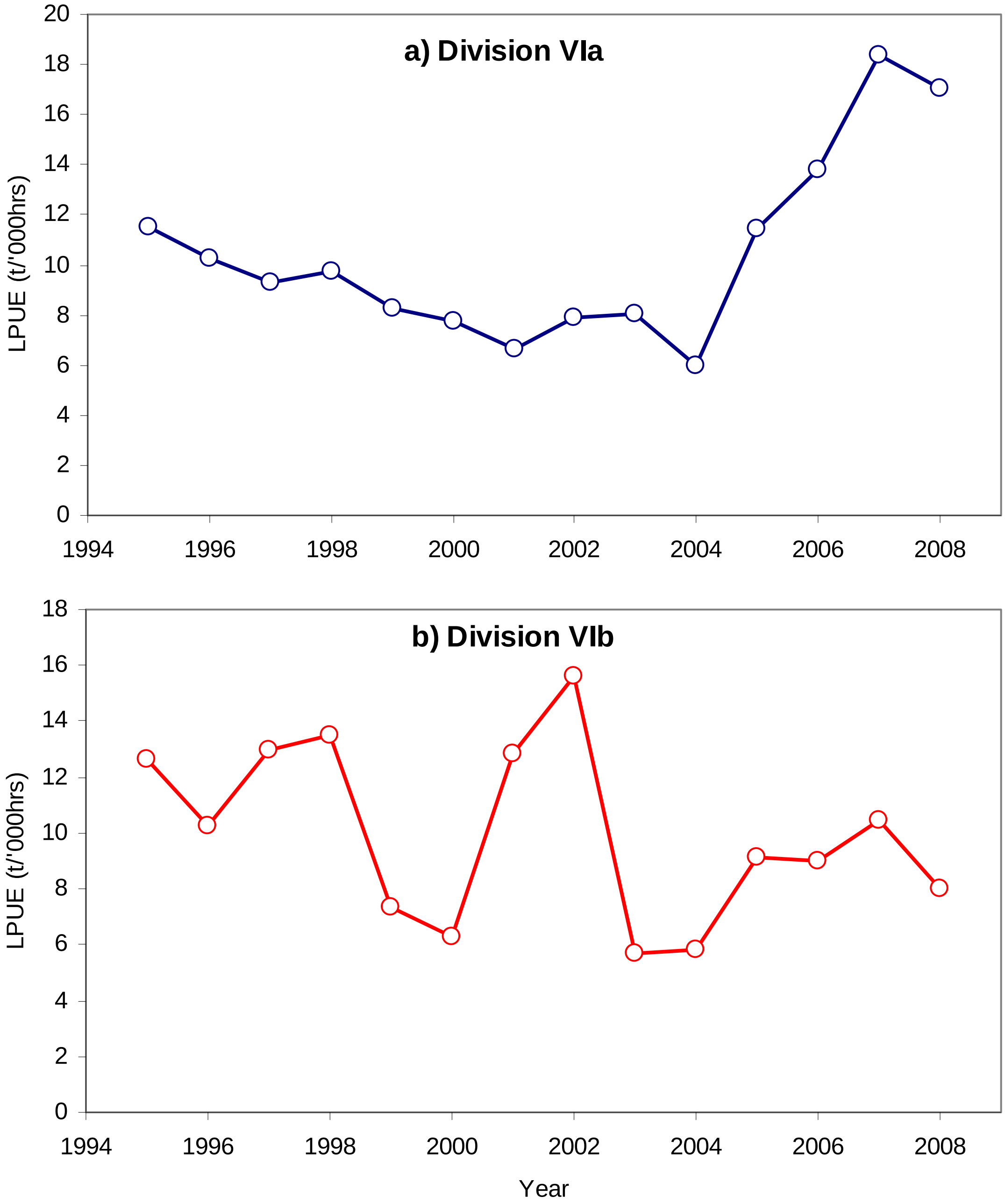


Figure 5.2.6. Lpue for the Irish otter trawl fleet with effort in hours fished for a) Division VIa, and b) Division VIb.

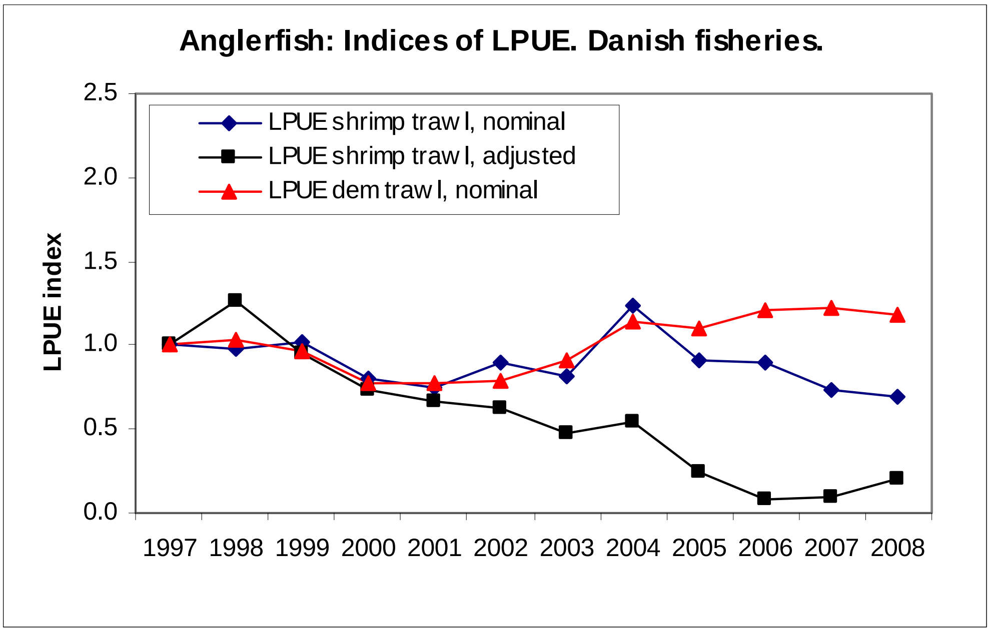


Figure 5.2.7. Anglerfish in the North Sea and Division IIIa. Danish lpue by demersal trawl and shrimp trawl, relative to 1997. Based on nominal logbook records as well as development in gear and engine power (shrimp trawl).

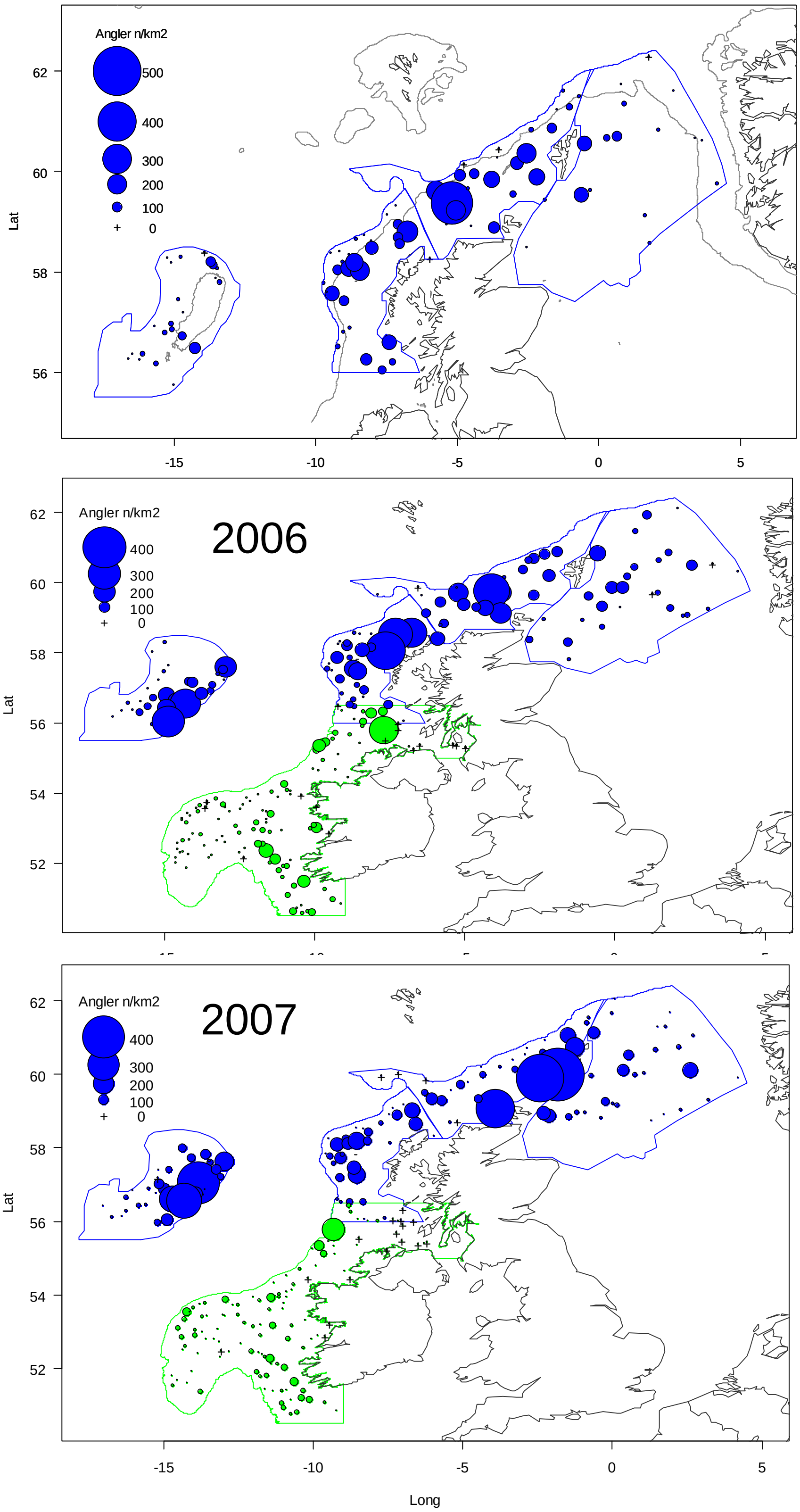


Figure 5.2.8. Maps of the northern continental shelf around the British Isles showing the number density of anglerfish during the 2005–2007 anglerfish surveys. Each circle is centred on the sample location and the size of the circle is proportional to the number density in n/km2 according to the legend (top left). Blue circles represent trawl based densities based on Scottish surveys; green symbols Irish surveys. Trawl densities account for herding but not footrope escapes.

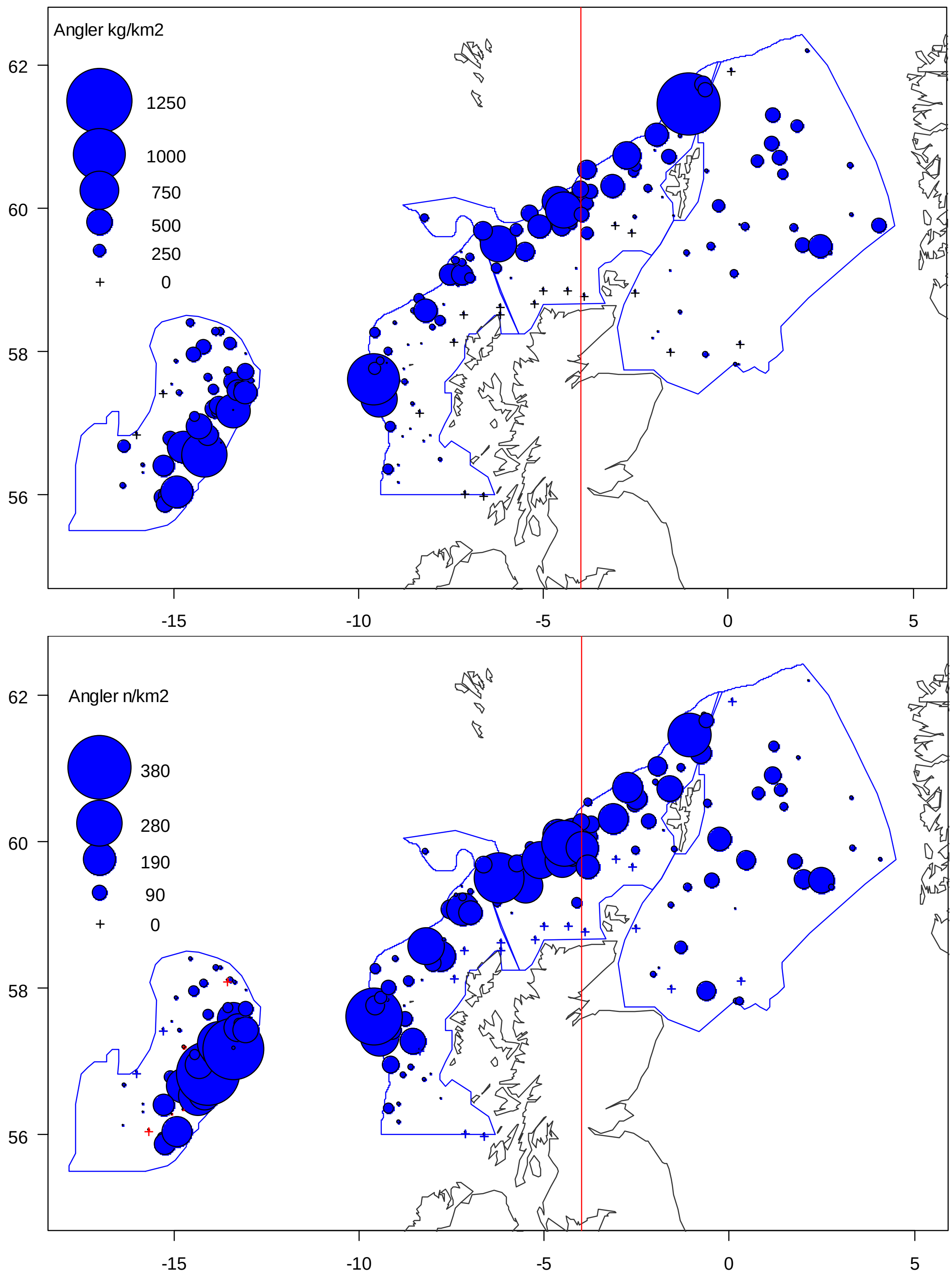


Figure 5.2.9. Map of the northern continental shelf around Scotland showing the number density of anglerfish during the 2008 surveys. Each circle is centred on the sample location and the size of the circle is proportional to the number density in n/km2 (top) and weight density (bottom) according to the legend (top left). Blue circles represent trawl based densities; red symbols represent visual based densities. Trawl densities account for herding but not footrope escapes. The red line indicates the position of the 4° line of latitude which separates ICES Areas IV (east) and VI (west).

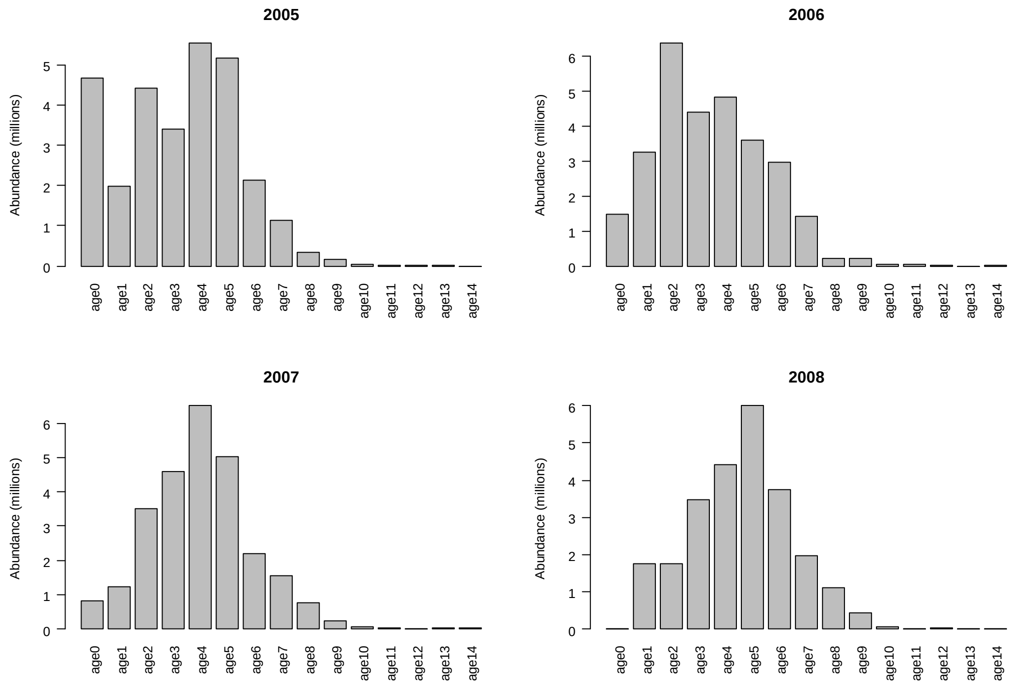


Figure 5.2.10. Estimates of total abundance at age for each of the anglerfish surveys 2005-2008.

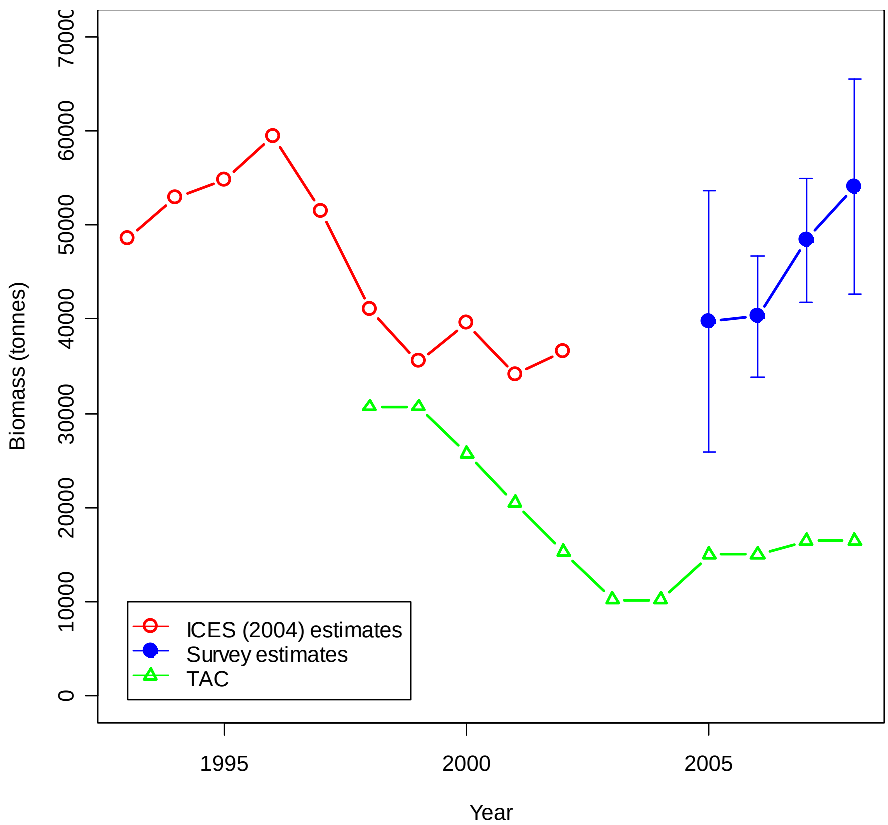


Figure 5.2.11. Estimates of total biomass of anglerfish for the Northern shelf: blue filled circles are based on the Marine Scotland anglerfish surveys, with confidence intervals derived from variance estimates of the surveys without footrope catchability; red open circles are estimates derived by ICES 2004; green open triangles are Total Allowable Catches (TAC).

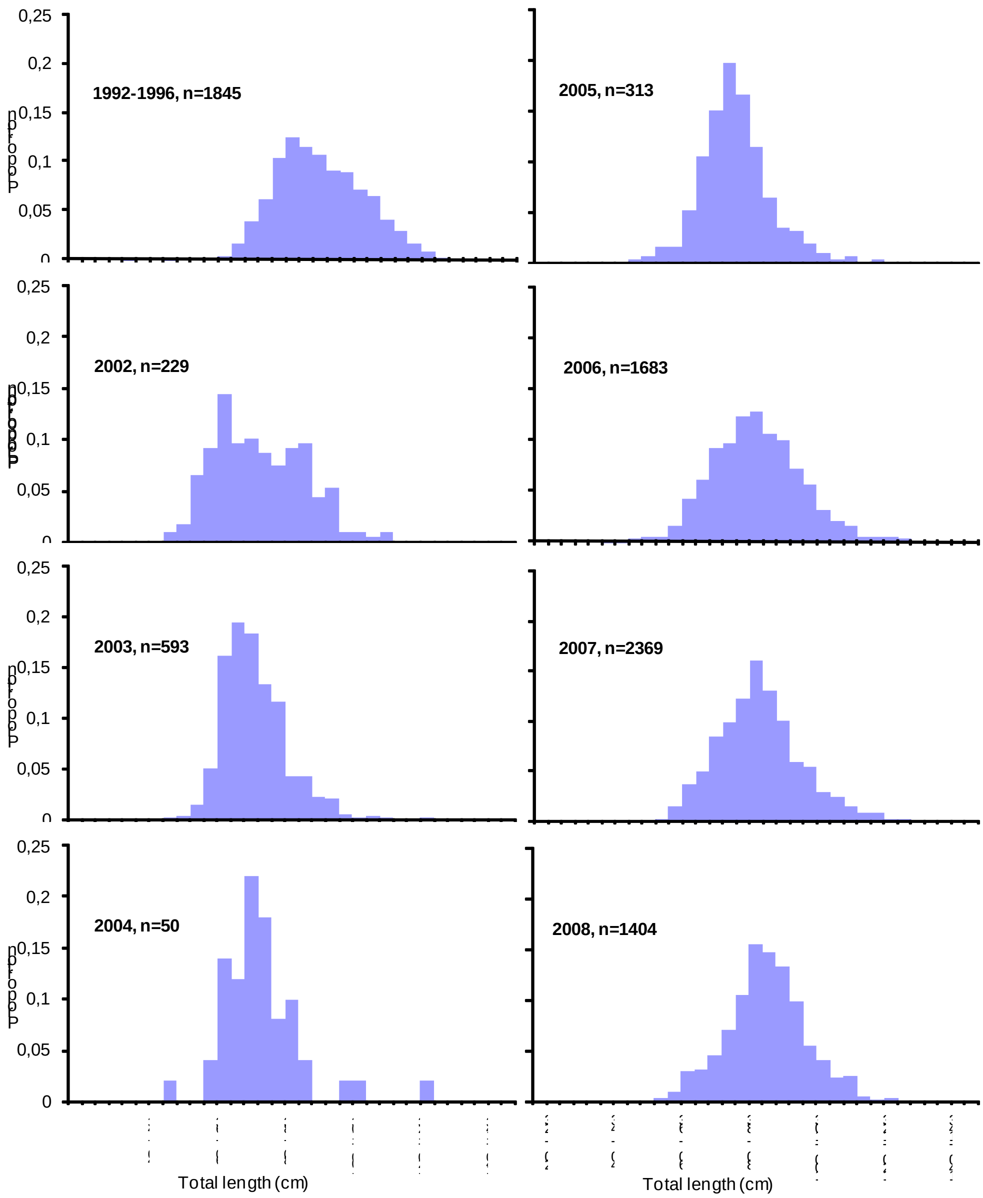


Figure 5.2.12. Anglerfish in IIa. Length distributions for anglerfish caught in the directed coastal gillnetting in Division IIa during 1992–2008. Note that data are lacking for 1997–2001.

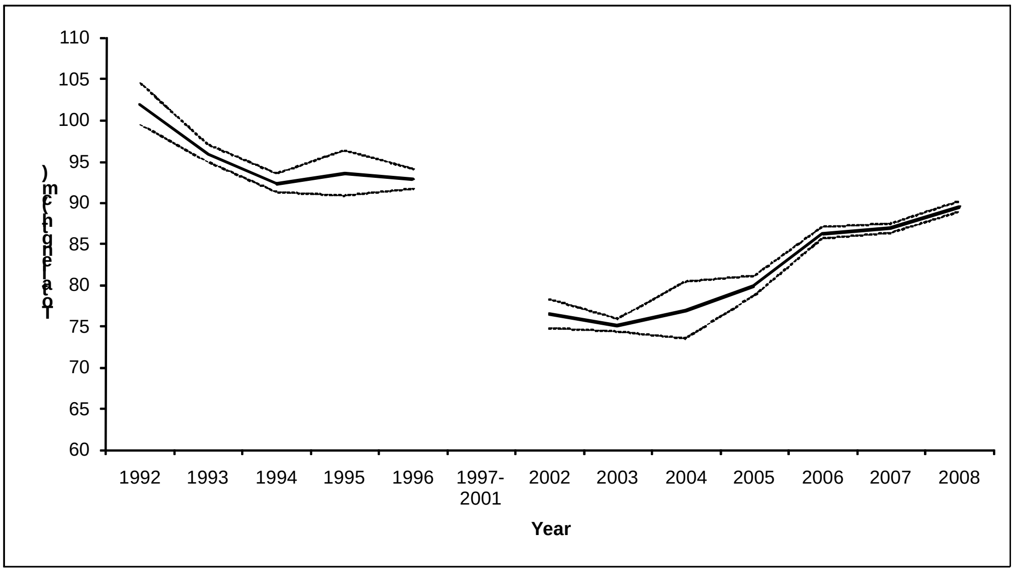


Figure 5.2.13. Anglerfish in IIa. Mean lengths for anglerfish caught in the directed coastal gillnetting in Division IIa during 1992–2008, dotted lines represents ±2SE of the mean. Note that data are lacking for 1997–2001.

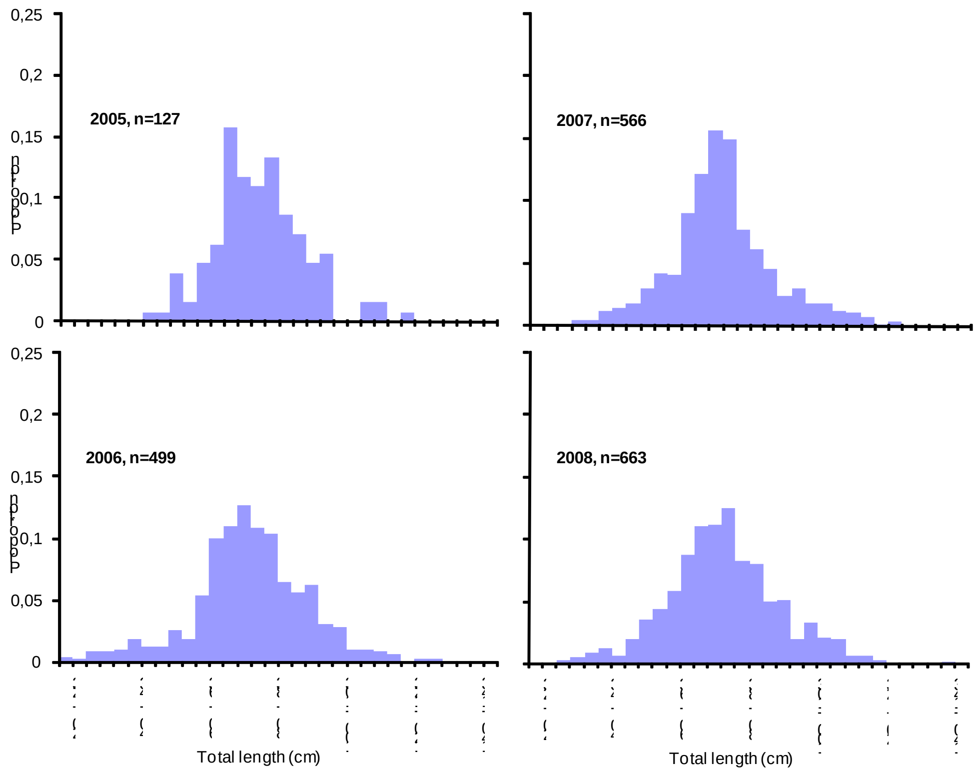


Figure 5.2.14. Anglerfish in IIa. Length distribution for anglerfish caught as bycatch by other gears (offshore gillnetting and longlining) in Division IIa in 2005–2008.

5.3 Megrim in division IV and VI

Type of assessment in 2009

ICES has not conducted an analytical assessment of this stock since 1999. Megrim continues to be a monitored stock and a benchmark analysis will be required before an assessment can be presented. Based on the recommendation of WGNSDS 2008, WGCSE now also considers megrim in IVa and IIa.

ICES advice applicable to 2008

Catches in 2007 should be based on the recent average (2004–2006), about 1400 t. This includes landings in Division VIa and VIb and unallocated landings in Subarea IV.

ICES advice applicable to 2009

The new landings, cpue, and survey data available for this stock do not change the perception of the stock and do not give reason to change the advice from 2007. The advice on this stock for the fishery in 2009 is therefore the same as the advice given in 2007 for the 2008 fishery: Catches should be based on the recent average (2004–2006), about 1400 t. This includes landings in Division VIa and VIb and unallocated landings in Subarea IV.

5.3.1 General

Stock description and management units

Megrim stock structure is uncertain and historically the Working Group has considered megrim populations in VIa and VIb as separate stocks. The Review Group questioned the basis for this in 2004. Data collected during an EC study contract (98/096) on the 'Distribution and biology of anglerfish and megrim in the waters to the West of Scotland' demonstrated significantly different growth parameters and significant population structure difference between megrim sampled in VIa and VIb (Anon, 2001). Spawning fish occur in both areas but whether these populations are reproductively isolated is not clear. As noted by WGNSDS 2008, megrim in IVa has historically not been considered by ICES and WGNSDS 2008 recommended that VIa megrim should be considered by WGCSE. Landings data from IV and IIa are now included in this Report and work is underway to collect international catch and weight-at-age data for IV as well as VI.

Fishery in 2008

During spring of 2007 a significant fishery for shoaling cod in the Celtic Sea and restrictive effort allocations prompted the Irish boats to switch their efforts away from VIa, this has resulted in a reduction in recorded effort during the 2nd quarter relative to previous years. Irish effort data also demonstrate an increase in activity in VIb; this is also likely to be in response to effort restrictions. This activity pattern is again noted for 2008. Reporting of effort form Scottish fleets is not mandatory so it is not possible to determine the trends in effort for the main fleets targeting this stock although anecdotal evidence suggests some degree of effort displacement to VIb from both IV and VIa.

Based on landings data presented to the working group, only 53% of the overall TAC for VI, EC waters of Vb and international waters of XII and XIV was used. It should be noted that no landings data were made available to the working group by Spain. The lack of uptake is largely driven by the failure of France to utilize quota in line with previous years, other countries such as Ireland and the UK had a greater uptake.

2008 TAC for VI, EC waters of Vb and international waters of XII and XIV			
	TAC	WG Landings	% TAC uptake[1]
Spain	295	nr	nr
France	1148	130	11
Ireland	336	240	71
UK	813	1010	124
EC Total	2592	1380	53

***nr – not reported to the working group**

[1] – post regulation quota swaps have not been taken into account

The uptake of the TAC for ICES division IV and IIa was 99%. Landings data were only received from the UK, which holds 96% of the TAC.

2008 TAC for EC IV and IIa			
	TAC	WG landings	% TAC uptake[1]
Belgium	5	nr	
Denmark	4	nr	
Germany	4	nr	
France	26	nr	
Netherlands	21	nr	
UK	1537	1518	99%
EC	1597		

[1] – post regulation quota swaps have not been taken into account

Discard data were only available from Ireland and indicate that discarding of this species is low (~9%). Qualitative observations for Irish activity in 2009 indicate that there has been a large reduction in effort in VIa as a consequence of the increase in mesh size from 100 mm to 120 mm plus the mandatory use of a 120 mm square mesh panel. Effort restrictions in VIa in conjunctions with an absence of kw.days restrictions in the Celtic Sea, has reduced effort further in VIa.

5.3.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1.

It has not been possible to construct full international catch numbers-at-age for the past few years. Data from 2005 to 2007 are required from the UK (VI and IV) and France (IV).

Landings

Official landings data for each country together with Working Group best estimates of landings from VIa and VIb and are demonstrated in Table 5.3.1 and landings from IV in Table 5.3.2. The WG best estimates of landings are those supplied by stock co-ordinators of the various countries and differ from the official statistics in some years. These were supplied for VIa by Ireland, Scotland and France in 2008. Landings have increased in recent years and are more in line with historical trends.

Catches of megrim comprise two species, *Lepidorhombus whiffiagonis* and *L. boscii*. Information available to the Working Group indicates that *L. boscii*, are a negligible proportion of the Scottish and Irish megrim catch (Kunzlik *et al.*, 1995; Anon, 2001). It is not clear to the WG whether landings of other countries are accurately partitioned by megrim species. Megrim are caught in association with anglerfish by some fleets and are area misreported along with anglerfish. As with anglerfish, the reported Subarea VI landings have been adjusted to the Working Groups estimate of catch by including landings declared from Sub-area IV in the ICES statistical rectangles immediately east of the 4 degree W line (see anglerfish Annex 5.2 for a detailed methodology). Area misreporting peaked in 1996 and 1997 when around 50% of the estimated Working Group landings for Division VIa were area misreported. Corrected landings by ICES statistical rectangle are shown in Figure 5.3.1.

Discards

Discard data were only made available by Ireland. Discard data from the otter trawl fleet were available for VIa. A mean discard rate of 9% is observed, based on data from 9 trips and 147 individual hauls (Figure 5.3.2).

Surveys

In 2005, Scotland initiated a new industry-science partnership survey to provide an absolute abundance estimate for anglerfish (see Section 5.2). Four surveys have been carried out to date and these cover the main distribution of the anglerfish fishery. The survey is also considered to have greater spatial coverage for megrim and as such is recommended by WKAGME 2008 as the main source of data of megrim relative abundance for the Northern Shelf. Currently, only four years of data are available (2005–2008) as data from the 2009 survey are not yet available, but the time-series will be updated as soon as this becomes available (summer 2009).

For the four years of survey data available, the sample locations and the density of megrim are illustrated in Figure 5.3.3 as numbers (number per square kilometre) and in Figure 5.3.4, as weight (kilograms per square kilometre). The highest densities of megrim occurred close to the 200 m contour in the northern and western areas, and on the eastern slopes of the Rockall plateau; high densities were also present in the northern North Sea.

The results of the survey are presented in Table 5.3.3. The abundance and biomass time-series are given in Figures 5.3.5 and 5.3.6 respectively. The increase in abundance and biomass on the Northern Shelf from 2005 to 2008 was 97% and 57% respectively: In each case, over 50% of this abundance and biomass was contained in Sub-area IV (North Sea).

Using the ration of the average abundance estimate from the first two years of the time-series with the last two years in line with the method proposed by the EC for setting TACs for category 6 stocks, gives an increase in relative biomass of 51% for the entire survey area (Table 5.3.4). Split by area, the biomass estimates increase by 50 and 52% for ICES Area VI and IV (partial coverage) respectively. It should be noted that the five year time-series indicated in the EC policy statement is not yet available. However, when the data from the 2009 survey become available, this will present a five year time-series and the estimates will be revaluated.

Commercial cpue

Catch and effort (days fished and kw.days) data were available for the Irish otter trawl fleets from 1995–2008 for both VIa and VIb (Table 5.3.5; Figures 5.3.7 and 5.3.8). Lpue in VIa has revealed a gradual decline over the time period, but a marked increase of 36% was observed in 2008. This increase in lpue in 2008 was not observed in VIb, where lpue continues to decline for the Irish OTB. Irish effort has also continued to decline in recent years and current OTB effort in kW days has declined by 58% since 2003. No effort data are available for either France of UK, who combined have 76% of the TAC.

5.3.3 Historical stock development

No analytical assessment has been agreed for this stock since 1999.

State of the stock

The state of the stock is unknown.

5.3.4 Short-term projections

There is no accepted analytical assessment for this stock.

5.3.5 Biological reference points

Precautionary approach reference points.

No precautionary reference points have been defined for this stock.

5.3.6 Uncertainties and bias in assessment and forecast

There is no accepted analytical assessment for this stock.

5.3.7 Recommendation for next Benchmark

Before a benchmark can be recommended, it is first necessary to construct international catch numbers/weights-at-length and age for the main fleets engaged in the fishery. For megrim in VI, this requires data from Ireland, UK, France and Spain and for megrim in IV, from the UK.

Effort data for the main fleets engaged in both the VI and IV megrim fisheries are required to provide a time-series of trends in commercial lpue in both VI and IV.

5.3.8 Management considerations

The TAC in VI has not been fully utilized. However, the uptake rate is country specific, with full uptake being reported by some member states. Partial quota by individual member states may be an artefact of reduction in effort rather than reflective of a reduction in biomass. Data from the anglerfish survey suggest an upward trend in abundance. The TAC in IV has been fully utilized and the data from the anglerfish survey indicate an increase in biomass over the time-series. Data from the 2009 survey will provide a five year time-series, which will provide a sufficiently long time-series to apply the EC communication to ICES (Comm. 2009, 224) regarding Category 6 stocks where MSY proxy is not available (category 6.5 or 6.6). The state of the stock relative to F_{msy} is currently undefined.

Table 5.3. 1. Megrim in Subarea VIa (upper) and VIb (lower). Nominal catch (t) of Megrim West of Scotland and Rockall, as officially reported to ICES and WG best estimates of landings.

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008[1]
Belgium	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0		
Denmark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
France	398	455	504	517	408	618	462	192	172	0	135	252	79	92	50	48	53	104	130
Ireland	317	260	317	329	304	535	460	438	433	438	417	509	280	344	278	156	221	191	172
Netherlands	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0		
Spain	91	48	25	7	1	24	22	87	111	83	98	92	89	98	45	69	52	5	
UK – Eng.&Wales and N.Irl.	25	167	392	298	327	322	156	123	65	42	20	7	14	13	17	10	0	8	
UK – Scotland	1093	1223	887	896	866	952	944	954	841	831	754	770	643	558	469	269	336	658	
UK																			868
Offical Total	1924	2154	2125	2047	1907	2451	2044	1795	1622	1394	1424	1630	1105	1105	859	552	662	966	1170
Unallocated	286	278	424	674	786	1047	2010	1477	1083	1254	823	843	723	537	469	9	213	n/a	8
As used by WG	2210	2432	2549	2721	2693	3498	4054	3272	2705	2648	2247	2473	1828	1642	1328	561	875	1301	1426
Area Mispreported landings	339	338	466	735	871	1126	2062	1556	1156	1066	868	829	731	544	421	n/a	212	478	250

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
France	-	-	-	-	-	-	-	-	-	.	4	<0.5	<0.5	-	-	-	-	-	
Ireland	196	240	139	128	176	117	124	141	218	127	167	176	87	83	43	68	95	87	68
Spain	363	587	683	594	574	520	515	628	549	404	427	370	120	93	71	88	59	19	
UK - Eng+Wales+N.Irl.	19	14	53	56	38	27	92	76	116	57	57	42	41	74	42	19	9	.	
UK - England & Wales	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
UK - Scotland	226	204	198	147	258	152	112	164	208	278	309	236	207	382	372	207	181	.	
UK																			142
Offical Total	804	1045	1073	925	1046	816	843	1009	1091	866	964	824	455	632	528	382	344	106	210
As used by WG																			

Table 5.3.2. Megrim in Subarea IV. Nominal catch (t) of Megrim North Sea, as officially reported to ICES and WG best estimates of landings.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	4	3	2	7	2	7	5	3	5	4	10	2	5	3	-	-	2	6	3
Denmark	2	1	4	6	1	2	7	5	18	21	29	52	8	11	7	1	6	11	
France	-	-	36	25	27	24	14	16	14	.	7	5	6	11	9	3	4	18	19
Germany	.	6	3	4	1	2	1	2	4	1	3	1	-	2	2	4	7	16	4
Germany, Fed. Rep. of	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Ireland	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	.	
Netherlands	24	28	27	30	28	26	9	20	30	26	20	11	9	7	11	19	22	20	3
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	1	1	
Spain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	
Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
UK - Eng+Wales+N.Irl.	17	9	47	8	19	44	4	3	5	4	2	2	3	1	1	1	9	17	
UK - England & Wales	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
UK - N. Ireland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
UK - Scotland	1126	1169	1372	1736	2000	2193	3221	3091	2628	2121	2044	1854	1675	1235	1130	958	1340	1436	
UK																			1542
Official total	1176	1216	1491	1816	2078	2298	3261	3140	2704	2177	2115	1927	1706	1271	1160	986	1391	1525	1571
As used by WG																			1321

Table 5.3.3. Estimates of relative megrim abundance and biomass from Scottish-Irish anglerfish surveys

	Abundance (millions)				Biomass (tonnes)			
	2005	2006	2007	2008	2005	2006	2007	2008
Area IV (partial)	11.7	11	14.8	18.9	4652	3629	5509	6953
Area VI	5.5	9.3	13.8	15	2444	3127	4258	4206
Northern Shelf (partial)	17.2	20.3	28.6	33.9	7096	6757	9766	11 159

Table 5.3.4. Changes in relative megrim abundance and biomass from Scottish-Irish anglerfish surveys based on percentage changes in mean abundance and biomass from the first two years of the survey relative to the mean of the last two years.

	Abundance		Biomass		Abundance	Biomass
	Mean 05/06	Mean 07/08	Mean 05/06	Mean 07/08	Percentage	Change
Area IV (partial)	11.35	16.85	4140	6231	48%	50%
Area VI	7.40	14.40	2785	4232	95%	52%
Northern Shelf (partial)	18.75	31.25	6926	10462	67%	51%

Table 5.3.5. Trends in lpue for Irish OTB fleets for VIa and VIb. Lpue is estimated for both kW days and hours fished.

	VIa				VIb			
Year	Hours	lpue (Hrs)	Kw.Days	lpue (Kw.D)	Hours	lpue (Hrs)	kw.Days	lpue (Kw.D)
1995	56863	9.01	1408312	0.36	9029.25	15.3	599053	0.23
1996	60960	7.19	1388902	0.32	7219	16.98	469212	0.26
1997	63159	6.35	1462368	0.27	7169	19.55	377836	0.37
1998	57398	6.63	1343782	0.28	7337	28.04	403310	0.51
1999	54075	6.5	1348480	0.26	8680	15.49	437920	0.31
2000	52847	6.83	1325585	0.27	9883	15.9	613229	0.26
2001	47224	8.91	1320179	0.32	7232	22.91	593467	0.28
2002	35016	6.83	1007965	0.24	2626	31.79	217918	0.38
2003	39211	8.42	1536279	0.21	4540	18.19	478464	0.17
2004	35217	7.66	1279049	0.21	2233	19.00	205349	0.21
2005	30748	8.78	1075974	0.25	3844	17.68	216991	0.31
2006	28014	7.74	1031169	0.21	5904	16.16	464965	0.21
2007	25373	7.22	911973	0.20	6589	12.85	548392	0.15
2008	17327	9.93	630615	0.27	9740	6.98	n/a	n/a

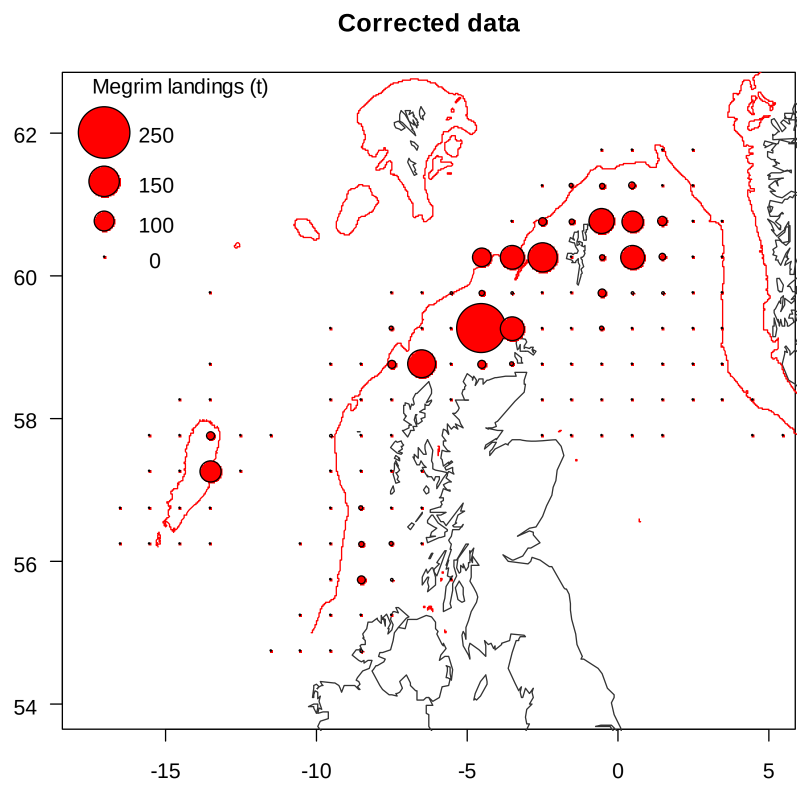


Figure 5.3. 1. Map of the Northern shelf of the British Isles showing catches of megrim by vessels from Ireland and Scotland in 2008, by ICES statistical rectangle: circle size is proportional to catch size and shaded according to proportion caught by nation. The catches have been adjusted to account for estimated misreporting of megrim into Area IV from Area VI. Source: ICES Working Group on the Assessment of Northern Shelf Demersal Stocks (ICES 2007).

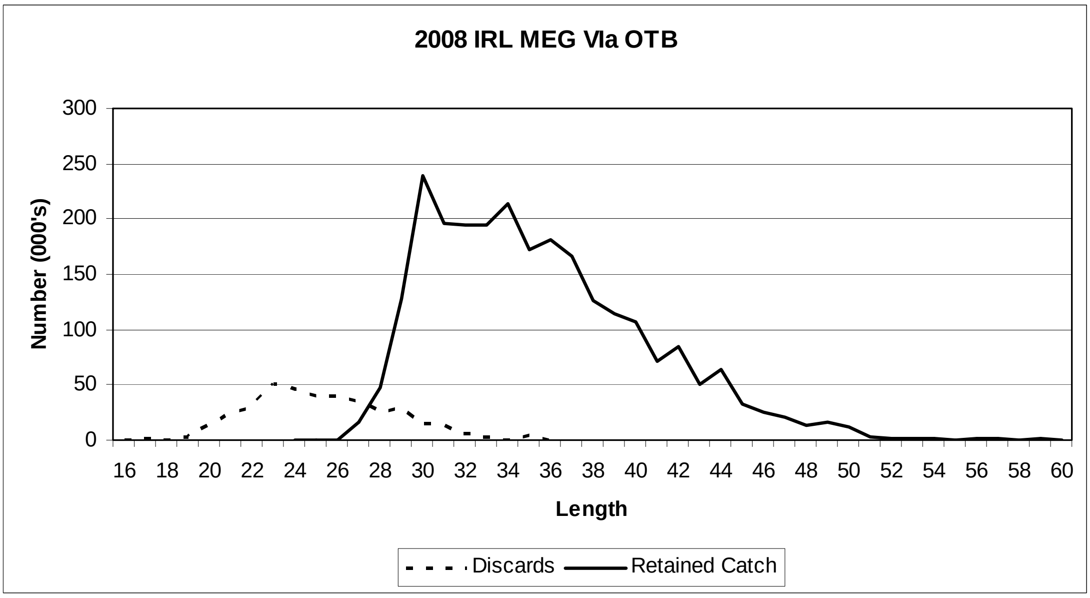


Figure 5.3.2. Raised length–frequency of Irish landings and discards for VIa otter trawlers.

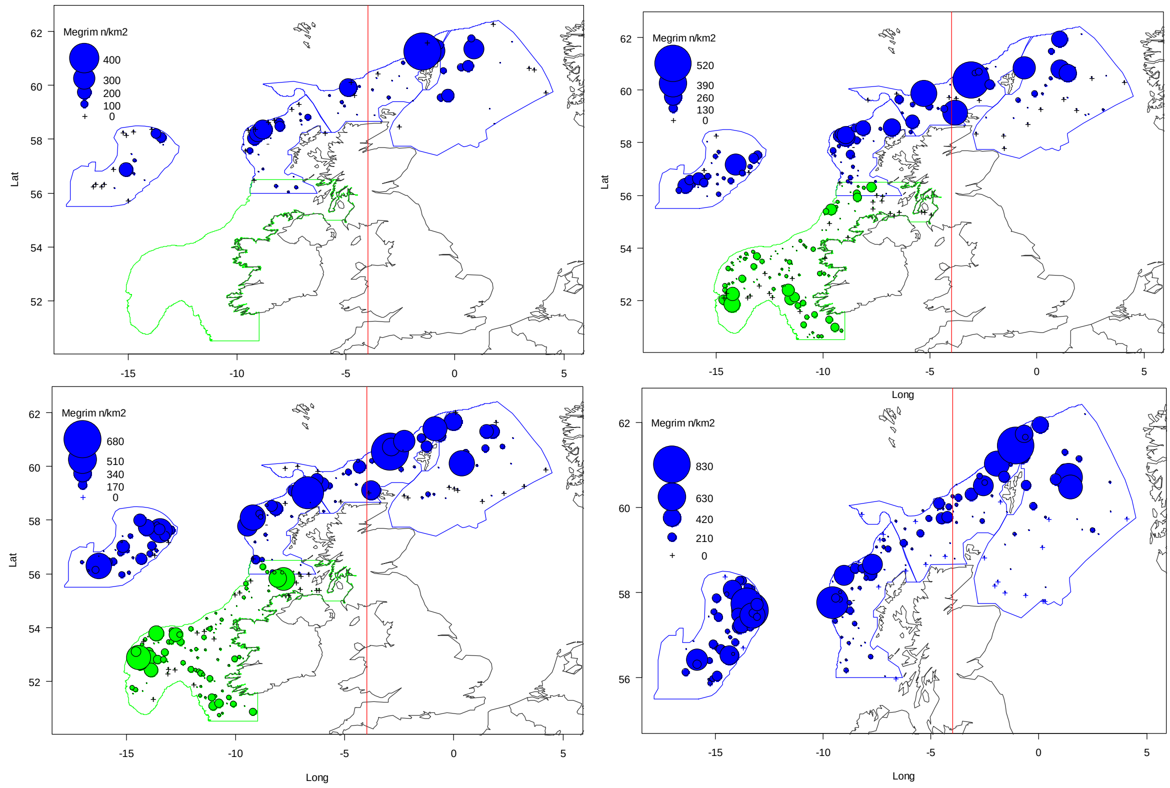


Figure 5.3.3. Number of Megrim caught during the anglerfish surveys 2005–2008. Each circle (blue for Scottish surveys; green for Irish surveys) is centred on the sample location and the size of the circle is proportional to the number density in n/km² according to the legend (top left). The red line indicates the position of the 4° line of latitude which separating ICES Areas IV (east) and VI (west).

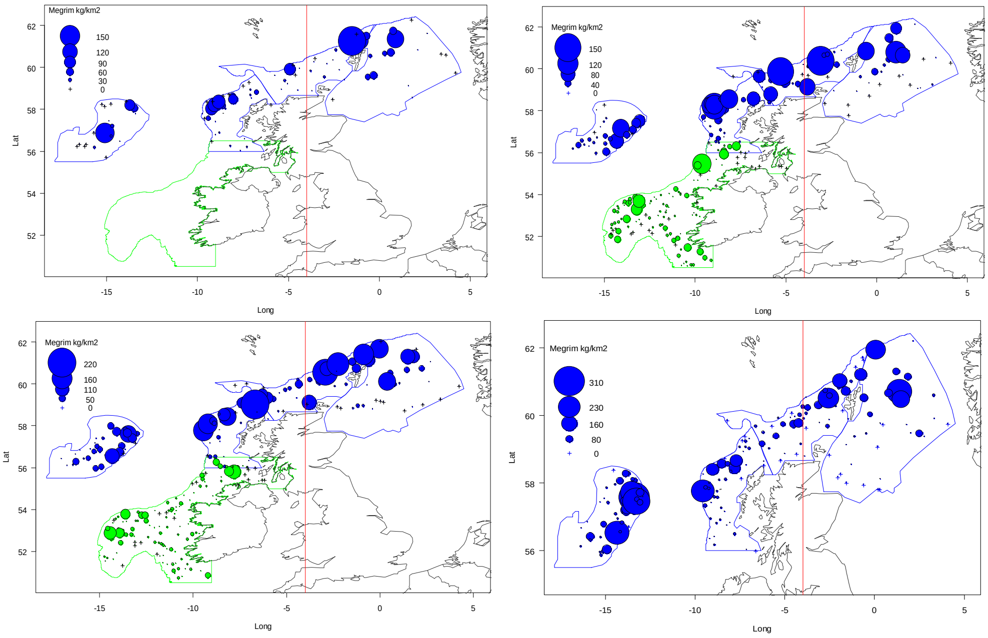


Figure 5.3.4. Weight of Megrim caught during the anglerfish surveys 2005–2008. Each circle (blue for Scottish surveys; green for Irish surveys) is centred on the sample location and the size of the circle is proportional to the number density in n/km² according to the legend (top left). The red line indicates the position of the 4° line of latitude which separating ICES Areas IV (east) and VI (west).

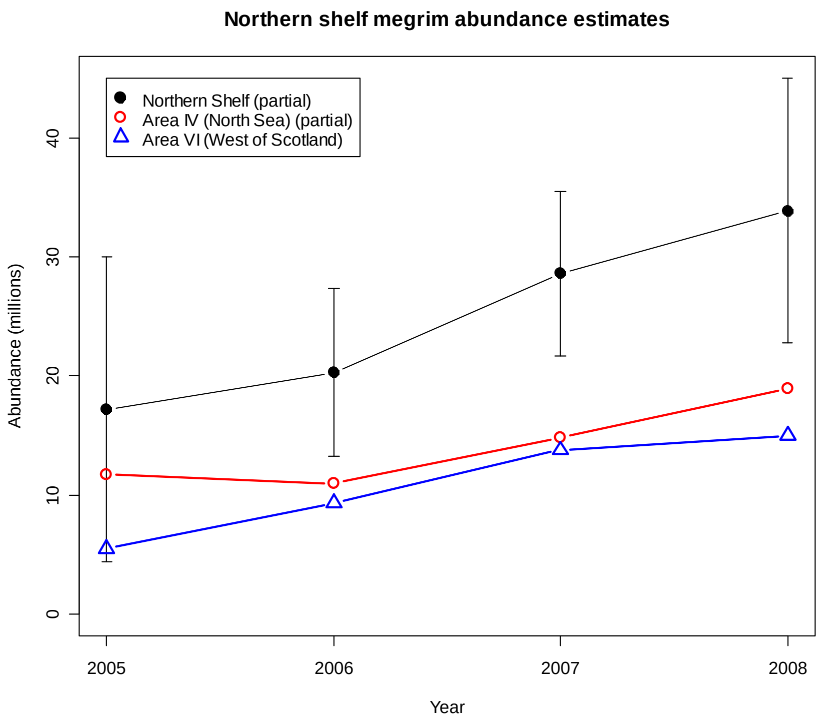


Figure 5.3.5. Estimates of the abundance of megrim on the Northern Shelf from the 2005–2008 anglerfish surveys. 95% confidence intervals are plotted as error bars on the total Northern Shelf estimates.

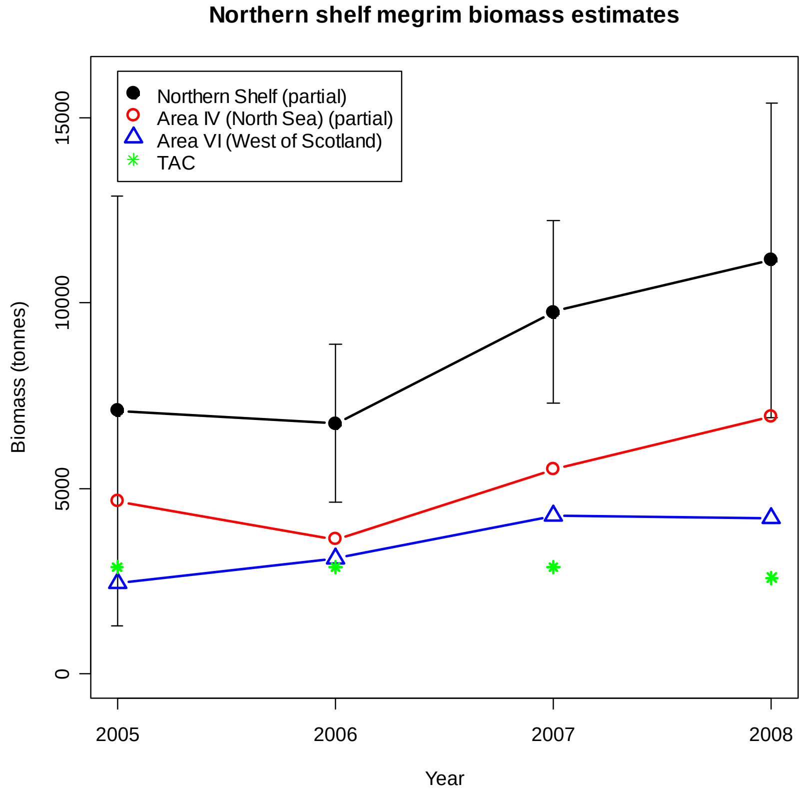


Figure 5.3.6. Estimates of the biomass of megrim on the Northern Shelf from the 2005–2008 anglerfish surveys. 95% confidence intervals are plotted as error bars on the Northern Shelf estimates.

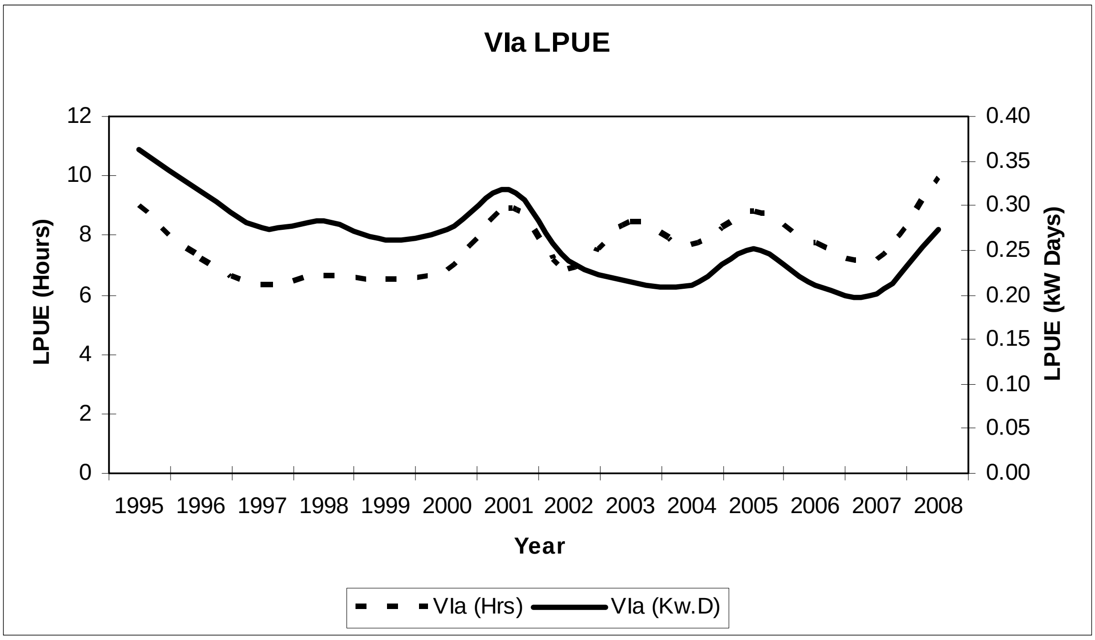


Figure 5.3.7. Lpue trends in VIa megrim from the Irish OTB fleet. Lpue is expressed in both hours fished and kW days.

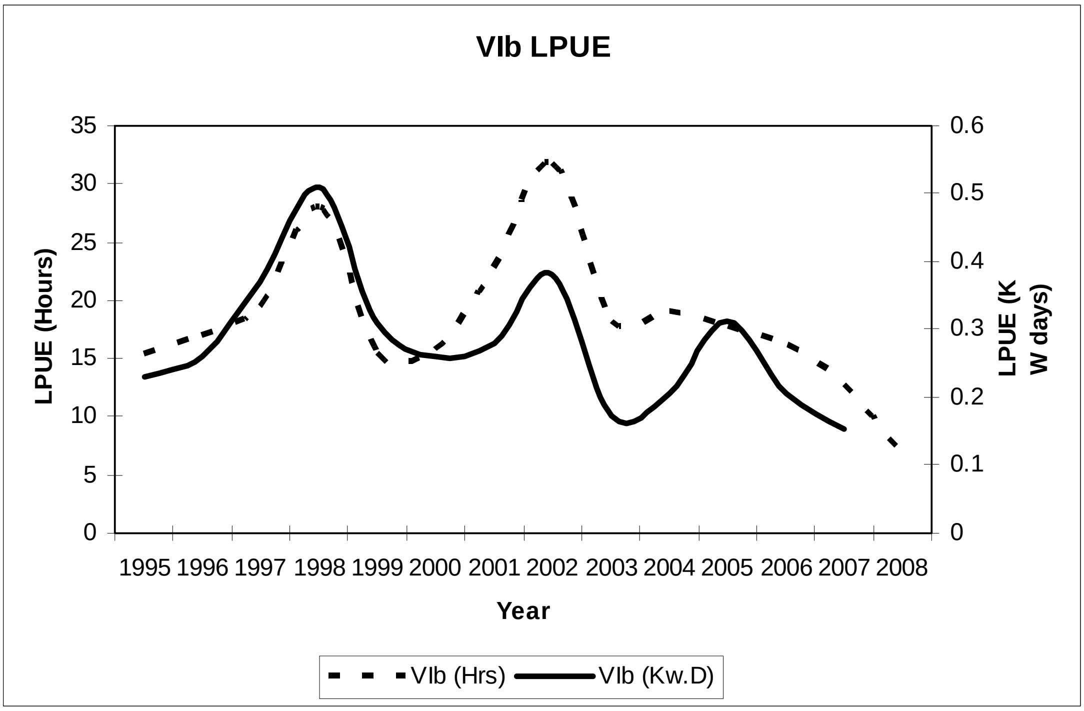


Figure 5.3.8. Lpue trends in VIb megrim from the Irish OTB fleet. Lpue is expressed in both hours fished and kW days.

6 Irish Sea

6.1 Area overview

Description of fisheries

Fishing effort and vessel numbers within the Irish Sea have declined in recent years by around 28% and 15% respectively (Figure 6.1.1). The majority of these declines stem from demersal trawling, the dominant fleet type in the area. This fleet accounts for over half the fishing effort in the Irish Sea. Several sub fleets exist within this fleet. The largest of these are the otter trawls, with a small proportion of demersal seines. The otter trawl vessels of this fleet primarily utilize 70–89 mm meshes (Figure 6.1.2a). The majority of this fleet belong to targeted *Nephrops* fisheries. Two main *Nephrops* fisheries exist in the Irish Sea, one in the East (FU14) and one in the West (FU15). These fisheries are traditionally more active during summer as *Nephrops* spend more time outside their burrows and thus more available to the fishery at this time. In recent years the fishing season has been extending. A number of other species are caught in relatively low levels by this fishery, including cod, haddock, plaice, anglerfish, and to a lesser extent sole. Although relative landings of cod within this fishery are low compared with the quantities of *Nephrops* landed, this fleet's contribution to the total cod landed within the Irish Sea is generally high. A small proportion of the demersal trawl fleet utilizes 100–119 mm meshes and targets the traditional whitefish fishery. This takes a mixture of species, specifically cod, haddock and whiting which used to be an important fishery within the Irish Sea, but has declined to low levels since 2003 following the adoption of larger meshed gear.

A beam trawl fleet operates within this area and accounted for around 15% of fishing effort in 2007. In 2008 Irish and Belgian beam trawlers displayed large declines in effort within the Irish Sea as a result of economic pressures including fuel costs. These vessels operate across the whole area with no specific ground focus. The majority of vessels employ meshes in the range of 80–89 mm (Figure 6.1.2b). This fleet primarily targets flatfish species, plaice and sole in particular. There is also a fishery for ray species. These fisheries have bycatches of anglerfish, and low catches of cod, haddock and whiting.

Gillnetting also occurs in the Irish Sea. However, this is a very small fleet within the Irish Sea, accounting for around 1% of effort. Effort is focused to the south/southwestern area of the Irish Sea and is a subsection of a larger fleet operating within the Celtic Sea. In addition there is some gillnetting activity around the Isle of Man, however this is minimal. The primary target of those operating in the southern area is cod. Low landings of other species including haddock, saithe and anglerfish also occur. In relation to mesh size, although a number of different ranges are used, 150–219 mm has dominated in the last couple of years, moving away from 100–149 mm which used to be the primary mesh range used (Figure 6.1.2c).

More detailed, stock specific descriptions are given within the individual Irish Sea stock sections. Information within this section is taken from the STECF report of the SGRST-08–03 Working Group on the Fishing Effort Regime, 2008.

Regulations and their effects

A number of regulations are in operation within the Irish Sea in addition to those affecting the area as a whole and are highlighted. Those affecting individual stocks are discussed in the relevant stock section.

Effort management

The Irish Sea has been under days at sea effort management as part of a Cod Recovery Plan since 2000 in an attempt to reduce fishing mortality on cod stocks. This saw vessels assigned a maximum number of days-at-sea annually according to the gear and mesh size combinations used. While this regulation reduced the overall effort expended by vessels using mesh sizes equal to or greater than 100 mm, the days-at-sea cap was not considered to have limited the effort of vessels using gears less than 100 mm which constitute the greatest proportion of effort within the area. Effort within the larger mesh categories, i.e. the traditional whitefish fishery, has demonstrated large declines. Some vessels previously operating with mesh sizes equal to or greater than 100 mm have taken measures to remain viable. Such measures include switching to mesh sizes less than 100 mm or utilizing several different mesh sizes during the year to gain greater days allocation, both of which result in different selection patterns. Other vessels have moved to alternative fishing grounds outside the effort management restrictions such as the Celtic Sea.

2009 has seen the introduction of a new long-term management plan for cod, Council Regulation (EC) 1342/2008 which has resulted in a new effort allocation system. This new system provides individual member states with an effort allocation in kilowatt (kW) days-at-sea based on the actual amount of effort expended within the Irish Sea from a defined reference period. The allocation of kW days-at-sea by gear grouping is now regulated by individual member states replacing the individual vessel days-at-sea allocation by gear groupings set as part of the annual TAC and quota regulations.

The application of the harvest control rule stipulates that if cod stocks are considered to be below minimum spawning stock levels, then fishing mortality should be reduced by 25%. In 2009 this resulted in a reduction in effort allocation for the Irish Sea of 25%. This new management strategy is perceived to be restrictive by some nations for certain gear-mesh categories, particularly where effort has increased within a category since the reference period. Both the earlier days-at-sea scheme and the current kW days-at-sea system have resulted in a switching away from the Irish Sea into other areas not covered by effort management such as the Celtic Sea and Rockall.

While the regulation is likely to have resulted in some degree of effort displacement, the provisions of Article 13 of 1342/2008 allow member states to recoup all or part of the effort reductions applied in 43/2009. Various national programmes have been enacted in 2008 and 2009 that aim to reduce cod catches through a range of measures including spatial and temporal avoidance plans and technical measures.

Closed areas

As a consequence of the depleted state of the Irish Sea cod stock, and following ICES advice, a recovery plan for cod in the Irish Sea was introduced in 2000. Commission Regulation (EC) No 304/2000 established emergency closed areas to fishing for cod from mid February to the end of April in the western and eastern Irish Sea to protect spawning cod aggregations. Council Regulation (EC) 2549/2000, which came into force on 1 January 2001, with amendments in Council Regulation (EC) No 1456/2001, of 16 July 2001, established additional technical measures for the protection of juveniles. The closed area in the Irish Sea and additional technical regulations were extended to 2001 in Council Regulation (EC) 300/2001 and to 2002 in Council Regulation (EC) 254/2002. The main difference in the recovery measures for 2002, onwards from those of 2001 is that a closed area remained only in the western Irish Sea.

Within the closed area there are a number of derogations allowing *Nephrops* fishing during the closure. Irish scientists successfully tested inclined separator panels in *Nephrops* trawlers, revealing large reductions in bycatch of cod. Vessels using such panels have been allowed to fish over a wider area of the closure since 2002. Figure 6.1.3 shows the location of the closed area and shading indicates the derogations permitted. Vessels displaced from the closed area either switched to twin-rigging for *Nephrops*, fished for cod in the North Channel and Clyde (the latter of which was subsequently closed to protect the West of Scotland stock), or stopped fishing during the closer period. The effect of this closer on individual stocks is unknown.

In its review of the effectiveness of the closure STECF 2007 concludes that the Irish Sea cod closure in 2000 was of appropriate extent and duration to encompass the majority of the spawning stock throughout the spawning season. The closure since 2001 encompasses the majority of the western Irish Sea spawning cod population for most of the spawning season but excludes the eastern Irish Sea spawning population. On the basis of the information available, STECF was unable to determine the extent to which the closure has reduced fishing mortality to a lower value than would otherwise have occurred, through the protection of adult cod during spawning or influencing changes in fishing effort in the different fleets.

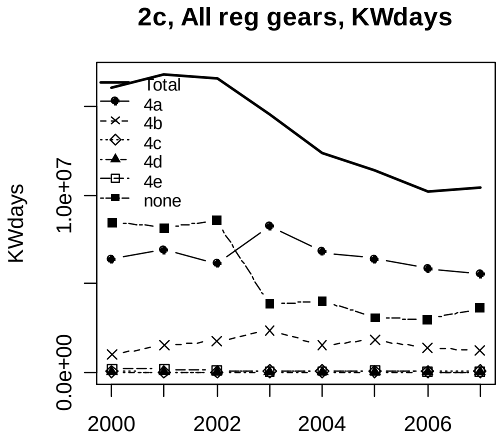
Three further seasonal closures are in place, either annually or triennially, within the Irish Sea, and relate to restricting fishing for herring. It is believed these closures have very little impact on demersal stocks as they only apply to herring, without specific gear restrictions. Details of these closures can be found in Council Regulation (EC) No.850/98.

Within the Irish Sea a number of technical measures are in place. The majority of have been in place for a number of years, giving little future change in fishing patterns. Square mesh panels, for example, have been mandatory for UK otter trawlers since 1993 and for Irish trawlers since 1994 to reduce catches of undersized fish. There are also beam trawl fishing restrictions in the Irish Sea. It is prohibited to use any beam trawl of mesh size range 70–79 mm or 80–90 mm unless the entire upper half of the anterior part of such a net consists of a panel of netting material attached directly to the headline of the net, extending towards the posterior of the net for at least 30 meshes and constructed of diamond-meshed netting material of which no individual mesh is of mesh size less than 180 mm.

Species-specific measures such as minimum landing sizes are stock specific and are discussed in the relevant chapters. In terms of species composition, technical regulations are also in operation within the area. For example, in January 2000 technical regulations for EU waters came into force (Council Regulation (EC) 850/98 and its amendments) prescribing minimum target species' compositions for different gear mesh size ranges. Since 2001, cod in the Irish Sea have been a legitimate target species for towed gears with a minimum codend mesh size of 100 mm.

Inclined separator panels are used in the *Nephrops* fishery as a derogation within the cod closed area to reduce catches of non-*Nephrops* species. With the introduction of the new effort management system, the use of similar panels (separator grids) by Irish fishers will increase as a technical measure to recoup effort by reducing cod catches to below 1%. This will alter the fishing pattern of these vessels, resulting in a single species *Nephrops* fishery, greatly reducing fish catches.

(a)



(b)

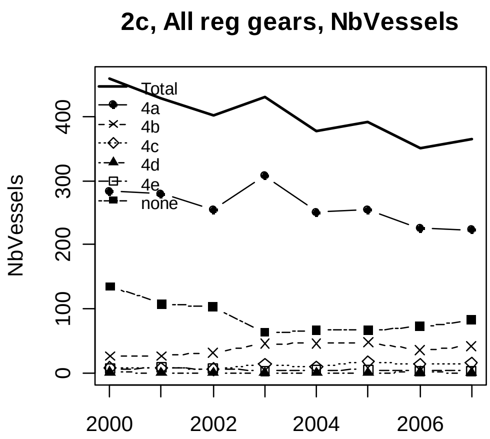
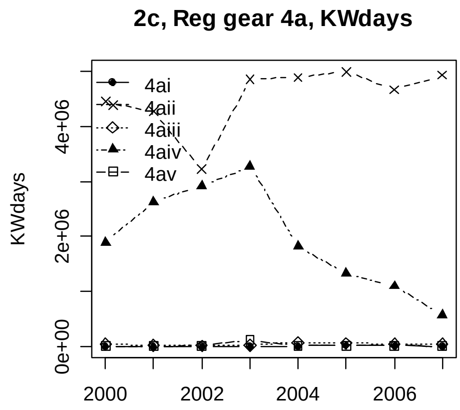
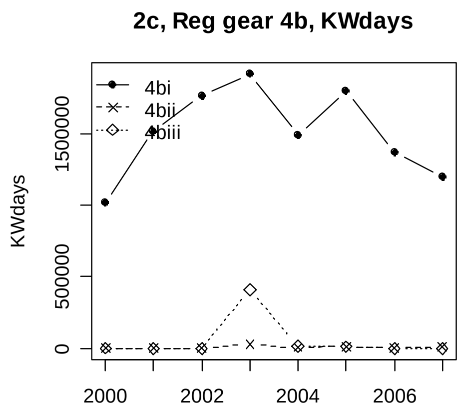


Figure 6.1.1. kW days-at-sea fishing effort (a) and number of vessels (b) by gear type within the Irish Sea. Taken from STECF report of the SGRST-08–03 Working Group on the Fishing Effort Regime, 2008. Figures should only be read from 2003 onwards, as the Irish effort component was unavailable by mesh size information prior to this. Legend key: 4a demersal trawl, 4b beam trawl, 4c gillnet, 4d trammelnet, 4e longline.

(a)


2c, Reg gear 4a, KWdays
KWdays
0e+00
2e+06
4e+06
2000
2002
2004
2006
4ai
4aii
4aiii
4aiv
4av

(b)


2c, Reg gear 4b, KWdays
KWdays
0
500000
1500000
2000
2002
2004
2006
4bi
4bii
4biii

(c)

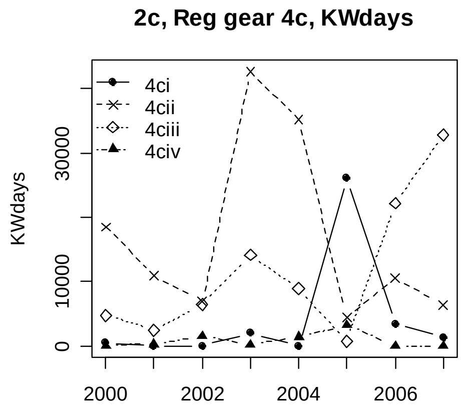


Figure 6.1.2. kW days-at-sea fishing effort demersal trawl (a), beam trawl (b), and gillnet (c) by mesh size ranges within the Irish Sea. Taken from STECF report of the SGRST-08–03 Working Group on the Fishing Effort Regime, 2008. Figures should only be read from 2003 onwards, as the Irish effort component was unavailable by mesh size information prior to this. Legend key: 4ai 16–31 mm, 4aii 70–89 mm, 4aiii 90–99 mm, 4aiv 100–119 mm, 4av ≥120 mm, 4bi 80–89, 4bii 90–99 mm, 4biii 100–119, biv ≥120 mm, 4ci <110 mm, 4cii 110–149 mm, 4ciii 150–219 mm, 4civ ≥220 mm.

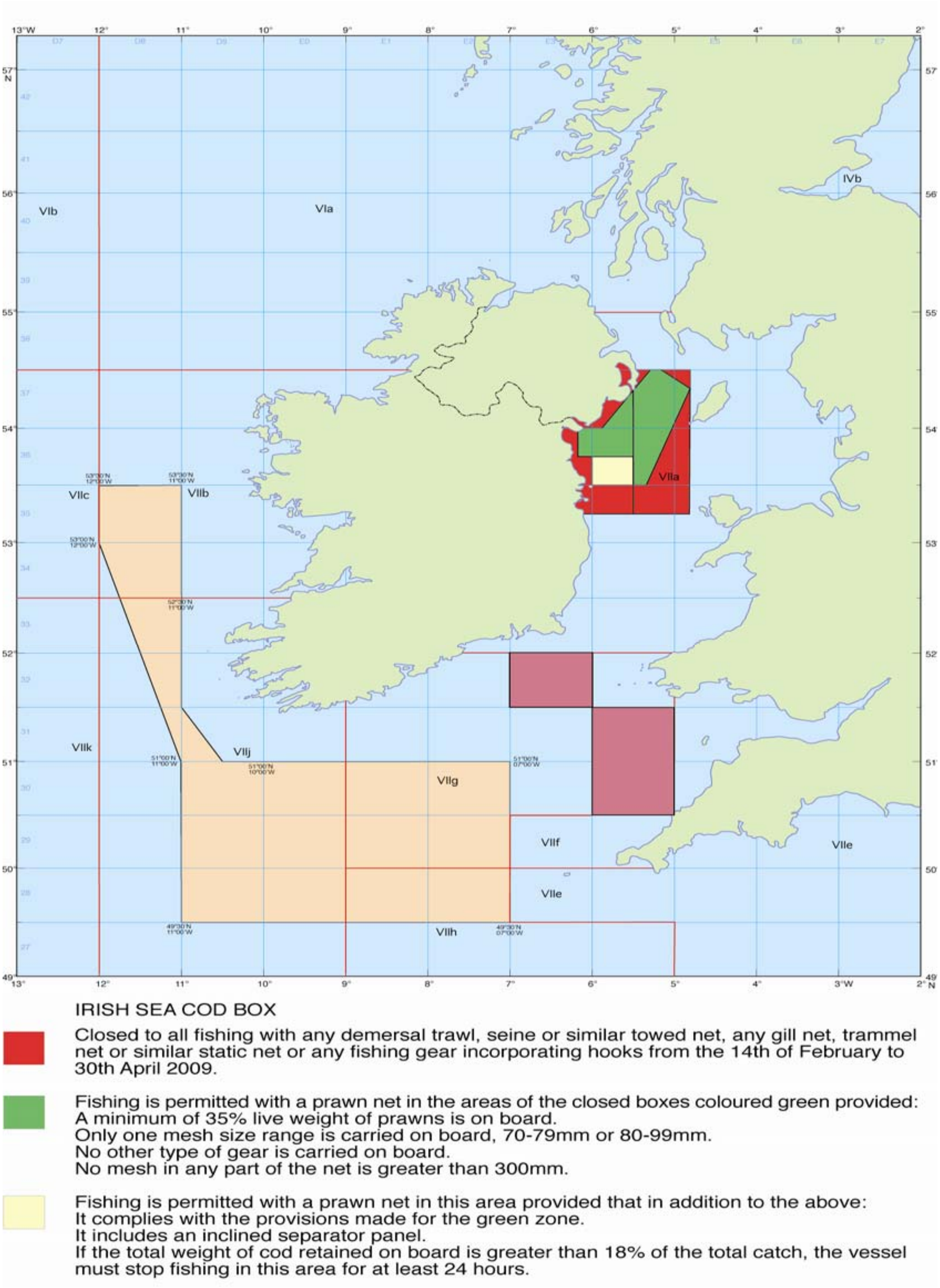


Figure 6.1.3. Location of the Irish Sea cod box, including details of derogations. Pink and purple areas relate to hake and cod boxes outside the scope of this overview. Produced courtesy of An Board Iascaigh Mhara (the Irish Sea Fisheries Board).

6.2 Cod in VIIa

Type of assessment

This is an update assessment. The assessment has not yet been included in ICES benchmarking process.

ICES advice applicable to 2008

"Because the existing recovery plan does not include the elements or measures necessary to rebuild the stock at the current SSB (well below B_{lim}), ICES continues to advise on exploitation boundaries in relation to precautionary limits and recommends that the fisheries for cod be closed until an initial recovery of the cod SSB has been proven. Any catches that are taken in 2008 will prolong the recovery to B_{pa}."

ICES advice applicable to 2009

Same wording of advice as for 2008.

6.2.1 General

Stock description and management units

The stock and the management unit are both ICES Division VIIa (Irish Sea).

Management applicable to 2008 and 2009

Management of cod is by TAC, days-at-sea limits and technical measures. The ICES advice, and the agreed TACs and associated implications for cod in Division VIIa since 2002, have been as follows:

Year	Single stock exploitation boundary (t)	Basis for ICES advice	TAC (t)	Change in F associated with TAC[1]
2002	-	Establish recovery plan	3200	- 58%
2003	-	Closure of all fisheries for cod	1950	- 64%
2004	0	Zero catch	2150	- 65%
2005	0	Zero catch	2150	-31%
2006	0	Zero catch	1828	(no forecast)
2007	0	Zero catch	1462	(no forecast)
2008	0	Zero catch	1199	(no forecast)
2009	0	Zero catch	899	(no forecast)

[1] Calculated from F multipliers in status quo forecast.

Technical regulations in force in the Irish Sea, including those associated with the cod recovery plan since 2000, are described in Section 6.1.

Fishery in 2008

Landings of cod in 2008 (Table 6.2.1) were the lowest recorded. The percentage landed into Northern Ireland increased from 57% in 2007 to 79% in 2008 (Table 6.2.2), the majority taken by whitefish otter trawlers and *Nephrops* trawlers. The percentage landed into southern Ireland declined from 27% to 13% between 2007 and 2008. Northern Ireland acquired additional quota in 2008, while WG landings figures for southern Ireland were well below the quota. Irish fleets experienced elevated catch rates of cod in the Celtic Sea off SE Ireland in 2008, and a number of cod landings incorrectly reported as taken in VIIa were reallocated to the Celtic Sea. WG landings figures in 2008 were 55% of the TAC. The WG figures have been around 50% of the TAC since 2004.

6.2.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1 in the WGCSE report.

Fishery landings

The input data on fishery landings and age compositions are split into three periods (Figure 6.2.1):

1) 1968–1990. Landings in this period, provided to ICES by stock coordinators from all countries, were assumed to be accurate and were used directly as the input data for the assessment.
2) 1991–1999. TAC reductions in this period caused substantial misreporting of cod landings into several major ports in one country, mainly species misreporting. Landings into these ports were estimated based on observations of cod landings by different fleet sectors during regular port visits (see stock Annex). For other national landings, the WG figures provided to ICES stock coordinators were used, as in period (1).
3) 2000 onwards. Cod recovery measures were considered to have caused greater problems with estimation of fishery removals than in period (2). The ICES WG landings data provided by stock coordinators for all countries, as in period (1) were input to B-Adapt and the annual total removals (in excess of the assumed M) were estimated within the assessment model.

The annual numbers-at-age landed, total landed weight, and the mean weights-at-age in the landings by age class, are given in Tables 6.2.3 and 6.2.4. Previous WGs have demonstrated there are no long-term trends in catch weights-at-age from 1982 onwards. However, weights-at-age prior to 1982 are fixed at constant values lower than estimated for subsequent years, leading to sums-of-products errors. A revision of historical catch-at-age data and associated weights is needed.

The catch-at-age data were screened using separable VPA (reference age 3; terminal F = 1.5; S = 1.0; default year weighting; age weighting 0.001 at-ages 0–1, 0.01 at-ages 1–2 and 1.0 at-ages 2–3 and over). The data continue to demonstrate a persistent change in residuals for log catch ratios at-ages 1–2 after 1991 (Figure 6.2.2). Outliers at-age 5–6 in 2003/04 and age 1–2 in 2006/07 are not associated with any obvious anomalies in any national dataset and reflect small catches and sample sizes.

Discards data

No discards data are included in the assessment. Suitable discards estimates are not available prior to the mid 1990s and are not complete for many subsequent years. Available data indicates that discarding has historically been mainly a function of MLS and therefore mainly restricted to catches of 1-gp cod. This pattern continued in 2008 (Figures 6.2.3 and 6.2.4 and Table 6.2.5). Historical F and recruitment for 1-gp cod are therefore underestimated.

Available discards data are given in Table 6.2.5. It has not been possible yet to compile a matrix of international fleet-raised discards estimates by year and age for use in assessments. Discards data will be fully evaluated in any future benchmark assessment.

Biological data

The assessment uses time-invariant values of M=0.2 (all ages) and combined-sex proportion mature values of 0 at-age 1, 0.38 at-age 2 and 1.0 for older ages (see stock Annex for derivation).

Survey data used in assessment

The surveys used in the assessment are described in the Stock Annex, and the series are updated in Table 6.2.6. The ENG BTS-Sept survey is now worked up using automated *r* code, and the dataseries supplied this year include only data for 1993 onwards (1991 and 1992 data were supplied last year) and some small changes to indices in some other years were made. A sensitivity test of the B-Adapt model including or excluding the 1991 and 1992 data from last year demonstrated negligible effect of excluding these two years.

Internal consistency of survey data

The survey data during spring each year are of critical importance for tuning the B-Adapt and estimating catch bias because adult cod are better represented than during autumn surveys. The data for these surveys were screened by fitting the SURBA model using settings described in the Stock Annex, and examining the diagnostic plots. The NIGFS-Mar and ScoGFS-Q1 surveys do not exhibit any marked year-effects, and appear to track year-class variations with good consistency (Figure 6.2.5). Strong positive residuals at-age 1 are noted for 1994–1996 in the SURBA model fit for NIGFS-Mar (Figure 6.2.5, bottom panels).

Consistency between survey-series

The three series of summer–autumn 0-gp indices used in the update B-Adapt assessment do not consistently follow the trends in year-class effects from the SURBA model applied to the NIGFS-Mar and ScoGFS-Q1 data (Figure 6.2.6). While the surveys give similar signals for some year classes, there are some years (e.g. 2004–2005 and 2001) where the series diverge noticeably. The NIGFS-Mar and ScoGFS-Q1 SURBA models provide very similar trends in year-class strength.

Empirical estimates of SSB from the NIGFS-Mar and ScoGFS-Q1 surveys (calculated from all age groups) diverge considerably in 1999 and 2002–2003 (Figure 6.2.7). SSB trends estimated by fitting the SURBA model exhibit slightly more coherent trends. Both survey-series indicate a recent decline in SSB.

Commercial cpue

Commercial cpue data are available for this stock but are not currently used in the assessment.

Other relevant data

Table 6.2.6 includes indices of abundance from the UK Fisheries Science Partnership (www. cefas.co.uk/fsp). These are not used in the update assessment and have not yet been evaluated through any benchmarking process, although are presented as supporting evidence. The indices for the western Irish Sea have been revised using a new stratification scheme and therefore differ from the values in last year's WGNSDS report (see WD 8). The SSB trends from the UK Fisheries Science Partnership trawl surveys support the trends given by the NIGFS-Mar survey from 2004 onwards (Figure 6.2.8).

A Cefas Q4 IBTS trawl survey series covering the Irish Sea and Celtic Sea in November commenced in 2004. Cod abundance indices will be provided from this survey in future.

Estimates of cod SSB from applications of the annual egg production method, using gene probes to identify early stage cod eggs, are available for 2006 and further estimates will become available from surveys in 2008 and 2010. These will be evaluated in future benchmark assessments.

6.2.3 Historical stock development

Deviations from stock annex

The assessment does not deviate from the procedure used last year and described in the stock annex.

Software used and model options chosen

The B-Adapt method is described in the Stock Annex. Software version B-Adapt-F.exe (13/5/06) was used to allow estimation of removals bias from 2000 onwards.

Model settings for the update assessment are given in Table 6.2.7. B-Adapt can use survey data for the year after the last year of catch data, and in this assessment the survey indices for NIGFS-Mar in 2009 are used. An input F-multiplier for 2009 is required for adjusting the survey indices to the start of the year. In view of the new cod recovery measures which involved a 25% reduction in cod TAC in 2009, an F-multiplier of 0.75 was applied in 2009.

Input data types and characteristics

New data added to the update B-Adapt assessment are the fishery landings data for 2008, the NIGFS-Mar survey data for 2009 and the NIGFS-Oct, ENG BTS-Sept and NI MIK net 0-gp indices for 2008. As discussed in Section 6.2.2, the 1991 and 1992 indices have been removed from the ENG BTS-Sept data. The update B-Adapt assessment follows the same procedure as in the 2008 assessment by including the sample-based estimates of landings at three major ports from 1991–1999, while estimating removals in excess of the assumed natural mortality rate in subsequent years. The sample based estimates of landings for 2000–2002 and 2005 provide a comparison with the B-Adapt removals estimates.

Data screening

Screening of input catch and survey data is described in Section 6.2.2.

Final update assessment: diagnostics

The diagnostics of the update B-Adapt run are given in Table 6.2.8. Note that these are from the non-bootstrap application of the model. The catchability residuals from the update assessment are given in Figure 6.2.9. A trend in catchability residuals for 2–4 year old cod exists in the first five years of the NIGFS-Mar survey series. This is not reflected in the SURBA residuals shown in Figure 6.2.5. In contrast, the three positive values at-age 1 in 1995–1996 in NIGFS-Mar B-Adapt residuals are evident in the SURBA analysis, indicating a change in survey selectivity.

Final update assessment: retrospective analysis

The estimation of catch bias in B-Adapt effectively removes survey catchability trends from 2000 onwards, and the assessment therefore exhibits no retrospective bias (Figure 6.2.10).

Final update assessment: long-term trends

The population numbers and F at-age from the update B-Adapt assessment are given in Tables 6.2.9 and 6.2.10, and the VPA summary data are given in Table 6.2.11. These are the point estimates from the non-bootstrap option. The long-term trends in landings, F, SSB and recruitment are shown in Figure 6.2.11, using the bootstrap option to give 5th and 95th percentiles from 1000 boot-strap runs selecting randomly from the survey catchability residuals. Note that the 50th percentiles differ slightly from the point estimates from the non-bootstrap option.

The B-Adapt estimates of total removals for 2000–2008 (in excess of the WG landings figures and natural mortality M=0.2) may represent unaccounted discards, landings and additional natural mortality. The B-Adapt estimates of total removals (including unaccounted removals) were close to the WG landings figures including sample-based estimates for 2000 and 2001, but the 90% confidence limits of the B-Adapt estimates for 2002 and 2005 lie above the WG landings estimates.

The recruitment trends from B-Adapt are very similar to the indices from SURBA for the NIGFS-Mar and ScoGFS surveys (Figure 6.2.12), indicating that the historical trends are well captured by the survey and fishery age-composition data. The SURBA and B-Adapt indices of SSB indicate very low SSB since 2005, and continued high total mortality rates (Figure 6.2.12). Given the highly truncated age composition in the stock, and the internal procedure in SURBA for estimating recent Z, the SURBA trends in Z are probably poorly estimated.

Comparison with previous assessments

The retrospective analysis (Figure 6.2.10) provides a comparison with the results of the assessment carried out in 2008. The current assessment is a direct update without any changes to procedures or data (other than some adjustments to the ENG BTS-Sept series which have virtually no discernible effect on the assessment). The current assessment is very consistent with the previous assessment.

The state of the stock

The spawning-stock biomass has declined tenfold since the late 1980s and is suffering reduced reproductive capacity (SSB < B_{lim} of 6000 t).

The fishing mortality estimates since 1988 have remained above the F_{lim} value of F=1.0 and the stock has therefore been harvested unsustainably over this period.

Fishing mortality throughout the assessment period has been well above the candidate reference points ($\mathbf{F}_{max}$ and $\mathbf{F}_{0.1}$) associated with high long-term yields and a low risk of depleting the productive potential of the stock.

Recruitment has been below average for the past seventeen years. The seven most recent year classes are among the smallest on record and all lie below a segmented regression line fitted to the stock–recruit data, indicating lower than expected recruitment given the SSB estimates (Figure 6.2.13). The estimated breakpoint in the regression is close to the B_{pa} of 10 000t.

6.2.4 Short-term predictions

As a consequence of the inability to identify the source of the bias in removals estimates from B-Adapt assessment, and the relationship between future TACs and total removals, detailed short-term catch forecasts have not been given for this stock for several years. The update B-Adapt assessment, including a 25% F reduction in 2009, indicates a 35% reduction in SSB between 2009 and 2010. This is a consequence of the very poor recruitment in 2007 and 2008 (weakest year classes recorded).

SSB PERCENTILE	2007	2008	2009	2010
5th	1040	1232	1130	714
25th	1260	1454	1427	926
50th	1448	1676	1692	1107
75th	1644	1900	2024	1329
95th	1983	2300	2636	1685

6.2.5 Medium-term projections

Medium-term projections are carried out to look at the possible future trends in the stock in response to changes in total mortality. The contribution of the fishery to the total removals estimates over and above reported landings is unknown.

Estimating recruiting year-class strength

The B-Adapt estimates for the 2007 and 2008 year classes are less than 20% of the 1992–2006 GM and less than 30% of the 2002–2006 GM, but are considered appropriate to inclusion in forecasts as they are estimated from three 0-gp surveys as well as the NIGFS-Mar survey at-ages 1–2 up to 2009.

YEAR	YEAR CLASS	SOURCE	NUMBER-AT-AGE 0 ('000)
2006	2006	B-Adapt (point estimate)	1376
2007	2007	B-Adapt (point estimate)	279
2008	2008	B-Adapt (point estimate)	435
2009	2009	Bootstrap 2002-08 y.c.: (50th percentile)	1208[1]
		GM (2002 – 08 y.c.)	966

[1] **Average of 50th percentiles over 10-year B-Adapt projection.**

Following the recommendation from RGNSDS 2007 that bootstrapping the 1992–2006 recruitment estimates may have led to overoptimistic forecasts, a short series of 2002–2008 was chosen for forecasts this year. The stock recruit plot (Figure 6.2.13) demonstrates that recruitment estimates for these years were well below the segmented regression line. In the absence of any indicators of improved environmental conditions for recruitment from 2009 onwards, and taking into account the expected further decline in SSB, the 2002–2008 series was considered the most plausible predictor of recruitment in at least the next few years.

Scenarios examined

The mortality rate as a result of removals in excess of the assumed natural mortality of M=0.2 is referred to below as F*. Two medium-term stochastic projections were carried out using the bootstrap option in B-Adapt:

1) Zero F* from 2010 onwards;

2) 25% reduction in F* per year until F* attains the value of F=0.4 adopted by the Commission as the long-term management objective.

The second projection represents an annual reduction in F* equivalent to reductions in F that Management Plan may seek to achieve through annual 25% reductions in TAC. However, the bootstrap procedure does not simulate any additional variability and risk associated with limits on interannual TAC variability, or any changes in discarding or compliance.

The removals figures generated in the projection implicitly include the level of removals bias estimated by B-Adapt for 2008 in each simulation. It is currently not possible to attribute these to any actual losses not accounted for in the model inputs, or to any remaining bias as a result of incorrect assumptions in the B-Adapt implementation.

Model inputs

Model inputs were as follows:

Number of simulations: 1000.

Recruitment from 2009 onwards: bootstrapped in each simulation from model estimates for the weak year classes observed from 2002–2008.

Status quo F: B-Adapt F(2–4) for 2008 in each simulation.

Intermediate year assumption: To allow for a potential reduction in F* in 2009 associated with the 25% TAC reduction, an F-multiplier of 0.75 was applied in 2009. This approach has also been adopted for North Sea cod at the WGNSSK May 2009 meeting.

Results

Reducing F* to zero from 2010 onwards allows a high probability (100%) of recovery of SSB to above B_{lim} by 2015 (Figure 6.2.14) despite continued very poor recruitment. There is also a high probability (~85%) of SSB > B_{pa} by 2015.

A stepwise reduction in F* by 25% per year (until the year when the 50th percentile of F* reaches 0.40) results in a 26% probability of SSB > B_{lim} by 2015 and zero probability of achieving B_{pa} (Figure 6.2.15). The probability of SSB>B_{lim} in 2015 is close to the result of the simulation testing of the cod Management Plan (WGCSE 2009 WD 4) for the option of no limit on TAC changes between years, but indicates a much smaller probability of SSB>B_{pa} by 2015. The update B-Adapt starts from a lower F in 2008 but assumes a more pessimistic recruitment scenario than in WD 4.

6.2.6 Biological reference points

The current reference points for Irish Sea cod are given below:

Precautionary approach (unchanged since 1998)

B_{lim}	6000 t	B_{pa}	10 000 t
F_{lim}	1.00	F_{pa}	0.72

Targets

F_y	0.40	(Council Regulation (EC) 1342/2008)

Yield and spawning biomass per Recruit (from 2004 Assessment)

$\mathbf{F}_{max}$	0.31	$\mathbf{F}_{0.1}$	0.18

ACOM has advised that candidates for reference points which are consistent with high long-term yields and a low risk of depleting the productive potential of the stock are in the range of $\mathbf{F}_{0.1}$–$\mathbf{F}_{max}$.

6.2.7 Management plans

The Irish Sea cod management plan, as described in Council Regulation (EC) 1342/2008 has been evaluated independently by ICES (WGCSE 2009 WD 4) using the approach adopted in AGCREMP 2008 and is not consistent with the ICES Precautionary Approach (Section 9.2).

The long-term target for the management plan is a fishing mortality of 0.4, based on the EU-Norway negotiated target for North Sea cod. This target is above the F_{max} value of 0.32 for Irish Sea cod but well below the current estimates of total removals mortality in excess of M=0.2.

6.2.8 Uncertainties and bias in assessment and forecast

Landings data

The quality of the commercial landings and catch-at-age data for this stock deteriorated in the 1990s following reductions in the TAC without associated control of fishing effort. The Working Group has, since the 1990s, attempted to overcome this problem by incorporating sample-based estimates of landings from three major ports in the WG landings figures. The data for this method have become more limited since 2003, and the WG uses the B-Adapt modelling approach to estimate subsequent removals from 2000 onwards. The unaccounted removals figures given by B-Adapt could potentially include components as a result of increased natural mortality and discarding as well as misreported landings or catches from the stock taken outside VIIa, albeit distributed according to the age composition in the landings.

Discarding

Estimates of discards are patchy for Irish Sea cod, although more comprehensive sampling is now required through the EU Data Collection Framework. Discarding has historically been mainly at-age 1, and the absence of raised estimates of discarding for all fleets will result in underestimation of historical F at-age 1. Strict controls on catch reporting following the introduction of the Registration of Fish Buyers and Sellers regulations has resulted in documented increases in discarding of cod above the MLS off the west of Scotland and in the Celtic Sea (see Sections 3.2 and 7.2). This could also occur in the Irish Sea, although observer data in 2008 provided no evidence of this. Compliance with catch composition rules for some fleets could also result in increased discarding of cod. Implementation of unbiased sampling schemes to estimate discarding with adequate precision is likely to be of increasing importance for this stock to prevent further deterioration in fishery catch data.

Surveys

The Irish Sea has relatively good survey coverage up to 2009. The surveys in general give consistent signals of fish abundance at-age. All existing survey data indicate a severe depletion of the SSB during a 7-year run of very poor recruitment. The UK Fisheries-Science Partnership surveys of the Irish Sea cod spawning grounds in spring 2005–2009 (not in the assessment), carried out using commercial trawlers, indicated a widespread distribution of cod mostly at low density but with some localized aggregations (WGCSE 2009 WD 8). The time-series of SSB indices demonstrates a downward trend similar to that revealed by the other surveys used in the assessment, and the highly truncated age composition of cod in the FSP surveys supports the ICES assessment, indicating continuing high mortality rates.

Model formulation

The B-Adapt estimates of removals bias continue to vary around relatively high values of 2.0–3.0 despite more accurate catch reporting and lack of evidence of significant discarding of cod above MLS. There could potentially be unaccounted losses from other sources, for example because of fishery catches taken outside VIIa during seasonal migrations, a gradual shift in distribution to areas beyond VIIa, or increases in natural mortality. The estimates of bias could also be influenced by any remaining non-randomness of survey catchability or outlying values, or by incorrect assumptions in the model (e.g. constant survey catchability, removals bias not age-dependent). For this reason, the absolute values of the estimated unallocated removals should not be over-interpreted. There is currently no evidence from surveys and fishery age compositions of a significant improvement in age structure that could be caused by management measures. The interpretation in B-Adapt is that there continues to be a relatively large unaccounted-for removal of fish from the stock, but unfortunately there is currently very little direct evidence to evaluate the potential source(s) of this and how much is as a consequence of fishing in VIIa or elsewhere.

Stock structure and migrations

The VIIa commercial fishery for cod extends into the North Channel, particularly for vessels using midwater trawls. It is not clear if the cod in this region belong to the Irish Sea stock, the nearby Clyde stock which exhibits dense aggregations of adult fish during spring in the area covered by the Clyde closure, or to other VIa cod populations. Incorrect allocation of catches to stocks could lead to biases in the assessments.

Recent tagging of cod off Greencastle on the north coast of Ireland (O Cuaig and Officer, 2007), and more limited tagging on UK Fisheries Science Partnership surveys (Armstrong *et al.*, WD2 to WGNSDS 2007), have demonstrated movements of cod between Division VIa and VIIa. Most recaptures in VIIa from cod tagged in VIa have come from the North Channel and in or near the deep basin in the western Irish Sea that is a southward extension of the North Channel. The research surveys used for tuning the VIIa cod assessment cover only the western and eastern Irish Sea, and do not extend into the deeper water of the North Channel, where large catches of cod were made by midwater trawlers in the 1980s and 1990s.

Historical tagging studies have also demonstrated more limited movements of cod between spawning components in the western and eastern Irish Sea, for which the migrations tend to be in a north-south direction. STECF Sub-group SGRST (2005, Appendix 4) concluded that management of the Irish Sea stock on the basis of sub-stock assessment regions would be difficult in practice, particularly the separation of catches when the stock units are mixed. Further tagging and genetics studies are required to investigate stock structure, seasonal movements and mixing in VIIA and neighbouring areas.

6.2.9 Recommendations for next benchmark assessment

Year	Candidate stocks to be benchmarked	Supporting justification and comment(s)	Indicated expertise necessary at the benchmark meeting-in addition to the experts from the ICES community

2012?	Western waters cod stocks (Area VI and VII excl VIId).	Cod stocks in Divisions VI and VII comprise an assemblage of metapopulations with varying degrees of mixing. Fishing effort, predation and other environmental drivers including climate change impact the populations in different ways across the range of the stocks. The stocks have proven difficult to assess because of data deficiencies and an inability to demonstrate responses to changes in fishing effort and other management controls. Improved management advice may benefit more from quantifying the spatial dynamics of cod in relation to spatial variations in fishing and other pressures than by trying to refine the current modelling approaches applied to the current stock definitions and management units. To make progress towards this, an initial Data Workshop is proposed to collate and interpret existing and new data on cod stock structure and mixing, distribution patterns, spatial variations in size/age structure and biological characteristics as well as pressures including predation, fishing and climate. Such analyses will be facilitated by high-resolution spatial data on fishery catches and effort by métier using VMS, rectangle data, employing GIS methods. It will be necessary to develop an international database holding spatially resolved datasets (landings, discards, effort, size/age/biological data, surveys, environmental variables) and data manipulation routines to allow evaluation of the effect on the assessments of altering the stock unit definition. Data on cod movement parameters will be required to allow development of operating models for testing assessment and management procedures and ultimately developing and testing spatially disaggregated assessment models. New datasets e.g. on discarding, biology, predation, surveys and fishing effort/cpue would be evaluated. The Data Workshop would build on and review the outcomes of a major UK collaborative programme on cod stock structure and spatial dynamics, which will be completed in 2011. The ensuing Benchmark Assessment workshop would evaluate the appropriateness of current assessment methods in the light of the Data Workshop outcomes, and explore alternative approaches as candidates for providing management advice. This could potentially include changes to the spatial units for assessment or the development of spatially disaggregated assessment models including mixing coefficients.

6.2.10 Management considerations

A number of emergency and cod recovery plan measures have been introduced since 2000 to conserve Irish Sea cod. These include a spawning closure since 2000 and effort control since 2003. There have also been several vessel decommissioning schemes. As it has not been possible to provide analytical catch forecasts in recent years, the TAC has been reduced by 15–20% annually since 2006 and by 25% in 2009. These measures may have prevented a further increase in fishing mortality of cod or may have resulted in some reduction in fishing mortality. However, the current assessment does not provide sufficiently robust estimates of fishing mortality to allow the possible changes to be determined.

Although recent recruitment patterns appear well estimated in the assessment, the problem of inaccurate landings and discards estimates makes it difficult to estimate the absolute value and recent trends in fishing mortality. However, all sources of information on age composition in the stock, from the fishery as well as surveys using research vessels and chartered commercial vessels, indicates a continued paucity of cod older than four years of age in the Irish Sea indicating a continued very high mortality rate. Possible causes of this include:

- TACs have not restricted catches as intended. Substantial underreporting of landings is known to have occurred since the 1990s, although there is some indication that this is reduced since 2006. However the assessment continues to indicate a large unaccounted removal of fish. The relative contribution of fishing to this has not been identified.
- The effort reductions have not been sufficient, although considerable effort reductions have been observed in some fleets (particularly vessels using >100 mm mesh);
- Cod continues to be taken in mixed demersal fisheries (particularly for haddock, sole and *Nephrops*);
- Time and area closures have not been sufficient to lead to rebuilding of this stock.
- Other, non-fishery causes such as increased natural mortality have increased over time.

It is difficult to reconcile the large apparent mortality rate and unaccounted removals in recent years with the larger reduction in fishing effort by whitefish trawlers demonstrated by STECF subgroup SGRST 2008, the very low abundance of cod, and the evidence of more accurate catch reporting since the introduction of the Registration of Buyers and Sellers.

The scientific evaluation of the revised cod Management Plan (Council Regulation (EC) 1342/2008) indicates that it may not be sufficiently precautionary to allow rebuilding of the Irish Sea cod stock to a level where it can regain historic productivity by 2015 (see Section 9.2). The probability of recovery of the cod stock will be increased by measures to eliminate discards of cod which historically have mainly comprised under-sized fish.

A closure of the western Irish Sea spawning grounds for cod from mid February to end of April has been in place since 2000, with an extension to the eastern Irish Sea in 2000. The closure was reviewed in 2007 by STECF SGMOS-07–03. On the basis of the information available, SGMOS-07–03 was unable to determine the extent to which the closure has reduced fishing mortality to a lower value than would otherwise have occurred, through protection of adult cod during spawning or influencing changes in fishing effort in the different fleets. SGMOS advised that a comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required to evaluate the cod closure.

Surveys of cod eggs in the Irish Sea in 2006 involving the UK and Ireland indicated that half of the spawning took place in areas not included in the spring-spawning closure, indicating that the design of the closure may no longer be optimal (See Figure 8.5.8.1.1 in WGNSDS 2008). The spawning closure encompassed most of the spawning in the western Irish Sea although spawning commenced earlier in the east (See Figure 8.5.8.1.2 in WGNSDS 2008). Preliminary estimates of spawning-stock biomass of cod based on the annual egg production and estimates of fecundity and sex ratio are 2130 t (RSE 34%) in the western Irish Sea, 2760 t (RSE 21%) in the eastern Irish Sea and 4890 t (RSE 20%) for the whole Irish Sea. Hence more than half of the spawning stock in 2006 was spawning in areas not encompassed by the spring cod closure. The update B-Adapt assessment provides an SSB estimate of 2743 t for the Irish Sea in 2006, roughly 60% of the egg production estimate. Further estimates of cod SSB from this method will become available in 2009 from surveys carried out in 2008.

Table 6.2.1. Nominal landings (t) of COD in Division VIIa as officially reported to ICES, and figures used by ICES.

COUNTRY	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008[1]
Belgium	187	142	183	316	150	60	283	318	183	104	115	60	67	26
France	166	148	268	269	n/a	53	74	116	151	29	35	18[2]	17[2]	3
Ireland	1,414	2,476	1,492	1,739	966	455	751	1,111	594	380	220	275[2]	608[2]	643
Netherlands	-	25	29	20	5	1	-	-	-					
Spain	-	-	-	-	-	-	-	-	14	-	-			
UK (England, Wales & NI)	2,330	2,359	2,370	2,517	1,665	799	885	1,134	505	646	594	591[2]	423[2]	545
UK (Isle of Man)	22	27	19	34	9	11	1	7	7	5	n/a	n/a	n/a	n/a
UK (Scotland)	414	126	80	67	80	38	32	29	23	15	3	6[2]	2[2]	n/a
Total	4,533	5,303	4,441	4,962	2,875	1,417	2,026	2,715	1,477	1,179	967	950	1,091	1217
Unallocated	54	-339	1,418	356	1,909	-143	226	-20	-192	-107	-57	-110	-389	-556
Total as used by WG	4587[3]	4964[3]	5859[3]	5318[3]	4784[3]	1274[4]	2252[4]	2695[4]	1285[4]	1072[4]	910[4]	840[4]	702[4]	661[4]

[1]Preliminary. [2]Revised. n/a = not available [3] includes sample-based estimates of landings into three ports [4] based on official data only.

Table 6.2.2. Cod in VIIa. Working Group figures for annual landings by country since 2000.

(a) WG landings (tonnes)

Year	NI	E&W	Scotland	Ireland	France	Belgium	Isle of Man	Netherlands	Total	TAC	%uptake
2000	638	156	39	321	52	56	11	0	1273	2100	61
2001	697	209	32	645	361	300	8	0	2251	2100	107
2002	983	171	39	953	251	294	1	2	2695	3200	84
2003	381	118	32	415	145	187	7	0	1285	1950	66
2004	539	103	15	271	37	103	5	0	1072	2150	50
2005	523	72	4	168	31	108	3	0	910	2150	42
2006	552	32	6	172	17	59	3	0	840	1828	46
2007	396	27	2	191	18	66	2	0	702	1462	48
2008	523	22	1	85	3	27	1	0	661	1199	55

(b) Percentage of annual total

Year	NI	E&W	Scotland	Ireland	France	Belgium	Isle of Man	Netherlands	Total
2000	50.1	12.3	3.0	25.2	4.1	4.4	0.9	0.0	100
2001	31.0	9.3	1.4	28.6	16.1	13.3	0.4	0.0	100
2002	36.5	6.4	1.5	35.4	9.3	10.9	0.0	0.1	100
2003	29.7	9.2	2.5	32.3	11.3	14.6	0.6	0.0	100
2004	50.3	9.6	1.4	25.2	3.5	9.6	0.4	0.0	100
2005	57.5	7.9	0.5	18.5	3.5	11.8	0.3	0.0	100
2006	65.7	3.8	0.7	20.4	2.0	7.1	0.3	0.0	100
2007	56.5	3.8	0.3	27.2	2.5	9.5	0.3	0.0	100
2008	79.0	3.4	0.1	12.9	0.5	4.0	0.2	0.0	100

Table 6.2.3. Cod in VIIa. Landings numbers-at-age used in the update B-Adapt assessment.

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AGE											
0	0	0	0	0	0	0	0	0	0	0	0
1	364	882	1317	2739	789	2263	530	1699	1135	816	687
2	1563	1481	1385	2022	3267	1091	3559	642	3007	511	1092
3	1003	1050	352	904	824	1783	557	1407	363	1233	310
4	456	269	204	144	250	430	494	294	500	163	311
5	177	186	163	67	58	173	131	249	61	218	39
6	28	76	52	39	39	60	46	95	79	31	47
+gp	2	37	19	12	20	21	28	22	25	40	18
0 TOTALNUM	3593	3981	3492	5927	5247	5821	5345	4408	5170	3012	2504
TONSLAND	8541	7991	6426	9246	9234	11819	10251	9863	10247	8054	6271
SOPCOF %	87	81	94	97	86	91	86	93	97	99	113

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	1762	2533	1299	345	814	1577	1218	974	4323	2792
2	1288	2797	3635	2284	932	1195	2105	2248	1793	4734
3	608	729	1448	1455	751	439	703	699	841	702
4	127	243	244	557	499	240	158	203	252	263
5	164	49	99	102	154	161	84	64	75	71
6	38	51	23	57	27	56	51	33	19	27
+gp	33	4	24	22	19	19	26	32	24	11
0 TOTALNUM	4020	6406	6772	4822	3196	3687	4345	4253	7327	8600
TONSLAND	8371	10776	14907	13381	10015	8383	10483	9852	12894	14168
SOPCOF %	113	102	108	99	98	101	100	100	100	100

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	582	710	1973	1375	223	749	498	318	523	204
2	2163	1075	1408	1243	2907	569	1283	1113	1149	1926
3	1886	545	442	664	403	848	180	700	501	335
4	231	372	127	132	119	68	163	38	213	80
5	86	70	98	42	16	20	7	39	17	28
6	21	23	15	46	6	9	3	4	12	7
+gp	16	7	7	3	7	1	3	2	5	1
0 TOTALNUM	4985	2802	4070	3505	3681	2264	2137	2214	2418	2581
TONSLAND	12751	7379	7095	7735	7555	5402	4587	4964	5859	5318
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	70	289	338	196	45	68	42	14	49	14
2	843	176	841	564	439	101	224	142	205	166
3	871	107	53	405	93	158	62	112	56	87
4	66	50	13	7	35	21	33	16	11	9
5	21	4	9	2	1	6	5	8	1	3
6	6	1	0	2	0	2	1	3	0	0
+gp	0	0	2	1	0	1	0	0	0	0
0 TOTALNUM	1877	627	1256	1177	613	357	367	296	322	279
TONSLAND	4784	1274	2252	2695	1285	1072	910	840	702	661
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 6.2.4. Cod in VIIa. Mean weights-at-age in the landings. These are also used as stock weights-at-age.

Table 2 Catch weights at age (kg)

YEAR		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AGE												
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
	2	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66
	3	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33
	4	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09
	5	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19
	6	6.76	6.76	6.76	6.76	6.76	6.76	6.76	6.76	6.76	6.76	6.76
+gp		8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
0 SOPCOFAC		0.8734	0.8126	0.9407	0.9683	0.8622	0.9114	0.8575	0.9261	0.9706	0.9855	1.1288
	1											

Table 2 Catch weights at age (kg)

YEAR		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE											
	0	0	0	0	0	0	0	0	0	0	0
	1	0.61	0.61	0.61	1.01	0.995	0.679	0.783	0.805	0.713	0.607
	2	1.66	1.66	1.66	1.524	1.842	1.813	2.023	1.825	2.161	1.563
	3	3.33	3.33	3.33	3.488	3.988	3.808	4.244	3.862	3.91	3.756
	4	5.09	5.09	5.09	5.573	5.964	5.865	5.825	5.855	6.41	5.668
	5	6.19	6.19	6.19	7.592	7.966	7.475	7.5	7.391	7.821	8.017
	6	6.76	6.76	6.76	8.697	9.306	9.818	8.81	8.116	9.888	9.749
+gp		8.3	8.3	8.3	10.18	10.925	10.748	9.504	9.471	10.658	10.208
0 SOPCOFAC		1.1267	1.023	1.0757	0.991	0.9835	1.0132	1.0039	1.0034	1.0002	1.0001

Table 2 Catch weights at age (kg)

YEAR		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE											
	0	0	0	0	0	0	0	0	0	0	0
	1	0.936	0.842	0.856	0.813	0.847	0.798	0.9	0.98	0.846	0.925
	2	1.846	1.938	1.637	1.964	1.706	1.923	1.84	1.625	1.937	1.647
	3	3.223	3.572	3.542	3.993	3.666	3.608	4	3.256	3.624	3.729
	4	5.408	5.277	5.419	5.975	5.675	6.08	5.791	5.298	5.291	5.371
	5	6.571	7.531	6.39	6.923	7.365	7.68	8.452	7.721	6.115	7.033
	6	8.256	8.398	8.507	8.509	9.486	8.272	8.712	8.836	8.672	8.833
+gp		11.052	12.699	10.397	11.1	10.761	11.258	9.56	12.256	11.263	12.155
0 SOPCOFAC		0.9977	0.9971	1.0029	1.0026	1.0005	0.9996	1	1.0004	1.0002	1.0017

Table 2 Catch weights at age (kg)

YEAR		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE											
	0	0	0	0	0	0	0	0	0	0	0
	1	0.853	0.851	0.99	0.942	1.205	1.112	0.913	0.826	0.832	0.894
	2	1.624	1.985	1.823	1.836	1.662	2.202	1.938	1.843	1.852	1.587
	3	3.179	3.573	4.149	3.439	3.287	3.634	3.514	3.666	3.781	3.543
	4	5.505	5.138	5.606	5.727	5.425	6.505	5.318	4.709	5.347	6.001
	5	7.517	7.148	7.332	7.708	10.198	7.638	7.739	6.393	7.991	7.573
	6	10.137	8.528	8.471	9.639	10.308	8.937	7.94	7.562	10.038	9.722
+gp		12.618	7.692	9.667	10.761	13.696	7.572	12.237	12.236	0	8.123
0 SOPCOFAC		0.9998	1.0007	1.0016	0.9987	0.9953	0.9961	0.9972	1.0021	1.0043	0.9996

Table 6.2.5. Cod in VIIa. Estimates of numbers discarded in 1996–2008. Data are numbers ('000 fish) discarded by each fleet, estimated from numbers per sampled trip raised to total fishing effort by each fleet, for the range of quarters indicated. Sampling scheme (a) provides independent self-sampling estimates for the UK (NI) *Nephrops* fishery also covered by observer data in schemes (b) and (d). An asterisk indicates years/fleets where the data are raised to the trip level rather than to the entire fleet.

a) Self sampling scheme: N.Ireland single trawl Nephrops vessels. Estimates are extrapolated to all N.Ireland vessels catching *Nephrops* (single and twin trawl)

	1996 Q1-4	1997 Q1-4	1998 Q1-4	1999 Q1-4	2000 Q1-4	2001 Q1-4	2002 Q1-4	2003 Q1	2004	2005	2006	2007	2008
Age	43 trips	39 trips	48 trips	39 trips	44 trips	43 trips	35 trips	8 trips	0 trips	0 trips	0 trips	0 trips	
0	56	3	0	70	32	4	0	0					
1	82	63	14	83	397	31	22	0					

(b) Observer scheme: N.Ireland vessels catching *Nephrops* (single trawl only) (*not raised to fleet level – no. of fish)

	1996	1997	1998	1999 Q3-4	2000 Q1-3	2001 Q1	2002	2003	2004	2005	2006 Q3-4*	2007 Q1-4	2008 Q1-4
Age	0 trips	0 trips	0 trips	4 trips	6 trips	1 trip	0 trips	0 trips	0 trips	0 trips	9 trips *	29 trips	55 trips
0				0	0	0					19	5.0	2.5
1				0	53	0					7	15.2	2.7
2												0.6	0.7

(c) Observer scheme: N.Ireland midwater trawl 0

	1996	1997 Q2-4	1998 Q1-3	1999 Q3-4	2000 Q1	2001 Q1	2002	2003	2004	2005	2006	2007	2008
Age	0 trips	n/a	n/a	5 trips	4 trips	2 trips	0 trips	0 trips	0 trips	0 trips	0 trips	0 trips	1 trip
0		0	0	1.6	0	0							0
1		17	4	0	0.8	0							0.45
2		0.5	2	0	0	0							0

(d) Observer scheme: N.Ireland twin trawl (*not raised to fleet level – no. of fish)

	1996	1997 Q2-4	1998 Q1-3	1999 Q4	2000 Q1-4	2001 Q1	2002	2003	2004	2005	2006 Q3-4*	2007 Q1-4	2008 Q1-4
Age	0 trips	n/a	n/a	1 trips	10 trips	2 trips	0 trips	0 trips	0 trips	0 trips	incl. with single Nephrops trawls	14 trips	16 trips
0		12	0	12	33	0						0.8	2.8
1		19	38	1	45	0						12.5	12.9
2		0.2	13	0	0	0						0.1	0.2

(e) Observer scheme: Republic of Ireland otter trawlers (*not raised to fleet level – total no. of fish for trips sampled)

	1996 Q1-4	1997 Q1-4	1998 Q1-4	1999 Q1-4	2000 Q1-4	2001 Q1-4	2002 Q1-4	2003 Q1-4	2004 Q1-4	2005 Q1-4	2006 Q1-4	2007 Q1-4	2008 Q1-4
Age	8 trips *	8 trips *	7 trips *	4 trips *	10 trips *	2 trips *	1 trip *	9 trips *	11 trips *	8 trips *	5 trips *	15 trips *	18 trips*
0	52	301	0	8	2320	58	124	0	3213	8268	774	0	
1	374	333	202	16	798		176	0	2577	632	150	691	441
2	6	87	0	0	10		0	0	598	0	0	0	

(f) Observer scheme: UK(E&W) Demersal otter trawl

	1996	1997	1998	1999	2000 Q1-2	2001 Q1,2,4	2002 Q1,3,4	2003 Q1,2,4	2004 Q1-4	2005 Q1,2	2006	2007	2008
Age	0 trips	0 trips	0 trips	0 trips	21 trips	8 trips	4 trips	4 trips	7 trips	4 trips			
0					0	0	0	0	0	0	see comment 1		
1					38.91	9.21	3.43	0.6	17.71	1.26			
2					0.05	4.46	0	0.62	0.81	0.36			

(g) Observer scheme: UK(E&W) Nephrops trawl

	1996	1997	1998	1999	2000	2001 Q1,2	2002 Q3,4	2003 Q2	2004 Q1-3	2005 Q2	2006	2007	2008
Age	0 trips	0 trips	0 trips	0 trips	0 trips	8 trips	3 trips	2 trips	7 trips	1 trip			
0						0	0	0	0.03	0	see comment 1		
1						3.09	0.03	0	0.24	0			
2						0.7	0	0	0	0			

(h) Observer scheme: UK(E&W) Danish anchor seine

	1996	1997	1998	1999	2000	2001 Q2	2002 Q3	2003	2004 Q3	2005	2006	2007	2008
Age	0 trips	0 trips	0 trips	0 trips	0 trips	2 trips	1 trip	0 trips	1 trip				
0						0	0		0		see comment 1		
1						0	0		0				

(i) Observer scheme: UK(E&W) beam trawl

	1996	1997	1998	1999	2000 Q2	2001	2002 Q1	2003	2004	2005 Q4	2006	2007	2008
Age	0 trips	0 trips	0 trips	0 trips	1 trip	0 trips	1 trip	0 trips	0 trips	2 trips			
0					0		0			0	see comment 1		
1					4.34		0.54			0			

comment 1 UK data for 2006-2008 available to WGNSDS/WGCSE as length compositions only, for combined gears

Table 6.2.6. Cod in VIIa: survey indices. Approximate relative standard errors for age groups used in the assessment are given for UK (NI) groundfish surveys. Years/ages used in assessments are in bold.

ScoGFS :Scottish spring groundfish survey of the Irish Sea — Numbers per 10 Hours Fishing
Feb-March

Survey	1-gp	2-gp	3-gp	4-gp	5-gp	6-gp	7+
1996	**3**	**31**	**44**	**7**	9	0	0
1997	**22**	**29**	**15**	**13**	2	0	1
1998	**5**	**81**	**27**	**5**	1	0	0
1999	**7**	**33**	**93**	**15**	5	0	0
2000	**51**	**6**	**11**	**16**	0	1	0
2001	**28**	**56**	**1**	**1**	4	0	0
2002	**13**	**18**	**37**	**1**	1	0	0
2003	**8**	**69**	**18**	**9**	0	0	0
2004	**8**	**11**	**49**	**0**	3	0	0
2005	**1**	**25**	**8**	**9**	1	0	0
2006	**2**	**5**	**11**	**0**	2	0	0

ScoGFS :Scottish autumn groundfish survey of the Irish Sea — Numbers per 10 Hours Fishing
October

Survey	0-gp	1-gp	2-gp	3-gp	4-gp
1997	3	28	19	1	2
1998	0	8	42	5	0
1999	164	2	24	6	2
2000	24	136	4	0	0
2001	0	0	7	0	0
2002	0	18	15	9	0
2003	2	0	27	0	0
2004	2	12	5	5	0
2005	3	8	25	2	0

NI-GFS March groundfish survey — Numbers per 3-miles (approx. 1-h tow) — RSE = approximate relative standard error

Survey	1-gp	2-gp	3-gp	4-gp	5-gp	6-gp	7+	RSE(1gp)	RSE(2gp)	RSE(3gp)	RSE(4gp)
1992	23.257	5.005	1.965	0.248	0.000	0.031	0.017	0.58	0.36	0.26	0.40
1993	**1.381**	**6.488**	**0.446**	**0.104**	0.014	0.028	0.000	0.67	0.22	0.25	0.39
1994	**13.804**	**1.097**	**1.203**	**0.084**	0.014	0.000	0.000	0.48	0.35	0.21	0.35
1995	**7.007**	**3.862**	**0.200**	**0.108**	0.000	0.010	0.000	0.30	0.25	0.41	0.39
1996	**11.061**	**3.293**	**1.117**	**0.014**	0.088	0.000	0.013	0.62	0.18	0.21	1.00
1997	**5.373**	**4.158**	**0.667**	**0.214**	0.014	0.000	0.000	0.32	0.21	0.21	0.38
1998	**1.694**	**7.692**	**0.569**	**0.120**	0.000	0.000	0.000	0.21	0.16	0.30	0.53
1999	**0.495**	**2.531**	**2.419**	**0.153**	0.028	0.000	0.000	0.27	0.20	0.15	0.43
2000	**6.296**	**1.011**	**0.346**	**0.330**	0.000	0.023	0.000	0.36	0.13	0.31	0.44
2001	**4.067**	**5.614**	**0.184**	**0.058**	0.040	0.000	0.000	0.29	0.15	0.39	0.42
2002	**6.622**	**2.533**	**3.335**	**0.000**	0.000	0.011	0.000	0.59	0.19	0.38	-
2003	**0.739**	**10.792**	**1.041**	**0.327**	0.037	0.030	0.058	0.32	0.21	0.30	0.26
2004	**2.170**	**1.720**	**0.886**	**0.054**	0.044	0.000	0.000	0.57	0.30	0.21	0.40
2005	**0.635**	**2.251**	**0.294**	**0.280**	0.183	0.000	0.000	0.56	0.29	0.60	0.64
2006	**1.700**	**1.308**	**0.583**	**0.025**	0.000	0.000	0.011	0.52	0.26	0.37	0.71
2007	**1.644**	**1.244**	**0.306**	**0.051**	0.000	0.000	0.000	0.41	0.21	0.38	0.66
2008	**0.407**	**2.172**	**0.130**	**0.052**	0.042	0.010	0.000	0.46	0.32	0.39	0.66
2009	**1.440**	**0.590**	**0.330**	**0.090**	0.000	0.000	0.000	0.60	0.23	0.26	0.68

NI-GFS October groundfish survey — Numbers per 3-miles (approx. 1-h tow) — RSE = approximate relative standard error

Survey	0-gp	1-gp	2-gp	3-gp	4-gp	5-gp	6-gp	7+	RSE(0gp)	RSE(1gp)	RSE(2gp)
1992	**0.579**	11.094	0.501	0.476	0.086	0.000	0.000	0.000	0.58	0.36	0.28
1993	**7.808**	5.532	1.464	0.008	0.000	0.000	0.000	0.034	0.43	0.84	0.34
1994	**19.962**	16.725	0.254	0.104	0.000	0.000	0.000	0.000	0.28	0.43	0.42
1995	**7.886**	12.068	0.333	0.000	0.000	0.000	0.000	0.000	0.55	0.91	0.38
1996	**14.813**	4.866	0.501	0.065	0.000	0.000	0.000	0.000	0.42	0.50	0.30
1997	**4.204**	13.222	0.972	0.000	0.000	0.000	0.000	0.000	0.45	0.41	0.40
1998	**0.370**	3.765	1.639	0.057	0.000	0.000	0.000	0.000	0.38	0.36	0.37
1999	**20.225**	0.585	0.325	0.095	0.000	0.000	0.000	0.000	0.34	0.68	0.43
2000	**7.242**	3.016	0.020	0.000	0.000	0.000	0.000	0.000	0.36	0.33	1.00
2001	**8.411**	5.068	1.099	0.000	0.000	0.000	0.000	0.000	0.45	0.35	0.35
2002	**0.897**	4.879	0.377	0.125	0.000	0.000	0.000	0.000	0.86	0.58	0.55
2003	**2.759**	1.614	0.294	0.000	0.000	0.000	0.000	0.000	0.48	0.66	0.63
2004	**4.437**	5.790	0.237	0.000	0.000	0.000	0.000	0.000	0.30	0.48	0.75
2005	**8.245**	7.061	1.077	0.173	0.029	0.000	0.000	0.000	0.52	0.89	0.62
2006	**1.170**	1.302	0.015	0.066	0.000	0.000	0.000	0.000	0.45	0.53	1.00
2007	**0.068**	0.870	0.000	0.030	0.000	0.000	0.000	0.000	0.66	0.80	-
2008	**0.190**	0.170	0.170	0.000	0.000	0.000	0.000	0.000	0.57	1.00	1.00

Table 6.2.6 (contd.)

Irish GFS. Irish groundfish survey of the Irish Sea. RV Celtic Explorer Total nos. per survey
October

	0-gp	1-gp	2-gp	3-gp	4-gp	5-gp	6-gp	7+
2003	16	29	31	3	1	0		
2004	23	74	7	2	0			

UK Fishery Science Partnership western Irish Sea pelagic trawl survey (mean nos. per hour) SSB index = kg/hr
Feb-March (revised)

	0-gp	1-gp	2-gp	3-gp	4-gp	5-gp	6-gp	7+	SSB index
2004		-	-	-	-	-	-	-	13.29
2005		0.000	0.427	1.409	0.990	0.084	0.025	0.035	12.01
2006		0.003	0.536	2.815	0.427	0.104	0.010	0.007	8.26
2007		0.008	0.611	1.322	0.585	0.055	0.058	0.029	11.78
2008		0.003	0.221	0.824	0.147	0.084	0.020	0.019	3.93
2009		0.009	0.171	1.152	0.377	0.099	0.018	0.012	5.37

UK Fishery Science Partnership eastern Irish Sea otter trawl survey (mean nos. per hour) SSB index = kg/hr
Feb-March (revised)

	0-gp	1-gp	2-gp	3-gp	4-gp	5-gp	6-gp	7+	SSB index
2005		0.06	4.02	0.25	0.38	0.004	0.01	0	5.97
2006		0.83	0.77	0.67	0.007	0.042	0	0.001	3.31
2007		0.59	1.43	0.09	0.08	0	0	0	1.77
2008		0.01	1.80	0.32	0.02	0.03	0.003	0.01	2.60
2009		0.50	0.36	0.21	0.09	0.01	0.004	0.00	1.58

ENG BTS-Sept beam trawl survey. No. per 100km
September (revised)

Survey	0-gp
1991	
1992	
1993	**22**
1994	**30**
1995	**40**
1996	**29**
1997	**32**
1998	**2**
1999	**49**
2000	**37**
2001	**24**
2002	**7**
2003	**9**
2004	**22**
2005	**41**
2006	**6**
2007	**4**
2008	**7**

NIMIKNET pelagic 0-gp index
May-June

Survey	0-gp
1994	**57.4**
1995	**6.9**
1996	**66.3**
1997	**5.7**
1998	**0.1**
1999	**26.2**
2000	**6.1**
2001	**9.6**
2002	**3.4**
2003	**3.2**
2004	**25.8**
2005	**11.4**
2006	**9.0**
2007	**0**
2008	**0.8**

Table 6.2.7. B-Adapt model settings for update run in 2009. Same settings as in 2008 final run.

SETTING	VALUES
Plus group	5-plus
Fbar range	2–4 (arithmetic mean)
Year range for tuning VPA	1992 onwards
Surveys after final year of catch data used.	Yes; Fmult = 0.75 for 2009 WGCSE
VPA model or cohort analysis used	v (exact)
First age with constant catchability	Entered as 0 for all tuning fleets
q-plateau	Entered as 3 for all tuning fleets
Tapered time weighting applied	No
Number of missing catch multipliers	9 for WGCSE 2009 (bias estimated from 2000 onwards)
No. ages for terminal F mean, and scaling factor for mean	ages = 1; scaling factor = 1.0; arithmetic mean (i.e. F(4) = F(3))
Constraint on F or catch? Stiffness weight (λ)	Constrain F; λ = 1.0
Prior weighting of fleets	None
Output tables	VPA output table 16 (not SOP corrected)

Table 6.2.8. Selected diagnostics from update B-Adapt (not bootstrap run).

Lowestoft VPA Program
13/05/2009 16:35
Adapt Analysis

"IRISH SEA COD WGCSE 2009 COMBSEX PLUSGROUP"

CPUE data from file cod7tun.txt

Catch data for 41 years : 1968 to 2008. Ages 0 to 5+

Fleet	First year	Last year	First age	Last age	Alpha	Beta
NIGFSMAR(1-4gp)	1993	2009	1	4	0.25	0.35
ScoGFS-Q1 Survey (No	1996	2009	1	4	0.25	0.35
NIGFSOCT(0 2-gp)	1992	2009	0	0	0.83	0.88
ENGBTS-Sept	1993	2009	0	0	0.75	0.79
NIMIKNET	1994	2009	0	0	0.38	0.46

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Fleet	PowerQ ages<x	QPlateau ages>x
NIGFSMAR(1-4gp)	0	3
ScoGFS-Q1 Survey (N	0	3
NIGFSOCT(0 2-gp)	0	3
ENGBTS-Sept	0	3
NIMIKNET	0	3

Catchability independent of stock size for all ages

Bias estimation :
Bias estimated for the final 9 years.
Oldest age F estimates in 1968 to 2009 calculated as 1.000 * the mean F of ages 3- 3
Total F penalty applied lambda = 1.000

Individual fleet weighting not applied

INITIAL SSQ =	1521.00527
PARAMETERS =	13
OBSERVATIONS =	196
SSQ =	89.36789
QSSQ =	83.73328
CSSQ =	5.63461
IFAIL =	0
IFAILCV = 0	

Regression weights	1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0	0	0	0	0	0	0	0	0	0
1	0.113	0.141	0.239	0.15	0.204	0.157	0.126	0.043	0.136	0.17
2	1.356	1.173	0.733	1.243	1.106	0.77	0.791	1.132	0.997	0.76
3	1.99	1.868	1.588	1.735	1.437	1.476	1.2	2.231	1.664	1.543
4	1.99	1.868	1.588	1.735	1.437	1.476	1.2	2.231	1.664	1.543

Population numbers (Thousands)

YEAR \ AGE	0	1	2	3	4
1999	5.64E+03	7.19E+02	1.23E+03	1.08E+03	8.14E+01
2000	3.97E+03	4.61E+03	5.26E+02	2.59E+02	1.21E+02
2001	4.64E+03	3.25E+03	3.28E+03	1.33E+02	3.27E+01
2002	1.23E+03	3.80E+03	2.10E+03	1.29E+03	2.23E+01
2003	2.07E+03	1.01E+03	2.68E+03	4.95E+02	1.86E+02
2004	1.26E+03	1.69E+03	6.73E+02	7.25E+02	9.64E+01
2005	1.46E+03	1.03E+03	1.19E+03	2.55E+02	1.36E+02
2006	1.38E+03	1.19E+03	7.47E+02	4.40E+02	6.29E+01
2007	2.79E+02	1.13E+03	9.36E+02	1.97E+02	3.87E+01
2008	4.35E+02	2.29E+02	8.05E+02	2.83E+02	3.06E+01

Estimated population abundance at 1st Jan 2009

0.00E+00	3.56E+02	1.58E+02	3.08E+02	4.95E+01

Taper weighted geometric mean of the VPA populations:

4.17E+03	3.61E+03	2.54E+03	9.16E+02	2.43E+02

Standard error of the weighted Log(VPA populations) :

0.9329	0.8598	0.6999	0.7809	1.0355

Table 6.2.8 contd.

Log population residuals (unweighted). << Residuals removed: SEE PLOTS >>

Fleet : NIGFSMAR(1-4gp)

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4
Mean Log q	-1.8789	-1.3266	-1.5764	-1.5764
S.E(Log q)	0.5376	0.3318	0.472	0.7723

Regression statistics :
Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	0.81	1.42	2.94	0.8	16	0.42177	-1.88
2	1.04	-0.29	1.09	0.79	16	0.35613	-1.33
3	0.86	0.945	2.23	0.76	16	0.40653	-1.58
4	1.21	-0.582	1.23	0.38	15	0.91138	-1.8

Fleet : ScoGFS-Q1 Survey (No

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4
Mean Log q	-5.4474	-3.7779	-2.826	-2.826
S.E(Log q)	0.8627	0.4391	0.6651	0.935

Regression statistics :
Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	0.82	0.531	5.84	0.48	11	0.73011	-5.45
2	0.79	1.314	4.54	0.81	11	0.33323	-3.78
3	0.65	2.128	4.03	0.8	11	0.37024	-2.83
4	0.93	0.256	2.34	0.66	9	0.62977	-2.18

Fleet : NIGFSOCT(0 2-gp)

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	0
Mean Log q	-1.7913
S.E(Log q)	0.9657

Regression statistics :
Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	0.57	3.564	4.26	0.82	17	0.42126	-1.79

Fleet : ENGBTS-Sept

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	0
Mean Log q	-4.653
S.E(Log q)	0.6782

Regression statistics :
Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	1.26	-1.078	3.89	0.55	16	0.85008	-4.65

Fleet : NIMIKNET

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	0
Mean Log q	-5.645
S.E(Log q)	1.2972

Regression statistics :
Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	0.66	1.096	6.33	0.47	14	0.85158	-5.64

Table 6.2.8. Contd.

Year	Est.Landings	Landings	Bias
1968	9779	8541	
1969	9834	7991	
1970	6831	6426	
1971	9549	9246	
1972	10710	9234	
1973	12968	11819	
1974	11955	10251	
1975	10650	9863	
1976	10557	10247	
1977	8173	8054	
1978	5556	6271	
1979	7430	8371	
1980	10534	10776	
1981	13858	14907	
1982	13503	13381	
1983	10183	10015	
1984	8274	8383	
1985	10442	10483	
1986	9819	9852	
1987	12891	12894	
1988	14166	14168	
1989	12781	12751	
1990	7400	7379	
1991	7074	7095	
1992	7715	7735	
1993	7551	7555	
1994	5404	5402	
1995	4587	4587	
1996	4962	4964	
1997	5858	5859	
1998	5309	5318	
1999	4785	4784	
2000	2428	1274	1.907
2001	4182	2252	1.86
2002	6597	2695	2.445
2003	4861	1285	3.765
2004	3535	1072	3.285
2005	2424	910	2.657
2006	2756	840	3.288
2007	1856	702	2.655
2008	1570	661	2.374

Parameters

Age	Survivors	s.e log est
0	355.79648	0.36737
1	157.99212	0.37102
2	308.35218	0.42215
3	49.48531	0.48587

Year	Multiplier	s.e log est
33	1.90691	0.22712
34	1.86014	0.24526
35	2.44471	0.22972
36	3.76542	0.23739
37	3.28488	0.24324
38	2.65672	0.23891
39	3.28828	0.21974
40	2.65455	0.24845
41	2.37395	0.2797

Variance covariance matrix

0.13496	0.01104	0.01029	0.00545	0.00914	0.01041	0.01026	0.00978	0.00933	0.00932	0.0095	0.01077	0.01179
0.01104	0.13766	0.01855	0.0074	0.00865	0.0098	0.00975	0.00941	0.00926	0.00879	0.00698	0.00268	0.02489
0.01029	0.01855	0.17821	0.00315	0.00862	0.0098	0.00977	0.00951	0.00936	0.00836	0.00471	0.01335	-0.002
0.00545	0.0074	0.00315	0.23607	0.00825	0.00935	0.00866	0.00854	0.00896	0.00765	0.00614	-0.00648	0.00385
0.00914	0.00865	0.00862	0.00825	0.05158	0.01654	0.00785	0.00768	0.00884	0.00946	0.00954	0.00932	0.009
0.01041	0.0098	0.0098	0.00935	0.01654	0.06015	0.01673	0.00673	0.00782	0.00995	0.01083	0.01069	0.01028
0.01026	0.00975	0.00977	0.00866	0.00785	0.01673	0.05277	0.01761	0.00762	0.0078	0.00951	0.01022	0.00997
0.00978	0.00941	0.00951	0.00854	0.00768	0.00673	0.01761	0.05635	0.01645	0.00715	0.00707	0.00894	0.00937
0.00933	0.00926	0.00936	0.00896	0.00884	0.00782	0.00762	0.01645	0.05917	0.01875	0.00606	0.00633	0.00789
0.00932	0.00879	0.00836	0.00765	0.00946	0.00995	0.0078	0.00715	0.01875	0.05708	0.01496	0.00566	0.00581
0.0095	0.00698	0.00471	0.00614	0.00954	0.01083	0.00951	0.00707	0.00606	0.01496	0.04829	0.01719	0.00866
0.01077	0.00268	0.01335	-0.00648	0.00932	0.01069	0.01022	0.00894	0.00633	0.00566	0.01719	0.06173	0.02265
0.01179	0.02489	-0.002	0.00385	0.009	0.01028	0.00997	0.00937	0.00789	0.00581	0.00866	0.02265	0.07823

Table 6.2.9. Cod in VIIa. Point estimates of population numbers-at-age at-age from the update B-Adapt assessment.

Population numbers (Thousands)

YEAR	0	1	2	3	4	5+
1968	6512	3424	3710	1600	727	0
1969	8506	5332	2475	1640	420	191
1970	15131	6964	3571	711	412	106
1971	5239	12388	4516	1684	268	155
1972	13883	4289	7680	1891	574	91
1973	3107	11366	2802	3367	812	246
1974	11055	2544	7270	1317	1168	282
1975	3533	9051	1606	2777	580	515
1976	5103	2893	5881	740	1020	213
1977	5529	4178	1353	2135	282	389
1978	12082	4527	2686	650	652	86
1979	14196	9892	3087	1222	255	256
1980	7923	11623	6513	1376	459	96
1981	3461	6487	7238	2832	477	159
1982	5264	2833	4142	2685	1028	173
1983	7879	4310	2009	1359	903	346
1984	7922	6451	2796	813	444	295
1985	6350	6486	3864	1221	274	150
1986	18442	5199	4214	1290	375	84
1987	8743	15099	3380	1448	434	126
1988	3803	7158	8481	1170	438	131
1989	4904	3113	3361	2732	335	125
1990	5648	4015	2025	835	570	70
1991	8751	4624	2648	701	201	137
1992	1709	7165	2022	914	182	52
1993	5110	1399	4629	553	163	32
1994	3699	4184	945	1212	97	29
1995	3121	3028	2751	268	243	19
1996	5792	2555	2031	1107	61	55
1997	2103	4742	1806	672	285	16
1998	879	1722	3411	460	110	47
1999	5637	719	1226	1079	81	19
2000	3971	4615	526	259	121	9
2001	4638	3251	3282	133	33	15
2002	1231	3797	2096	1291	22	5
2003	2069	1008	2677	495	186	3
2004	1264	1694	673	725	96	36
2005	1459	1035	1186	255	136	18
2006	1376	1194	747	440	63	33
2007	279	1126	936	197	39	6
2008	435	229	805	283	31	6
2009		356	158	308	49	5

Table 6.2.10. Cod in VIIa. Point estimates of fishing mortality-at-age from the update B-Adapt assessment. Figures for 2009 are the values assumed for a 25% reduction in F in the intermediate year.

YEAR	AGE						
	0	1	2	3	4	5+	F(2-4)
1968	0	0.125	0.616	1.137	1.137	1.137	0.963
1969	0	0.201	1.047	1.181	1.181	1.181	1.136
1970	0	0.233	0.552	0.775	0.775	0.775	0.700
1971	0	0.278	0.670	0.877	0.877	0.877	0.808
1972	0	0.226	0.625	0.646	0.646	0.646	0.639
1973	0	0.247	0.555	0.858	0.858	0.858	0.757
1974	0	0.260	0.762	0.620	0.620	0.620	0.667
1975	0	0.231	0.574	0.802	0.802	0.802	0.726
1976	0	0.560	0.813	0.764	0.764	0.764	0.781
1977	0	0.242	0.533	0.986	0.986	0.986	0.835
1978	0	0.183	0.587	0.734	0.734	0.734	0.685
1979	0	0.218	0.608	0.780	0.780	0.780	0.723
1980	0	0.274	0.633	0.859	0.859	0.859	0.784
1981	0	0.249	0.792	0.813	0.813	0.813	0.806
1982	0	0.144	0.915	0.890	0.890	0.890	0.898
1983	0	0.233	0.705	0.918	0.918	0.918	0.847
1984	0	0.312	0.629	0.886	0.886	0.886	0.800
1985	0	0.231	0.897	0.981	0.981	0.981	0.953
1986	0	0.231	0.868	0.889	0.889	0.889	0.882
1987	0	0.377	0.861	0.995	0.995	0.995	0.950
1988	0	0.556	0.933	1.052	1.052	1.052	1.012
1989	0	0.230	1.192	1.367	1.367	1.367	1.309
1990	0	0.216	0.861	1.223	1.223	1.223	1.102
1991	0	0.627	0.864	1.149	1.149	1.149	1.054
1992	0	0.237	1.097	1.523	1.523	1.523	1.381
1993	0	0.193	1.140	1.538	1.538	1.538	1.406
1994	0	0.219	1.058	1.406	1.406	1.406	1.290
1995	0	0.199	0.710	1.289	1.289	1.289	1.096
1996	0	0.147	0.905	1.155	1.155	1.155	1.072
1997	0	0.130	1.167	1.613	1.613	1.613	1.464
1998	0	0.140	0.950	1.532	1.532	1.532	1.338
1999	0	0.113	1.356	1.990	1.990	1.990	1.779
2000	0	0.141	1.173	1.868	1.868	1.868	1.636
2001	0	0.239	0.733	1.588	1.588	1.588	1.303
2002	0	0.150	1.243	1.735	1.735	1.735	1.571
2003	0	0.204	1.106	1.437	1.437	1.437	1.327
2004	0	0.157	0.770	1.476	1.476	1.476	1.240
2005	0	0.126	0.791	1.200	1.200	1.200	1.064
2006	0	0.043	1.132	2.231	2.231	2.231	1.864
2007	0	0.136	0.997	1.664	1.664	1.664	1.442
2008	0	0.170	0.760	1.543	1.543	1.543	1.282
2009	*0*	*0.128*	*0.570*	*1.157*	*1.157*	*1.157*	*0.961*

Table 6.2.11. Cod in VIIa. Summary data from the update B-Adapt assessment. "B-Adapt removals" are the estimated total removals from 2000 onwards in excess of removals as a consequence of the assumed natural mortality rate.

Run title : "IRISH SEA COD

Summary (without SOP correction) At 13/05/2009 16:36

Year	Recruits age 0 (thousands)	Total biomass (t)	Spawning stock biomass (t)	Input landings (t)	B-Adapt removals (t)	FBAR 2- 4
1968	6512	19351	13444	8541		0.9634
1969	8506	18040	12241	7991		1.1365
1970	15131	17709	9785	6426		0.7005
1971	5239	23476	11271	9246		0.808
1972	13883	26393	15873	9234		0.6386
1973	3107	30044	20227	11819		0.7572
1974	11055	27155	18121	10251		0.6671
1975	3533	25060	17886	9863		0.7262
1976	5103	21465	13647	10247		0.7806
1977	5529	16614	12673	8054		0.8352
1978	12082	14188	8662	6271		0.6851
1979	14196	19638	10426	8371		0.723
1980	7923	26103	12310	10776		0.7836
1981	3461	29723	18317	14907		0.8062
1982	5264	27025	20249	13381		0.8981
1983	7879	21842	15260	10015		0.8471
1984	7922	18773	11249	8383		0.7999
1985	6350	21980	12055	10483		0.9532
1986	18442	20979	12026	9852		0.8823
1987	8743	28289	12995	12894		0.9503
1988	3803	26056	13492	14168		1.0121
1989	4904	21061	14300	12751		1.3086
1990	5648	14540	8725	7379		1.1025
1991	8751	13177	6531	7095		1.0541
1992	1709	15518	7231	7735		1.3814
1993	5110	12376	6295	7555		1.4055
1994	3699	10460	5995	5402		1.2903
1995	3121	10439	4575	4587		1.0964
1996	5792	10298	5747	4964		1.072
1997	2103	11795	5614	5859		1.4642
1998	879	9886	4810	5318		1.3383
1999	5637	6764	4916	4784		1.7786
2000	3971	6610	2035	1274	2428	1.6362
2001	4638	10159	3231	2252	4182	1.3029
2002	1231	12136	6173	2695	6597	1.5709
2003	2069	8365	4392	1285	4861	1.3267
2004	1264	6936	4134	1072	3535	1.2405
2005	1459	5052	2683	910	2424	1.064
2006	1376	4582	2743	840	2756	1.8644
2007	279	3651	1639	702	1856	1.4417
2008	435	2737	1741	661	1570	1.2819
2009		2009	1533			
Average (1968-2008)	5798	16499	9652	7227	3357	1.0823

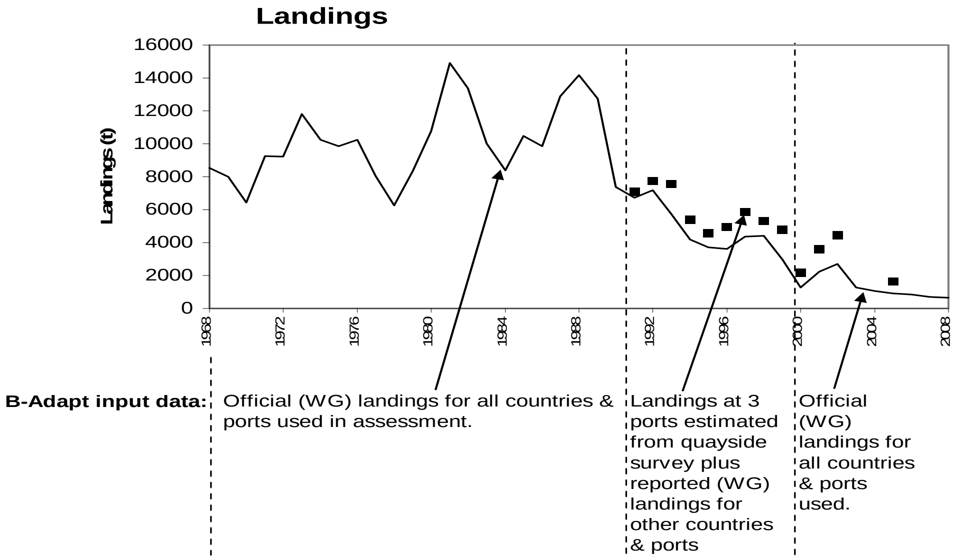


Figure 6.2.1. Cod in VIIa. Landings data used in the B-Adapt assessment.

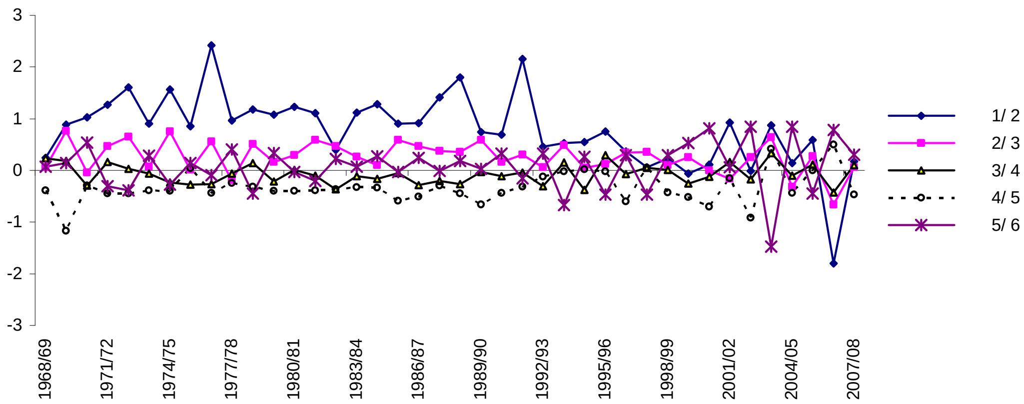
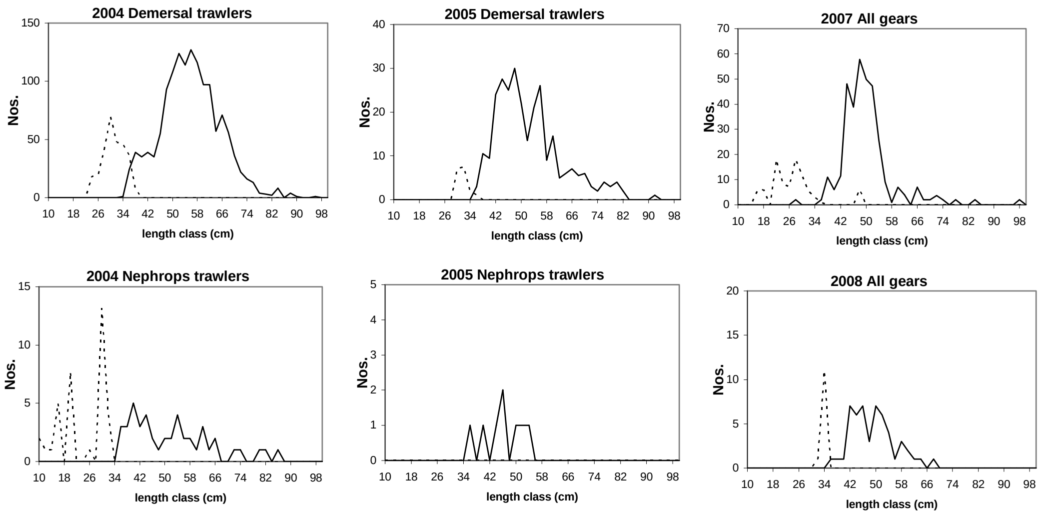
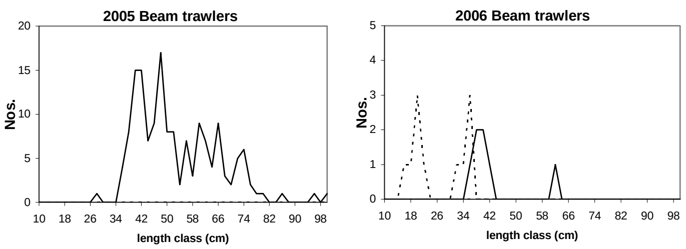


Figure 6.2.2. Cod in VIIa. Separable VPA residuals.





Number of trips sampled

	Demersal	Nephrops	Beam	All
2004	7	7	0	14
2005	4	2	2	8
2006	3	1	1	5
2007				26
2008				29

Figure 6.2.3. Cod in VIIa. Length frequencies of retained and discarded cod recorded by observers on UK (E&W) fishing vessels in 2004–2008 (nos. for observed trips).

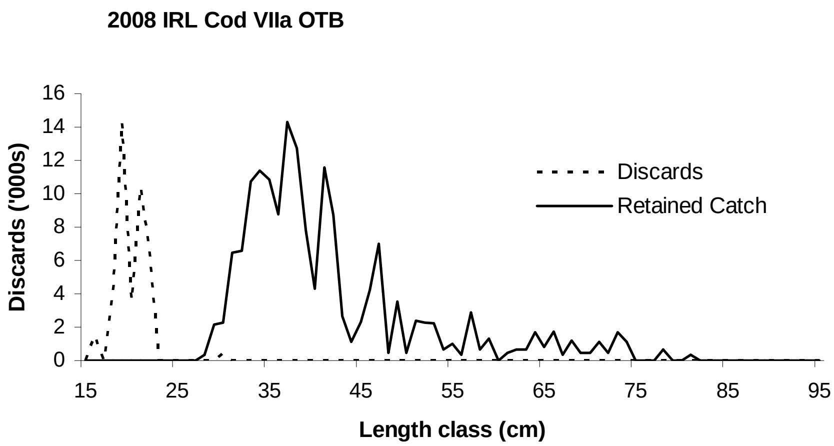


Figure 6.2.4. Cod in VIIa. Length frequencies of retained and discarded cod recorded by observers on Irish otter trawl vessels in 2008, raised to fleet level (no. trips sampled = 18).

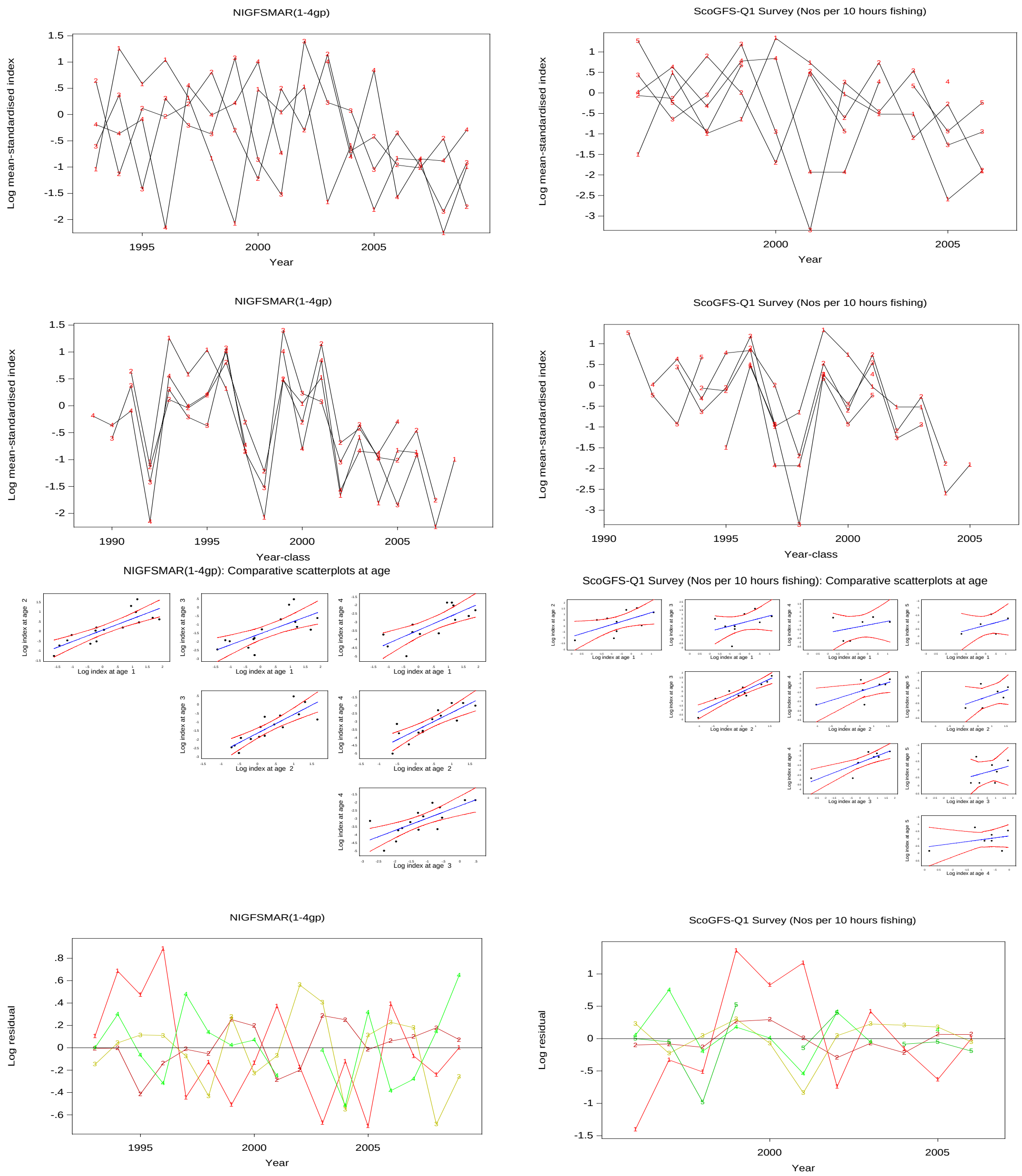


Figure 6.2.5. Cod in VIIa. Log survey indices for NIGFS-Mar and ScoGFS-Q1 trawl surveys by year and year class; comparative scatterplots of indices within year classes, and residuals from Surba model fits.

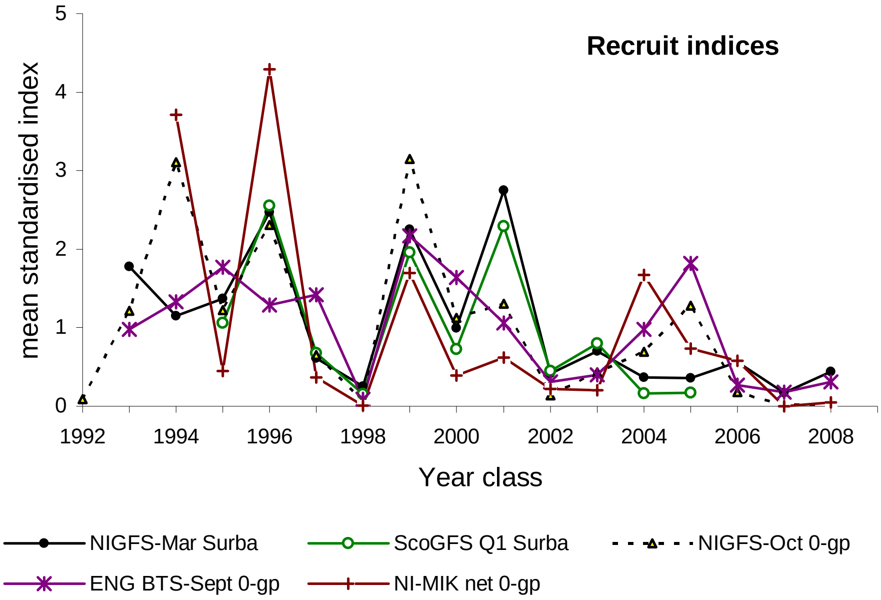


Figure 6.2.6. Cod in VIIa. Consistency between trends in year-class strength estimated from SURBA analysis of NIGFS-Mar and ScoGFS-Q1 surveys and the other 0-gp indices used in the assessment.

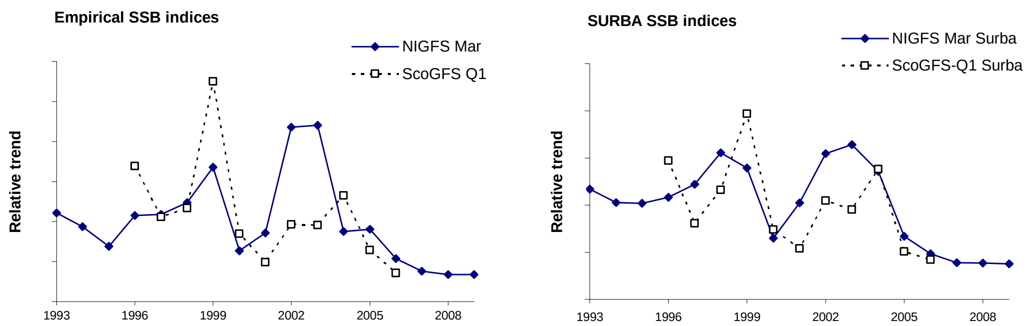


Figure 6.2.7. Cod in VIIa. Mean-standardized empirical SSB indices and SURBA model SSB trends from the NIGFS-Mar and ScoGFS-Q1 trawl surveys.

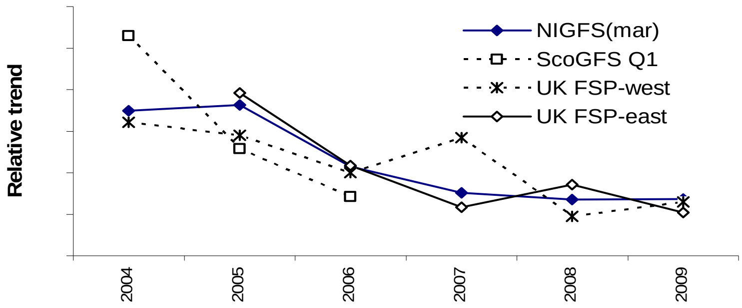


Figure 6.2.8. Trends in empirical SSB indices from 2004 onwards from the NIGFS-Mar and ScoGFS-Q1 surveys compared with equivalent indices from UK Fisheries Science Partnership surveys of the western and eastern Irish Sea in February–March.

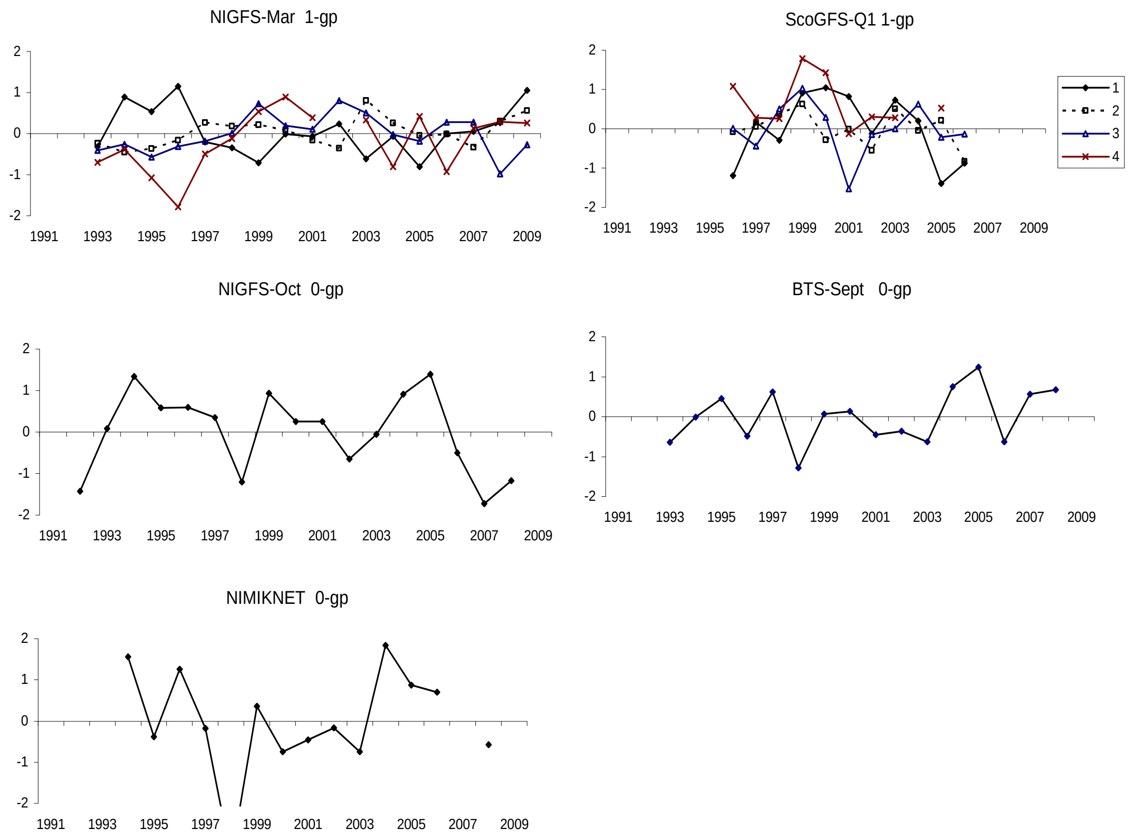


Figure 6.2.9. Cod in VIIa: Catchability residuals from the update B-Adapt run (non-bootstrap option).

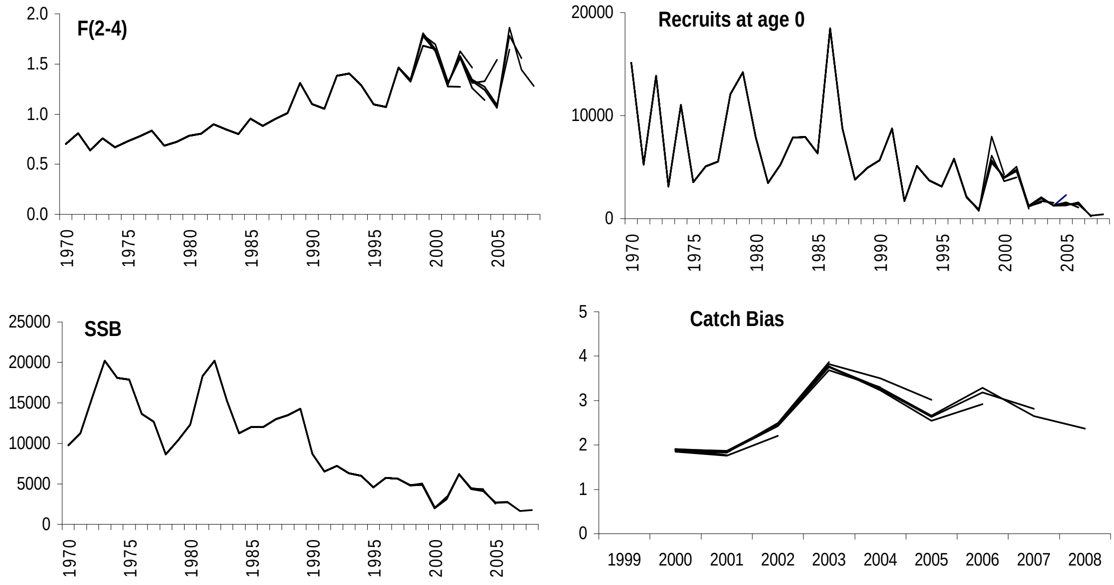


Figure 6.2.10. Retrospective plots for B-Adapt cod assessment. All runs use the non-bootstrap option and therefore give point estimates rather than bootstrap 50th percentiles.

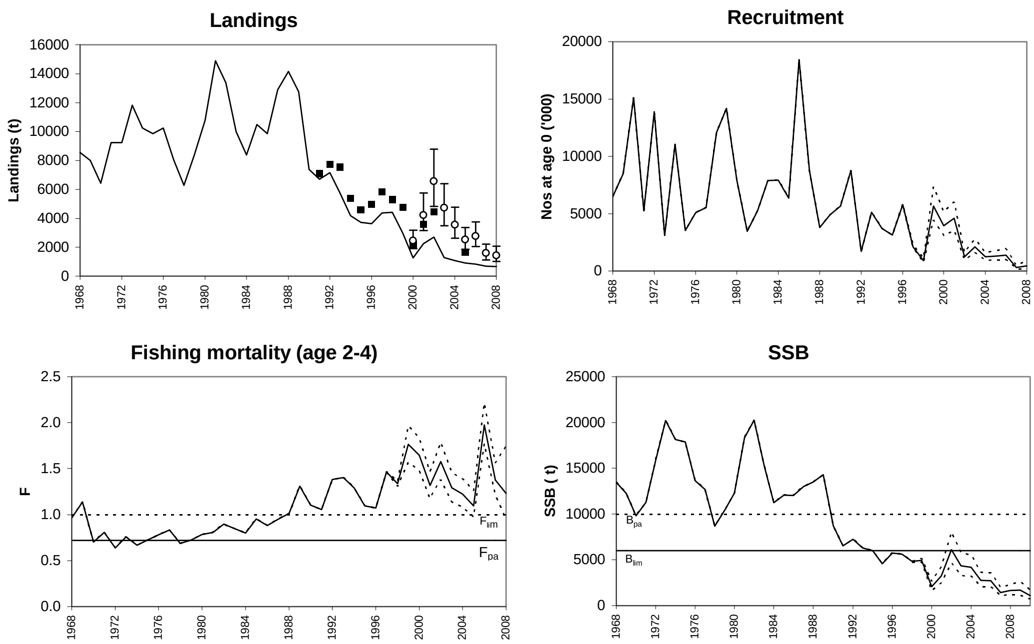


Figure 6.2.11. Stock summary plot from update B-Adapt run. Continuous line on landings plot is the reported landings; filled squares are landings in 1991–2002 and 2005 including sample-based estimates at three ports; open circles with 90% confidence intervals are total removals estimates (in excess of assumed natural mortality) from B-Adapt. Dotted lines on plots are 5th and 95th bootstrap percentiles.

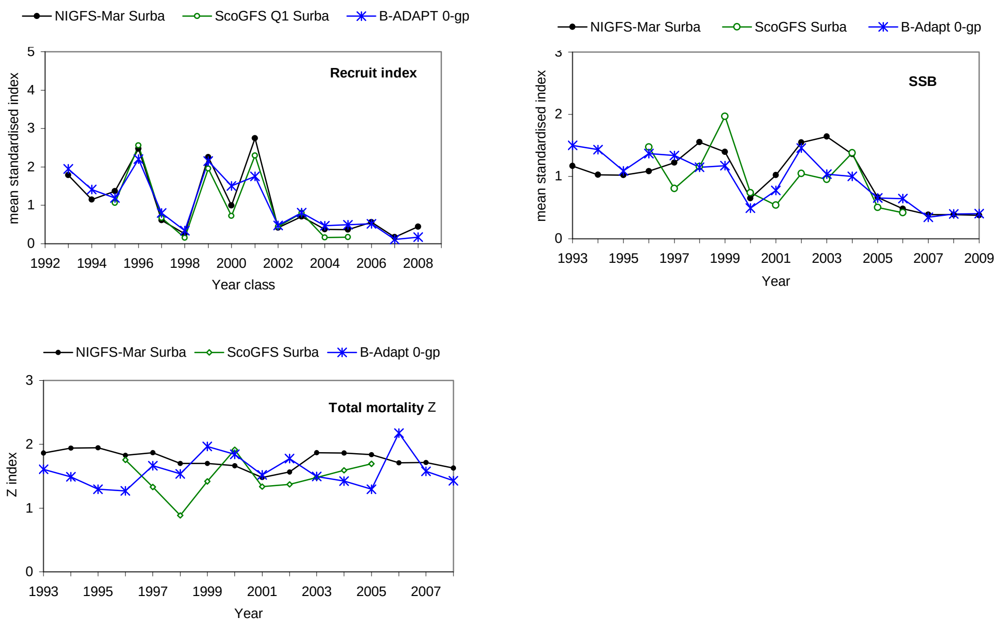


Figure 6.2.12. Cod in VIIa: comparison of updated B-ADAPT stock trends with indices of recruitment, SSB and fishing mortality from SURBA runs with NIGFS-Mar and ScoGFS-Q1 surveys. The B-Adapt estimates of F have been increased by M=0.2 to give Z indices comparable with the SURBA values.

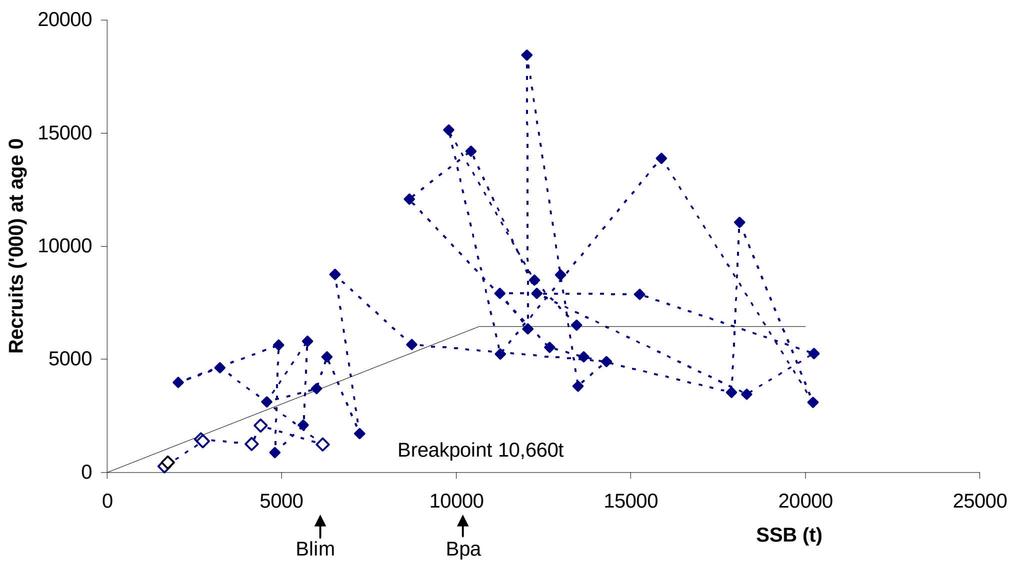


Figure 6.2.13. Cod in VIIa. Stock-recruit data with segmented regression model fitted assuming lognormal variability of recruitment. The most recent 7 year classes are indicated by open symbols.

Fbar(2-4)	Year		
Percentile	2009	2010	2014
0.05	0.72	0.00	0.00
0.25	0.82	0.00	0.00
0.5	0.92	0.00	0.00
0.75	1.06	0.00	0.00
0.95	1.31	0.00	0.00

SSB	Year		
Percentile	2010	2011	2015
0.05	714	1598	8028
0.25	926	2068	10799
0.5	1107	2475	13044
0.75	1329	2922	15606
0.95	1685	3618	19354

Removals	Year		
Percentile	2009	2010	2011
0.05	769	0	0
0.25	938	0	0
0.5	1109	0	0
0.75	1308	0	0
0.95	1689	0	0

P(SSBYear > Blim)			
2010	2011	2013	2015
0.00	0.00	0.79	1.00

P(SSBYear > Bpa)			
2010	2011	2013	2015
0.00	0.00	0.16	0.83

Zero F projection
Recruitment 2002 - 2008
25% F reduction in 2009

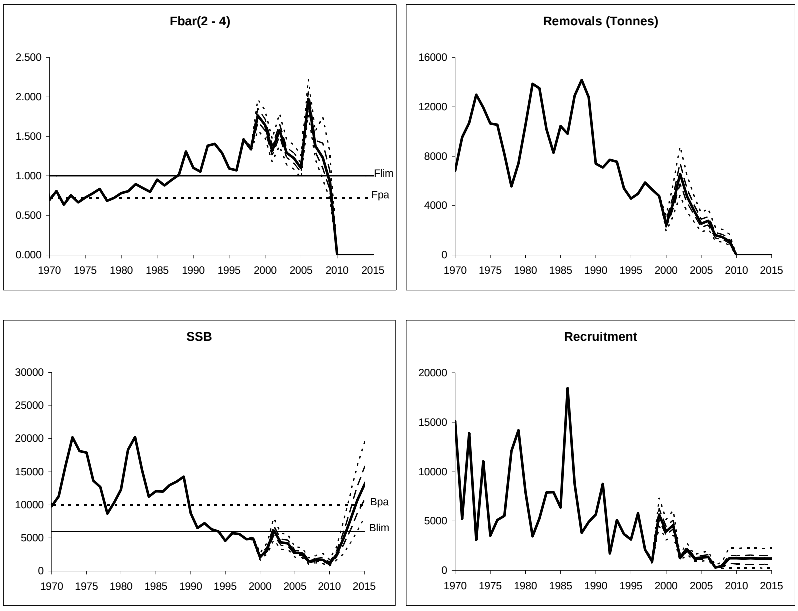


Figure 6.2.14. Cod in VIIa. Projection to 2015 based on the update B-Adapt assessment, assuming 25% F reduction in 2009 and zero F in subsequent years. Recruitment is bootstrapped from the 2002–2008 year classes. Percentiles of F, SSB and removals, and probability of SSB>B$_{lim}$, are tabulated for selected years.

Fbar(2-4)	Year		
Percentile	2009	2010	2014
0.05	0.72	0.54	0.31
0.25	0.82	0.62	0.36
0.5	0.92	0.69	0.40
0.75	1.06	0.80	0.46
0.95	1.31	0.98	0.57

SSB	Year		
Percentile	2010	2011	2015
0.05	714	878	2829
0.25	926	1233	4038
0.5	1107	1552	4989
0.75	1329	1872	6068
0.95	1685	2383	7882

Removals	Year		
Percentile	2009	2010	2011
0.05	769	477	442
0.25	938	590	658
0.5	1109	677	799
0.75	1308	775	962
0.95	1689	946	1208

P(SSBYear > Blim)			
2010	2011	2013	2015
0.00	0.00	0.06	0.26

P(SSBYear > Bpa)			
2010	2011	2013	2015
0.00	0.00	0.00	0.00

25% reduction in F to F=0.4
Recruitment 2002 - 2008

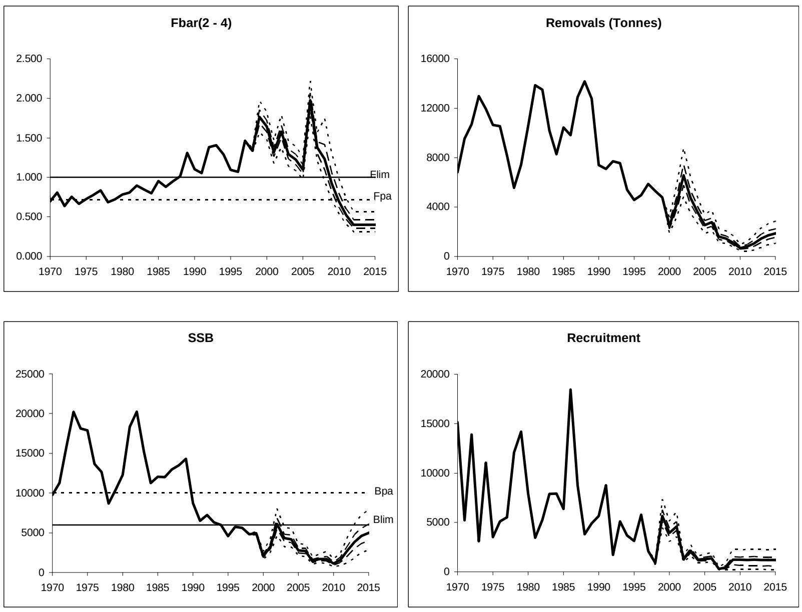


Figure 6.2.15. Cod in VIIa. Projection to 2015 based on the update B-Adapt assessment, assuming 25% annual F reduction in 2009 until the year when median F reaches a value of 0.4. Recruitment is bootstrapped from the 2002–2008 year classes. Percentiles of F, SSB and removals, and probability of SSB>B$_{lim}$, are tabulated for selected years.

6.3 Haddock in Division VIIa

Type of assessment

The Working Group performed an update assessment for this stock in 2009.

ICES advice applicable to 2008

The advice from ICES for 2008, under single-stock exploitation boundaries, was as follows:

Exploitation boundaries in relation to precautionary limits: The available information is inadequate to evaluate spawning stock or fishing mortality relative to precautionary reference points. SSB is increasing and recent recruitments appear to be above average. ICES recommends that fishing effort should not be allowed to increase.

ICES advice applicable to 2009

Exploitation boundaries in relation to precautionary limits: The available information is inadequate to evaluate spawning-stock or fishing mortality relative to precautionary reference points. SSB is increasing and recent recruitments appear to be above average. ICES recommends that fishing effort should not be allowed to increase.

Mixed fisheries advice for 2009 is given in Section 1.

6.3.1 General

Stock descriptions and management units

The stock and management units are both ICES Division VIIa (Irish Sea). Prior to the TAC regulation for 2009 the VIIa TAC was set as a precautionary allocation within the overall Division VII, VIII, IX and X.

Management applicable to 2008 and 2009

Management measures include TAC and effort restrictions as well as technical measures. As a consequence of the bycatch of cod in the haddock fishery, the effort regulations affecting Irish Sea haddock remain linked to those implemented under the cod recovery plan. TAC for 2009 was increased despite 25% decrease in the cod TAC.

ICES advice and agreed TACs since 2002 are summarized below:

YEAR	SINGLE SPECIES EXPLOITATION BOUNDARY[1]	BASIS	TAC	F MULTIPLIER ASSOCIATED WITH TAC[2]
2002	<1200	Reduce F below Fpa	1300[1]	0.38
2003	0	Linked to cod	585[1]	<0.1
2004	<1500	Reduce F below Fpa	<1500[1]	0.53
2005	<1370	Reduce F below Fpa	<1370[1]	0.50
2006	-	Substantial reduction in F	<1275[1]	no forecast
2007	-	Substantial reduction in F	<1179[1]	no forecast
2008	-	No increase in effort	<1238[1]	no forecast
2009	-	No increase in effort	1424	no forecast

1) VIIa allocation for VII, VIII, IX, X.

2) From short-term forecast.

Technical measures and effort regulations are described in the overview section. The minimum landing size for haddock in the Irish Sea is 30 cm.

Fishery in 2008

The characteristics of the fishery are described in the Stock Annex. An overview of the fisheries in the Irish Sea is given in Section 6.1.

The fishery in 2008 was prosecuted by the same fleets and gears as in recent years, with directed fishing prevented inside the cod closure in spring. The targeted whitefish fishery that developed during the 1990 using semi-pelagic trawls, continued to decline during 2008.

The reported uptake of TAC has been poor since 2004, with the exception of 2007. The estimated percentage uptake of UK, Irish and Belgium quotas in 2008 were 101% (estimated 595 t of 592 t quota), 59% (319 t of 536 t) and 74% (15 t of 20 t), respectively. The French fleet had <1% uptake of their quota. For these figures, quota swaps have, however, not been taken into account.

Table 6.3.1 gives nominal landings of haddock from the Irish Sea (Division VIIa) as reported by each country to ICES since 1984.

6.3.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1. The landings of the fleets sampled by quarter comprise 75% of the international total in 2008.

Landings

Table 6.3.2 gives the long-term trend of nominal landings of haddock from the Irish Sea (Division VIIa) as reported to ICES since 1972, together with Working Group estimates. The 1993–2005 WG estimates (excl. 2003) include sampled-based estimates of landings into a number of Irish Sea ports. Sampled-based evidence suggests that 2006 –2008 WG estimates are equal to reported landings.

The methods for estimating quantities and composition of haddock landings from VIIa, used in previous years, are described in the Stock Annex (Annex 6.3). The series of numbers-at-age in the international commercial landings is given in Table 6.3.3, and includes sampled-based estimates of unallocated landings in all years. Sampling levels were not considered adequate to derive catch age compositions in 2003. The time-series mean weight-at-age in the landings is given Table 6.3.4.

Discards

The series of the Irish and Northern Irish discard data, raised to the number of trips, were updated. Discard numbers-at-age for the different sampled fleets are given in Table 6.3.5. The proportions of discards-by-age for the different sampled fleets are given in Table 6.3.6. There are various issues relating to the reliability of the data, which needs to be addressed at the next benchmark assessment for this stock.

Methods for estimating quantities and composition of discards from UK (NI) and Irish *Nephrops* trawlers are described in the Stock Annex (Annex 6.3). Sampling levels have increased in recent years, but the highly variable and very large estimates of discarding for this fleet observed by previous WG are, however, still evident.

Biological data

The derivation of biological parameters and variables is described in the Stock Annex Natural mortality was assumed as 0.2 for all ages and years, and proportion mature knife-edged at-age 2 for all years.

There is evidence of a decline in mean length of adult haddock over time (Figure 6.3.1), which needs to be reflected in the stock weights-at-age. Since 2001 the WG calculated stock weights by fitting a von Bertalanffy growth curve with year-class effects on values of asymptotic length, using all available survey estimates of mean length-at-age in March as described in the Stock Annex 6.3. The procedure was up-dated this year using NIGFS-Mar and quarter one commercial landings data for 2008. The time-series of length weight parameters indicate a reduction in expected weight-at-length since 1996 (see Stock Annex for historical data):

	Length-weight parameters		Expected weight-at-length	
Year	a	B	30 cm	40 cm
2005	0.00489	3.174	238	593
2006	0.00506	3.165	239	595
2007	0.00469	3.194	244	612
2008	0.00523	3.159	242	601
2009	0.00431	3.224	249	629

The following parameter estimates were obtained (last year's estimates in parentheses):

Mean LI_{yc} = 80.5 cm (81.3); K = 0.191 (0. 193); t_0 = -0.419 (-0. 396)

Year-class effects giving estimates of asymptotic length relative to the mean LI_{yc} were as follows (2007 and 2008 data were combined as there is only one observation for the 2008 year class):

Year class	Effect	Year class	Effect
1990	1.225	1999	0.950
1991	1.164	2000	0.968
1992	1.095	2001	0.995
1993	1.109	2002	0.957
1994	1.123	2003	0.861
1995	1.095	2004	0.835
1996	1.008	2005	0.874
1997	0.984	2006	0.894
1998	0.996	2007/2008	0.867

The year-class effects demonstrate a smooth decline from the mid-1990s coincident with the rapid growth of the stock and may represent density-dependent growth effects, although other environmental factors may contribute. The close fit of the model to observed length-at-age data is shown by year class in Figure 6.3.1. The resultant stock weights-at-age are given in Table 6.3.7.

Surveys

The survey data considered in the assessment for this stock are given in Table 6.3.8. Survey-series for haddock available to the Working Group are described in the Stock Annex for 7a haddock. The following age-structured abundance indices were used in the assessment:

- UK (NI) groundfish survey (NIGFS) in March (age classes 1 to 5, years 1992–2009).

Additional age-structured abundance indices, that provided auxiliary information, are available from the following sources:

- UK (NI) groundfish survey (NIGFS) in October (age classes 0 to 3; years 1991 to 2008).
- UK (NI) Methot–Isaacs–Kidd (MIK) net survey in June (age 0; years 1994–2008).
- UK Fishery Science Partnership Irish Sea roundfish survey, 2004–2009 (www.cefas.co.uk/fsp)

The relative abundance indices are plotted against time in Figure 6.3.2. Surveys give similar signals for all ages (0–4). The two 0-group indices indicate reduced recruitment in 2007 and 2008. Strong year classes were evident for all age groups in all surveys, indicating that the different surveys were capturing the prominent year-class signals in this stock (Figure 6.3.3). Correlation between survey indices by age is positive for all surveys and demonstrate high consistency within each fleet, but patchy consistency between the fleets (Stock Annex 6.3). The indices from the UK Fishery Science Partnership survey in the western Irish Sea also display similar year-class signals to the other survey series. The international landings-at-age (excl. 2003) reveal similar patterns of year-class variation to the surveys (Figure 6.3.2), giving confidence in the combined ability of the surveys to track year classes through time.

The empirical trend in SSB from both the NIGFS series demonstrate the growth in SSB in the mid-1990s, a decline to 2000 and a subsequent variable trend (Figure 6.3.4). In recent years, both surveys demonstrate a marked increasing trend in SSB since 2005, but diverge considerably in 2008. The NIGFS-Oct survey has fewer age classes of adult fish (relatively small numbers of age 3 and older) compared with the NIGFS-Mar survey. Empirical SSB will thus respond fast to recruitment changes for the NIGFS-Oct survey-series.

Commercial cpue

Commercial cpue data are available for this stock but are not currently used in the assessment.

Other relevant data

An IBTS-coordinated UK trawl survey started in the Irish Sea in November/December 2004. Survey index data from this survey have not yet been provided to the Working Group.

6.3.3 Historical stock development

Deviation from stock annex

The assessment presented is the single fleet SURBA analysis, using only the NIGFS-Mar survey. The assessment does not deviate from the procedure used last year, as described in the Stock Annex.

SURBA 3.0 was used for the assessment and model settings (similar to last year's assessment) are given below:

	WGCSE 2009
Year range:	1992–2009
Age range:	1–5
Catchability:	1.0 at all ages
Age weighting	1.0 at all ages
Smoothing (Lambda):	1.0
Cohort weighting:	not applied
Reference age	2
Survey used	NIGFS-Mar

Data screening

Screening of internal and between survey consistency is described in Section 6.3.2.

Final update assessment

SURBA model residuals (log population indices) for the NIGFS-Mar survey demonstrate noisy residuals (Figure 6.3.5). Residuals display some evidence of year effects in older ages in some years and a negative trend in age 1 residuals in recent years. The age 2 residual pattern from the NIGFS-Mar survey continue to reveal better patterns than the other ages. The NIGFS-Mar survey model display quite large retrospective patterns in SSB (Figure 6.3.5) during the early 2000s, probably related to an overestimation of the 2001 year class. There are also large retrospective patterns in mortality estimates, highlighting the difficulty in estimating mortality for this stock.

The trends in Z, SSB and recruitment for the assessment using the NIGFS-Mar survey data, and the model residuals are given in Figures 6.3.6 and 6.3.7. The SURBA fitted numbers-at-age and total mortality-at-age given in Table 6.3.9. The SURBA index of Z generally follows the much noisier empirical estimates. Both the empirical and SURBA estimates of SSB give a similar increasing trend from 2005–2008, followed by in decrease in 2009. The recruitment estimates at-age 1 indicate a lower recruitment in 2007 and 2008 than in the previous 4 years. In general, the SURBA results capture similar year-class dynamics than observed from the raw survey indices (Figure 6.3.2).

Comparison with previous assessments

The perception of the stock has not changed since last year's assessment. Figure 6.3.8 compares the relative trends between the SURBA fitted estimates from this year's to last year's assessment. The two series demonstrate similar trends. The most recent SSB estimate indicates that the stock has decline since last year. Although the relative SSB estimate for 2009 is still above the series average, the SSB is expected to decrease further as a consequence of two successive years of below average recruitment.

State of the stock

Stock trends indicate an increase in SSB over the time-series. The stock is characterized by highly variable recruitment and after a prolonged period of above average recruitment, both the raw survey indices and the model indicate below average recruitment in 2007 and 2008. Total mortality remains stable.

6.3.4 Short-term projections

No short-term forecast has been performed in 2008 for this stock. This year the WG projected the SSB for 2010 using the 2009 survey information. Because maturity for the stock is considered as knife-edge at-age 2, all the age classes that will comprise the 2010 year class are already represented by the 2009 quarter one survey index. SSB for 2010 was projected using an average of the last three years total mortality from the SURBA model, a three year average of stock weights (2007–2009) and 10-year geometric mean recruitment.

The projected SSB trend is illustrated in Figure 6.3.9. SURBA fitted recruitment estimates are also compared with recruitment from the 0-gp indices (NIGF-Oct and MIK net), indicating that the model estimates might overestimate the strength of the 2007 and 2008 year classes, suggesting that the projected SSB might also be an overestimate.

6.3.5 Medium-term predictions

Medium-term predictions were not carried out for this stock.

6.3.6 Biological reference points

Precautionary approach reference points

There is currently no biological basis for defining appropriate reference points, in view of the rapid expansion of the stock size over a short period (ACFM, October 2002). ACFM (2007) proposed that F_{pa} be set at 0.5 by association with other haddock stocks, however, the Working Group no longer considers an F_{pa} value determined in association with other haddock stocks as appropriate. The absolute level of F in this stock at present is poorly known.

Yield and biomass-per-recruit

Yield-per-recruit (YPR) and SSB per recruit (SPR) for the Irish Sea stock were calculated by the 2004 WGNSDS, conditional on the exploitation pattern for landings in 2000–2002 given for ages 0 to 5+ by XSA, using MFYPR software. Long-term (1993–2003) catch weights and stock weights-at-age were used. Input data are given in Table 6.3.10, and the summary output is given in Table 6.3.11. The YPR and SPR curves are plotted in Figure 6.3.10.

6.3.7 Management plans

There is no specific management plan for haddock in the Irish Sea. As a consequence of the bycatch of cod in the haddock fishery, the regulations affecting Irish Sea haddock remain linked to those implemented under the cod management plan (Council Regulation (EC) 1342/2008).

6.3.8 Uncertainties and bias in assessment and forecast

This assessment is based on survey trends only as recent levels of catch are uncertain. After a period of poor sampling of landings for length and age, the 2007 and 2008 sampling levels and coverage were adequate to allow compilation of catch-at-age data. Discard sampling levels also increased significantly in the last two years. The highly variable and very large estimates of discarding for this fleet observed by previous WG are still evident. Historical landings data for this stock are uncertain, but sample-based estimates of landings suggest that the accuracy of officially reported landings has improved substantially in since 2006. The recent catch-at-age data are still considered too inaccurate, as a consequence of poor sampling information, to form the basis for a traditional analytical assessment based on catch-at-age data.

The narrow age range in the haddock stock and the resulting small numbers caught at older ages in the surveys restricted the number of age classes that could be used in the model. This and the differences in catchability-at-age between surveys make the total mortality difficult to estimate. The survey data used in the assessment are quite consistent both internally and between fleets, probably as a consequence of the very large data contrast between year-class strengths as well as the restricted distribution of the stock. The recruitment pattern for this stock since the early 1990s is relatively well established and can be tracked fairly consistently through both the surveys and commercial catches. Hence it can be established with some confidence how, qualitatively, the catch and stock is likely to be impacted in the short term by recent year classes. There is, however, some difference between the 0-gp and 1-gp indices for two most recent weaker year classes.

Knowledge of basic biology of Irish Sea haddock is expanding through data on growth, maturity and distribution obtained during trawl surveys. Patterns of movement within the Irish Sea and between the Irish Sea and surrounding areas are poorly understood, and it is assumed that the Irish Sea stock is essentially self-sustaining at present. Trends in length and weight-at-age in the stock over time are apparent and reduced growth appears to have coincided with the growth of the stock. This may represent density-dependent growth effects (although other environmental factors may contribute) that will affect any forecast and lead to overoptimistic forecast estimates unless correctly predicted.

The projected survey estimate of biomass should only be used for interpreting trends rather than a relative estimate. The problem is with using Z–M as a proxy for F in the SURBA-based assessment, when the survey Z is really only a measure of loss and not necessarily a measure of total mortality. Survey Z is also influenced by catchability at-age in the survey, which is assumed to be the same for all the age classes. The additional recruitment survey indices indicate that the recruitment estimates for the last two years might be lower than indicated by the current survey based assessment. The NIGFS-Oct survey has good internal consistency (see Stock Annex) and both 0-gp indices appear to indicate relative year-class strength well historically (Figures 6.3.2 and 6.3.3).

The perception of the stock from this year's assessment does not differ qualitatively from that obtained last year.

6.3.9 Recommendations for next benchmark assessment

The primary concern with this stock is that recent catch-at-age data are considered inaccurate to form the basis for a traditional analytical assessment based on catch-at-age data. This has been attributed to poor sampling information, which has improved in the last two years. The absence of reliable discard estimates is also serious deficiency that must be addressed if management is to be based on catch-at-age analysis. Levels of discard sampling have increased substantially in the last two years and reliable discards-at-age matrix could be formulated over the next few years.

The problems of generating reliable catch-at-age numbers for this stock are not likely to be solved in the short term. Furthermore, with the sharp decline in whitefish directed effort in the Irish Sea, sampling opportunities for haddock from landings are not likely to improve.

6.3.10 Management considerations

Following decades of very low recruitment and biomass as indicated by very low fishery catches, this stock grew substantially in the 1990s following sudden pulses of recruitment, and has gone from a minor bycatch species to one of the most economically valuable target species in the Irish Sea. Since the mid 1990s the haddock population in the Irish Sea is experiencing one of the largest and most sustained period of growth. The recruitment signals are clearly revealed by surveys, but the steep age profile in the catches and the resultant dependence of the fishery on highly variable recent year classes means that catch and SSB forecasts will be uncertain. The prevention of directed fishing for haddock during the cod closures in 2000–2007, other than during limited fishing experiments, should have curtailed the directed fisheries on mature haddock that occur in spring.

Haddock in the Irish Sea are taken as both a bycatch in *Nephrops* and cod fisheries, and in a directed fishery using midwater trawls and otter trawls. The latter fishery also takes a bycatch of cod, which has been a matter of some concern in drawing up the Irish Sea cod management plan. The distribution of the haddock stock is largely encompassed by the cod closure, and the closure has impacted directed haddock fishing at a time of year when fishers claim that haddock are most available. Since the cod closure was put in place in 2000 and the reduction in fishing opportunities for the whitefish fleet in particular, there has been a gradual shift in the timing of the haddock fishery from being predominantly during the first half of the year to a fishery that now mainly operates in the second half of the year. This is during a time when there is less overlap in the distribution of adult haddock and cod in the Irish Sea and a directed fishery for haddock is less likely to generate bycatches of cod in the same area.

The extent of discarding is also uncertain as a consequence of inadequate information. Significant discard sampling levels were, however, obtained through the "Irish Sea enhanced data collection programme" and increased observer coverage in the last two years as part of national Data Collection Regulation programmes. This will improve the quality of input data into the assessment and aid identification of sources of unallocated removals. Sampling schemes since the 1990s have, however, revealed that discard rates are very variable, but could be high for some fleets. Discard rates could be reduced by using more selective fishing gears in the small mesh fisheries and by increasing the TAC to avoid highgrading. The decline in growth rate might also result in discarding occurring at progressively older ages.

ACFM 2007 proposed that F_{pa} be set at 0.5 by association with other haddock stocks. The assessment since 2004 has been indicative of SSB and recruitment trends only. F/Z is poorly estimated and currently unknown. The SURBA Z-values are only a relative measure and do not mean anything unless the catchability-at-age in the survey(s) are quantified. The SURBA Z-values cannot be taken as an absolute, which makes effort based management very difficult, especially measured against a non stock specific reference point. The use of F reference points are not a sound basis for management for this stock until an assessment incorporating fishery age composition data and hence providing reliable historical estimates of F is available.

Under the EU policy for setting TACs, the Irish Sea haddock stock would be classified as a category 6 stock (i.e. state of stock not known precisely). The guidelines require first an evaluation of current levels of F in relation to F_{MSY}, if MSY proxy is available. Current F estimates are considered uncertain and unreliable. Applying the evaluation of stock change in a decreasing SSB scenario (SSB avg (last 2 years) exceeds SSB avg (preceeding 3 years) < 20%), gives a change of 16% using the SURBA estimates of SSB and would imply no change in TAC under the proposed rules.

The EU Cod Management Plan will impact the management measures for haddock in 2010 and the setting of a TAC for this stock.

Table 6.3.1. Nominal landings (t) of haddock in Division VIIa, 1984–2008, as officially reported to ICES. (Working Group figures are given in Table 6.3.2).

COUNTRY	1984	1985	1986	1987	1988	1989	1990	1991	1992
Belgium	3	4	5	10	12	4	4	1	8
France	38	31	39	50	47	n/a	n/a	n/a	73
Ireland	199	341	275	797	363	215	80	254	251
Netherlands	-	-	-	-	-	-	-	-	-
UK (England & Wales)1	29	28	22	41	74	252	177	204	244
UK (Isle of Man)	2	5	4	3	3	3	5	14	13
UK (N. Ireland)	38	215	358	230	196	…	…	…	…
UK (Scotland)	78	104	23	156	52	86	316	143	114
Total	387	728	726	1287	747	560	582	616	703

COUNTRY	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	18	22	32	34	55	104	53	22
France	41	22	58	105	74	86	n/a	49
Ireland	252	246	320	798	1005	1699	759	1238
Netherlands	-	-	-	1	14	10	5	2
UK (England & Wales)1	260	301	294	463	717	1023	1479	1061
UK (Isle of Man)	19	24	27	38	9	13	7	19
UK (N. Ireland)	…	…	…	…	…	…	…	…
UK (Scotland)	140	66	110	14	51	80	67	56
Total	730	681	841	1453	1925	3015	2370	2447

COUNTRY	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	68	44	20	15	22	23	30	15*
France	184	72	146	20	36	20	11	0.4*
Ireland	652	401	229	296	139	184	477	317*
Netherlands	-	-	-	-	-		-	-
UK (England & Wales)1	1238	551	248	421	344	419	559	
UK (Isle of Man)	1	-	-	-	-	-	-	
UK (N. Ireland)	…	…	…	…	…	…	…	…
UK (Scotland)	86	47	31	9	6	9	1	
UK								538*
Total	2229	1115	674	761	547	655	1078	870*

***Preliminary.**

11989–2008 Northern Ireland included with England and Wales.

n/a = not available.

Table 6.3.2. Haddock in VIIa. Total international landings of haddock from the Irish Sea, 1972–2008, as officially reported to ICES. Working Group figures, assuming 1972–1992 official landings to be correct, are also given. The 1993–2005 WG estimates include sampled-based estimates of landings at a number of Irish Sea ports. Landings in tonnes live weight.

Year	Official landings	WG landings
1972	2204	2204
1973	2169	2169
1974	683	683
1975	276	276
1976	345	345
1977	188	188
1978	131	131
1979	146	146
1980	418	418
1981	445	445
1982	303	303
1983	299	299
1984	387	387
1985	728	728
1986	726	726
1987	1287	1287
1988	747	747
1989	560	560
1990	582	582
1991	616	616
1992	703	656
1993	730	813
1994	681	1043
1995	841	1753
1996	1453	3023
1997	1925	3391
1998	3015	4902
1999	2370	4129
2000	2447	1380
2001	2229	2498
2002	1115	1972
2003	674	n/a
2004	761	1278
2005	547	699
2006	655	647
2007	1078	1066
2008	n/a	929

Table 6.3.3. Haddock in VIIa: catch numbers-at-age (include partial estimates of misreporting up to 2005).

	Table 1	Catch numbers-at-age				Numbers*10**-3										
YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE																
0	0	0	0	0	0	0	0	0	0	0	n/a	0	0	0	0	0
1	94	30	1341	109	1285	100	91	459	597	120	n/a	54	38	7	13	131
2	1250	123	1322	4619	700	6427	519	915	2263	632	n/a	203	523	340	918	426
3	18	861	107	735	2411	292	4462	238	1116	1853	n/a	751	133	631	695	831
4	1	3	222	16	203	539	49	374	80	196	n/a	76	219	74	141	253
+gp	1	2	5	30	16	35	72	28	127	28	n/a	97	43	78	52	69
0 TOTALNUM	1364	1019	2997	5509	4615	7393	5193	2014	4183	2829	n/a	1181	956	1130	1819	1710
TONSLAND	813	1043	1753	3023	3391	4902	4129	1380	2498	1971	n/a	1278	699	647	1066	929
SOPCOF %	100	100	100	100	95	100	100	97	100	100	n/a	100	99	100	100	100

Table 6.3.4. Haddock in VIIa: catch weights-at-age.

	Catch weights-at-age (kg)															
YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE																
0	0	0	0	0	0	0	0	0	0	0	n/a	0	0	0	0	0
1	0.351	0.346	0.361	0.346	0.348	0.190	0.325	0.329	0.300	0.279	n/a	0.401	0.273	0.244	0.240	0.308
2	0.596	0.560	0.545	0.474	0.592	0.530	0.416	0.474	0.452	0.357	n/a	0.519	0.417	0.354	0.440	0.385
3	1.688	1.103	0.898	0.917	1.002	1.130	0.802	0.786	0.859	0.749	n/a	1.007	0.697	0.505	0.638	0.539
4	2.520	2.730	1.983	2.034	1.349	2.000	2.064	1.573	1.243	1.361	n/a	1.940	1.256	0.872	0.786	0.746
+gp	2.520	2.522	2.178	2.682	1.955	2.550	2.854	2.365	1.869	2.107	n/a	2.544	2.268	1.841	1.987	1.264
0 SOPCOFAC	0.9995	1.0008	1.0007	1.0029	0.9465	0.9958	0.9996	0.9675	1.0002	0.9991						

Table 6.3.5. Haddock in VIIa: Estimates of Irish Sea haddock discards 1995–2008. Data are numbers ('000 fish) discarded by the fleet, estimated from numbers per sampled trip raised to total fishing effort by each fleet, for the range of quarters indicated. Tables (b) and (d) represent estimates from limited observer sampling of N. Ireland vessels also included within the self-sampling estimates for N. Ireland trawlers catching *Nephrops* (Table (a)). Table (f) is the total for sampled fleets and quarters, excluding missing quarters or fleets. Table (e) is the revised figures supplied to the 2005 WG.

a) Self sampling scheme: N.Ireland single trawl Nephrops vessels. Estimates are extrapolated to all N.Ireland vessels catching *Nephrops* (single and twin trawl) (approx 40 trips sampled per year).

	1996 Q1-4	1997 Q1-4	1998 Q1-4	1999 Q1-4	2000 Q1-4	2001 Q1-4	2002 Q1-4	2003 Q1	2004	2005	2006	2007	2008
Age	43 trips	39 trips	48 trips	39 trips	44 trips	43 trips	35 trips	8 trips					
0	4485	100	1552	1274	110	1083	851	0	n/a	n/a	n/a	n/a	n/a
1	229	1209	318	342	2384	140	1073	62	n/a	n/a	n/a	n/a	n/a
2	179	88	210	69	253	199	37	28	n/a	n/a	n/a	n/a	n/a
3	0	0	0	0	0	0	11	0	n/a	n/a	n/a	n/a	n/a

(b) Observer scheme: N.Ireland vessels catching *Nephrops* (single trawl only) (*not raised to fleet level – no. of fish)

				1999 Q3-4	2000 Q1-3	2001 Q1					2006 Q3-4*	2007 Q1-4	2008 Q1-4
Age				4 trips	6 trips	1 trip					9 trips	29 trips	55 trips
0				2185	210	0					8391	901	625
1				22	280	1677					809	1553	295
2				0	57	1593					60	681	124
3				0	0	0					15	74	17

(c) Observer scheme: N.Ireland midwater trawl

		1997 Q2-4	1998 Q1-3	1999 Q3-4	2000 Q1	2001 Q1							2008 Q4
Age		n/a	n/a	5 trips	4 trips	2 trips							1 trip
0		0	0	68	0	0							0
1		178	316	96	20	0.4							7
2		19	1342	35	83	19							15
3		4	0	2	5	0							2

(d) Observer scheme: N.Ireland twin trawl (*not raised to fleet level – no. of fish)

		1997 Q2-4	1998 Q1-3	1999 Q4	2000 Q1-4	2001 Q1					2006 Q3-4*	2007 Q1-4	2008 Q1-4
Age		n/a	n/a	1 trips	10 trips	2 trips					2 trip	14 trips	16 trips
0		34	4	26	10	0					363	369	0
1		284	205	3	13	3					59	275	756
2		6	382	0	10	19					9	77	172
3		0.5	0	0	0	0					0	9	8

(e) Observer scheme: Republic of Ireland otter trawlers

	1996 Q1-4	1997 Q1-4	1998 Q1-4	1999 Q1-4	2000 Q1-4	2001 Q1-4	2002 Q1-4	2003 Q1-4	2004 Q1-4	2005 Q1-4	2006 Q1-4	2007 Q1-4	2008 Q1-4
Age	8 trips	8 trips	7 trips	4 trips	10 trips	2 trips	1 trip	9 trips	11 trips	8 trips	5 trips	16 trips	18 trips
0	3808	165	565	87	182	5349	47	1169	5663	776	3966	1122	322
1	713	11396	1973	58	2193	7354	31	1747	6566	2350	10140	8735	1226
2	297	303	3564	59	580	140	0	1178	2301	996	3856	3995	783
3	0	0	0	0	0	15	0	10	225	120	132	435	44
4	0	0	0	0	0	0	0	0	0	0	0	1	2

(f) Total for sampled fleets and quarters: NI self sampling scheme (a); NI midwater trawl (c); ROI otter trawl (e)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Age	51 trips	n/a	n/a	48 trips	58 trips	47 trips	36 trips	17 trips	n/a	n/a	n/a	n/a	n/a
0	8293	265	2117	1429	292	47	36	17	n/a	n/a	n/a	n/a	n/a
1	942	12783	2607	496	4597	6432	898	1169	n/a	n/a	n/a	n/a	n/a
2	476	410	5116	163	916	7494	1104	1809	n/a	n/a	n/a	n/a	n/a
3	0	4	0	2	5	358	37	1206	n/a	n/a	n/a	n/a	n/a
4	0	0	0	0	0	15	11	10	n/a	n/a	n/a	n/a	n/a

revised

Table 6.3.6. Haddock in VIIa: Proportion by number-at-age discarded by sampled fleets.

		Proportion discarded			
Fleet	Period	age 0	age 1	age 2	age 3
Midwater trawl	Q2-Q4 1997		0.93	0.37	0.02
Midwater trawl	Q1-Q3 1998		0.99	0.16	0.00
Midwater trawl	Q3-Q4 1999	1.00	0.79	0.31	0.00
Midwater trawl	Q1 2000		1.00	0.44	0.04
Midwater trawl	Q1 2001		1.00	0.30	
Midwater trawl	Q4 2008	1.00	0.97	0.90	0.30
Single Nephrops	Q3-Q4 1999	1.00	0.94		
Single Nephrops	Q1-Q3 2000	1.00	0.97	0.45	
Single Nephrops	Q1 2001		1.00	0.49	
Single Nephrops	Q3-Q4 2006	1.00	1.00	0.96	0.50
Single Nephrops	Q1-Q4 2007	1.00	1.00	0.94	0.79
Single Nephrops	Q1-Q4 2008	1.00	0.99	0.78	0.18
Twin trawl	Q2-Q4 1997	1.00	1.00	0.61	0.04
Twin trawl	Q1-Q3 1998	1.00	1.00	0.76	0.00
Twin trawl	Q4 1999	1.00	1.00		
Twin trawl	Q1 – Q4 2000	1.00	0.96	0.28	
Twin trawl	Q1 2001		1.00	0.12	
Twin trawl	Q3-Q4 2006	1.00	1.00	0.81	0.00
Twin trawl	Q1-Q4 2007	1.00	1.00	0.91	0.63
Twin trawl	Q1-Q4 2008	1.00	0.99	0.71	0.06
OTB	Q1-Q4 2007	1.00	1.00	0.93	0.65
OTB	Q1-Q4 2008	1.00	0.97	0.90	0.17

Table 6.3.7. Haddock in VIIa: stock weights-at-age

	Table 3 Stock weights-at-age (kg)																
YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE																	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0.095	0.083	0.085	0.083	0.070	0.060	0.057	0.048	0.052	0.056	0.050	0.035	0.032	0.038	0.040	0.037	0.038
2	0.427	0.343	0.352	0.366	0.361	0.257	0.229	0.232	0.204	0.218	0.233	0.201	0.145	0.132	0.154	0.166	0.154
3	1.074	0.982	0.793	0.796	0.874	0.749	0.568	0.514	0.552	0.477	0.489	0.515	0.462	0.331	0.304	0.351	0.391
4	1.796	2.045	1.717	1.320	1.436	1.388	1.291	0.967	0.929	0.979	0.799	0.815	0.904	0.801	0.584	0.524	0.635
+gp	2.590	3.063	3.149	2.520	2.173	2.031	2.148	1.973	1.631	1.493	1.428	1.202	1.267	1.373	1.285	0.941	0.866

Table 6.3.8. Haddock in VIIa: Available tuning data (file name: h7ani.tun). Ages used in assessment are in bold type.

```
IRISH   SEA   haddock,2009   WG,ANON,COMBSEX,TUNING   DATA(effort,   nos   at-age)107
NIGFS March [Northern Ireland March Groundfish Survey – Effort: numbers caught/3
nm]1992 20091 1 0.21 0.251 5       1   1525    23     0     0     0   0
       1    139   569    31     0     0   0
       1    644    58   183     0     0   0
       1  24823   437     0    43     0   0
       1   1065  3743    67     3     1   0
       1  25118   474  1457    44     0   2
       1   3913  8694    70   105     1   0
       1   6058   680  2072    16    11   0
       1  14028  1853    64   147     2   3
       1   3277  6990   770    40    20   0
       1  28755   842  1059    78     1   0
       1   6966 14162   341   356    26   0
       1  19945  2379  2206    45    35   0
       1  24488  6454   406   234    13   2
       1  13444 12721  2194    91    33   0
       1  20918 11325  3661   240    16  11
       1   7480 12009  2559   495    48   0
       1   9345  3888  2877   163    37   5
Fleets below not included in assessment:
NIGFS Oct [Northern Ireland October Groundfish Survey – Effort: numbers caught/3 nm]
1991 2008
1 1 0.83  0.88
0 3
        1   15780      70      0      0     0     0
        1     124     784    151      0     0     0
        1    4462     101    375      3     0     0
        1   56683    1137     12     79     0     0
        1    1661   10153     74      0     5     0
        1  143300    1167   1480     13     0     0
        1   16400   39680    174     98     1     0
        1   41820    1243   3778     22     3     4
        1   80674    2835     71    145     0     1
        1    6545    8598    763     31    39     0
        1   75017    2003   2742    311     0    20
        1   15116   10501     86    365     0     0
        1   53922    7125   3008     59    79     0
        1   70337   14413   1261    649     0     0
        1   47030   12962   1743     59     8     0
        1   35748   10788   3607    392    52     0
        1    9654    9804   4050   1057    41     0
        1    9037    4880   2242    277    24     0
MIK net May/June [Northern Ireland Methot-Isaacs–Kidd net survey in May/June – Ef-
fort: numbers/km^2]
1994 2008
1 1 0.38 0.47
0 0
        1     47000
        1      1700
        1     47800
        1     14500
        1      2500
        1     15400
        1      1700
        1     17100
        1      1200
        1      4250
        1     25970
        1      8250
        1     40240
        1      3820
        1      6638
```

Table 6.3.9. Haddock in VIIa: SURBA 3.0 fitted numbers-at-age, total mortality-at-age, SSB and Z using the NIGFS-Mar survey data.

Numbers-at-age						Total mortality-at-age				
	Age					Age				
Year	1	2	3	4	5	1	2	3	4	5
1992	0.354	0.013	0	0	0	0.636	0.660	1.106	1.375	1.375
1993	0.055	0.188	0.007	0	0	0.818	0.848	1.421	1.766	1.766
1994	0.390	0.024	0.080	0.002	0	0.977	1.014	1.698	2.110	2.110
1995	5.592	0.147	0.009	0.015	0	1.284	1.332	2.232	2.774	2.774
1996	0.444	1.549	0.039	0.001	0.001	0.879	0.912	1.528	1.898	1.898
1997	8.914	0.184	0.622	0.008	0	1.212	1.257	2.107	2.618	2.618
1998	0.713	2.653	0.052	0.076	0.001	1.194	1.238	2.075	2.578	2.578
1999	2.817	0.216	0.769	0.007	0.006	1.153	1.197	2.005	2.491	2.491
2000	5.446	0.889	0.065	0.104	0.001	1.060	1.100	1.843	2.291	2.291
2001	1.192	1.886	0.296	0.010	0.011	1.186	1.231	2.062	2.563	2.563
2002	6.713	0.364	0.551	0.038	0.001	0.780	0.809	1.355	1.684	1.684
2003	2.077	3.079	0.162	0.142	0.007	0.963	1.000	1.675	2.081	2.081
2004	6.743	0.793	1.133	0.030	0.018	1.073	1.114	1.866	2.319	2.319
2005	10.253	2.305	0.260	0.175	0.003	1.055	1.095	1.834	2.279	2.279
2006	6.246	3.569	0.771	0.042	0.018	0.906	0.940	1.575	1.958	1.958
2007	9.846	2.524	1.394	0.160	0.006	0.947	0.983	1.646	2.046	2.046
2008	3.647	3.819	0.945	0.269	0.021	1.233	1.279	2.143	2.663	2.663
2009	3.314	1.063	1.063	0.111	0.019	1.029	1.067	1.788	2.222	2.222
Stock summary										
Year	Recruits (age 0)	log SE (rec)	SSB	TSB	Z(2-3)	SE (Z)				
1992	0.354	0.363	0.006	0.04	0.883	0.39				
1993	0.055	0.297	0.087	0.093	1.135	0.279				
1994	0.390	0.269	0.091	0.123	1.356	0.217				
1995	5.592	0.290	0.085	0.56	1.782	0.188				
1996	0.444	0.249	0.601	0.638	1.220	0.213				
1997	8.914	0.266	0.623	1.247	1.682	0.181				
1998	0.713	0.264	0.827	0.87	1.657	0.177				
1999	2.817	0.262	0.507	0.668	1.601	0.175				
2000	5.446	0.255	0.341	0.603	1.472	0.179				
2001	1.192	0.272	0.575	0.637	1.647	0.177				
2002	6.713	0.240	0.38	0.756	1.082	0.183				
2003	2.077	0.251	0.92	1.024	1.337	0.183				
2004	6.743	0.257	0.789	1.025	1.490	0.179				
2005	10.253	0.258	0.617	0.945	1.465	0.177				
2006	6.246	0.256	0.784	1.022	1.258	0.181				
2007	9.846	0.275	0.913	1.307	1.315	0.184				
2008	3.647	0.329	1.126	1.261	1.711	0.185				
2009	3.314	0.404	0.666	0.792	1.428	0.121				

Table 6.3.10. Haddock in VIIa: Input for yield/Recruit.

MFYPR version 2a
Run: Had7a_2004WG_yield
Had7a_2004WG_yieldMFYPR Index file 11/05/2004
Time and date: 10:55 13/05/2004
Fbar age range: 2-4

Age	M	Mat	PF	PM	SWt	Sel	CWt
0	0.2	0	0	0	0.000	0.000	0.000
1	0.2	0	0	0	0.061	0.140	0.322
2	0.2	1	0	0	0.302	0.544	0.492
3	0.2	1	0	0	0.754	1.118	0.967
4	0.2	1	0	0	1.377	1.057	1.814
5	0.2	1	0	0	2.259	1.057	2.308

Weights in kilograms

Table 6.3.11. Haddock in VIIa: Yield-per-recruit output table.

MFYPR version 2a
Run: Had7a_2004WG_yield
Time and date: 10:55 13/05/2004
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	5.5167	5.8695	3.6979	5.8200	3.6979	5.8200
0.1000	0.0906	0.2211	0.3492	4.4167	3.5229	2.5980	3.4733	2.5980	3.4733
0.2000	0.1813	0.3298	0.4658	3.8781	2.4296	2.0593	2.3801	2.0593	2.3801
0.3000	0.2719	0.3951	0.5037	3.5564	1.8139	1.7377	1.7644	1.7377	1.7644
0.4000	0.3626	0.4390	0.5098	3.3412	1.4279	1.5225	1.3783	1.5225	1.3783
0.5000	0.4532	0.4709	0.5022	3.1861	1.1681	1.3674	1.1186	1.3674	1.1186
0.6000	0.5439	0.4952	0.4888	3.0683	0.9843	1.2496	0.9347	1.2496	0.9347
0.7000	0.6345	0.5146	0.4735	2.9752	0.8490	1.1564	0.7995	1.1564	0.7995
0.8000	0.7252	0.5305	0.4580	2.8993	0.7464	1.0805	0.6969	1.0805	0.6969
0.9000	0.8158	0.5438	0.4431	2.8358	0.6666	1.0171	0.6170	1.0171	0.6170
1.0000	0.9065	0.5552	0.4293	2.7818	0.6030	0.9631	0.5535	0.9631	0.5535
1.1000	0.9971	0.5651	0.4167	2.7350	0.5515	0.9163	0.5019	0.9163	0.5019
1.2000	1.0878	0.5739	0.4052	2.6939	0.5090	0.8751	0.4594	0.8751	0.4594
1.3000	1.1784	0.5817	0.3947	2.6573	0.4733	0.8386	0.4238	0.8386	0.4238
1.4000	1.2691	0.5887	0.3853	2.6245	0.4431	0.8057	0.3936	0.8057	0.3936
1.5000	1.3597	0.5951	0.3768	2.5947	0.4172	0.7760	0.3676	0.7760	0.3676
1.6000	1.4503	0.6009	0.3692	2.5676	0.3946	0.7489	0.3451	0.7489	0.3451
1.7000	1.5410	0.6063	0.3622	2.5427	0.3749	0.7240	0.3253	0.7240	0.3253
1.8000	1.6316	0.6113	0.3559	2.5197	0.3574	0.7010	0.3079	0.7010	0.3079
1.9000	1.7223	0.6159	0.3501	2.4983	0.3418	0.6796	0.2923	0.6796	0.2923
2.0000	1.8129	0.6202	0.3449	2.4784	0.3278	0.6597	0.2783	0.6597	0.2783

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.9065
FMax	0.3811	0.3455
F0.1	0.2074	0.188
F35%SPR	0.2494	0.2261

Weights in kilograms

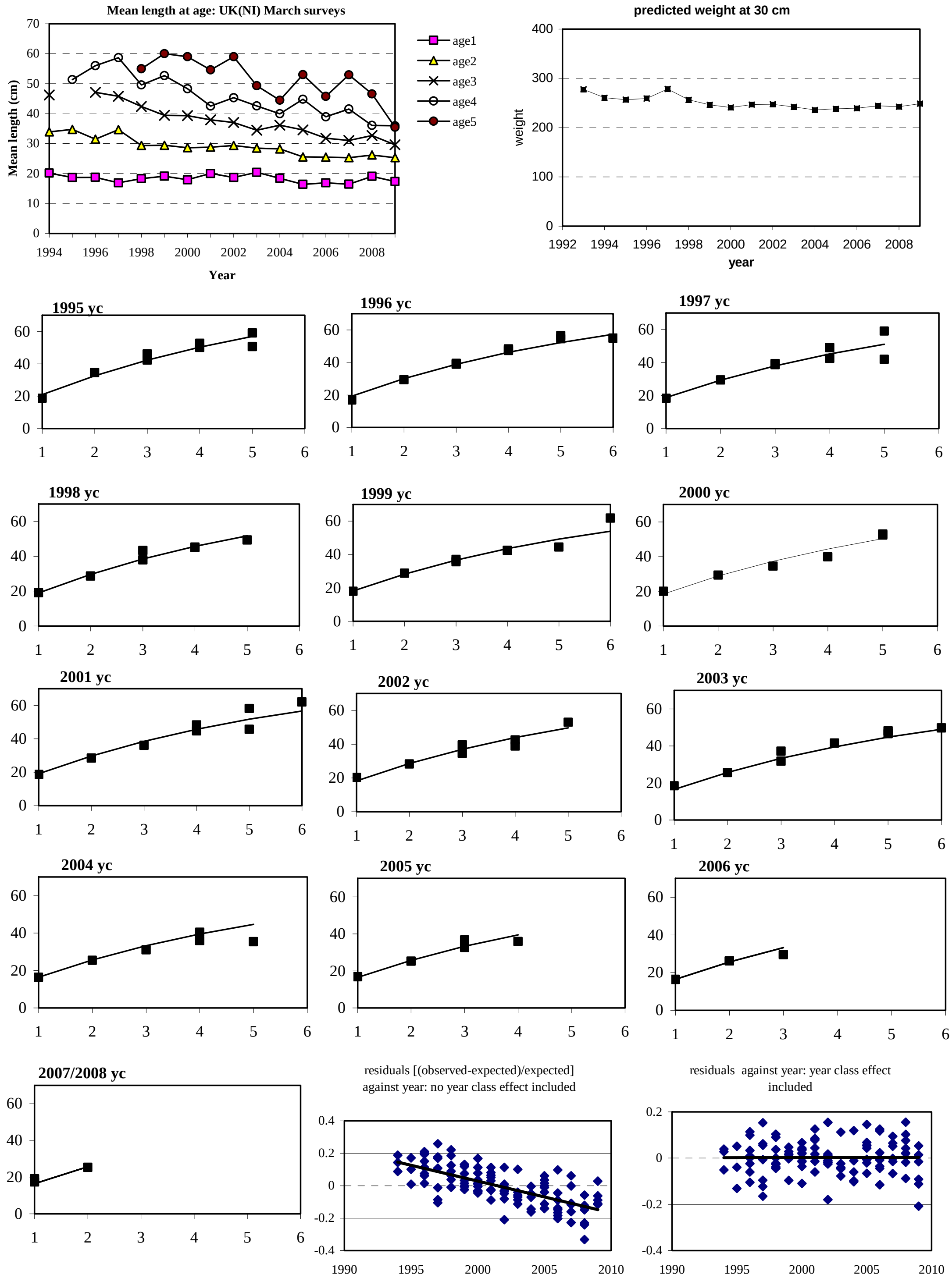


Figure 6.3.1. Haddock in VIIa: Growth of haddock in the Irish Sea. Top two panels: mean length-at-age in UK (N. Ireland) groundfish surveys in March, by year and age, and expected mean weight-at-length based on length-weight parameters from each survey. Lower panels: mean length-at-age from March surveys, and from Quarter 1 commercial landings at-age 3 and over, by year class. Lines are von Bertalanffy model fits with year-class effect included. Model residuals are shown for the fit without year-class effects, and for the fit with year-class effects.

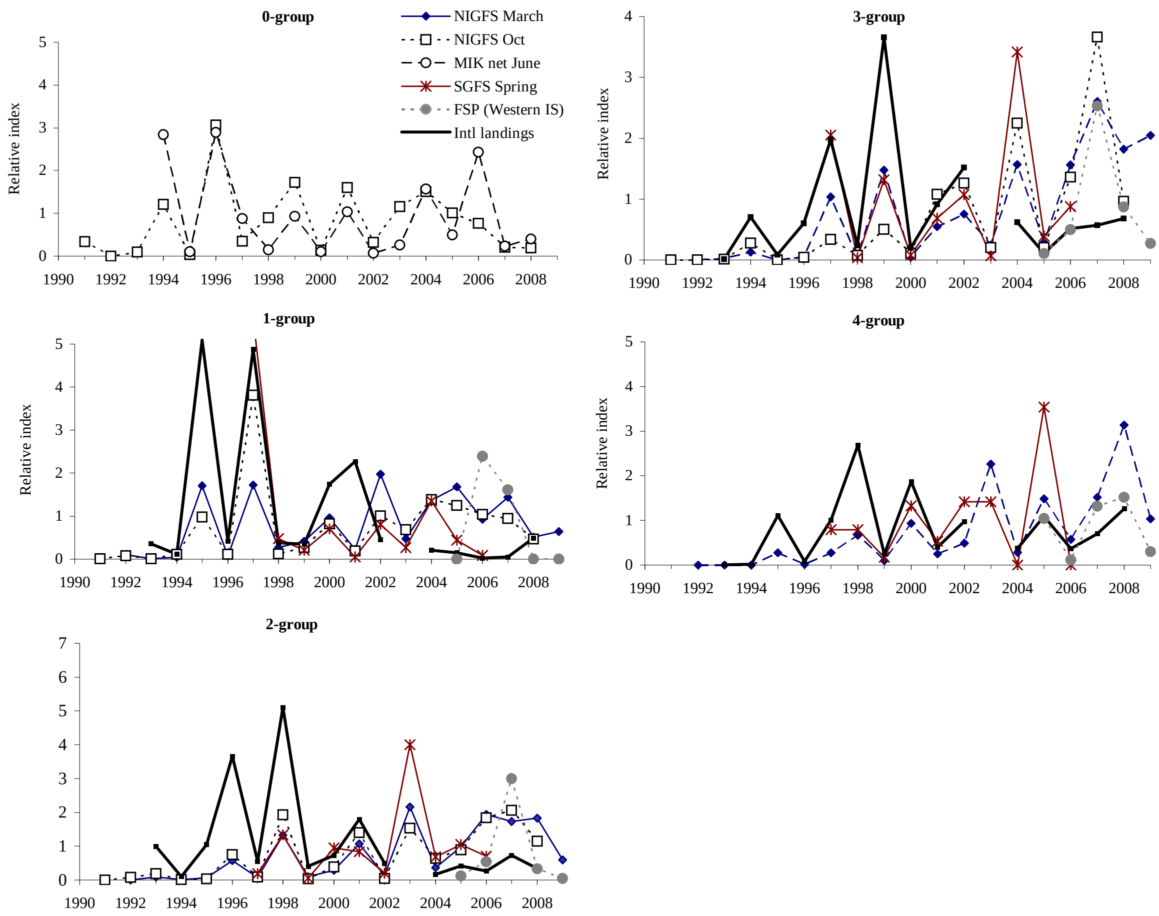


Figure 6.3.2. Haddock in VIIa: Trends in raw survey indices compared with international landings, by age class and year. All values are standardized to the mean for years common to all series in each plot (except for short FSP series).

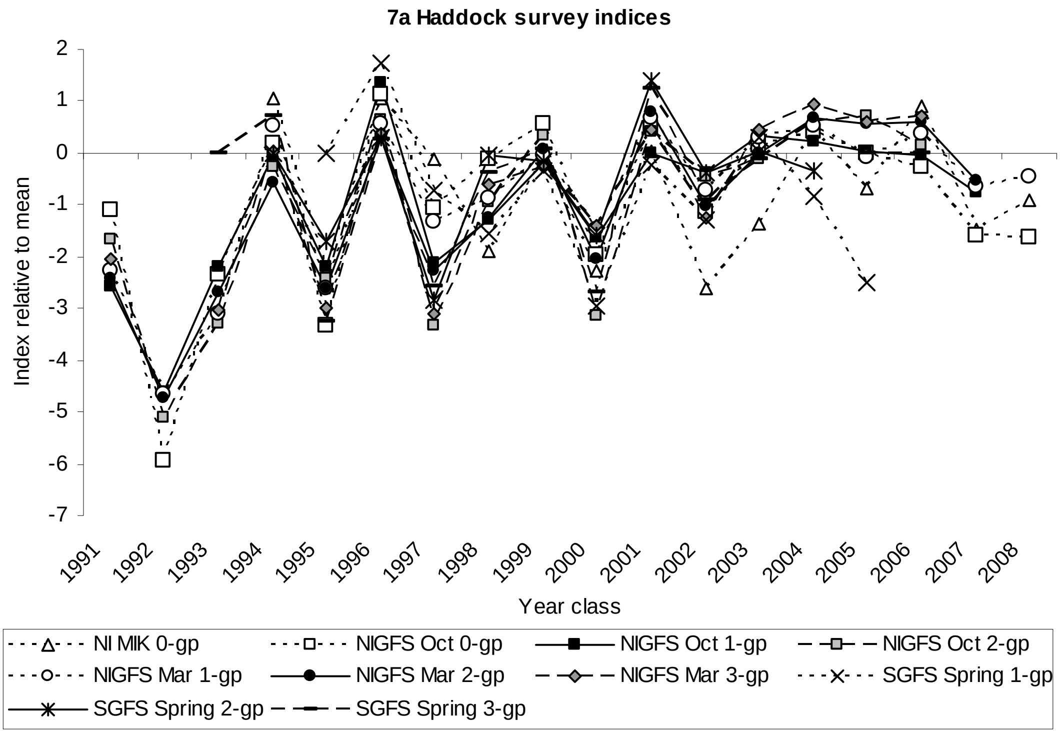


Figure 6.3.3. Haddock in VIIa: Time-series plots of the logarithms of survey indices at-age by year class, after standardizing by dividing by the series mean for years from 1991. Data have only been illustrated for the most abundant ages for comparison of year-class signals.

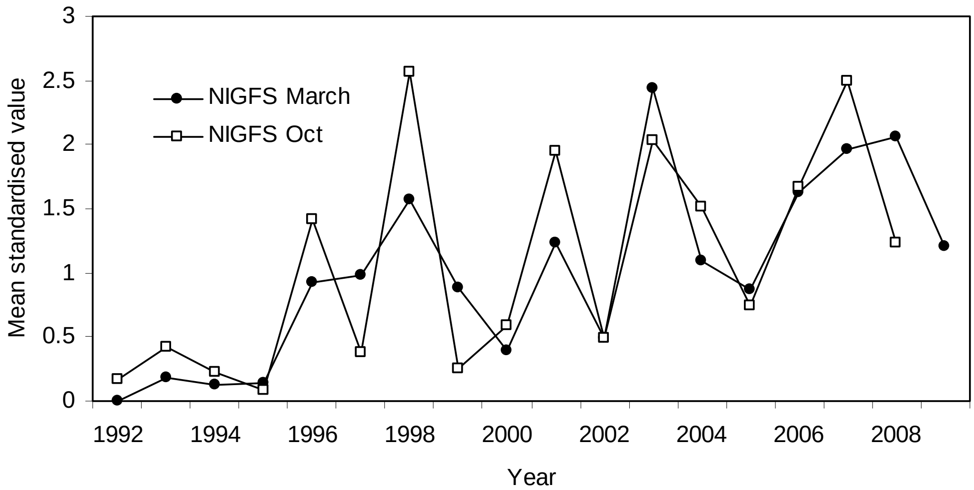


Figure 6.3.4. Haddock in VIIa: Mean Standardised empirical SSB indices from the NIGFS-Mar and NIGFS-Oct surveys, based on raw indices up to age 6.

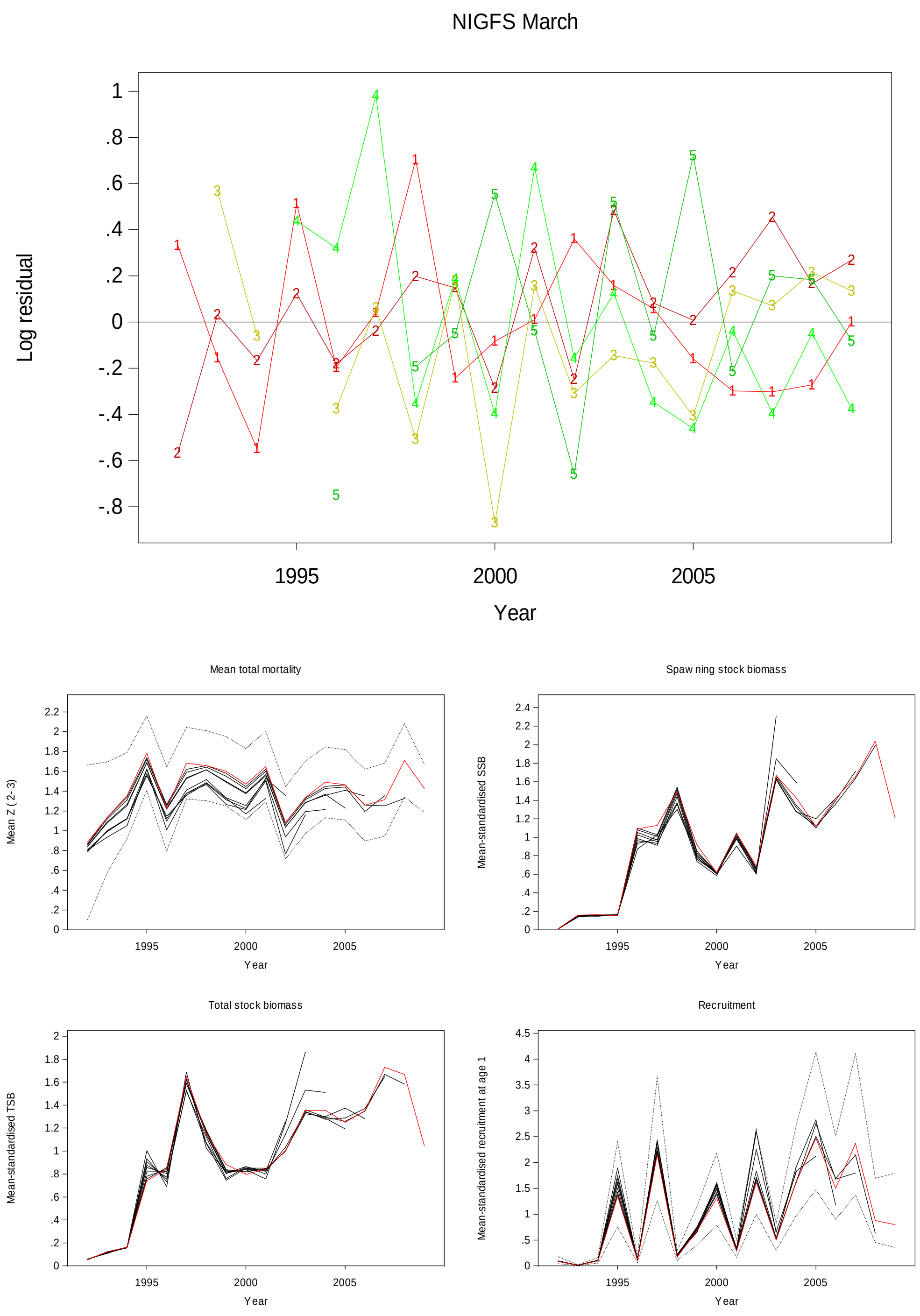


Figure 6.3.5. Haddock VIIa: SURBA 3.0 Residuals-at-age (top panel) and retrospective plots (bottom panel) for the NIGFS-Mar survey.

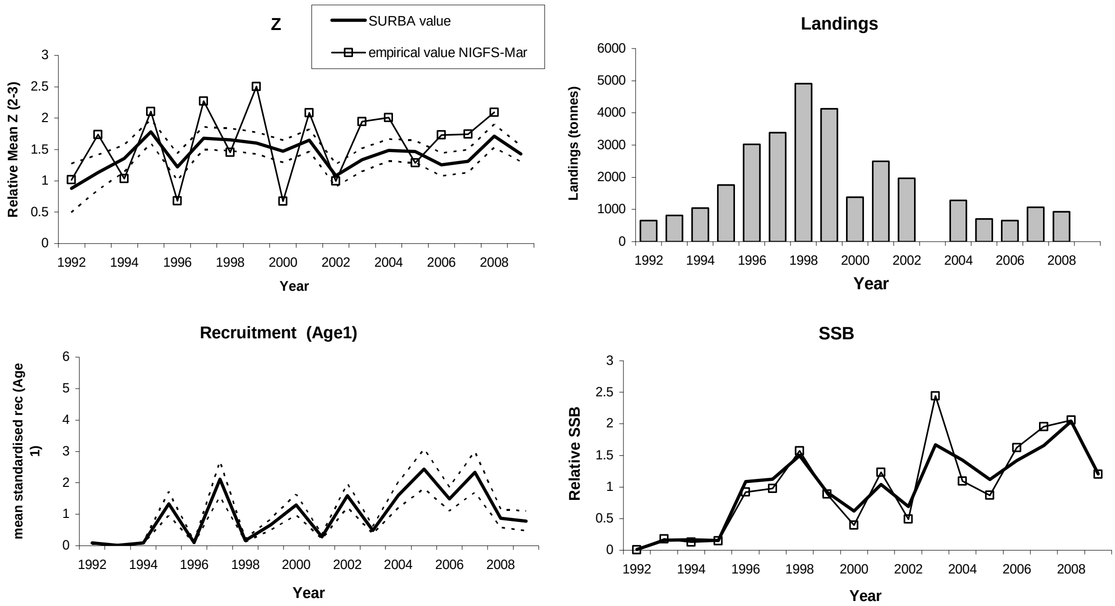


Figure 6.3.6. Haddock VIIa: Summary plots of landings and results of final SURBA 3.0 run using the NIGFS-Mar survey data. Dotted lines are +/-1SE. Empirical estimates of SSB and Z given by SURBA from the raw survey data are also shown.

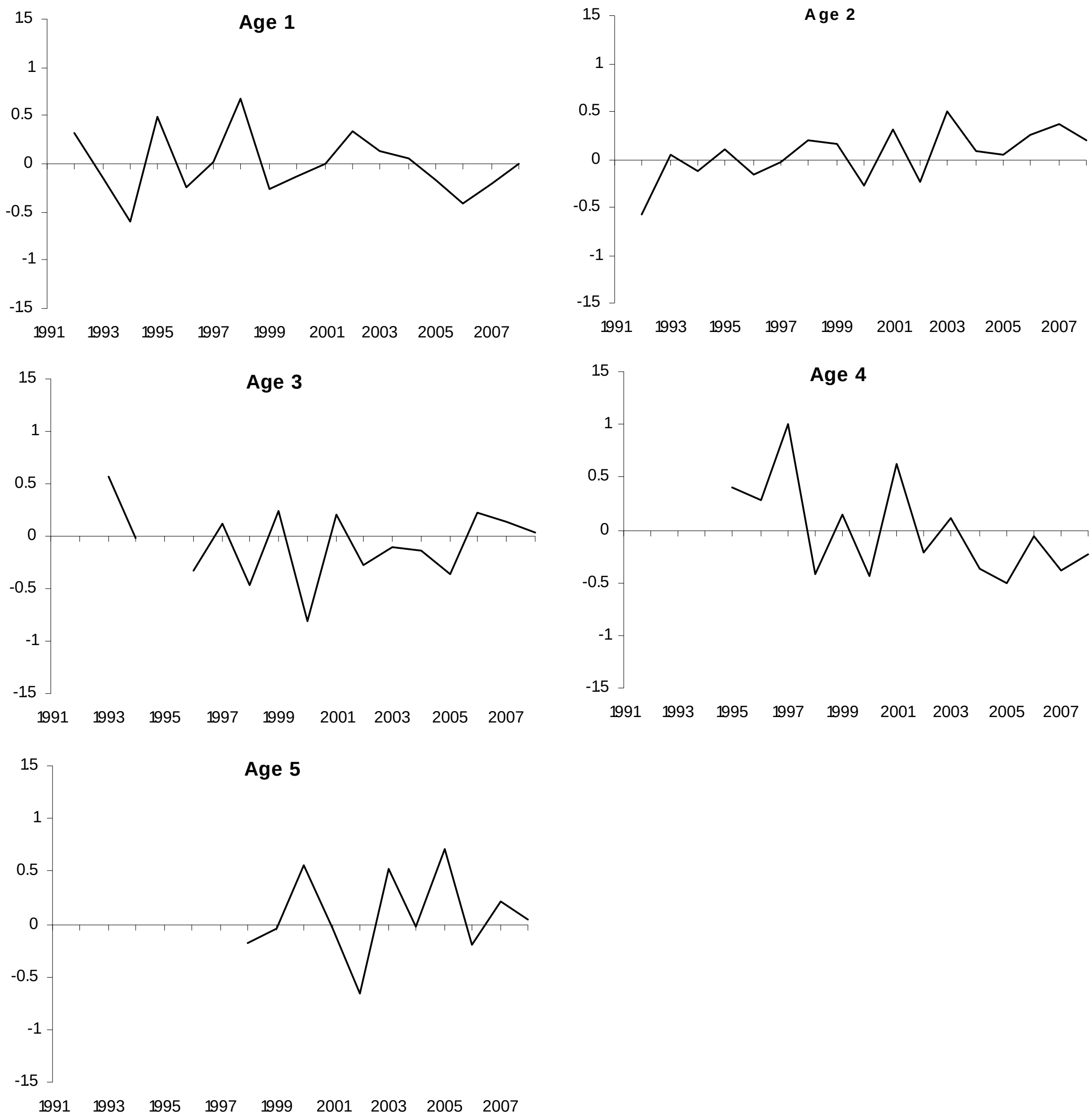


Figure 6.3.7. Haddock VIIa: SURBA 3.0 Residuals-at-age for final run using the NIGFS-Mar survey data.

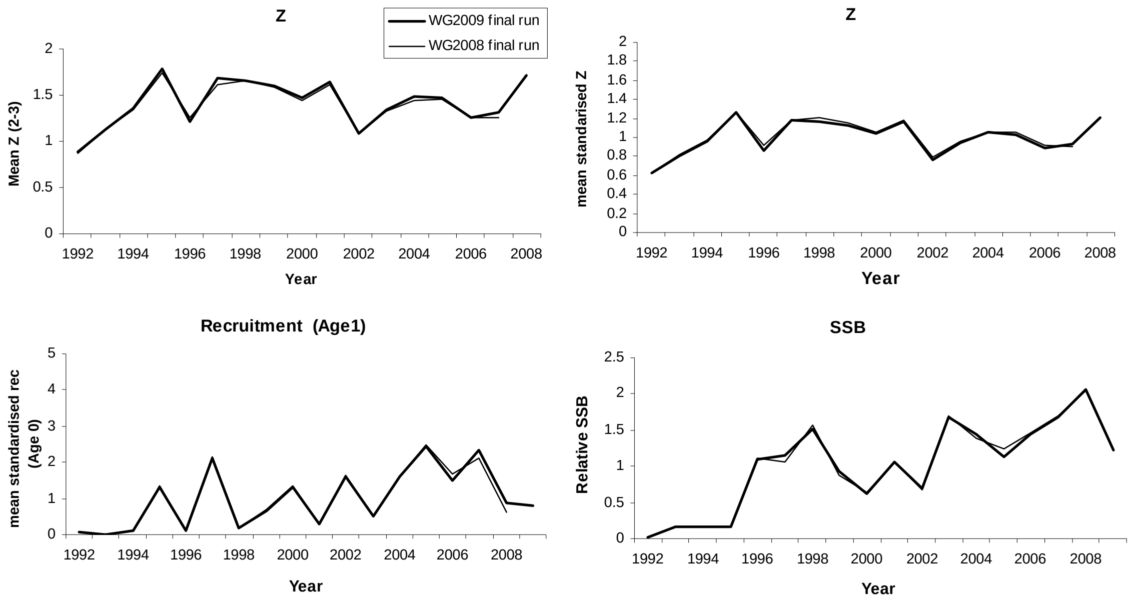


Figure 6.3.8. Haddock VIIa: Trends in SSB, recruitment and Z(2–3) from the 2008 and 2009 SURBA. SSB and recruitment are standardized to the mean for years common to all series (1992–2008) in each plot.

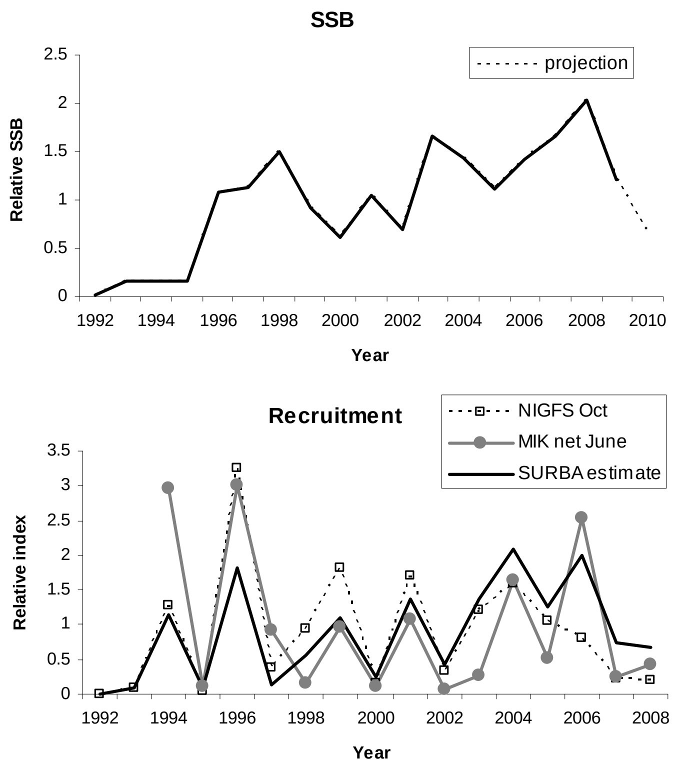
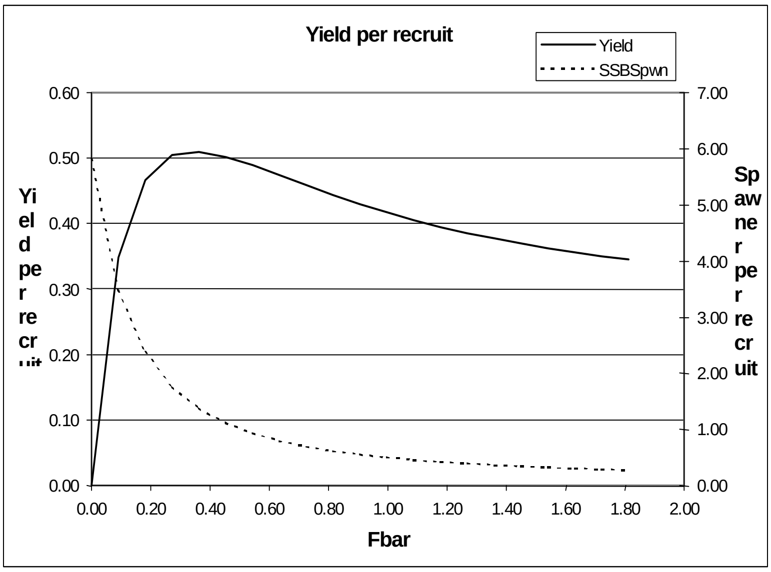


Figure 6.3.9. Haddock VIIa: Trend in SSB form 2009 SURBA projected to 2010 (top panel) and SURBA estimate of recruitment compared with available 0-gp indices. SSB and recruitment are standardized to the mean for years common to all series (1994–2008) in each plot.



MFYPR version 2a
Run: Had7a_2004WG_yield
Time and date: 10:55 13/05/2004

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.9065
FMax	0.3811	0.3455
F0.1	0.2074	0.1880
F35%SPR	0.2494	0.2261

Weights in kilograms

Figure 6.3.10. Haddock VIIa: Yield-per-recruit based on analysis carried out in 2004.

6.4 *Nephrops* in Division VIIa (Irish Sea East, FU14)

Type of assessment in 2009

No advice was required for this stock this year so the report consists of an update to available data and text describing the fishery. No assessment or data analyses have been carried out.

ICES advice applicable to 2008

The advice was biannual and still valid from the 2006 assessment which implied that effort should not increase compared with 2003–2005 levels.

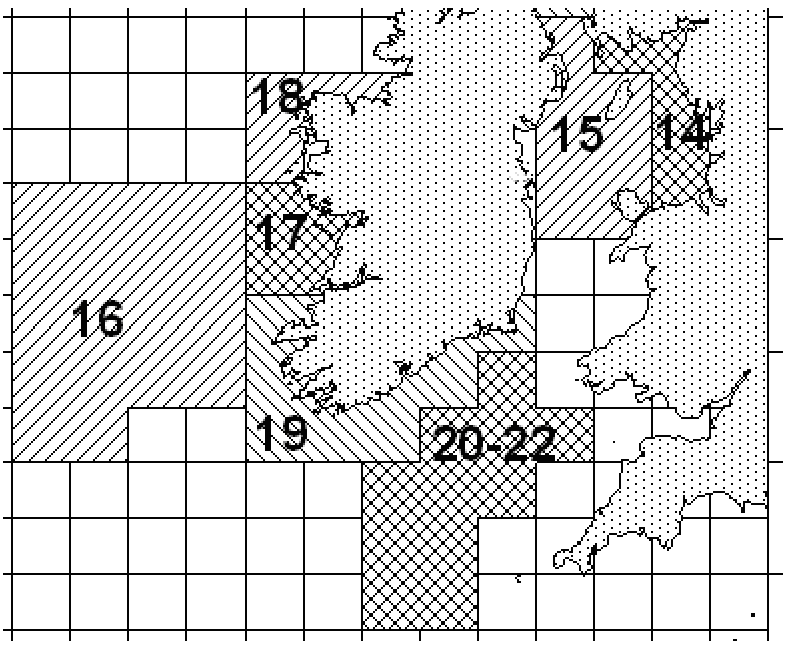
ICES advice applicable to 2009

This stock was reassessed in 2008 based on trends in the fishery and biological parameters. The advice for this fishery for 2009 and 2010 was that landings and effort should not increase above that recorded for 2007.

6.4.1 General

Stock description and management units

The Irish Sea East *Nephrops* stock (FU14) is in ICES Subarea VII which includes the Irish Sea West (FU15) stock; the Porcupine Bank (FU16); Aran Grounds (FU17); North-West Irish Coast (FU18), South-East and South-West Irish Coast (FU19); and the Celtic Sea stock (FU20–22). The TAC is set for the whole of Subarea VII which does not correspond to the areas occupied by these stocks.



Functional units in VIIa

Management applicable in 2007 and 2008

The TAC is currently set for the larger TAC Area VII. The TAC for 2009 is currently set at 24 650 tonnes, a 2% reduction on the 2007/2008 TAC of 25 153 tonnes. The TAC area includes a number of *Nephrops* stocks demonstrating different levels of exploitation. A single TAC covering a number of distinct stocks allows the possibility of unrestricted catches being taken from a heavily exploited stock when advice suggests they should be limited.

In 2008 the main fleets targeting *Nephrops* include directed single-rig and twin-rig otter trawlers operating out of ports in UK (NI), UK (E&W) and Ireland. Details of all regulations including effort controls in place are provided in the Stock Annex.

The fishery in 2008

Between 1999 and 2003 the number of vessels fishing for *Nephrops* in FU14 declined by 40% to a fleet of around 50 vessels. This was largely as a consequence of the reduction in the number of visiting UK vessels and the decommissioning of part of the Northern Ireland and local English fleets. Since then the number of vessels fishing the area has returned to around 80 vessels mainly from Northern Ireland. Currently, just under 30 of these vessels, between 6 and 21 m in length, have their 'home' ports in Whitehaven, Maryport and Fleetwood, England. The rest of the fleet is generally made up of larger vessels from Northern Ireland.

In 2008 about 70% of the landings from this fishery were made to Whitehaven and about 20% to Kilkeel. Over half of the Northern Ireland and a few of the English vessels use twin or triple trawls and account for around 30% of the *Nephrops* landings-in-weight from this FU. Between 1999 and 2008, the recorded number of vessels using these multiple trawls has fluctuated without trend between 15 and 29 vessels, with around 90% of these vessels coming from Northern Ireland. The earlier decline in the fleet was mainly in the number of single trawlers.

Of the Northern Ireland fleet, the proportion of vessels using multiple trawls, the average vessel size and average fishing effort per trip have all increased since 1999. The proportion returning, at the end of a *Nephrops* trip in FU14 to land in to Northern Ireland increased from only 6% in 1999 to around 35% from 2005 onward.

There has been little apparent change in the make-up of the English and Welsh fleet over the last couple of years. However the current state of other stocks, technical conservation and cod recovery measures has had an effect on mesh sizes and fishing patterns. Traditionally a summer fishery, anecdotal data and records of monthly landings indicate the season is starting earlier and ending earlier.

In 2008 very few landings of note were made until May due in part to poor catches of prawns but mainly the weather. Poor weather affected most of June through to August. When the weather was okay local reports of catch rates were poor. This continued over summer. The larger Northern Ireland vessels continued to make larger landings although less frequently. By September some of the UK fleet had already moved to other fisheries-including the North Sea. The number of UK vessels moving from this summer fishery to the Farn Deeps fishery in winter has dropped from 30 in 2007 to only 9 in 2008.

6.4.2 Data

An overview of the data provided and used by the WG is provided in Table 2.3.

Landings

Official landings as reported to ICES from FU 14 are presented in Table 6.4.1 and were updated for 2008. Between 1987 and 2006, landings from FU14 appeared relatively stable, fluctuating around a long-term average of about 550 t (Table 6.4.2 and Figure 6.4.1). Landings in 2007 were at their highest level since 1978 at 959 t, this is after landings dropped in 2003 to their lowest apparent level since 1974. The landings figure of 792 t in 2008 is still higher than any others recorded since 1991, however, the introduction of the Buyers and Sellers' legislation in 2006 by the UK precludes direct comparison with previous years as reported levels are considered to have significantly improved.

Over the last 10 years UK vessels have landed, on average, 89% of the reported annual international landings. Irish vessels increased their share of the landings to 35% in 2002 but it has since declined to 4% in 2008 (Table 6.4.2).

The official landings as reported by each country were updated for 2007.

Length composition

Quarterly length compositions of landings, catch and discards were available from the UK England and Wales for most of the period 1992–2007. The numbers of samples taken are presented in Table 2.2. The raising and collation procedures are documented in the stock annex B1. Landings sampling deteriorated in 2005 but improved in 2007. Figure 6.4.4 shows the annual catch and landings length distributions. Discard rates have been estimated from the same figures and have declined in the last six years from 29% to 22% of total catch-by-weight and 48% and 36% by number. Females generally have a higher discard rate because they are smaller.

A summary of mean size information is provided in Table 6.4.5. The mean sizes in the catch and landings appear relatively stable. The increasing lpue of the <35 mm CL categories and decline in mean size of the landings (Figure 6.4.3 and Figure 6.4.1) could be indicative of good recruitment. The declining discard rate might suggest that this could be related to a change in selectivity. This is supported by the local enforcement agency who noted an increase in the proportion of tails landed in 2007. The mean size in the landings remains relatively stable only exhibiting a slight decline over the last few years.

A 10% TAC increase in 2006 followed by a 17% increase in 2007 coupled with the implementation in the UK of buyers and sellers regulations effective from and throughout 2006, has improved the accuracy of reported landings information. The TAC increases appear to have reduced the reasons to misreport and the legislation provides the quality control. Landings do not appear to have exceeded the advised TAC for this Functional Unit.

Commercial cpue

The introduction of the Buyers and Sellers' legislation for 2006 complicates the interpretation of any prior trends. In 2007, most of the landings were made into England with a large proportion of these landings (67% of the directed landings) being made by visiting Northern Irish vessels. UK *Nephrops* directed effort fluctuated around a downward trend since 1978 reaching a minimum in 2004. From 2003 effort has remained relatively stable fluctuating without trend around a mean of 13 800 hrs. Quarterly effort plots display a predominance of effort in the 2nd and 3rd quarters (Figure 6.4.2).

In light of the limited indices available for this stock, trends in recent lpue are still reviewed as some of the best available information despite reservations about the accuracy of the historical landings. The UK lpue series is based on a combination of directed *Nephrops* voyages by English and Welsh vessels landing to Fleetwood and Whitehaven, where the weight of *Nephrops* landed is more than 25% of the total landing and all trips by visiting Northern Irish vessels which target *Nephrops* (Table 6.4.4). Analysis of the lpue trends for this reference fleet reveals that between 1989 and 2004 there is little correspondence between the E&W and NI figures. Uncertainties about the recorded landings during this period could account for some of the differences as they fall back into step after 2004. Further data and analysis is required to determine whether this series continues to be appropriate. Between 1990 and 2003 the combined lpue has fluctuated between 17 and 26 kg/hour trawling. Since then lpue has risen year on year to 39 kg/hour trawling in 2007, the highest level in the series (Figure 6.4.1). A small decline in 2008 reflects the influence of the NI fleet on the series as the lpue of the E&W fleet has continued to rise. The lpue of the Northern Irish fleet is driving this trend and since 2004 has been at a level comparable with the Republic of Ireland fleet. This could reflect a change in reporting and/or a change in targeted effort rather than any biological phenomena.

Male *Nephrops* predominate landings and the annual proportion of females appears highly dependent on the fishing effort in the third quarter (Figure 6.4.2). Lpues for males and females <35 mm CL (Figure 6.4.3) appear to exhibit the same general trends. Minima in 2003 were followed by upward trends to the highest values in both series in 2007. The lpue of the larger males (>35 mm) has been increasing since 2002 and continues to rise. The quarterly pattern of availability to the fishery of females >35 mm, means that meaningful statistics for this portion of the population are highly dependent upon the level of fishing and the sampling effort deployed in the 3rd quarter.

Surveys

In August 2007 and 2008 the UK and the Republic of Ireland carried out an underwater TV survey of the *Nephrops* grounds in the Eastern Irish Sea. The survey was of a fixed grid design and was carried out using the same protocols used in UWTV surveys in the Western Irish Sea. This survey was not reviewed at WKNEPH 2009, requires further validation and therefore the results are only considered preliminary and are presented in the stock annex.

Data analyses

No assessment has been presented in 2009 and a discussion of management considerations can be found in the report of WGNSDS 2008.

Table 6.4.1. ICES Division VIIa, North of 53° N: Total *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles, 1999–2008.

Year	FU 14	FU 15	Other	Total
1999	625	10786	1	11 412
2000	567	8370	0	8937
2001	532	7441	1	7974
2002	577	6793	0	7370
2003	376	7052	1	7428
2004	472	7267	3	7750
2005	570	6530	0	7100
2006	628	7534	0	8162
2007	959	8424	0	9383
2008*	726	10514	1	11 241

*** provisional**

Table 6.4.2. Irish Sea East (FU14): Landings (tonnes) by country, 1999–2008.

Year	Rep. of Ireland	UK	Other countries **	Total
1999	153	471	0	625
2000	114	451	2	567
2001	26	506	0	532
2002	203	373	1	577
2003	69	306	1	376
2004	62	409	1	472
2005	34	536	0	570
2006	34	594	0	628
2007	86	873	0	959
2008*	29	698	0	726

*** provisional**

**** Other countries includes Belgium and Isle of Man**

Table 6.4.3. Irish Sea East (FU14): Effort ('000 hours trawling) and lpue (kg/hour trawling) of *Nephrops* directed voyages by UK trawlers, 1999–2008.

Year	Effort	LPUE
1999	18.4	19.8
2000	17.9	21.2
2001	20.3	20.7
2002	14.7	20.1
2003	14.1	16.7
2004	12.1	27.5
2005	13.8	28.5
2006	13.1	29.6
2007	15.7	39.7
2008*	13.7	35.3

*** provisional**

Table 6.4.4. Irish Sea East (FU14): Effort ('000 hours trawling) and lpue (kg/hour trawling) of *Nephrops* directed voyages by Republic of Ireland trawlers, 1999–2008.

Year	Effort	LPUE
1999	2.3	55.4
2000	2.5	43.6
2001	0.5	43.9
2002	3.3	57.1
2003	1.1	37.6
2004	1.4	42.8
2005	0.8	40.6
2006	0.7	53.7
2007	1.7	49.3
2008*	0.6	41.5

*** provisional**

Table 6.4.5. Irish Sea East (FU14): Mean sizes (mm CL) of male and female *Nephrops* from UK vessels landing in England and Wales, 1998–2007.

	CATCH		LANDINGS	
YEAR	Males	Females	Males	Females
1999	na	na	35.5	32.5
2000	29.2	28.3	33.7	32.3
2001	31.6	29.2	34.2	32.5
2002	32.0	29.2	35.1	32.0
2003	36.4	30.7	38.4	34.5
2004	32.2	29.4	35.2	33.1
2005	32.8	29.9	34.6	32.3
2006	33.8	31.4	36.1	32.6
2007	31.7	29.8	33.5	32.1
2008*	31.6	28.7	33.4	30.9

*** provisional**

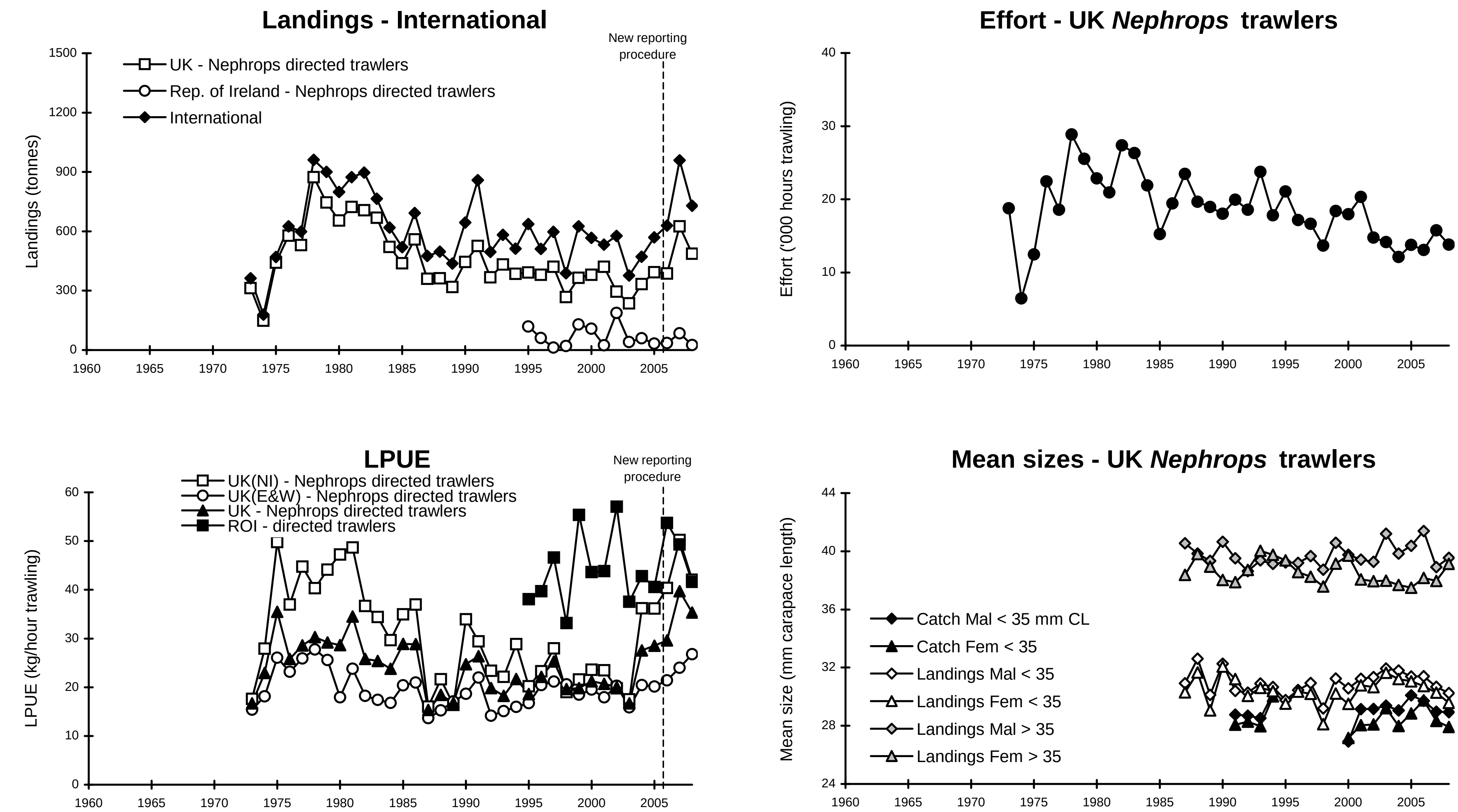


Figure 6.4.1. Irish Sea East (FU14): Long-term trends in landings, effort, cpues and/or lpues, and mean sizes of *Nephrops*.

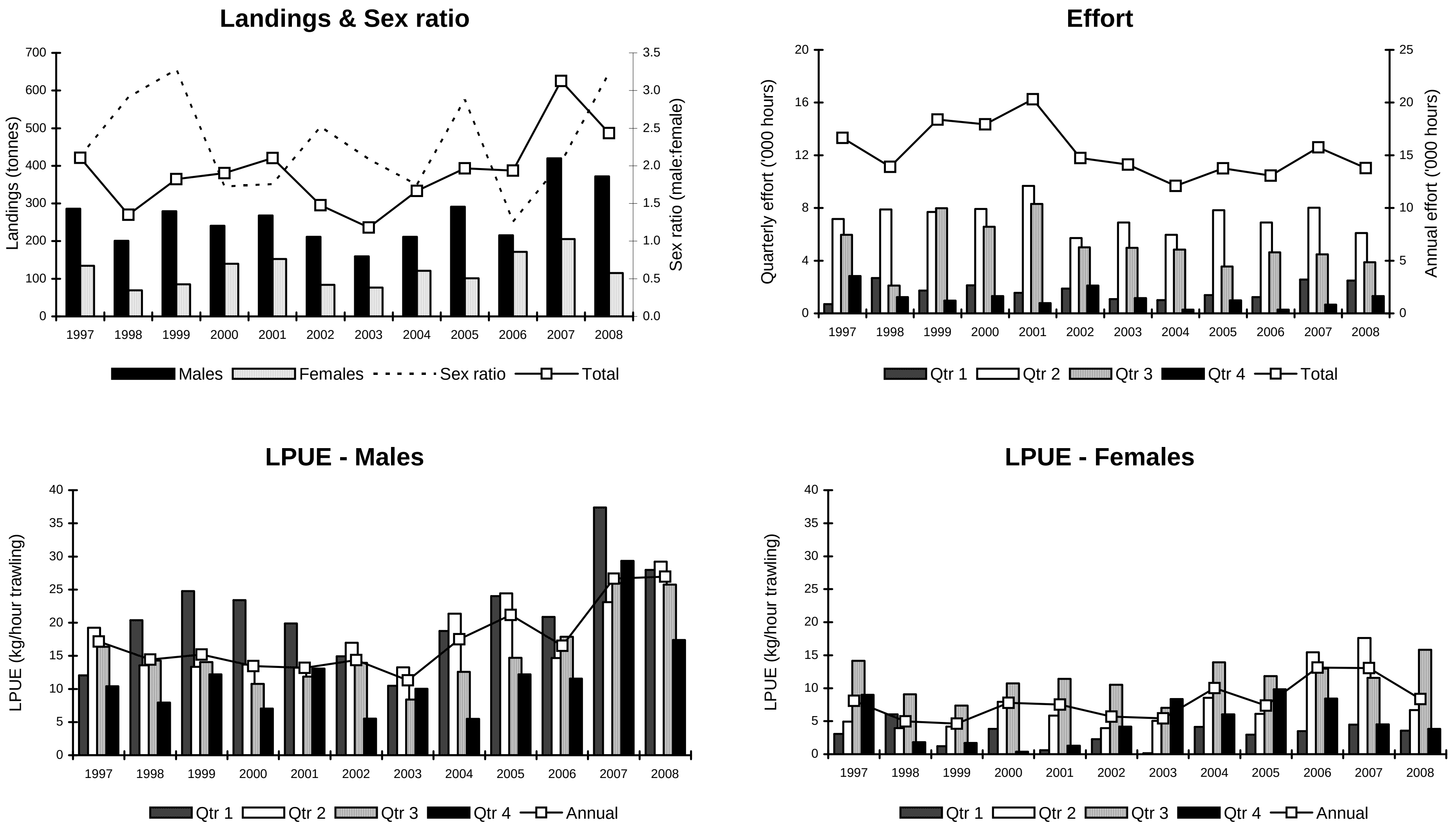


Figure 6.4.2. Irish Sea East (FU14): Landngs, effort and lpues by quarter and sex from UK *Nephrops* directed trawlers.

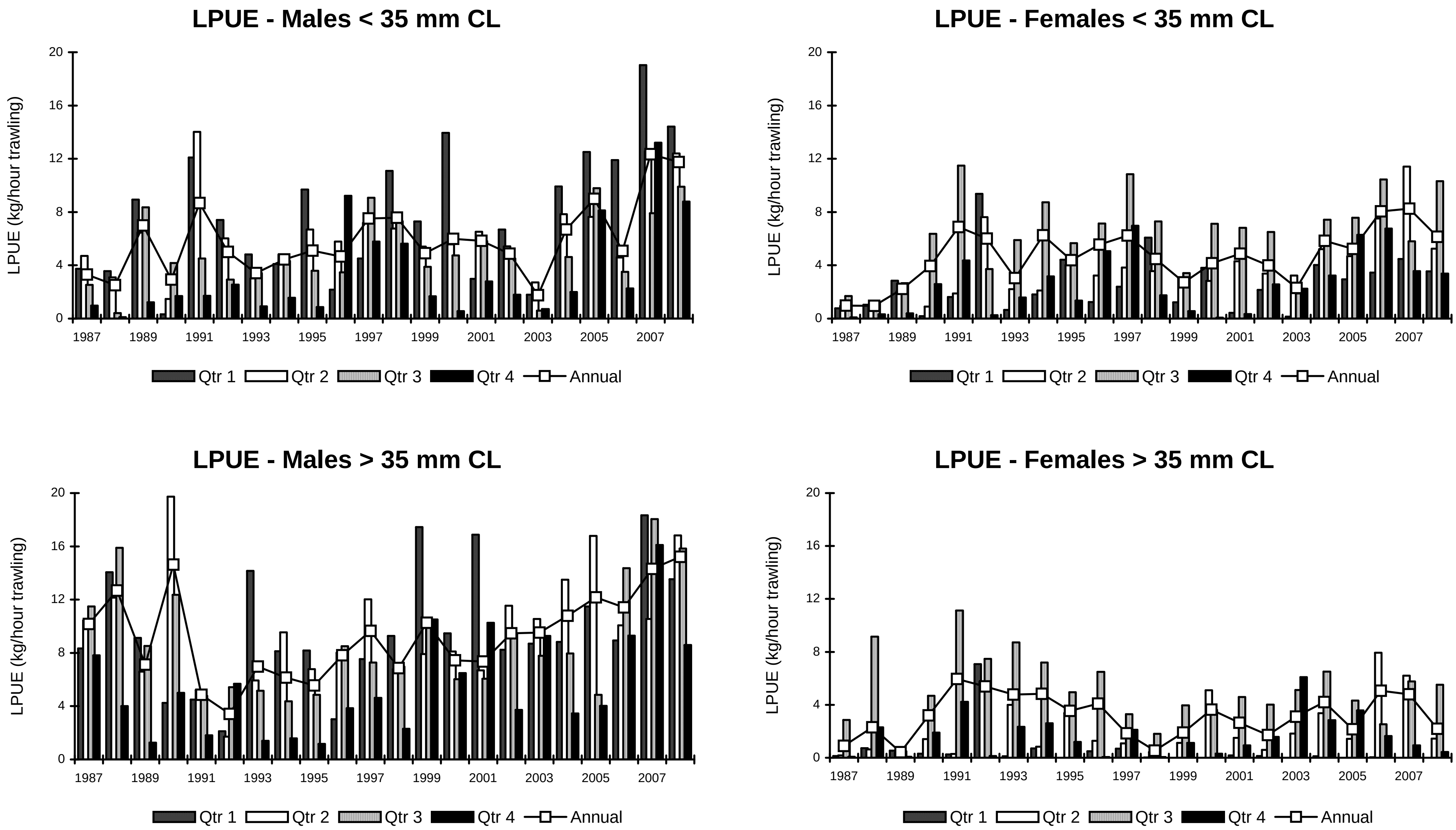


Figure 6.4.3. Irish Sea East (FU14): Lpues by s sex and quarter for selected size groups, UK *Nephrops* directed trawlers.

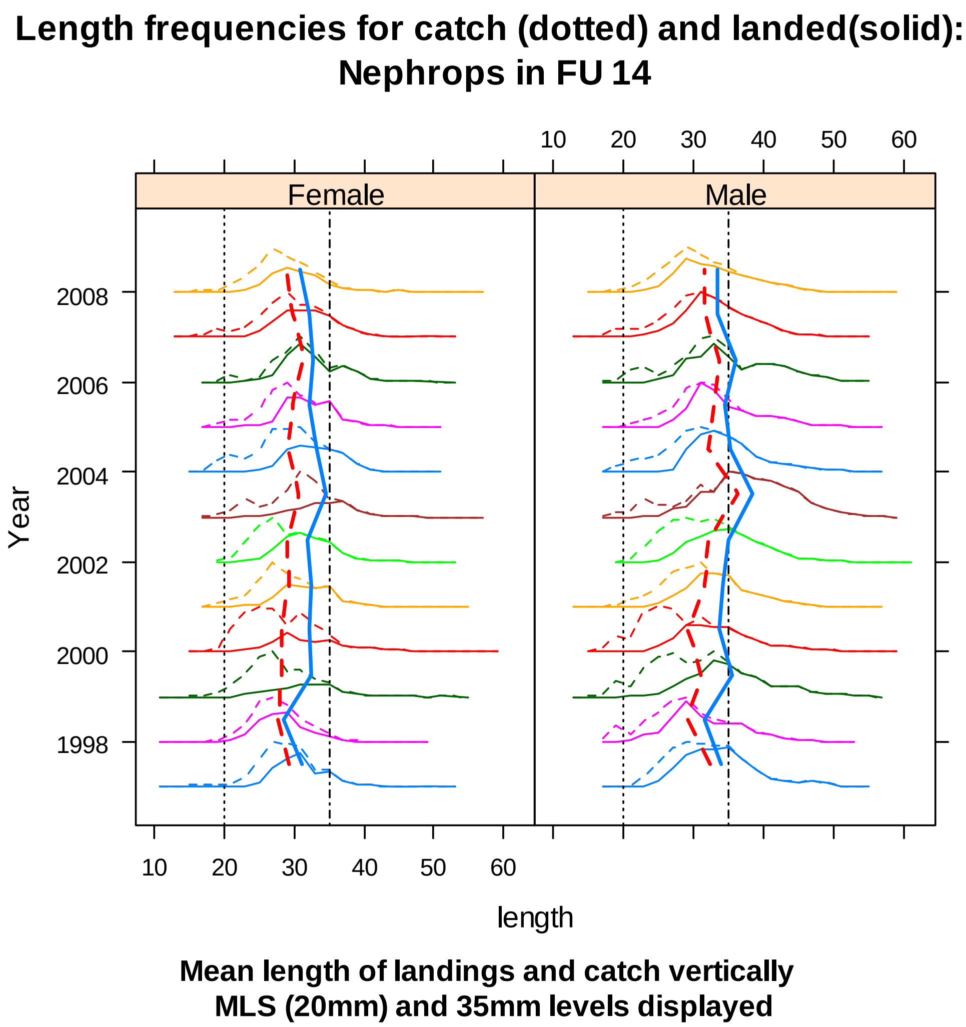


Figure 6.4.4. Irish Sea East (FU14): Length frequency distributions of male and female landings and catch, 1997–2008.

6.5 Irish Sea West, FU15

Type of assessment in 2009

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by WKNEPH 2009 and is described in the Stock Annex.

ICES advice applicable to 2007 and 2008

Given the uncertainties surrounding the landings for this stock it is not possible to provide advice on catches in 2007. The stocks in this area appear to be in good condition and have sustained current levels of effort for many years. Therefore ICES advises that effort in this fishery should not be allowed to increase compared with 2003–2005 levels.

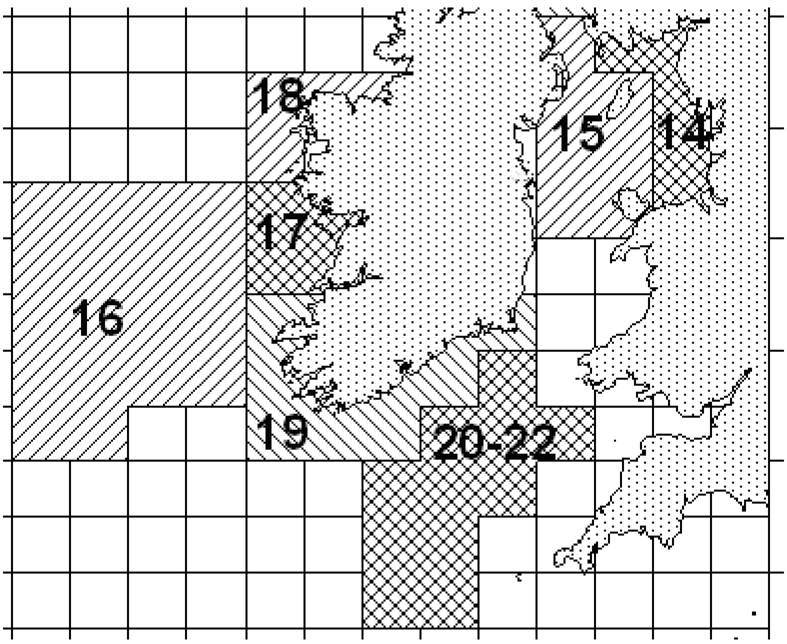
ICES advice applicable to 2009

The current fishery appears sustainable. Therefore, ICES recommends that *Nephrops* fisheries should not be allowed to increase relative to 2007. This corresponds to landings of no more than 8500 tonnes for the Western Irish Sea stock.

6.5.1 General

Stock description and management units

The Irish Sea West *Nephrops* stock (FU15) is in ICES Subarea VII which includes the Irish Sea East (FU14) stock; the Porcupine Bank (FU16); Aran Grounds (FU17); North-West Irish Coast (FU18), South-East and South-West Irish Coast (FU19); and the Celtic Sea stock (FU20–22). The TAC is set for the whole of Subarea VII which does not correspond to the areas occupied by these stocks.



Functional units in VIIa

The Fishery in 2008

The *Nephrops* fishery in the Irish Sea west is economically the most important in ICES Division VIIa and is mainly prosecuted by vessels from UK (Northern Ireland) and Ireland. (Table 6.5.1). No major changes have been reported in the fishery with around 130 vessels from Northern Ireland and 56 Irish vessels reporting landings from this area in 2008. Of the Irish vessels, 44 reported landings in excess of 10 tonnes, accounting for ~98% of Irish landings.

Official landings as reported to ICES from FU15 are presented in Table 6.5.1 and were updated for 2008. Total declared international *Nephrops* landings reported from FU15 in 2008 were 10 514 t and were the second highest in the time-series (Table 6.5.2 and Figure 6.5.1). Irish landings were 3139 t and were the highest since 1999. UK vessels landed 7321 t which was the highest on record and Northern Irish landings contributed to over 95% of this figure. The UK registration of buyers and sellers regulation introduced in 2006 should have reduced misreporting and probably contributed to the perceived increase in landings and lpue.

Although there was a significant reduction in effort by the UK fleet in 2006 and 2007 as a result of a migration of vessels to the North Sea there was a slight effort increase in 2008 to 2003-2006 levels (Table 6.5.3). Irish effort has remained constant in recent years (Table 6.5.4). Lpue for both fleets peaked to a record high in 2008. The mean sizes of *Nephrops* in the catches of both the Northern Irish and Irish fisheries have fluctuated without obvious trend for many years.

Discarding of undersized and unwanted *Nephrops* occurs in this fishery and new data from Northern Ireland for 2008 demonstrates that the discard pattern differs between UK (19.9% by number) and Ireland (30.1% by number) vessels. The discard rate estimated at the Benchmark Workshop was based on data for the Irish fleet while the value used in the assessment is based on combined discard data from both fleets for 2008 (22.8% by number).

Further general information on the fishery can be found in the Stock Annex.

6.5.2 Data

Landings and discards

Commercial size composition data for landings and discards were provided by Northern Ireland and Ireland in 2008. Northern Ireland sampling programme resumed in 2008 after a break of 5 years (2003 to 2007). Sample data are used to compute international removals (Landings + dead discards).

Biological

Data of the mean sizes of *Nephrops* in the landings of Northern Ireland trawlers is available for 2008 (Table 6.5.5, Figure 6.5.1). The mean size in the catches of males and females appears to lie within the overall series range. The dataseries of the mean sizes of *Nephrops* in the landings of Irish trawlers is provided (Table 6.5.6, Figure 6.5.1). The mean size in the catches of males varied between 26.4 and 29.1 mm CL, and for females between 24.6 and 40 mm CL.

Other data used in the assessment were as listed in the stock annex compiled by the Benchmark meeting WKNEPH 2009.

Surveys

Since 2003 Ireland and Northern Ireland have jointly carried out underwater television surveys of the main *Nephrops* grounds in the western Irish Sea. These surveys were based on a randomized fixed grid design. The methods used during the surveys were similar to those employed for UWTV surveys of other *Nephrops* stocks and were as agreed by WKNEPTV, WKNEPBID, SGNEPS and WKNEPH. An average of 145 valid stations was covered by the two surveys combined and the data were raised to a stock area of around 5287 x 10^6 m^2 as detailed in Table 6.5.7. Details of the survey methodology are available in WKNEPTV 2007.

Northern Ireland have completed spring (April) and summer (August) *Nephrops* trawl surveys since 1994 and provide data on catch rates, size composition and biological data (maturity and sex ratio) from a fixed grid of stations in the western Irish Sea as detailed in the Stock Annex. Trawls survey catch rates, sex ratio and mean demonstrate no clear trend over the time-series (Figure 6.5.2).

6.5.3 Historical stock development

The UWTV survey work-up method employed assumes that the width of the viewed transects is the entire lower edge of the TV screen on which the burrows are counted. This can be calculated from the TV camera parameters and the position of the camera in relation to the seabed. A new camera and sledge improved the resolution of the footage captured during the Northern Ireland 2008 survey and Figure 6.5.3 shows the distribution of stations sampled in 2008. A re-working of the UWTV survey abundances for 2003 and 2004 were presented to the meeting and burrow abundance time-series were krigged as described in WD No 13**.** These data along with other meta-data are demonstrated in Table 6.5.7. Figure 6.5.4 is a contour plot of the krigged density estimates for FU15 over the period 2003–2008.

The use of the UWTV surveys for the provision of *Nephrops* management advice was extensively reviewed by WKNEPH (ICES, 2009). A number of potential biases were highlighted including those because of edge effects; species burrow misidentification and burrow occupancy. A cumulative bias correction factor estimated for FU15 was 1.14 which means the TV survey is likely to overestimate *Nephrops* abundance by 14%.

The underwater TV survey is again presented as the best available information on the FU15 *Nephrops* stock and provides a fishery-independent estimate of *Nephrops* abundance. The 2008 TV survey data presented at the meeting reveals that despite a downward trend since 2004 (Figures 6.5.5 and 6.5.6) the abundance remains higher than other areas. Catch rates from the Northern Ireland trawl survey fluctuate around the time-series mean over the period 1994–2008 (Figure 6.5.2).

6.5.4 Short term projections

A landings prediction for 2010 was made for FU15 using the approach agreed at the Benchmark Workshop (WKNEPH ICES, 2009). Northern Ireland catch composition data were available for 2008 and these demonstrated a significantly lower discard rate than the Irish data used in the benchmark assessment. As the Northern Ireland catch contributed to more than 65% of FU15 landings in 2008 the mean harvest ratios estimated by WKNEPH from length and age-based models were recalculated using the same models applied to the combined data. The Table below displays landings predicted at a range of harvest ratios, including those equivalent to fishing at $F_{0.1}$, F_{max} and the fishery in 2008. The harvest ratios equivalent to $F_{0.1}$and F_{max} are significantly lower than those previously presented as a consequence of a revision of the assumptions regarding the size range of *Nephrops* inhabiting the burrows observed in the TV survey and the combined bias adjustment factor proposed by the benchmark meeting.

The inputs to the landings forecast were as follows:

Mean weight in Northern Ireland and Ireland landings (2008) = 13.21 g

Discard rate based on Northern Ireland and Ireland sampling 2008 = 20.9%

Survey bias = 1.14.

			Implied fishery	
Harvest rate		Survey Index (Millions)	Retained number (Millions)	Landings (tonnes)
	0%	4,288	0	0
	2%	"	68	896
	4%	"	136	1792
	6%	"	203	2688
	8%	"	271	3583
	10%	"	339	4479
	12%	"	407	5375
F0.1	12.2%	"	413	5465
	14%	"	474	6271
	16%	"	542	7167
	18%	"	610	8063
	20%	"	678	8959
Fmax	20.4%	"	691	9138
	22%	"	746	9854
F Current	23.5%		795	10 514
	24%	"	813	10 750

		Basis
Landings Mean Weight (KG)	0.0132	Sampling 2008
Survey Overestimate Bias	1.14	WKNEPH 2009
Survey Numbers (Millions)	4889	UWTV Survey 2008
Prop of removals retained by the Fishery	0.79	Sampling 2008

6.5.5 Medium-term projection

No medium term projection was performed for this stock.

6.5.6 Biological reference points

Harvest ratios equating to fishing at $F_{0.1}$ and F_{max} were calculated in WKNEPH 2009. These calculations assume that the TV survey has a knife-edge selectivity at 17 mm and that the supplied length frequencies represented the population in equilibrium. As explained in Section 6.5.4 data from Northern Ireland and Ireland were combined to provide revised harvest ratio estimates for $F_{0.1}$ and F_{max} which were used in the short-term projections presented in the management options table in Section 6.5.4.

$F_{0.1}$ = 12.2%

F_{max}= 20.4%

6.5.7 Management plans

A number of cod recovery measures have been introduced since 2000 to conserve promote recovery of Irish Sea cod stocks. These include a closure of the western Irish Sea cod spawning grounds from mid February to end of April since 2000, with a later extension to the eastern Irish Sea. Despite a partial derogation for *Nephrops* vessels during the closed period the distribution of effort on *Nephrops* has been affected by this management plan. There have also been various decommissioning schemes to reduce fishing effort. A 25% effort reduction on cod is in hand along with technical measures to reduce cod bycatch.

6.5.8 Uncertainties and bias in assessment and forecast

There are several key uncertainties and bias sources in the method proposed (these are discussed further in WKNEPH 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007, WKNEPHBID 2008, SGNEPS 2009). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that was more accurate but no more precise (WKNEPH 2009). The survey estimates themselves are likely to be fairly precisely estimated given the homogeneous distribution of burrow density and the modelling of spatial structuring. The cumulative bias estimates for FU15 are largely based on expert opinion. The precision of these cannot yet be characterized. Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates.

In the provision of catch options based on the absolute survey estimates additional uncertain-ties related to mean weight in the landings and the discard rates also arise. For FU15 deterministic estimates of the mean weight in the landings and discard rates for 2008 have been used because sampling data were not available from Northern Ireland for several of the previous years.

There is a gap of 16 months between the survey and the start of the year for which the assessment is used to set management levels. It is assumed that the stock is in equilibrium during this period (i.e. recruitment and growth balance mortality) although this is rarely the case. The effect of this assumption on realized harvest rates has not been investigated but remains a key uncertainty.

6.5.9 Quality of assessment

The length composition and sex ratio of catches have been well sampled since 1995 by Ireland and comprehensive sampling by Northern Ireland resumed in 2008. This provided a robust combined dataset of length distributions for 2008 which provide good representation of the fishery and was used in the assessment.

The quality of landings data has improved in the last two years but because of concerns over the accuracy of earlier years, the final assessment adopted is independent of official statistics.

Underwater TV surveys have been conducted annually for this stock since 2003. The number of valid stations in the survey has remained relatively stable throughout the time period.

6.5.10 Management considerations

Concerns about underreporting in earlier years have been largely overcome by the UK's introduction of Buyers and Sellers legislation in 2006. Discrepancies in landings in earlier years create problems in using commercial data for analytical assessments and providing TAC recommendations. Recounting of the 2003 and 2004 UWTV survey footage demonstrated an increase in density in 2004 followed by a declining trend. The high densities recorded by UWTV however suggest that the observed decline is from a very high level and the levels are still above those reported for other Functional Units for which UWTV surveys have been performed.

Harvest ratios generated from age and length-based models ratified by the benchmark assessment WKNEPH (ICES, 2009) indicate that this stock was being exploited above F_{max} in 2008. Although the benchmark workshop estimated bias correction indices for this survey series there are no precision estimates are available. Despite evidence of under reporting the FU15 *Nephrops* fishery has been sustained for over 40 years with much higher levels of fishing effort during the nineties than in recent years. There is no evidence from trends in population data (e.g. mean size and sex ratio) of a problem with the stock and this is reinforced by data generated by trawl surveys. These observations suggest that the fishing mortalities and harvest ratios estimated by the current methods are too high and should be treated with caution.

The previous ICES practice of basing TAC recommendations on reported landings where there is evidence of underreported landings is not appropriate, as these stocks appear to be sustainable with higher catch rates, though the exact magnitude of these in earlier years is unknown. Despite the results from the UWTV analysis there is no evidence that this stock is in trouble and is apparently stabile with high densities of small *Nephrops* and no sign of recruitment failure.

Table 6.5.1. Official catch data *Nephrops* VIIa as reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Belgium	0	0	0	0	0	0	0	0	0	2
France	91	55	62	3,539	3,797	2,977	8	8	16	6
Ireland	4,682	4,639	3,201	2,840	2,000	3,200	2,370	2,614	2,337	3,303
Isle of Man	7	18	39	8	25	61	14	32	14	29
UK - Eng+Wales+N.Irl.	0	0	0	6,002	6,155	6,805	5,572	5,900	6,300	5,944
UK - England & Wales	693	474	693	0	0	0	0	0	0	0
UK - N. Ireland	5,188	5,091	5,255	0	0	0	0	0	0	0
UK – Scotland	32	29	16	43	24	59	29	17	18	63
Total	10 693	10 306	9266	12 432	12 001	13 102	7993	8571	8685	9347

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Belgium	1	1	0	0	1	0	1	1	1	2
France	1	1	0	0	1	0	0	1	0	1
Ireland	2,156	3,695	2,754	4,698	3,621	2,892	2,403	2,846	2896	2187
Isle of Man	20	24	17	10	3	2	0	1	13	12
UK - Eng+Wales+N.Irl.	6,103	7,163	6,316	6,514	5,328	5,213	4,841	4,621	4,899	5,046
UK - England & Wales	0	0	0	0	0	0	0	0	0	0
UK - N. Ireland	0	0	0	0	0	0	0	0	0	0
UK – Scotland	14	17	74	38	31	34	90	27	55	8
Total	8295	10 901	9161	11 260	8985	8141	7335	7497	7864	7256

Country	2006	2007	2008*
Belgium	1	1	2
France		1	
Ireland	2122	3036	3196
Isle of Man			
UK - Eng+Wales+N.Irl.	6122	6611	
UK - England & Wales			
UK - N. Ireland			
UK - Scotland	30	73	
UK		6677	8086
Total	8275	9722	11 283

***Preliminary**

Table 6.5.2. ICES Division Vlla, North of 53° N: Total *Nephrops* landings as estimated by the working group (tonnes) (a) by Functional Unit plus Other rectangles, 1999–2008 and (b) by country and (c) by country in FU15 only.

(a)

Year	FU14	FU15	Other	Total
1999	624	10 786	0	11 410
2000	567	8370	2	8939
2001	532	7441	0	7973
2002	577	6793	1	7371
2003	376	7052	1	7429
2004	472	7267	1	7739
2005	570	6530	0	7100
2006	628	7534	0	8162
2007	959	8424	0	9383
2008*	726	10 514	1	11 241

(b)

Year	Belgium	Rep. of Ireland	Isle of Man	UK	Other countries	Total
1999	0	4735	6	6669	0	11 410
2000	2	3547	0	5388	2	8939
2001	0	2715	3	5255	0	7973
2002	1	2494	1	4874	1	7371
2003	1	2765	4	4658	1	7429
2004	1	2844	13	4879	1	7739
2005	0	2150	0	4950	0	7100
2006	0	2083	1	6079	0	8162
2007	0	2823	0	6560	0	9383
2008*	1	3168	52	8071	1	11 241

(c)

Year	Rep. of Ireland	Isle of Man	UK	Other countries	Total
1999	4582	6	6198	0	10 786
2000	3433	0	4937	0	8370
2001	2689	3	4749	0	7441
2002	2291	1	4501	0	6793
2003	2696	4	4352	0	7052
2004	2782	13	4470	1	7267
2005	2116	0	4413	0	6530
2006	2048	1	5485	1	7534
2007	2736	0	5688	0	8424
2008*	3139	52	7321	2	10 514

*** provisional**

Table 6.5.3. Irish Sea West (FU15): Landings (tonnes), effort ('000 hours trawling), and lpue (kg/hour trawling) of Northern Ireland *Nephrops* trawlers, 1999–2008.

YEAR	LANDINGS	EFFORT	LPUE
1999	6032	172	35.1
2000	4758	169	28.2
2001	4587	164	28.0
2002	4495	131	34.4
2003	4146	141	29.4
2004	4273	144	29.6
2005	4235	138	30.6
2006	5356	144	37.2
2007	5511	127	43.4
2008*	7055	141.3	49.9

*** provisional**

Table 6.5.4. Irish Sea West (FU15): Catches and landings (tonnes), effort ('000 hours trawling), cpue and lpue (kg/hour trawling) Republic of Ireland *Nephrops* Directed Trawlers 1999–2008.

YEAR	EFFORT	LANDINGS	LPUE
1999	74.5	4011	53.9
2000	61.1	3160	51.7
2001	52.4	2475	47.2
2002	49.0	2238	45.7
2003	45.4	2680	59.1
2004	51.5	2649	51.5
2005	48.6	2071	42.6
2006	50.6	1963	38.8
2007	48.0	2582	53.8
2008*	47.1	3118	66.2

*** provisional**

Table 6.5.5. Irish Sea West (FU15): Mean sizes (mm CL) of male and female *Nephrops* in Northern Ireland catches, landings and discards, 1999–2008.

	Catches		Landings		Discards	
Year	Males	Females	Males	Females	Males	Females
1999	27.7	24.5	29.1	26.1	22.0	21.7
2000	27.7	24.5	29.4	26.3	22.5	22.6
2001	25.7	23.6	26.1	24.4	21.7	21.2
2002	26.7	24.1	26.7	24.9	21.8	21.7
2003	na	na	na	na	na	na
2004	na	na	na	na	na	na
2005	na	na	na	na	na	na
2006	na	na	na	na	na	na
2007	na	na	na	na	na	na
2008	26.4	25.2	27.4	26.0	21.9	22.0

na = not available.

Table 6.5.6. Irish Sea West (FU15): Mean sizes (mm CL) of male and female *Nephrops* in Republic of Ireland catches, landings and discards, 1999–2008.

	Catches		Landings		Discards	
Year	Males	Females	Males	Females	Males	Females
1999	26.4	24.9	28.7	27.1	23.3	22.8
2000	29.1	27.1	32.2	29.7	24.3	24.0
2001	26.7	24.8	28.6	27.0	23.0	22.2
2002	28.9	25.4	30.2	27.8	24.6	23.6
2003	27.7	24.9	29.7	26.9	24.0	23.1
2004	28.1	26.1	29.7	27.8	23.9	23.7
2005	28.5	26.8	30.1	29.1	23.9	23.2
2006	27.7	25.5	29.5	27.1	23.8	23.1
2007	27.7	25.4	29.8	27.9	24.0	23.3
2008*	27.4	24.6	28.9	26.6	22.0	21.4

*** provisional.**

Table 6.5.7. Irish Sea West (FU15): Results from NI/ROI collaborative UWTV surveys of *Nephrops* grounds in 2003–2008. Not corrected for bias.

Year	Number of stations	Number of boundary points	Mean Density (No./m2)	Domain Area (km2)	Raised abundance estimate (billion burrows)
2003*	160	54	1.25	5291.867978	6.959853625
2004*	147	45	1.52	5302.444023	8.47707119
2005	140	64	1.08	5288.395287	6.01096494
2006	138	50	1.07	5428.69286	5.928355701
2007	148	53	1.00	5452.291054	5.554172406
2008	141	37	0.88	5287.456376	4.888586634

*Preliminary results from revised counts.

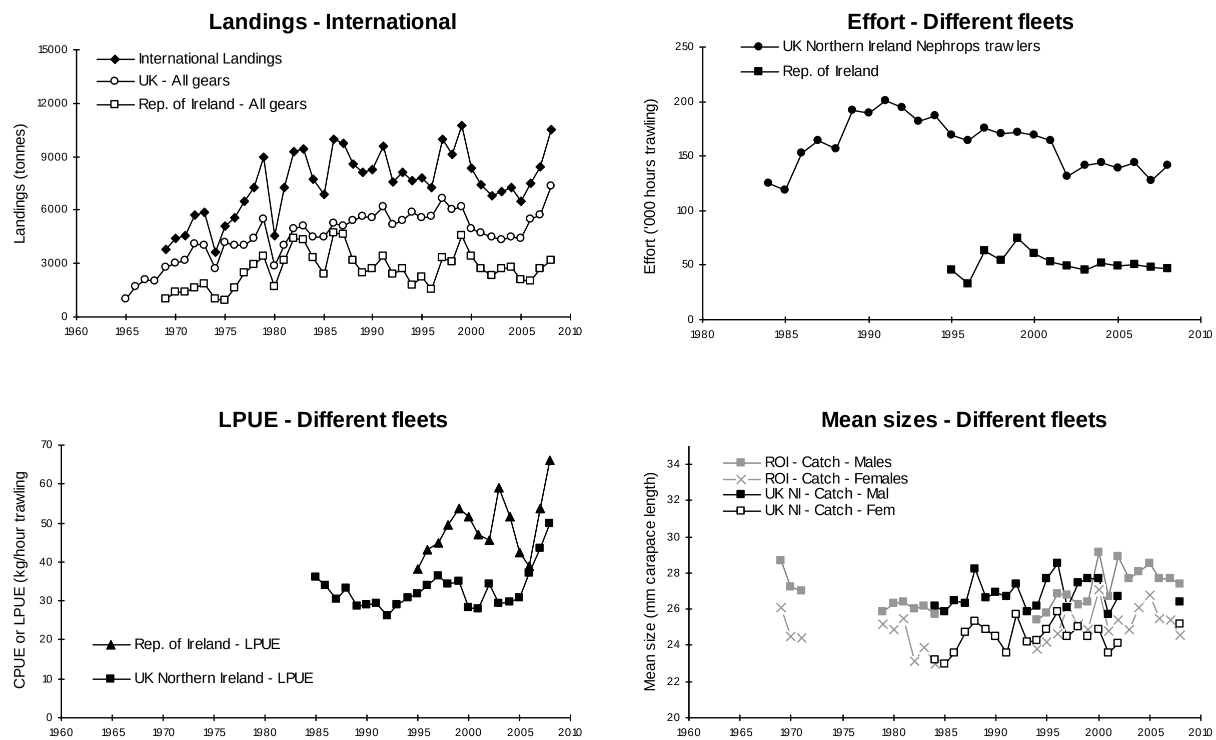


Figure 6.5.1. Irish Sea West (FU15): Long-term trends in landings, effort, cpues and/or lpues, and mean sizes of *Nephrops*.

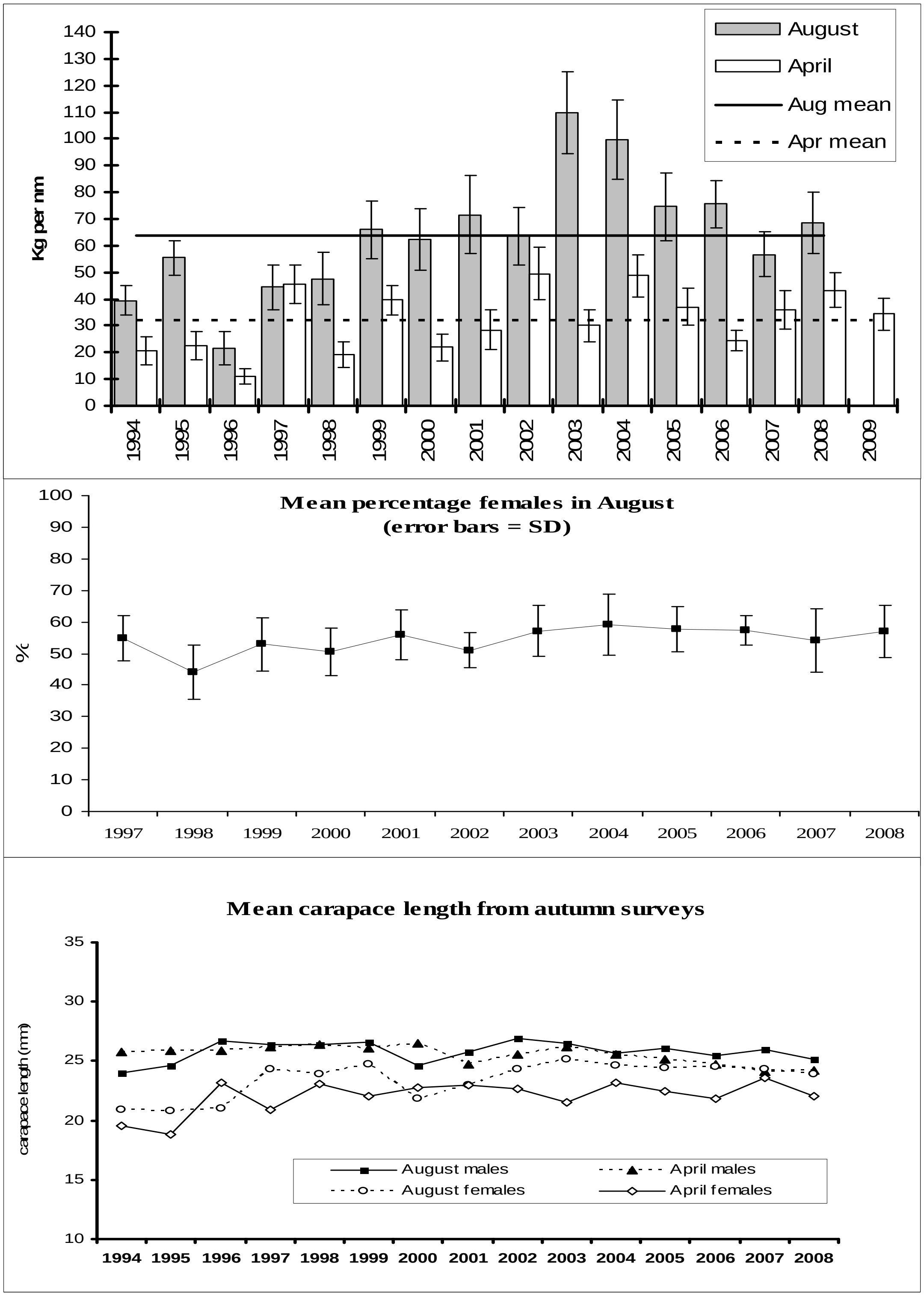


Figure 6.5.2. Irish Sea West (FU15): ***Nephrops*** **catches, sex ratio mean size from NI trawl surveys.**

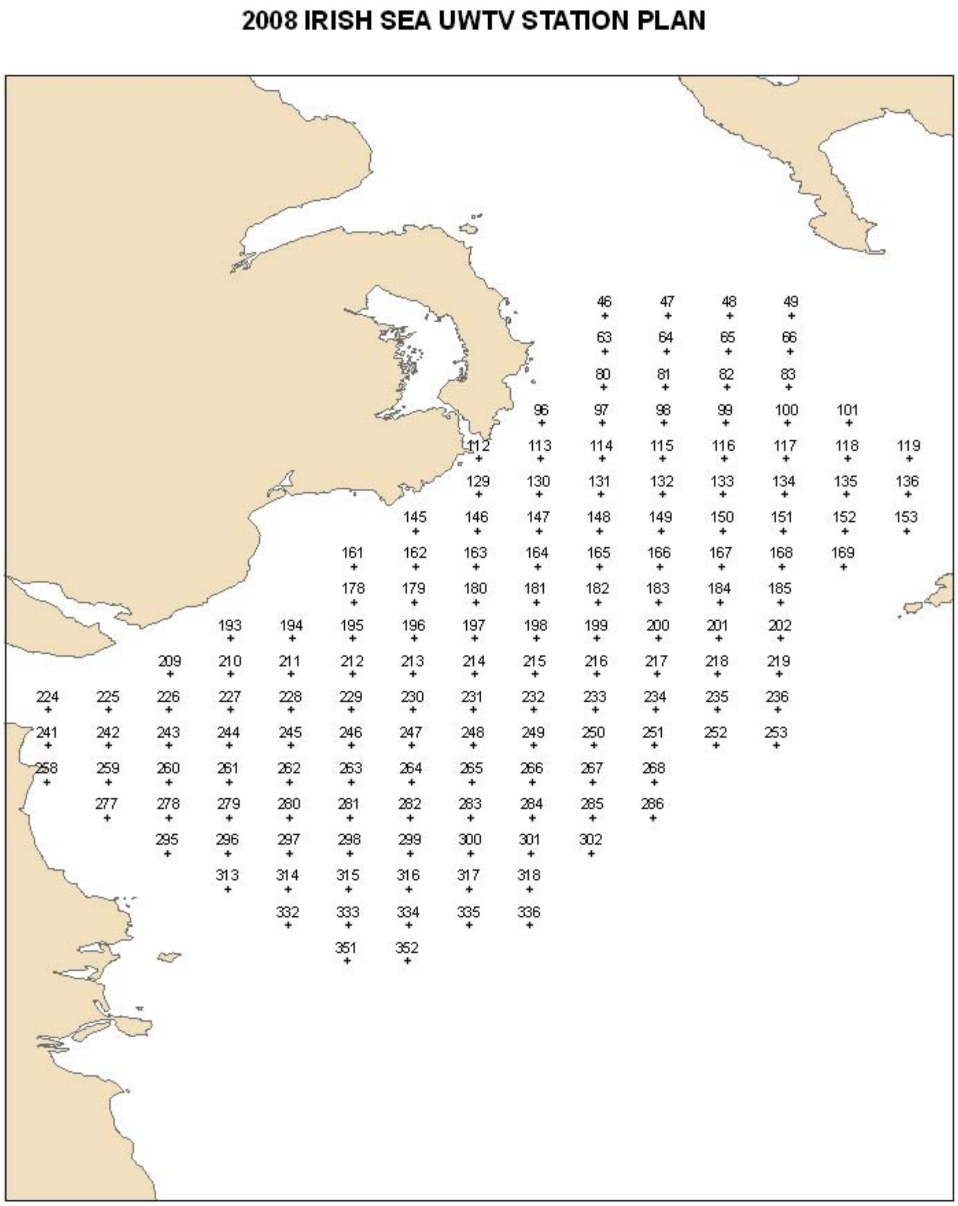


Figure 6.5.3. Irish Sea West (FU15): UWTV Stations for 2008 survey.

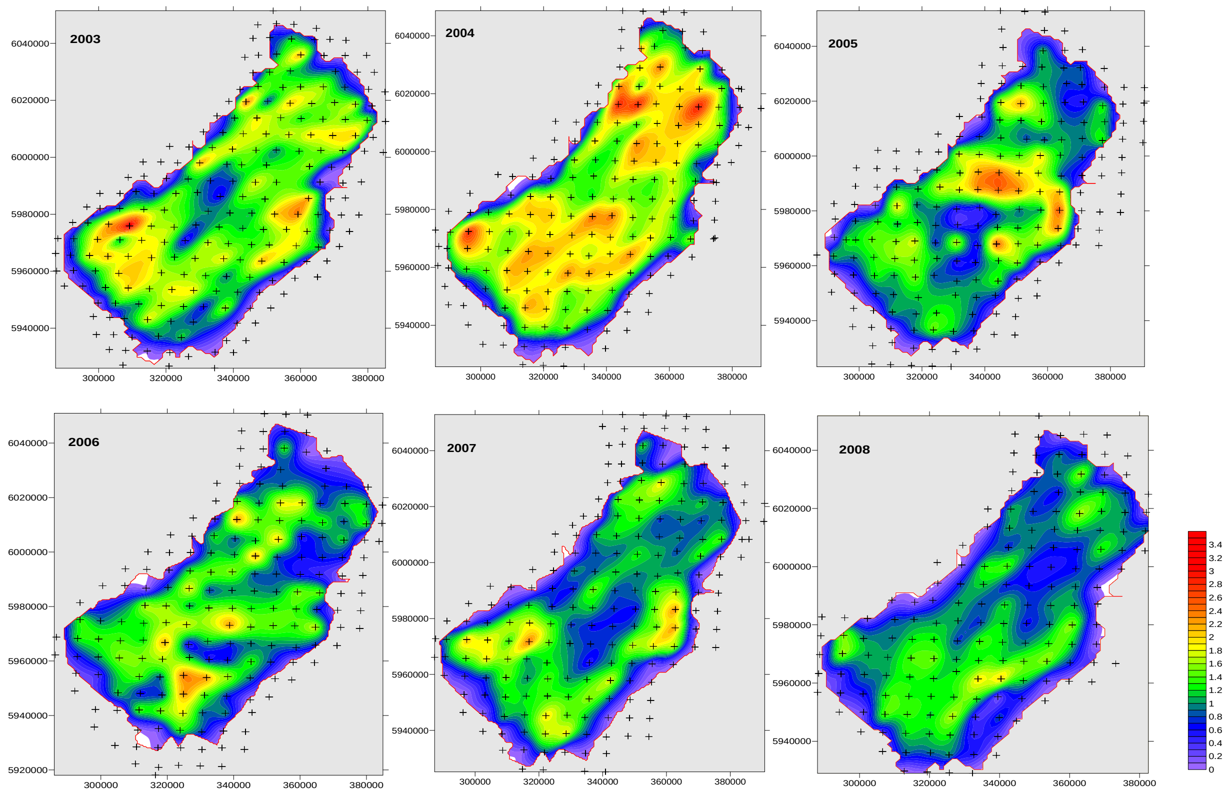


Figure 6.5.4. Irish Sea West (FU15): Contour plots of the krigged density estimates for the Irish Sea from 2003–2008.

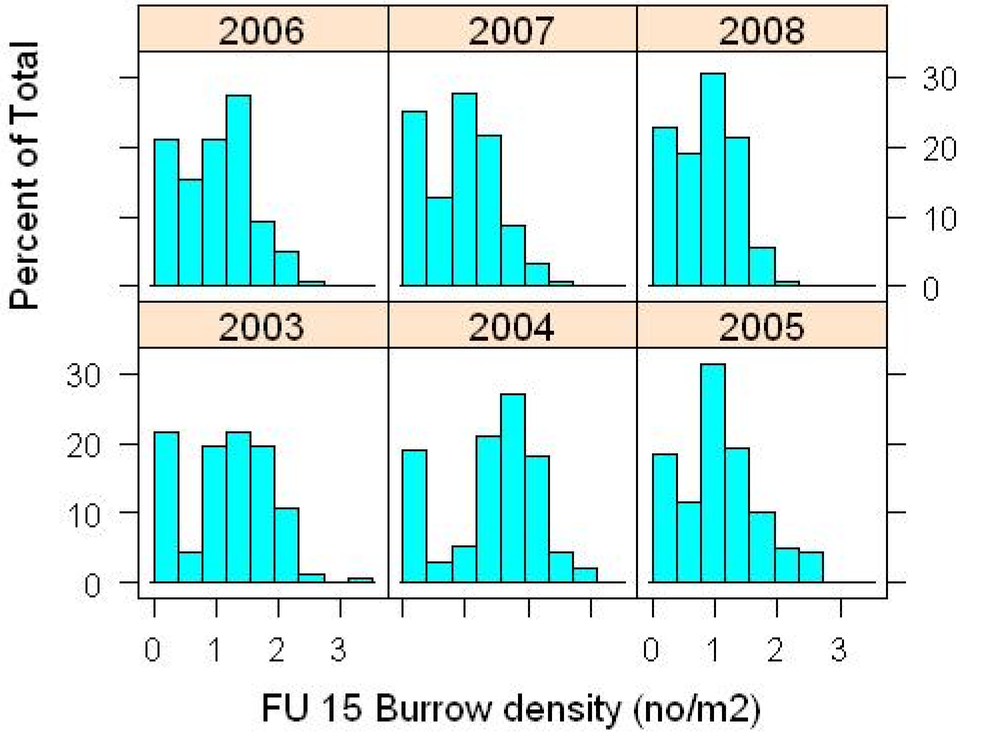


Figure 6.5.5. Irish Sea West (FU15): Burrow density distributions 2003–2008.

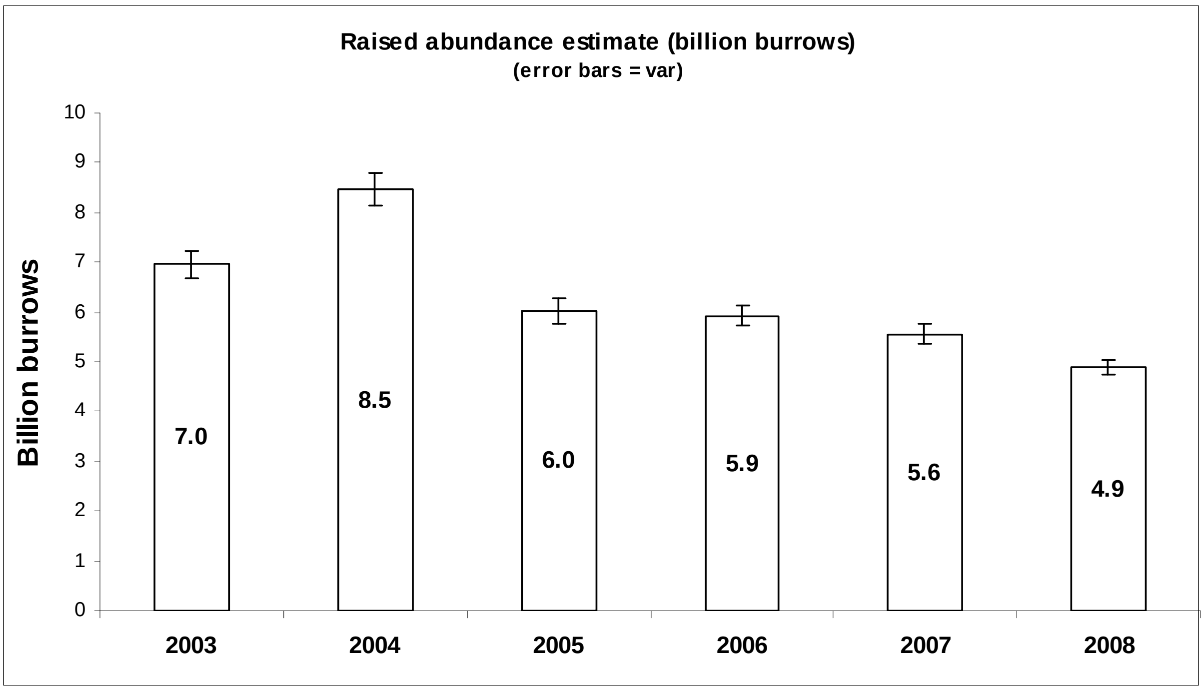


Figure 6.5.6. Irish Sea West (FU15): Burrow cluster abundance from UWTV surveys. Not corrected for bias.

6.6 Whiting in VIIa

Type of assessment

No assessment or data analyses are conducted this year and only input tables and text describing the fishery and input data has been updated. The advice is the same as last year.

ICES advice applicable to 2008

The Single Stock Exploitation Boundary advised by ICES for 2008 was as follows:

- Exploitation boundaries in relation to precautionary limits.

On the basis of the stock status ICES advises that catches of whiting in 2008 should be the lowest possible.

ICES advice applicable to 2009

Same wording of advice as for 2008.

6.6.1 General

Stock description and management units

The stock and the management unit are both ICES Division VIIa (Irish Sea).

Management applicable to 2008 and 2009

Recent management advice is summarized below:

YEAR	ACFM ADVICE	BASIS	TAC
2002	0	Lowest possible F	1000
2003	0	Lowest possible F	500
2004	0	Zero catch	514
2005	0	Lowest catch	514
2006	0	Lowest catch	437
2007	0	Lowest catch	371
2008	0	Lowest catch	278
2009	0	Lowest catch	209

There are no specific recovery plans for whiting in VIIa, however, the technical measures for cod described in Section 6.1 will also affect vessels catching whiting. The minimum landing size (MLS) for whiting is 27 cm. Section 6.1 summarizes the technical measures in place in the Irish Sea. Technical measures remain unchanged for 2008 and 2009.

Fishery in 2008

The closure of the western Irish Sea to whitefish fishing from mid February to the end of April, designed to protect cod, was continued in 2008 but is unlikely to have affected whiting catches which are mainly bycatch in the derogated *Nephrops* fishery. *Nephrops* vessels can obtain a derogation to fish in certain sections of the closed area, providing they fit separator panels to their nets to allow escape of cod and other fish. As in previous years, the Irish and UK NI *Nephrops* fishery demonstrates a peak in activity in summer, which is outside the time of the closed period for cod. In 2008, for the third year in succession, *Nephrops* landings by the Irish fleet fishing in the Smalls grounds (VIIg) have surpassed those from the Irish Sea grounds. This reflects the increasing amount of effort by Irish East Coast vessels in Division 7g where in general, better prices are obtained for their catch.

6.6.2 Data

An overview of the data provided and used by the WG is displayed in Table 2.1 (Section 2) in the WGCSE report.

Fishery landings

Table 6.6.1 gives the nominal landings of VIIa whiting as reported by each country to ICES. The officially reported landings have declined since 1996. While landings figure for most countries in 2008 continue this trend, Irish vessels had reported a peak in landings of 187 t in 2007, compared with 67 t in 2008 and 55 t in 2006. Working Group estimates of catch available since 1980 are illustrated in Figure 6.6.1 and indicate the declining trend since the start of the time-series.

No revisions to the previous years working group estimate of landings were made.

There is evidence that officially reported landings of whiting in the past (especially around the mid 1990s) have been inaccurate as a consequence of misreporting. Landings data have previously been partially corrected by using sample-based estimates of landings at a number of Irish Sea ports. As a result of the low level of landings recently, this has not been carried out since 2003.

The introduction of UK and Irish legislation requiring registration of fish buyers and sellers may mean that the reported landings from 2006 onwards are more representative of actual landings.

Sampling and raising methods previously used are described in the stock Annex for VIIa whiting. Methods for estimating quantities and composition of whiting landings from VIIa are described in the Stock Annex (Section B1.1).

Landings, discards and total catch numbers and weights-at-age for the period 1980 to 2002 as estimated by WGNSDS 2002 are given in Tables 6.6.3 to 6.6.8. The proportion of the total catch comprising of discards from the *Nephrops* fleets increased over time at-ages 1 and over (Table 6.6.9), although this will also reflect trends in catch of vessels not sampled for discards. While the proportion of discarded fish has increased this is largely because of the decline in abundance of marketable sized (>27 cm) whiting and the total volume over time has declined as revealed in Table 6.6.10. Mean weights-at-age for landings and discards are presented in Figure 6.6.3.

Since 2003 it has not been possible to construct catch numbers-at-age for this stock because of a number of factors, including low levels of landings leading to low levels of sampling and restricted access to some ports in some years.

Discards data

Discard Data available for Whiting VIIa include:

- Discard numbers-at-age from 1980–2002 estimated from the NI *Nephrops* fishery and raised to the International Fleet (from the NI self sampling scheme).
- Discard numbers-at-age from the Irish Otterboard Trawl Fleet from 1996–2008, including length frequency data.
- Discard Length Frequencies for the UK (E and W) fleet, 2004–2008, raised to trip.

- Discard numbers-at-age for the NI fleet for 1997–2001, and 2006–2008, raised to trip, including length frequency data from the NI observer scheme.

Methods for estimating quantities and composition of discards from UK (NI) and Irish *Nephrops* trawlers are described in the Stock Annex (Section B1.2). Irish discard estimates (1996–2008), raised according to the methods described in Borges *et al.*, 2005 were available to the Working Group (Table 6.6.11).

Mean weights-at-age are also presented (Figure 6.6.4 (b)).

The length frequency of discards of sampled fleets in 2008 is given in Figure 6.6.5.

Biological data

The derivation of these parameters and variables is described in the Stock Annex 6.6.

Survey data used in assessment

Table 6.6.2 describes the survey data made available to the working group. Slight revisions have been made to the UKE and W-BT survey time-series.

Figure 6.6.2 provides a comparison of mean catch weights of whiting from the eastern and western Irish Sea for UK (NI) groundfish surveys from March 1992 to March 2009 demonstrating a continued decline in catch rates since 2003.

Further information on whiting distribution is detailed in the results of Fisheries Science Partnership surveys of Irish Sea round fish stocks (www.cefas.co.uk/fsp).

Survey-series for whiting provided to the Working Group are further described in the stock Annex for VIIa whiting (SectionB.3).

Commercial cpue

Commercial catch and effort series data available to the Working Group are described in the stock Annex for VIIa whiting (Section B.4). Although effort data were provided for the UK (E&W) and Ireland, it was decided not to include these data in the report as it was considered not to be indicative of lpue trends because of the low levels of landings and changes in discard practices.

6.6.3 Historical stock development

Deviations from stock annex

The assessment does not deviate from the procedure used last year and described in the stock Annex.

The state of the stock

The state of the stock is unknown.

6.6.4 Short-term predictions

There is no analytical assessment for this stock.

6.6.5 Biological reference points

Precautionary approach reference points.

No precautionary reference points have been defined for this stock.

6.6.6 Uncertainties and bias in assessment and forecast

There is no analytical assessment for this stock.

6.6.7 Recommendations for next benchmark assessment

Before a benchmark can be recommended, it is first necessary to construct international catch numbers/weights-at-length and age for the main fleets engaged in the fishery since 2003. Effort data for the main fleets engaged in whiting VIIa fisheries are required to provide a time-series of trends in commercial lpue. None of these issues will be resolved in the short term and a benchmark assessment of this stock in the near future is unlikely.

Table 6.6.1 Nominal catch (t) of WHITING in Division VIIa, 1988-2008, as officially reported to ICES and Working Group estimates of discards.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Belgium	90	92	142	53	78	50	80	92	80	47
France	1,063	533	528	611	509	255	163	169	78	86
Ireland	4,394	3,871	2,000	2,200	2,100	1,440	1,418	1,840	1,773	1,119
Netherlands									17	14
UK(Engl. & Wales)[a]	1,202	6,652	5,202	4,250	4,089	3,859	3,724	3,125	3,557	3,152
Spain										
UK (Isle of Man)	15	26	75	74	44	55	44	41	28	24
UK (N.Ireland)	4,621									
UK (Scotland)	107	154	236	223	274	318	208	198	48	30
UK										
Total human consumption	11,492	11,328	8,183	7,411	7,094	5,977	5,637	5,465	5,581	4,472
Estimated Nephrops fishery discards used by the WG[b]	1,611	2,103	2,444	2,598	4,203	2,707	1,173	2,151	3,631	1,928
Working Group Estimates	11,856	13,408	10,656	9,946	12,791	9,230	7,936	7,044	7,966	4,205

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*
Belgium	52	46	30	27	22	13	11	10	4.2	3	1.9
France	81	150	59	25	33	29	8	13	3.7	3	0.25
Ireland	1,260	509	353	482	347	265	96	94	55.3	187	67.56
Netherlands	7	6	1								
UK(Engl. & Wales)[a]	1,900	1,229	670	506	284	130	82	47	21.7	3	10.7
Spain						85					
UK (Isle of Man)	33	5	2	1	1	1	1				
UK (N.Ireland)											
UK (Scotland)	22	44	15	25	27	31	6				
UK											
Total human consumption	3,355	1,989	1,130	1,066	714	554	204	164	84.9	196	80.41
Estimated Nephrops fishery discards used by the WG[b]	1,304	1,092	2,118	1,012	740	n/a	n/a	n/a	n/a	n/a	n/a
Working Group Estimates	3,533	2,762	2,880	1,745	1,487	676	184	158	86	196	80

[a] 1989-onwards Northern Ireland included with England and Wales.
[b] Based on UK(N.Ireland) and Ireland data.
[*] Preliminary.

Table 6.6.2. Whiting in VIIa. Survey data available to WGCSE 2009. Survey Titles highlighted in bold have been updated.

NIGFS West-October: Northern Ireland October Groundfish Survey - Irish Sea West - Nos. per 3 nm

1994 2008

1 1 0.83 0.88

0 5

1	6077	1139	36	33.0	1.8	0.1	1994
1	4660	962	130	10.0	4.7	1.5	1995
1	5933	792	117	20.0	1.7	0.5	1996
1	8722	628	125	10.0	4.9	0.2	1997
1	8199	708	134	16.0	0.7	0.0	1998
1	7481	360	44	4.0	1.4	0.0	1999
1	4037	593	32	2.0	2.1	0.3	2000
1	15262	761	205	16.0	0.1	0.0	2001
1	7229	1712	114	11.7	0.9	0.5	2002
1	8487	1600	469	19.1	1.2	0.1	2003
1	11446	1119	124	12.0	0.0	0.0	2004
1	5433	299	54	7.2	0.5	0.0	2005
1	4625	173	22	4.7	0.5	0.0	2006
1	5932	1491	125	4.2	0.2	0.0	2007
1	13253	2814	294	10.0	0.0	0.0	2008

NIGFS West-March: Northern Ireland March Groundfish Survey - Irish Sea West - Nos. per 3 nm

1994 2009

1 1 0.21 0.25

0 4

1	4307	73	121	6	0	1994
1	3604	988	53	30	1	1995
1	2323	587	188	11	15	1996
1	3250	447	52	14	1	1997
1	3857	535	71	9	3	1998
1	2373	228	39	7	2	1999
1	4037	231	23	3	0	2000
1	1998	631	30	2	1	2001
1	3580	163	36	3	0	2002
1	2952	812	25	6	1	2003
1	3568	174	36	1	0	2004
1	1219	97	6	1	0	2005
1	1266	150	12	0	0	2006
1	1825	190	10	1	0	2007
1	1254	290	17	1	0	2008
1	1941	227	10	1	0	2009

NIGFS East-October: Northern Ireland October Groundfish Survey - Irish Sea East - Nos. per 3 nm

1994 2008

1 1 0.83 0.88

0 5

1	749	472	179	165.0	29.0	3.0	1994
1	2515	259	178	41.0	47.0	9.0	1995
1	1005	517	127	64.0	15.0	10.0	1996
1	640	668	682	88.0	26.0	6.0	1997

1	1446	277	178	95.0	11.0	4.0	1998
1	2287	1388	260	102.0	79.0	3.0	1999
1	1972	1288	216	26.0	22.0	9.0	2000
1	2998	691	300	35.0	7.0	5.0	2001
1	1296	1285	349	76.0	8.5	2.0	2002
1	3783	1939	1104	155.4	25.0	3.2	2003
1	1820	521	347	109.1	7.7	1.7	2004
1	1247	865	296	17.5	1.9	0.6	2005
1	2304	150	52	9.0	2.1	0.0	2006
1	1094	827	165	18.4	2.9	3.1	2007
1	2329	873	81	1.3	0.2	0.0	2008

Table 6.6.2 (cont'd). Whiting in VIIa. Survey data available to WGCSE 2009.

NIGFS East-March: Northern Ireland March Groundfish Survey - Irish Sea East - Nos. per 3 nm

1993	2009					
1	1 0.21	0.25				
1	5					
1	611	290	390	47	12.0	1994
1	448	522	142	109	25.0	1995
1	1094	221	203	40	44.0	1996
1	561	1054	91	33	2.0	1997
1	409	903	522	32	11.0	1998
1	1023	407	135	52	6.0	1999
1	1481	524	229	35	4.0	2000
1	631	739	162	15	9.0	2001
1	869	1043	243	54	13.1	2002
1	1118	1328	178	24	5.7	2003
1	1026	302	69	4	1.6	2004
1	499	129	41	12	3.9	2005
1	964	323	39	10	0.7	2006
1	623	120	11	3	0	2007
1	669	417	51	3	0	2008
1	956	313	47	2	0	2009

UKE&W-BTS: Corystes Irish Sea Beam Trawl Survey (Sept) - Prime stations only - Effort and numbers-at-age (per km towed)

1988	2008		
1	1 0.75	0.79	
0	1		
1	326	134	1988
1	226	66	1989
1	316	242	1990
1	494	74	1991
1	451	596	1992
1	297	197	1993
1	196	133	1994
1	1952	74	1995
1	172	207	1996
1	406	277	1997
1	905	186	1998
1	581	153	1999
1	321	139	2000
1	596	197	2001
1	283	103	2002
1	520	184	2003
1	908	339	2004
1	845	293	2005
1	1019	222	2006
1	369	90	2007
1	826	85	2008

Table 6.6.2 (cont'd). Whiting in VIIa. Survey data available to WGCSE 2009.

NIGFS-Oct E&W: Northern Ireland October Groundfish Survey - Irish Sea East & West - Nos. per 3 nm

1992	2008						
1	1 0.83	0.88					
0	5						
1	1454	995	96	26.0	4.0	0.0	1992
1	1554	425	300	27.0	2.0	0.1	1993
1	2450	686	133	123.0	20.0	2.0	1994
1	3199	483	163	30.9	33.6	6.9	1995
1	2628	605	124	50.0	10.8	6.8	1996
1	3219	655	504	63.0	19.0	4.0	1997
1	3601	414	164	70.0	7.9	3.0	1998
1	3945	1060	191	70.0	54.1	1.7	1999
1	2631	1066	158	18.0	15.8	6.1	2000
1	6911	713	270	29.0	4.7	3.1	2001
1	3189	1421	274	55.4	6.1	1.5	2002
1	5284	1831	901	111.9	17.4	2.2	2003
1	4892	712	276	78.1	5.3	1.2	2004
1	2583	684	219	14.2	1.5	0.4	2005
1	3045	157	43	7.6	1.6	0.0	2006
1	2638	1039	153	13.8	2.0	2.1	2007
1	5815	1492	149	4.1	0.1	0.0	2008

NIGFS-March E&W: Northern Ireland March Groundfish Survey- Irish Sea East & West - Nos. per 3 nm

1992	2009						
1	1 0.21	0.25					
1	5						
1	1477	456	94	29	5.0	0.0	1992
1	667	655	67	9	2.0	0.5	1993
1	1790	221	304	34	8.0	5.0	1994
1	1696	698	116	85	17.0	3.0	1995
1	1478	280	160	28	32.0	5.6	1996
1	1419	860	79	27	1.7	4.3	1997
1	1730	767	196	12	3.3	0.1	1998
1	1453	350	104	38	5.0	1.0	1999
1	2297	431	163	25	2.7	0.0	2000
1	1067	704	120	11	7	1.6	2001
1	1734	762	177	38	9	0.3	2002
1	1703	1163	129	18	4	0.0	2003
1	1837	261	59	3	1	0.1	2004
1	729	119	30	9	3	0.3	2005
1	1054	274	31	7	1	0.1	2006
1	1007	142	11	2	0.1	0.0	2007
1	856	376	40	3	0.2	0.0	2008
1	1270	285	35	1	0.1	0.1	2009

Table 6.6.2 (cont'd). Whiting in VIIa. Survey data available to WGCSE 2009.

UKNI-MIK: Northern Ireland MIK Net Survey

1994	2008	
1	1 0.46	0.50
0	0	
1	778	1994
1	225	1995
1	397	1996
1	205	1997
1	59	1998
1	91	1999
1	40	2000
1	167	2001
1	19	2002
1	148	2003
1	101	2004
1	135	2005
1	118	2006
1	82	2007
1	99	2008

ScoGFS Spring: Scottish groundfish survey in Spring

1996	2006								
1	1	0.15	0.21						
1	8								
1	11610	4051	1898	362	229	59	3	4	1996
1	16322	16200	2953	964	250	105	39	1	1997
1	22145	8187	3817	137	110	0	5	0	1998
1	19815	6642	1706	282	11	0	27	0	1999
1	13019	1662	169	71	36	6	0	0	2000
1	9419	4541	407	40	2	0	0	0	2001
1	15605	3060	430	34	1	0	0	0	2002
1	14798	5404	375	45	0	4	0	0	2003
1	9199	2219	583	27	1	0	0	0	2004
1	3783	899	200	56	3	0	0	0	2005
1	7317	1040	319	32	2	0	0	0	2006

ScoGFS Autumn : Scottish groundfish survey

1995	2005							
1	1	0.83	0.91					
0	6							
1								
1	30094	8827	2530	435	215	4	0	1997
1	18457	7166	1291	37	35	26	0	1998
1	73309	7357	2166	263	219	0	6	1999
1	16862	8677	503	242	25	12	0	2000
1	0	140	133	13	0	0	0	2001
1	30324	16655	1435	224	2	28	0	2002
1	26671	7170	1138	69	0	0	0	2003
1	42435	19333	3321	319	3	0	0	2004
1	16510	3382	97	4	2	3	0	2005

Table 6.6.2 (cont'd). Whiting in VIIa. Survey data available to WGCSE 2009.

IR-ISCSGFS : Irish Sea Celtic Sea GFS 4th Qtr - Effort min. towed - No.-at-age
1997 2002
1 1 0.8 0.9
0 5

540	1566	3330	793	154	23	12	1997
1020	48396	6534	2249	170	15	0	1998
1170	208494	3302	624	24	28	2	1999
1128	97502	4402	25	1	0	0	2000
1221	28881	29577	3123	177	1	0	2001
1035	12112	10237	1497	225	33	5	2002

IR-Q4 IBTS: IRISH GFS RV Celtic Explorer: NUMBERS AT AGE
2003 2004
1 1 0.89 0.91
0 5

1	72340	19658	13391	1617	605	0	2003
1	75196	14563	1293	147	5	2	2004

IR-OTB : Irish Otter trawl - Effort in h - VIIa Whiting numbers-at-age - Year
1995 2002
1 1 0 1
1 6

80314	6	437	206	261	21	1	1995
64824	64	682	1528	266	71	4	1996
92178	3	368	494	418	55	19	1997
93533	20	395	838	117	27	30	1998
110275	34	398	531	130	19	3	1999
82690	40	192	155	58	8	0	2000
77541	13	397	444	42	22	3	2001
77863	21	173	383	88	8	8	2002

UKNI-Pelagic trawl : Northern Ireland Midwater trawlers - Effort in h - No per h fished
1993 2002
1 1 0 1
2 6

74014	3174	1060	172	29.5	4.8	1993
73778	1706	4340	574	72.8	16.2	1994
52773	1997	416	719	37.9	7.2	1995
53083	1432	2276	361	327.4	41.8	1996
55863	1241	660	549	12.3	17.5	1997
61153	438	423	98	45.8	2.7	1998
72859	162	185	57	13.5	11.6	1999
46412	67	53	11	7.9	1.1	2000
50302	7	4	2	0.5	0.2	2001
57754	189	316	90	11	15	2002

Table 6.6.2 (cont'd). Whiting in VIIa. Survey data available to WGCSE 2009.

UKNI-Otter trawl : Northern Ireland single-rig otter trawlers - Effort in h - No per h fished - includes discards

1993 2002

1 1 0 1

0 6

195323	10308	9217	21444	2791	261	28	2	1993
191705	3172	11286	3957	9723	747	75	16	1994
161025	5228	10692	8874	987	1312	17	1	1995
154418	8663	20784	6748	4623	551	460	56	1996
165612	4344	12001	5864	1292	528	7	7	1997
149088	5869	11381	2368	1135	200	50	1	1998
146990	14625	3517	1202	344	59	12	8	1999
130117	4403	12613	3082	520	61	14	8	2000
131418	10658	6663	1833	228	64	13	10	2001
108616	4601	8586	1068	265	44	3	2	2002

UKE&W-Otter trawl : England/Wales Otter Trawl

1981 2000

1 1 0 1

2 6

107	906	766	162	103	4	1981	
127	1984	893	340	67	49	1982	
88	685	1065	227	67	21	1983	
103	1395	439	475	80	29	1984	
103	2077	889	148	125	25	1985	
90	2246	1006	158	20	17	1986	
131	2206	1505	316	58	5	1987	
132	1885	827	161	30	6	1988	
140	1344	1201	234	40	10	1989	
117	2076	671	222	35	14	1990	
107	2374	793	165	48	5	1991	
97	2072	1020	177	42	3	1992	
79	784	654	157	31	5	1993	
43	110	454	91	15	3	1994	
43	460	188	375	7	1	1995	Revised at NSWG 1997
42	260	604	102	90	10	1996	
40	331	211	155	7	1	1997	
37	311	355	81	28	1	1998	
23	194	175	46	11	8	1999	
27	186	134	47	36	4	2000	

Table 6.6.3. Whiting in VIIa (Irish Sea). International catch-at-age ('000) for human consumption 1980 to 2002.Partially corrected for misreporting. No 2003–2008 estimates were possible due to low landings and resulting poor sampling.

Age	1980	1981
0	0	0
1	14520	11203
2	21811	29011
3	6468	16004
4	2548	2596
5	350	821
6+	621	339

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	41	0	0	0	0	0	0	0	0	102
1	5427	4886	18254	15540	6306	10149	6983	11645	9502	7426
2	18098	9943	12683	35324	16839	21563	25768	14029	17604	18406
3	19340	9100	5257	8687	10809	6968	6989	13011	4734	5829
4	6108	4530	2571	996	1877	1943	1513	3645	1477	993
5	813	1165	1045	675	285	242	396	490	318	311
6+	400	321	402	372	270	111	197	177	128	84

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0	38	0	0	129	0	0	1	0	0	0
1	8380	2742	3245	1124	1652	610	329	341	319	111	67
2	21907	21468	6983	10095	6162	4239	3287	2806	1364	1189	748
3	7959	7327	18509	3020	7432	2567	4727	2607	1002	1006	1480
4	1374	932	1801	4444	1263	1795	888	741	299	171	376
5	462	135	208	233	1082	87	261	160	115	53	48
6+	93	27	50	21	135	79	95	119	15	20	41

Table 6.6.4. Whiting in VIIa (Irish Sea). International catch-at-age ('000) discarded, 1980 to 2002. No 2003–2008 estimates were possible because of low landings and resulting poor sampling.

Age	1980	1981
0	12786	9865
1	32318	24935
2	6888	9162
3	65	162
4	26	26
5	0	0
6+	0	0

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	4047	23847	26394	12380	28364	16594	6922	17247	4216	20349
1	8489	7328	33900	26461	21111	40598	17958	20701	31810	29334
2	560	2036	1568	1859	1464	1875	1940	2476	3353	3823
3	19	9	11	9	33	0	0	26	72	146
4	0	0	0	0	0	0	0	0	0	1
5	0	0	0	0	0	0	0	0	0	0
6+	0	0	0	0	0	0	0	0	0	0

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	1497	12639	3731	7118	12732	8163	6096	20851	7321	16940	8538
1	61451	13979	12063	17613	39647	25497	27131	7677	38922	12631	13412
2	10404	17707	1812	7015	8168	5352	2293	2117	4395	3150	1588
3	97	426	1702	492	1976	689	550	228	564	102	231
4	0	5	29	234	81	141	44	34	55	10	33
5	0	0	0	0	0	0	0	2	1	0	0
6+	0	0	0	0	0	0	0	2	10	0	1

Table 6.6.5. Whiting in VIIa (Irish Sea). International catch-at-age ('000) landed and discarded, 1980 to 2002. No 2003–2008 estimates were possible because of low landings and resulting poor sampling.

Age	1980	1981
0	12786	9865
1	46838	36138
2	28699	38173
3	6533	16166
4	2574	2622
5	350	821
6+	621	339

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	4088	23847	26394	12380	28364	16594	6922	17247	4216	20451
1	13916	12214	52154	42001	27417	50747	24941	32346	41312	36760
2	18658	11979	14251	37183	18303	23438	27708	16505	20957	22229
3	19359	9109	5268	8696	10842	6968	6989	13037	4806	5975
4	6108	4530	2571	996	1877	1943	1513	3645	1477	994
5	813	1165	1045	675	285	242	396	490	318	311
6+	400	321	402	372	270	111	197	177	128	84

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	1497	12677	3731	7118	12861	8163	6096	20852	7321	16940	8538
1	69831	16721	15308	18737	41299	26107	27460	8018	39242	12742	13479
2	32311	39175	8795	17110	14330	9591	5580	4923	5758	4338	2336
3	8056	7753	20211	3512	9408	3256	5277	2835	1566	1108	1711
4	1374	937	1830	4678	1344	1936	932	776	354	181	409
5	462	135	208	233	1082	87	261	161	115	53	48
6+	93	27	50	21	135	79	95	121	25	20	42

Table 6.6.6. Whiting in VIIa (Irish Sea). International mean weight-at-age (kg) of the human consumption catch, 1980 to 2002. No 2003–2008 estimates were possible because of low landings and resulting poor sampling.

Age	1980	1981
0	0.133	0.133
1	0.216	0.216
2	0.269	0.269
3	0.365	0.365
4	0.533	0.533
5	0.630	0.630
6+	0.772	0.888

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.133	0	0.144	0	0.134	0	0	0	0	0.115
1	0.216	0.215	0.208	0.174	0.184	0.173	0.152	0.197	0.198	0.172
2	0.269	0.279	0.257	0.250	0.225	0.223	0.214	0.209	0.220	0.210
3	0.365	0.397	0.403	0.333	0.342	0.363	0.330	0.269	0.313	0.266
4	0.533	0.491	0.550	0.478	0.512	0.535	0.547	0.433	0.436	0.352
5	0.630	0.605	0.699	0.567	0.709	0.720	0.763	0.680	0.676	0.453
6+	0.736	0.655	0.745	0.642	0.940	0.933	1.005	1.079	0.800	0.692

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0	0.117	0	0	0	0	0	0.120	0.064	0	0
1	0.160	0.151	0.169	0.188	0.196	0.171	0.169	0.166	0.179	0.182	0.145
2	0.198	0.186	0.198	0.219	0.217	0.219	0.202	0.218	0.216	0.250	0.214
3	0.274	0.233	0.227	0.273	0.244	0.244	0.240	0.255	0.269	0.319	0.273
4	0.361	0.332	0.304	0.334	0.288	0.296	0.274	0.328	0.317	0.346	0.356
5	0.513	0.454	0.378	0.551	0.365	0.396	0.350	0.352	0.347	0.538	0.449
6+	1.007	0.892	0.496	1.320	0.415	0.537	0.421	0.328	0.412	0.337	0.428

Table 6.6.7. Whiting in VIIa (Irish Sea). International mean weight-at-age (kg) of the discarded catch, 1980 to 2002. No 2003–2008 estimates were possible because of low landings and resulting poor sampling.

AGE	1980	1981
0	0.034	0.034
1	0.062	0.062
2	0.125	0.125
3	0.230	0.230
4	0	0
5	0	0
6+	0	0

AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.029	0.033	0.024	0.022	0.023	0.024	0.021	0.026	0.034	0.030
1	0.072	0.101	0.075	0.080	0.058	0.078	0.069	0.063	0.060	0.051
2	0.125	0.147	0.130	0.137	0.126	0.157	0.114	0.105	0.113	0.115
3	0.141	0.245	0	0	0.155	0	0.449	0.091	0.115	0.130
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6+	0	0	0	0	0	0	0	0	0	0

AGE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0.014	0.029	0.029	0.031	0.026	0.026	0.017	0.028	0.024	0.017	0.016
1	0.050	0.050	0.048	0.055	0.051	0.041	0.034	0.038	0.036	0.034	0.033
2	0.110	0.089	0.123	0.120	0.111	0.101	0.090	0.086	0.100	0.088	0.082
3	0.137	0.143	0.154	0.153	0.161	0.141	0.130	0.147	0.128	0.119	0.127
4	0	0.175	0.149	0.179	0.186	0.170	0.145	0.237	0.150	0.194	0.141
5	0	0	0	0	0	0	0	0.218	0.213	0	0
6+	0	0	0	0	0	0	0	0.174	0.152	0	0.213

Table 6.6.8. Whiting in VIIa (Irish Sea). International mean weight-at-age (kg) of the total catch (landings plus discards) 1980 to 2002. No 2003–2008 estimates were possible due to low landings and resulting poor sampling.

Age	1980	1981
0	0.034	0.040
1	0.110	0.118
2	0.235	0.240
3	0.363	0.364
4	0.529	0.529
5	0.630	0.630
6+	0.772	0.888

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.031	0.033	0.032	0.021	0.025	0.024	0.021	0.026	0.036	0.031
1	0.135	0.146	0.125	0.107	0.100	0.101	0.088	0.111	0.094	0.077
2	0.265	0.256	0.244	0.245	0.217	0.217	0.201	0.193	0.204	0.194
3	0.365	0.397	0.403	0.333	0.342	0.363	0.330	0.269	0.310	0.263
4	0.533	0.491	0.550	0.478	0.512	0.535	0.547	0.433	0.436	0.352
5	0.630	0.605	0.700	0.567	0.709	0.720	0.763	0.680	0.676	0.453
6+	0.736	0.655	0.745	0.642	0.940	0.933	1.005	1.079	0.800	0.692

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0.014	0.029	0.030	0.031	0.027	0.026	0.017	0.028	0.024	0.017	0.016
1	0.063	0.067	0.074	0.063	0.057	0.044	0.035	0.044	0.038	0.036	0.033
2	0.170	0.142	0.183	0.179	0.159	0.153	0.156	0.161	0.127	0.132	0.124
3	0.272	0.228	0.221	0.257	0.230	0.222	0.228	0.246	0.218	0.301	0.253
4	0.361	0.331	0.301	0.326	0.284	0.287	0.268	0.324	0.291	0.338	0.339
5	0.513	0.454	0.378	0.551	0.364	0.396	0.350	0.351	0.347	0.538	0.449
6+	1.007	0.892	0.496	1.320	0.715	0.679	0.421	0.325	0.310	0.337	0.425

Table 6.6.9. Whiting in VIIa (Irish Sea). Estimate of Discarding from *Nephrops* fleet as proportion of total International Catch-at-age. This does not include discards from the fleets other than the *Nephrops* fleet.

AGE	0	1	2	3	4	5
1981	1.000	0.690	0.240	0.010	0.010	0
1982	0.990	0.610	0.030	0.001	0	0
1983	1.000	0.600	0.170	0.001	0	0
1984	1.000	0.650	0.110	0.002	0	0
1985	1.000	0.630	0.050	0.001	0	0
1986	1.000	0.770	0.080	0.003	0	0
1987	1.000	0.800	0.080	0	0	0
1988	1.000	0.720	0.070	0	0	0
1989	1.000	0.640	0.150	0.002	0	0
1990	1.000	0.770	0.160	0.015	0	0
1991	0.995	0.798	0.172	0.024	0.001	0
1992	1.000	0.880	0.322	0.012	0	0
1993	0.997	0.836	0.452	0.055	0.005	0
1994	1.000	0.788	0.206	0.084	0.016	0
1995	1.000	0.940	0.410	0.140	0.050	0
1996	0.990	0.960	0.570	0.210	0.060	0
1997	1.000	0.977	0.558	0.212	0.073	0
1998	1.000	0.988	0.411	0.104	0.047	0
1999	1.000	0.957	0.430	0.081	0.044	0.009
2000	1.000	0.992	0.763	0.360	0.154	0.005
2001	1.000	0.991	0.726	0.092	0.055	0
2002	1.000	0.995	0.680	0.135	0.081	0.000
Mean 81–02	0.999	0.817	0.311	0.070	0.027	0.001

Table 6.6.10. Whiting in VIIa (Irish Sea). Estimated landed and discarded catch. Partially corrected for misreporting.

	Catch ('000 t)	
Year	Landed	Discarded
1980	13461	3324
1981	17646	2960
1982	17304	808
1983	10525	1820
1984	11802	3433
1985	15582	2654
1986	10300	2115
1987	10519	3899
1988	10245	1611
1989	11305	2103
1990	8212	2444
1991	7348	2598
1992	8588	4203
1993	6523	2707
1994	6763	1173
1995	4893	2151
1996	4335	3631
1997	2277	1928
1998	2229	1304
1999	1670	1092
2000	762	2118
2001	733	1012
2002	747	740
2003	401	n/a
Mean:	7990	2253

Table 6.6.11. Whiting VIIa Discard Numbers and Mean Weights at Age of Irish otter trawl fleet 1996-2008

Age	1996 Numbers ('000)	1996 Weight (kg)	1997 Numbers ('000)	1997 Weight (kg)	1998 Numbers ('000)	1998 Weight (kg)	1999 Numbers ('000)	1999 Weight (kg)	2000 Numbers ('000)	2000 Weight (kg)	2001 Numbers ('000)	2001 Weight (kg)
0	5631.20	0.015	4110.63	0.027	5073.57	0.027	187.26	0.036	7850.12	0.033	20981.54	0.016
1	5925.33	0.035	8361.19	0.044	5939.53	0.064	276.50	0.102	3098.24	0.047	8883.11	0.054
2	1802.90	0.111	3243.45	0.120	3826.20	0.107	150.99	0.174	137.80	0.153	1413.48	0.126
3	144.34	0.217	696.18	0.200	440.05	0.185	43.70	0.235	30.31	0.229	479.38	0.133
4	6.02	0.206	68.71	0.241	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
5	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	22.95	0.136
6	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
7	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
8	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
9	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
10	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
11	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
12	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
13	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
14+	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
OTB Discards (tonnes, whole weight)		520.8		1024.1		1010.3		71.6		434.3		1054.5

Sampling Information	1996	1997	1998	1999	2000	2001
Number of Trips	8	8	7	4	10	2
Number of Hauls	48	44	58	40	111	34

Age	2003 Numbers ('000)	2003 Weight (kg)	2004 Numbers ('000)	2004 Weight (kg)	2005 Numbers ('000)	2005 Weight (kg)	2006 Numbers ('000)	2006 Weight (kg)	2007 Numbers ('000)	2007 Weight (kg)	2008 Numbers ('000)	2008 Weight (kg)
0	1921.76	0.016	17091.56	0.018	442.07	0.010	1534.97	0.016	5138.89	0.043	4585.77	0.025
1	2419.56	0.036	7347.29	0.034	2531.84	0.035	1483.43	0.060	23000.16	0.038	7879.78	0.040
2	1287.21	0.178	731.35	0.101	783.68	0.091	621.58	0.133	3282.67	0.095	1485.70	0.093
3	603.20	0.246	142.50	0.165	129.28	0.159	99.02	0.218	916.09	0.145	161.03	0.119
4	108.64	0.268	96.30	0.218	40.12	0.154	16.82	0.312	10.96	0.276	13.46	0.130
5	0.00	0.000	0.00	0.000	24.48	0.371	0.00	0.000	1.92	0.304	0.00	0.000
6	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
7	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
8	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
9	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
10	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
11	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
12	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
13	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
14+	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
OTB Discards (tonnes, whole weight)		523.6		680.3		201.3		223.2		1544.7		585.3

Sampling Information	2003	2004	2005	2006	2007	2008
Number of Trips	9	11	8	5	15	18
Number of Hauls	60	122	96	56	90	91

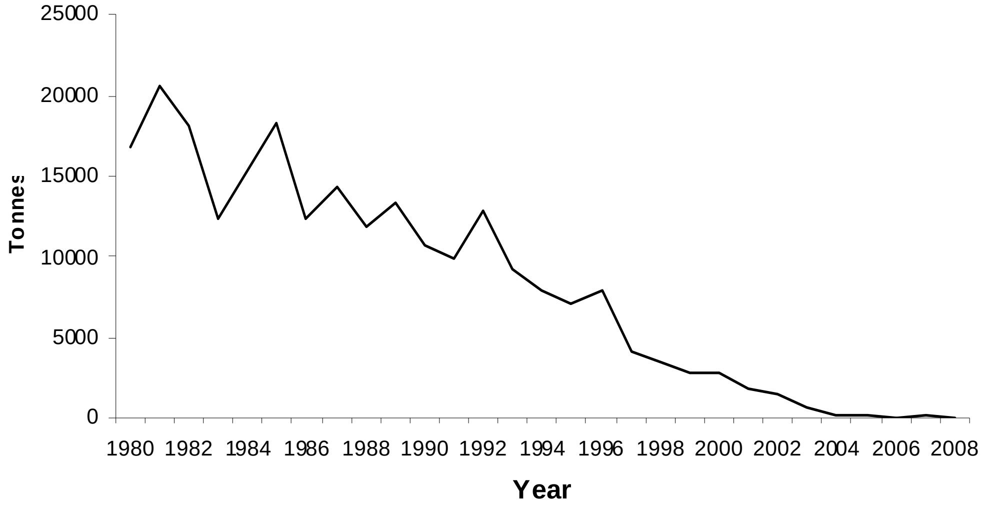


Figure 6.6.1 Whiting VIIa. Working group estimates of landings 1980-2008. Note landings data prior to 2003 has been adjusted for misreporting and includes estimates of discards.

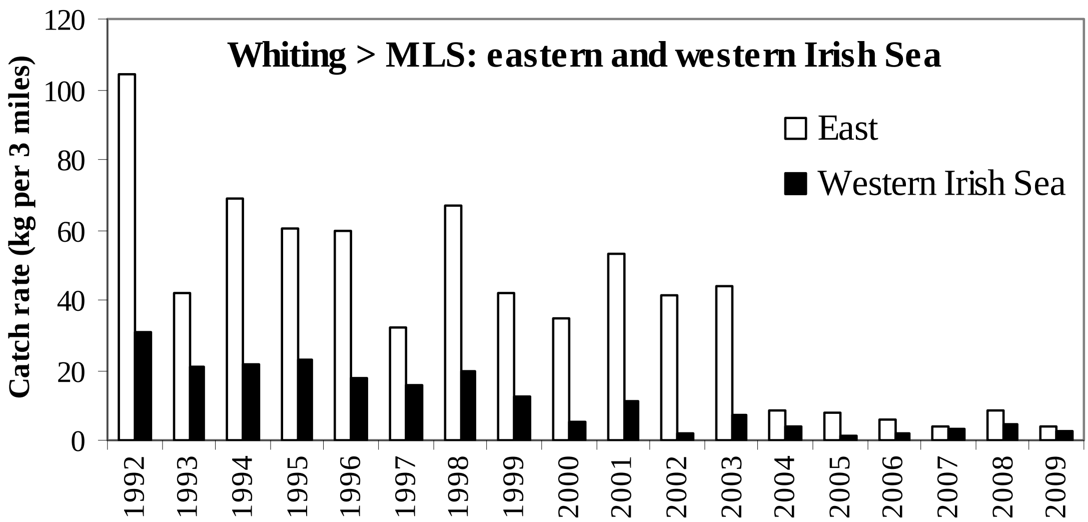
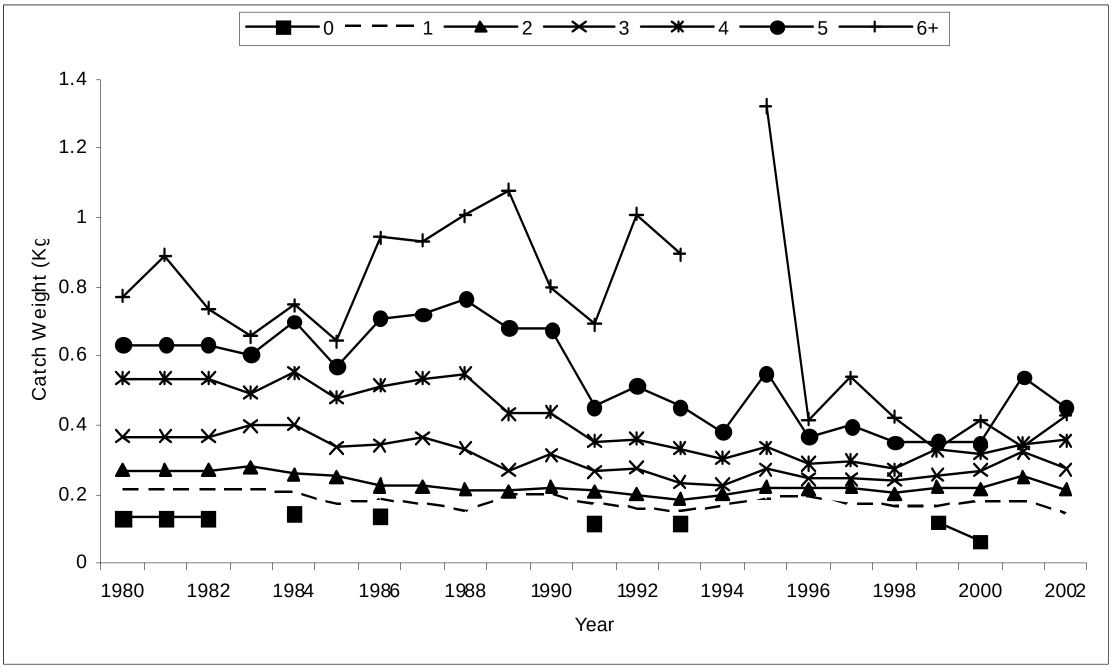


Figure 6.6.2.Mean catch rates in eastern and western Irish Sea of whiting in kg per 3-mile tow, for fish at and above the minimum landing size (27 cm) for UK (NI) groundfish surveys in March 1992–2009.

a)



b)

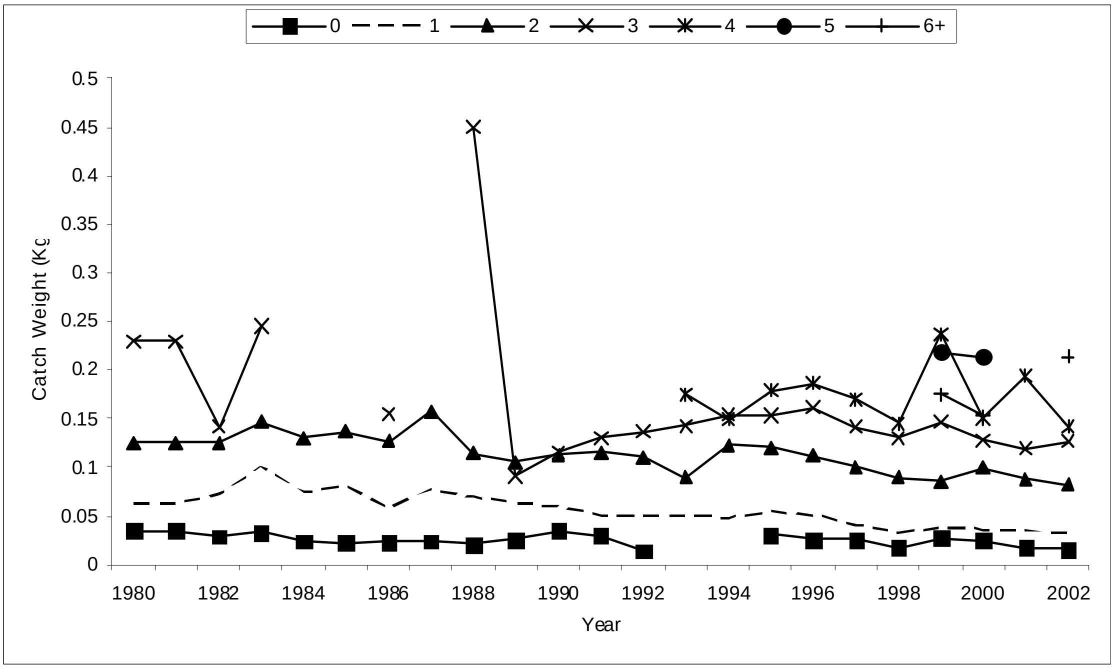
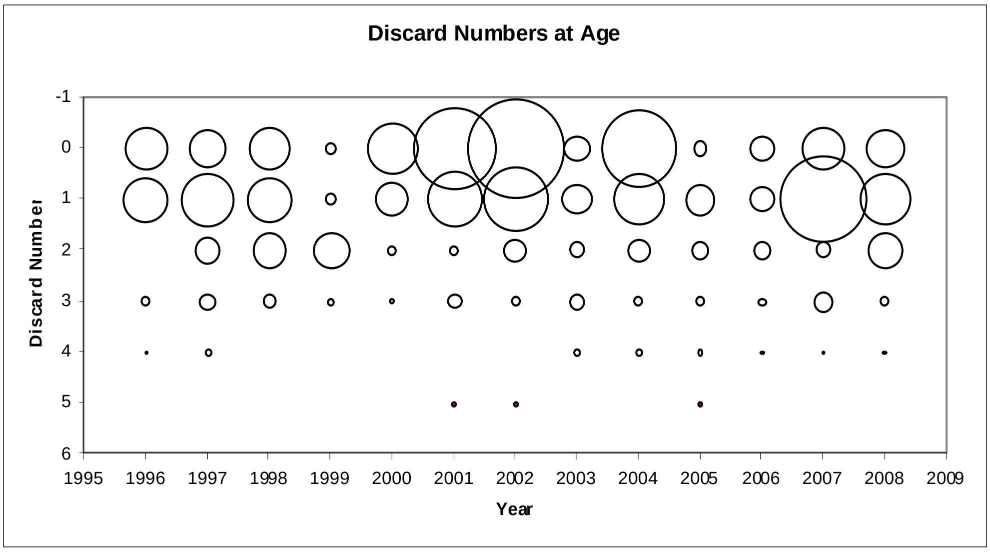


Figure 6.6.3 Mean weights at age in the Human Consumption Fishery (landings) (a) and in the Discards (b) for Whtiting in VIIa

a)



b)

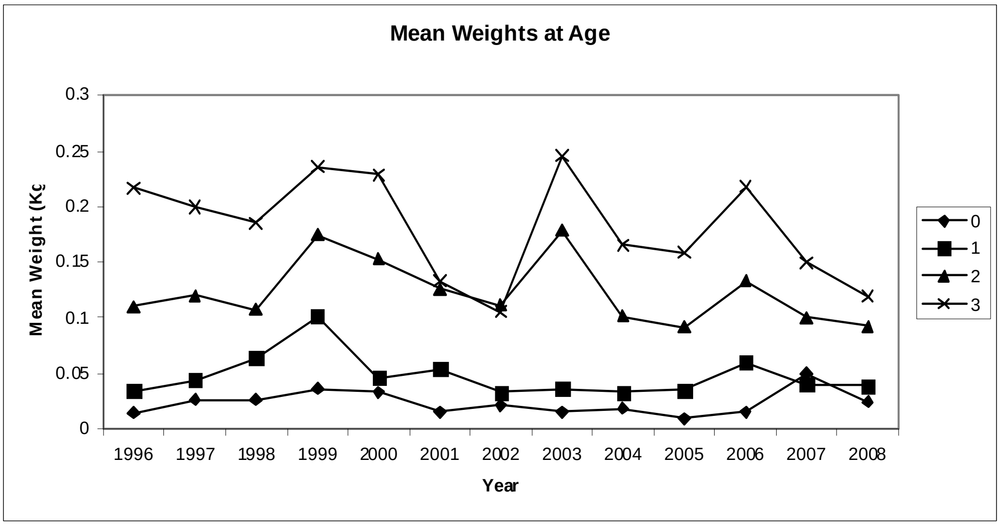


Figure 6.6.4 Whiting VIIa Discard Numbers (a) and Mean Weights at age (b) for the Irish Otterboard Trawl Fleet (1996-2008)

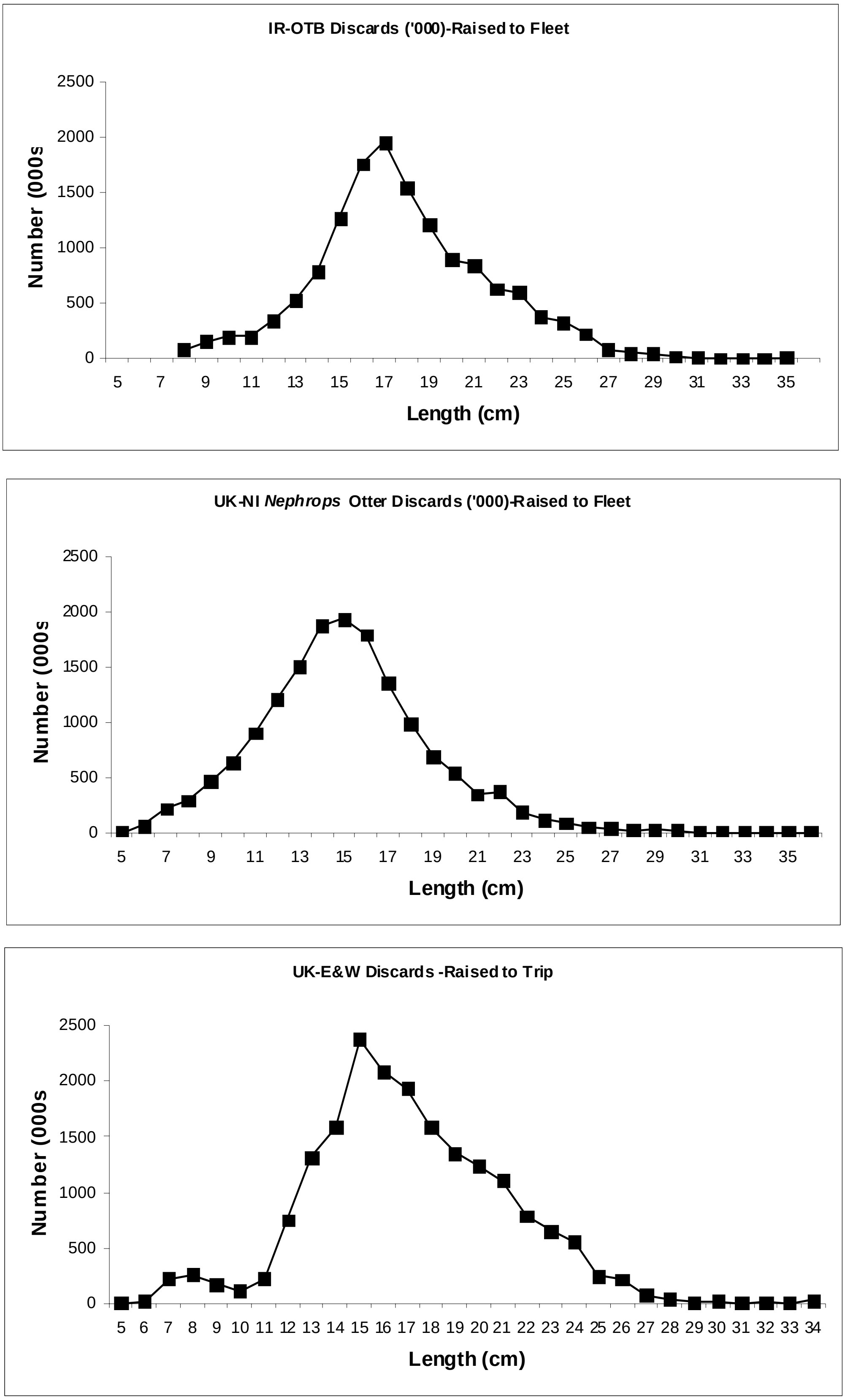


Figure 6.6.5 Discard Length Frequency of Whiting VIIa in 2008. Note due to low levels of retained catch, and hence low sampling, this data is not presented.

6.7 Plaice in Subdivision VIIa

Type of assessment in 2009

In accordance with the agreed protocols for this year's working group the final assessment has been presented as an update assessment using the same settings as last year.

ICES advice applicable to 2008

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects.

Fishing mortality is estimated to be below $\mathbf{F}_{0.1}$ (0.13). Fishing at $\mathbf{F}_{0.1}$ is expected to lead to landings of 1700 t in 2008.

There would be little gain to the long-term yield by increasing fishing mortalities above current levels.

Exploitation boundaries in relation to precautionary limits.

In order to harvest the stock within precautionary limits, fishing mortality should be kept below $\mathbf{F}_{pa}$ (0.45). This corresponds to catches of less than 5200 t in 2008 and will lead to a reduction in SSB to 10 200 t in 2009.

ICES advice applicable to 2009

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects.

The current fishing mortality (2007) is estimated to be 0.09, which is below the rate expected to lead to high long-term yields and low risk of stock depletion. There would be little gain to the long-term yield by increasing fishing mortalities above current levels. Fishing at $F_{0.1}$ corresponds to landings in 2009 of 1430 t.

Exploitation boundaries in relation to precautionary limits.

Fishing mortality should be kept below F_{pa} (0.45). This corresponds to catches of less than 3960 t in 2009 and will maintain SSB above B_{pa} in 2010.

6.7.1 General

Stock description and management units

Management applicable in 2008 and 2009

There is a minimum landing size in force for VIIa plaice of 27 cm.

Management of plaice in Division VIIa is by TAC and technical measures. The agreed TACs and associated implications for plaice in Division VIIa are detailed in the tables below.

2008

Species: Plaice *Pleuronectes platessa*		**Zone**: VIIa PLE/07A.
Belgium	47	
France	21	
Ireland	1 209	
The Netherlands	14	
United Kingdom	558	
EC	1 849	
TAC	1 849	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

2009

Species: Plaice *Pleuronectes platessa*		**Zone**: VIIa (PLE/07A.)
Belgium	37	
France	16	
Ireland	934	
The Netherlands	11	
United Kingdom	432	
EC	1 430	
TAC	1 430	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

The fishery in 2008

A general description of the fishery can be found in the stock annex and Section 6.1.

National landings data reported to ICES and Working Group estimates of total landings are given in Table 6.7.2.1. The TAC in 2008 was 1849 tonnes, with the working group estimate of landings in 2008 being 563 tonnes, which is approximately 30% of the allowable catch and representing a 30 % decrease comparable with 2007 landings. The shortfall of estimated landings from the total allowable catch has occurred in previous years, but appears to be increasing. It seems unlikely that the poor uptake of the quota is a consequence of an inability to catch sufficient quantities of plaice, and a shortfall in the uptake of the TAC is common for this stock.

Table 6.7.2.2 and Figure 6.7.2.1 show that effort levels have decreased between 2007 and 2008 for all fleets. The UK otter trawl fleet is at a series low, but anecdotal information from the fishing industry has suggested an abundance of plaice in Area VIIa in recent years. Belgian vessels operating in Division VII typically move in and out of the Irish Sea depending on the season, specifically the Bristol Channel and Celtic Sea, the Bay of Biscay and the southern North Sea. For the UK (E&W), the otter trawl fleet reports the majority (approximately 99%) of plaice landings, which are typically low in the first quarter when the fish are generally found further offshore in deeper water. The Irish fishery landings were split mostly between otter trawlers (51%), and beam trawlers (46%).

The beam trawl component is mostly taken as part of a mixed fishery, and some of the landings also come as bycatch from the *Nephrops* fishery. Landings by the otter fleet in 2008 were taken throughout the year with the highest landings occurring in quarter 1. The beam fleets were reasonably constant throughout the year except in quarter 2 which had lower landings.

High levels of discarding are known to occur in this fishery. Previous sampling studies for discards in the Irish Sea indicate that discarding of plaice is substantial and that only a small proportion of the total catch may be retained on board.

For general mixed fishery advice applicable to this stock and other species taken in the same fisheries see Section 6.1.

6.7.2 Data

Landings

National landings data reported to ICES and Working Group estimates of total landings are given in Table 6.7.2.1. Working Group estimate of landings in 2007 required updating following minor revisions by the UK(SCO)(same weight but redistributed through year) and Ireland (1495 t).

The procedures used to produce the landings figures are documented in the annex.

Discards

Routine discard sampling has been conducted by the UK (E&W) since 2000 and by Ireland since 1993. Northern Ireland has collected data from 1996 but not from 2003–2005 and Belgium since 2003. Length distribution estimates of landed and discarded fish are presented for UK (E&W) (Figure 6.7.2.3), Irish (Figure 6.7.2.4) and Belgian fleets (Figure 6.7.2.5), although Belgian data are missing since 2007.

Although these time-series of discard observations are available, they have so far not been raised to fleet level and are therefore not currently incorporated in the assessment. WKDRP has investigated the issue of raising discard samples to total catches but has not provided any clear advice on the best approach to adopt. In addition there is a considerable historical time period for which no discard sampling has taken place. Work is ongoing on the issue of raising samples and in the calculation of a historical time-series of discard data, but raising remains problematic given the low sampling levels. See Working Document 8. WGNSDS 2005.

Biological

Catch numbers-at-age are given in Table 6.7.2.5. Weights-at-age in the catch and stock are given in Tables 6.7.2.6–6.7.2.7. The history of the derivation of the catch weights and stock weights used in this assessment is described in the stock annex.

Catch weights-at-age for 2008 were obtained from the quadratic fit:

$$Wt = 0.0047*age^2 - 0.009*age + 0.2298$$

and used a SOP correction of 0.98571.

Catch weights-at-age calculations for this stock were problematic this year for ages greater than 12 because of the small number of sampled fish. Also UK (E&W) and Irish values of weight-at-age demonstrate very different values in these older fish. This needs to be addressed at the next benchmark assessment.

Surveys

All available tuning data are demonstrated in Table 6.7.2.4. As a consequence of inconsistencies in the available commercial tuning fleets, Irish Sea plaice assessments since 2004 have only included the UK (E&W) beam trawl survey (BTS) (September: 1989–2007) and the two UK (NI) spawning biomass indices. For more information see WGNSDS 2004.

Survey index log (cpue) plots demonstrated the UK (E&W) BTS to have good internal consistency, as can be seen by Figures 6.7.2.6 and 6.7.2.7.

The biomass indices of the UK (E&W) beam trawl survey indicates a rise over the time period (Figure 6.7.2.2), however this index covers only the eastern part of the Irish Sea so that the picture is not necessarily representative of the whole stock. Disaggregating the UK (NI) groundfish survey into areas corresponding to the UK beam trawl survey (Strata 4–7 in the UK (NI)) groundfish survey further complicates the picture (Figure 6.7.2.8), in part because the estimates are much more variable because this survey is not designed to target plaice. However, although there are varying trends seen in the indices between the surveys and years, the general trend appears to be an increase in abundance until the early 2000s at which point it begins to decrease, before increasing again in the last few years. The trends are broadly consistent with the UK (E&W) beam trawl survey as can be seen by Figure 6.7.2.2. The evidence suggests that biomass increased over the whole area until 2003, followed by a decline from these high levels thereafter. There is some evidence that biomass may be beginning to increase again.

SSB estimates of plaice in the Irish Sea are estimated using the Annual Egg Production Method (AEPM) and given below.

Year	SSB
1995	10 509
2000	14 700
2006	14 640

The results reveal substantial differences to ICES assessment values, but they do confirm that SSB of plaice in the Irish Sea is lightly exploited. For more details see stock annex.

Work is currently being undertaken to supply cpue values for the Q4 western IBTS survey (UK, E&W) for the Irish Sea area. It is anticipated that this time-series will contribute to this assessment in future once a sufficient time-series has been developed.

Commercial cpue

All available tuning data are demonstrated in Table 6.7.2.4. Age based tuning data available for this assessment comprise 3 commercial fleets; the UK (E&W) otter trawl fleet (UK (E&W) OTB, 1987–2008), the UK (E&W) beam trawl fleet (UK (E&W) BT, 1989–2008) and the Irish otter trawl fleet (IR-OTB, 1995–2008). As a consequence of inconsistencies in the available tuning fleets, Irish Sea plaice assessments since 2004 have omitted these indices. For more information see WGNSDS 2004.

Other relevant data

6.7.3 Stock assessment

Model:

ICA

Software:

FLICA. (Software versions are given in Table 6.7.3.1.)

Model options this year and last year:

Assessment year	2008		2009	
Assessment model	ICA		ICA	
Tuning fleets	UK(E&W)OTB		UK(E&W)OTB	
		Series omitted		Series omitted
	UK(E&W)BTS Sept		UK(E&W)BTS Sept	
		1989–2007		1989–2008
		ages 2–7		ages 2–7
	UK(E&W)BTS March		UK(E&W)BTS March	
		Survey omitted		Survey omitted
	UK(E&W)BT		UK(E&W)BT	
		Series omitted		Series omitted
	IR-OTB		IR-OTB	
		Series omitted		Series omitted
	UK(NI) GFS Mar		UK(NI) GFS Mar	
		1992–2007		1992–2008
		Biomass index		Biomss index
	UK(NI) GFS Oct		UK(NI) GFS Oct	
		1992–2007		1992–2008
		Biomass index		Biomass index
Time-series weights	Full-time-series unweighted		Full-time-series unweighted	
Num yrs for separable	7		8	
Reference age	5		5	
Terminal S	1		1	
Catchability model fitted	linear		linear	
SRR fitted	No		No	
Catch no-at-age range	2–9+		2–9+	

Input data:

As described in annex.

Data Screening

Data was screened as described in the annex.

Final Update Assessment

An update ICA assessment has been presented to the working group based on the settings used last year. A summary plot is shown in Figure 6.7.3.3.

The ICA assessment settings for this year are demonstrated in the Table above, with changes to the previous year's settings displayed in bold. Settings from previous year can be found in the annex.

Output from FLICA is given in Table 6.7.3.1, with F and population estimates given in Tables 6.7.3.2 and 6.7.3.3. Trends in the ICA residuals for UK (E&W) beam trawl survey and NIGFS biomass survey have been noticed in recent years, and are again present in this year's assessment (Figure 6.7.3.1). These will need to be investigated at the benchmark meeting.

A retrospective analysis was carried out and the results are shown in Figure 6.7.3.2. It can be seen that the assessment has a consistently biased retrospective pattern for SSB, recruitment and F, however a general trend of increasing SSB and decreasing fishing mortality is evident.

Comparison with previous assessments

Comparisons from this years and last year's ICA assessment are shown in Figure 6.7.3.4. SSB estimations are broadly similar to the exception of the later years, in which the 2009WG assessment demonstrates a smaller estimated increase. The recruitment comparison demonstrates a similar situation, with the 2009WG model revealing generally lower estimates of recruitment over the last few years. The F patterns both demonstrate a general reducing trend since the early nineties, but with the 2009WG model at slightly higher values.

State of the stock

Trends in F, SSB, recruitment and landings, for the full-time-series, are demonstrated in Table 6.7.3.4 and Figure 6.7.3.3. The update assessment estimates that fishing mortality rose to very high levels in the mid 1970s but has declined from these levels over the subsequent 40 years. Fishing mortality since the early 1990s has revealed a marked and almost continuous decline and in 2008 is estimated to be at its lowest level in the time-series (0.0626). Spawning biomass levels demonstrate a sinusoidal pattern over the time-series. High SSB levels occurred at the beginning of the time-series, and although it is estimated to have been steadily rising since 2000 it is still short of the earlier highs. Estimated recruitment levels have been variable over the time-series, but the levels declined markedly in the early 1990s and have displayed only minor variations until 2008, which has the highest value since 1988.

SSB in 2008 was above B_{pa}, and fishing mortality has been declining since the early 1990s and has been below F_{pa} since 1998.

6.7.4 Short-term projections

A forecast is presented in this Report as usual, as part of the update procedure, but as a consequence of the consistent retrospective bias in the assessment the Working Group considers any short-term forecast to be unreliable.

Population numbers for short-term forecasts were taken from the ICA output of survivors at-ages 4 and above in 2009. Numbers-at-age 2 were taken as GM(90–06) (8.4 million). Because of the considerable uncertainty of the estimate of recruitment-at-age

2 in 2008, populations numbers-at-age 3 in 2009 have been overwritten with the GM(90–06) estimate depreciated for F_{sq} and M (7418 age 3's in 2009).

The short-term forecast was run as a *status quo* projection. Input data are displayed in Table 6.7.4.1. The single option predicted forecast is given in Table 6.7.4.2, and the management option output is demonstrated in Table 6.7.4.3 and summarized in the Table below.

Year	Landings (t)	Source	SSB (t) Jan 1st	Source
2008	563	WG Estimate	8088	ICA
2009	957	SQ Forecast	9203	SQ Forecast
2010	1042	SQ Forecast	10 130	SQ Forecast

Proportions that the 2004 to 2008 year classes will contribute to landings and SSB in 2009 and 2010 are demonstrated in Table 6.7.4.4. Approximately 19% of the predicted landings in 2009 and 40% of the predicted landings in 2010 rely on year classes for which geometric mean recruitment has been assumed.

The predicted catch for 2009 assuming status quo F is 957 t, and SSB is predicted to increase to 9203t. The TAC for 2009 is 1430 t.

Estimating recruiting year-class abundance

The update ICA estimates the strength of the 2006 year class at 13.2 million two year olds in 2008, which is above GM64–06 (11.8 million) and the arithmetic mean (1964–2006) (12.7 million). Considering the consistently low recruitment levels since the 1990s (Figure 6.7.3.3), GM90–06 (8.4 million) is used as the recruit estimates in the short-term forecast.

Earlier analyses have however revealed that recruitment estimates can be variable depending on model settings, and consequently recruitment is considered to be poorly estimated.

The recruitment estimates using ICA and GM90–06 are summarized below. Those used for the short-term forecasts are displayed in bold.

UPDATE ASSESSMENT	ICA ESTIMATE	GM 90–06
2008 recruitment-(000's) at-age 2	13 238	**8428**
2009 recruitment-(000's) at-age 2		**8428**
2010 recruitment-(000's) at-age 2		**8428**
2011 recruitment-(000's) at-age 2		**8428**

6.7.5 Medium-term projections

There are no medium term projections for this stock.

6.7.6 Biological reference points

Biological reference points were proposed for this stock by the 1998 Working Group as below:

F_{lim}	No proposal	
F_{pa}	0.45	(on the basis of F_{med} and long-term considerations)
B_{lim}	No proposal	

B_{pa}	3100 t	(on the basis of B_{loss} and evidence of high recruitments at low SSBs)

Yield-per-recruit analyses were performed and are presented in Table 6.7.4.5 and Figure 6.7.3.5, but given the uncertainties associated with the short-term forecast of this stock, the results should be treated with caution. F_{max} was calculated as 0.4365 and $F_{0.1}$ as 0.1385.

6.7.7 Management plans

There is no management plan for this stock. The cod long-term management plan does affect métiers catching plaice in the Irish Sea.

6.7.8 Uncertainties and bias in assessment and forecast

Discard levels in this fishery are estimated to be very high and fish at the younger ages may be subject to substantially greater mortality levels than currently estimated. The landings of young fish represent only a small proportion of those caught and the lack of adequate information on mortality rates at these ages seriously impairs the ability to estimate recruitment levels in the population. There are no sufficiently reliable estimates of discard levels for the entire time-series of catch for this stock, to allow inclusion in the assessment.

It has been noted in previous years that aspects of this assessment appear to be deteriorating. Specific concerns in recent years have been the contradictory signals provided by the surveys, the lack of contrast in the strength of incoming year classes and a retrospective bias in estimates of F and SSB.

Catch weights-at-age calculations for this stock were problematic this year for ages greater than 12 because of the small number of sampled fish. Also UK (E&W) and Irish values of weight-at-age reveal very different values in these older fish. This needs to be addressed at the next benchmark assessment.

The only age based tuning data in this assessment is restricted to the area where the increase in the plaice stock appears to be most dramatic. Further work needs to be carried out to determine to which degree the rise in SSB predicted by the UK (E&W) beam trawl survey is representative of the stock as a whole.

There is evidence of a decline in weight-at-age from the raw commercial landings data. This is less apparent in the available survey data.

6.7.9 Recommendations for next benchmark

2009 ICES review:

The 2009 ICES review group raised concerns regarding the lack of discard information in the analysis. Although investigations into methods of determining age based estimates of discards for the entire time-series of catch have been undertaken the results are not considered reliable enough to include as part of an assessment. It was also suggested that further investigations be made to determine to which degree the rise in SSB predicted by the UK (E&W) beam trawl survey is representative of the stock as a whole. These issues should be addressed at the flatfish benchmark meeting scheduled for later this year.

YEAR	CANDIDATE STOCK	SUPPORTING JUSTIFICATION	SUGGESTED TIME	INDICATE EXPERTISE NECESSARY AT BENCHMARK MEETING.
2009	VIIa Plaice	Discards not available for assessment but are considered significantly larger than landings. Catch weights display trends in recent years and it was noticed in 2009 that UK (E&W) and Irish catch-at-wgt data demonstrate very different results. It is unsure whether the only age based indices used to tune the assessment are representative of the stock.	2011	Expert group members.

6.7.10 Management considerations

Status quo F (average 2006–2008) is estimated to be 0.0969; below $\mathbf{F_{0.1}}$ and well below $\mathbf{F_{pa}}$. SSB in 2008 is estimated at 8088 t, and at 9203 t in 2009, both of which are well above $\mathbf{B_{pa}}$ (3100 t). However, given the poor fit of the assessment model, estimates of fishing mortality and stock biomass should be interpreted with caution.

Although the precise levels of F and SSB are considered poorly estimated, the overall state of the stock is consistently estimated to have low fishing mortality ($<F_{pa}$) and high spawning biomass ($>B_{pa}$). Therefore the stock is considered to be within safe biological limits.

A fishing mortality of F_{pa} (0.45) forecasts that landings in 2010 would be 4103 tonnes (Table 6.7.4.3). This however requires a substantial increase in F (F multiplier = 4.64), and the landings would be far greater than the current TAC level, which is currently not met by the fishery. However, as a consequence of the consistent retrospective bias in the assessment the Working Group considers any short-term forecast to be unreliable and the results should therefore be treated with caution.

The considerable level of discarding in this fishery indicates a mismatch between the minimum landing size and the mesh size of the gear being used. A decrease in the minimum landing size would not resolve the discarding problem as the market for small plaice is generally poor.

Table 6.7.2.1 Nominal landings (t) of PLAICE in Division VIIa as officially reported to ICES.

Country	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008 [1]
Belgium	321	128	332	327	3443	459	327	275	325	482	636	628	431	566	343	194	156
France	42	19	13	10	11	8	8	5	14	91	8	7	2	9	2	2	1
Ireland	1,355	654	547	557	538	543	730	541	420	378	370	490	328	272	179	194	101
Netherlands	-	-	-	-	69	110	27	30	47	-	-	-	-	-	-	-	
UK (Eng.&Wales)[2]	1,381	1,119	1,082	1,050	878	798	679	687	610	607	569	409	369	422	414	412	316
UK (Isle of Man)	24	13	14	20	16	11	14	5	6	1	1	1	0	0	0	0	…
UK (N. Ireland)	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
UK (Scotland)	70	72	63	60	18	25	18	23	21	11	7	9	4	1	0	0	0
UK (Total)																	
Total	3,193	2,005	2,051	2,024	1,874	1,954	1,803	1,566	1,443	1,488	1,591	1,544	1,134	1,270	934	801	534
Discards	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unallocated	74	-9	15	-150	-167	-83	-38	34	-72	-15	31	10	-19	226	-2	-3	-29
Total figures used by the Working Group for stock assessment	3,267	1,996	2,066	1,874	1,707	1,871	1,765	1,600	1,371	1,473	1,623	1,559	1,143	1,281	932	805	563

[1]Provisional.

[2]Northern Ireland included with England and Wales.

{UK (Total) excludes Isle of Man data}.

Table 6.7.2.2 Irish Sea plaice. English standardised LPUE and effort, Belgian beam trawl LPUE and effort and Irish otter trawl LPUE and effort series

Year	LPUE							Effort ('000hrs)				
	Beam [4] trawl survey		English [1]		Belgian [3]	Ireland[7]		English [2]		Belgian [5]	Ireland	
	March	September	Otter Trawl	Beam Trawl	Beam Trawl	Otter Trawl	Beam Trawl	Otter Trawl	Beam Trawl	Beam Trawl	Otter Trawl	Beam Trawl
1972			6.96		9.8			128.4		6.8		
1973			6.33		9.0			147.6		16.5		
1974			7.45		10.4			115.2		14.2		
1975			7.71		10.7			130.7		16.2		
1976			5.03		5.8			122.3		15.1		
1977			4.82		5.3			101.9		13.4		
1978			6.77	4.88	6.9			89.1	0.9	12.0		
1979			7.18	15.23	8.0			89.9	1.7	13.7		
1980			8.24	8.98	8.6			107.0	4.3	20.8		
1981			6.87	4.91	7.1			107.1	6.4	26.7		
1982			4.92	1.77	4.4			127.2	5.5	21.3		
1983			5.32	3.08	7.8			88.1	2.8	18.5		
1984			7.77	6.98	6.8			103.1	4.1	13.6		
1985			9.97	25.70	8.8			102.9	7.4	21.9		
1986			9.27	4.21	8.7			90.3	17.0	38.3		
1987			7.20	3.57	8.2			130.6	22.0	43.2		
1988		392	5.02	3.05	6.3			132.0	18.6	32.7		
1989		253	5.51	13.59	6.2			139.5	25.3	36.7		
1990		239	5.93	12.02	7.2			117.1	31.0	38.3		
1991		157	4.79	10.56	7.5			107.3	25.8	15.4		
1992		188	4.20	9.99	11.9			96.8	23.4	23.0		
1993	91	235	3.97	9.50	5.0			78.9	21.5	24.4		
1994	128	225	4.90	7.79	9.2			43.0	20.1	31.6		
1995	134	169	5.08	7.69	9.5	3.2	17.0	43.1	20.9	27.1	80.3	8.6
1996	-[6]	210	5.37	12.96	11.8	4.1	18.9	42.2	13.3	22.2	64.8	6.3
1997	147	262	5.25	7.66	13.9	3.1	13.7	39.9	10.8	29.3	92.2	9.0
1998	113	249	5.00	5.66	12.3	3.7	22.2	36.9	10.4	23.8	93.5	11.6
1999	-[6]	264	5.38	7.76	12.0	2.3	23.2	22.9	11.0	22.1	110.3	14.7
2000	-[6]	357	5.02	13.04	11.6	2.0	13.8	27.0	6.3	18.2	82.7	11.4
2001		281	3.35	8.33	13.6	2.5	10.8	33.0	12.5	28.5	77.5	13.1
2002		340	5.66	5.46	10.7	2.8	7.9	24.8	8.0	36.2	77.9	17.7
2003		503	2.60	3.76	8.8	4.1	9.5	23.9	14.0	23.0	73.8	18.7
2004		540	3.17	4.20	14.9	2.1	8.6	23.5	7.4	27.6	72.5	14.2
2005		367	4.85	4.67	15.3	2.0	8.0	16.7	11.6	31.8	68.3	14.7
2006		356	6.50	2.19	11.6	1.4	6.3	5.2	4.6	28.1	64.9	11.9
2007		432	17.94	4.22	8.4 [8]	1.2	6.1	4.4	3.2	19.4 [8]	73.2	14.0
2008		397	9.03	4.47	13.3 [8]	0.9	5.2	2.7	1.3	10.1 [8]	58.8	9.5

1 Whole weight (kg) per corrected hour fished, weighted by area
2 Corrected for fishing power (GRT)
3 Kg/hr
4 Kg/100km
5 Corrected for fishing power (HP)
6 Carhelmar survey, Kg/100km not available
7 All years updated in 2007 due to slight historical differences
8 Raw effort data not corrected.

Fishing power corrections are detailed in Appendix 2 of the 2000 working group report

Table 6.7.2.3 Irish Sea Plaice: UK (NI) index of relative SSB trends by region

NI_GFS Mar

	Estimated mean abundance			Estimated standard error		
Year	Combined Str1-7	West Str1-3	East Str4-7	Combined Str1-7	West Str1-3	East Str4-7
1992	9.59	6.40	10.54	4.39	2.13	5.66
1993	13.27	21.40	10.85	2.22	5.56	2.36
1994	10.09	5.38	11.50	2.56	1.83	3.27
1995	7.59	6.56	7.89	1.39	1.66	1.74
1996	7.96	14.41	6.04	1.68	5.94	1.28
1997	13.73	15.80	13.11	3.99	6.78	4.76
1998	12.50	19.61	10.38	3.62	10.88	3.39
1999	9.37	19.10	6.46	2.34	7.42	2.09
2000	15.79	35.36	9.96	5.40	22.56	1.97
2001	13.52	23.78	10.46	2.11	6.21	2.02
2002	13.36	25.65	9.70	3.24	8.93	3.25
2003	26.79	55.52	18.23	8.36	32.38	4.95
2004	10.55	8.60	11.13	4.77	5.23	7.58
2005	15.86	27.20	12.48	3.54	8.59	3.82
2006	9.57	16.33	7.55	1.80	6.15	1.45
2007	8.73	21.76	4.84	1.81	7.00	1.06
2008	6.33	9.26	5.46	0.90	5.71	1.01
2009	11.00	17.85	8.96	1.89	4.61	2.03

NI_GFS Oct
Autumn

	Estimated mean abundance			Estimated standard error		
Year	Combined Str1-7	West Str1-3	East Str4-7	Combined Str1-7	West Str1-3	East Str4-7
1991	0.81	3.38	0.04	0.39	1.71	0.03
1992	4.83	2.76	5.45	0.85	1.26	1.04
1993	4.64	2.91	5.16	0.95	1.18	1.18
1994	9.20	8.65	9.36	2.27	3.74	2.72
1995	4.77	8.31	3.72	1.28	3.52	1.29
1996	8.69	9.95	8.32	2.15	5.67	2.22
1997	8.22	7.67	8.38	2.18	2.80	2.71
1998	5.39	4.21	5.74	1.45	2.39	1.75
1999	6.90	4.91	7.50	2.29	3.12	2.82
2000	10.50	2.84	12.78	6.42	1.16	8.33
2001	13.93	4.03	16.88	6.45	1.96	8.35
2002	9.98	6.63	10.98	3.80	3.45	4.82
2003	18.65	10.09	21.20	5.41	4.87	6.87
2004	8.49	2.52	10.28	1.90	1.10	2.44
2005	11.58	3.88	13.88	4.39	2.39	5.66
2006	7.20	2.59	8.57	1.98	1.47	2.53
2007	8.48	6.09	9.19	1.69	2.55	2.05
2008	11.28	4.66	13.26	3.06	2.50	3.91

Table 6.7.2.4. Irish Sea Plaice: tuning fleet data available. Figures shown in bold are those used in the assessment.

Irish Sea plaice, 2008

101

UK BT SURVEY (Sept-Trad) - Prime stations only

1989 2008

1 1 0.75 0.85

1 8

129.710 309 441 530 77 13 44 3 0

128.969 1688 405 176 90 54 30 3 1

123.780 591 481 68 47 4 4 24 3

129.525 1043 470 267 23 19 14 14 3

131.192 1106 812 136 101 16 8 21 4

124.892 815 608 307 68 33 12 17 8

126.004 1283 387 179 84 16 18 0 1

126.004 1701 601 124 74 49 9 11 1

126.004 1363 668 322 65 50 23 8 7

126.004 1167 767 212 95 34 23 14 3

126.004 1189 965 344 113 38 17 7 7

126.004 2112 659 298 141 73 22 7 3

126.004 1468 663 218 130 89 28 10 7

126.004 1734 1615 647 243 79 51 16 17

126.004 1480 1842 827 296 122 62 39 10

126.004 1816 1187 1184 404 261 57 57 14

122.298 869 1295 666 499 297 111 17 17

123.743 1220 840 722 411 178 83 59 16

126.004 2667 1255 525 417 196 95 45 37

UK(E+W)TRAWL FLEET (calculated using ABBT age compositions)

1987 2008

1 1 0 1

1 14

130.597 24.4 1475.8 1434.6 1593.3 409.0 291.2 31.4 46.8 16.9 24.2 11.2 1.4 3.2 3.6

```
131.950 22.0 1374.8 1421.0  455.0 295.5 142.5 78.9  8.1 28.9  6.7  9.6 3.5 4.1 1.1
139.521 10.6  771.5 2102.0  801.1 235.2  99.8 48.0 37.6 13.7 11.0  6.3 6.7 3.2 1.7
117.058  8.2  501.0 1094.3  983.9 217.0  82.8 60.0 17.5 15.9  4.5  3.2 6.7 3.0 2.2
107.288 94.3  949.9  451.3  419.5 245.0  99.7 35.2 38.7 12.1 11.1  0.6 3.6 1.8 1.5
 96.802 80.8  851.1  907.2  181.3 114.6  82.4 28.6  8.3 17.8  7.3  5.4 0.4 1.3 0.8
 78.945 12.9  387.7  519.1  367.7  63.5  55.7 69.5 21.8  5.2 10.7  2.6 1.1 0.0 0.2
 42.995 38.8  408.3  534.9  142.5  92.5  18.2 12.3 15.9  7.3  1.8  1.3 2.2 0.5 0.0
 43.146  7.3  350.1  512.5  255.7  88.9  46.1 10.9  4.8  8.3  2.4  1.7 0.7 0.2 0.2
 42.239 10.9  326.5  280.3  198.7  80.5  32.9 15.3  4.8  2.0 10.0  2.1 0.7 0.6 0.1
 39.886 11.2  250.6  214.7  125.2  74.2  37.5 12.8 12.4  1.8  0.8  1.4 0.4 0.2 0.7
 36.902  1.6  202.7  318.6  105.3  40.6  37.6 16.5  9.8  4.5  0.5  0.5 1.0 0.3 0.2
 22.903 17.6  139.2  200.5  120.0  35.0  14.0  9.0  5.4  1.6  0.8  0.2 0.1 0.1 0.0
 26.967  0.0  107.1  233.3  185.0  95.5  18.5 14.4  9.8  5.9  2.7  2.1 0.9 0.4 .01
 32.964  5.5   65.9  130.4  124.0 108.7  53.2 17.4 10.6  7.1  3.0  0.5 0.7 0.1 0.1
 24.762  0.5   78.6  175.8   95.3  58.6  33.0 23.8  3.3  2.5  1.4  0.4 0.4 0.0 0.1
 23.851  0.0   34.1   79.6   88.7  35.6  16.1 12.3  7.4  2.3  0.4  0.3 0.2 0.0 0.2
 23.456  1.5   34.8  149.1  103.1  60.6  27.0  8.7  5.8  4.3  1.2  0.7 0.2 0.1 0.0
 16.683  0.0   32.6   52.6  108.1  95.1  40.0 17.8  7.5  5.4  1.7  1.3 0.6 0.2 0.1
  5.218  0.8   15.1   46.9   34.8  55.1  23.4 13.9  4.9  2.6  1.9  0.7 0.6 0.1 0.0
  4.404  0.0    2.5   33.7   94.5  58.4  50.4 17.3 16.7  2.2  1.5  0.5 0.3 0.1 0.0
  2.710  0.1    5.8   27.8   37.9  40.9  23.9 15.4  7.3  2.9  1.1  0.5 0.2 0.1 0.0

UK(E+W)BEAM TRAWL FLEET
1987 2008
1 1 0 1
1 14
21.997  0.0   1.1  27.1 113.1 36.0 31.3  2.9  6.7  1.9 3.1 0.6 0.1 0.2 0.1
18.564  0.0   2.0  48.0  23.7 24.4 13.2  8.5  1.4  2.6 1.6 1.5 0.6 0.8 0.3
25.291  3.1 132.8 297.5 163.4 52.6 42.4 25.1 16.1  4.3 5.3 3.3 5.7 2.6 1.1
31.003  2.2 136.2 391.9 361.1 78.2 30.2 17.2  8.4  3.6 1.5 1.9 3.8 1.4 0.5
25.838 17.3 282.5 182.9 174.5 91.8 35.9 11.2 11.8  3.5 4.7 0.2 1.0 0.6 0.3
23.399  3.9 141.5 335.6  79.6 64.6 45.5 18.6  8.0 12.2 7.1 4.0 0.2 0.7 1.0
21.503  0.6  73.4 112.8  95.2 23.3 24.2 32.0 11.8  4.5 7.1 2.2 1.2 0.0 0.4
```

```
20.145 13.4 151.8 186.1  39.9 26.0  6.8  6.6  7.8  3.5 1.2 0.9 1.2 0.2 0.0
20.932  5.2 183.4 229.1 100.6 33.1 16.1  3.9  1.7  3.3 1.0 0.9 0.5 0.1 0.2
13.320 13.4 144.0 111.4  75.3 30.8 11.0  5.9  2.1  1.2 2.7 0.5 0.2 0.4 0.3
10.760  0.9  98.6  69.5  39.0 30.2 13.5  3.7  3.2  0.5 0.4 0.3 0.2 0.1 0.1
10.386  0.3  63.5 103.7  32.6 12.0  9.7  6.3  2.7  1.8 0.3 0.2 0.5 0.2 0.0
11.016  4.8  51.3 124.4  80.4 24.4 12.5 10.5  5.6  0.9 0.8 0.2 0.2 0.2 0.1
 6.275  0.0  25.2  61.4  46.6 27.9  7.3  6.5  4.5  1.9 0.7 0.7 0.7 0.1 0.1
12.495  1.5  20.6  47.5  56.6 42.7 20.8  7.0  4.5  2.5 1.2 0.4 0.1 0.1 0.0

 8.017  0.0  11.5  33.1  21.0 18.8 14.9  8.0  2.3  1.3 1.4 0.4 0.4 0.0 0.0
13.996  0.0  11.4  45.5  47.7 20.9 10.0  8.7  5.4  1.7 0.3 0.0 0.3 0.0 0.1
 7.396  0.2  18.0  29.4  11.7 11.9  5.1  1.7  1.4  1.0 0.3 0.2 0.1 0.0 0.0
11.406  0.1   6.5  11.0  24.0 20.7  9.2  3.4  1.6  1.3 0.4 0.4 0.1 0.1 0.0
 4.649  0.2   2.7   8.1   4.9  8.2  3.8  2.6  0.9  0.6 0.5 0.2 0.2 0.1 0.0
 3.197  0.0   0.2   3.2   7.2  4.5  5.3  1.8  1.3  0.3 0.3 0.1 0.1 0.0 0.0
 1.300  0.0   0.0   1.4   3.5  3.9  2.1  1.7  0.8  0.3 0.1 0.1 0.0 0.0 0.0

UK BT SURVEY (March) - Prime stations only
1993 1999
1 1 0.15 0.25
1 8
126.931  480  662  141  71  12  8  11  3
115.442  361  662  370  98  47  5   7 10
126.189  859  647  340 120  29 28   0 10
134.343 1559  908  295  98  49 16   8  1
121.742  967  905  351  63  39 31  10 13
130.081  648  957  217  82  24 23  12  1
130.822  570  770  389  98  26 11   9  6

IR-JPS : Irish Juvenile Plaice Survey 2nd Qtr - Effort min. towed - Plaice No.-at-
age
1991 2004
1 1 0.37 0.43
```

```
1 7
555   185  206   60  21   9   1  1
570  1785  268   48  16   7   2  2
600   643  630  189  45   8  21  3
585   614  254  196  33   8   2  0
570   840  321  110  86  18   5  2
675   752  221  134  39  57   7  0
675   665  303  105  41  22  17  5
675   311  466  191  48  11   7  4
660     0    0    0   0   0   0  0
645   805  342   72  61  32   9  2
675   743  739  213  88  43  14  5
660   273  145   40   2   1   1  0
660   346  322  152  78  20   9  7
660  1046  501  171  86  50  10  6

IR-OTB : Irish Otter trawl - Effort in hours - VIIa Plaice numbers-at-age - Year
1995 2008
1 1 0 1
2 12
70682   5   84  263  202   51   29  24  10   5   1   1
58166   4   94  157  227   97   26   8   6   4   2   1
75029  27  136  197  147   74   74  21  12  16   3   2
81073  49  140  176  124  104  128  64  29  21  10   5
93221  51  129  152  126   71   46  32  19   4   2   1
64320  11   92   98   88   24   10   8   3   1   4   0
77541  55   90   97  104  100   38  16  11   3   1   0
77863   6   67  179  122   90   53  22  11   6   1   0
73854  18  177  278  174  102   48  19   5   3   1  13
72507  25  105  116   90   31   23  16  12   1   4   0
68336   1   45   89  129   80   43  17  10   8   1   2
64876   4   40   34   51   40   37  19  12  12   4   0
73157  14   47   77   58   40   17  11   5   2   1   0
```

58812 4 16 35 45 23 11 6 2 1 1 1

UK(NI) GFS Spring and autumn spawning biomass indices

2 16 2

'Year''VPA' 'DARDS' 'DARDA'

1992 1 9.59 4.83

1993 1 13.27 4.64

1994 1 10.09 9.20

1995 1 7.59 4.77

1996 1 7.96 8.69

1997 1 13.73 8.22

1998 1 12.50 5.39

1999 1 9.37 6.90

2000 1 15.79 10.50

2001 1 13.52 13.93

2002 1 13.36 9.98

2003 1 26.79 18.65

2004 1 10.55 8.49

2005 1 15.86 11.58

2006 1 9.57 7.20

2007 1 8.73 8.48

2008 1 6.33 11.28

2009 1 11.00

Table 6.7.2.5. Irish Sea plaice: Catch numbers-at-ages 1 to 15+.

	Ages														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**
1964	0	997	1911	1680	446	851	480	140	26	155	30	2	1	1	10
1965	28	1416	3155	2841	1115	555	309	300	17	20	5	2	1	1	1
1966	0	120	4303	3605	2182	620	588	386	181	13	20	7	7	3	6
1967	0	164	1477	5593	4217	995	642	267	210	176	86	35	5	6	1
1968	0	171	1961	3410	4641	1611	319	113	135	24	17	3	4	1	1
1969	59	430	2317	2932	2080	2227	779	184	58	100	80	22	9	4	1
1970	9	803	2278	2179	1877	1028	899	239	64	29	52	51	20	3	2
1971	0	427	3392	3882	1683	1371	491	497	244	60	65	36	11	9	1
1972	0	142	3254	5136	1461	752	555	627	353	169	55	40	38	19	12
1973	0	925	4091	5233	2682	642	345	238	183	238	129	40	14	11	17
1974	7	1200	2530	2694	2125	1045	191	139	56	47	95	40	5	5	5
1975	18	1370	4313	1902	1158	933	152	119	81	94	47	72	18	16	4
1976	23	2553	4333	2425	902	563	391	198	59	79	47	22	58	11	5
1977	565	4124	2767	2470	839	236	150	112	63	21	15	8	8	10	3
1978	22	3063	5169	1535	542	202	98	54	52	43	10	9	4	4	2
1979	12	3380	5679	1835	363	187	109	61	68	68	17	5	6	4	6
1980	3	2783	6738	2560	646	312	125	64	24	54	16	13	7	5	5
1981	22	1742	5939	2984	837	222	105	53	52	41	28	35	13	3	11
1982	27	715	3288	3082	1358	330	137	69	44	36	11	15	11	14	13
1983	51	2924	2494	3211	1521	648	211	110	53	30	13	15	9	11	11
1984	41	3159	5179	1182	1054	459	299	113	60	13	22	15	10	6	13
1985	4	2357	6152	3301	614	429	262	181	78	36	21	8	7	3	6
1986	31	1652	5280	2942	1287	344	371	112	92	54	24	9	5	3	9
1987	62	3717	5317	5252	1341	1072	123	121	75	74	25	8	10	12	13
1988	46	2923	5040	2552	1400	750	316	84	112	44	41	28	38	21	37
1989	24	1735	5945	2671	854	436	214	153	56	47	26	38	18	7	19
1990	15	1019	2715	2935	1132	465	259	98	51	22	15	15	9	6	7
1991	180	2008	1506	1929	1205	465	182	122	49	34	5	6	3	3	4
1992	151	1958	3209	1435	1358	903	388	118	74	44	27	15	9	3	4
1993	28	910	1649	1357	474	556	377	179	42	50	16	8	2	3	2
1994	98	1146	2173	1309	644	318	245	134	86	18	6	9	6	1	3
1995	21	961	1703	1936	764	318	138	70	47	23	9	4	1	1	3
1996	37	856	1345	1196	943	370	128	44	25	37	14	7	5	1	2
1997	28	830	1590	1513	1003	482	285	139	42	53	12	7	1	2	1
1998	5	691	1739	1025	612	476	403	177	91	52	25	17	19	2	1
1999	68	803	1505	1294	696	280	196	117	69	43	6	4	1	0	1
2000	0	450	1174	1284	685	212	219	102	55	19	14	7	2	2	2
2001	14	374	1138	1083	767	409	178	90	45	18	6	2	4	0	0
2002	1	206	940	1482	842	539	318	96	48	17	4	3	0	0	0
2003	0	286	1031	1314	707	415	253	127	48	22	12	7	1	3	0
2004	7	198	967	1104	705	246	114	88	74	11	11	1	1	0	0
2005	6	228	708	1177	890	461	204	92	55	37	12	12	4	2	1
2006	5	180	620	550	684	346	220	87	53	46	20	6	2	1	1
2007	0	64	350	859	506	401	150	114	27	14	5	3	0	0	0
2008	1	99	386	389	409	215	141	61	36	9	7	3	1	1	0

Table 6.7.2.6. Irish Sea plaice: Catch weights-at-ages 1 to 15+.

	Ages														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**
1964	0	0.19	0.292	0.413	0.463	0.597	0.831	1.042	1.155	0.552	1.358	1.015	1.544	1.605	1.654
1965	0.07	0.177	0.269	0.388	0.556	0.653	0.69	0.719	0.801	1.198	1.167	0.971	1.477	1.535	1.581
1966	0	0.152	0.223	0.316	0.418	0.532	0.697	0.691	0.939	0.983	1.074	1.071	1.233	1.281	1.32
1967	0	0.133	0.218	0.299	0.382	0.516	0.518	0.759	0.791	0.682	0.783	0.514	1.152	1.198	1.234
1968	0	0.149	0.213	0.313	0.413	0.509	0.584	0.777	0.893	0.957	1.017	0.887	1.174	1.22	1.257
1969	0.056	0.146	0.215	0.311	0.405	0.541	0.643	0.787	0.897	0.744	0.723	1.097	1.185	1.231	1.269
1970	0.058	0.149	0.219	0.324	0.417	0.523	0.648	0.685	0.908	0.925	0.877	0.603	1.231	1.279	1.318
1971	0	0.14	0.207	0.295	0.396	0.489	0.595	0.753	0.654	0.852	0.731	1.079	1.153	1.198	1.235
1972	0	0.143	0.235	0.332	0.432	0.56	0.737	0.712	0.959	1.071	1.144	1.208	1.288	1.339	1.379
1973	0	0.143	0.218	0.316	0.415	0.491	0.645	0.694	0.791	0.898	0.927	0.863	1.204	1.252	1.29
1974	0.063	0.158	0.246	0.334	0.445	0.514	0.686	0.847	0.964	1.052	1.108	1.048	1.326	1.378	1.42
1975	0.072	0.185	0.275	0.398	0.531	0.644	0.749	0.924	1.147	1.169	1.359	1.36	1.533	1.593	1.641
1976	0.06	0.15	0.228	0.323	0.419	0.525	0.59	0.719	0.797	0.842	0.834	1.003	1.267	1.317	1.357
1977	0.059	0.153	0.226	0.34	0.43	0.51	0.592	0.738	0.84	1.016	0.945	1.1	1.252	1.301	1.34
1978	0.071	0.185	0.268	0.391	0.525	0.672	0.72	0.91	1.035	1.049	1.264	1.329	1.497	1.556	1.603
1979	0.069	0.176	0.262	0.376	0.557	0.668	0.794	0.915	0.997	0.968	1.274	1.227	1.471	1.529	1.575
1980	0.066	0.177	0.255	0.365	0.483	0.517	0.671	0.884	1.047	1.072	1.259	1.273	1.403	1.458	1.503
1981	0.069	0.176	0.267	0.376	0.512	0.592	0.678	0.863	1.097	0.804	1.276	1.31	1.309	1.509	1.554
1982	0.201	0.274	0.284	0.348	0.421	0.545	0.65	0.651	0.78	0.777	1.185	1.164	1.147	1.164	1.744
1983	0.232	0.261	0.29	0.319	0.368	0.426	0.484	0.552	0.629	0.716	0.803	0.91	1.026	1.161	1.316
1984	0.26	0.29	0.33	0.38	0.47	0.56	0.66	0.76	0.87	0.98	1.1	1.24	1.42	1.63	1.94
1985	0.29	0.31	0.34	0.39	0.47	0.54	0.63	0.73	0.84	0.94	1.06	1.2	1.38	1.6	1.9
1986	0.27	0.28	0.34	0.42	0.5	0.54	0.63	0.83	0.92	1.02	1.21	1.48	1.42	1.72	1.61
1987	0.26	0.29	0.315	0.37	0.44	0.52	0.61	0.72	0.82	0.95	1.08	1.21	1.36	1.52	1.7
1988	0.23	0.26	0.3	0.37	0.46	0.55	0.68	0.82	0.96	1.12	1.3	1.48	1.69	1.9	2.13
1989	0.227	0.272	0.321	0.374	0.43	0.491	0.555	0.623	0.694	0.77	0.849	0.932	1.019	1.109	1.205
1990	0.2	0.257	0.316	0.376	0.439	0.504	0.57	0.639	0.709	0.781	0.856	0.932	1.01	1.091	1.173
1991	0.247	0.267	0.295	0.332	0.377	0.431	0.494	0.566	0.646	0.735	0.832	0.938	1.053	1.176	1.309
1992	0.169	0.218	0.274	0.337	0.407	0.484	0.568	0.658	0.756	0.86	0.971	1.089	1.213	1.345	1.483
1993	0.26	0.27	0.292	0.328	0.375	0.436	0.508	0.594	0.691	0.802	0.925	1.06	1.208	1.368	1.541
1994	0.156	0.207	0.268	0.338	0.416	0.504	0.6	0.706	0.821	0.945	1.077	1.219	1.37	1.53	1.698
1995	0.201	0.229	0.266	0.312	0.366	0.429	0.501	0.581	0.67	0.768	0.874	0.99	1.114	1.246	1.387
1996	0.144	0.203	0.268	0.338	0.414	0.496	0.584	0.677	0.776	0.881	0.992	1.108	1.23	1.358	1.492
1997	0.134	0.184	0.239	0.299	0.362	0.43	0.502	0.579	0.66	0.745	0.834	0.928	1.027	1.129	1.236
1998	0.202	0.222	0.252	0.294	0.346	0.41	0.484	0.569	0.665	0.773	0.891	1.02	1.16	1.31	1.472
1999	0.174	0.213	0.257	0.309	0.366	0.43	0.501	0.577	0.661	0.751	0.847	0.949	1.058	1.174	1.296
2000	0	0.222	0.257	0.302	0.357	0.422	0.497	0.581	0.676	0.78	0.894	1.018	1.152	1.296	1.45
2001	0.142	0.205	0.269	0.337	0.407	0.479	0.554	0.632	0.712	0.795	0.88	0.968	1.058	1.151	1.247
2002	0.185	0.225	0.271	0.324	0.383	0.449	0.521	0.6	0.685	0.776	0.874	0.978	1.089	1.206	1.329
2003	0	0.244	0.289	0.34	0.395	0.455	0.52	0.59	0.665	0.745	0.83	0.92	1.014	1.114	1.219
2004	0.207	0.23	0.261	0.3	0.348	0.404	0.468	0.542	0.623	0.713	0.811	0.918	1.033	1.157	1.289
2005	0.172	0.212	0.254	0.299	0.345	0.394	0.445	0.499	0.554	0.612	0.672	0.734	0.799	0.865	0.934
2006	0.227	0.232	0.249	0.278	0.32	0.374	0.44	0.518	0.609	0.712	0.827	0.954	1.094	1.246	1.41
2007	0	0.215	0.247	0.283	0.325	0.371	0.422	0.479	0.54	0.606	0.677	0.753	0.834	0.92	1.011
2008	0.224	0.233	0.252	0.28	0.318	0.365	0.421	0.486	0.56	0.644	0.737	0.84	0.951	1.072	0

Table 6.7.2.7. Irish Sea plaice: Stock weights-at-ages 1 to 15+.

	Ages 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1964	0.024	0.109	0.226	0.348	0.412	0.545	0.767	0.981	1.085	0.54	1.311	0.991	1.508	1.544	1.63
1965	0.023	0.105	0.213	0.327	0.48	0.587	0.641	0.68	0.769	1.152	1.128	0.948	1.442	1.477	1.558
1966	0.019	0.087	0.177	0.266	0.366	0.48	0.643	0.652	0.881	0.947	1.036	1.038	1.204	1.233	1.301
1967	0.018	0.082	0.169	0.251	0.336	0.464	0.482	0.716	0.747	0.66	0.758	0.509	1.125	1.152	1.216
1968	0.018	0.083	0.168	0.263	0.36	0.458	0.541	0.732	0.838	0.921	0.982	0.862	1.146	1.174	1.238
1969	0.019	0.084	0.17	0.261	0.355	0.485	0.593	0.742	0.841	0.719	0.701	1.062	1.157	1.185	1.25
1970	0.019	0.087	0.175	0.272	0.365	0.472	0.599	0.647	0.854	0.891	0.848	0.594	1.201	1.231	1.298
1971	0.018	0.082	0.164	0.249	0.346	0.442	0.55	0.709	0.625	0.821	0.708	1.044	1.126	1.153	1.217
1972	0.02	0.091	0.186	0.28	0.379	0.504	0.678	0.672	0.902	1.031	1.103	1.168	1.258	1.288	1.359
1973	0.019	0.085	0.173	0.267	0.363	0.445	0.596	0.655	0.748	0.866	0.895	0.84	1.176	1.204	1.271
1974	0.021	0.094	0.192	0.282	0.39	0.468	0.634	0.798	0.906	1.014	1.07	1.018	1.295	1.326	1.399
1975	0.024	0.109	0.218	0.336	0.463	0.582	0.695	0.873	1.078	1.127	1.311	1.317	1.497	1.533	1.617
1976	0.02	0.09	0.181	0.272	0.368	0.475	0.548	0.679	0.757	0.812	0.808	0.974	1.237	1.267	1.337
1977	0.02	0.089	0.179	0.286	0.375	0.461	0.55	0.696	0.794	0.978	0.914	1.065	1.222	1.252	1.321
1978	0.024	0.106	0.213	0.33	0.457	0.602	0.668	0.859	0.977	1.011	1.22	1.286	1.462	1.497	1.58
1979	0.023	0.104	0.208	0.317	0.481	0.599	0.733	0.862	0.941	0.935	1.23	1.19	1.436	1.471	1.552
1980	0.022	0.099	0.201	0.307	0.422	0.474	0.623	0.833	0.983	1.032	1.215	1.232	1.37	1.403	1.48
1981	0.023	0.103	0.21	0.318	0.446	0.537	0.63	0.814	1.03	0.777	1.231	1.268	1.28	1.452	1.532
1982	0.02	0.09	0.209	0.309	0.408	0.478	0.568	0.658	0.747	0.847	0.946	1.046	1.146	1.255	1.365
1983	0.019	0.087	0.213	0.3	0.348	0.397	0.455	0.523	0.59	0.677	0.765	0.861	0.968	1.094	1.239
1984	0.02	0.1	0.23	0.35	0.43	0.52	0.61	0.71	0.82	0.93	1.04	1.17	1.33	1.53	1.79
1985	0.02	0.1	0.24	0.36	0.43	0.51	0.59	0.68	0.79	0.89	1	1.13	1.29	1.49	1.75
1986	0.02	0.12	0.26	0.38	0.44	0.52	0.61	0.72	0.83	0.96	1.12	1.26	1.41	1.56	1.72
1987	0.02	0.1	0.24	0.345	0.405	0.48	0.56	0.66	0.77	0.885	1.01	1.15	1.29	1.44	1.61
1988	0.245	0.258	0.288	0.335	0.401	0.484	0.585	0.704	0.841	0.995	1.168	1.358	1.565	1.791	2.034
1989	0.206	0.249	0.296	0.347	0.402	0.46	0.522	0.588	0.658	0.732	0.809	0.89	0.975	1.064	1.156
1990	0.173	0.229	0.286	0.346	0.408	0.471	0.537	0.604	0.674	0.745	0.818	0.894	0.971	1.05	1.132
1991	0.241	0.256	0.28	0.312	0.353	0.403	0.462	0.529	0.605	0.689	0.782	0.884	0.994	1.114	1.241
1992	0.147	0.193	0.245	0.305	0.372	0.445	0.525	0.612	0.706	0.807	0.914	1.029	1.15	1.278	1.413
1993	0.259	0.263	0.28	0.308	0.35	0.404	0.47	0.549	0.641	0.745	0.862	0.991	1.132	1.287	1.453
1994	0.133	0.18	0.236	0.302	0.376	0.459	0.551	0.652	0.762	0.882	1.01	1.147	1.293	1.449	1.613
1995	0.19	0.214	0.247	0.288	0.338	0.396	0.464	0.54	0.625	0.718	0.82	0.931	1.051	1.179	1.316
1996	0.117	0.173	0.234	0.302	0.375	0.454	0.539	0.63	0.726	0.828	0.936	1.049	1.168	1.293	1.424
1997	0.11	0.158	0.211	0.268	0.33	0.396	0.466	0.54	0.619	0.702	0.789	0.881	0.977	1.077	1.182
1998	0.197	0.211	0.236	0.272	0.319	0.377	0.445	0.525	0.616	0.718	0.83	0.954	1.088	1.234	1.39
1999	0.158	0.193	0.234	0.282	0.337	0.397	0.465	0.538	0.618	0.705	0.798	0.897	1.003	1.115	1.234
2000	0	0.208	0.238	0.278	0.328	0.388	0.458	0.538	0.627	0.727	0.836	0.955	1.084	1.223	1.372
2001	0.112	0.173	0.237	0.303	0.372	0.443	0.517	0.593	0.672	0.753	0.837	0.924	1.013	1.105	1.199
2002	0.167	0.204	0.247	0.297	0.353	0.415	0.484	0.56	0.641	0.73	0.824	0.925	1.033	1.147	1.267
2003	0	0.223	0.266	0.314	0.367	0.424	0.487	0.554	0.627	0.704	0.787	0.874	0.966	1.063	1.166
2004	0.199	0.217	0.244	0.279	0.323	0.375	0.435	0.504	0.581	0.667	0.761	0.864	0.975	1.094	1.222
2005	0.153	0.192	0.233	0.276	0.322	0.369	0.419	0.472	0.526	0.583	0.642	0.703	0.766	0.832	0.9
2006	0.229	0.228	0.239	0.262	0.298	0.345	0.405	0.478	0.562	0.659	0.768	0.889	1.023	1.168	1.326
2007	0	0.201	0.231	0.265	0.303	0.347	0.396	0.45	0.509	0.572	0.641	0.714	0.793	0.876	0.965
2008	0.222	0.227	0.242	0.265	0.298	0.34	0.391	0.452	0.522	0.601	0.69	0.787	0.894	1.01	1.136

Table 6.7.3.1. Irish Sea plaice : Final ICA diagnostics and output.

```
FLICA CONFIGURATION SETTINGS

sep.2       : NA

sep.gradual : TRUE

sr          : FALSE

sr.age      : 2

lambda.age  : 1 1 1 1 1 1 1 0

lambda.yr   : 1 1 1 1 1 1 1 1

lambda.sr   : 0

index.model : linear linear linear

index.cor     :  1  -92559631349317830736220086604086468264682600488620284042662244  -
92559631349317830736220086604086468264682600488620284042662244

sep.nyr     : 8

sep.age     : 5

sep.sel     : 1


FLR, R SOFTWARE VERSIONS

R version 2.8.1 (2008-12-22)

Package  : FLICA

Version  : 1.4-10

Packaged : Sat Mar 21 18:30:56 2009; mpa

Built    : R 2.8.0; ; 2009-03-21 18:30:58; windows

Package  : FLAssess

Version  : 1.99-101

Packaged : Fri Aug  8 18:09:07 2008; LTK00

Built    : R 2.7.1; i386-pc-mingw32; 2008-08-08 18:09:10; windows

Package  : FLCore

Version  : 3.0

Packaged : Fri Apr 17 20:25:20 2009; LTK00

Built    : R 2.8.1; i386-pc-mingw32; 2009-04-17 20:25:23; windows


FITTED SELECTION PATTERN

Units  :  NA
```

age \ year	2001	2002	2003	2004	2005	2006	2007	2008
2	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117
3	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605
4	1.130	1.130	1.130	1.130	1.130	1.130	1.130	1.130
5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6	1.108	1.108	1.108	1.108	1.108	1.108	1.108	1.108
7	0.929	0.929	0.929	0.929	0.929	0.929	0.929	0.929
8	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

FIT PARAMETERS

	Value	Std.dev	Lower.95.pct.CL	Upper.95.pct.CL
F, 2001	0.329884	0.1732	0.234915	0.463246
F, 2002	0.322466	0.1724	0.229999	0.452106
F, 2003	0.286084	0.1751	0.202967	0.403239
F, 2004	0.184354	0.1761	0.130544	0.260345
F, 2005	0.201353	0.1737	0.143266	0.282992
F, 2006	0.139064	0.1707	0.099511	0.194337
F, 2007	0.098132	0.1711	0.070171	0.137236
F, 2008	0.065170	0.1766	0.046107	0.092115
Selectivity-at-age 2	0.116913	0.1755	0.082888	0.164905
Selectivity-at-age 3	0.605449	0.1591	0.443269	0.826967
Selectivity-at-age 4	1.130273	0.1455	0.849887	1.503162
Selectivity-at-age 6	1.108329	0.1311	0.857160	1.433098
Selectivity-at-age 7	0.928849	0.1299	0.720032	1.198225
Terminal year pop, age 2	13236.660984	0.3356	6856.938386	25552.102724
Terminal year pop, age 3	7217.631849	0.2428	4484.791489	11615.748390
Terminal year pop, age 4	5966.968698	0.1987	4042.314719	8808.001831
Terminal year pop, age 5	5709.376361	0.1706	4086.982608	7975.805518
Terminal year pop, age 6	3361.082541	0.1600	2456.344184	4599.060636
Terminal year pop, age 7	2964.719462	0.1535	2194.558004	4005.162531
Terminal year pop, age 8	1671.899559	0.1576	1227.595346	2277.011025

```
Last true age pop, 2001     349.380087  0.3322      182.193046      669.984108

Last true age pop, 2002     419.358353  0.2495      257.149320      683.888365

Last true age pop, 2003     678.394663  0.2186      441.955641     1041.324685

Last true age pop, 2004     816.128130  0.2105      540.247346     1232.889214

Last true age pop, 2005     797.825826  0.1931      546.475967     1164.783242

Last true age pop, 2006     993.687243  0.1794      699.111805     1412.384014

Last true age pop, 2007    1547.247879  0.1628     1124.666529     2128.609626

Index 2, biomass, Q           0.002303  0.0801        0.001968        0.002694

Index 3, biomass, Q           0.001699  0.0801        0.001453        0.001988

Index 1, age 2 numbers, Q     0.000854  0.1679        0.000615        0.001187

Index 1, age 3 numbers, Q     0.000507  0.1666        0.000366        0.000703

Index 1, age 4 numbers, Q     0.000336  0.1664        0.000243        0.000466

Index 1, age 5 numbers, Q     0.000239  0.1669        0.000173        0.000332

Index 1, age 6 numbers, Q     0.000218  0.1684        0.000157        0.000303

Index 1, age 7 numbers, Q     0.000216  0.1759        0.000153        0.000305


INDEX RESIDUALS

UK(E&W) beam Survey

Units  :  NA

   year

age    1989    1990   1991    1992   1993    1994     1995    1996   1997

  2 -0.8266 -0.3494 -0.532 -0.4563 -0.138 -0.1549  -0.4760  0.0189 -0.124

  3  0.0223 -0.7378 -1.103  0.0275 -0.753 -0.1272  -0.4442 -0.7021  0.377

  4 -0.6353 -0.6120 -0.993 -1.0469  0.137 -0.4572  -0.4151 -0.4243 -0.288

  5 -1.0160  0.0319 -2.715 -0.7729 -0.418  0.0316  -1.0195 -0.0104  0.182

  6  0.7683  0.6924 -1.887 -0.5991 -0.687  0.1966   0.0797 -1.0122 -0.114

  7 -0.9225 -1.2371  1.210  0.0285  0.664  1.0354 -99.0000  0.0336 -0.565

   year

age     1998    1999        2000    2001   2002  2003  2004   2005   2006

  2 -0.02175  0.3545 -0.06123707 -0.3059  0.734 0.655 0.423  0.311 0.0799

  3 -0.35225  0.0424  0.03016206 -0.3535  0.475 0.852 0.950  0.617 0.4286

  4  0.10641 -0.0822  0.00000516  0.0759  0.617 0.521 0.868  0.851 0.8037

  5  0.00277  0.1533  0.27631889  0.3307  0.370 0.690 1.067  1.253 0.4254
```

```
  6  0.16719 -0.1063  0.14013311 -0.1112  0.339 0.660 0.363  0.671 0.3431
  7  0.16576 -0.4611 -0.42678129 -0.2213 -0.230 0.483 0.904 -0.498 0.3034
   year
age    2007    2008
  2  0.4533  0.4162
  3  0.2837  0.4658
  4  0.4977  0.4775
  5  0.6152  0.5220
  6  0.1077 -0.0115
  7 -0.0554 -0.2107

NI SSB Spring
Units  :  NA
     year
age     1992   1993  1994   1995  1996  1997   1998   1999  2000 2001  2002
  all -0.508 -0.398 0.309 -0.311 0.230 0.250 -0.223 0.0401 0.412 0.55 0.138
     year
age    2003   2004   2005   2006   2007   2008
  all 0.626 -0.148 0.0756 -0.498 -0.345 -0.198

NI SSB Autumn
Units  :  NA
     year
age    1992   1993   1994   1995  1996  1997   1998  1999  2000  2001  2002
  all 0.349 0.0975 -0.151 -0.162 0.459 0.314 0.0422 0.516 0.216 0.126 0.684
     year
age     2003   2004   2005   2006  2007 2008
  all -0.235 0.0863 -0.517 -0.619 -1.08    0

CATCH RESIDUALS
Units  :  Thousands NA
   year
age    2001    2002    2003   2004    2005    2006   2007    2008
```

2	0.0991	-0.3245	-0.0858	0.196	0.0206	0.3696	-0.324	0.0445
3	0.0594	-0.3673	-0.0160	0.119	-0.0721	-0.0805	-0.104	0.3826
4	-0.1364	0.1186	-0.1616	0.177	-0.1106	-0.3200	0.187	-0.0270
5	-0.0508	0.2267	0.0688	0.156	0.3213	0.1448	0.317	0.1856
6	-0.1735	-0.0211	-0.0240	-0.283	-0.1373	-0.0573	0.101	-0.0272
7	0.1027	0.2293	-0.0462	-0.331	-0.0653	-0.0318	-0.124	-0.1527
8	-0.0337	-0.1319	-0.2294	-0.389	-0.4023	-0.3370	-0.180	-0.4895
9	0.0000	0.0000	0.0000	0.000	0.0000	0.0000	0.000	0.0000

INDEX RESIDUALS

UK(E&W) beam Survey

Units : NA

year

age	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	-0.8266	-0.3494	-0.532	-0.4563	-0.138	-0.1549	-0.4760	0.0189	-0.124
3	0.0223	-0.7378	-1.103	0.0275	-0.753	-0.1272	-0.4442	-0.7021	0.377
4	-0.6353	-0.6120	-0.993	-1.0469	0.137	-0.4572	-0.4151	-0.4243	-0.288
5	-1.0160	0.0319	-2.715	-0.7729	-0.418	0.0316	-1.0195	-0.0104	0.182
6	0.7683	0.6924	-1.887	-0.5991	-0.687	0.1966	0.0797	-1.0122	-0.114
7	-0.9225	-1.2371	1.210	0.0285	0.664	1.0354	-99.0000	0.0336	-0.565

year

age	1998	1999	2000	2001	2002	2003	2004	2005	2006
2	-0.02175	0.3545	-0.06123707	-0.3059	0.734	0.655	0.423	0.311	0.0799
3	-0.35225	0.0424	0.03016206	-0.3535	0.475	0.852	0.950	0.617	0.4286
4	0.10641	-0.0822	0.00000516	0.0759	0.617	0.521	0.868	0.851	0.8037
5	0.00277	0.1533	0.27631889	0.3307	0.370	0.690	1.067	1.253	0.4254
6	0.16719	-0.1063	0.14013311	-0.1112	0.339	0.660	0.363	0.671	0.3431
7	0.16576	-0.4611	-0.42678129	-0.2213	-0.230	0.483	0.904	-0.498	0.3034

year

age	2007	2008
2	0.4533	0.4162
3	0.2837	0.4658
4	0.4977	0.4775

```
  5  0.6152  0.5220
  6  0.1077 -0.0115
  7 -0.0554 -0.2107

NI SSB Spring
Units  :  NA
     year
age     1992   1993  1994   1995  1996  1997   1998   1999  2000 2001  2002
  all -0.508 -0.398 0.309 -0.311 0.230 0.250 -0.223 0.0401 0.412 0.55 0.138
     year
age    2003   2004   2005   2006   2007   2008
  all 0.626 -0.148 0.0756 -0.498 -0.345 -0.198

NI SSB Autumn
Units  :  NA
     year
age    1992   1993   1994   1995  1996  1997   1998  1999  2000  2001  2002
  all 0.349 0.0975 -0.151 -0.162 0.459 0.314 0.0422 0.516 0.216 0.126 0.684
     year
age     2003   2004   2005   2006  2007 2008
  all -0.235 0.0863 -0.517 -0.619 -1.08    0
```

Table 6.7.3.2. Irish Sea plaice: Final ICA population numbers-at-age.

year

age	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	21712	29169	15150	13619	10922	12524	18564	17295	11833	8757	11719	11524
3	11231	18319	24539	13324	11924	9526	10703	15709	14937	10362	6897	9266
4	5401	8166	13284	17722	10428	8734	6275	7354	10748	10194	5360	3748
5	2788	3215	4581	8400	10475	6053	4999	3524	2898	4732	4153	2237
6	2611	2054	1807	2023	3511	4950	3420	2676	1552	1205	1695	1699
7	1714	1518	1301	1022	865	1607	2307	2069	1092	674	470	530
8	533	1070	1056	604	308	468	698	1205	1374	450	275	238
9	857	168	648	1174	505	697	645	1033	1504	1196	501	663

year

age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	9676	15029	16187	20117	18207	13569	7399	18762	18792	19823	14400	17624
3	8933	6187	9461	11480	14667	13534	10398	5890	13893	13699	15366	11219
4	4186	3874	2899	3567	4875	6708	6448	6140	2890	7472	6397	8681
5	1547	1451	1136	1138	1450	1934	3159	2838	2447	1457	3539	2923
6	903	531	505	501	669	682	932	1531	1097	1184	718	1934
7	636	276	250	258	269	302	397	517	751	544	648	315
8	328	200	105	130	127	122	169	223	261	387	237	229
9	465	228	241	371	246	421	354	288	322	340	415	411

year

age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
2	18847	11511	6618	10266	9081	9937	8312	7199	6768	8446	8609	7613	7550	9497
3	12141	13970	8579	4913	7219	6216	7958	6295	5481	5198	6711	6986	5997	6273
4	4980	6052	6827	5064	2945	3402	3966	5020	3986	3599	3120	4320	4783	4217
5	2805	2033	2869	3309	2685	1271	1747	2291	2639	2414	1777	1806	2618	3038
6	1338	1180	1004	1485	1807	1113	683	946	1316	1457	1202	1002	950	1680
7	715	487	638	456	881	759	467	309	541	820	841	621	626	644
8	164	338	232	323	234	418	321	186	145	360	460	369	367	350
9	628	466	296	276	349	288	309	234	300	305	538	391	363	282

year

age	2002	2003	2004	2005	2006	2007	2008

```
  2 8170 10050 8096 10185 8183 8233 13238
  3 8104  6978 8621  7027 8823 7141  7219
  4 4557  5913 5205  6838 5517 7194  5968
  5 2576  2807 3796  3748 4830 4182  5710
  6 1937  1655 1870  2800 2718 3728  3362
  7 1034  1202 1069  1352 1986 2066  2966
  8  420   679  817   799  995 1548  1673
  9  276   396  617   714 1053  556   958
```

```
SURVIVORS AFTER TERMINAL YEAR
   year
age  2009
  2    NA
  3 11652
  4  6155
  5  4917
  6  4745
  7  2774
  8  2476
  9  2186
```

Table 6.7.3.3. Irish Sea plaice: Final ICA fishing mortality-at-age.

year

age	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
2	0.0499	0.0529	0.00844	0.0129	0.0168	0.0371	0.047	0.0265	0.0128	0.119	0.115
3	0.1987	0.2014	0.20543	0.1250	0.1914	0.2975	0.255	0.2595	0.2621	0.539	0.490
4	0.3987	0.4581	0.33829	0.4058	0.4239	0.4380	0.457	0.8113	0.7003	0.778	0.754
5	0.1856	0.4563	0.69718	0.7524	0.6297	0.4510	0.505	0.6999	0.7572	0.907	0.774
6	0.4223	0.3366	0.45022	0.7301	0.6612	0.6433	0.382	0.7757	0.7145	0.823	1.043
7	0.3513	0.2427	0.64722	1.0785	0.4936	0.7147	0.530	0.2891	0.7659	0.775	0.561
8	0.3252	0.3518	0.48776	0.6275	0.4898	0.5360	0.449	0.5715	0.6558	0.812	0.759
9	0.3252	0.3518	0.48776	0.6275	0.4898	0.5360	0.449	0.5715	0.6558	0.812	0.759

year

age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
2	0.135	0.327	0.343	0.224	0.196	0.177	0.146	0.108	0.180	0.196	0.135	0.130
3	0.675	0.716	0.638	0.855	0.736	0.662	0.621	0.407	0.592	0.500	0.642	0.451
4	0.765	0.939	1.107	0.815	0.780	0.805	0.633	0.701	0.800	0.565	0.627	0.663
5	0.788	0.949	0.936	0.699	0.411	0.635	0.610	0.604	0.830	0.606	0.588	0.485
6	0.862	1.064	0.632	0.549	0.501	0.676	0.422	0.468	0.592	0.582	0.482	0.703
7	0.361	1.038	0.848	0.533	0.589	0.673	0.458	0.454	0.563	0.545	0.709	0.920
8	0.749	1.008	0.890	0.780	0.681	0.755	0.614	0.561	0.731	0.609	0.680	0.688
9	0.749	1.008	0.890	0.780	0.681	0.755	0.614	0.561	0.731	0.609	0.680	0.688

year

age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	0.253	0.179	0.174	0.178	0.232	0.259	0.102	0.158	0.153	0.144	0.110	0.089
3	0.692	0.576	0.596	0.407	0.392	0.633	0.329	0.341	0.337	0.301	0.391	0.320
4	1.010	0.776	0.626	0.604	0.514	0.720	0.547	0.429	0.523	0.382	0.586	0.426
5	0.661	0.746	0.585	0.539	0.485	0.761	0.500	0.493	0.434	0.474	0.577	0.452
6	0.875	0.891	0.495	0.670	0.402	0.748	0.747	0.674	0.439	0.353	0.430	0.541
7	0.531	0.628	0.622	0.559	0.547	0.624	0.741	0.803	0.637	0.288	0.458	0.703
8	0.812	0.773	0.648	0.590	0.508	0.758	0.600	0.582	0.507	0.387	0.524	0.521
9	0.812	0.773	0.648	0.590	0.508	0.758	0.600	0.582	0.507	0.387	0.524	0.521

year

age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008

2	0.119	0.0653	0.0386	0.0377	0.0334	0.0216	0.0235	0.0163	0.0115	0.00762
3	0.259	0.2323	0.1997	0.1952	0.1732	0.1116	0.1219	0.0842	0.0594	0.03946
4	0.381	0.3340	0.3729	0.3645	0.3234	0.2084	0.2276	0.1572	0.1109	0.07366
5	0.522	0.3240	0.3299	0.3225	0.2861	0.1844	0.2014	0.1391	0.0981	0.06517
6	0.350	0.2693	0.3656	0.3574	0.3171	0.2043	0.2232	0.1541	0.1088	0.07223
7	0.406	0.4610	0.3064	0.2995	0.2657	0.1712	0.1870	0.1292	0.0912	0.06053
8	0.408	0.3485	0.3299	0.3225	0.2861	0.1844	0.2014	0.1391	0.0981	0.06517
9	0.408	0.3485	0.3299	0.3225	0.2861	0.1844	0.2014	0.1391	0.0981	0.06517

Table 6.7.3.4 Irish Sea plaice: Update ICA stock summary.

Year	Recruitment Age 2	TSB	SSB	F_{bar} (Ages 3-6) f	Landings Tonnes	Landings SOP
1964	21712	11851	8392	0.3013	2879	1.000
1965	29169	14256	9448	0.3631	3664	1.000
1966	15150	13865	9960	0.4228	4268	1.000
1967	13619	13340	10169	0.5033	5059	1.000
1968	10922	12165	9638	0.4766	4695	0.999
1969	12524	11352	9113	0.4575	4394	0.999
1970	18564	11007	8403	0.3999	3583	1.000
1971	17295	10969	8222	0.6366	4232	1.000
1972	11833	11919	9047	0.6085	5119	1.000
1973	8757	9238	7074	0.7615	5060	1.000
1974	11719	7385	5472	0.7651	3715	1.000
1975	11524	7950	5727	0.7723	4063	0.999
1976	9676	5627	3934	0.9171	3473	0.999
1977	15029	4845	3026	0.8283	2904	0.989
1978	16187	6027	3571	0.7296	3231	1.000
1979	20117	7141	4191	0.6072	3428	1.000
1980	18207	7726	4656	0.6944	3903	1.000
1981	13569	8356	5456	0.5715	3906	0.999
1982	7399	7240	5191	0.5450	3237	0.999
1983	18762	6898	4569	0.7034	3639	0.996
1984	18792	8694	5555	0.5633	4241	1.006
1985	19823	10090	6426	0.5847	5075	1.002
1986	14400	11061	7289	0.5755	4806	1.011
1987	17624	10285	6926	0.8096	6220	1.001
1988	18847	13109	7397	0.7472	5005	0.997
1989	11511	11297	6737	0.5756	4372	0.996
1990	6618	8693	5790	0.5549	3275	0.998
1991	10266	7927	4846	0.4484	2554	0.984
1992	9081	7121	4725	0.7153	3267	0.990

1993	9937	7104	4066	0.5309	1996	0.998
1994	8312	6276	3974	0.4843	2066	0.993
1995	7199	6101	3832	0.4333	1874	0.998
1996	6768	5888	4064	0.3772	1707	0.997
1997	8446	5561	3769	0.4959	1871	0.998
1998	8609	6287	3965	0.4351	1765	0.998
1999	7613	6080	3901	0.3780	1600	0.992
2000	7550	6305	4092	0.2899	1371	1.000
2001	9497	7028	4729	0.3170	1473	0.997
2002	8170	7660	5117	0.3099	1623	0.999
2003	10050	8925	5869	0.2749	1559	1.000
2004	8096	8497	5794	0.1772	1143	0.997
2005	10185	9083	6318	0.1935	1281	1.000
2006	8183	9774	6972	0.1336	934	0.997
2007	8233	9594	7042	0.0943	805	0.998
2008	13238	11654	8088	0.0626	563	0.999

Table 6.7.4.1. VIIa plaice, input to short-term forecast for update run.

MFDP version 1a
Run: revised09b
Time and date: 15:44 15/05/2009
Fbar age range: 3-6

2009

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
2	8428	0.12	0.24	0	0	0.219	0.012	0.227
3	7418	0.12	0.57	0	0	0.237	0.061	0.249
4	6155	0.12	0.74	0	0	0.264	0.114	0.280
5	4917	0.12	0.93	0	0	0.300	0.101	0.321
6	4745	0.12	1	0	0	0.344	0.112	0.370
7	2774	0.12	1	0	0	0.397	0.094	0.428
8	2476	0.12	1	0	0	0.460	0.101	0.494
9	2186	0.12	1	0	0	0.600	0.101	0.642

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
2	8428	0.12	0.24	0	0	0.219	0.012	0.227
3	.	0.12	0.57	0	0	0.237	0.061	0.249
4	.	0.12	0.74	0	0	0.264	0.114	0.280
5	.	0.12	0.93	0	0	0.300	0.101	0.321
6	.	0.12	1	0	0	0.344	0.112	0.370
7	.	0.12	1	0	0	0.397	0.094	0.428
8	.	0.12	1	0	0	0.460	0.101	0.494
9	.	0.12	1	0	0	0.600	0.101	0.642

2011

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
2	8428	0.12	0.24	0	0	0.219	0.012	0.227
3	.	0.12	0.57	0	0	0.237	0.061	0.249
4	.	0.12	0.74	0	0	0.264	0.114	0.280
5	.	0.12	0.93	0	0	0.300	0.101	0.321
6	.	0.12	1	0	0	0.344	0.112	0.370
7	.	0.12	1	0	0	0.397	0.094	0.428
8	.	0.12	1	0	0	0.460	0.101	0.494
9	.	0.12	1	0	0	0.600	0.101	0.642

Input units are thousands and kg - output in tonnes

Table 6.7.4.2. VIIa plaice, Single option prediction detailed forecast for update run.

MFDP version 1a
Run: revised09b
Time and date: 15:44 15/05/2009
Fbar age range: 3-6

Year:		2009	F multiplier:		1	Fbar:	0.097				
Age	F		CatchNos	Yield		StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.012		95	21		8428	1843	2023	442	2023	442
3	0.061		414	103		7418	1761	4228	1004	4228	1004
4	0.114		626	175		6155	1625	4555	1202	4555	1202
5	0.101		446	143		4917	1473	4573	1370	4573	1370
6	0.112		474	175		4745	1632	4745	1632	4745	1632
7	0.094		235	100		2774	1102	2774	1102	2774	1102
8	0.101		224	111		2476	1139	2476	1139	2476	1139
9	0.101		198	127		2186	1311	2186	1311	2186	1311
Total			2711	957		39099	11886	27559	9203	27559	9203

Year:		2010	F multiplier:		1	Fbar:	0.097				
Age	F		CatchNos	Yield		StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.012		95	21		8428	1843	2023	442	2023	442
3	0.061		412	103		7386	1753	4210	999	4210	999
4	0.114		629	176		6190	1634	4580	1209	4580	1209
5	0.101		441	142		4871	1460	4530	1357	4530	1357
6	0.112		394	146		3942	1356	3942	1356	3942	1356
7	0.094		318	136		3763	1495	3763	1495	3763	1495
8	0.101		203	100		2240	1030	2240	1030	2240	1030
9	0.101		339	217		3738	2241	3738	2241	3738	2241
Total			2831	1042		40556	12812	29025	10130	29025	10130

Year:		2011	F multiplier:		1	Fbar:	0.097				
Age	F		CatchNos	Yield		StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.012		95	21		8428	1843	2023	442	2023	442
3	0.061		412	103		7386	1753	4210	999	4210	999
4	0.114		626	176		6163	1627	4561	1204	4561	1204
5	0.101		444	142		4898	1468	4556	1365	4556	1365
6	0.112		390	144		3905	1343	3905	1343	3905	1343
7	0.094		265	113		3126	1242	3126	1242	3126	1242
8	0.101		275	136		3038	1397	3038	1397	3038	1397
9	0.101		434	279		4792	2873	4792	2873	4792	2873
Total			2942	1115		41736	13546	30209	10866	30209	10866

Input units are thousands and kg - output in tonnes

Table 6.7.4.3. VIIa plaice, Prediction with management options for update run.

MFDP version 1a
Run: revised09b
IRISH SEA PLAICE, 2008
Time and date: 15:44 15/05/2009
Fbar age range: 3-6

2009				
Biomass	SSB	FMult	FBar	Landings
11886	9203	1	0.097	957

2010					2011	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
12812	10130	0	0	0	14580	11852
.	10130	0.1	0.0097	109	14472	11749
.	10130	0.2	0.0194	216	14365	11647
.	10130	0.3	0.0291	323	14259	11546
.	10130	0.4	0.0388	429	14154	11446
.	10130	0.5	0.0485	533	14051	11347
.	10130	0.6	0.0582	637	13948	11249
.	10130	0.7	0.0679	740	13846	11152
.	10130	0.8	0.0776	842	13745	11056
.	10130	0.9	0.0873	942	13645	10960
.	10130	1	0.097	1042	13546	10866
.	10130	1.1	0.1067	1141	13448	10773
.	10130	1.2	0.1164	1239	13351	10681
.	10130	1.3	0.1261	1336	13255	10589
.	10130	1.4	0.1358	1432	13160	10499
.	10130	1.5	0.1455	1527	13066	10409
.	10130	1.6	0.1552	1621	12973	10320
.	10130	1.7	0.1649	1714	12881	10232
.	10130	1.8	0.1746	1807	12789	10145
.	10130	1.9	0.1843	1898	12699	10059
.	10130	2	0.194	1989	12609	9974
	10130	4.6	0.4462	4068	10559	8029
	10130	4.64	0.4500	4103	10529	7998
	10130	4.7	0.4559	4138	10490	7963

Input units are thousands and kg - output in tonnes

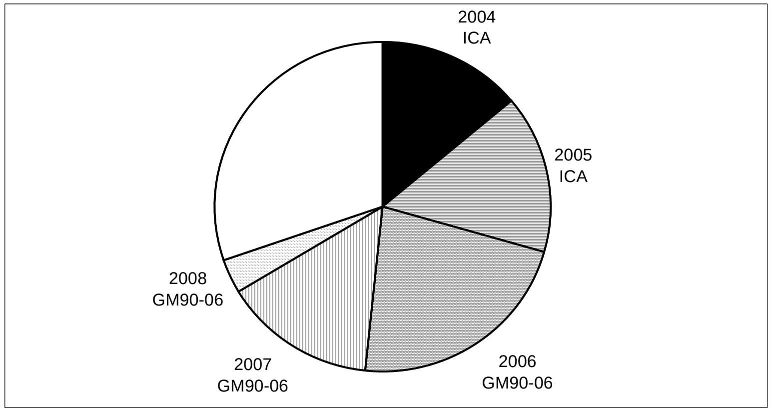
Table 6.7.4.4 Plaice in VIIa - Final run.
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2004	2005	2006	2007	2008
Stock No. (thousands) of 2 year-olds	8183	8233	8428	8428	8428
Source	ICA	ICA	GM90-06	GM90-06	GM90-06
Status Quo F:					
% in 2009 landings	16.4	23.1	15.3	3.5	-
% in 2010	13.9	15.6	22.2	14.6	3.4
% in 2009 SSB	14.9	13.1	10.9	4.8	-
% in 2010 SSB	13.4	13.4	11.9	9.9	4.4
% in 2011 SSB	11.4	12.4	12.6	11.1	9.2

GM : geometric mean recruitment

Plaice in VIIa - Final run. : Year-class % contribution to

a) 2010 landings



b) 2011 SSB

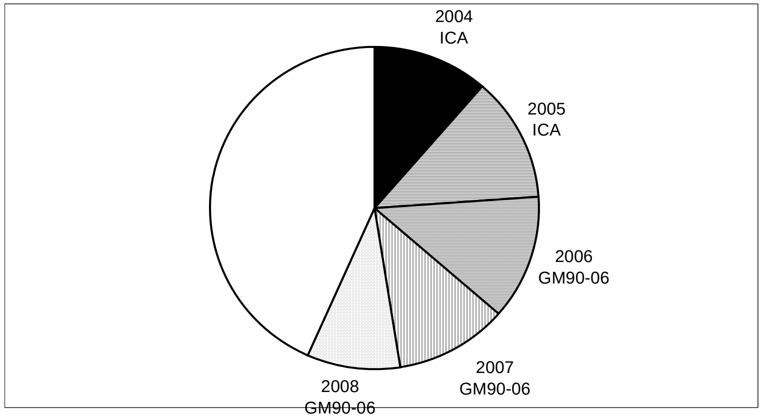


Table 6.7.4.5 Final run - Yield per Recruit table under current selection pattern

MFYPR version 2a
Run: revised09
Time and date: 11:25 16/05/2009
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	8.8433	3.7896	7.4486	3.4643	7.4486	3.4643
0.1000	0.0097	0.0680	0.0327	8.2777	3.4688	6.8858	3.1442	6.8858	3.1442
0.2000	0.0194	0.1261	0.0596	7.7937	3.1964	6.4046	2.8726	6.4046	2.8726
0.3000	0.0291	0.1765	0.0819	7.3748	2.9625	5.9885	2.6394	5.9885	2.6394
0.4000	0.0388	0.2205	0.1006	7.0088	2.7597	5.6253	2.4374	5.6253	2.4374
0.5000	0.0485	0.2593	0.1163	6.6861	2.5825	5.3054	2.2610	5.3054	2.2610
0.6000	0.0582	0.2938	0.1296	6.3996	2.4265	5.0216	2.1057	5.0216	2.1057
0.7000	0.0679	0.3246	0.1409	6.1436	2.2883	4.7682	1.9682	4.7682	1.9682
0.8000	0.0776	0.3523	0.1506	5.9133	2.1652	4.5406	1.8458	4.5406	1.8458
0.9000	0.0873	0.3774	0.1589	5.7051	2.0548	4.3350	1.7361	4.3350	1.7361
1.0000	0.0970	0.4001	0.1660	5.5160	1.9555	4.1485	1.6375	4.1485	1.6375
1.1000	0.1067	0.4209	0.1722	5.3434	1.8657	3.9786	1.5484	3.9786	1.5484
1.2000	0.1164	0.4400	0.1776	5.1854	1.7842	3.8231	1.4676	3.8231	1.4676
1.3000	0.1261	0.4575	0.1822	5.0400	1.7100	3.6802	1.3941	3.6802	1.3941
1.4000	0.1358	0.4737	0.1862	4.9059	1.6421	3.5487	1.3269	3.5487	1.3269
1.5000	0.1455	0.4887	0.1897	4.7819	1.5800	3.4271	1.2654	3.4271	1.2654
1.6000	0.1552	0.5026	0.1928	4.6667	1.5228	3.3144	1.2089	3.3144	1.2089
1.7000	0.1649	0.5155	0.1955	4.5595	1.4701	3.2096	1.1569	3.2096	1.1569
1.8000	0.1746	0.5276	0.1978	4.4595	1.4214	3.1121	1.1089	3.1121	1.1089
1.9000	0.1843	0.5389	0.1998	4.3660	1.3763	3.0210	1.0644	3.0210	1.0644
2.0000	0.1940	0.5495	0.2016	4.2784	1.3345	2.9357	1.0232	2.9357	1.0232

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.097
FMax	4.5001	0.4365
F0.1	1.4275	0.1385
F35%SPR	1.5935	0.1546

Weights in kilograms

Figure 6.7.2.1. Irish Sea plaice: Effort and lpue for commercial fleets.

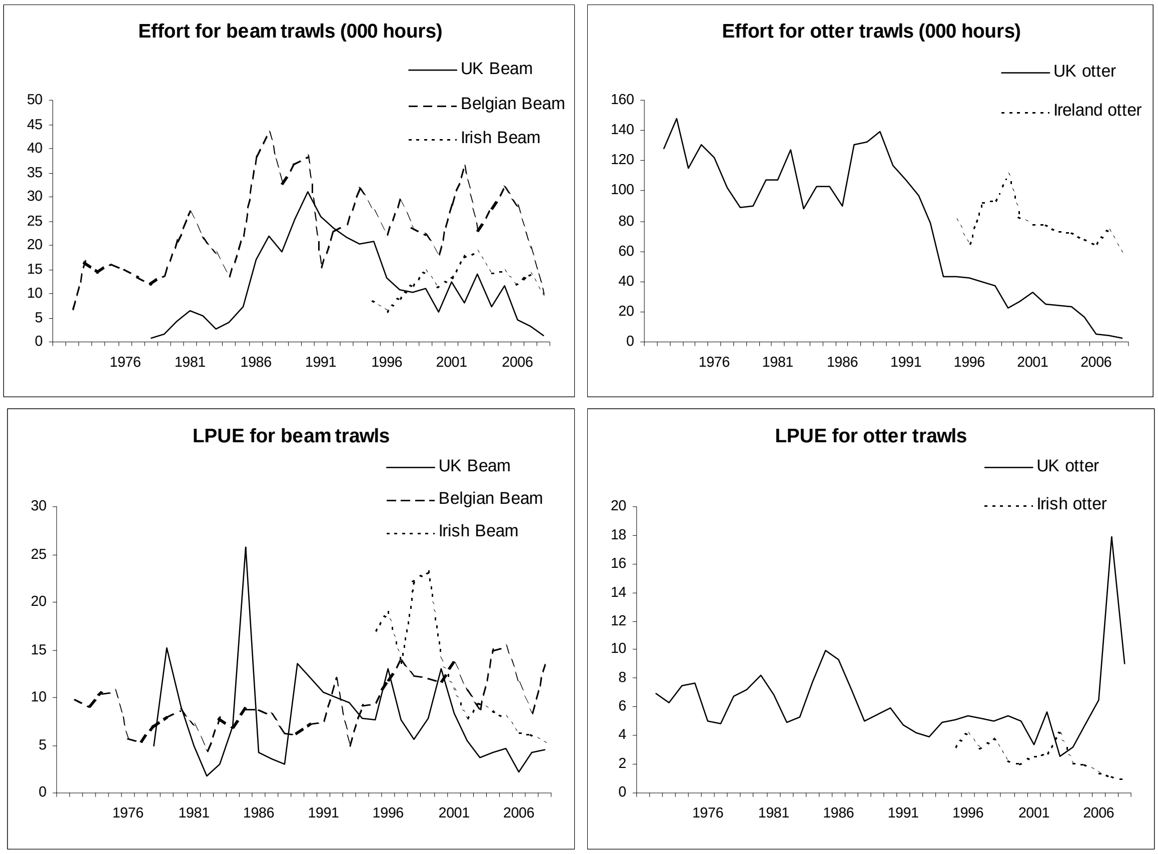


Figure 6.7.2.2. Mean standardized indices of spawning biomass derived from NIGFS_MAR, NIGFS_OCT and biomass from UK (E&W) beam trawl survey.

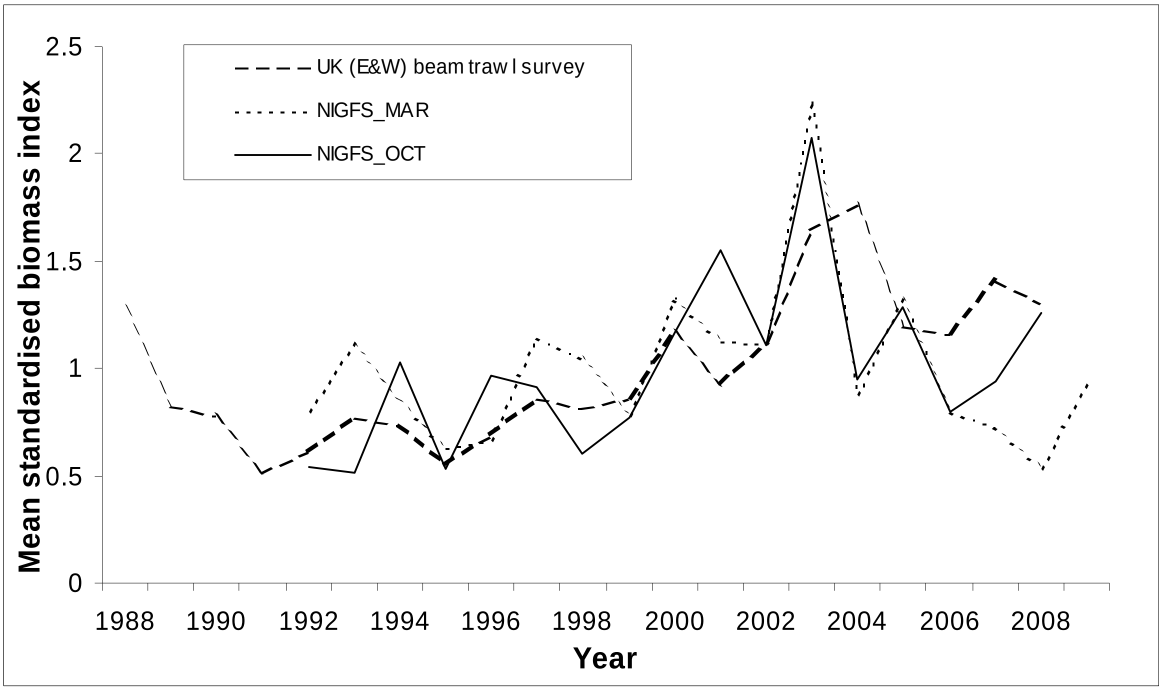


Figure 6.7.2.3. Length distributions of discarded and retained catches from UK (E&W).

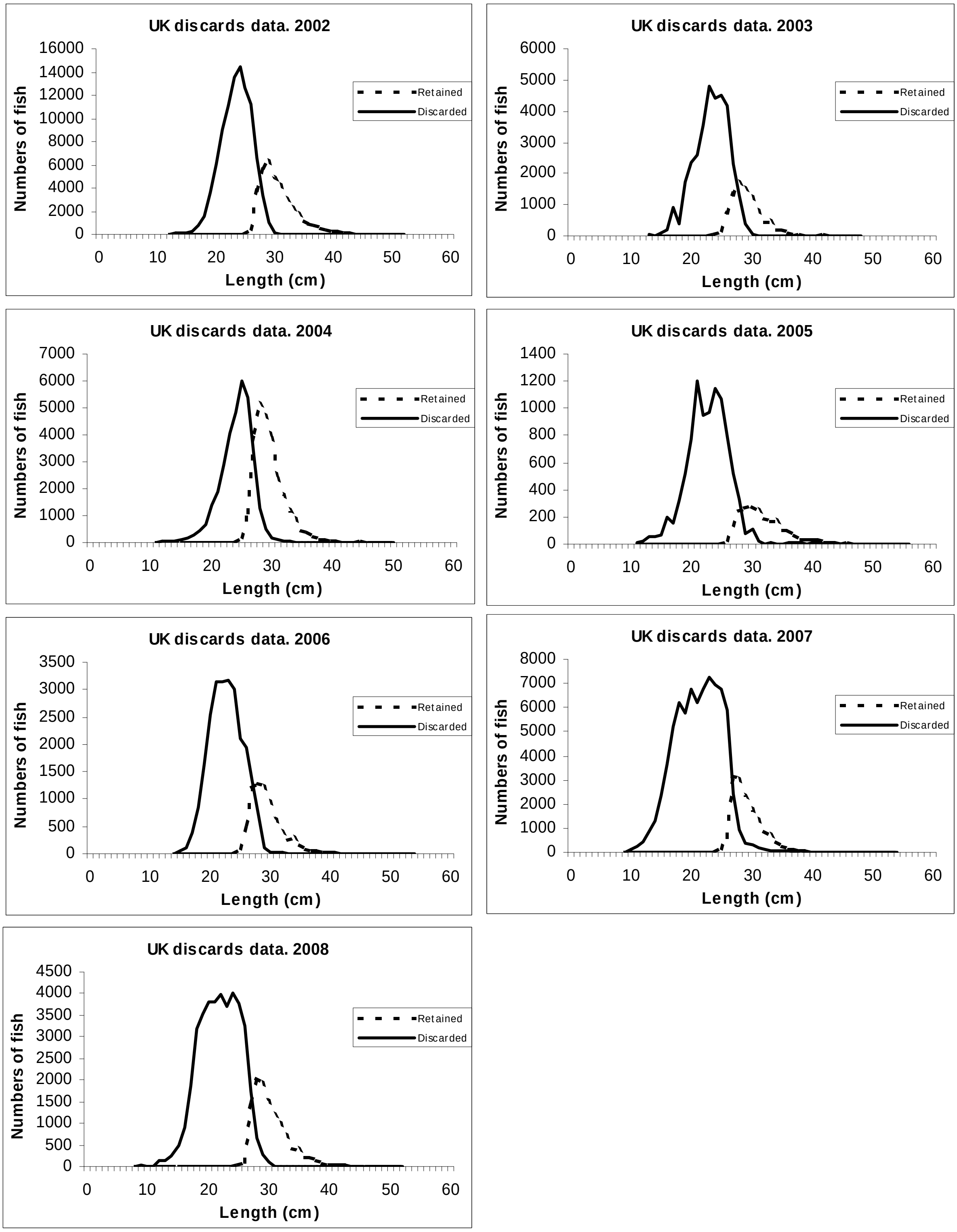


Figure 6.7.2.4 Length distributions of discarded and retained catches from Ireland.

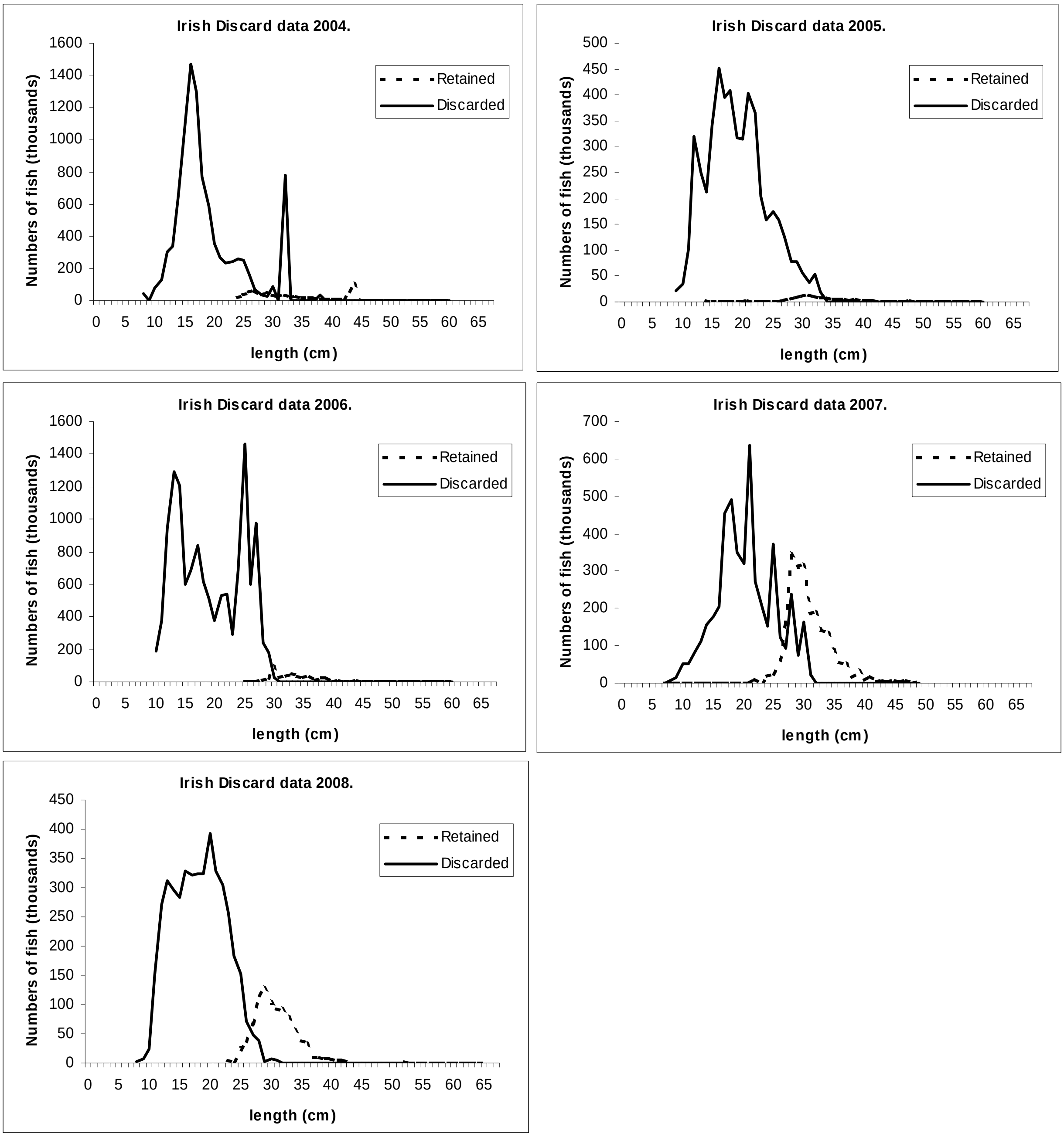


Figure 6.7.2.5 Length distributions of discarded and retained catches from Belgium.

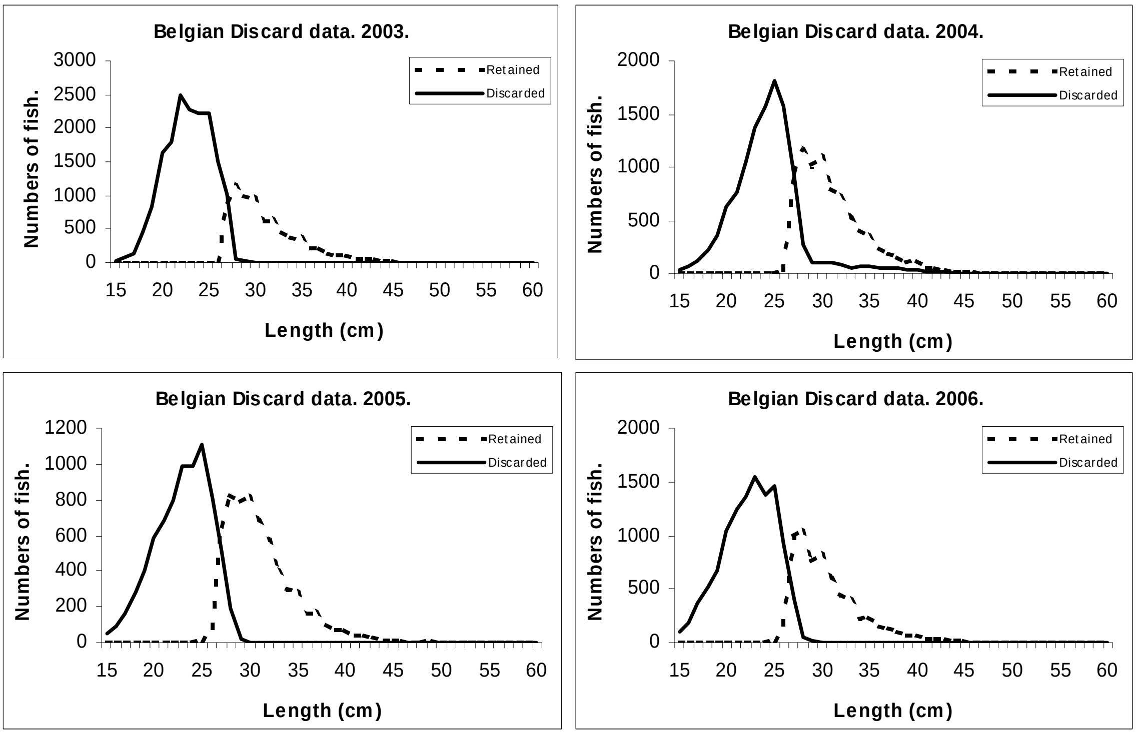


Figure 6.7.2.6. Log cpue plot of UK BT survey by year.

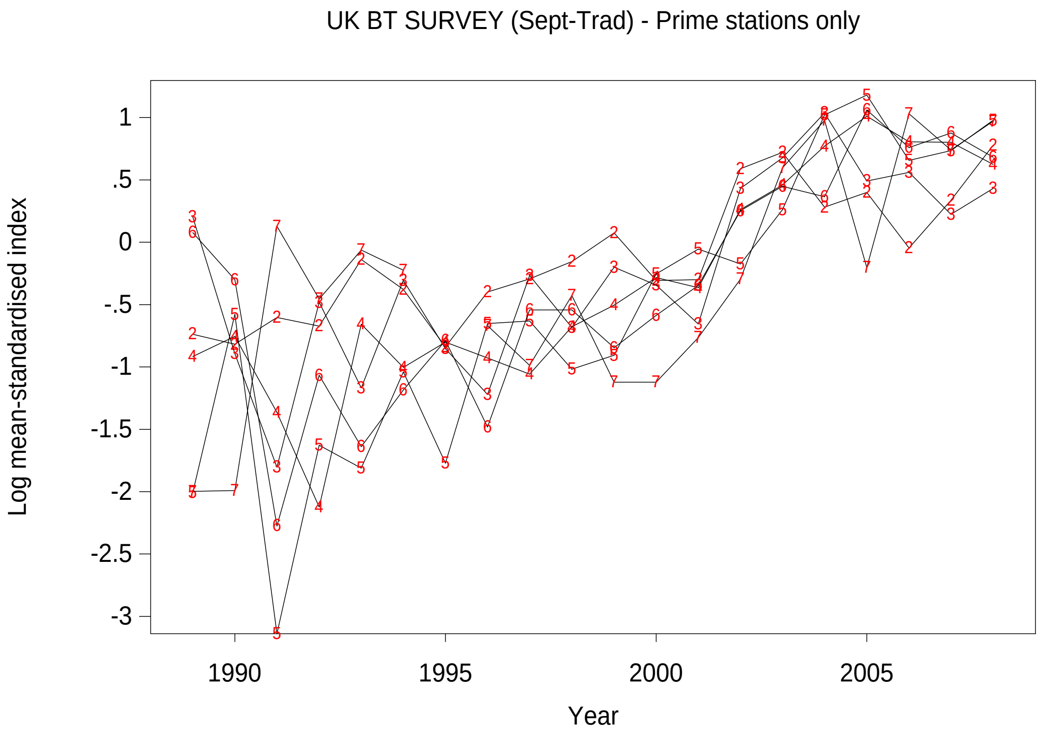


Figure 6.7.2.7. Log cpue plot of UK BT survey by year class.

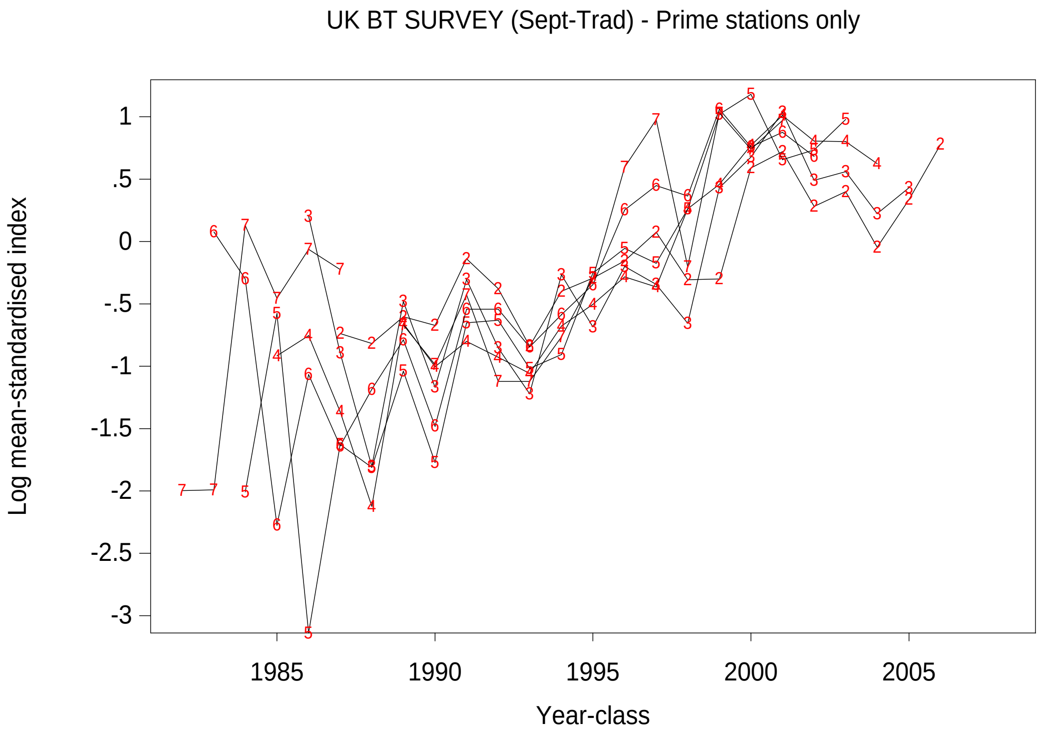


Figure 6.7.2.8. UK (NI) groundfish survey SSB indices split into spring (left hand panels(?)) and autumn (right hand panels(?)) sampling and eastern (strata 4–7), western (strat 1–3) and total.

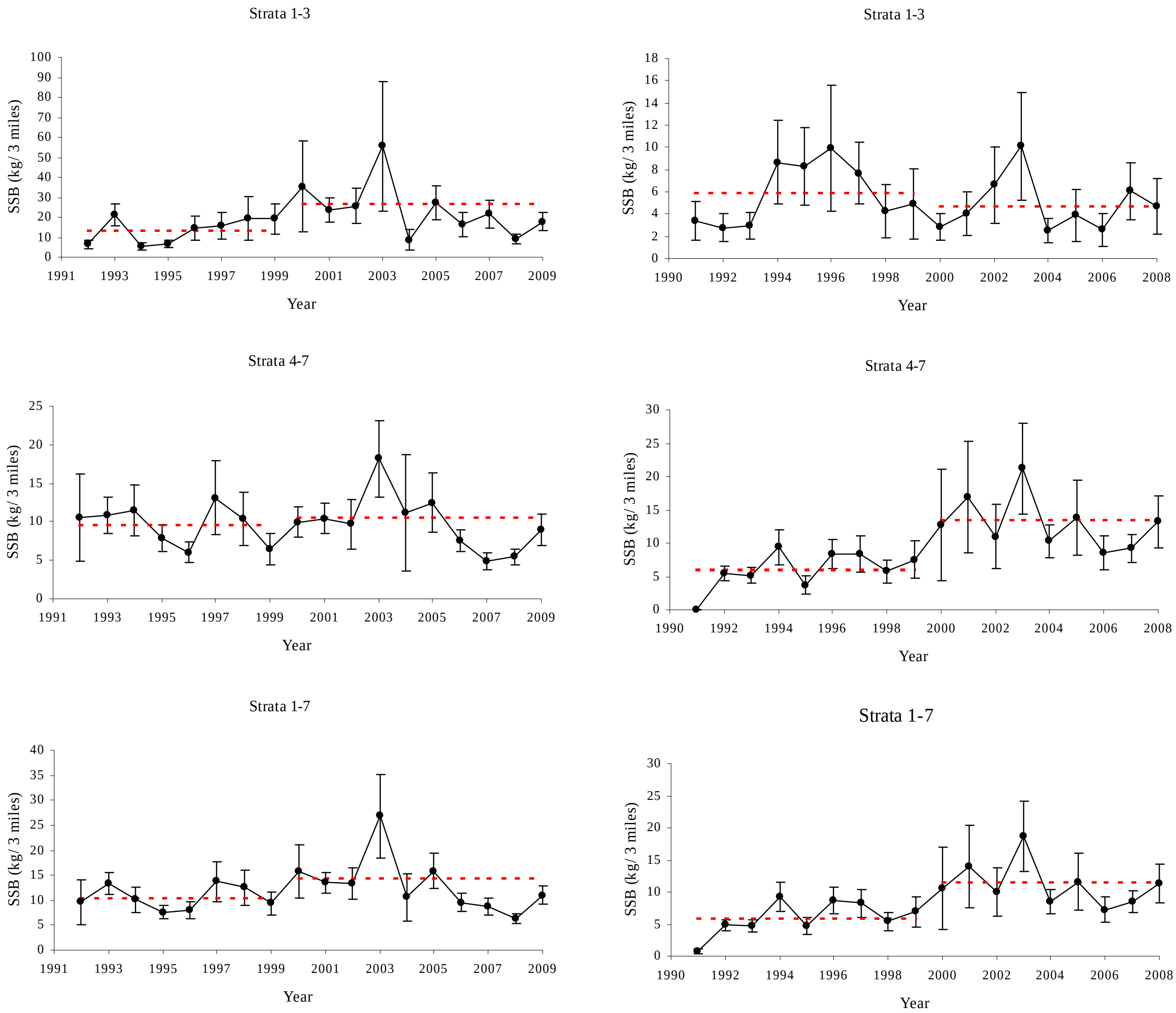


Figure 6.7.3.1 ICA residuals for UK (E&W) beam trawl survey at-age, NIGFS SSB indices.

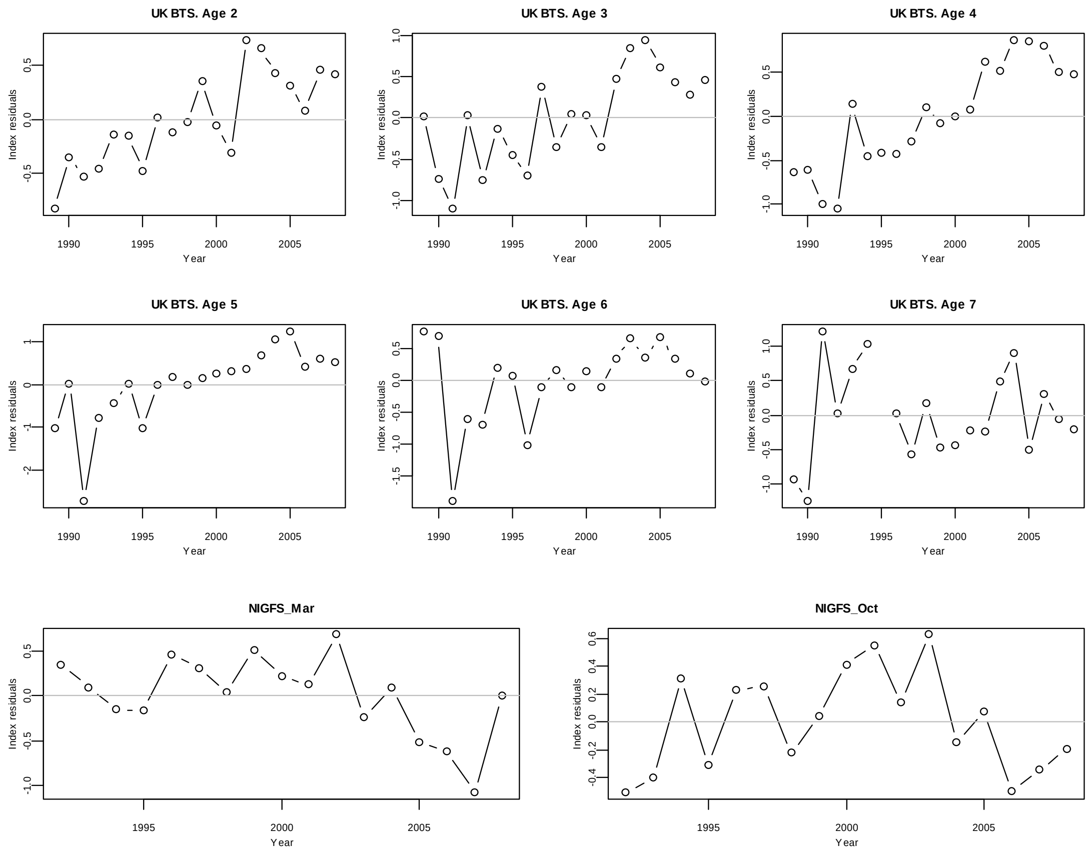


Figure 6.7.3.2. Retrospective pattern for update ICA.

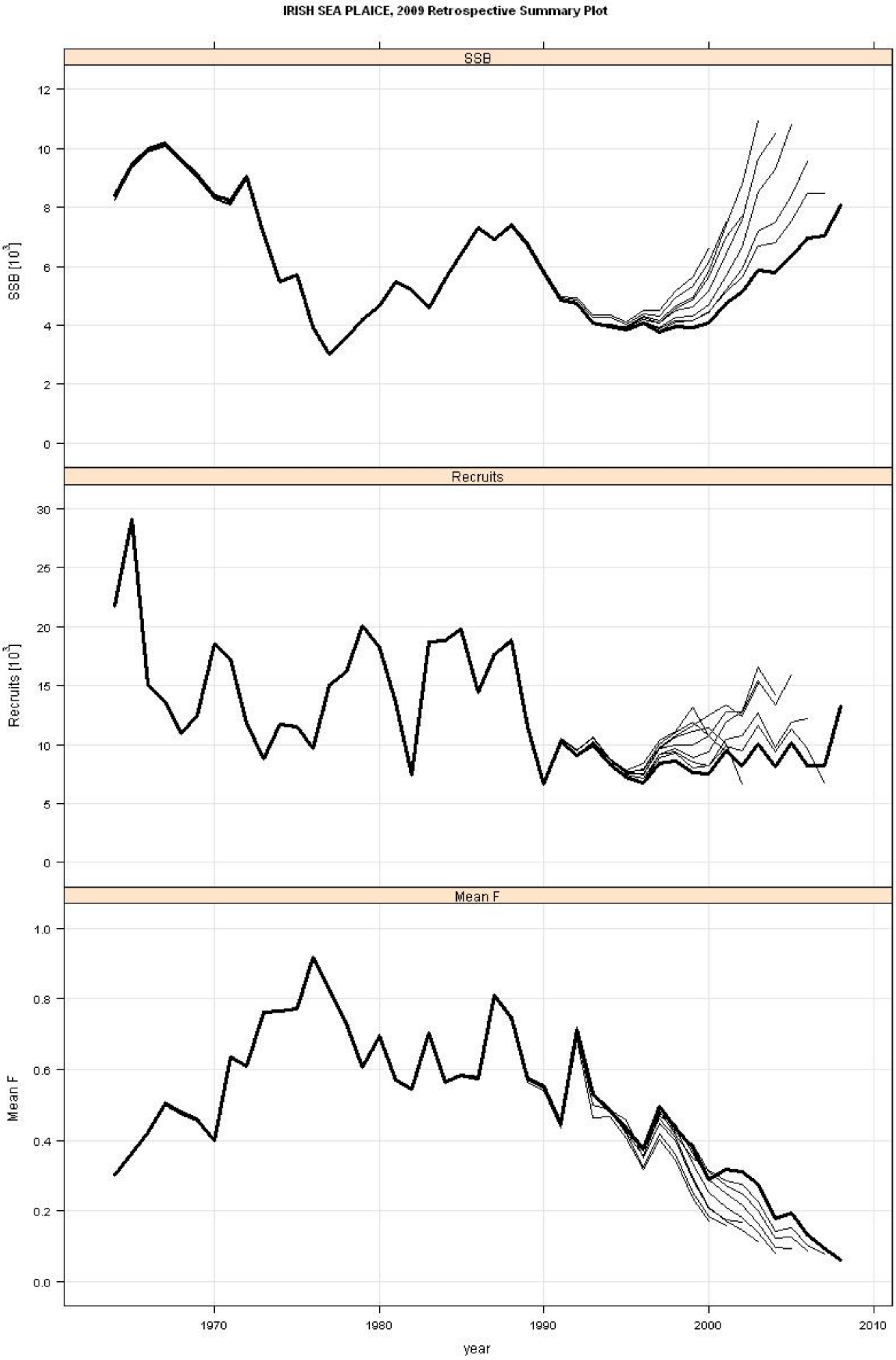


Figure 6.7.3.3. Irish Sea plaice: Summary plot for update ICA assessment.

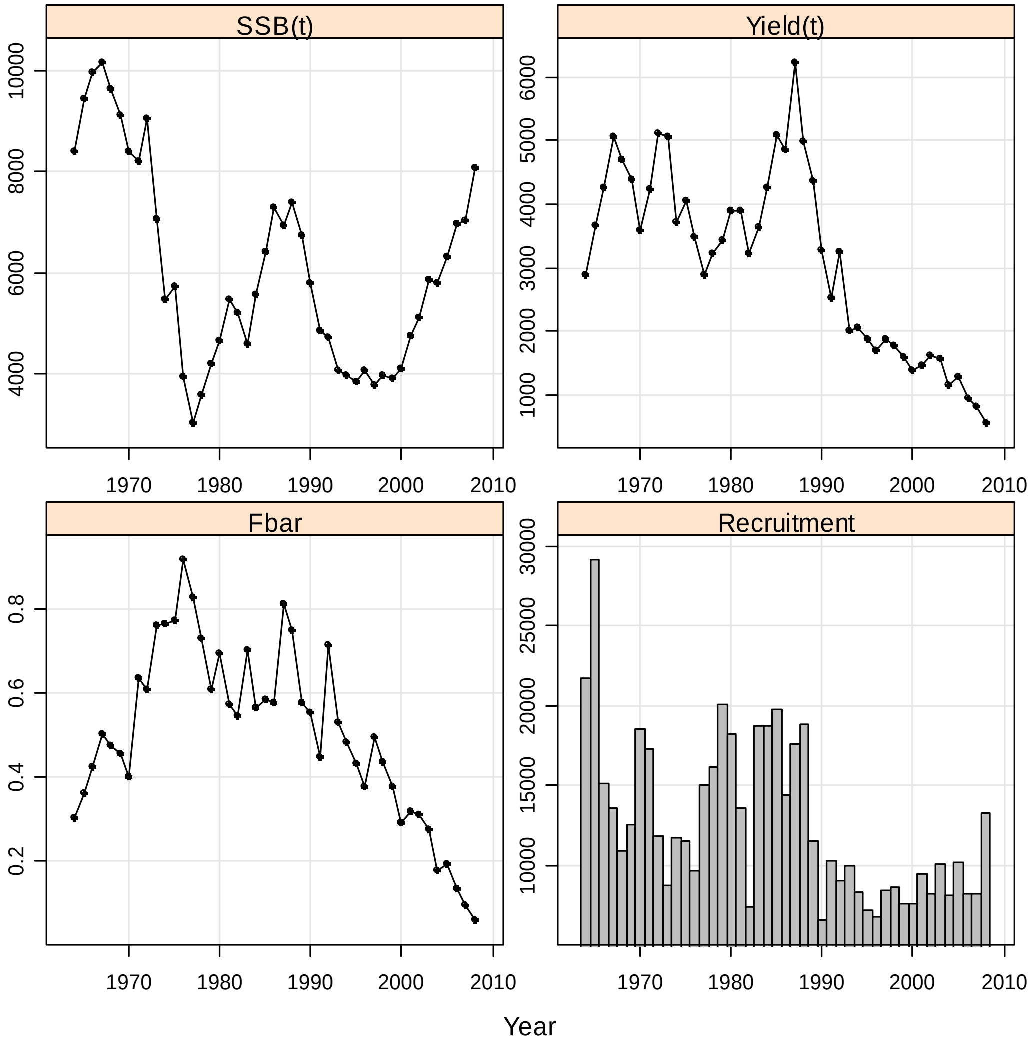
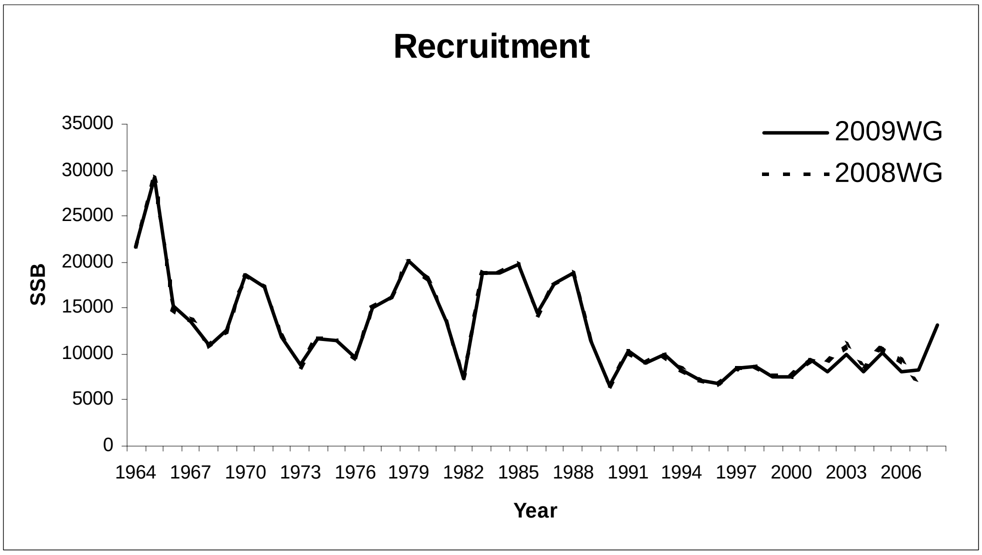
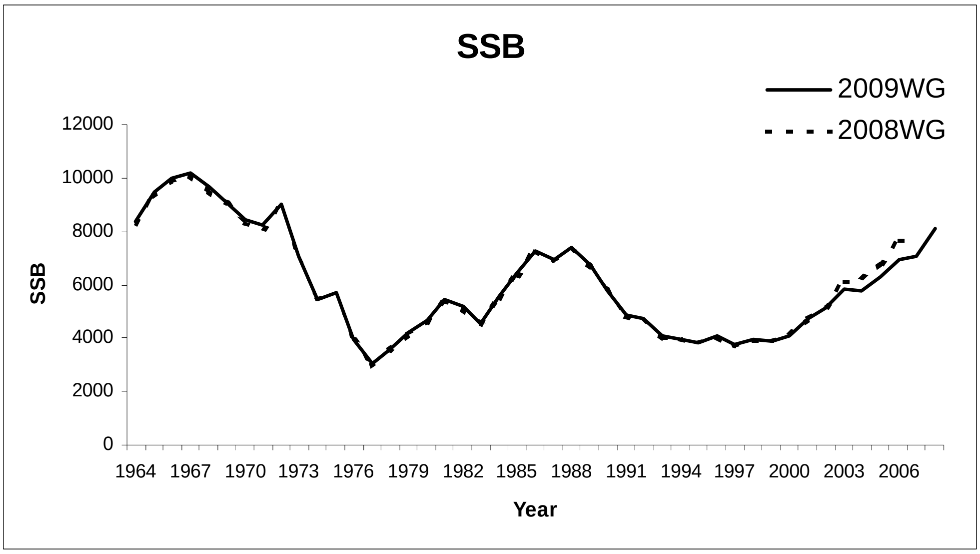


Figure 6.7.3.4. Comparison of recruitment, SSB and F_{bar} between 2008 and 2009 ICA assessments.





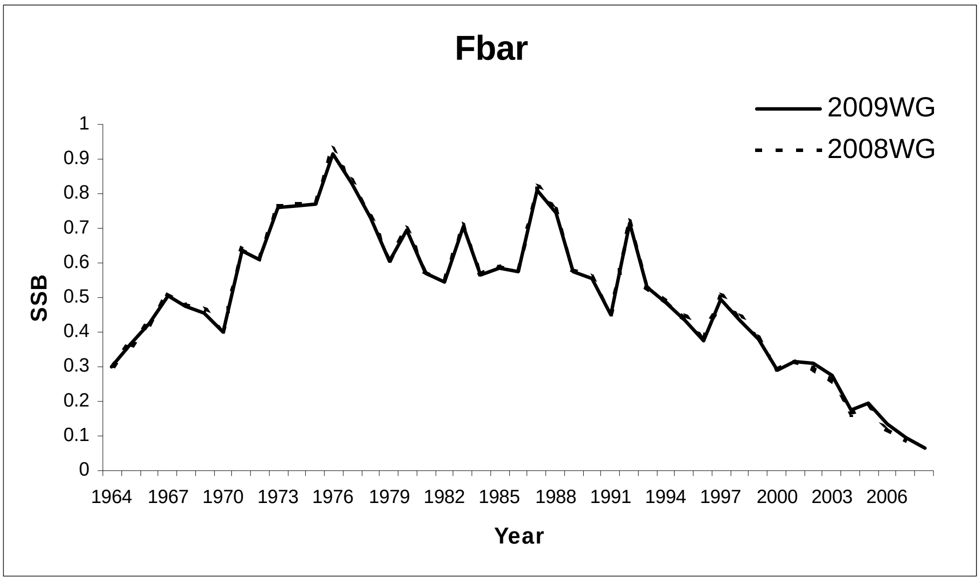
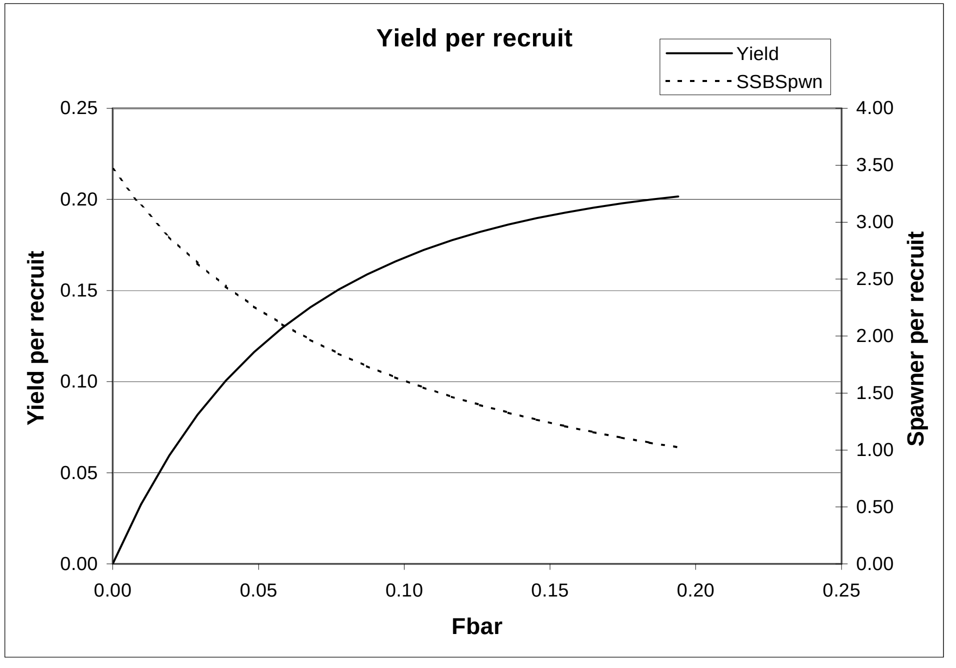
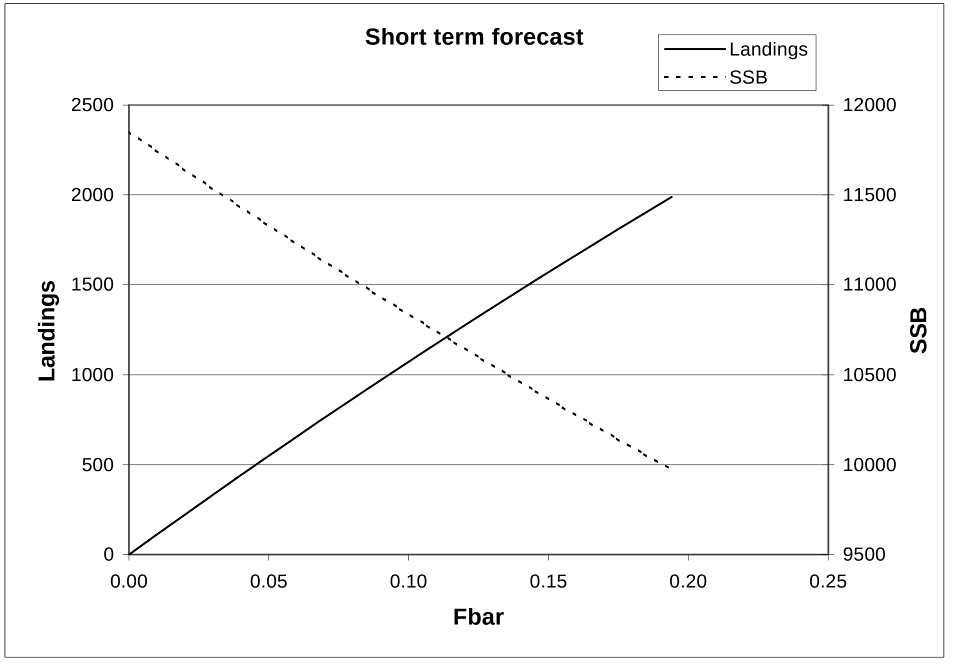


Figure 6.7.3.5 VIIa plaice, yield per recruit and short term forecast from final ICA.





MFYPR version 2a
Run: revised09
Time and date: 11:25 16/05/2009

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.0970
FMax	4.5001	0.4365
F0.1	1.4275	0.1385
F35%SPR	1.5935	0.1546

Weights in kilograms

MFDP version 1a
Run: revised09b
IRISH SEA PLAICE, 2008
Time and date: 15:44 15/05/2009
Fbar age range: 3-6

Input units are thousands and kg - output in tonnes

6.8 Sole in Division VIIa (Irish Sea)

Type of assessment in 2009

This assessment is an Update Assessment, and consequently no changes have been made to assessment or forecast procedures compared with last year.

ICES advice applicable to 2008

Based on the most recent estimates of SSB and fishing mortality ICES classifies the stock as suffering reduced reproductive capacity and at risk of being harvested unsustainably. SSB has declined since 2001 to low levels and reached the lowest level in 2006. Fishing mortality has been close to or above F_{lim} throughout most of the time-series. Recent recruitment levels have been lower than earlier in the time-series.

Single-stock exploitation boundaries

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects.

Fishing mortality is estimated to be well above $F_{0.1}$ (0.2). There will be little gain to the long-term yield by increasing fishing mortalities above $F_{0.1}$.

Exploitation boundaries in relation to precautionary limits

Given the low SSB and low recruitment since 2000, it is not possible to identify any non-zero catch which would be compatible with the precautionary approach.

ICES advice applicable to 2009

Based on the most recent estimates of SSB (in 2008) and fishing mortality (in 2007) ICES classifies the stock as suffering reduced reproductive capacity and at risk of being harvested unsustainably. SSB has continuously declined since 2001 to low levels and reached its lowest level in 2007. Fishing mortality has been close to or above F_{lim} throughout most of the time-series. Recent recruitment levels have been lower than earlier in the time-series.

Single-stock exploitation boundaries

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

Fishing mortality is estimated to be well above $F_{0.1}$ (0.19).

Exploitation boundaries in relation to precautionary limits

Given the low SSB and low recruitment since 2000, it is not possible to identify any non-zero catch which would be compatible with the precautionary approach. ICES recommends a closure of the fishery in 2009 and a recovery plan should be developed and implemented as a prerequisite to reopening the fishery.

6.8.1 General

Stock description and management units

The sole fisheries in the Irish Sea are managed by TAC (see text tables below) and technical measures, with the assessment area corresponding to the stock area. Technical measures in force are minimum mesh sizes and minimum landing size (24 cm). In addition beam trawlers, fishing with mesh sizes equal to or greater than 80 mm, are obliged to have 180 mm mesh sizes in the entire upper half of the anterior part of their net. More details can be found in Reg 254/2002 and the Stock Annex.

Since 2000, a spawning closure for cod has been in force. The first year of the regulation the closure covered the Western and Eastern Irish Sea. Since then, closure has been mainly in the Western part whereas the sole fishery takes place mainly in the Eastern part of the Irish Sea and no direct impact on the sole stock is expected from this closure.

Other regulations applicable to area VIIa are summarized in Section 6.1.

Management applicable to 2008 and 2009

TAC 2008

Species: Common sole *Solea solea*		Zone: VIIa SOL/07A.
Belgium	326	
France	4	
Ireland	90	
The Netherlands	103	
United Kingdom	146	
EC	669	
TAC	669	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TAC 2009

Species: Common sole *Solea solea*		Zone: VIIa (SOL/07A.)
Belgium	237	
France	3	
Ireland	80	
The Netherlands	75	
United Kingdom	107	
EC	502	
TAC	502	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

Year	Single stock exploitation bounderies	Basis	TAC	% change in F associated with TAC*	WG landings
2005	<1000t	Keep F below Fpa	960t	+ 3	855t
2006	< 930t	Recent catch levels (2002-2004)	960t	-	570t
2007	0t	Zero catch	816t	+ 1	492t
2008	0t	Zero catch	669t	0	333t
2009	0t	Zero catch	502t	- 3	

*** F calculated, based on a *Status quo* forecast.**

Fishery in 2008

The main countries fishing for Irish Sea sole are Belgium, Ireland and UK.

After a serious drop in beam trawl effort by 48% between 2003 and 2007, effort also reduced substantially in 2008 (in the order of 33–50%). Fishing behaviour has changed in response to high fuel prices, especially in fuel consumptive fishing practices such as the beam trawl. In this context beam trawlers have tested different methods in order to reduce their fuel costs. These include (a) reducing the weight of the beam trawl by decreasing the length of the beam or (b) reducing the weight of the shoes, and (c) the use of economo-meters (to monitor fuel consumption). Some beam trawlers are also using benthic drop out panels that release about 75% of benthic invertebrates from the catches. Full square mesh codends are also being tested in order to reduce the capture of benthos further and improve the selection profile on gadoids.

There has been a switch by Irish trawlers to reduce gear size in some cases by as much as 20%. There is also evidence of larger vessels switching from twin-rigging back to single rigging to reduce fuel consumption. The 24 m+ range vessels are now working at around 50–60% of their total power in a bid to reduce fuel costs. This implies a reduction in catch rates, and may also effect the length distribution of the catches. Several Irish beam trawlers were decommissioned in 2008.

Around 10% of the Belgian beam trawlers were decommissioned between August 2005 and November 2006 (having its full impact from 2007 onwards). Over the years 2007/2008 an additional 5% of the Belgian vessels were taken out of the fleet, but their capacity was redistributed over the remaining vessels. Although this has resulted in an increase in the average nominal capacity per vessel, the effective capacity per vessel remained the same.

6.8.2 Data

Landings

An overview of the landings data provided and used by the WG is provided in Table 6.8.1. The WG estimated the total international landings at 333 t in 2008, of which 69% (229 t) was landed by Belgium, 20% (65 t) by Ireland, 8% (26 t) by the UK (England and Wales) and the remainder by Northern Ireland and France (Table 6.8.1). These landing-figures correspond to an international uptake of only 49,8% of the agreed TAC in 2008 (669 t), and the lowest value in the time-series.

No revisions were made to the historical data. Irish landings submitted to the WG for 2007 were revised upward by 1% to 116 t. No corrections for this were made in the 2009-assessment, but this will be done in the 2010 assessment, together with other possible revisions.

Quarterly age compositions for 2008 were available from Belgium, UK (E&W) and Ireland as well as quarterly landings from Northern Ireland and France. The sampled fleets are those taking the major part of the international landings. Annual length distributions are given in Table 6.8.2.

Catch numbers-at-age data are given in Table 6.8.3.

Catch weights-at-age for 2008 were calculated from Belgian, UK and Irish data, weighted by national catch numbers-at-age, then quadratically smoothed (using age = 1.5, 2.5, etc.) and SOP-corrected. The quadratic fit used for 2007 was:

$Wt=0.1251+(0.0395*(AGE+0.5))-(7E-4*(AGE+0.5)^2)$

The quadratic fit used for 2008 was:

$Wt=0,1112+(0.0369*(AGE+0.5))-(0.001*(AGE+0.5)^2)$

Table 6.8.4 gives catch weights.

Stock weights-at-age were derived from the smoothed catch weight-at-age by setting age=1.0, 2.0, etc. Stock weights-at-age are given in Table 6.8.5.

Further details on raising methods are given in the stock annex.

Discards

Discarding of sole based on Belgian vessel trips ranged between 0 to 5% by weight in 2004 (5 trips and 115 hauls) and between 0 to 8% in 2005 (4 trips and 90 hauls). Discard information from the UK indicated that around 2% numbers of fish were discarded in 2005, around 20% in 2006 and 8% in 2007. The 2006 figure is unusual high for a species like sole but was as a result of high discard rates during one observer trip in the fourth quarter. Sparse discard information from previous years also indicated low discard rates of sole. It is therefore unlikely that the non-inclusion of discard data in the assessment is seriously undermining the quality of the assessment. Therefore, no new information on sole discards in the Irish Sea in more recent years was processed, and no discard tables and figures are presented in this report.

There is no accurate information on the level of misreporting, but given the partial uptake of the agreed TAC in recent years, it is not considered a problem for this stock.

Biological

Natural mortality, maturity and proportions of natural mortality and fishing mortality before spawning were set as in previous years.

Natural mortality was set at 0.1 yr^{-1} (all ages and all years).

The maturity ogive used is as previously:

Age	1	2	3	4	5	6 and older
	0.00	0.38	0.71	0.97	0.98	1.00

The proportions of natural mortality and fishing mortality before spawning were both set to 0 to reflect the SSB calculation date of 1 January.

Surveys

Cpue and effort series were available from a UK (E&W) September beam trawl survey (1988–2008) and a UK March beam trawl survey (1993–1999) (Tables 6.8.6–7 and

Figure 6.8.1). The Irish Groundfish Survey (IRGFS) that was only carried out in VIIa in 2003 and 2004 is no longer retained in Table 6.8.6 (compared with last year's WGNSDS-reports). From 2006 onwards, only the two UK beam trawl surveys have been used as tuning indices in the Irish Sea sole assessments.

Commercial cpue

Commercial tuning data were available for Belgian beam trawlers, UK (E&W) beam and otter trawlers and Irish otter trawlers (Tables 6.8.6–7 and Figure 6.8.1). In 2006, the commercial tuning fleets were removed from the final assessment. The main reason for their removal was a retrospective step change in the time-series of SSB. Given the "update status" of this assessment, no attempts were made to look at the potentials for including the commercial tuning fleets again.

Effort from both Belgian and UK commercial beam trawl fleets increased from the early seventies until the late eighties. Since then UK beam trawl effort has declined. The Belgian beam trawl effort declined in the early nineties, increased the early 2000s and decreased again recently. Effort of the Irish beam trawl fleet has remained more or less stable. In 2008 however, effort declined substantially for all commercial fleets (Tables 6.8.6–7 and Figure 6.8.1).

Cpue for both UK and Belgian beam trawlers was at a higher level in the late seventies and early eighties. More recently cpue for these beam trawlers is fluctuating at a lower level. Irish beam trawl cpue declined over the period 1995–2002 but has increased again recently.

6.8.3 Historical stock development

The method used to assess Irish Sea sole is XSA, using two survey tuning-series (Tables 6.8.6-7). It should be noted that the year range of the UK March beam trawl survey only covers 1993 up to 1999.

Data screening

No exploratory runs using different settings than last year's assessment, or taking revisions from earlier data into account, are presented in this report for Irish Sea sole.

Final update assessment

The model settings for the final assessment are summarized below. Because this is an update assessment, settings were kept the same as last year. Log catchability residuals for the final run are given in Figure 6.8.2. There are no apparent trends. The XSA diagnostics, and the estimates of fishing mortality and the population numbers are given in Tables 8.6.8–10. The summary is given in Table 6.8.11 and Figure 6.8.3.

Assmnt Year	2004	2006	2007	2008	2009
Assmnt Model	XSA	XSA	XSA	XSA	XSA
Fleets					
Bel Beam Trwl	1975–2003 4–9	omitted	omitted	omitted	omitted
UK Trawl	1991–2003 2–9	omitted	omitted	omitted	omitted
UK Sept BTS	1988–2003 2–9	: 1988–2005 2–7	: 1988-2006 2–7	: 1988-2007 2–7	:1988–2008 2–7
UK Mar BTS	1993–1999 2-9	: 1993–1999 2–7	: 1993-1999 2–7	: 1993–1999 2–7	:1993–1999 2–7
Time Ser. Wts	tricubic 20years	: linear 20 years	: linear 20 years	: linear 20 years	: linear 20 years
Power Model	none	: none	: none	: none	: none
Q plateau	5	5	7	7	7
Shk se	0.8	1.5	1.5	1.5	1.5
Shk age-year	5 yrs 5 ages	: 5 yrs 3 ages	: 5 yrs 3 ages	: 5 yrs 3 ages	: 5 yrs 3 ages
Pop Shk se	: 0.3	: 0.3	: 0.3	: 0.3	: 0.3
Prior Wting	: none	: none	: none	: none	: none
Plusgroup	: 10	: 8	: 8	: 8	: 8
Fbar	4–7	4–7	4–7	4–7	4–7

Survivor and F estimates coming from the UK (E+W) September beam trawl survey and from F shrinkage are not always in line with each other. But given that the survey gets high weights (>96%) throughout, the survey has a bigger influence on the final estimates. The March survey was discontinued after 1999, and therefore does not contribute to the estimates in the final year.

The retrospective analysis is presented in Figure 6.8.4. A retrospective pattern is apparent in SSB, although for most recent estimates the yearly revisions are minor. Recruitment levels appear to be consistently estimated throughout the retrospective period.

Comparison with previous assessments

A comparison of the estimates of this year's assessment with last year's is given in Figure 6.8.5. Recruitment trends, historical SSB and fishing mortality estimates are very similar.

State of the stock

Estimated trends of Irish Sea sole landings, SSB, fishing mortality and recruitment are presented in Table 6.8.11 and Figure 6.8.3. Landings of Irish Sea sole have been declining since the late eighties and reached a record low of 332 t in 2008. SSB has been at a lower level since the early nineties compared with the period before. Since 2001 SSB has been decreasing dramatically and reached the lowest observed estimate in 2008 (for the first time only reaching values below 2000 t since 2006). High fishing mortalities were observed during the late eighties until the mid nineties. Thereafter fishing mortality has declined somewhat, but remained fluctuating around F_{lim}. Since 2001 recruitment has been well below average.

6.8.4 Short-term projections

Estimating year-class abundance

The estimates up to the 2005 year class were taken from XSA.

The 2006 year class (age 2 in 2008) was estimated using RCT3 (input in Table 6.8.12, output in Table 6.8.13). Both RCT3 and XSA estimate a weak 2005 year class (higher for RCT3), but the RCT3 estimate was taken over the XSA estimate because it uses more recent survey data and is in line with last year's procedure.

The different estimates at-age 2 are summarized below. The values in bold were selected for further predictions.

Year class	2006	2007	2008 and older
XSA	1785	-	-
RCT3	2665	**3556**	-
GM	5484	5484	**5484**

The input to the short-term catch predictions is given in Table 6.8.14. Weights-at-age averaged over the last three years were used as input for the predictions. As for last year, fishing mortality-at-age was averaged over the last three years, not rescaled. XSA estimates up to year class 2006 were used for the starting population. For the year class 2007 the RCT3 estimate was used. GM over the full period was assumed for the recruiting ages from 2009 onwards.

The short-term catch option table is given in Table 6.8.15, a detailed management option table is presented in Table 6.8.16. A short-term forecast plot is shown in Figure 6.8.6. Assuming F_{sq}, landings in 2009 are estimated to be around 465 t, compared with a TAC of 552 t.

The relative contributions of the different year classes to the landings and SSB are presented in Table 6.8.17 and Figure 6.8.8. Given the low stock size, predictions become more dependent on the assumed incoming recruitment. 50% of the predicted landings in 2010 and 54% of the predicted SSB in 2011 are based on the assumed GM recruitment.

6.8.5 Medium-term projection

No medium-term forecasts were carried out for this stock.

6.8.6 Biological reference points

Precautionary approach reference points

Biological reference points are:

$\mathbf{B}_{lim}$ = 2200t Basis: $\mathbf{B}_{lim}$=$\mathbf{B}_{loss}$ Changed in ACFM 2007

(from 2800 to 2200 t). The lowest observed spawning stock, followed by an increase in SSB.

$\mathbf{B}_{pa}$ = 3100t Basis: $\mathbf{B}_{pa}$ ~ $\mathbf{B}_{lim}$ * 1.4 Changed in ACFM 2007 (from 3800 to 3100 t).

$\mathbf{F}_{lim}$=0.4 Basis: $\mathbf{F}_{lim}$=$\mathbf{F}_{loss}$ Although poorly defined, based that there is evidence that fishing mortality in excess of 0.4 has led to a general stock decline and is only sustainable during periods of above-average recruitment.

F$_{pa}$=0.3 Basis: **F**$_{pa}$ be set at 0.30. This F is considered to have a high probability of avoiding **F**$_{lim}$.

Yield-per-recruit analysis

A yield-per-recruit analysis was carried out (Figure 6.8.7). Current fishing mortality (0.38) is well above $F_{0.1}$ (0.15). F_{max} was estimated at 0.85, but was considered to be not well defined given flat yield-per-recruit curve.

Yield and spawning biomass-per-Recruit F-reference point (2009):

	Fish Mort	Yield/R	SSB/R
	Ages 4–7		
Average last 3 years	0.38	0.20	0.62
Fmax*	0.85	0.21	0.33
F0.1	0.15	0.17	1.22
Fmed	0.26	0.19	0.84

6.8.7 Management plans

No management plan is currently in place for Irish Sea sole.

6.8.8 Uncertainties and bias in assessment and forecast

Sampling

The major fleets fishing for Irish Sea sole are sampled. Sampling is considered to be at a reasonable level. Under the DCF there is an initiative to coordinate sampling across the three countries involved in the fishery. One of the problems in this assessment may well be the quality of historical catch-at-age data.

Landings

There is no reliable information on the accuracy of the landing statistics. The national quota for Ireland (taking about 20% of the total international landings) was restrictive in 2007 but not in 2008. Nevertheless, the total TAC uptake over the last 3 years was only in the rage of 50–60%. In this context, misreporting is not considered to be a major problem for these years.

Discards

The absence of discard data is unlikely to affect the quality of the assessment as information from 2003, 2004 and 2005 and 2007 indicates that discarding ranges by weight vary between 0 and 8%. In 2006 high discard rates were estimated for the UK beam trawl fleet, but this estimate was heavily influenced by one observation made in the fourth quarter.

Effort

There are no indications of Irish Sea sole fisheries misreporting effort. Effort in sole targeting beam trawl fisheries has declined substantially in the last few years.

Surveys

The UK (E&W) September beam trawl survey appears to track year-class strength well. As previously investigated, this tuning fleet is also quite consistent in estimating year-class strength of the same year class at different ages. Therefore the Working Group had confidence in using the UK (E&W) September survey. The bias problem in the assessment may be the result of the precise survey and less precise catch-at-age data.

Model formulation

At the moment XSA is used to assess Irish Sea sole. In the WG of 2007 the model settings were changed which did have a considerable impact on the estimates of SSB and fishing mortality. Because of the major revisions, ACFM changed the biomass reference points in its meeting of 2007. In the last two year's update assessment (2008–2009) no major changes were apparent.

6.8.9 Recommendations for next Benchmark

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
2009	Sole VIIa	The priority should be to develop a long-term plan to rebuild the stock to sustainable levels. The WG recommends that various HCR might be developed and tested through simulations. The reintroduction of commercial tuning series into the assessment should be examined. The retrospective application of an international age–length-key and historical precision of catch-at-age data should be investigated. The approach to smoothing catch weight and stock weights should be looked at. Weights in some years look unusual e.g. 2004. Given the current assessment diagnostics the choice of q plateau and f-bar range could also be reviewed.	2011	Expert group members

6.8.10 Management considerations

SSB in 2008 is estimated at its lowest observed value, and well below B_{lim}. Recruitment at-age 2 has been well below average since 2001, and is estimated to remain low in 2006–2008. The model indicates that fishing mortality has come down over the last couple of years (as did effort for most fleets fishing on Irish Sea sole), but it remains above F_{pa}.

It is not possible for the stock to reach $\mathbf{B}_{pa}$ in one year. A management plan for effort reduction that can be phased in over a number of years and implemented in conjunction with technical conservation measures should be considered.

Given the successive recent low recruitment, predictions become more dependent on the assumed incoming recruitment. 54% of the predicted SSB in 2011 is based on that assumption. A GM recruitment was used, which might be an optimistic assumption given the consecutive low recruitments in recent years.

Sole is caught in a mixed fishery with other flatfish as well as gadoids. Information from observer trips indicates that discarding of sole is relatively low.

Table 6.8.1 - Sole in VIIa. Nominal landings (tonnes) as officially reported by ICES, and working group estimates of the landings.

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008 *
Belgium	930	987	915	1010	786	371	531	495	706	675	533	570	525	469	493	674	817	687	527	662	419.3	306.0	214.4
France	17	5	11	5	2	3	11	8	7	5	5	3	3	0.5	3	4	4	4	1	3	0.4	1.0	1.4
Ireland	235	312	366	155	170	198	164	98	226	176	133	130	134	120	135	135	96	103	77	85	82.5	115.0	64.0
Netherlands	-	-	-	-	-	-	-	-	-	-	149	123	60	46	60	-	-	-	-	-	-	-	-
UK (Engl.& Wales)[1]	637	599	507	613	569	581	477	338	409	424	194	189	161	165	133	195	165	217	106	103	69.4	66.0	45.2
UK (Isle of Man)	1	3	1	2	10	44	14	4	5	12	4	5	3	1	1	+	+	+	+	+	+	n/a	n/a
UK (N. Ireland)[1]	50	72	47																				
UK (Scotland)	46	63	38	38	39	26	37	28	14	8	5	7	9	8	8	4	3	3	1	1	n/a	4.0	n/a
Total	1916	2041	1885	1823	1576	1223	1234	971	1367	1300	490	1027	895	810	833	1012	1085	1014	712	854	572	492	325
Used by WG	1995	2808	1999	1833	1583	1212	1259	1023	1374	1266	1002	1003	911	863	818	1053	1087	1014	699	855	569	492	333
Unallocated	79	767	114	10	7	-11	25	52	7	-34	512	-24	16	54	-15	41	2	0	-13	1	-3	0	8

* Preliminary

[1] 1989 onwards: N. Ireland included with England & Wales

Table 6.8.2. Sole in VIIa. Annual length distributions by fleet (2008).

Length (cm)	Beam trawl	All but beam	All gears	All gears
20				56
21				136
22			8039	702
23	25	16	48597	1797
24	6291	159	98110	2576
25	6864	1555	134881	4513
26	9002	4717	135393	10656
27	6518	5544	102911	13473
28	6346	7363	86461	15475
29	3537	6324	63889	23901
30	3534	4202	52271	14278
31	4932	3496	45369	9581
32	4208	3292	37576	9027
33	1735	3677	29619	9111
34	1383	2902	20226	9151
35	1411	2052	14504	8919
36	715	1459	10467	8574
37	695	813	8752	9068
38	435	894	6119	8660
39	279	516	4164	6863
40	189	241	3061	3625
41	102	721	2602	2617
42	88	56	1783	2538
43	18	225	1406	1304
44	24	0	980	1054
45	22	8	485	723
46	10	8	153	345
47	3		147	273
48	2		10	434
49	2		113	67
50	2		52	
51	0		22	
52	5			
53				
54				
55				
56				
57				
58				
59				
60				
Total	58377	50240	918138	179497

Table 6.8.3 - Sole in VIIa. Catch numbers at age (in thousands)

	1970	1971	1972	1973	1974	1975	1976	1977	1978
2	29	113	31	368	25	262	29	221	65
3	895	434	673	363	891	733	375	416	958
4	1009	2097	730	2195	576	2386	1332	1292	649
5	467	1130	1537	557	1713	539	2330	774	1009
6	1457	232	537	815	383	842	247	1066	442
7	289	878	172	267	422	157	544	150	638
+gp	2537	1887	1500	1143	971	1006	739	648	587
TOTALNUM	6683	6771	5180	5708	4981	5925	5596	4567	4348
TONSLAND	1785	1882	1450	1428	1307	1441	1463	1147	1106
SOPCOF %	100	100	100	100	100	100	100	100	100

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2	108	187	70	8	37	651	154	141	189	32
3	1027	939	580	346	165	786	1601	3336	3348	444
4	3433	1968	1668	1241	998	380	1086	3467	4105	4752
5	829	3055	1480	1298	758	610	343	961	3185	2102
6	637	521	1640	711	757	343	334	235	844	1310
7	326	512	114	641	416	424	164	277	307	203
+gp	620	1145	865	397	709	557	739	848	808	516
TOTALNUM	6980	8327	6417	4642	3840	3751	4421	9265	12786	9359
TONSLAND	1614	1941	1667	1338	1169	1058	1146	1995	2808	1999
SOPCOF %	100	100	100	100	100	100	100	100	100	100

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	179	564	1317	363	83	122	132	60	789	167
3	771	1185	1270	2433	543	1342	920	469	713	1728
4	775	986	841	918	1966	1069	1444	1188	474	466
5	3978	598	300	556	559	1578	737	741	710	256
6	1178	2319	226	190	251	394	1010	430	408	315
7	552	592	1173	156	199	133	179	509	258	191
+gp	255	466	459	929	686	524	350	347	531	423
TOTALNUM	7688	6710	5586	5545	4287	5162	4772	3744	3883	3546
TONSLAND	1833	1583	1212	1259	1023	1374	1266	1002	1003	911
SOPCOF %	100	100	100	100	100	100	100	100	100	100

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2	301	88	267	88	329	146	518	115	179	100
3	1069	1013	1259	442	1082	946	1066	630	462	391
4	1258	1180	909	1329	1042	352	617	554	399	255
5	297	556	604	1122	704	332	408	233	242	204
6	115	190	471	551	308	292	257	126	87	113
7	136	66	68	194	155	91	167	142	37	65
+gp	232	224	238	119	201	78	248	250	212	114
TOTALNUM	3408	3317	3816	3845	3821	2237	3281	2050	1618	1242
TONSLAND	863	818	1053	1090	1014	709	855	569	492	332
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 6.8.4 - Sole in VIIa. Catch weights at age (kg)

	1970	1971	1972	1973	1974	1975	1976	1977	1978
2	0.130	0.152	0.126	0.151	0.138	0.130	0.120	0.085	0.093
3	0.153	0.178	0.164	0.178	0.174	0.172	0.161	0.146	0.147
4	0.178	0.204	0.201	0.204	0.209	0.210	0.200	0.202	0.197
5	0.204	0.230	0.237	0.230	0.241	0.244	0.239	0.251	0.243
6	0.232	0.257	0.272	0.256	0.272	0.275	0.276	0.293	0.286
7	0.260	0.284	0.306	0.283	0.301	0.303	0.313	0.330	0.326
+gp	0.377	0.419	0.417	0.392	0.396	0.367	0.457	0.387	0.429
SOPCOFAC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2	0.134	0.146	0.162	0.112	0.189	0.191	0.144	0.122	0.135	0.111
3	0.165	0.169	0.183	0.171	0.212	0.225	0.189	0.164	0.164	0.147
4	0.199	0.193	0.207	0.225	0.238	0.257	0.231	0.203	0.196	0.183
5	0.234	0.219	0.234	0.275	0.266	0.288	0.272	0.241	0.231	0.218
6	0.271	0.247	0.264	0.321	0.298	0.318	0.310	0.277	0.268	0.252
7	0.311	0.275	0.296	0.362	0.332	0.347	0.346	0.311	0.308	0.286
+gp	0.451	0.380	0.452	0.456	0.458	0.409	0.430	0.407	0.462	0.419
SOPCOFAC	1.000	1.001	1.000	1.000	1.000	1.000	0.999	0.999	1.000	0.999

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	0.125	0.135	0.133	0.149	0.102	0.175	0.129	0.156	0.154	0.187
3	0.163	0.162	0.172	0.177	0.156	0.198	0.182	0.193	0.197	0.209
4	0.201	0.192	0.208	0.207	0.205	0.227	0.232	0.228	0.237	0.234
5	0.237	0.227	0.241	0.239	0.248	0.261	0.277	0.263	0.275	0.263
6	0.271	0.265	0.272	0.274	0.285	0.301	0.318	0.296	0.311	0.295
7	0.304	0.307	0.300	0.310	0.318	0.346	0.356	0.327	0.345	0.331
+gp	0.389	0.414	0.345	0.379	0.370	0.509	0.451	0.410	0.407	0.440
SOPCOFAC	1.000	1.000	1.000	0.999	0.999	1.001	1.000	1.000	1.002	1.000

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2	0.179	0.143	0.184	0.163	0.143	0.188	0.203	0.209	0.219	0.197
3	0.217	0.190	0.231	0.212	0.206	0.257	0.231	0.234	0.255	0.228
4	0.252	0.235	0.273	0.257	0.262	0.318	0.258	0.259	0.289	0.257
5	0.285	0.276	0.308	0.298	0.310	0.372	0.284	0.284	0.321	0.284
6	0.314	0.315	0.338	0.334	0.352	0.418	0.308	0.309	0.352	0.309
7	0.341	0.351	0.362	0.367	0.386	0.456	0.331	0.334	0.382	0.332
+gp	0.399	0.443	0.393	0.423	0.420	0.505	0.374	0.399	0.460	0.383
SOPCOFAC	1.001	1.000	1.001	1.000	1.000	1.000	1.002	1.003	1.000	0.999

Table 6.8.5 - Sole in VIIa. Stock weights at age (kg)

	1970	1971	1972	1973	1974	1975	1976	1977	1978
2	0.118	0.139	0.106	0.138	0.119	0.108	0.100	0.052	0.065
3	0.141	0.165	0.145	0.164	0.156	0.151	0.141	0.116	0.120
4	0.166	0.191	0.183	0.191	0.192	0.191	0.181	0.175	0.172
5	0.191	0.217	0.219	0.217	0.225	0.228	0.220	0.227	0.220
6	0.218	0.244	0.255	0.243	0.257	0.260	0.258	0.273	0.265
7	0.246	0.271	0.289	0.270	0.287	0.290	0.295	0.312	0.306
+gp	0.360	0.405	0.403	0.379	0.385	0.361	0.442	0.3815	0.417

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2	0.119	0.135	0.152	0.081	0.179	0.174	0.121	0.101	0.121	0.093
3	0.149	0.157	0.172	0.142	0.200	0.208	0.167	0.143	0.149	0.129
4	0.182	0.181	0.195	0.198	0.224	0.241	0.210	0.183	0.180	0.165
5	0.216	0.206	0.220	0.251	0.252	0.273	0.252	0.222	0.213	0.200
6	0.252	0.233	0.249	0.299	0.282	0.303	0.291	0.259	0.249	0.235
7	0.291	0.261	0.280	0.342	0.315	0.332	0.328	0.294	0.287	0.269
+gp	0.428	0.363	0.430	0.443	0.436	0.396	0.415	0.393	0.437	0.403

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	0.105	0.123	0.113	0.135	0.073	0.165	0.101	0.136	0.132	0.177
3	0.144	0.148	0.153	0.162	0.130	0.186	0.156	0.174	0.176	0.198
4	0.182	0.176	0.190	0.192	0.181	0.212	0.207	0.211	0.217	0.221
5	0.219	0.209	0.225	0.223	0.227	0.243	0.255	0.246	0.257	0.248
6	0.254	0.245	0.257	0.256	0.267	0.280	0.298	0.279	0.294	0.279
7	0.288	0.286	0.286	0.292	0.302	0.323	0.338	0.312	0.328	0.312
+gp	0.374	0.388	0.334	0.359	0.362	0.478	0.440	0.397	0.393	0.418

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2	0.159	0.119	0.158	0.137	0.109	0.151	0.189	0.196	0.201	0.181
3	0.199	0.167	0.208	0.188	0.175	0.224	0.218	0.221	0.237	0.213
4	0.235	0.213	0.253	0.235	0.235	0.289	0.245	0.246	0.272	0.243
5	0.269	0.256	0.291	0.278	0.287	0.346	0.271	0.271	0.305	0.271
6	0.300	0.296	0.324	0.317	0.332	0.396	0.296	0.296	0.337	0.297
7	0.328	0.334	0.351	0.351	0.370	0.438	0.320	0.321	0.367	0.321
+gp	0.391	0.430	0.386	0.413	0.415	0.497	0.365	0.386	0.447	0.375

Table 6.8.6 - Sole in VIIa. Tuning series (values in bold are used in the assessment)

BEL-BEAM Belgium Beam trawl (Effort = Corrected formula)

	1975	2005										
	1	1	0	1								
	4	14										
12.3		1045	275	393	69	105	94	61	72	11	15	64
11.8		568	1066	80	263	64	58	35	5	56	5	5
10.7		434	307	509	76	93	45	23	20	2	35	32
9.9		169	304	155	258	41	90	12	29	12	7	17
11.2		1455	510	323	193	162	37	36	9	41	0	0
16.7		958	1644	296	268	247	210	30	64	31	14	7
22.6		909	721	998	62	92	44	161	13	92	10	8
19.5		451	608	378	394	52	64	11	29	24	5	0
20.5		259	310	394	238	216	44	38	28	49	3	26
12		107	204	143	188	91	121	2	1	4	14	0
19.6		606	171	186	99	150	125	83	27	13	4	23
38		1531	468	138	135	90	104	69	69	20	8	21
43.2		1527	881	297	167	69	39	54	59	40	13	9
30.5		2027	1012	480	21	33	37	34	42	35	0	7
34		376	2423	751	250	59	15	9	2	14	0	1
36.1		307	223	1263	276	142	13	9	11	11	8	5
13.8		253	78	60	588	115	40	16	1	1	11	3
23.9		298	330	68	40	203	93	36	12	0	0	0
24.5		862	253	149	89	79	160	66	77	0	0	0
31		680	786	164	103	39	117	58	19	15	0	7
26.2		729	366	410	52	27	6	28	15	6	11	3
21.6		537	334	241	219	53	13	11	14	9	7	2
28.5		270	376	180	162	134	28	27	15	9	8	1
23.3		248	146	142	89	73	62	20	20	9	10	3
21.7		693	199	65	50	37	21	17	9	6	4	6
18.6		685	220	107	31	15	33	13	7	9	0.6	8
30.5		600	284	248	39	35	44	33	1	3	0.2	4
38.6		1138	814	349	109	30	9	2	1	1	1	0
24.45		724	436	196	84	20	7	2	1	0	2	1
25.58		313	197	159	47	12	11	6	3	0	0	0
32.15		505	342	156	71	87	9	7	1	13	2	1

E+W September beam trawl survey

	1988	2008								
	1	1	0.75	0.85						
	1	9								
100.062		118	**196**	**180**	**410**	**76**	**40**	**4**	0	4
129.71		218	**304**	**180**	**74**	**284**	**56**	**32**	8	6
128.969		1712	**534**	**122**	**42**	**88**	**194**	**40**	20	6
123.78		148	**1286**	**122**	**26**	**16**	**14**	**55**	19	7
129.525		220	**309**	**657**	**142**	**34**	**22**	**7**	75	17
131.192		83	**330**	**143**	**211**	**40**	**17**	**7**	16	36
124.892		60	**408**	**203**	**73**	**132**	**49**	**11**	13	6
126.004		246	**154**	**253**	**110**	**30**	**67**	**12**	5	5
126.004		886	**126**	**32**	**76**	**46**	**23**	**31**	8	2
126.004		1158	**577**	**72**	**24**	**55**	**27**	**16**	30	7
126.004		539	**716**	**292**	**18**	**6**	**24**	**23**	5	18
126.004		385	**293**	**255**	**203**	**29**	**8**	**26**	5	6
126.004		354	**464**	**147**	**219**	**91**	**13**	**2**	13	6
126.004		91	**284**	**192**	**65**	**96**	**64**	**6**	3	12
126.004		205	**61**	**121**	**126**	**42**	**79**	**49**	2	1
126.004		242	**210**	**51**	**97**	**81**	**40**	**43**	26	1
126.004		406	**240**	**119**	**27**	**77**	**45**	**41**	17	19
122.298		53	**165**	**69**	**25**	**13**	**35**	**25**	4	6
126.004		107	**110**	**90**	**45**	**36**	**9**	**16**	15	10
126.004		125	**93**	**49**	**57**	**41**	**11**	**4**	6	12
122.298		126	**125**	**60**	**21**	**43**	**23**	**6**	2	9

Table 6.8.6 - Sole in VIIa. Continued

E+W March beam trawl survey

	1993	1999								
	1	1	0.15	0.25						
	1	9								
126.931		18	**337**	**147**	**332**	**73**	**15**	**17**	10	41
115.442		8	**354**	**208**	**69**	**151**	**51**	**14**	11	9
126.189		24	**96**	**186**	**140**	**30**	**104**	**27**	10	8
134.343		651	**114**	**49**	**110**	**78**	**32**	**54**	10	12
121.742		130	**417**	**33**	**17**	**69**	**23**	**11**	46	17
130.081		47	**421**	**330**	**39**	**19**	**48**	**27**	12	37
130.822		45	**227**	**284**	**177**	**14**	**4**	**34**	12	7

UK(E+W) Beam trawl

	1991	2008												
	1	1	0	1										
	2	14												
25.838		267	426	212	84	58	218	53	34	4	1	2	1	0
23.399		36	460	176	68	37	32	121	34	38	3	1	0	0
21.503		11	74	355	98	36	48	25	34	13	22	5	2	4
20.145		24	228	150	234	87	17	25	19	42	10	17	1	0
20.392		47	239	231	130	199	55	11	22	5	34	10	11	3
13.32		0	13	109	98	49	100	37	9	8	6	14	8	3
10.76		0	111	50	81	58	24	46	34	12	12	0	8	1
10.386		43	219	40	28	49	31	12	22	11	9	2	1	0
11.016		53	115	134	12	15	25	10	9	14	9	0	1	2
6.275		16	90	84	82	9	6	10	5	5	7	2	1	1
12.495		33	184	100	145	107	12	4	17	12	10	6	4	2
8.017		4	63	152	50	79	47	5	4	6	3	1	1	1
13.996		28	63	178	149	78	52	72	7	5	8	3	7	14
7.396		54	61	29	43	25	12	10	5	1	1	4	0	1
11.406		10	81	44	16	45	37	17	10	17	3	0	3	3
4.649		7	28	33	11	5	10	12	7	9	5	2	0	1
3.197		22	20	34	17	6	1	7	7	6	3	2	1	1
1.302		1	11	5	7	12	1	2	4	3	4	0	3	1

IR-OTB : Irish Otter trawl - Effort in hours - VIIa Sole numbers at age - Year

	1995	2005									
	1	1	0	1							
	2	10									
70682		6.8	17.7	25.5	9.2	25.8	3.6	0.8	1.5	1.9	1995
58166		0	5.7	12.9	12.7	4.7	4.7	2.2	0.2	0	1996
75029		27.8	10.2	4.1	9.2	6.4	3.5	3.9	1	0.2	1997
81073		5.5	40.7	14.7	6.6	12.3	5.4	2.7	4.1	1	1998
93221		26.6	36.8	30.9	5.1	3.8	5.3	2.4	0.5	1.2	1999
64320		1.6	13.2	13.4	11	3.4	1.1	1	0.4	0	2000
77541		0.2	6.1	18.6	18.6	10.8	2.1	4.1	1.3	0.3	2001
39996		20.3	20	30.2	16.4	8.2	2.9	2.4	1.4	0.5	2002
73854		0.9	35.9	21.7	9.8	3.3	0.5	0.8	0.2	0.2	2003
72507		9	15.1	4.1	3.2	1.9	1.6	0.3	0.2	0.1	2004
##											
31142		4	1.7	1.6	1.6	0.6	0.1	0	0	0	2005
##											

Please note the 2005 data is based only on Q3 and Q4 data and has not been raised to annual effort.
It should not be included as part of this time series.

Table 6.8.7 - Sole in VIIa. Effort and cpue series.

	CPUE							Effort				
	Belgium[1]	UK(E+W)[3]		UK[5]		Ireland		Belgium[2]	UK(E+W)[4]		Ireland[6]	
	beam	beam	otter	beam survey		otter	beam	beam	beam	otter	otter	beam
Year	Whole year	Whole year	Whole year	Sept	March	Whole year	Whole year	Whole year	Whole year	Whole year	Whole Year	Whole Year
1972	-	-	1.06	-	-	-	-	-	-	128.4	-	-
1973	-	-	1.06	-	-	-	-	-	-	147.6	-	-
1974	-	-	1.09	-	-	-	-	-	-	115.2	-	-
1975	21.4	-	1.39	-	-	-	-	28.4	-	130.7	-	-
1976	23.1	-	0.94	-	-	-	-	24.9	-	122.3	-	-
1977	19.8	-	0.80	-	-	-	-	22.1	-	101.9	-	-
1978	18.1	34.32	1.04	-	-	-	-	17.5	0.9	89.1	-	-
1979	33.4	32.01	1.43	-	-	-	-	20.4	1.7	89.9	-	-
1980	28.2	31.70	1.01	-	-	-	-	32.0	4.3	107.0	-	-
1981	22.2	21.32	0.75	-	-	-	-	36.5	6.4	107.1	-	-
1982	22.0	29.94	0.53	-	-	-	-	26.5	5.5	127.2	-	-
1983	13.9	37.31	0.57	-	-	-	-	28.7	2.8	88.1	-	-
1984	22.5	16.24	0.71	-	-	-	-	17.5	4.1	103.1	-	-
1985	20.6	17.34	0.56	-	-	-	-	27.0	7.4	102.9	-	-
1986	19.1	19.23	0.84	-	-	-	-	44.5	17.0	90.3	-	-
1987	17.7	14.82	0.77	-	-	-	-	51.6	22.0	130.6	-	-
1988	21.3	11.81	0.46	158.7	-	-	-	38.2	18.6	132.0	-	-
1989	21.9	9.17	0.70	145.9	-	-	-	42.2	25.3	139.5	-	-
1990	17.5	9.52	0.61	190.1	-	-	-	42.4	31.0	117.1	-	-
1991	18.7	10.43	1.12	170.5	-	-	-	17.1	25.8	107.3	-	-
1992	19.2	9.50	1.02	158.3	-	-	-	25.1	23.4	96.8	-	-
1993	20.0	7.60	0.54	97.3	104.7	-	-	23.9	21.5	78.9	-	-
1994	19.1	11.76	0.74	107.7	91.9		-	32.5	20.1	43.0	-	-
1995	18.1	14.96	0.95	89.5	79.3	0.38	12.69	28.6	20.9	43.1	80.3	8.64
1996	17.7	9.44	0.53	86.8	-	0.25	14.94	23.2	13.3	42.2	64.8	6.26
1997	16.6	10.49	0.73	151.2	63.3	0.23	8.53	30.7	10.8	39.9	92.2	9.86
1998	19.0	8.42	0.48	140.8	89.3	0.38	7.77	24.7	10.4	36.9	93.5	11.58
1999	19.5	9.94	0.60	107.3	-	0.29	9.22	22.7	11.0	22.9	110.3	14.67
2000	15.5	12.90	0.44	122.6	-	0.29	8.49	26.0	6.3	27.0	82.7	11.42
2001	15.0	11.72	0.15	96.9	-	0.38	7.86	36.8	12.5	32.8	77.5	13.13
2002	15.0	16.73	1.48	76.0	-	0.32	4.67	47.0	8.0	24.8	77.9	17.67
2003	14.8	13.20	0.15	88.6	-	0.34	4.20	43.6	14.0	23.9	73.9	18.70
2004	15.4	13.86	0.17	98.9	-	0.14	4.31	32.0	7.4	23.5	72.5	14.19
2005	16.7	9.14	0.19	48.9	-	0.16	4.70	37.5	11.4	16.7	68.3	14.67
2006	15.7	7.83	0.52	52.6	-	0.16	6.00	24.6	4.6	5.2	66.2	12.20
2007	11.3	16.38	0.42	53.0	-	0.37	6.39	23.7	3.2	4.4	73.1	14.00
2008*	15.9	15.25	0.30	50.7	-	0.20	6.13	11.8	1.3	2.7	58.8	9.46

All CPUE values in Kg/hr except UK beam survey (Kg/100 km)

[1] Kg/000'hr

[2] 000' hours fishing

[3] Kg/000'hr fished (GRT corrected > 40' vessels)

[4] 000'hours fished (GRT corrected > 40' vessels)

[5] Kg/100km fished

[6] 000'hours

* Provisional

Table 6.8.8 - Sole in VIIa. Diagnostics

Lowestoft VPA Version 3.1

14/05/2009 15:32

Extended Survivors Analysis

IRISH SEA SOLE,2007 WG,COMBSEX,PLUSGROUP.

CPUE data from file SOL7ATUN.DAT

Catch data for 39 years. 1970 to 2008. Ages 2 to 8.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
E+W September beam t	1988	2008	2	7	.750	.850
E+W March beam trawl	1993	2008	2	7	.150	.250

Time series weights :

Tapered time weighting applied
Power = 1 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1,500

Minimum standard error for population
estimates derived from each fleet = 0,300

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = 0,01058

Final year F values

Age	2	3	4	5	6	7
Iteration 29	0.0545	0.3169	0.3976	0.2187	0.2277	0.4021
Iteration 30	0.0544	0.3162	0.3962	0.2175	0.2257	0.3969

Regression weights

0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00

Fishing mortalities

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2	0.055	0.016	0.074	0.034	0.120	0.047	0.182	0.076	0.106	0.054
3	0.210	0.236	0.288	0.153	0.632	0.522	0.495	0.313	0.429	0.316
4	0.370	0.336	0.306	0.492	0.561	0.381	0.682	0.459	0.297	0.396
5	0.527	0.246	0.256	0.669	0.465	0.308	0.900	0.524	0.330	0.217
6	0.698	0.674	0.303	0.348	0.341	0.317	0.369	0.689	0.334	0.226
7	0.253	1.022	0.479	0.176	0.138	0.142	0.269	0.318	0.388	0.397

Table 6.8.8 - Sole in VIIa. Diagnostics continued

XSA population numbers (Thousands)

YEAR \ AGE	2	3	4	5	6	7
1999	5.92E+03	5.93E+03	4.28E+03	7.63E+02	2.41E+02	6.39E+02
2000	5.95E+03	5.07E+03	4.35E+03	2.68E+03	4.07E+02	1.08E+02
2001	3.91E+03	5.30E+03	3.63E+03	2.82E+03	1.89E+03	1.88E+02
2002	2.78E+03	3.28E+03	3.59E+03	2.42E+03	1.97E+03	1.26E+03
2003	3.05E+03	2.43E+03	2.55E+03	1.99E+03	1.12E+03	1.26E+03
2004	3.32E+03	2.45E+03	1.17E+03	1.32E+03	1.13E+03	7.21E+02
2005	3.27E+03	2.87E+03	1.31E+03	7.23E+02	8.76E+02	7.45E+02
2006	1.66E+03	2.47E+03	1.58E+03	6.01E+02	2.66E+02	5.48E+02
2007	1.86E+03	1.39E+03	1.63E+03	9.04E+02	3.22E+02	1.21E+02
2008	1.99E+03	1.52E+03	8.19E+02	1.10E+03	5.88E+02	2.09E+02

Estimated population abundance at 1st Jan 2009

0.00E+00	1.70E+03	1.00E+03	5.01E+02	8.03E+02	4.28E+02

Taper weighted geometric mean of the VPA populations:

3.32E+03	2.98E+03	2.05E+03	1.32E+03	7.59E+02	4.52E+02

Standard error of the weighted Log(VPA populations) :

0.5285	0.5395	0.5989	0.605	0.7432	0.8654

Log catchability residuals.

Fleet : E+W September beam t

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996
2	99.99	0.08	0.47	0.57	0.03	-0.22	0.21	0.23	-0.24
3	99.99	0.41	-0.07	-0.23	0.55	-0.18	0.02	0.35	-0.62
4	99.99	0.17	-0.19	-0.84	0.54	0.01	-0.16	0.15	-0.17
5	99.99	-0.10	0.91	-0.74	-0.11	-0.39	-0.02	-0.59	-0.28
6	99.99	-0.37	0.18	-0.28	-0.01	-0.20	0.43	-0.08	-0.17
7	99.99	-0.16	0.12	-0.24	-0.16	-0.27	0.13	-0.36	-0.09

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005
2	0.19	0.52	-0.22	0.20	0.18	-1.05	0.16	0.15	-0.07
3	-0.03	0.22	0.09	-0.28	-0.01	-0.10	-0.28	0.47	-0.23
4	-0.09	-0.70	0.48	0.51	-0.54	0.28	0.41	-0.23	-0.15
5	-0.07	-0.86	0.22	-0.11	-0.10	-0.45	0.24	0.48	-0.20
6	-0.25	-0.43	0.18	0.12	-0.12	0.09	-0.03	0.06	0.13
7	0.52	0.21	0.11	-0.07	0.04	-0.01	-0.16	0.35	-0.04

Age	2006	2007	2008
2	0.09	-0.17	0.05
3	0.01	0.07	0.13
4	0.04	0.12	-0.08
5	0.67	0.24	0.03
6	0.19	-0.08	0.00
7	-0.18	0.01	-0.10

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7
Mean Log q	-7.4961	-7.8303	-7.9918	-7.8255	-7.7843	-7.8608
S.E(Log q)	0.3572	0.2654	0.3541	0.4153	0.1839	0.2053

Table 6.8.8 - Sole in VIIa. Diagnostics continued

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.83	0.919	7.60	0.78	20	0.30	-7.50
3	0.94	0.361	7.84	0.83	20	0.26	-7.83
4	0.81	1,222	7.92	0.84	20	0.28	-7.99
5	1.17	-0.621	7.93	0.62	20	0.50	-7.83
6	1.07	-0.804	7.87	0.94	20	0.20	-7.78
7	1.00	-0.011	7.86	0.95	20	0.22	-7.86

Fleet : E+W March beam trawl

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	99.99	99.99	99.99	99.99	0.07	0.37	-0.05	-0.17	0.08	0.18
3	99.99	99.99	99.99	99.99	0.02	0.19	0.14	-0.23	-0.78	0.36
4	99.99	99.99	99.99	99.99	0.46	-0.22	0.25	0.03	-0.59	-0.06
5	99.99	99.99	99.99	99.99	0.35	0.26	-0.57	0.24	0.25	0.20
6	99.99	99.99	99.99	99.99	-0.25	0.6	0.38	0.08	-0.31	0.37
7	99.99	99.99	99.99	99.99	0.12	0.08	0.14	0.00	-0.43	0.03

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2	-0.31	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	0.28	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	0.27	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	-0.50	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	-0.60	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	0.13	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7
Mean Log q	-7.7979	-8.1293	-8.2319	-8.2447	-8.2145	-7.8712
S.E(Log q)	0.2653	0.4822	0.3983	0.4557	0.5188	0.2417

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.88	0.287	7.88	0.88	7	0.33	-7.80
3	0.60	1,441	8.20	0.94	7	0.23	-8.13
4	0.69	1,407	8.13	0.96	7	0.22	-8.23
5	0.86	0.273	8.10	0.82	7	0.56	-8.24
6	0.69	1,039	7.74	0.93	7	0.35	-8.21
7	0.93	0.129	7.77	0.81	7	0.33	-7.87

Terminal year survivor and F summaries :

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2006

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	1785	0.374	0	0	1	0.938	0.052
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	846	1.5				0.062	0.107

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1705.	0.36	0.19	2	0.51	0.054

Table 6.8.8 - Sole in VIIa. Diagnostics continued

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	1021	0.237	0.144	0.61	2	0.966	0.311
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	604	1.5				0.034	0.48

Weighted prediction :

Survivors at end of year	Int s,e	Ext s,e	N	Var Ratio	F
1003.	0.23	0.12	3	0.517	0.316

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2004

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	505	0.208	0.055	0.27	3	0.965	0.392
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	396	1.5				0.035	0.478

Weighted prediction :

Survivors at end of year	Int s,e	Ext s,e	N	Var Ratio	F
501.	0.21	0.05	4	0.248	0.396

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2003

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	828	0.196	0.035	0.18	4	0.971	0.211
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	294	1.5				0.029	0.507

Weighted prediction :

Survivors at end of year	Int s,e	Ext s,e	N	Var Ratio	F
803.	0.2	0.09	5	0.476	0.217

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	436	0.184	0.065	0.35	5	0.975	0.22
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	211	1.5				0.025	0.411

Weighted prediction :

Survivors at end of year	Int s,e	Ext s,e	N	Var Ratio	F
428.	0.18	0.08	6	0.418	0.226

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	127	0.178	0.107	0.6	6	0.973	0.396
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	191	1.5				0.027	0.28

Weighted prediction :

Survivors at end of year	Int s,e	Ext s,e	N	Var Ratio	F
129.	0.18	0.1	7	0.564	0.397

Table 6.8.9 - Sole in VIIa. Fishing mortality

	1970	1971	1972	1973	1974	1975	1976	1977	1978
2	0.0083	0.0117	0.0103	0.0299	0.0045	0.0421	0.0079	0.0148	0.0076
3	0.1196	0.148	0.0809	0.1435	0.0846	0.1574	0.0704	0.1349	0.0741
4	0.2956	0.3988	0.3518	0.362	0.3156	0.303	0.4189	0.3251	0.2862
5	0.4444	0.5544	0.5057	0.4393	0.472	0.4841	0.4813	0.4067	0.4028
6	0.4292	0.3671	0.4929	0.4872	0.5433	0.397	0.3789	0.3747	0.3809
7	0.3909	0.4416	0.4516	0.4309	0.4451	0.3959	0.4278	0.3699	0.3577
+gp	0.3909	0.4416	0.4516	0.4309	0.4451	0.3959	0.4278	0.3699	0.3577
FBAR 4-7	0.39	0.4405	0.4505	0.4299	0.444	0.395	0.4267	0.3691	0.3569

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2	0.0128	0.0391	0.0162	0.0033	0.0066	0.0445	0.01	0.0063	0.0596	0.0096
3	0.142	0.132	0.147	0.0933	0.0784	0.17	0.1321	0.275	0.18	0.1736
4	0.3633	0.3901	0.3244	0.4691	0.3735	0.2325	0.3326	0.4126	0.563	0.3702
5	0.6309	0.5636	0.5051	0.3998	0.5175	0.3651	0.3026	0.4875	0.7309	0.5583
6	0.4247	0.9434	0.5962	0.4291	0.3809	0.414	0.3101	0.3114	0.9412	0.6724
7	0.4746	0.635	0.4769	0.4341	0.4254	0.3383	0.3161	0.4054	0.7495	0.537
+gp	0.4746	0.635	0.4769	0.4341	0.4254	0.3383	0.3161	0.4054	0.7495	0.537
FBAR 4-7	0.4734	0.633	0.4757	0.433	0.4243	0.3375	0.3153	0.4042	0.7461	0.5344

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	0.0439	0.113	0.1169	0.0821	0.0143	0.0246	0.0714	0.0254	0.1085	0.0264
3	0.2952	0.3982	0.3535	0.2919	0.1525	0.297	0.2327	0.3432	0.4114	0.325
4	0.4551	0.6643	0.484	0.4136	0.3605	0.4439	0.5297	0.4682	0.6112	0.4583
5	0.5352	0.6762	0.3814	0.6066	0.4227	0.4862	0.5547	0.5044	0.5015	0.699
6	0.6218	0.6088	0.517	0.3931	0.5382	0.5272	0.5851	0.6503	0.5094	0.3847
7	0.5915	0.6519	0.6323	0.7265	0.8151	0.5405	0.4286	0.585	0.9351	0.4212
+gp	0.5915	0.6519	0.6323	0.7265	0.8151	0.5405	0.4286	0.585	0.9351	0.4212
FBAR 4-7	0.5509	0.6503	0.5037	0.5349	0.5341	0.4995	0.5245	0.552	0.6393	0.4908

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	FBAR 06-08
2	0.0549	0.0157	0.0745	0.0339	0.1204	0.0473	0.1822	0.0757	0.1064	0.0544	0.0788
3	0.21	0.2356	0.2875	0.1526	0.6315	0.5221	0.4954	0.3128	0.4294	0.3162	0.3528
4	0.3697	0.3355	0.3058	0.4921	0.5611	0.3806	0.6815	0.4593	0.2971	0.3962	0.3842
5	0.5267	0.2465	0.2556	0.6693	0.4655	0.3079	0.8998	0.5238	0.3304	0.2175	0.3572
6	0.6978	0.6738	0.3034	0.3475	0.3412	0.3171	0.3688	0.6891	0.3342	0.2257	0.4163
7	0.2534	1.0220	0.4786	0.1759	0.1383	0.1425	0.2689	0.318	0.3885	0.3969	0.3678
+gp	0.2534	1.0220	0.4786	0.1759	0.1383	0.1425	0.2689	0.318	0.3885	0.3969	
FBAR 4-7	0.4619	0.5695	0.3358	0.4212	0.3765	0.287	0.5548	0.4975	0.3375	0.3091	

Table 6.8.10 - Sole in VIIa. Stock numbers at age (start of year, in thousand)

	1970	1971	1972	1973	1974	1975	1976	1977	1978
2	3695	10180	3187	13142	5875	6689	3862	15816	9085
3	8350	3316	9104	2854	11541	5292	5803	3466	14100
4	4145	6704	2588	7597	2237	9595	4091	4894	2741
5	1368	2791	4071	1647	4786	1476	6412	2435	3199
6	4389	794	1451	2222	961	2701	823	3586	1467
7	939	2586	498	802	1235	505	1643	510	2231
+gp	8213	5535	4321	3419	2830	3223	2223	2195	2045
TOTAL	31100	31905	25219	31682	29465	29481	24858	32902	34868

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2	8936	5126	4587	2552	5881	15713	16281	23760	3436	3538
3	8158	7983	4461	4084	2302	5286	13599	14586	21365	2930
4	11847	6405	6330	3484	3366	1926	4035	10782	10024	16147
5	1863	7454	3923	4141	1972	2097	1381	2618	6458	5166
6	1935	897	3839	2142	2512	1064	1317	923	1455	2813
7	907	1145	316	1913	1262	1553	636	874	612	514
+gp	1717	2546	2387	1180	2142	2034	2858	2665	1600	1299
TOTAL	35364	31557	25843	19498	19438	29672	40107	56207	44950	32406

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	4380	5548	12551	4842	6155	5277	2015	2519	8064	6733
3	3171	3793	4484	10104	4035	5490	4659	1697	2222	6546
4	2228	2136	2304	2849	6828	3135	3691	3340	1090	1333
5	10090	1279	995	1285	1705	4308	1820	1967	1892	535
6	2674	5346	589	615	634	1011	2397	946	1075	1037
7	1300	1299	2631	318	375	335	540	1208	447	584
+gp	597	1017	1024	1879	1285	1313	1051	819	912	1289
TOTAL	24440	20418	24578	21891	21017	20869	16173	12497	15701	18057

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	GMST 70-06	AMST 70-06
2	5924	5946	3910	2777	3048	3324	3270	1659	1864	1985		5484	6737
3	5934	5074	5297	3284	2429	2445	2869	2466	1391	1516	1705	4991	6070
4	4280	4352	3627	3595	2551	1169	1313	1582	1632	819	1003	3682	4604
5	763	2676	2816	2417	1989	1317	723	601	904	1097	501	2225	2823
6	241	407	1892	1973	1120	1130	876	266	322	588	803	1310	1663
7	639	108	188	1264	1261	721	745	548	121	209	428	763	951
+gp	1087	365	655	774	1633	617	1103	962	690	364	351		
TOTAL	18866	18928	18385	16085	14032	10722	10897	8083	6924	6579	4791		

Table 6.8.11 - Sole in VIIa. Summary

	RECRUITS Age 2	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4-7
1970	3695	6709	6071	1785	0.294	0.39
1971	10180	6982	5895	1882	0.3192	0.4405
1972	3187	5277	4652	1450	0.3117	0.4505
1973	13142	6141	4831	1428	0.2956	0.4299
1974	5875	5697	4707	1307	0.2777	0.444
1975	6689	5704	4963	1441	0.2904	0.395
1976	3862	5035	4508	1463	0.3245	0.4267
1977	15816	4609	3946	1147	0.2907	0.3691
1978	9085	5382	4497	1106	0.246	0.3569
1979	8936	6323	5239	1614	0.3081	0.4734
1980	5126	6073	5215	1941	0.3722	0.633
1981	4587	5634	4925	1667	0.3385	0.4757
1982	2552	4334	3996	1338	0.3349	0.433
1983	5881	4804	3985	1169	0.2934	0.4243
1984	15713	6512	4473	1058	0.2365	0.3375
1985	16281	7214	5301	1146	0.2162	0.3153
1986	23760	8583	6419	1995	0.3108	0.4042
1987	3436	8016	6753	2808	0.4158	0.7461
1988	3538	5727	5313	1999	0.3762	0.5344
1989	4380	4809	4335	1833	0.4228	0.5509
1990	5548	3963	3361	1583	0.4711	0.6503
1991	12551	4011	2915	1212	0.4157	0.5037
1992	4842	4048	3146	1259	0.4002	0.5349
1993	6155	3345	2869	1023	0.3565	0.5341
1994	5277	4622	3745	1374	0.3669	0.4995
1995	2015	3518	3149	1266	0.4021	0.5245
1996	2519	2792	2463	1002	0.4067	0.552
1997	8064	2999	2209	1003	0.4541	0.6393
1998	6733	3925	2799	911	0.3255	0.4908
1999	5924	4040	3079	863	0.2803	0.4619
2000	5946	3481	2755	818	0.2969	0.5695
2001	3910	4388	3642	1053	0.2891	0.3358
2002	2777	3904	3450	1090	0.3159	0.4212
2003	3048	3443	3085	1014	0.3287	0.3765
2004	3324	2913	2423	709	0.2926	0.287
2005	3270	2660	2082	855	0.4106	0.5548
2006	1659	2048	1674	569	0.34	0.4975
2007	1864	1885	1539	492	0.3198	0.3375
2008	1985	1557	1228	332	0.2702	0.3091
Arith. Mean	6491	4695	3888	1282	.3338	.4644
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		
	5484.2174					

Table 6.8.12. Sole in VIIa. Input to RCT3 (XSA = XSA estimates at-age 2, M2 = abundance indices at-age 2 from UK (E&W) March beam trawl survey, S2 = abundance indices at-age 2 from UK (E&W) September beam trawl survey, M1 and S1 similar as previous but at-age 1).

Irish Sea sole recruits - age 2

4	40	2			
1968	3695	-11	-11	-11	-11
1969	10180	-11	-11	-11	-11
1970	3187	-11	-11	-11	-11
1971	13142	-11	-11	-11	-11
1972	5875	-11	-11	-11	-11
1973	6689	-11	-11	-11	-11
1974	3862	-11	-11	-11	-11
1975	15816	-11	-11	-11	-11
1976	9085	-11	-11	-11	-11
1977	8936	-11	-11	-11	-11
1978	5126	-11	-11	-11	-11
1979	4587	-11	-11	-11	-11
1980	2552	-11	-11	-11	-11
1981	5881	-11	-11	-11	-11
1982	15713	-11	-11	-11	-11
1983	16281	-11	-11	-11	-11
1984	23760	-11	-11	-11	-11
1985	3436	-11	-11	-11	-11
1986	3538	-11	196	-11	-11
1987	4380	-11	304	-11	118
1988	5548	-11	534	-11	218
1989	12551	-11	1286	-11	1712
1990	4842	-11	309	-11	148
1991	6155	265	330	-11	220
1992	5277	307	408	14	83
1993	2015	76	154	7	60
1994	2519	85	126	19	246
1995	8064	343	577	485	886
1996	6733	324	716	107	1158
1997	5924	174	293	36	539
1998	5946	-11	464	34	385
1999	3910	-11	284	-11	354
2000	2777	-11	61	-11	91
2001	3048	-11	210	-11	205
2002	3324	-11	240	-11	242
2003	3270	-11	165	-11	406
2004	1659	-11	110	-11	53
2005	-11	-11	93	-11	107
2006	-11	-11	125	-11	125
2007	-11	-11	-11	-11	126

M2
S2
M1
S1

Table 6.8.13. Sole in VIIa. Output from RCT3

```
 Analysis by RCT3 ver3.1 of data from file:

 sol7arct.txt

 Irish Sea sole recruits - age 2

 Data for    4 surveys over   40 years:  1968 - 2007

 Regression type = C
 Tapered time weighting not applied
 Survey weighting not applied

 Final estimates shrunk towards mean
 Minimum S.E. for any survey taken as    .00
 Minimum of   3 points used for regression

 Forecast/Hindcast variance correction used.

 Year class =   2006

         I-----------Regression----------I  I-----------Prediction------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept    Error          Pts  Value   Value   Error Weights

 M2
 S2       .77   4.00    .25   .808     19   4.84    7.74     .280     .661
 M1
 S1       .69   4.57    .45   .577     18   4.84    7.90     .498     .209

                                    VPA Mean =    8.61     .630     .130

 Year class =   2007

          I-----------Regression----------I  I-----------Prediction-----I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series         cept    Error          Pts  Value   Value   Error Weights

 M2
 S2
 M1
 S1       .69   4.57    .45   .577     18   4.84    7.91     .498     .616

                                    VPA Mean =    8.61     .630     .384

 Year      Weighted      Log     Int      Ext     Var      VPA       Log
 Class      Average      WAP     Std      Std    Ratio               VPA
          Prediction            Error    Error

 2006        2665      7.89     .23      .20      .79
 2007        3556      8.18     .39      .34      .77
```

Table 6.8.14 - Sole in VIIa. Catch forecast input data

MFDP version 1a
Run: s7a
Time and date: 16:29 17/05/2009
Fbar age range: 4-7

Recruits age 2 in 2009 RCT3, in 2010 GM (1970-2006)
Catch and Stock weights 2006-2008
F mean 2006-2008

2009

Age	*N*	*M*	*Mat*	*PF*	*PM*	*SWt*	*Sel*	*CWt*
2	3556	0.1	0.38	0	0	0.192667	0.0788	0.2084
3	1705	0.1	0.71	0	0	0.223667	0.3528	0.239033
4	1003	0.1	0.97	0	0	0.253667	0.3842	0.268333
5	501	0.1	0.98	0	0	0.282333	0.3572	0.296300
6	803	0.1	1	0	0	0.310000	0.4163	0.323267
7	428	0.1	1	0	0	0.336333	0.3678	0.349233
8	351	0.1	1	0	0	0.402649	0.3678	0.413797

2010

Age	*N*	*M*	*Mat*	*PF*	*PM*	*SWt*	*Sel*	*CWt*
2	5484	0.1	0.38	0	0	0.192667	0.0788	0.2084
3	.	0.1	0.71	0	0	0.223667	0.3528	0.239033
4	.	0.1	0.97	0	0	0.253667	0.3842	0.268333
5	.	0.1	0.98	0	0	0.282333	0.3572	0.296300
6	.	0.1	1	0	0	0.310000	0.4163	0.323267
7	.	0.1	1	0	0	0.336333	0.3678	0.349233
8	.	0.1	1	0	0	0.402649	0.3678	0.413797

2011

Age	*N*	*M*	*Mat*	*PF*	*PM*	*SWt*	*Sel*	*CWt*
2	5484	0.1	0.38	0	0	0.192667	0.0788	0.2084
3	.	0.1	0.71	0	0	0.223667	0.3528	0.239033
4	.	0.1	0.97	0	0	0.253667	0.3842	0.268333
5	.	0.1	0.98	0	0	0.282333	0.3572	0.296300
6	.	0.1	1	0	0	0.310000	0.4163	0.323267
7	.	0.1	1	0	0	0.336333	0.3678	0.349233
8	.	0.1	1	0	0	0.402649	0.3678	0.413797

Input units are thousands and kg - output in tonnes

Table 6.8.15 - Sole in VIIa. Management option table

MFDP version 1a
Run: s7a
IRISH SEA SOLE,2009 WG,COMBSEX,PLUGROUP,
Time and date: 16:29 17/05/2009
Fbar age range: 4-7

2009 Biomass	SSB	FMult	FBar	Landings
1997	1451	1.0000	0.3814	465

2010 Biomass	SSB	FMult	FBar	Landings	2011 Biomass	SSB
2627	1767	0.0000	0.0000	0	3683	2683
.	1767	0.1000	0.0381	65	3619	2623
.	1767	0.2000	0.0763	128	3558	2565
.	1767	0.3000	0.1144	190	3498	2509
.	1767	0.4000	0.1526	249	3441	2455
.	1767	0.5000	0.1907	306	3385	2402
.	1767	0.6000	0.2288	362	3331	2351
.	1767	0.7000	0.2670	415	3279	2302
.	1767	0.8000	0.3051	468	3228	2255
.	1767	0.9000	0.3432	518	3179	2209
.	1767	1.0000	0.3814	567	3132	2164
.	1767	1.1000	0.4195	615	3086	2121
.	1767	1.2000	0.4577	660	3042	2080
.	1767	1.3000	0.4958	705	2998	2039
.	1767	1.4000	0.5339	748	2957	2000
.	1767	1.5000	0.5721	790	2916	1963
.	1767	1.6000	0.6102	831	2877	1926
.	1767	1.7000	0.6483	870	2839	1891
.	1767	1.8000	0.6865	909	2802	1856
.	1767	1.9000	0.7246	946	2766	1823
.	1767	2.0000	0.7628	982	1287	566

Input units are thousands and kg - output in tonnes

Table 6.8.16 - Sole in VIIa. Detailed results

MFDP version 1a
Run: s7a
IRISH SEA SOLE,2009 WG,COMBSEX,PLUSGROUP,
Time and date: 16:29 17/05/2009
Fbar age range: 4-7

Year: 2009 F multiplier: 1 Fbar: 0.3814

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0788	257	53	3556	685	1351	260	1351	260
3	0.3528	484	116	1705	381	1211	271	1211	271
4	0.3842	305	82	1003	254	973	247	973	247
5	0.3572	144	43	501	141	491	139	491	139
6	0.4163	261	84	803	249	803	249	803	249
7	0.3678	126	44	428	144	428	144	428	144
8	0.3678	103	43	351	141	351	141	351	141
Total		1679	465	8347	1997	5608	1451	5608	1451

Year: 2010 F multiplier: 1 Fbar: 0.3814

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0788	396	82	5484	1057	2084	402	2084	402
3	0.3528	844	202	2974	665	2111	472	2111	472
4	0.3842	330	89	1084	275	1052	267	1052	267
5	0.3572	177	52	618	174	606	171	606	171
6	0.4163	103	33	317	98	317	98	317	98
7	0.3678	141	49	479	161	479	161	479	161
8	0.3678	143	59	488	196	488	196	488	196
Total		2134	567	11444	2627	7137	1767	7137	1767

Year: 2011 F multiplier: 1 Fbar: 0.3814

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0788	396	82	5484	1057	2084	402	2084	402
3	0.3528	1301	311	4586	1026	3256	728	3256	728
4	0.3842	576	155	1891	480	1834	465	1834	465
5	0.3572	192	57	668	189	655	185	655	185
6	0.4163	127	41	391	121	391	121	391	121
7	0.3678	56	19	189	64	189	64	189	64
8	0.3678	178	74	606	244	606	244	606	244
Total		2825	739	13815	3179	9015	2209	9015	2209

Input units are thousands and kg - output in tonnes

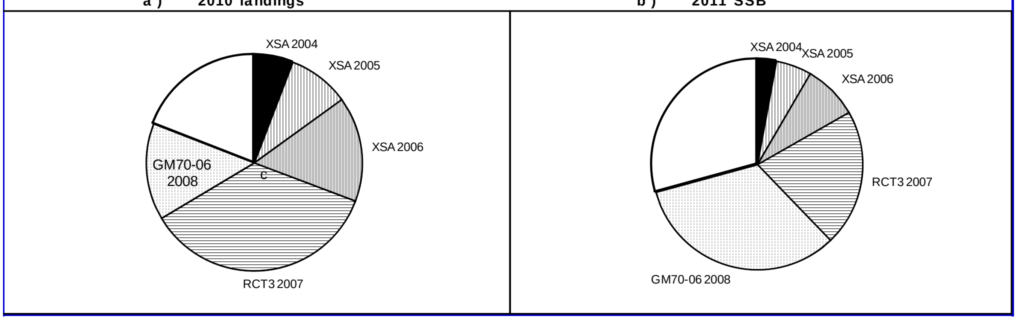
Table 6.8.17 Sole in VIIa
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			2004	2005	2006	2007	2008
Stock No. (thousands) of 2 year-olds			1659	1864	1985	3556	5484
Source			XSA	XSA	XSA	RCT3	GM70-06
Status Quo F:							
% in	2009	landings	9.2	17.6	24.9	11.4	-
% in	2010	landings	5.8	9.2	15.7	35.7	14.5
% in	2009	SSB	9.6	17.0	18.7	17.9	-
% in	2010	SSB	5.5	9.7	15.1	26.7	22.8
% in	2011	SSB	2.9	5.5	8.4	21.1	33.0

GM : geometric mean recruitment

Fig. 6.8.8 - Sole VIIa. Yearclass contribution % to 2010 landings and 2011 SSB

a) 2010 landings b) 2011 SSB



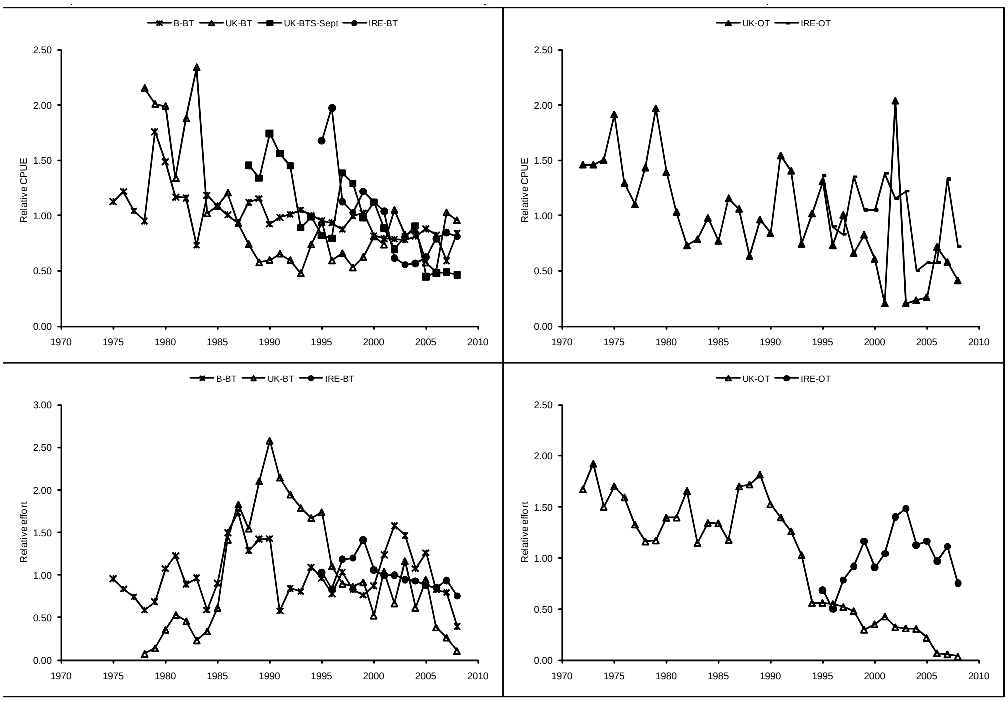


Figure 6.8.1 - Sole in VIIa. Relative CPUE and effort series for beam trawlers from Belgium (B-BT), the UK (UK-BT) and Ireland (IRE-BT); for otter trawlers from the UK (UK-OT) and Ireland (IRE-OT); and CPUE series for the UK(E+W) September beam trawl survey (UK-BTS-Sept)

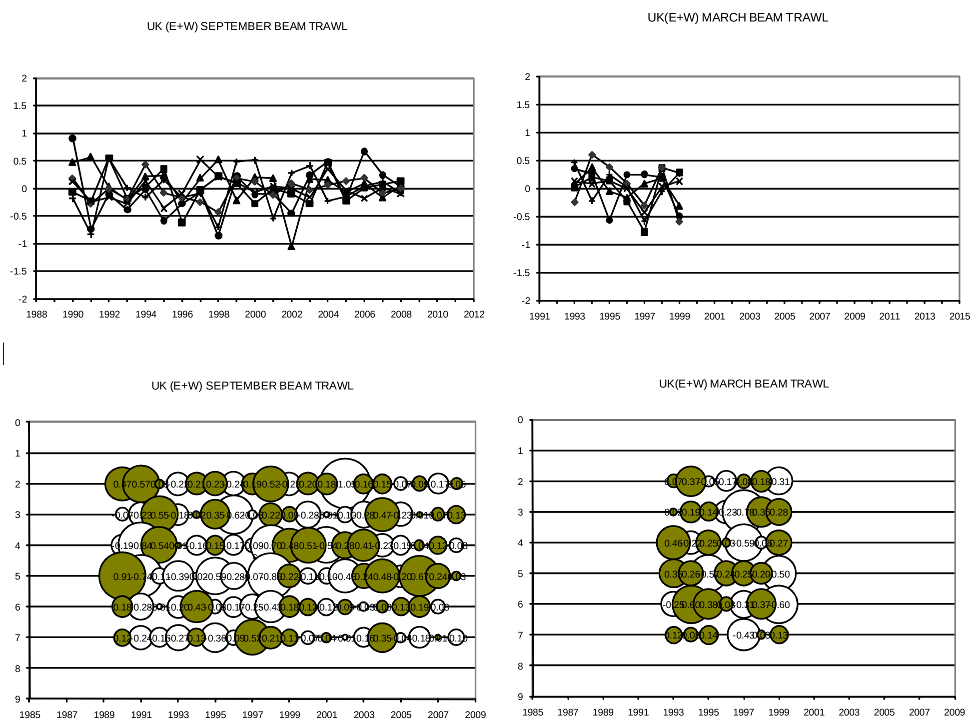


Figure 6.8.2. Sole in VIIa. Catchability residuals of final XSA run.

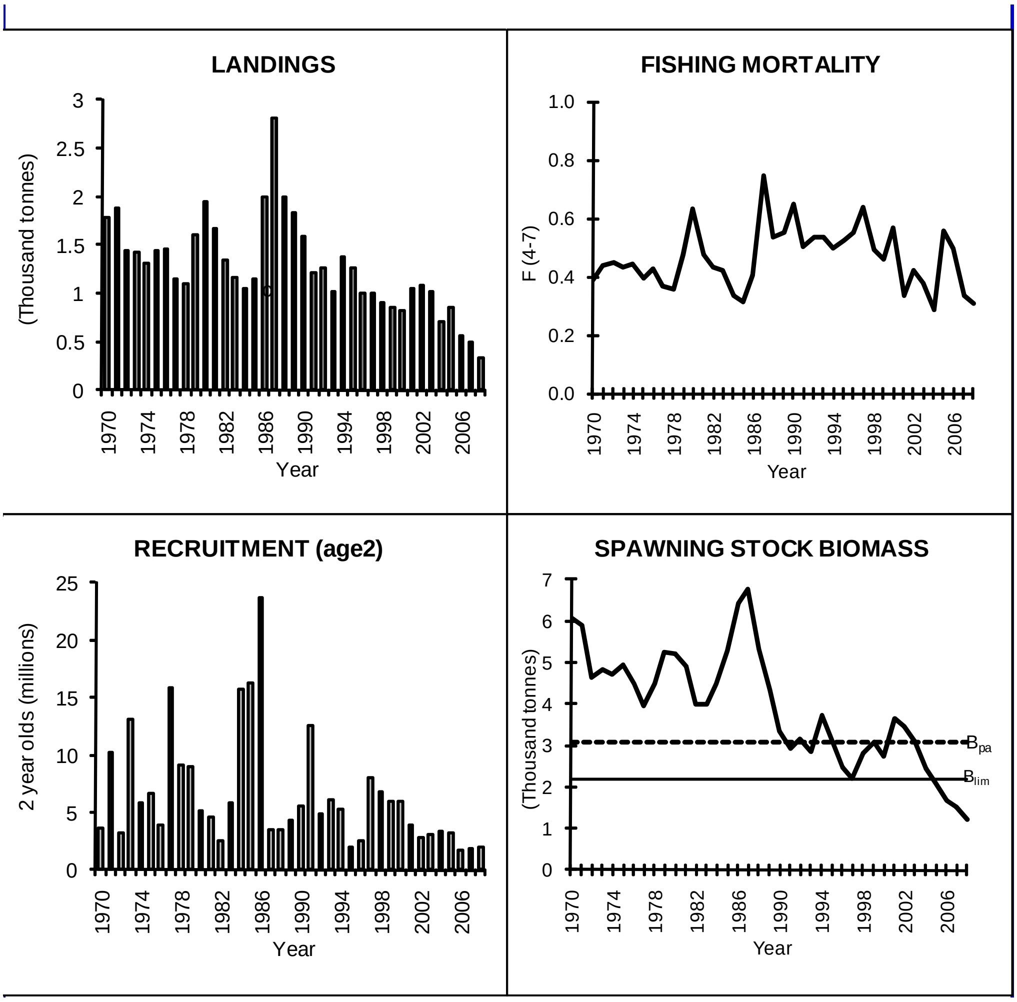
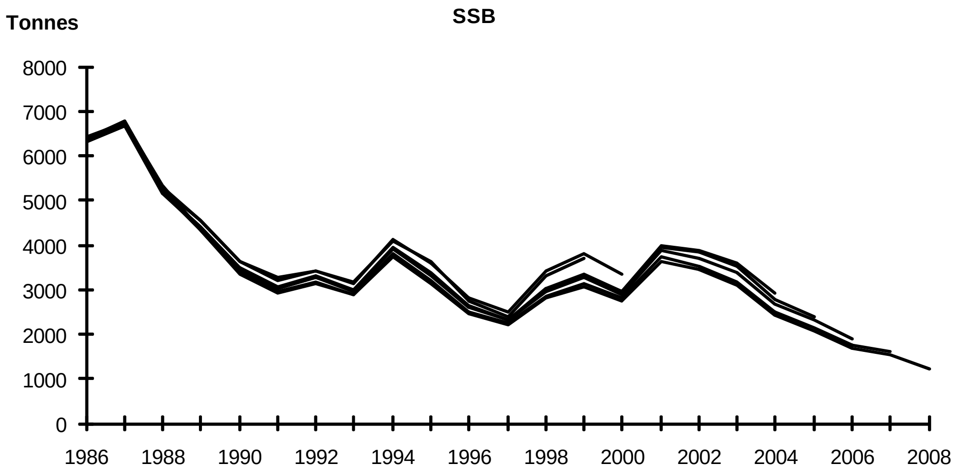


Figure 6.8.3. Sole in VIIa. Summary (B_{lim} = 2200 t, B_{pa} = 3100 t, F_{lim} = 0.4, Fpa = 0.3).

Figure 6.8.4 - Sole in VIIa. Retrospective



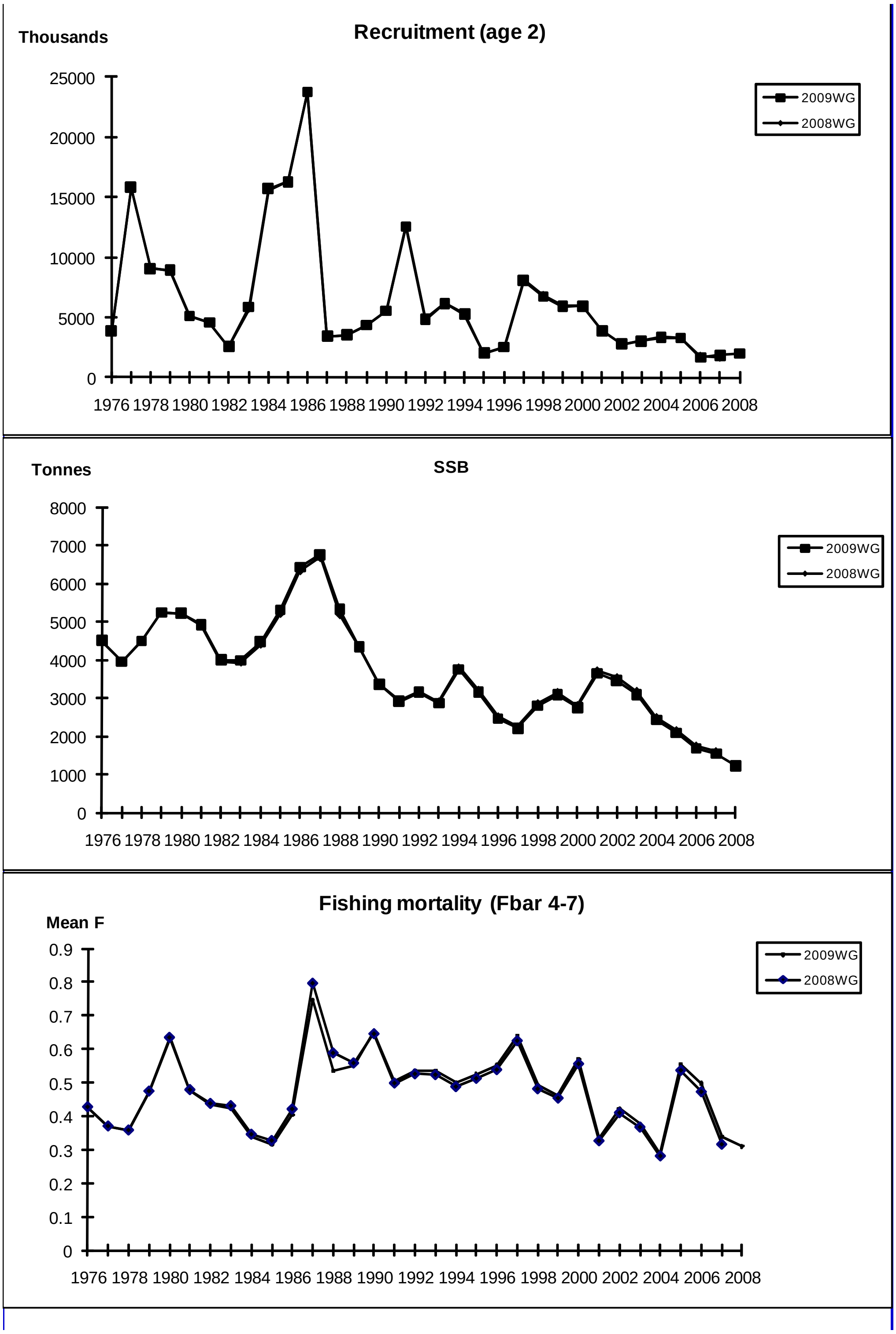


Figure 6.8.5. Sole in VIIa. Comparison of trends in Recruitment, SSB and Fishing Mortality from last year's (WG2008) and this year's final assessment (WG2009, same procedure as last year incl. an additional datayear).

Figure 6.8.6 - Sole in VIIa. Short term forecast

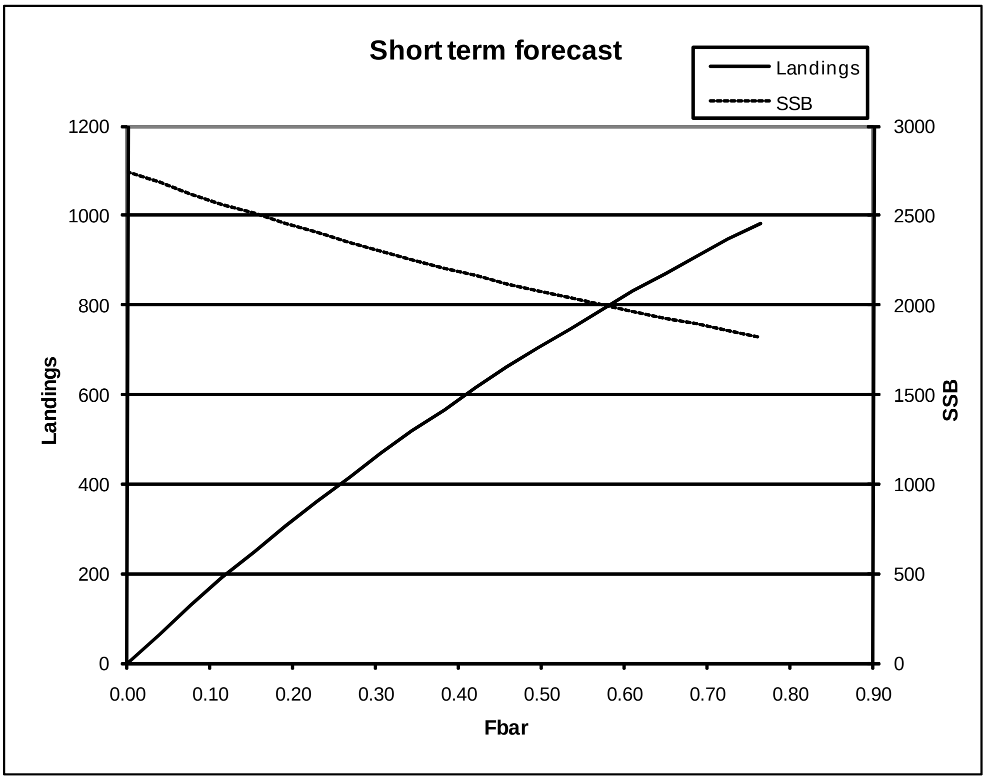
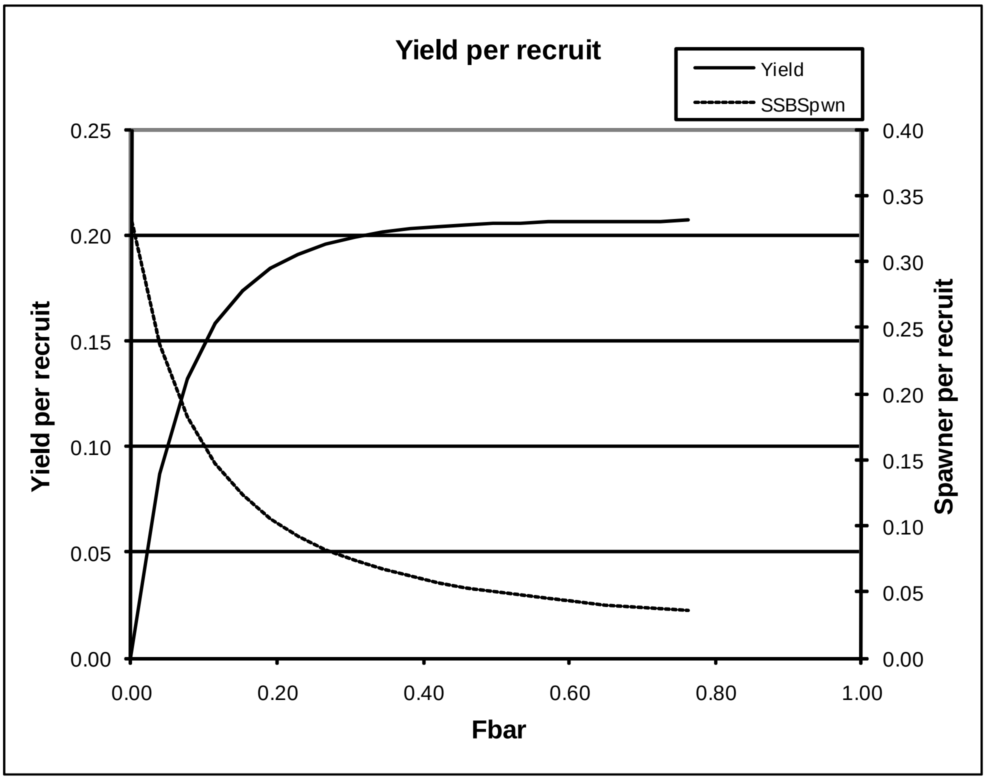


Figure 6.8.7 - Sole in VIIa. Yield per recruit



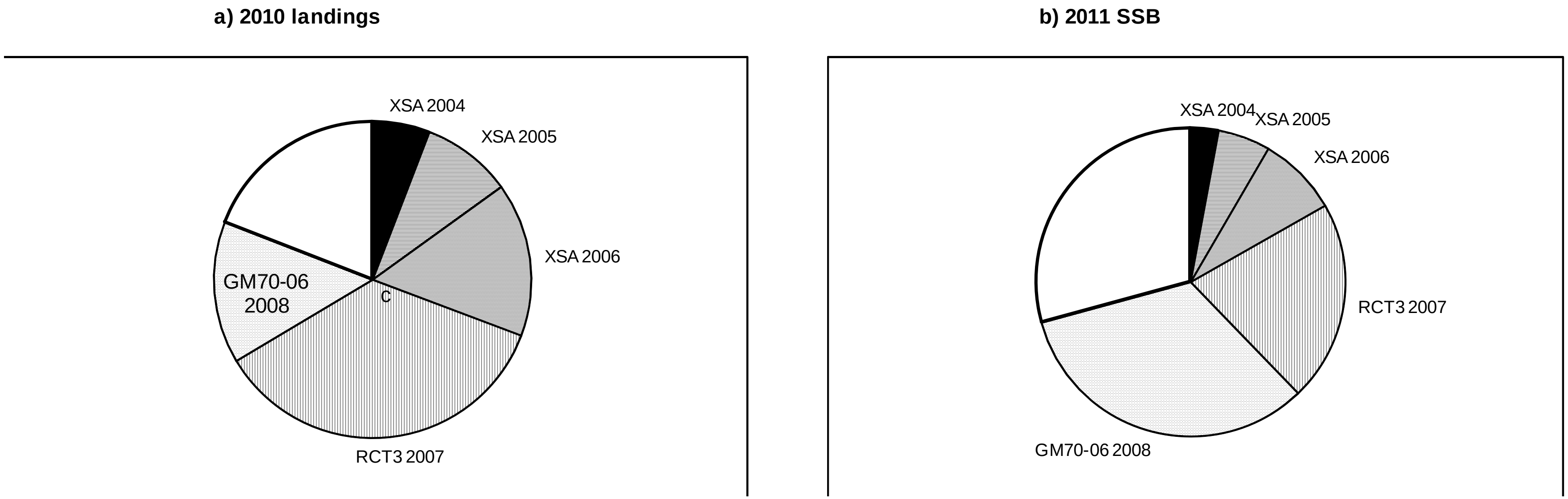


Figure 6.8.8. Sole VIIa. Year-class contribution % to 2010 landings and 2011 SSB.

7 Celtic Sea and West of Ireland (VIIb, c, f, g, h, j and k)

7.1 Fisheries overview Celtic Sea and West of Ireland

The stocks under the remit of this Working Group are cod, haddock, whiting, sole and plaice in ICES Divisions VIIb, c and e–k, and *Nephrops* in FUs 16, 17, 19 and 20–22. These demersal stocks are mainly fished by beam trawlers, demersal seiners, gill-netters and otter trawlers. The main countries exploiting these demersal stocks are France, Ireland, the United Kingdom and Belgium. Except for *Nephrops* in FU16 these stocks are mainly distributed on the shelf <200 m.

In the western part of VIIb, j, h there are fisheries for species such as hake, anglerfish and megrim. These are mainly concentrated around the shelf break but there are also significant catches in some fisheries on the shelf. Spain is also active in this region but is not included in this overview of the fisheries in ICES Divisions VIIbc, e–k. Consequently the effort descriptions that are given below are restricted to these four countries. More details on Spanish fisheries in the area can be found in the WGHMM report.

This area is rather complex in terms of countries, gears, target species, etc. Fishery descriptions can be made from several different perspectives and these can and do give different perspectives on what is important in an area. In this section information from several different sources is presented. In time WGCES will work towards developing a more integrated view of fisheries in this area. This will require integrated high resolution data from all countries involved. The goal is to be able to present a detailed analysis of the spatial and temporal patterns of métiers and their impact on individual stocks and the marine ecosystem as a whole.

Celtic Sea (ICES Divisions VIIfgh)

The Table below, which is a modified version of the métiers level 6 groupings under the DCF, clearly demonstrate the prevalence of France, UK and Ireland for the fishing effort of the area, with Belgium represented in the beam trawl métier.

Table 7.1.1. Métiers level 6 of the DCF, corresponding to 90% of the total fishing effort (Days) by countries operating in the Celtic Sea (ICES Division VIIfgh) modified from the version in the RCM Atlantic 2008.

Metier	BEL	FRA	UK	IRL	Total
FPO_CRU_0_0_0		354	24 961	903	26 218
OTB&OTT_DEF_70-99_0_0		15 301	5686	4809	25 796
OTB&OTT_CRU_70-99_0_0		8302	205	4535	13 042
GNS_DEF_120-219_0_0		2015	7676	1312	11 003
TBB_DEF_70-99_0_0	5984		7494	2742	10 236
LHM_FIF_0_0_0		114	6506	39	6659
OTB_DEF_100-119&>220_0_0		1094	4246		5340
GNS_CRU_>=220_0_0		21	1742		1763

Among the métiers listed in the table above, several are targeting species not relevant to the WGCSE. These are pots for crustaceans (FPO_CRU), handlines for sea bass and mackerel (LHM_FIF), set gillnets for crustaceans (GNS_CRU).

Following is a description of the main fishing activities as they appear in the table above:

1) OTB&OTT_DEF_70–99: This is the dominant trawl activity in the Celtic Sea. Within the DCR Level 6 grouping there are two distinct métiers targeting mainly gadoids and benthic species (mainly anglerfish). The former has been declining in importance in recent years whereas the latter has become more important.

2) OTB&OTT_CRU_70–99: This is the *Nephrops* targeting trawl fleet. Again there are two distinct métiers recognized by WGCSE one focused almost exclusively on large volumes of small *Nephrops* (i.e. where *Nephrops* accounts for >60% of the landed weight) and one with more mixed *Nephrops* and demerals fish catches. The former is focused on the Celtic Sea deep or "Smalls" mainly whereas the latter is more spread out throughout the Celtic Sea where there is suitable habitat for *Nephrops*.

3) TBB_DEF_70–99: Beam trawl targeting flatfish, operated and monitored by respectively UK, Belgium and Ireland. The distribution of the activity covers certain grounds where sole, anglerfish, cuttlefish and megrim are abundant and the seabed is suitable for beam trawling.

4) GNS_DEF_120-219_0_0: This DCR level 6 grouping includes Set gillnets mainly targeting anglerfish (*Lophius spp.*) and those targeting gadoids.

5) OTB_DEF_100-119: This is similar to category 1 except larger mesh is used. Given the poor selectivity of 70–99 mm mesh for many of the gadoids and other demersal fish the use of this larger mesh should be encouraged in the Celtic Sea.

Recent effort trends

In 2008 the STECF Working Groups SGRST compiled fishing effort and catch data for VIIfg. The following is extracts from their report:

"Vessels from Belgium, France, Ireland and UK (E&W) operate in the Divisions VIIfg. In terms of kW*days, France contributes 56%, Ireland 26%, England 9% and Belgium 8% (average 2002–2007). Spain accounts for the small amount of remaining effort. The fishery in this area is dominated (54%) by the bottom trawls (and Danish seine) using mesh-size category 4aiv (100–119 mm). Bottom trawls using mesh-size category 4aii (70–89 mm) and beam trawlers with 80–89 mm mesh size (4bi) contribute a further 16 and 18% respectively. The total effort in area VIIfg has decreased by 29% since 2002. This decrease is mostly as a consequence of bottom trawls using 100–119 mm mesh size (a reduction of 36%)."

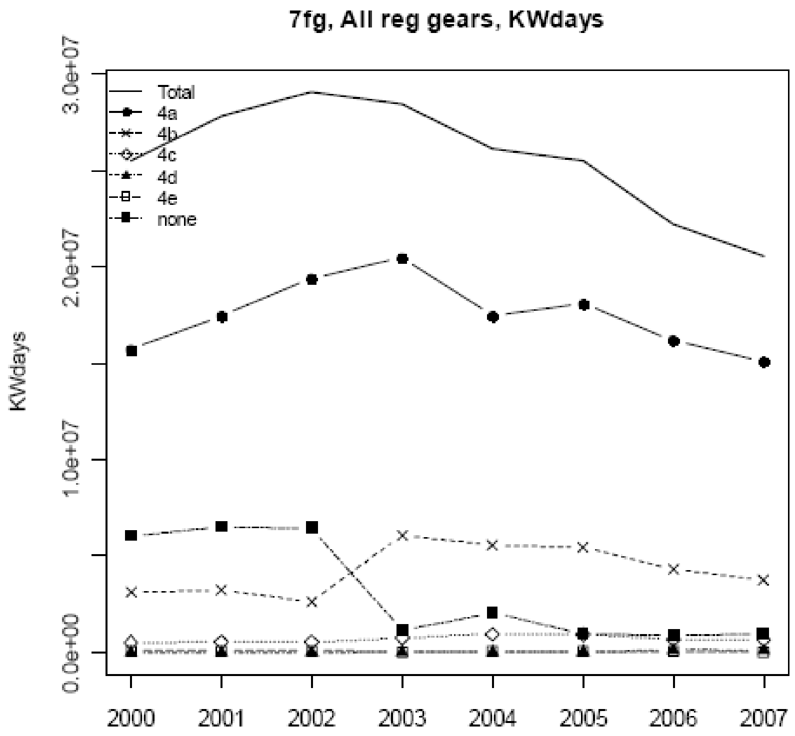


Figure 7.1.1. Trend in nominal effort in kW*days by gear type in the ICES Divisions VIIfg, 2000–2007. 4a = demersal trawl, 4b = beam trawl, 4c = gillnets, 4d = trammelnets, 4e = longlines.

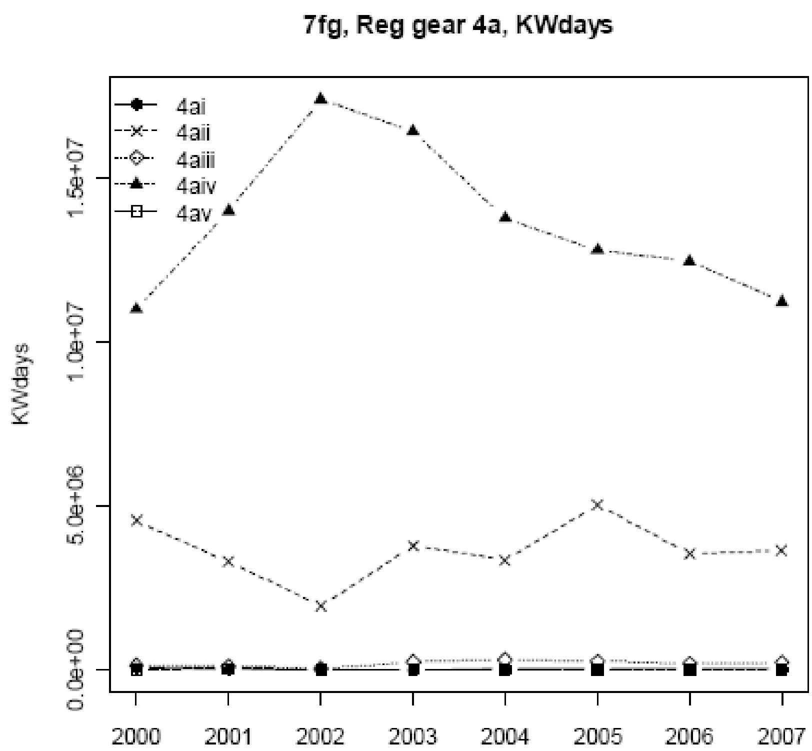


Figure 7.1.2. Trend in nominal effort in kW*days by for Otter Trawls in the ICES Divisions VIIfg, 2000–2007. 4aiv = Mesh size 100–119 mm, 4aii = Mesh size 70–89 mm.

West of Ireland (ICES Divisions VIIbcjk)

The table below, which is a modified version of the métiers level 6 groupings under the DCF, clearly demonstrate the prevalence of Spain, France, UK and Ireland for the fishing effort of the area, with Denmark and the Netherlands represented in pelagic trawl métiers.

Table 7.1.2. Métiers level 6 of the DCF, corresponding to 90% of the total fishing effort (Days) by countries operating in the Celtic Sea (ICES Division VIIfgh) modified from the version in the RCM Atlantic 2008.

Métiers	DNK	ESP	FRA	GER	IRL	NLD	UK	Grand Total
OTB_DEF_70-99_0_0		8513	1792		6682		400	17 387
LLS_DEF_0_0_0		10704	194				1019	11 917
OTB_DEF_100-119_0_0		8513	111				2578	11 202
OTB_CRU_70-99_0_0			508		1075		945	2528
GNS_DEF_50-70_0_0		1632						1632
GNS_DEF_120-219_0_0			1172		2		33	1207
OTM_SPF_32-69_0_0	169		26	103		557	286	1140
GNS_DEF_>=220_0_0				212	0		805	1017
OTB_CRU_100-119_0_0							1011	1011
FPO_CRU_0_0_0				41	903		29	972

Among the métiers listed in the Table above, several shaded métiers are targeting species not relevant to the WGCSE. LLS_DEF_0_0_0 is mainly targeting hake. OTM_SPF_32-69_0_0 is targeting small pelagic including mackerel horse mackerel and blue whiting and FPO_CRU_0_0_0 is targeting crabs and lobsters in coastal waters.

Following is a description of the main fishing activities as they appear in the Table above:

1) OTB&OTT_DEF_70–99: This is the dominant trawl activity in the west of Ireland. Within the DCR Level 6 grouping there are several distinct métiers targeting mainly hake, megrim, monkfish or a mixture close to the shelf break. In addition there are some more coastal fisheries target gadoid, flatfish and a mixture of benthic species. The later are more relevant to WGCSE.

2) OTB_DEF_100–119 are mainly targeting anglerfish and not that relevant to WGCSE.

3) OTB_CRU_70–99 and 100–119 include the *Nephrops* fleet targeting the Aran Grounds FU17 and Porcupine Bank FU16.

4) GNS all. These Level 6 groupings include some métiers that may have minor bycatches of species assessed by WGCSE but are mainly targeting either hake, monkfish or deep-water species.

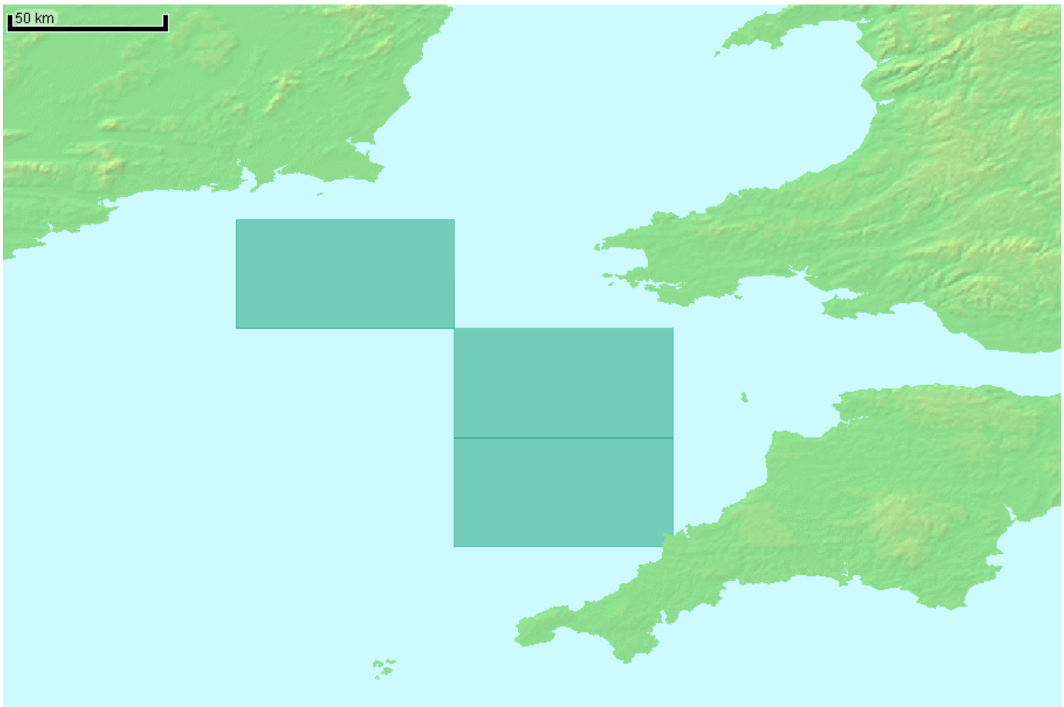
Regulations and their effects

The Celtic Sea was not included in the long-term management plan for cod. There is qualitative evidence available from WGFTFB 2009 that this has resulted in an influx of activity from other areas that are subject to effort restrictions. The extent of this influx is currently undetermined as logbook or VMS data for 2009 is unavailable.

Closed areas

The main closed area effecting stocks and fisheries is the Celtic Sea is the so called "Trevoe's closure".

Council Regulation (EC) No 41/2007, Annex III, part A 7 prohibits fishing in ICES rectangles 30E4, 31E4 and 32E3 during February and March 2007, with derogations for vessels using pots, creels or vessels using nets with less than 55 mm mesh size for pelagic species. The prohibition does not apply within 6 nautical miles from the baseline (Appendix 2.3).



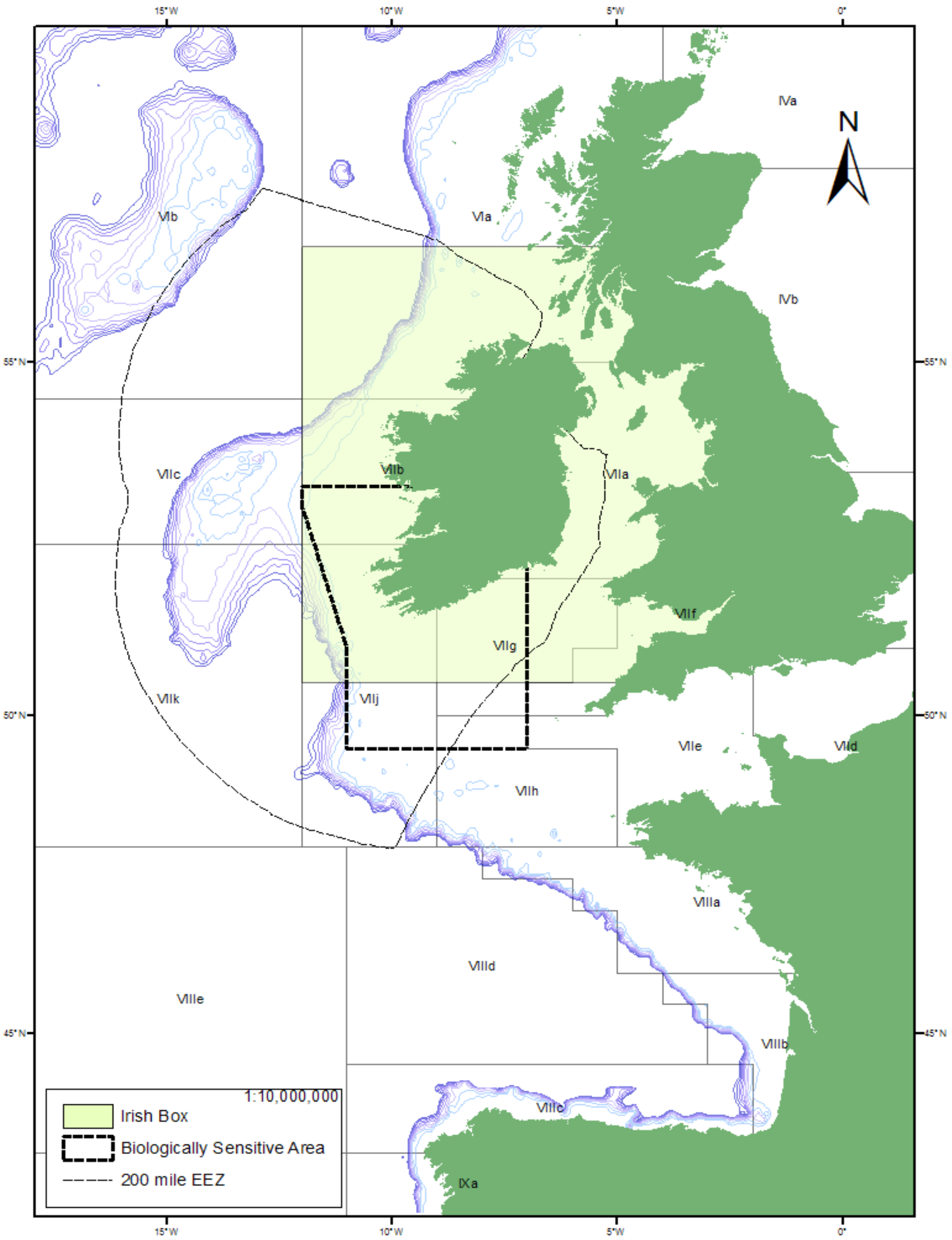
STECF 2007 concludes the closure is potentially effective measure for displacing fishing activities away from spawning aggregations off the North Cornwall and hence making vessels less efficient at catching cod. The major impact of the closure appears to have been on French trawlers that historically have taken a large fraction of the VIIe–k cod landings.

The effectiveness of the closed rectangle off the Irish Coast is less evident as a consequence of its lesser importance as a fishing ground for the EU whitefish fleets and the poorer knowledge of the distribution of cod spawning activity off the SE coast of Ireland. The impact of this closure was evaluated by ICES two years ago in response to a special request from the EC, and ICES concluded that it could not quantitatively disentangled the potential benefits of the closed area from other factors. In particular the closed area has resulted in changes in fishing patterns of cod in the Celtic Sea.

The Biologically Sensitive Area (BSA)

The Biologically Sensitive Area (BSA) is situated off the west and south coasts of Ireland and is considered to be an area of high ecological importance for fish life-history stages. It contains important spawning and nursery grounds for exploited Northeast Atlantic fish species, and it is an area subjected to high commercial fishing activity. The BSA was established under Article 6 of Council Regulation No. 1954/2003, and replaced the Irish box which was set up under the Iberian Act of Accession 1986, in order to protect the area from increased fishing pressure. The BSA comprises parts of

ICES Subareas VIIb, VIIg VIIj and VIIh. There are specific effort measures in place for the BSA. To date there has been no full evaluation of the impacts of this measure on the fleets or stocks. The increased mesh size for towed gears (>100 mm) required in part of the box probably results in improve selection for a number of species of interest to WGCSE.



The position of the Irish Box (now dismantled) and the Biologically Sensitive Area (BSA)

Impacts of fisheries on the ecosystems

ICES WGRED Report 2008

The Celtic Sea groundfish community consists of over a hundred species and the most abundant 25 make up 99 percent of the total estimated biomass and around 93 percent of total estimated numbers (Trenkel and Rochet, 2003). Population and community analyses have revealed that fishing has impacted a number of commercial species, primarily because individuals of too small a size have been caught and discarded in the past (Trenkel and Rochet, 2003; Rochet *et al*., 2002).The size structure of the fish community has changed significantly over time, and a decrease in the relative abundance of larger fish has been accompanied by an increase in smaller fish (4–25 g) (Blanchard *et al*., 2005; Trenkel *et al*., 2004). Temporal analyses of the effects of fishing and climate variation suggest that fishing has had an impact. Megrim were somewhat more abundant in recent years, particularly along the coasts of southern Ireland and the Celtic Sea shelf edge (Mahé, 2001). Stronger effect on size-structure than changes in temperature. A marked decline in mean trophic level of the fish community over time has been documented (Pinnegar *et al*., 2003) and this has resulted from a reduction in the abundance of large piscivorous fish such as cod and hake, and an increase in smaller pelagic species which feed at a lower trophic level. Since 1990 the non-exploited species *Capros aper* has become particularly abundant in French and UK survey catches. This phenomenon has been reported as occurring elsewhere in the North Atlantic including the Bay of Biscay (Farina *et al*., 1997) and offshore seamounts (Fock *et al*., 2002).

ICES WGECO Report 2008

In the Celtic Seas, discarding levels differ between the different fleets but can be as high as two thirds of the total catch with increasing trends in recent years. There is general agreement that the size structure of the fish community has also changed significantly with a decrease in the relative abundance of large piscivorous fish such as cod and hake coincident with an increase in smaller pelagic species which feed at a lower trophic level. Zooplankton abundance has declined in the Region in recent years and the overall substantial decline in *Calanus* abundance, which is currently below the long-term mean, may have longer term consequences given the fish community shift towards smaller pelagic species feeding on zooplankton. There is some evidence that suggests the decline in *Calanus* may be as a consequence of increased feeding pressure of these smaller fish and hence an indirect effect of fishing, however, climate change factors are also implicated.

FTFB Report to WGCSE 2009 relevant to the Celtic Sea and West of Ireland (VIIb,c,f,g,h,j,k)

This Report outlines a number of technical issues relating to fishing technology that may impact on fishing mortality and more general ecological impacts. This includes information recent changes in commercial fleet behaviour that may influence commercial cpue estimates; identification of recent technological advances (creep); ecosystem effects; and the development of new fisheries in the Northern Shelf and Southern Shelf Assessment Areas including the Irish Sea and the Celtic Sea.

It should be noted that the information contained in this report does not cover fully all fleets engaged in Northern and Southern Shelf fisheries; information was obtained from Ireland, the UK-Scotland, Belgium, France, Spain (Basque region only) and Portugal. Limited information was received from the UK England, Wales and Northern Ireland.

Fleet dynamics

- All countries have reported very low prices for fish and shellfish. Indications that prices for some species have dropped by as much as 50% on 2007 levels. Many vessels have tied up because of low prices in 2009. This is compared with 2008 when vessels tied up because of high fuel prices. Traditional Spanish and French markets are particularly depressed. Imports and the world recession are the main reasons given (All countries: Implications: Low prices leading to reduced effort).

- The new days at sea regulations have caused serious problems for many vessels in the Irish fleet given under the first pilot period of February to the end of April 2009 many vessels received very small effort allocations. This has resulted in wide spread effort shifts from Area VIa and VIIa into Area VIIb–k. In particular there has been increased effort in the *Nephrops* fisheries in Area VIIg and VIIb. In VIIg at least 5 vessels of around 24 m/550 hp have been forced to move from VIIa to VIIg and VIIb because of the fact these were replacement vessels for ones that had decommissioned. These vessels had no track record and so got no entitlements in VIIa. (Ireland: Shift of effort from VIIa–VIIg and VIIb).
- Up to 3–4 Scottish vessels have also moved from the North Sea and west of Scotland to Area VIIb–k in 2008 and 2009. These vessels are all large vessels 24 m+ and are targeting *Nephrops* at the Porcupine Bank and Labadie Banks. This is thought motivated by the fact that there are no days at sea limitations in VIIb–k (Scotland: Implications: Shift of effort into VIIb–k).
- The decommissioning scheme introduced in Ireland in 2008 has now been completed. In all 19 041 kW and 6818 GT was removed from the fleet from the 45 vessels decommissioned under this scheme. In total Ireland has removed 72 vessels of 10 141 GT since 2005. The majority of vessels scrapped came from East and west coast ports from vessels which traditionally target *Nephrops* with uptake from the East and South East (Irish Sea/Smalls *Nephrops* fishery and beam trawl fleet) and the west coast (Aran and Porcupine *Nephrops* fisheries). Very few applications were received from the South coast which traditionally target whitefish. Much of the actual effort removed from the decommissioning scheme, however, has been partially negated through the introduction of ~25 modern second hand vessels (mostly ex-French) into the fleet and also a number of 12–18 m vessels. These have either replaced existing older, less efficient vessels, or owners who have taken advantage of 'semi-dormant' tonnage in Ireland. (Ireland: Implications: Reductions in Fleets but actual impact unknown).
- The Belgian fishing fleet numbered 102 fishing vessels at the beginning of 2008 and has now been reduced in 2009 to 98 active vessels because of 4 vessels going bankrupt (Belgium: Implications: Reduction in fleet size).
- There are now 5 Irish vessel freezing *Nephrops* on board. These vessels are all in the 20–24 m/500–700 hp size range. They are fishing with twin rig double bag trawls and are doing long trips of up to 14 days duration. These vessels are only retaining on-board large grade *Nephrops* (0–10 count per kg) as well as monkfish tails and headed cod. No other catch is retained on board including species such as haddock, flatfish, hake and John Dory. These vessels do however fish with 100 mm codends so discarding of *Nephrops* is slightly reduced as a consequence of increased selectivity. A further 6 vessels are currently being fitted out with freezing systems (Ireland: Increased effort and discarding of marketable fish).

Technology creep

- A number of vessels have started to use trawls with Dyneema headlines of 10–12 mm. This has reduced the overall drag of their gear and is motivated by high fuel costs in 2008. One seine net vessel reports a reduction in fuel consumption of around 400 litres per day fishing (Ireland; Implications: Improved fuel efficiency).

- There has been an increase in the use of double bag trawls in the *Nephrops* fisheries in VIIb–k. These nets have a wide bosom section and are very effective at catching *Nephrops* (Ireland: Implications: increased catching efficiency).
- 3 Scottish seiners are now fitted with seine power reels that allow them to haul without using a seine winch. This considerably increases the efficiency of the operation and allows an extra haul per day. These vessels are currently working in the North Sea but this could spread to the west of Scotland at a later date. Most of the French seiners working in VIIb–k are also using this system (Scotland ad France: Implications: Improved efficiency in seine-net fisheries).
- In 2009 more and more Belgium beam trawlers are using roller gear instead of the standard trawl shoes to reduce fuel consumption. About 3 vessels are also investigating the Dutch sumwing beam trawl to reduce fuel consumption as well. It is expected that this initiative will lead to gear modifications used in beam trawls, depending on legislation changes (Belgium: Implications: Adoption of fuel efficient gear).
- Belgium beam trawlers are increasingly being equipped with 3D mapping sonar which has opened up new areas to fishing close to wrecks and areas of hard ground (Belgium: Implications: Increased access to unfished areas).

Technical conservation measures

- A number of the larger *Nephrops* vessels (5–6 vessels) fishing on the Labadie and Jones Bank have begun to use 100 mm codends both north and south of the 51°N line and in an effort to reduce catches of small *Nephrops* (Ireland: Improved Selectivity).
- Several Irish vessels fishing in the Irish Sea during the 2009 cod closure got into trouble with the Irish Naval Services over the rigging of their inclined separator panels. The panels being used did not match the legislation currently in force but the owners and local netmakers pointed out that for small trawls it is impossible to install the panels as per the legislation. A common sense approach was adopted subsequently given the vessels in question were trying to fish selectively with the panel (Ireland: Implications: control and enforcement issue).
- The producers' organization In Belgium has set up a working group of ship owners to test gear modifications to beam trawls. The testing is partial funded nationally and partially voluntary testing. Gear modifications tested include a square mesh panel in the upper-aft of the trawl and bigger diamond meshes in the top panel. Both modifications have been tested in the Central North Sea in 2009 to reduce the bycatch of unwanted roundfish, particularly whiting and cod. Another beam trawler (1200 hp) fishing in the Irish Sea is using a combination of T90-codend, benthos release panel, big meshes in the top panel and roller gear. These modifications have been tested in 2006 on a project scale and are now used by the same vessel on voluntary basis (Belgium: Implications: Voluntary adoption of TCMs).

Ecosystem effects

- High discarding of cod in Area VIIb–k was reported in Q3 and Q4 in 2008 as a consequence of exhaustion of quota. This is likely to be repeated in 2009. Discarding has been widespread across all Irish demersal fleets. An example of the scale is reports from the owner of one seine net vessel, who discarded over 30 boxes of marketable cod (1–1½ tonnes) from one 5–6 day trip. The problems in 2008 have been put down to poor quota management which effectively led to unrestricted landings during February–March. Heaviest landings were made by the Irish gillnet fleet of around 6–8 vessels. Heavy landings led to very low prices and cod were sold as low as €1.20–1.40/kg during this period. (Ireland: Implications: High discarding).
- Boats entering the Trevose closed area in Area VIIg, statistical rectangle 32E3 had very poor catches when this box reopened. There seem to be an abundance of lesser spotted dogfish. Catches did improve after the box was reopened (Ireland: Implications: effectiveness of closed area).
- High catches of cod have been reported from the Jones and Labadie Banks in Area VIIj during Q2 of 2009. Cod seem to be particularly abundant in an area not normally associated with this species. Catches in excess of 5 tonnes per tow have been reported by a number of vessels targeting *Nephrops* in this area. All cod caught seem to be large fish (Ireland: Implications: Abundance of cod in a new area).
- There has not been a major shift in mesh size categories (anecdotic information**)** although some of the Belgian beam trawler fleet have been fishing with trawlnets of 150 mm mesh size instead of 120 mm in the belly of the net during summer of 2007 and 2008. These changes are especially prevalent on fishing grounds with a lot of weed, hydrozoans and bryozoans, namely ICES Subarea IVb and VIIg (Belgium: Implications: Reduced benthic impact).
- There is evidence in Portugal of gillnets being fished with long soak times far beyond the national maximum time legally allowed (Portugal: Implications: Source of unaccounted mortality and increased discarding).
- Landings from the Porcupine Bank *Nephrops* fishery have been reduced in 2009. Catches have improved in late April/May but there is a predominance of females in the catches which are difficult to sell as they are "green-headed" (Ireland, France, Spain, UK: Implications: Reduced catches in Porcupine *Nephrops* fisheries).

Development of new fisheries

- There have been increased catches of John Dory in Area VIIb–k in recent years and this species is now widespread and abundant all over the grounds. Catches of up to 300 kg per haul have been recorded with vessels consistently landing 100 kg–150 kg of John Dory consistently per trip (Ireland: Implications: Increased John Dory catches).
- As indicated 3 French vessels and up to 8 Dutch have been converted to seining. These vessels are targeting mixed demersal species in VIIb–k (most effort in VIIg) and also species such as red mullet, gurnard and squid in VIId and IVb. These vessels are much more powerful than seine-net vessels in Ireland and Scotland as they are converted vessels (beam

trawlers, whitefish trawlers and one tuna purse-seiner) (France and Netherlands: Implications: Targeted fishery on non-quota species).

- The Belgium fleet have been experimenting with outrigger trawls as an alternative to beam trawls since 2006. Currently there are 5 vessels using this gear mainly in VIIf, VIIg and IVc. The catch composition with this gear is different from with beam trawls with reduced sole catches but increased ray catches (up to 50% by weight) and also *Nephrops* in certain areas. Catches of plaice are similar and overall levels of discards seem to be reduced by around 20% compared with standard beam trawls (Belgium: Implications: Use of outrigger trawl).

7.2 Cod in Division VIIe–k (Celtic Sea)

Type of assessment in 2009

Trends analysis

The Benchmark Workshop WKROUND 2009 concluded that more work is required before Celtic Sea cod can be benchmarked successfully. All recommendations and the suggested responses are given below.

Recommendations of the WKROUND 2009

There has been a recent deterioration in the quality of assessment input data for this stock. Various corrections have been proposed to correct data for highgrading in the French fleet. In the interest of transparency and consistency these procedures need to be clearly documented in the stock annex. We can expect deviations from these over time but these will need to be documented in the EG reports.

A check list describing data provision and raising procedure needs to be developed to catalogue the approach to aggregation of historical assessment data. Data integration and integrated fishery descriptions at a regional level need to be developed for the Celtic Sea ecoregion. This could be facilitated by the development of a regional database (e.g. FISHFRAME) in which disaggregated sampling and fishery data could be housed. This database is expected in the next 1–2 years and will greatly help quality assurance and transparency required in the annex.

Suggested response

The geographical area of the Celtic sea stock has continuously evolved until 1997, where it is now stabilized as being the VIIe–k stock. The check list describing data provision and raising procedure as recommended by WKROUND 2009 is now in the stock annex. The suggested move to a regional database would have certainly eased the process but its implementation has faced difficulties resulting in *ad libitum* delay. Given this new situation, the minimum requirement would be to find the best compromise for including all historical datasets, together with the appropriate raising and aggregation rules in InterCatch. To this aim, all countries should upload the cod Celtic sea dataset into InterCatch as far back in time as possible and without changing the resolution of the data. The upload should occur during 2009, and the stock coordinator should be informed as soon as the process is done and successful.

Recommendations on the procedure for assessment updates

There needs to be an evaluation of sampling levels by fleet required to get precise enough discard estimates for stock assessment.

The availability of the COST tool will allow this analysis. The outcomes of such an analysis, likely to impact the national sampling programmes under the DCF, should be discussed in the forthcoming RCM Atlantic (September 2009). In order to prepare the ground, detailed discards samples, as defined in the DCF, from on-board observers in the Celtic sea should be sent to the stock coordinator before end of June 2009.

Most countries supply discard data to the WG but sampling levels are low and variable for the main fleets catching cod. Discard rates are also highly variable and changing in response to recruitment and management. There may be scope to develop co-operative projects with industry on self sampling, reference fleets, etc.

Since 2009, the concurrent sampling under DCF which involves more observations at sea should provide more data covering the entire year period. Self-sampling programmes as the French one's dedicated to Celtic Sea cod since the beginning of 2008 has proven to be efficient at providing with quarterly estimates of discarding, and thus will continue.

Reported landings data and "landings equivalents" since 2003 are thought to be underestimated. It may be possible to get some estimates of what true landings were from diaries or other sources. This is a major source of uncertainty in the assessment.

WGCSE acknowledges the fact that misreporting is the major source of uncertainty in the assessment. In recent years, the burden has been on the scientists to estimate the 'true' landings, resulting in adding more uncertainties rather than circumventing the issue. The group stresses that looking for fishers' diaries may help to construct reference series of lpues but not to reconstruct the historical landings time-series, and that close monitoring of the catches should get a top priority at the highest management level.

There is evidence from sampling on the Irish "biological survey" that maturity has changed for this stock. The new estimates change SSB by up to 20% which is significant and warrants future monitoring. There is no routine survey during Q1 to provide annual maturity estimates for this or other stocks in the Celtic Sea. Collecting maturity data from commercial fleets will probably be biased and may not be of use to the WG. RCM should consider international coordination of maturity sampling and whether a directed survey might be needed. Q1 catch weights might also be improved with a directed survey.

WGCSE supports this recommendation for RCM to coordinate the sampling for maturity.

Tagging (particularly data storage), genetic, otolith microchemistry and other tools have been applied to give better understanding of the cod stock in the North Sea and Baltic. The stock structure and migration behaviour of cod in the Celtic Sea is not as well studied. This may have significant importance in developing management for the stock particularly in relation to close areas. The RCM should consider whether a regionally coordinated tagging programme could be developed for this stock.

Tagging is not in the provision of the DCF, therefore this issue is not in the remit of the RCM.

The noise in the data from the surveys should be reduced which may require additional surveys.

Given the uncertainty in the landings, the surveys represent the main source of information for estimating the historical trends in the stock. Changing the surveys' design or programming additional stations is not thought to be relevant solutions, given the implications on other survey objectives. Adding a coastal survey to monitor the younger ages is unlikely to have a major impact on the quality of the assessment, but it should help to forecast incoming recruitment. Adding a survey in quarter 1 would be the best solution, in order to monitor both the concentration of fish and the maturity during the spawning period. Combining the two existing IBTS surveys might improve the precision of time-series. This would require survey practitioners and statisticians to consider the most appropriate way of do this (See section 10 recommendation 2). It is unlikely that statistically valid inter calibration will be achieved in the short term for a species that is rare on catches like cod.

ICES advice applicable to 2008

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects.

Fishing mortalities close to $\boldsymbol{F}_{max}$= 0.33 can be considered as candidate target reference points, which are consistent with taking high long-term yields and achieving a low risk of depleting the productive potential. The present fishing mortality (F_{sq} = 0.75) is above the candidate reference point.

Exploitation boundaries in relation to precautionary limits

Given the low stock size and recent poor recruitment, it is not possible to identify any non-zero catch which will be compatible with the precautionary approach. The forecast indicates that a zero catch in 2008 allows SSB to almost achieve B_{pa} in 2009.

ICES advice applicable to 2009

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects.

The current fishing mortality is estimated at 0.67, which is well above the range that would lead to high long-term yields and low risk of stock depletion.

Exploitation boundaries in relation to precautionary limits.

The exploitation boundaries in relation to precautionary limits imply landings of less than 2600 t in 2009, which is expected to rebuild SSB to the B_{pa} (= 8800 t) in 2010.

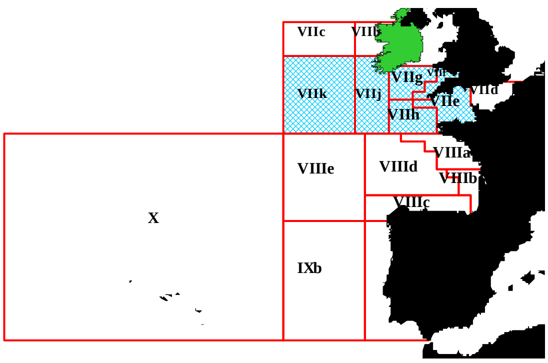
Conclusion on exploitation boundaries.

ICES recommends a 50% reduction in fishing mortality which is associated with landings in 2009 of 2600 t; the SSB is then expected to reach B_{pa} in 2010. This fishing mortality also corresponds to high long-term yield and low risk of stock depletion.

7.2.1 General

Stock description and management units

TAC 2009 is now in place for ICES Areas VIIb–c, VIIe-k, VIII, IX, X, and CECAF 34.1.1(1), excluding VIId, which is more relevant to the stock area than in the previous years, when the ICES Division VIId was included.



Red Boxes-TAC/Management Areas **Blue Shading– Assessment Area.**

Management applicable to 2008 and 2009.

TAC 2008

Species: Cod *Gadus morhua*		Zone: VIIb-k, VIII, IX and X; EC waters of CECAF 34.1.1 COD/7X7A34
Belgium	177	
France	3 033	
Ireland	753	
The Netherlands	25	
United Kingdom	328	
EC	4 316	
TAC	4 316 ([1])	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

([1]) Preliminary TAC. The final TAC will be established in the light of new scientific advice as soon as possible in the first half of 2008.

The final TAC 2008 has been established on 15/07/2008 and raised by 20% at 5174 t.

TAC 2009

Species: Cod *Gadus morhua*		Zone: VIIb-c, VIIe-k, VIII, IX and X; EC waters of CECAF 34.1.1 (COD/7XAD34)
Belgium	167	
France	2 735	
Ireland	825	
The Netherlands	1	
United Kingdom	295	
EC	4 023	
TAC	4 023	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

Fishery in 2008

Landings data used by the WG are displayed in Table 7.2.1.

French data have been slightly updated downward in years 2002, 2005–2007 as a consequence of corrections in the national database. The variations are at -2%, -4%, -2%, -3% in 2002, 2005, 2006 and 2007 respectively, compared with the data used at the WG SSDS last year. The Irish landings in 2007 have been revised upward by 13 t at 1210 t. and there is a minor revision of 2 t of the UK landings. International landings have decreased in 2008 at 3600 t. after the 2007 peak of 4200 t, which corresponded approximately to half of the average (8200 t) of the time-series. Since 1988, French landings accounted for ~70% of the international landings and they have declined to around 55% of the total in the recent years. Irish landings accounted on average at 14% but more recently ~28%. UK and Belgium have contributed on average to 9% and 4% respectively.

There are no estimates on the absolute level of misreporting for this stock but there is anecdotal information that misreporting has increased from 2002 when quotas became increasingly restrictive. Irish landings data in recent years have been corrected for area misreporting and/or landings from the Celtic Sea stock but reported from the southern rectangles of VIIa. These area corrections are summarized in table below.

Year	2004	2005	2006	2007	2008
Mis alloc (t)	108	54	103	514	558

French landings have been corrected for highgrading from 2003 to 2005. This reconstruction was described in WD#1 of the WG SSDS 2006. For smaller length classes, a scaling of French numbers-at-length based on UK length frequencies or UK number-at-length has been used to estimate length compositions of the component of French highgrading. The accuracy of this procedure is unknown but probably underestimates the highgrading levels in these years. Unfortunately, the sampling level of total catch at sea in that period was too poor to estimate the level of bias.

This procedure was not applied from 2006 onward because of the highgrading also observed in the UK landings. Instead, self sampling dataset obtained in 2008 has been applied to estimate the French highgrading level, assuming that the discarding practices in 2006–2007 were the same as the practice observed in 2008 on the main fleet self sampled. Applying this procedure back to 2003 was considered inappropriate. The representatives of Fishermen Organisations at the WKROUND 2009 have indicated that the discarding level was probably not the same in earlier years than in recent years and is linked to the level of TAC. The procedure has been described in the WD#17 of the WKROUND 2009.

The estimates of highgrading by year are slightly revised when annual landings statistics are updated. At this WG, the estimates are:

Year	2003	2004	2005	2006	2007	2008
HG (t)	210	148	74	432	592	322

Up to 2008, the TACs and national quotas were set for an area not matching the assessed area. Consequently, the successive slopes of landings data make it impossible to improve the estimates of highgrading back in time.

Irish misreporting assumed and French highgrading estimates since 2003 are summarized in table below (in percentages of landings statistics available)

Year	2003	2004	2005	2006	2007	2008
%	3	7	4	17	30	29

High grading also occurred in the UK catches in 2007–2008 but given the lower level of the landings, it has not been estimated. The MLS of the low Belgian landings is set at 40 cm.

7.2.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1.

Landings

Tables 7.2.2 and 7.2.3 display the annual length structure of the landings per métier and country and the catch numbers-at-age respectively. The levels of sampling are given to be appropriate and provided by the three main countries contributing to the landings.

It is noticeable that this stock has always been composed of a few age classes, as a consequence of rapid growth and early maturation. The catch number-at-age (Table 7.2.3 and Figure 7.2.1d) reveal that more than 50% of the stock abundance was composed of age 2 during the last 4 years.

Discards

Table 7.2.4 and Figures 7.2.1a–c show the length structure of landings and discards per country and quarter, adding a split by métier for France. French information is split into self-sampling and on-board observer programmes, noting that the latter is incomplete, because validation of some trips is still ongoing. It is noticeable that the majority of the cod discarded by France and UK has resulted from the highgrading behaviour. Discarding of undersized individuals is at low level for all countries.

Biological

Catch and stock weights are given in Tables 7.2.5 and 7.2.6 respectively. The final year estimates are in line with the recent historical values.

Natural mortality, percentage of F before spawning and the maturity ogive remained unchanged and are described in the stock annex.

Surveys

Table 7.2.7 displays the series of surveys examined at WGCSE. Internal consistency of the two ongoing IBTS surveys (FR-EVHOE & IR-GFS7gj combined) has been explored using SURBA software.

Figure 7.2.2a, summarizes the single fleet analysis for FR-EVHOE. The tracking of year classes is consistent for the relatively good YC 1996, 1999 and 2000, and poor YC 2001 and 2002, especially at-age 1. The weakness is in the between year consistency magnified at the older ages. The log residuals demonstrate a low magnitude of noise, resulting from systematic low catch rates.

Figure 7.2.2b, summarizes the single fleet analysis for IR-GFS7gj combined. The small time-series prevent from concluding any strong view on the consistency, but the tracking of recent year classes is in line with FR-EVHOE except for the 2007 YC.

The former UK-WCGFS was also included in the analysis for stabilizing the signal when looking at historical trends in the stock (Figure 7.2.2c).

Figure 7.2.2d shows SURBA model fits of mean Z for the three single fleets. The time-series of Z all fluctuate within the magnitude of the uncertainty, resulting in non robust general trends. Moreover, SURBA is known to provide poor estimates of parameters for the most recent years. As a result, no clear trend can be seen from the surveys.

Figure 7.2.2e shows the comparative analysis of age 1 index from the FR-EVHOE survey and the estimates of recruitment from a Separable VPA summary. FR-EVHOE demonstrates a fair ability to predict the level of expected recruitment. Following this, the 2007 YC is expected to be around the same level as the 3 previous years (slightly below average).

Commercial cpue

Tables 7.2.8a, b and c demonstrate the series of landings, fishing effort and lpue data-series for four French fleets, three UK fleets and eight Irish fleets which have been updated. Figure 7.2.3a and b show their trends. A general decreasing in the lpue trend is observed in almost all series between 1990 and 2004, when the TAC began to be constraining. From that point, the lpues seem to be stabilized, or even possibly increasing if highgrading is taken into account.

Different features are observed in the effort time-series. The métiers demonstrating the highest levels of effort have decreased significantly in the last 5–10 years; The effort shift from VIa to VIIg of the Irish Otter trawlers results in a different perspective by demonstrating a general increasing trend over the period.

A special effort has been made during the WG to combine international landings and effort datasets and produce historical distribution maps. These maps are composed of French, Irish, UK and Belgian landings respectively (Figure 7.2.4), France and Ireland effort (Figure 7.2.5) and lpue (Figure 7.2.6). Note these are data not corrected for misreporting or highgrading. These maps indicate that the geographical area of the stock is shrinking over the years. This is particularly visible in the distribution of the landings (Figure 7.2.4). The perceived decrease of landings over time is to be regarded with caution given the recent levels of misreporting and highgrading. The rectangles temporarily closed (30E4, 31E4 and 32E3) since 2005 were clearly among the most important for lpue.

7.2.3 Stock Assessment

Model used: None

No analytical assessment has been carried out on this stock, following the recommendations from WKROUND and the lack of revision of the datasets available.

7.2.4 Short-term projections

No short-term projections were carried out.

7.2.5 Medium-term projection

No medium-term projections were carried out.

7.2.6 Biological reference points

WKROUND has suggested that, unless there is an investigation on the possible change in the maturity ogive, there was no solid reason to change the biological reference points. The biological reference points are then recalled below:

Ref. point	ACFM 1998	WG 1999*	ACFM 1999	WG 2004	ACFM 2004
Flim	0.90 (Floss WG98)	0.90 (history WG99)	0.90 (history WG99)		0.90 (history WG99)
Fpa	0.68 (5th perc Floss WG98)	0.65 (Flim*0.72)	0.68 (5th perc Floss WG98)		0.68 (5th perc Floss WG98)
Blim	4,500t (Bloss =B76 WG98)	5,400t(Bloss=B76 WG99)	5,400t (Bloss=B76 WG99)	6,300t (Bloss=B76 WG04)	6,300t (Bloss=B76 WG04)
Bpa	8,000t (Blim*1.65)	9,000t (Blim*1.65)	10,000t (history)	Reject – no SR relation	8,800 t (Bpa = Blim * 1.4)

7.2.7 Management plans

A long-term management plan is currently under discussion for this stock.

7.2.8 Uncertainties and bias in assessment and forecast

The assessment of this stock is impaired by a strong uncertainty in the level of catches, especially because the TAC became constraining from 2003 onward. Moreover, this cod stock is the only European cod stock not assessed using surveys, because of a lack of robust trends mainly because of their low catch rates. For these reasons, and until more reliable information is available, WKROUND emphasized that the current assessment procedure, treating catch numbers as unbiased, was no longer appropriate.

7.2.9 Recommendation for next Benchmark

Not appropriate until new developments are in place regarding the shortcomings.

7.2.10 Management considerations

The exclusion of ICES Division VIId in the TAC area since 2009 makes the management area more in line with the boundaries of the stock.

Since 2005, ICES rectangles 30E4, 31E4, and 32E3 have been closed for most of the first quarter (Council Regulations 27/2005, 51/2006, and 41/2007, 40/2008 and 43/2009) with the intention of reducing fishing mortality on cod. At an annual resolution, maps of international effort distribution do not show evidence that this closure has redistributed effort of otter trawlers to other areas.

There have been major changes in fleet dynamics over the period of the assessment. Effort in the French otter trawlers has been declining since 1999 and a decommissioning plan has occurred in 2008 and a new plan is ongoing in 2009. Irish otter trawl effort increased between 1999 and 2003 and in VIIg, j has been stable over the last 4 years. During this period there has been a fleet modernisation and several decommissioning schemes in Ireland both within the national whitefish fleet and beam trawl fleet.

The perception of the state of the stock, based on trends analysis of surveys, and lpues statistics demonstrates a fragile equilibrium highly dependent on incoming recruitment levels. The total mortality estimated from the surveys does not reveal any trends, other than a fluctuation within the span of the uncertainty. An important point is the reduction of the geographical area of the stock, shown by the international landings distribution maps (Figure 7.2.4). The SSB dependence on recruitment is highlighted by the fact that more than 50% of the stock abundance was composed of age 2 during the last 4 years (Table 7.2.3).

The conflicting information on recruitment of the 2007 years given by the surveys indicates that, at best, the recruitment is expected to be around the recent values observed in the stock.

Table 7.2.1. **Nominal landings of Cod in Divisions VII e-k used by the Working Group**

Year	Belgium	France	Ireland	UK	Others	Total	SSDS 2008 Highgrading FR	SSDS 2008 Total	HG based on UK data Highgrading FR	HG based on UK data Total	Benchmark 2009 HG based on 2008 FR self sampling data Highgrading FR	Benchmark 2009 HG based on 2008 FR self sampling data Total
1971						5782						
1972						4737						
1973						4015						
1974						2898						
1975						3993						
1976						4818						
1977						3058						
1978						3647						
1979						4650						
1980						7243						
1981						10596						
1982						8766						
1983						9641						
1984						6631						
1985						8317						
1986						10475						
1987						10228						
1988	554	13863	1480	1292	2	17191						
1989	910	15801	1860	1223	15	19809						
1990	621	9383	1241	1346	158	12749						
1991	303	6260	1659	1094	20	9336						
1992	195	7120	1212	1207	13	9747						
1993	391	8317	766	945	6	10425						
1994	398	7692	1616	906	8	10620						
1995	400	8321	1946	1034	8	11709						
1996	552	8981	1982	1166	0	12680						
1997	694	8662	1513	1166	0	12035						
1998	528	8096	1718	1089	0	11431						
1999	326	5488	1883	897	0	8594						
2000	208	4281	1302	744	0	6535						
2001	347	6033	1091	838	0	8309						
2002	555	7368	694	618	0	9235						
2003	136	5222	517	346	0	6221	199	6420	210	6431	210	6431
2004	153	2425	663	282	0	3523	149	3672	148	3671	148	3671
2005	186	1623	870	309	0	2988	77	3065	74	3062	74	3062
2006	103	1896	959	368	0	3326	not estimated	3326	not estimated	3326	432	3758
2007	108	2509	1210	412	0	4239	not estimated	4239	not estimated	4239	592	4831
2008*	65	2064	1221	289	0	3639				3639	322	3961

* provisional

Scaled landings 1971-1987 (SSDS WG 1999)

Updated for the WKROUND and then for the WGCSE

Table 7.2.2 **Cod in Divisions VIIe-k. 2008 Landings in numbers at length.**

Length	France VIIfgh Gadoid trawlers	France VIIfgh Nephrops trawl.	France VII e-k	UK VII e-k Beam trawl	UK VII e-k ll bar beam trawl	Ireland VIIg+VIIaS	Ireland VIIj
24					9		
25					0		
26					0		
27				5	0		
28				0	0		
29				0	0	0	0
30				0	9	72	0
31				0	0	42	122
32				0	0	417	122
33				58	61	456	61
34				29	93	2346	0
35				121	389	1593	61
36				248	561	3657	305
37	55	17	185	578	586	6177	0
38	331	141	778	501	798	7637	366
39	198	189	800	586	1350	8569	0
40	503	172	1205	636	1484	9079	122
41	869	320	2277	772	1640	10871	427
42	839	320	2278	1049	1574	10816	609
43	994	502	3054	885	2079	14309	670
44	1820	376	3699	1317	1662	18231	366
45	1548	397	3737	1094	1852	16793	305
46	2365	401	6152	942	1460	14910	853
47	2128	563	5798	908	1389	14818	548
48	2404	925	6330	761	1452	12832	670
49	2964	744	7650	776	1224	12718	487
50	3601	558	11103	733	1559	11364	305
51	4811	1054	12185	849	1793	12301	975
52	5133	2250	14640	737	1497	10194	1219
53	5291	1286	12227	615	1755	11204	548
54	5397	2913	15440	570	1701	8213	792
55	4581	2583	14466	472	1694	10188	427
56	5135	2670	14224	668	1293	9066	366
57	4994	3079	14698	635	1521	5956	853
58	4399	2274	13356	577	1566	7591	548
59	4967	4440	15646	682	1616	6146	609
60	4348	3689	15049	787	1192	5770	487
61	4488	2374	12610	734	1191	6251	244
62	3686	2904	10656	1020	1001	6901	305
63	4350	2111	11231	848	1098	6406	609
64	4003	4031	14259	625	1267	7733	427
65	4294	1332	10158	750	969	9389	366
66	4375	1772	11769	584	1307	9212	0
67	4772	1800	11460	602	1347	8047	0
68	5171	2026	12300	442	1359	8598	122
69	4148	1652	10007	291	1393	7172	122
70	4225	4241	14430	434	1329	8656	61
71	4051	2197	11517	370	1449	10826	122
72	3931	3149	12536	268	1170	8963	122
73	3858	2741	12681	346	1107	7702	61
74	3374	2952	11679	286	1534	11022	0
75	3099	5056	13074	316	1220	7777	122

Table 7.2.2 continued.

76	2481	2438	7182	301	1126	7618	61
77	2722	2209	10147	268	1025	6302	0
78	2501	949	7204	179	852	6877	61
79	2274	3079	8061	175	833	5740	61
80	1909	3139	8955	144	919	3920	122
81	1740	2634	8244	141	573	4069	0
82	2040	1908	6229	134	703	3616	61
83	1700	2840	8375	98	638	2281	0
84	1737	2585	8152	117	538	3867	0
85	1572	3301	7867	56	608	2554	122
86	1774	1048	5368	75	491	3180	0
87	1708	1540	5009	65	416	1949	0
88	1300	1962	5968	128	404	3764	0
89	1096	1557	3988	67	313	2705	0
90	1104	1598	4807	129	311	2187	0
91	881	467	2791	107	333	1108	61
92	960	788	2269	115	173	1811	0
93	749	1019	3416	64	122	1423	0
94	499	496	2102	104	154	1195	0
95	351	600	1939	31	209	1438	0
96	391	456	1955	33	109	509	0
97	347	632	1557	64	56	321	0
98	392	657	1732	21	69	965	0
99	256	144	1017	48	88	447	61
100	197	435	1069	34	51	72	0
101	155	1083	1681	7	6	324	0
102	132	410	1095	18	28	105	0
103	143	371	776	13	60	32	0
104	82	292	494	7	53	16	0
105	73	32	166	30	14	88	0
106	62	281	504	17	21	358	0
107	22	84	187	5	43	152	0
108	17	0	65	8	8	72	0
109	48	0	86	21	30	16	0
110	50	75	186	0	19	0	0
111	4	179	327	0	8	16	0
112	0	17	44	7		0	0
113	15	85	404			0	0
114		0				0	0
115		102	32			16	0
116			122				0
117							0
118							0
119							
120							
Total	164987	113696	508915	29341	67008	460106	16516
Tw	596.0	529.0	2064.4			1160.2	
Mean leng	65.3	71.4	67.2	56.9	60.5	59.2	53.8
Mean Wei	3.612	4.653	4.056			2.522	

Table 7.2.3 Cod in Divisions VIIe-k (Celtic Sea) Catch numbers at age

Run title : Cod in Divisions VIIe-k,WGCSE09,index file

At 6/05/2009 14:55

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE								
1,	725,	4,	332,	1,	673,	51,	25,	197,
2,	461,	774,	239,	224,	136,	1456,	416,	497,
3,	557,	110,	346,	40,	185,	61,	236,	129,
4,	96,	205,	60,	118,	61,	107,	15,	116,
5,	35,	45,	74,	38,	105,	11,	60,	20,
6,	17,	26,	17,	37,	20,	22,	2,	34,
+gp,	11,	17,	11,	36,	33,	7,	17,	20,
0 TOTALNUM,	1902,	1181,	1079,	494,	1213,	1715,	771,	1013,
TONSLAND,	5782,	4737,	4015,	2898,	3993,	4818,	3059,	3647,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	438,	609,	315,	76,	1285,	737,	726,	651,	2741,	1830,
2,	357,	1213,	3086,	1157,	529,	1210,	1245,	1303,	946,	5443,
3,	263,	285,	811,	888,	540,	134,	465,	673,	448,	320,
4,	68,	175,	153,	169,	424,	97,	61,	254,	250,	133,
5,	104,	52,	41,	36,	77,	94,	40,	30,	62,	46,
6,	19,	55,	20,	19,	21,	22,	47,	31,	20,	21,
+gp,	32,	14,	12,	5,	11,	5,	15,	17,	15,	8,
0 TOTALNUM,	1281,	2403,	4438,	2350,	2887,	2299,	2599,	2959,	4482,	7801,
TONSLAND,	4650,	7243,	10597,	8766,	9641,	6631,	8317,	10475,	10228,	17191,
SOPCOF %,	100,	100,	100,	101,	100,	100,	101,	100,	98,	100,

1

Run title : Cod in Divisions VIIe-k,WGCSE09,index file

At 6/05/2009 14:55

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	666,	360,	1377,	1434,	274,	1340,	823,	617,	1184,	639,
2,	2639,	846,	1034,	2601,	2371,	692,	3320,	2248,	1870,	2545,
3,	2483,	1006,	229,	329,	928,	1199,	310,	1199,	951,	641,
4,	149,	663,	330,	64,	79,	258,	284,	134,	297,	254,
5,	77,	79,	203,	70,	24,	27,	73,	95,	48,	99,
6,	18,	21,	48,	53,	19,	10,	13,	43,	22,	36,
+gp,	11,	16,	14,	17,	16,	17,	5,	4,	6,	8,
0 TOTALNUM,	6043,	2991,	3235,	4568,	3711,	3543,	4828,	4340,	4378,	4222,
TONSLAND,	19809,	12749,	9336,	9747,	10425,	10620,	11709,	12681,	12035,	11431,
SOPCOF %,	100,	99,	100,	100,	100,	100,	100,	100,	100,	100,

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	2007,	2008,
AGE										
1,	496,	1693,	1091,	210,	103,	341,	295,	368,	491,	123,
2,	1141,	464,	2373,	2069,	556,	298,	664,	994,	1245,	769,
3,	756,	419,	136,	883,	827,	175,	138,	249,	409,	312,
4,	158,	169,	98,	64,	217,	168,	52,	25,	60,	101,
5,	59,	44,	70,	33,	15,	59,	45,	14,	9,	24,
6,	36,	17,	19,	12,	9,	8,	11,	13,	4,	4,
+gp,	14,	14,	19,	11,	7,	7,	2,	5,	4,	4,
0 TOTALNUM,	2660,	2820,	3806,	3282,	1734,	1056,	1207,	1668,	2222,	1337,
TONSLAND,	8594,	6536,	8308,	9236,	6420,	3672,	3062,	3776,	4830,	3961,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Area reallocation (Ireland 2004-2008) and high grading (France 2003-2008) included.

Table 7.2.4 a Length structure of landings and discards from sampling by UK

UK Cod VIIe-k 2008
Sampled data raised to trips sampled

Length	Q1		Q2		Q3		Q4	
(cm)	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded
25	0	2	0	1	0	0	0	0
26	0	0	0	0	0	0	0	0
27	0	1	0	0	0	0	0	0
28	0	0	0	1	0	0	0	5
29	0	0	0	0	0	2	0	0
30	0	0	0	0	0	0	0	0
31	0	0	0	1	0	0	0	0
32	0	2	1	0	0	1	0	0
33	0	1	1	3	0	1	0	0
34	0	0	0	1	0	4	0	0
35	1	5	1	10	3	3	0	0
36	3	0	4	1	1	2	0	0
37	2	4	13	6	2	0	0	0
38	2	0	6	0	13	0	0	0
39	4	0	4	0	10	3	1	0
40	7	0	11	0	21	1	1	0
41	9	0	2	0	40	0	3	0
42	7	0	8	0	35	5	1	0
43	5	0	5	0	41	0	7	1
44	10	0	2	0	33	3	7	0
45	7	0	1	0	32	3	4	0
46	9	0	2	0	15	2	14	3
47	6	0	0	0	10	6	8	0
48	3	0	3	2	5	2	6	2
49	7	0	0	0	0	1	13	0
50	1	0	2	3	2	4	7	0
51	7	0	1	0	2	6	4	0
52	4	0	3	0	2	4	2	1
53	3	0	4	0	1	11	3	0
54	3	8	7	1	3	18	3	0
55	3	0	5	1	3	12	2	0
56	6	0	1	1	2	14	4	5
57	6	0	5	1	6	10	3	0
58	2	0	4	0	1	10	2	3
59	1	0	3	1	4	9	4	1
60	1	0	1	0	10	10	3	1
61	1	0	1	0	3	6	1	1
62	2	0	6	0	5	4	4	0
63	6	0	2	0	6	3	4	0
64	6	0	0	0	9	3	3	2
65	3	0	2	2	1	2	7	0
66	9	0	0	0	7	1	5	1
67	5	0	2	2	5	1	9	1
68	1	0	2	2	2	1	5	1
69	3	0	2	0	2	1	4	2
70	7	0	3	1	1	2	3	0
71	5	0	5	0	2	0	2	3
72	3	0	2	2	3	1	3	1
73	3	0	4	2	3	0	1	0
74	3	0	4	1	0	0	3	1
75	6	0	5	1	4	2	8	1

Table 7.2.4a. continued.

76	0	2	0	1	6	1	4	1
77	1	0	3	1	6	0	4	1
78	2	0	3	2	3	0	1	1
79	1	0	0	0	3	0	3	1
80	1	0	2	5	3	0	2	1
81	0	0	4	0	2	0	1	4
82	1	0	1	1	3	0	4	0
83	0	1	1	0	2	1	2	0
84	1	0	1	0	3	0	6	1
85	4	0	3	1	3	0	3	1
86	0	0	2	0	3	0	2	0
87	2	0	4	0	1	0	1	0
88	1	1	1	0	1	0	3	0
89	1	1	1	1	0	0	1	0
90	2	0	0	0	1	0	1	0
91	0	0	1	0	0	0	4	0
92	0	0	0	0	0	0	0	0
93	0	0	1	1	1	0	0	0
94	0	0	0	0	0	0	2	0
95	0	0	0	0	1	0	1	0
96	0	0	0	1	0	0	0	0
97	0	0	0	0	0	0	0	0
98	1	0	0	0	0	0	0	0
99	0	0	0	0	1	0	1	0
100	0	0	0	0	0	0	1	0
101	0	0	0	0	1	0	2	0
102	0	0	0	0	0	0	0	0
103	1	0	0	0	0	0	0	0
104	0	0	0	0	0	1	1	0
105	0	0	0	0	0	0	1	0
106	0	0	0	0	0	0	0	0
107	0	0	0	0	0	0	1	0
108	0	0	2	0	0	0	0	0
109	0	0	0	1	0	0	0	0
110	0	0	0	0	0	0	0	0
111	0	0	0	0	0	0	1	0
Total N	201	28	170	62	394	177	217	47
Trips samplec	38		31		34		41	

Table 7.2.4b Length structure of landings and discards from sampling in Ireland

COD in ICES Division VIIg
Irish Otter Trawl Discard Numbers and Mean Weights at Age, and Raised length distribution
No of Trips= 15
No. of hauls = 183
Fishing Year 2008
Raised (using trips as variable)

	Frequency ('000)			Frequency ('000)	
Length (cm)	Discards	Retained Catch	Length (cm)	Discards	Retained Catch
25	2.75	0	66	0	44.25
26	12.52	0.00	67	0	3.72
27	0.00	0.00	68	0	14.76
28	0.00	0.00	69	0	17.35
29	1.28	0.00	70	0	3.49
30	3.97	0.00	71	0	20.01
31	9.95	1.22	72	0	9.88
32	7.84	2.44	73	0	22.30
33	10.75	0.00	74	0	53.57
34	0.23	3.14	75	0	21.16
35	8.11	2.85	76	0	17.53
36	14.69	2.11	77	0	16.10
37	7.06	6.62	78	0	46.79
38	6.28	6.70	79	0	38.67
39	7.75	14.48	80	0	2.57
40	13.90	8.86	81	0	37.12
41	2.83	11.21	82	0	14.14
42	2.41	6.77	83	0	15.12
43	1.38	25.63	84	0	22.08
44	0.00	35.71	85	0	7.16
45	4.85	14.64	86	0	0.24
46	0.00	27.01	87	0	17.40
47	0.00	18.37	88	0	10.62
48	0.00	36.49	89	0	6.30
49	0.00	15.03	90	0	12.18
50	0.00	28.35	91	0	0.00
51	0.00	25.56	92	0	5.93
52	0.00	42.78	93	0	2.98
53	0.00	1.12	94	0	0.33
54	0.00	14.82	95	0	1.81
55	0.00	20.46	96	0	0.62
56	0.00	12.57	97	0	4.72
57	0.00	18.34	98	0	3.61
58	1.83	13.83	99	0	0.00
59	0.00	25.91	100	0	0.00
60	0	16.15	101	0	0.00
61	0	24.14			
62	0	24.61		120.38	1077.59
63	0	24.28			
64	0	23.67			
65	0	27.17			

Table 7.2.4 c France Length structure of landings and discards from the Self Sampling Program
Sampling data raised by landing ratio to the total catch of the fleet in VIIfgh

2008	**Retained**				**Discarded**				
	FR-GADOID				FR-GADOID				
	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4		2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4
length					length				
20					20	0	0	0	0
21					21	0	0	0	0
22					22	0	0	0	0
23					23	0	0	0	0
24					24	0	40	0	0
25					25	0	20	0	0
26					26	0	0	0	0
27					27	46	20	14	0
28					28	0	60	41	15
29					29	69	40	0	107
30					30	161	40	96	168
31					31	323	241	329	259
32					32	576	181	233	229
33					33	1060	140	575	305
34					34	1129	281	726	442
35					35	1498	381	849	458
36					36	2235	481	534	549
37	24	31			37	2880	1244	835	580
38	280	31		19	38	3226	963	1013	656
39	154	16		29	39	3180	1625	671	610
40	398	16		89	40	4102	1946	342	610
41	567	78		224	41	3572	2187	205	366
42	617	126	18	78	42	3318	1805	205	427
43	646	47	62	239	43	3433	2066	137	320
44	1192	180	204	245	44	2973	2367	246	244
45	847	184	248	270	45	2419	2227	178	122
46	1642	159	254	310	46	1728	2628	233	153
47	1345	264	376	144	47	2327	2628	288	76
48	1100	254	752	300	48	1959	2086	411	183
49	1669	279	924	94	49	2143	1344	425	198
50	1548	763	1114	176	50	1360	1705	260	137
51	1770	995	1648	399	51	346	622	0	15
52	1701	1138	1967	327	52	138	782	0	76
53	1623	822	2466	379	53	69	582	0	76
54	1224	1111	2394	668	54	69	461	0	15
55	935	1072	2116	459	55	115	582	0	107
56	1355	1103	2288	390	56	46	140	0	92
57	824	1054	2415	702	57	46	181	0	107
58	907	832	2151	509	58	46	140	0	107
59	1087	995	2003	882	59	0	60	0	137

Table 7.2.4c. continued.

60	615	864	1999	871	60	0	120	0	61
61	1344	822	1768	555	61	23	0	0	92
62	948	731	1409	599	62	0	0	0	15
63	1372	765	1292	920	63	0	20	0	61
64	1283	669	1236	815	64	23	0	0	0
65	1410	633	1042	1209	65				31
66	1506	750	1480	639	66				0
67	2435	890	703	744	67				0
68	2504	1014	880	774	68				15
69	2038	796	623	691	69				0
70	2142	1067	542	474	70				31
71	2055	1020	532	445	71				46
72	2024	978	625	304	72				61
73	1885	1065	638	271	73				15
74	1664	869	705	135	74				31
75	1398	963	609	128	75				15
76	944	654	746	137	76				31
77	995	724	861	142	77				15
78	944	694	727	135	78				0
79	611	490	906	268	79				15
80	600	466	705	139	80				0
81	445	344	780	171	81				31
82	764	479	598	200	82				0
83	638	401	455	207	83				46
84	691	316	514	215	84				0
85	553	473	374	173	85				15
86	700	421	460	193	86				0
87	645	393	549	120	87				31
88	521	325	287	166	88				15
89	419	260	290	128	89				15
90	282	243	418	162	90				
91	275	237	236	131	91				
92	269	221	385	86	92				
93	255	189	167	137	93				
94	161	55	179	104	94				
95	58	52	180	61	95				
96	126	96	115	54	96				
97	71	112	120	44	97				
98	108	140	119	25	98				
99	83	59	81	33	99				
100	58	64	68	6	100				
101	17	65	56	17	101				
102	48	36	42	6	102				
103	25	34	57	28	103				
104		82			104				
105		47	26		105				
106	23	10	29		106				
107			9	13	107				
108			12	5	108				
109		25	23		109				
110		25	25		110				
111			4		111				
112					112				
113	7	8			113				
114					114				
115					115				
Tot N	61411	33681	50084	19810		46639	32438	8846	8632
N trips sample	5	13	10	6					
N hauls samp	91	288	154	67					

Table 7.2.4 c continued France Length structure of landings and discards from the Self Sampling Program
Sampling data of FR-GADOID raised by landing ratio to the total catch of the fleet in VIIfgh
Assuming the same discarding practice as the French Gadoid trawlers

2008	**Retained**					**Discarded**			
	FR-NEPHROPS					FR-NEPHROPS			
	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4		2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4
length					length				
200					200	0	0	0	0
210					210	0	0	0	0
220					220	0	0	0	0
230					230	0	0	0	0
240					240	0	78	0	0
250					250	0	39	0	0
260					260	0	0	0	0
270					270	13	39	11	0
280					280	0	117	34	19
290					290	20	78	0	132
300					300	46	78	78	207
310					310	93	469	268	320
320					320	166	351	190	283
330					330	305	273	469	377
340					340	325	547	592	547
350					350	431	742	693	566
360					360	643	937	436	679
370				17	370	829	2421	682	716
380	71			70	380	928	1874	827	811
390	71		31	87	390	915	3163	548	754
400	106		31	35	400	1180	3788	279	754
410	106		92	121	410	1027	4256	168	452
420	71		92	157	420	955	3514	168	528
430	212		123	167	430	988	4022	112	396
440	141	0	92	143	440	855	4608	201	302
450	72	86	123	116	450	696	4334	145	151
460	176	0	92	133	460	497	5115	190	189
470	106	86	154	218	470	670	5115	235	94
480	196	191	395	143	480	563	4061	335	226
490	288	211	167	79	490	616	2616	346	245
500	144	359	0	55	500	391	3319	212	170
510	255	485	228	86	510	99	1211	0	19
520	163	932	1052	103	520	40	1523	0	94
530	206	651	281	147	530	20	1132	0	94
540	382	1378	977	176	540	20	898	0	19
550	125	1591	754	113	550	33	1132	0	132
560	35	1381	1027	227	560	13	273	0	113
570	153	1756	999	171	570	13	351	0	132
580	230	864	797	384	580	13	273	0	132
590	145	2882	1229	183	590	0	117	0	170

Table 7.2.4c. continued.

600	91	2178	1169	251	600	0	234	0	75
610	132	1092	701	449	610	7	0	0	113
620	129	584	1606	585	620	0	0	0	19
630	76	292	1116	627	630	0	39	0	75
640	263	2570	633	565	640	7	0	0	0
650	163	106	745	318	650	0	0	0	38
660	323	1083	252	113	660	0	0	0	0
670	250	791	648	111	670	0	0	0	0
680	421	0	952	654	680	0	0	0	19
690	249	487	706	210	690	0	0	0	0
700	340	2931	764	205	700	0	0	0	38
710	833	404	505	455	710	0	0	0	57
720	626	1532	805	186	720	0	0	0	75
730	639	1017	809	276	730	0	0	0	19
740	281	1834	718	120	740	0	0	0	38
750	331	2965	1352	408	750	0	0	0	19
760	66	1341	857	174	760	0	0	0	38
770	275	1126	496	312	770	0	0	0	19
780	309	466	0	174	780	0	0	0	0
790	188	1731	1041	119	790	0	0	0	19
800	333	2021	533	252	800	0	0	0	0
810	108	1873	368	285	810	0	0	0	38
820	345	400	750	412	820	0	0	0	0
830	247	1447	825	321	830	0	0	0	57
840	172	1827	161	424	840	0	0	0	0
850	205	2108	972	17	850	0	0	0	19
860	209	231	419	188	860	0	0	0	0
870	203	352	663	322	870	0	0	0	38
880	142	1265	538	17	880	0	0	0	19
890	368	760	356	73	890	0	0	0	19
900	252	584	487	276	900				
910	61	0	203	204	910				
920	101	245	392	49	920				
930	138	273	341	267	930				
940		242	73	181	940				
950	58	231	149	162	950				
960	44	121	76	216	960				
970		381	203	48	970				
980	18	339	113	187	980				
990	76	0	26	43	990				
1000	93	121	87	134	1000				
1010	193	623	197	69	1010				
1020	84	231	0	95	1020				
1030	32	339	0	0	1030				
1040		216	76		1040				
1050	32	0	0		1050				
1060	50	231	0		1060				
1070	84	0	0		1070				
1080			0		1080				
1090			0		1090				
1100	32	0	0	43	1100				
1110	42	137	0		1110				
1120		0	0	17	1120				
1130			0	85	1130				
1140			0		1140				
1150	26		76		1150				
Tot N	13187	53984	32695	13830		13417	63143	7219	10670

Table 7.2.4d France Length structure of landings and discards from onbard observer program
Otter trawlers targetting demersal fish

	Retained					Discarded			
	OT_DEF					**OT_DEF**			
Length (cm)	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4	Length (cm)	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4
20	0	2	0	0	20	0	0	0	0
21	0	0	0	0	21	0	4	0	0
22	0	0	0	0	22	0	4	0	0
23	0	0	0	0	23	0	0	0	0
24	0	0	0	0	24	2	2	0	0
25	0	0	0	0	25	0	2	0	0
26	0	0	0	0	26	0	0	0	0
27	0	0	0	0	27	4	10	0	0
28	0	0	0	0	28	4	8	0	0
29	0	0	0	0	29	8	11	0	0
30	0	0	0	0	30	17	6	0	0
31	0	0	3	0	31	39	35	0	0
32	2	0	0	0	32	67	12	35	0
33	0	0	0	0	33	104	21	215	0
34	0	0	0	0	34	122	18	48	0
35	0	0	0	0	35	177	15	177	0
36	0	0	0	0	36	256	371	48	0
37	0	0	0	0	37	427	73	156	0
38	0	0	0	0	38	416	62	0	0
39	2	0	0	0	39	462	107	0	0
40	0	4	0	0	40	572	81	204	0
41	2	2	0	0	41	610	114	0	0
42	2	0	0	0	42	571	159	0	0
43	4	2	2	0	43	518	212	0	0
44	29	7	11	0	44	519	141	88	0
45	31	18	14	0	45	396	141	0	0
46	31	72	11	0	46	382	206	0	0
47	31	41	7	0	47	418	283	0	0
48	61	47	15	0	48	374	152	0	0
49	72	64	26	0	49	283	110	35	0
50	121	137	32	0	50	234	200	0	0
51	212	172	29	0	51	186	59	35	0
52	238	152	39	0	52	85	45	0	0
53	198	114	39	0	53	106	37	0	0
54	224	141	49	0	54	54	16	0	0
55	175	164	119	0	55	96	21	0	0
56	197	127	53	0	56	15	12	0	0
57	132	183	53	0	57	20	8	0	0
58	116	174	46	0	58	18	3	0	0
59	149	118	39	0	59	15	3	0	0
60	101	82	48	0	60	11	3	0	0

Table 7.2.4d. continued.

61	133	136	43	0	61	2	0	0	0
62	114	94	30	0	62	0	0	0	0
63	157	67	27	0	63	2	0	0	0
64	154	128	38	0	64	2	0	0	0
65	176	79	26	0	65	0	0	0	0
66	221	112	4	0	66	0	0	0	0
67	278	156	101	0	67	0	0	0	0
68	365	103	6	0	68	0	0	0	0
69	315	175	25	0	69	0	0	0	0
70	351	130	98	0	70	0	0	0	0
71	301	180	100	0	71	0	0	0	0
72	307	152	11	0	72	0	0	0	0
	322	214	196	0	73	0	0	0	0
74	238	160	7	0	74	0	0	0	0
75	223	147	179	0	75	0	0	0	0
76	183	111	23	0	76	0	0	0	0
77	138	110	101	0	77	0	0	0	0
78	135	91	30	0	78	0	0	0	0
79	114	99	260	0	79	0	0	0	0
80	112	77	5	0	80	0	0	0	0
81	91	39	10	0	81	0	0	0	0
82	123	92	88	0	82	0	0	0	0
83	75	134	87	0	83	0	0	0	0
84	79	57	92	0	84	0	0	0	0
85	81	78	88	0	85	0	0	0	0
86	76	95	5	0	86	0	0	0	0
87	79	70	8	0	87	0	0	0	0
88	73	103	5	0	88	0	0	0	0
89	50	52	86	0	89	0	0	0	0
90	42	64	14	0	90	0	0	0	0
91	51	35	2	0	91	0	0	0	0
92	39	23	91	0	92	0	0	0	0
93	48	46	10	0	93	0	0	0	0
94	26	17	79	0	94	0	0	0	0
95	4	20	0	0	95	0	0	0	0
96	19	20	84	0	96	0	0	0	0
97	4	27	8	0	97	0	0	0	0
98	13	20	2	0	98	0	0	0	0
99	8	17	84	0	99	0	0	0	0
100	4	29	8	0	100	0	0	0	0
101	4	16	0	0	101	0	0	0	0
102	8	11	0	0	102	0	0	0	0
103	4	9	2	0	103	0	0	0	0
104	2	5	0	0	104	0	0	0	0
105	0	18	2	0	105	0	0	0	0
106	2	4	3	0	106	0	0	0	0
107	0	0	2	0	107	0	0	0	0
108	0	0	0	0	108	0	0	0	0
109	2	6	0	0	109	0	0	0	0
110	0	8	0	0	110	0	0	0	0
111	0	3	0	0	111	0	0	0	0
Tot N	365	260	260			610	371	215	0
N hauls samp	214	308	61						
N trips sample	17	28	9						

Table 7.2.4d continued France Length structure of landings and discards from onbard observer program
Otter trawlers targetting Nephrops

	Retained OT_CRU 2008 -Q2	Discarded OT_CRU 2008 - Q2		Retained OT_CRU 2008 -Q2	Discarded OT_CRU 2008 - Q2
length (cm)			length (cm)		
20	0	0	66	7	0
21	0	0	67	7	0
22	0	0	68	8	0
23	0	0	69	7	0
24	0	0	70	4	0
25	0	0	71	5	0
26	0	0	72	10	0
27	0	0	73	8	0
28	0	0	74	15	0
29	0	16	75	18	0
30	0	0	76	7	0
31	0	0	77	7	0
32	0	0	78	13	0
33	0	0	79	6	0
34	0	0	80	17	0
35	0	0	81	7	0
36	0	0	82	9	0
37	0	31	83	5	0
38	0	0	84	5	0
39	0	0	85	7	0
40	0	0	86	3	0
41	0	0	87	9	0
42	0	0	88	7	0
43	0	0	89	8	0
44	1	0	90	11	0
45	0	16	91	6	0
46	4	0	92	5	0
47	2	0	93	4	0
48	8	0	94	2	0
49	4	0	95	5	0
50	6	0	96	2	0
51	9	0	97	2	0
52	8	0	98	1	0
53	4	0	99	0	0
54	8	0	100	6	0
55	10	0	101	2	0
56	1	0	102	2	0
57	5	0	103	0	0
58	6	0	104	0	0
59	4	0	105	2	0
60	13	0	106	0	0
61	9	0	107	0	0
62	6	0	108	0	0
63	5	0	109	0	0
64	16	0	110	0	0
65	4	0	111	0	0
			112	0	0
			113	0	0
			114	0	0
			115	1	0
Tot N				383	62
N hauls sampled				60	
N trips sampled				2	2

Table 7.2.5 Cod in Divisions VIIe-k (Celtic Sea) Catch weights at age

Run title : Cod in Divisions VIIe-k,WGCSE09,index file

At 6/05/2009 14:56

Table 2 Catch weights at age (kg)

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE								
1,	.9080,	.9080,	.9080,	.9080,	.9080,	.9080,	.9080,	.9080,
2,	2.1930,	2.1930,	2.1930,	2.1930,	2.1930,	2.1930,	2.1930,	2.1930,
3,	4.8310,	4.8310,	4.8310,	4.8310,	4.8310,	4.8310,	4.8310,	4.8310,
4,	7.4640,	7.4640,	7.4640,	7.4640,	7.4640,	7.4640,	7.4640,	7.4640,
5,	9.6690,	9.6690,	9.6690,	9.6690,	9.6690,	9.6690,	9.6690,	9.6690,
6,	11.7840,	11.7840,	11.7840,	11.7840,	11.7840,	11.7840,	11.7840,	11.7840,
+gp,	14.8159,	14.4792,	14.6675,	14.9506,	14.5262,	15.1279,	15.7144,	15.2267,
0 SOPCOFAC,	1.0006,	.9972,	.9982,	.9966,	1.0011,	1.0029,	1.0004,	.9974,

Table 2 Catch weights at age (kg)

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.9080,	.9080,	.9450,	.9450,	.9790,	.9810,	1.0010,	1.0540,	.9090,	.9060,
2,	2.1930,	2.1930,	1.5490,	2.2420,	2.5250,	2.6450,	2.6370,	2.5540,	2.5040,	2.1870,
3,	4.8310,	4.8310,	4.3850,	4.4740,	4.9610,	5.2840,	5.5210,	5.3980,	5.2640,	5.3180,
4,	7.4640,	7.4640,	7.5650,	7.7970,	7.4570,	7.8280,	8.0820,	7.4400,	8.0890,	7.9970,
5,	9.6690,	9.6690,	9.0600,	10.2500,	9.9650,	9.7580,	10.4070,	10.7820,	10.4470,	10.6490,
6,	11.7840,	11.7840,	12.7500,	12.4650,	12.0100,	11.6720,	11.4690,	12.3960,	13.5740,	12.4860,
+gp,	14.3395,	13.8620,	14.7237,	15.4408,	16.4710,	15.3396,	14.3697,	13.5580,	15.3490,	14.6217,
0 SOPCOFAC,	1.0006,	1.0003,	1.0002,	1.0146,	1.0006,	.9984,	1.0092,	1.0000,	.9844,	.9997,

1

Run title : Cod in Divisions VIIe-k,WGCSE09,index file

At 6/05/2009 14:56

Table 2 Catch weights at age (kg)

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	.8440,	.8800,	.9050,	.8150,	.8710,	.8740,	.8060,	.7870,	.7710,	.8530,
2,	2.0130,	2.3000,	2.1350,	1.9160,	2.0430,	2.0000,	1.9730,	1.8770,	2.0390,	1.8960,
3,	4.7060,	4.6240,	4.9870,	4.9160,	4.5080,	4.4920,	4.5890,	4.6390,	4.5160,	4.4610,
4,	7.6380,	7.1880,	6.7380,	7.3590,	6.8660,	7.9260,	7.5600,	6.9970,	7.3890,	6.8810,
5,	9.4380,	9.0450,	8.8650,	9.7440,	8.4310,	10.0920,	9.7500,	9.8540,	9.7190,	9.3290,
6,	12.9170,	11.7130,	10.8090,	11.4980,	10.9420,	12.2120,	11.1520,	11.4070,	11.8200,	11.2160,
+gp,	13.3935,	14.8144,	14.1344,	12.6295,	12.3344,	14.0578,	14.0814,	12.3707,	14.3670,	14.0713,
0 SOPCOFAC,	1.0003,	.9900,	1.0000,	1.0000,	1.0009,	1.0000,	.9999,	1.0000,	1.0006,	1.0012,

Table 2 Catch weights at age (kg)

YEAR,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	2007,	2008,
AGE										
1,	.9930,	.8630,	.7940,	.7570,	.8890,	.8840,	.7760,	.7890,	.7720,	.8470,
2,	2.0980,	2.5410,	2.0290,	1.8800,	1.8440,	2.1770,	2.1180,	1.7930,	1.6570,	1.8040,
3,	4.4950,	4.6290,	5.1120,	4.7280,	4.2740,	4.5430,	3.9070,	4.7160,	4.2760,	4.5410,
4,	7.3260,	7.0420,	7.8580,	6.7640,	6.6670,	7.0730,	6.1680,	7.4040,	7.4630,	7.1640,
5,	8.9450,	9.5020,	9.8320,	9.3600,	9.5060,	9.4350,	9.1940,	9.1860,	9.6970,	9.2290,
6,	11.2550,	10.6600,	11.4230,	10.7740,	11.0640,	10.8020,	11.5440,	11.6460,	11.8630,	11.0950,
+gp,	14.6309,	12.1360,	13.8977,	13.1661,	12.1431,	12.8979,	10.0370,	12.3902,	12.8190,	13.3042,
0 SOPCOFAC,	1.0017,	.9995,	.9991,	.9996,	.9992,	1.0014,	1.0020,	1.0005,	1.0011,	1.0026,

Table 7.2.6 Cod in Divisions VIIe-k (Celtic Sea) Stock weights at ages = 1st quarter values

Run title : Cod in Divisions VIIe-k,WGCSE09,index file

At 6/05/2009 14:56

Table 3 Stock weights at age (kg)

YEAR	1971	1972	1973	1974	1975	1976	1977	1978
AGE								
1	.6620	.6620	.6620	.6620	.6620	.6620	.6620	.6620
2	1.7090	1.7090	1.7090	1.7090	1.7090	1.7090	1.7090	1.7090
3	4.4440	4.4440	4.4440	4.4440	4.4440	4.4440	4.4440	4.4440
4	7.3210	7.3210	7.3210	7.3210	7.3210	7.3210	7.3210	7.3210
5	9.5290	9.5290	9.5290	9.5290	9.5290	9.5290	9.5290	9.5290
6	11.6050	11.6050	11.6050	11.6050	11.6050	11.6050	11.6050	11.6050
+gp	14.5404	14.1778	14.3755	14.5822	14.2402	14.8683	15.3589	14.9079

Table 3 Stock weights at age (kg)

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	.6620	.6620	.4600	.7040	.4460	.5120	.5810	.5280	.5220	.9060
2	1.7090	1.7090	1.5490	1.4880	1.9450	1.9510	2.0700	1.9020	1.9470	1.6210
3	4.4440	4.4440	2.2840	3.8760	4.4670	4.9280	5.3330	5.2860	4.8770	4.8870
4	7.3210	7.3210	7.8060	7.4070	7.3530	7.4330	8.3760	7.3820	7.9460	7.7770
5	9.5290	9.5290	10.5440	9.6240	9.7520	9.5520	10.8510	10.6890	10.3080	10.3020
6	11.6050	11.6050	11.4390	12.3160	11.2230	12.1800	11.5850	12.3930	14.4190	11.7860
+gp	14.0056	13.5130	14.6123	15.7394	17.4511	15.2018	14.9743	14.4820	15.4457	13.4600

1

Run title : Cod in Divisions VIIe-k,WGCSE09,index file

At 6/05/2009 14:56

Table 3 Stock weights at age (kg)

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	.8440	.6130	.5390	.6630	.7030	.6050	.6120	.6730	.4700	.4210
2	1.4630	1.7740	1.5380	1.3180	1.3850	1.7540	1.4440	1.2830	1.4100	1.3140
3	4.5140	4.3900	4.7910	4.6000	4.2780	4.1890	4.3460	4.4710	4.0790	4.3400
4	7.6150	7.1860	6.5240	6.5580	6.5740	7.7200	7.4520	6.7470	7.1120	6.6760
5	9.4380	8.4860	8.6310	9.3420	8.0660	9.7220	9.1400	9.8770	9.0440	9.3030
6	12.6920	10.7030	10.6720	11.2850	10.8150	12.1010	10.6460	11.4240	11.1560	11.1720
+gp	14.1533	14.6578	13.8090	12.4660	12.1295	13.9081	14.0514	12.8480	13.7300	12.8280

Table 3 Stock weights at age (kg)

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE										
1	.7780	.5610	.6300	.3520	.4820	.5910	.5880	.7030	.7220	.8690
2	1.5420	1.6960	1.4550	1.2570	1.3270	1.2580	1.6880	1.2160	1.3990	1.4490
3	4.2520	4.2230	4.9040	4.4520	4.1110	4.0530	4.0750	4.2330	3.7940	4.1880
4	7.1260	6.6270	7.8720	7.0460	6.6010	6.7590	5.9450	6.8190	6.9900	6.8960
5	8.7000	9.3260	10.1920	9.4000	9.1830	9.3720	9.0180	8.8950	9.8090	8.8810
6	11.1420	10.5050	11.6130	10.6140	10.6350	10.1580	11.3330	11.4870	12.2730	11.5430
+gp	15.2226	11.4651	13.8257	13.6879	12.5877	12.6100	11.4870	11.6694	14.8977	12.7292

Table 7.2.7. Series of surveys index examined at WGCSE.

```
UK-WCGFS West Coast March survey, effort in mn towed, numbers *10**2, final
survey in 2004
1992    2004
1       1       0.15    0.25
1       5
3774    2800    7100    400     200     200
3602    500     7250    4850    1230    100
1915    7400    600     3180    1130    300
3439    11200   14520   880     1400    700
3695    1300    6800    8500    1000    800
3826    3700    3200    3400    700     100
3744    1800    2500    2000    700     500
3823    200     1500    300     400     100
4092    3000    0       410     200     200
3700    1450    1100    1000    100     100
3387    200     5450    2960    430     100
2326    0       579     3154    410     100
1689    1400    0       200     1000    200
FR-EVHOE Groundfish  Oct-Nov survey in VIIf,g,h,j, numbers per 30 mn

1997    2008
1       1       0.75    1
1       5
1       0.213   0.095   0.246   0.117   0.048
1       0.212   0.52    0.207   0.045   0.045
1       0.155   0.184   0.283   0.015   0.03
1       1.046   0.041   0.118   0.064   0.013
1       0.716   0.18    0.029   0.038   0.018
1       0.033   0.313   0.148   0       0.015
1       0.052   0.041   0.142   0.061   0.008
1       0.056   0.115   0.072   0.053   0.017
1       0.255   0.12    0.055   0       0.026
1       0.125   0.139   0       0.048   0.045
1       0.321   0.206   0.117   0.033   0
1       0.217   0.141   0.117   0.096   0
IR-GFS-VIIgj combined: Irish Grounfish Survey (IBTS 4th Qrt)- Cod number per 30
mn towed (Interim indices for the new Celtic Explorer series)

2003    2008
1       1       0.79    0.92
1       5
1       0.167   0.223   0.229   0.075   0
1       0.3     0.106   0.035   0.018   0.018
1       0.967   0.138   0.035   0       0
1       0.632   0.2     0.031   0       0
1       0.837   0.279   0.103   0.029   0
1       0.164   0.432   0.104   0.015   0
```

Table 7.2.8a **Cod in Divisions VII e-k.**
Series of landings, effort and LPUE

	France											
	Fr gadoid trawlers VIIfgh			**Fr Nephrops trawlers VIIfgh**			**Fr Otter trawlers VIIe-k**			**Fr Otter trawlers VII e**		
Year	**Landings**	**Effort**	**LPUE**	**Landings**	**Effort**	**LPUE**	**Landings**	**Effort**	**LPUE**	**Landings**	**Effort**	**LPUE**
1978	Q2+Q3+Q4 for			Q2+Q3+Q4 for								
1979	consistency with			consistency with			includes Fr gadoid trawlers and					
1980	box closure			box closure			Fr Nephrops trawlers					
1981	during Q1 2005			during Q1 2005								
1982	and Feb-March 2006 to 2008			and Feb-March 2006 to 2008								
1983	1453	75.0	19.4	630	190.5	3.3	5443	904.3	6.0	472	210.6	2.2
1984	2002	60.6	33.1	671	170.5	3.9	4881	654.9	7.5	189	118.4	1.6
1985	1667	73.4	22.7	1023	150.7	6.8	6262	847.6	7.4	351	154.1	2.3
1986	2086	85.3	24.5	774	132.6	5.8	8046	932.0	8.6	431	220.4	2.0
1987	2804	107.8	26.0	778	145.7	5.3	8215	886.0	9.3	835	167.6	5.0
1988	6243	184.4	33.9	1726	144.1	12.0	13739	963.6	14.3	1320	199.4	6.6
1989	5171	166.3	31.1	1496	157.7	9.5	15715	1066.0	14.7	983	217.4	4.5
1990	3045	155.2	19.6	1138	206.3	5.5	9018	1073.3	8.4	383	198.6	1.9
1991	2096	127.1	16.5	690	186.2	3.7	5878	1013.2	5.8	335	177.7	1.9
1992	2304	133.0	17.3	1223	226.2	5.4	6709	1060.6	6.3	325	179.1	1.8
1993	2566	155.5	16.5	1236	205.3	6.0	8302	1095.6	7.6	295	238.4	1.2
1994	1725	121.8	14.2	1245	225.1	5.5	7353	959.7	7.7	306	185.1	1.7
1995	2598	128.2	20.3	1606	200.5	8.0	8248	1010.8	8.2	520	215.2	2.4
1996	2455	123.0	20.0	1450	181.6	8.0	8667	954.6	9.1	460	188.5	2.4
1997	2830	168.2	16.8	1246	152.6	8.2	8307	1057.5	7.9	584	258.3	2.3
1998	1707	139.3	12.3	805	111.1	7.2	5765	743.383*	7.76*	150*	28.2*	5.33*
1999	1271	138.8	9.2	546	114.6	4.8	5445	1047.3	5.2	647	298.4	2.2
2000	938	115.3	8.1	711	125.3	5.7	4254	1051.9	4.0	542	312.5	1.7
2001	1911	138.5	13.8	916	141.7	6.5	5957	1010.4	5.9	584	281.3	2.1
2002	2412	121.8	19.8	1083	147.6	7.3	7389	974.8	7.6	654	317.4	2.1
2003	1110	92.0	12.1	972	169.9	5.7	5157	1025.7	5.0	619	366.2	1.7
2004	469	83.1	5.6	462	128.2	3.6	2379	952.1	2.4	193	353.6	0.5
2005	483	79.1	6.1	343	113.3	3.0	1577	874.2	1.7	239	333.9	0.7
2006	430	55.6	7.7	376	108.3	3.5	1834	866.8	2.1	359	334.8	1.1
2007	678	63.4	10.7	509	85.1	6.0	2438	805.7	3.0	445	311.5	1.4
2008	496	54.0	9.2	445	78.1	5.7	1958	655.3	3.0	399	242.5	1.6

Units: landings in Tonnes live weight, Effort in 000s hours fished, LPUE in Kg/hour fished
* unreliable

	Fr gadoid trawlers VIIfgh			**Fr Nephrops trawlers VIIfgh**			**Fr Otter trawlers VIIe-k**		
	Landings	**Effort**	**LPUE**	**Landings**	**Effort**	**LPUE**	**Landings**	**Effort**	**LPUE**
FR- High grading input									
2003	1155	92.0	12.6	1011	169.9	6.0	5367	1025.7	5.2
2004	498	83.1	6.0	491	128.2	3.8	2527	952.1	2.7
2005	506	79.1	6.4	359	113.3	3.2	1651	874.2	1.9
2006	548	55.6	9.8	465	108.3	4.3	2229	866.8	2.6
2007	886	63.4	14.0	630	85.1	7.4	2995	805.7	3.7
2008	591	54.0	11.0	534	78.1	6.8	2284	655.3	3.5

Table 7.2.8b Cod in Divisions VII e-k. Series of landings, effort and LPUE

	UNITED KINGDOM (England + Wales)								
	Uk Otter trawlers VIIe-k			Uk Beam trawlers VIIe-k			Uk Otter trawlers VIIe		
Year	**Landings**	**Effort**	**LPUE**	**Landings**	**Effort**	**LPUE**	**Landings**	**Effort**	**LPUE**
1972	355	117.1	3.0				80	64.6	1.2
1973	223	118.5	1.9				58	69.5	0.8
1974	192	91.6	2.1				55	50.1	1.1
1975	136	100.3	1.4				38	54.7	0.7
1976	97	88.2	1.1				32	56.1	0.6
1977	119	88.5	1.3				78	55.4	1.4
1978	116	83.2	1.4	6	24.7	0.3	70	48.8	1.4
1979	130	73.5	1.8	14	44.0	0.3	74	49.9	1.5
1980	228	85.6	2.7	39	76.7	0.5	84	50.0	1.7
1981	324	104.3	3.1	63	87.6	0.7	76	46.9	1.6
1982	362	104.7	3.5	84	115.0	0.7	65	38.5	1.7
1983	163	82.1	2.0	84	135.3	0.6	73	52.6	1.4
1984	237	86.7	2.7	129	131.5	1.0	77	52.9	1.5
1985	249	90.3	2.8	145	152.5	1.0	64	57.7	1.1
1986	233	84.7	2.8	164	135.7	1.2	80	49.5	1.6
1987	221	84.3	2.6	246	177.1	1.4	96	45.1	2.1
1988	270	89.1	3.0	248	194.9	1.3	155	53.4	2.9
1989	186	84.1	2.2	230	198.2	1.2	105	54.7	1.9
1990	314	99.5	3.2	307	207.6	1.5	128	53.1	2.4
1991	243	76.7	3.2	258	203.2	1.3	84	40.8	2.0
1992	232	86.4	2.7	256	196.1	1.3	81	39.9	2.0
1993	181	61.9	2.9	220	208.4	1.1	43	39.2	1.1
1994	79	53.7	1.5	174	220.0	0.8	41	38.8	1.1
1995	115	52.3	2.2	239	243.1	1.0	55	35.5	1.5
1996	120	60.5	2.0	303	260.8	1.2	59	30.5	1.9
1997	149	66.7	2.2	299	264.8	1.1	79	33.3	2.4
1998	119	62.1	1.9	265	254.6	1.0	62	29.8	2.1
1999	90	98.4	0.9	257	251.4	1.0	47	27.5	1.7
2000	111	104.1	1.1	187	259.0	0.7	52	30.5	1.7
2001	110	85.3	1.3	256	272.7	0.9	59	31.9	1.8
2002	80	82.7	1.0	130	249.5	0.5	34	28.3	1.2
2003	58	72.3	0.8	103	282.1	0.4	24	25.1	1.0
2004	44	75.7	0.6	96	273.9	0.4	15	25.6	0.6
2005	41	76.4	0.5	102	270.3	0.4	17	21.1	0.8
2006	55	83.3	0.7	91	252.0	0.4	13	21.1	0.6
2007	49	87.6	0.6	111	239.9	0.5	22	22.4	1.0
2008	49	71.1	0.7	71	216.5	0.3	24	19.8	1.2

Units: landings in Tonnes live weight, Effort in 000s hours fished, LPUE in Kg/hour fished

Table 7.2.8 c **Cod in Divisions VII e-k.** **Series of landings, effort and LPUE**

	IRELAND			IRELAND			IRELAND			IRELAND		
	Ir Otter trawlers VIIg			Ir Beam trawlers VIIg			Ir Scottish seiners VIIg			Ir Gillnet VIIg		
	Landings	Effort	LPUE	Landings	Effort	LPUE	Landings	Effort	LPUE	Landings	Effort	LPUE
1995	429.9	63.6	6.8	85.8	20.8	4.1	111.27	6.43	17.3	114.92		
1996	569.3	60.0	9.5	112.6	26.8	4.2	164.87	9.73	16.9	338.84		
1997	401.9	65.1	6.2	131.6	28.3	4.7	215.24	16.13	13.3	52.81		
1998	450.6	72.3	6.2	166.9	35.3	4.7	264.14	14.94	17.7	87.32		
1999	300.9	51.7	5.8	190.6	40.9	4.7	64.59	8.01	8.1	211.92		
2000	279.4	60.6	4.6	180.7	37.0	4.9	106.04	9.90	10.7	157.03		
2001	339.5	69.4	4.9	96.6	39.7	2.4	111.09	16.33	6.8	107.99		
2002	213.0	77.7	2.7	57.9	31.6	1.8	70.84	20.86	3.4	34.13		
2003	167.4	86.8	1.9	57.1	49.3	1.2	38.07	20.91	1.8	31.17		
2004	190.2	97.0	2.0	74.3	54.9	1.4	54.86	19.38	2.8	60.65		
2005	294.9	124.4	2.4	118.7	49.7	2.4	66.13	14.81	4.5	77.697		
2006	390.0	119.2	3.3	128.6	60.5	2.1	90.98	14.79	6.2	63.73		
2007	323.0	136.5	2.4	96.2	55.9	1.8	58.52	15.82	3.7	85.44		
2008	349.3	125.6	2.8	84.7	36.7	2.3	55.59	11.65	4.8	87.98		

Units: landings in Tonnes live weight, Effort in 000s hours fished, LPUE in Kg/hour fished

	IRELAND			IRELAND			IRELAND			IRELAND		
	Ir Otter trawlers VIIj			Ir Beam trawlers VIIj			Ir Scottish seiners VIIj			Ir Gillnet VIIj		
	Landings	Effort	LPUE	Landings	Effort	LPUE	Landings	Effort	LPUE	Landings	Effort	LPUE
1995	338.5	93.7	3.6	0.1	0.2	0.2	75.52	5.26	14.4	179.57		
1996	326.4	70.2	4.6	8.7	1.5	5.9	124.55	8.15	15.3	64.96		
1997	352.8	83.2	4.2	3.4	1.8	1.9	115.81	10.73	10.8	45.47		
1998	262.3	89.6	2.9	19.2	5.2	3.7	103.37	6.61	15.6	59.13		
1999	76.7	40.6	1.9	27.6	7.4	3.7	9.57	1.41	6.8	24.01		
2000	95.5	64.6	1.5	21.2	6.9	3.1	23.71	3.49	6.8	13.98		
2001	140.4	67.7	2.1	10.4	3.0	3.5	27.95	4.42	6.3	12.69		
2002	150.1	90.4	1.7	5.4	3.1	1.7	24.65	8.87	2.8	12.23		
2003	78.5	111.3	0.7	8.8	9.0	1.0	14.72	9.15	1.6	6.17		
2004	36.1	92.0	0.4	2.5	2.2	1.2	11.57	9.18	1.3	4.21		
2005	40.6	73.9	0.5	4.7	2.4	1.9	17.76	6.09	2.9	3.30		
2006	42.7	65.9	0.6	2.0	1.5	1.3	15.64	5.33	2.9	7.18		
2007	39.0	80.5	0.5	7.8	2.4	3.3	9.83	3.51	2.8	6.50		
2008	33.5	66.3	0.5	2.6	1.1	2.3	9.46	2.84	3.3	6.55		

Units: landings in Tonnes live weight, Effort in 000s hours fished, LPUE in Kg/hour fished

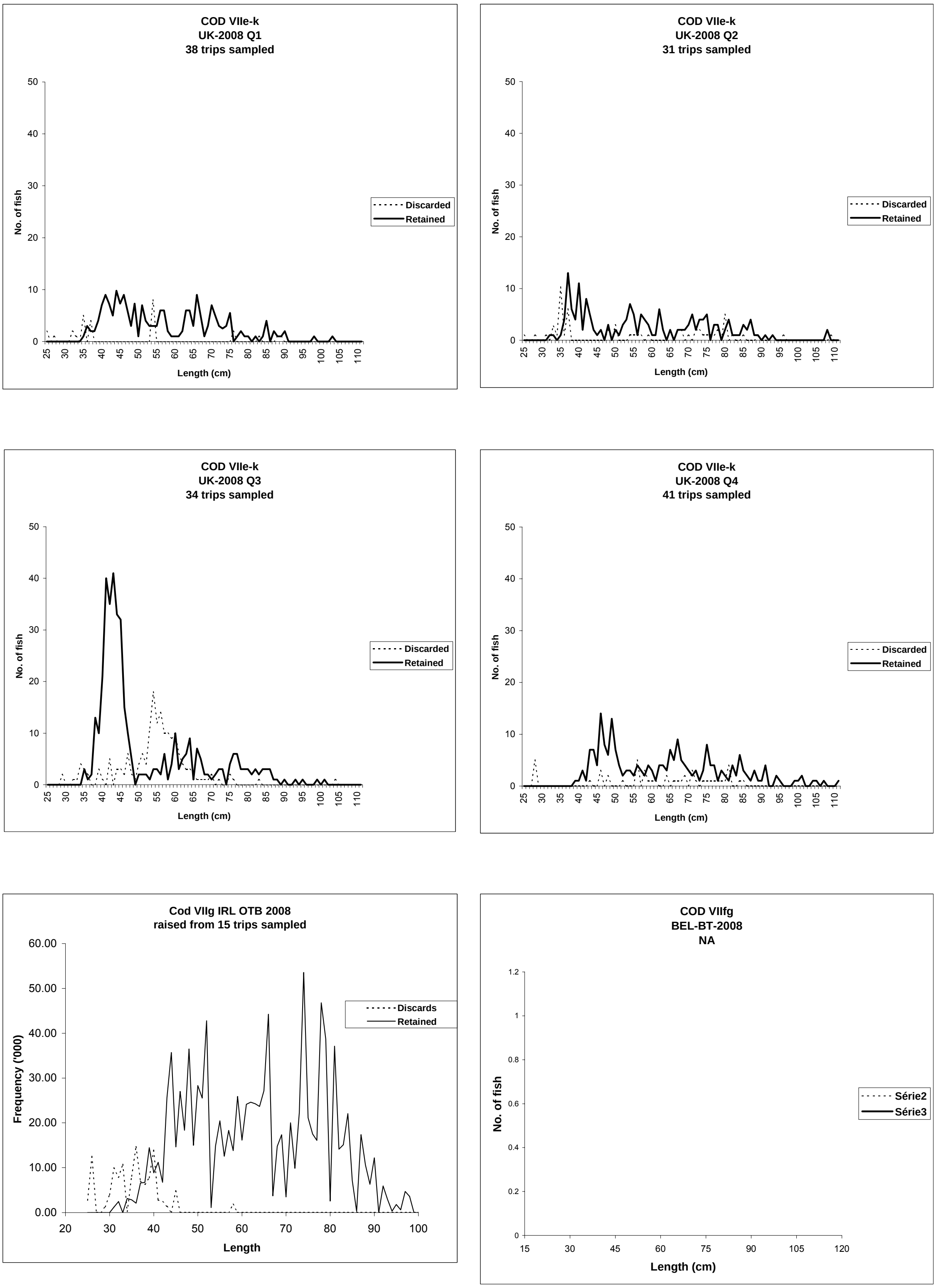
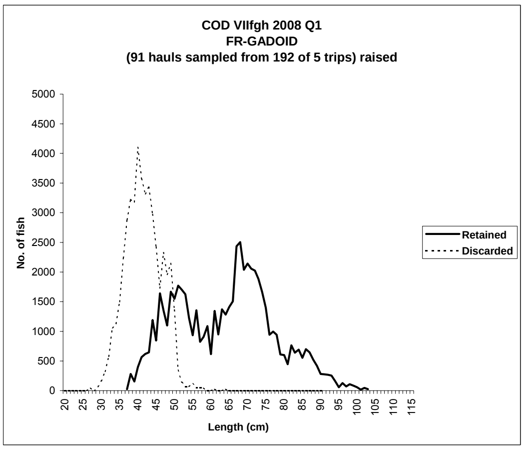
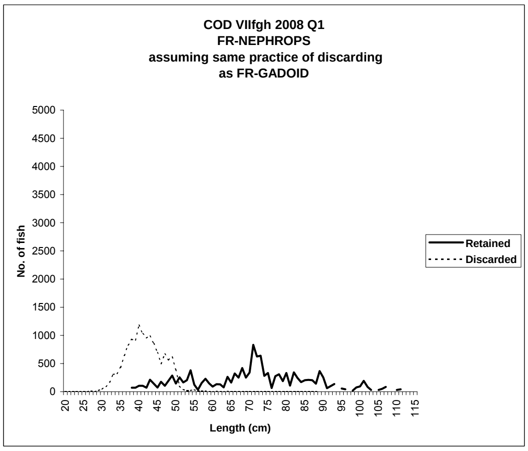
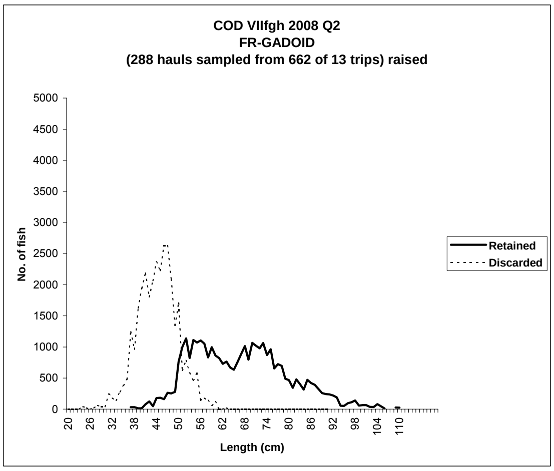
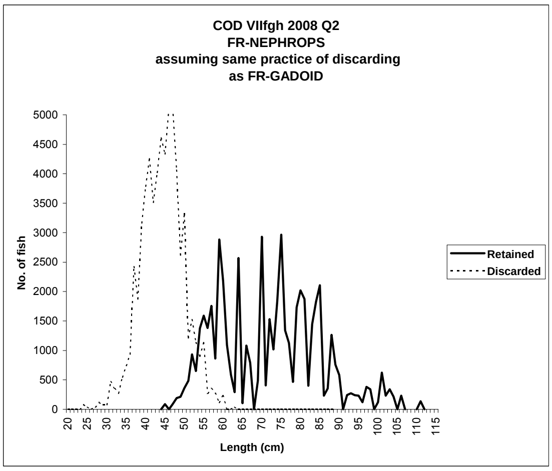


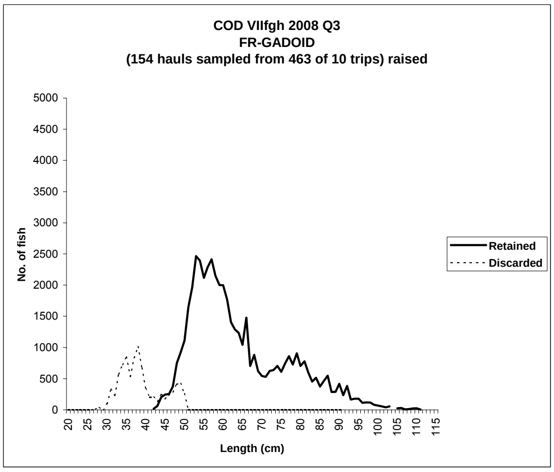
Figure 7.2.1a. Cod in Divisions VII e–k. 2008 Quarterly or annual length compositions of UK, Irish discards raised using effort ratio for Irish data, from hauls sampled for UK.

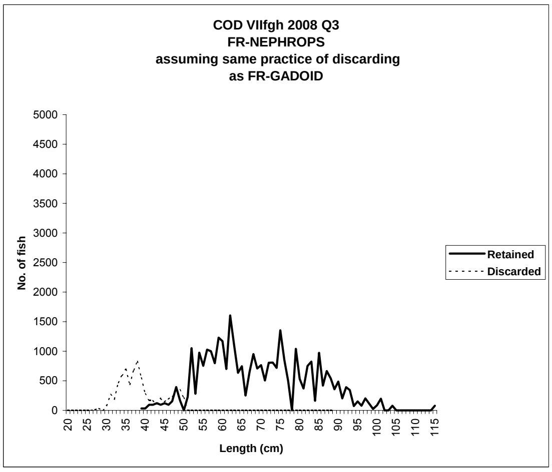

COD VIIfgh 2008 Q1
FR-GADOID
(91 hauls sampled from 192 of 5 trips) raised
No. of fish
Length (cm)
Retained
Discarded

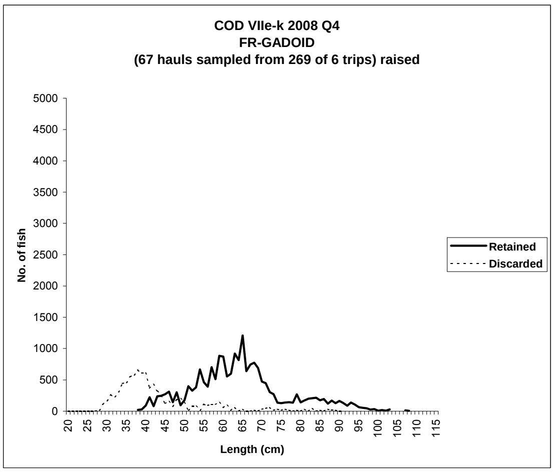

COD VIIfgh 2008 Q1
FR-NEPHROPS
assuming same practice of discarding
as FR-GADOID
No. of fish
Length (cm)
Retained
Discarded


COD VIIfgh 2008 Q2
FR-GADOID
(288 hauls sampled from 662 of 13 trips) raised
No. of fish
Length (cm)
Retained
Discarded


COD VIIfgh 2008 Q2
FR-NEPHROPS
assuming same practice of discarding
as FR-GADOID
No. of fish
Length (cm)
Retained
Discarded


COD VIIfgh 2008 Q3
FR-GADOID
(154 hauls sampled from 463 of 10 trips) raised
No. of fish
Length (cm)
Retained
Discarded


COD VIIfgh 2008 Q3
FR-NEPHROPS
assuming same practice of discarding
as FR-GADOID
No. of fish
Length (cm)
Retained
Discarded



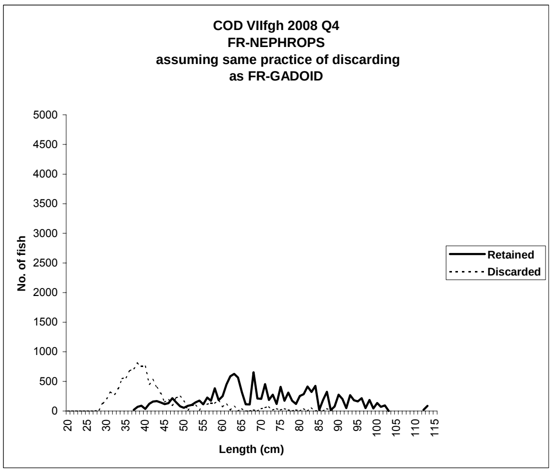
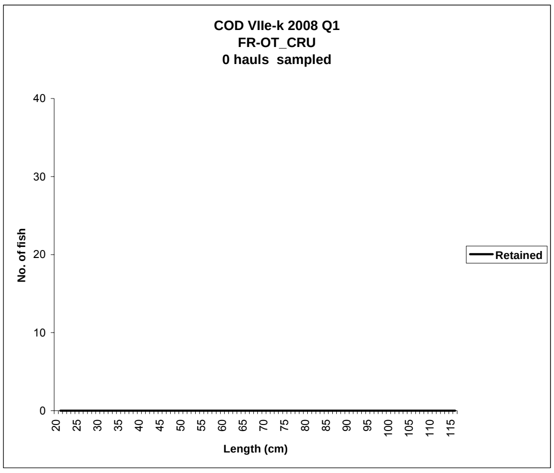
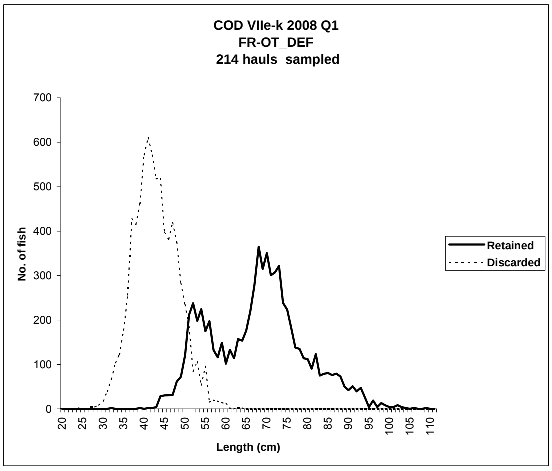
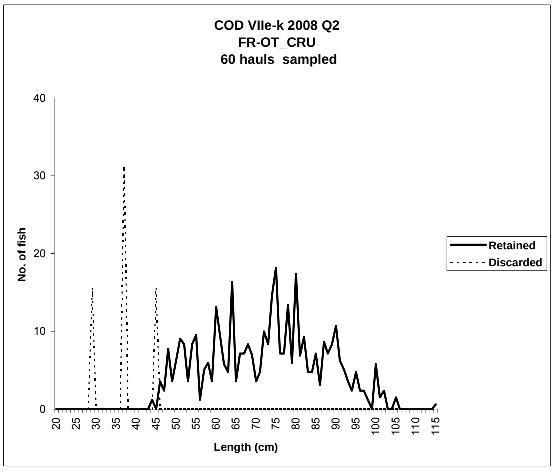
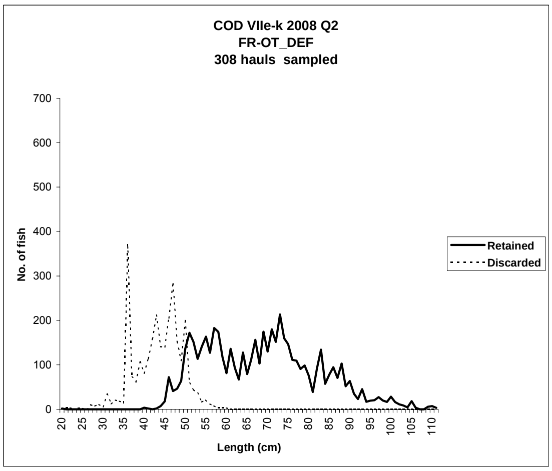


Figure 7.2.1.b. Cod in Divisions VII e–k. 2008 Quarterly length compositions of French catches in VIIfgh, Self sampling data from FR-GADOID raised by landings ratio.



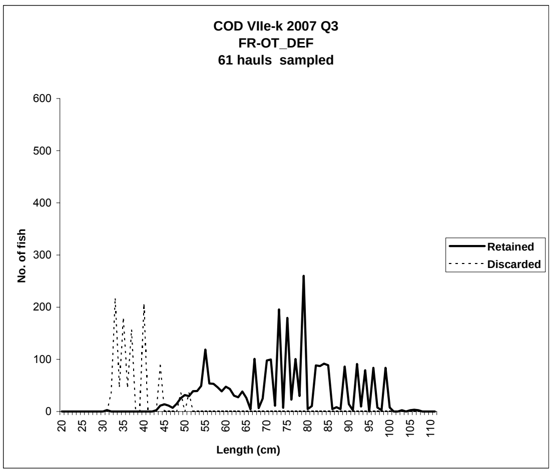






COD VIIe-k 2008 Q3
FR-OT_CRU

data not yet available



COD VIIe-k 2008 Q4
FR-OT_CRU, data not yet available

COD VIIe-k 2008 Q4
FR-OT_CRU, data not yet available

Figure 7.2.1c. Cod in Divisions VII e–k. 2008 Quarterly length compositions of French discards data available, from hauls sampled by observers at sea.

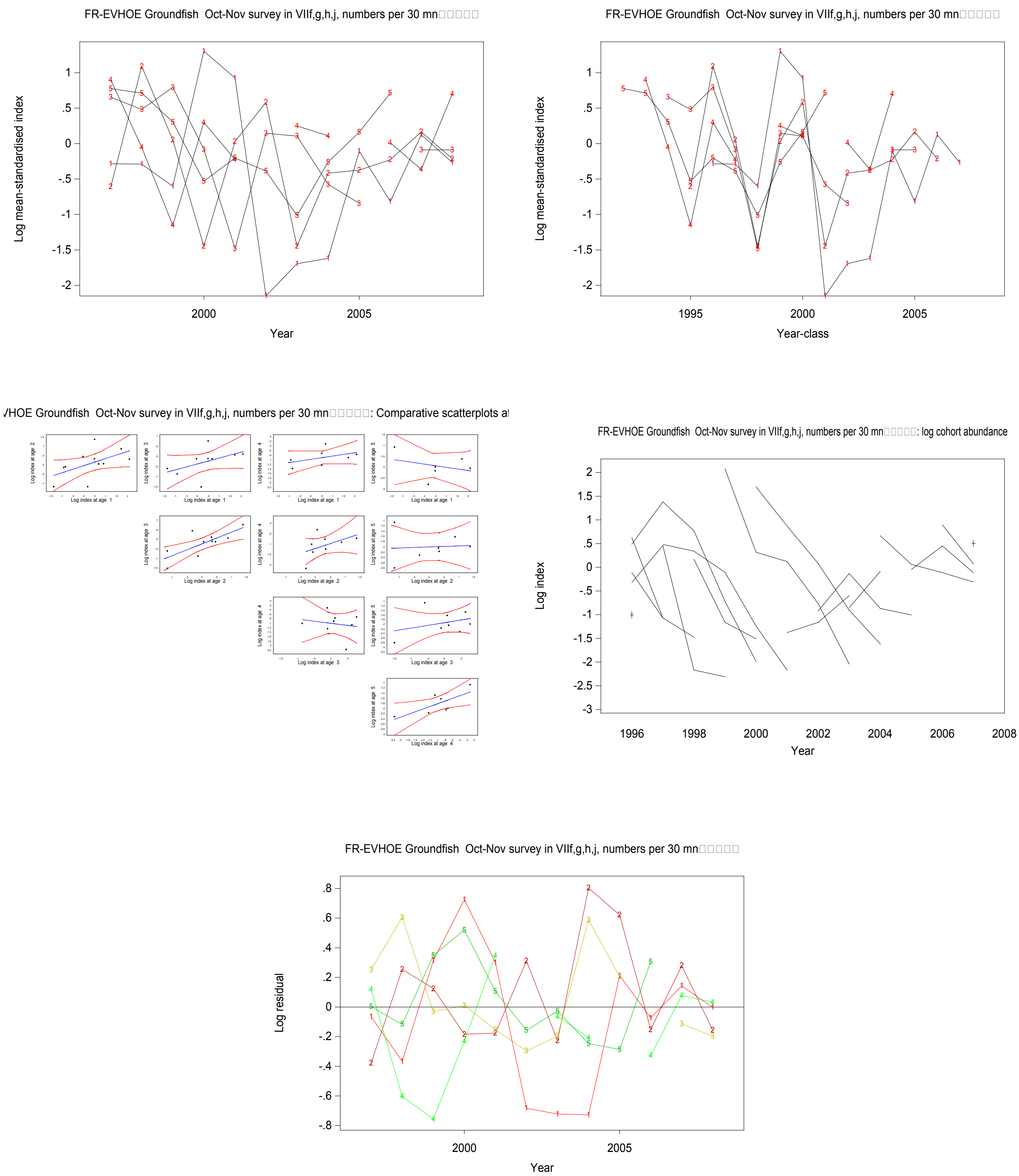


Figure 7.2.2a. Cod in VII e–k. Diagnostics SURBA v3.0 plots for FR-EVHOE survey, age groups 1–5. Log mean-standardized indices by year and age class, scatterplots, catch curves, and residuals. (Single fleet).

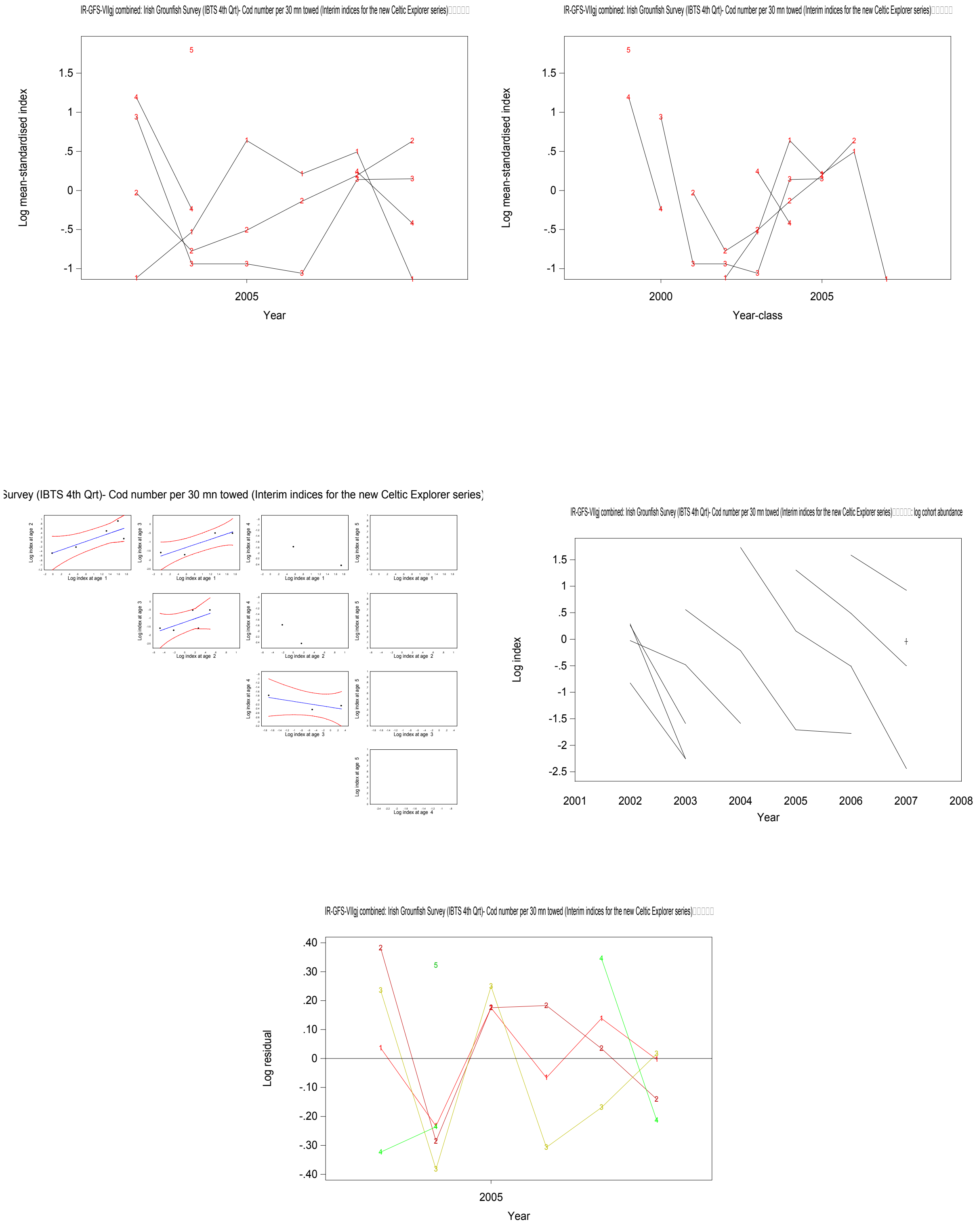


Figure 7.2.2b. Cod in VII e–k. Diagnostics SURBA v3.0 plots for IR-GFS7gj survey, age groups 1–5. Log mean-standardized indices by year and age class, scatterplots, catch curves, and residuals. (Single fleet).

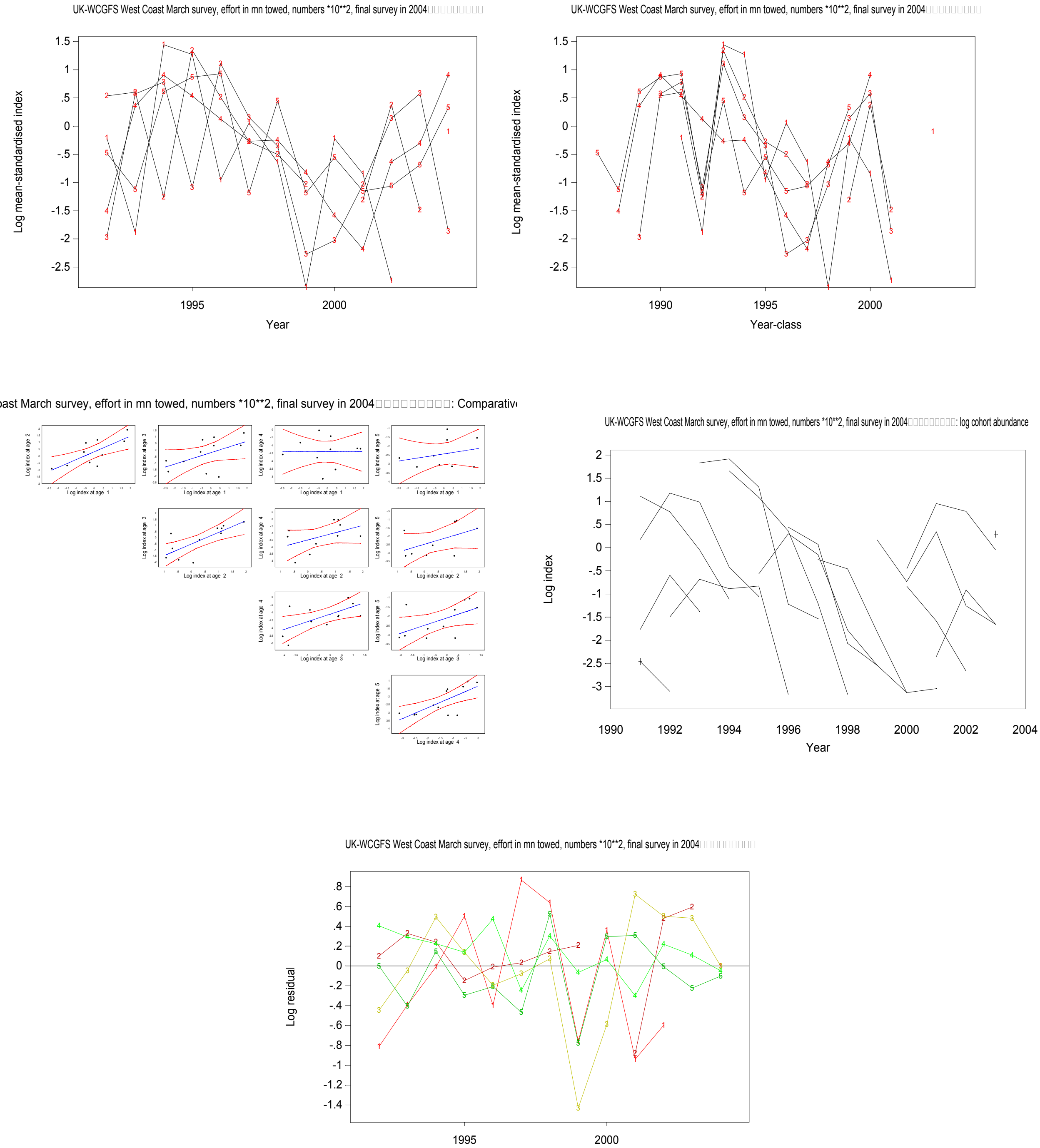
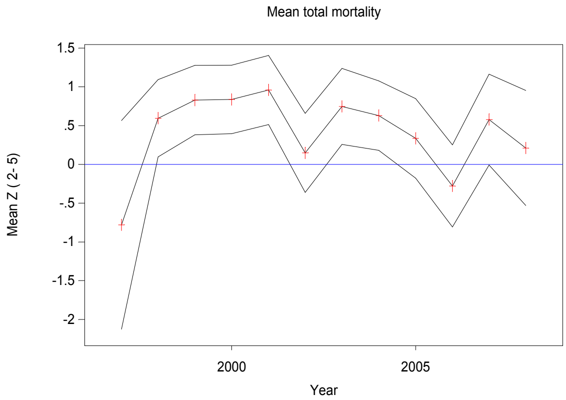
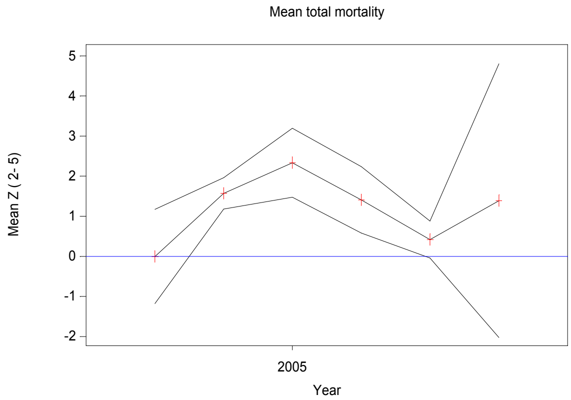


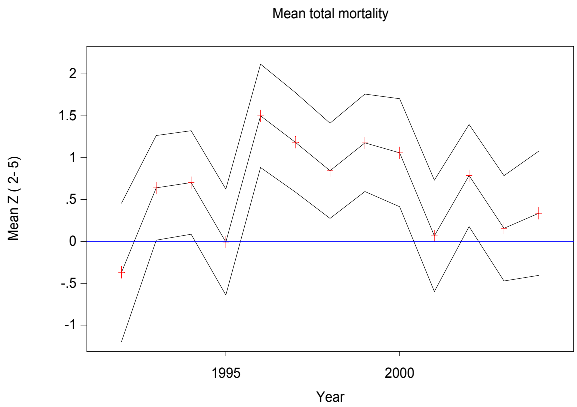
Figure 7.2.2c. Cod in VII e–k. Diagnostics SURBA v3.0 plots for UKWCGFS survey, age groups 1–5. Log mean-standardized indices by year and age class, scatterplots, catch curves, and residuals. (Single fleet).



FR-EVHOE



IR-GFS7gj



UK-WCGFS

Figure 7.2.2d. Cod in VII e–k. Trends of relative mean Z. SURBA v3.0 plots for the 3 surveys used separately.

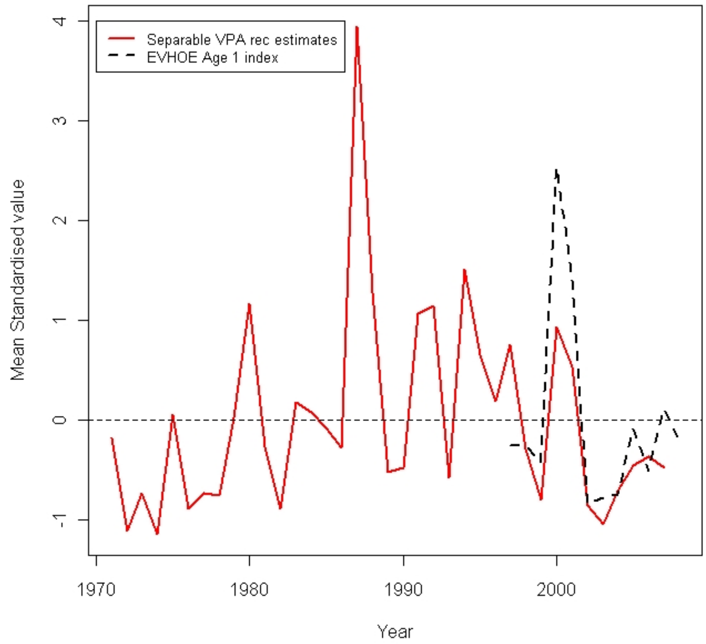
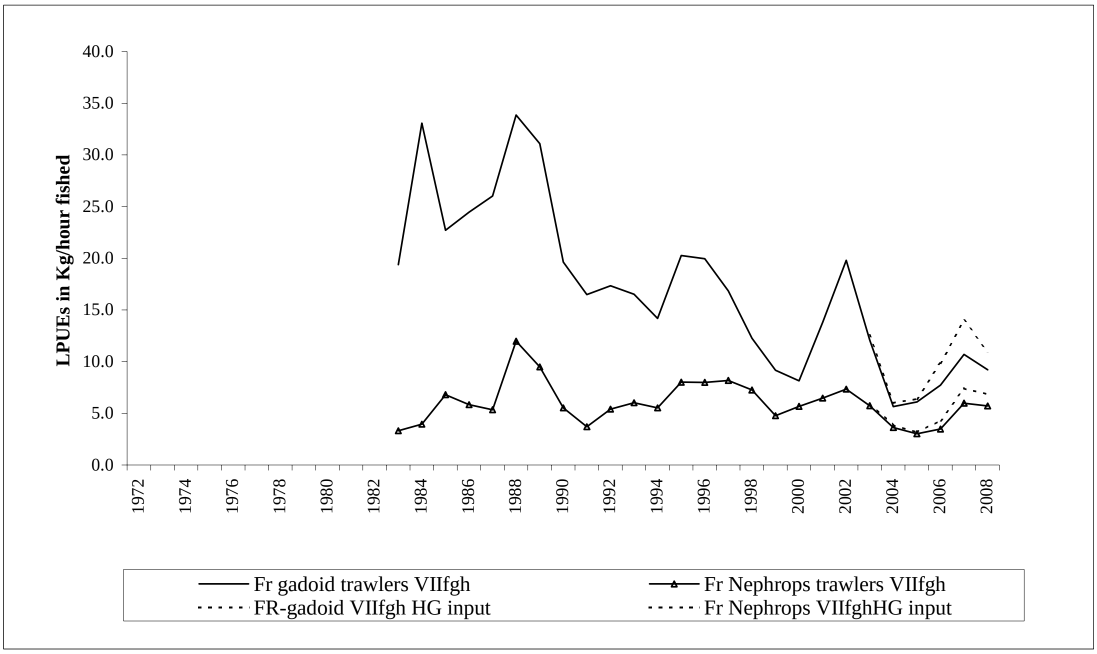


Figure 7.2.2e. Comparative trends of age 1 index from FR-EVHOE survey and the recruitment estimates from a separable VPA.



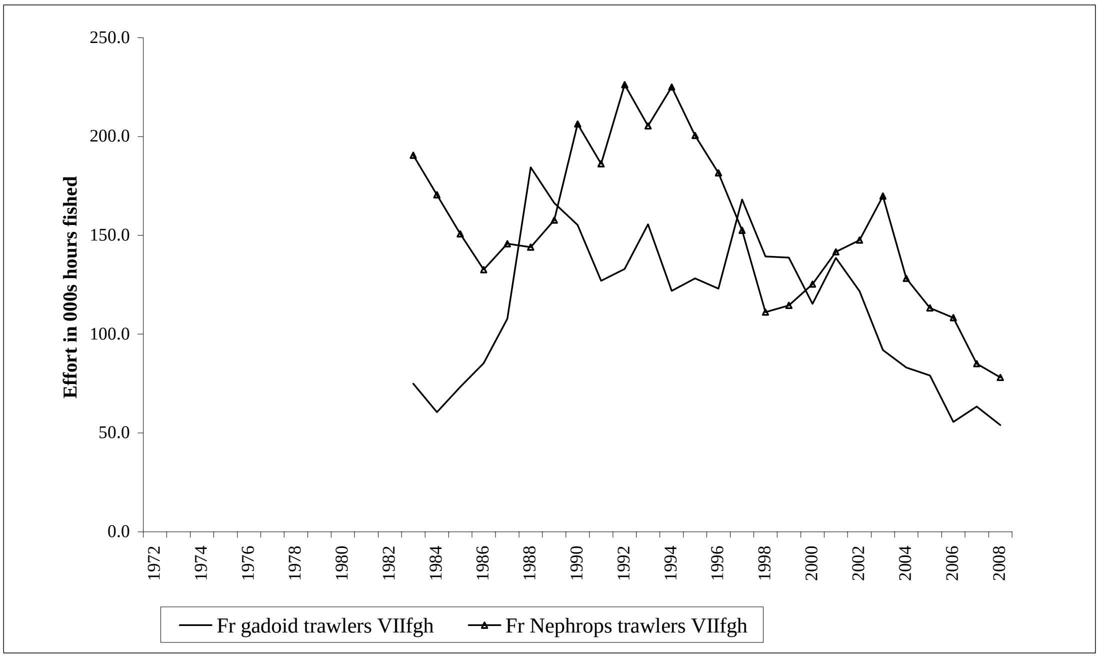
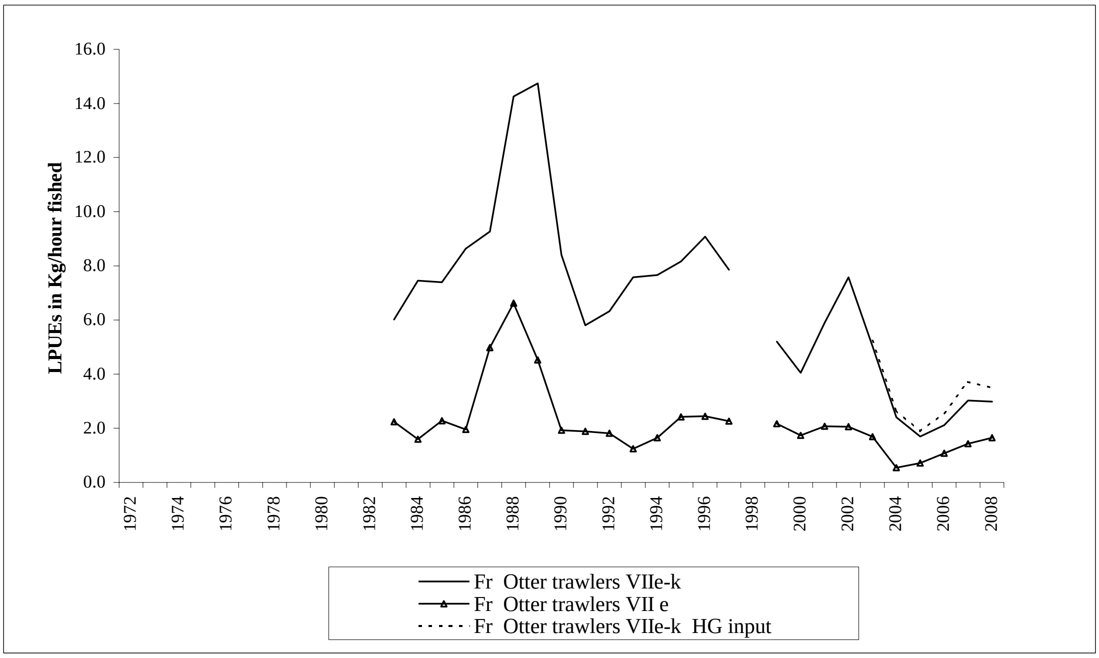
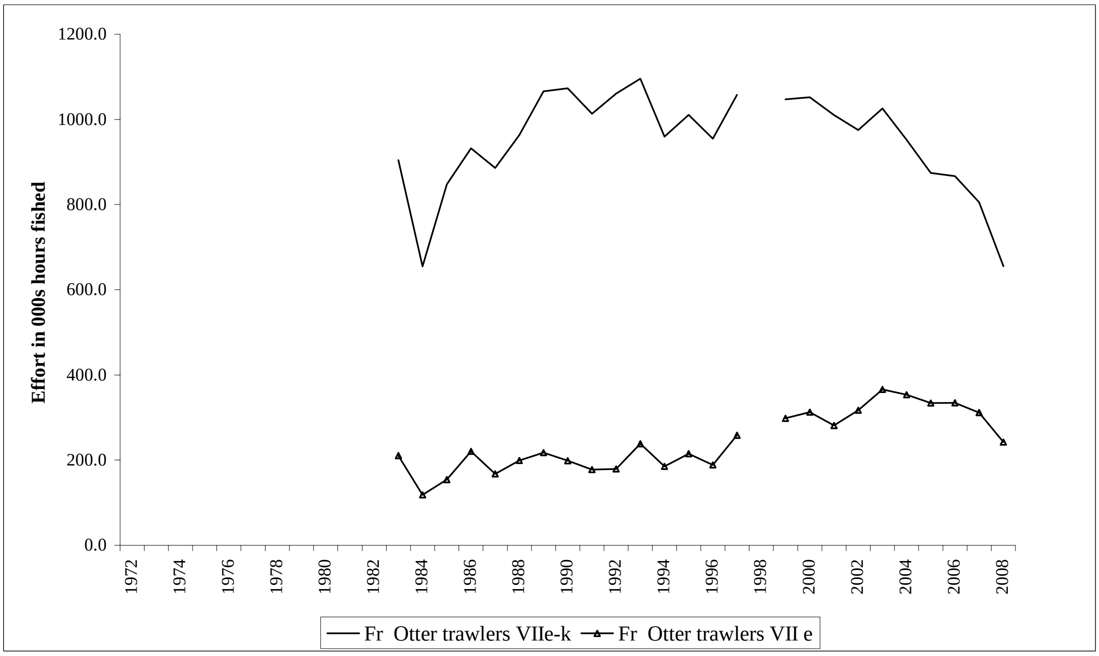


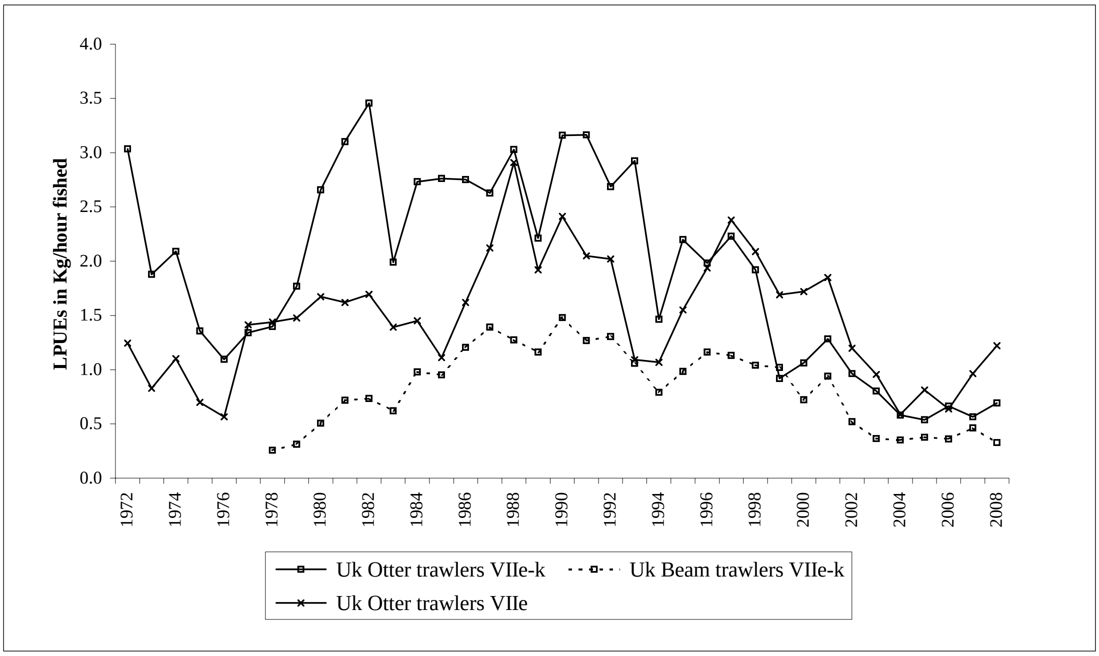
Figure 7.2.3a. Cod in VIIe–k Trends of lpues and effort. French Gadoid trawlers and French *Nephrops* trawlers in VIIfgh.





Unreliable dataset in VIIe 2008

Figure 7.2.3a. continued. Cod in VIIe–k. Trends of lpues and effort. French otter trawlers in VIIe–k (including Gadoid trawlers and *Nephrops* trawlers in VIIfgh) and French otter trawlers in VIIe.



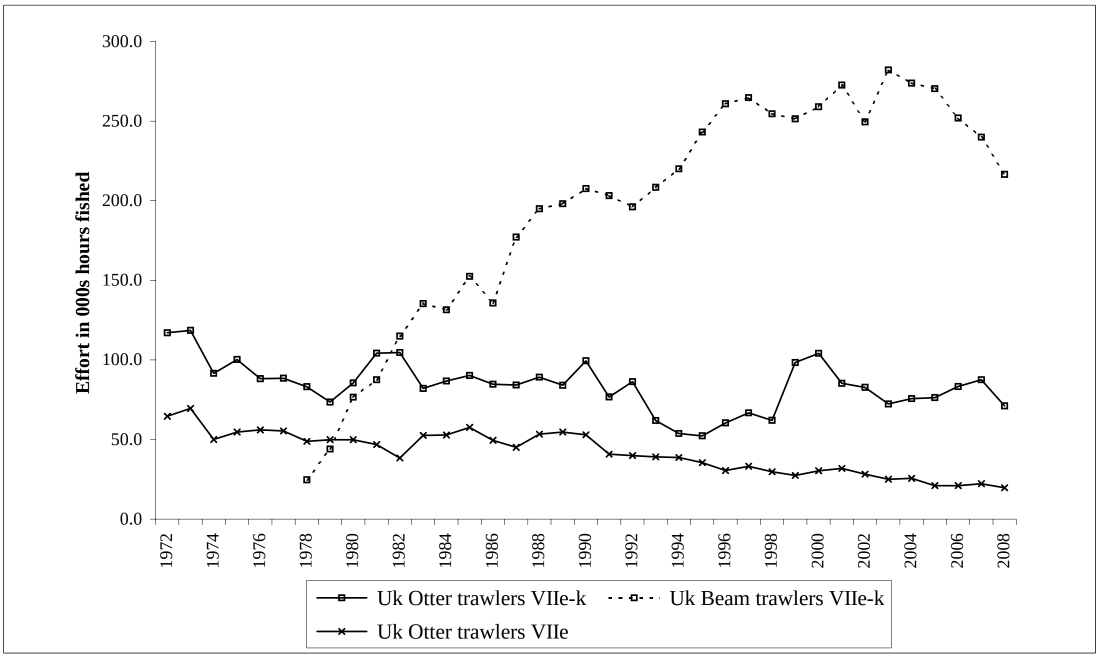
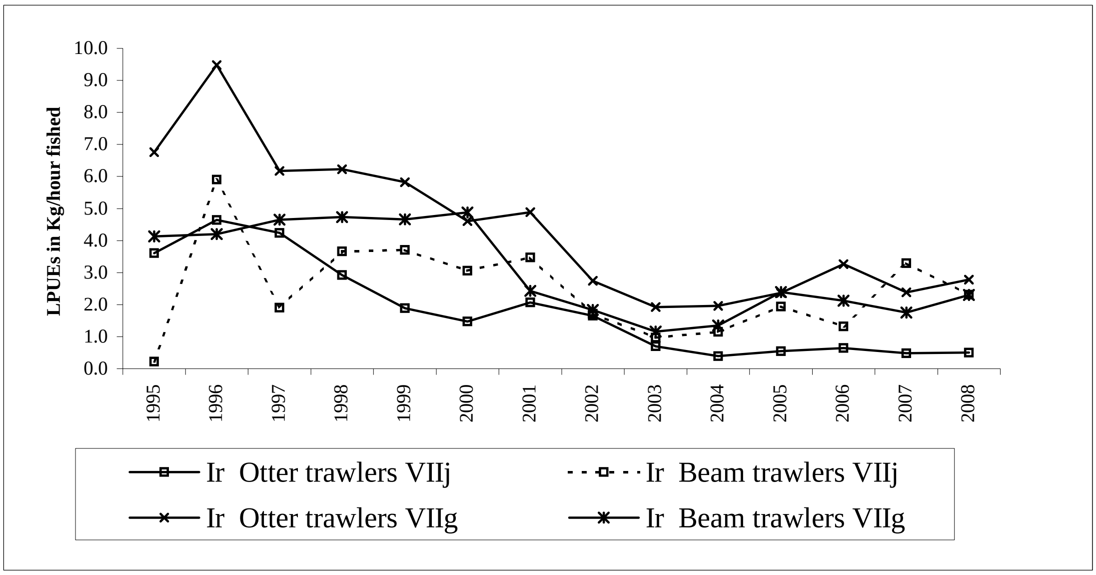


Figure 7.2.3a. continued. Cod in VIIe–k. Trends of lpues and effort. UK otter trawlers in VIIe–k and VIIe, UK beam trawlers in VIIe–k.



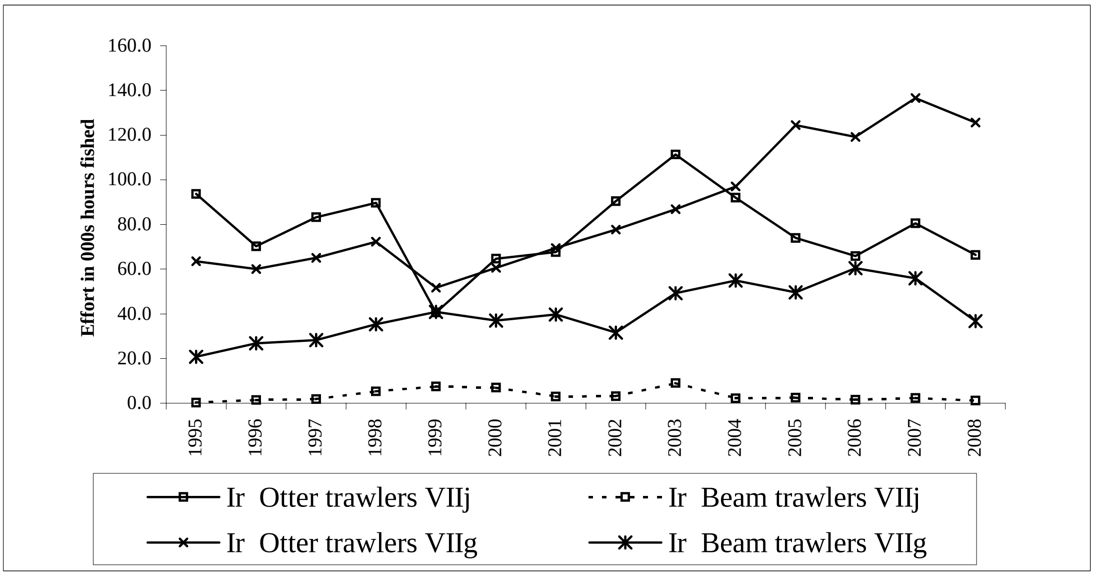
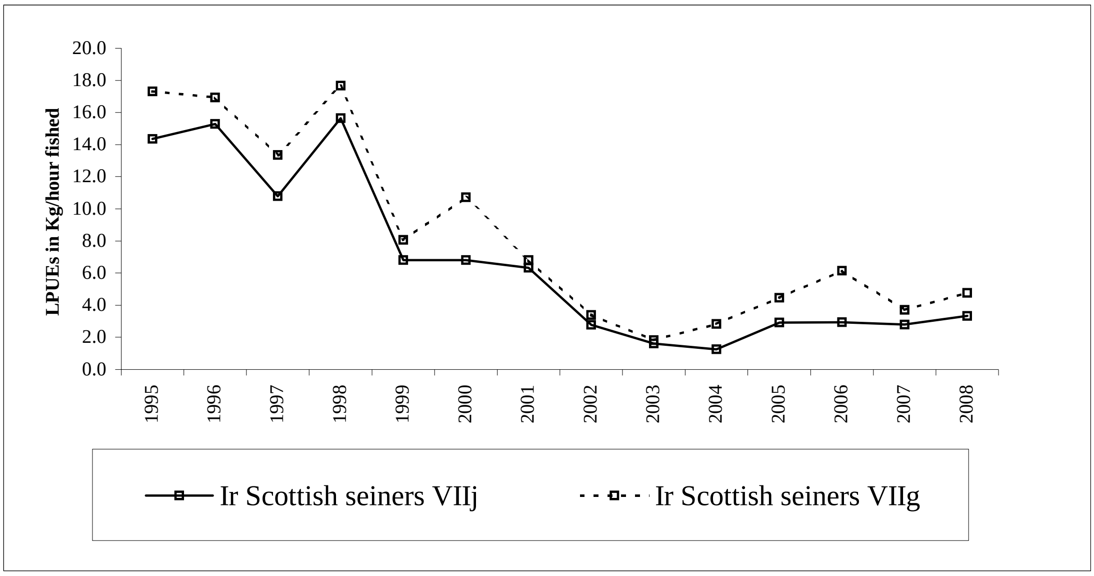


Figure 7.2.3b. Cod in VIIe–k. Trends of lpues and effort Irish otter trawlers in VIIg and VIIj, Irish beam trawlers in VIIg and VIIj.



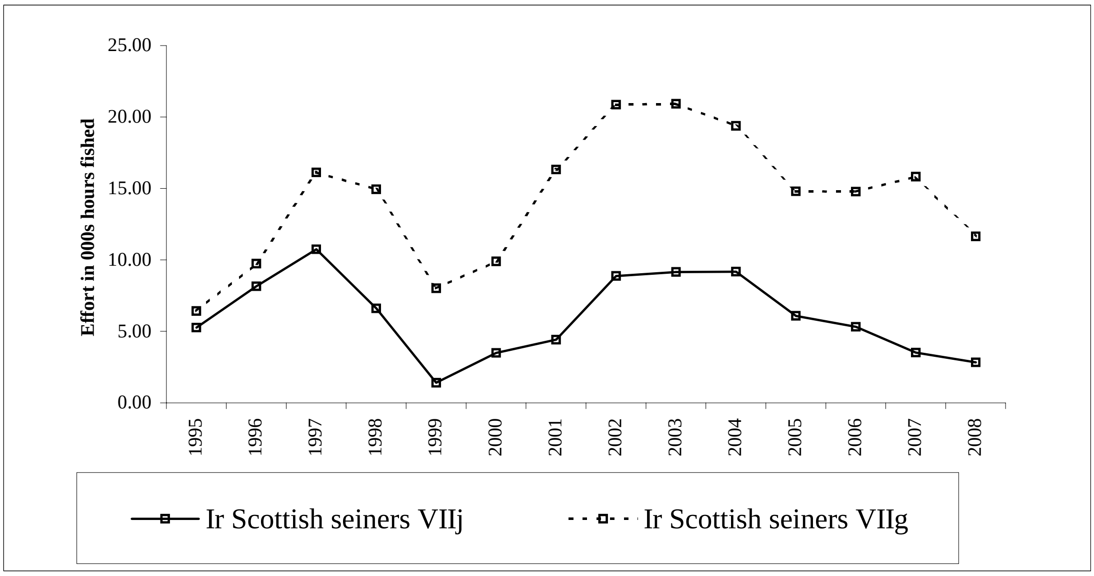


Figure 7.2.3b. Cod in VIIe–k. Trends of lpues and effort. Irish Scottish seiners in VIIg and VIIj.

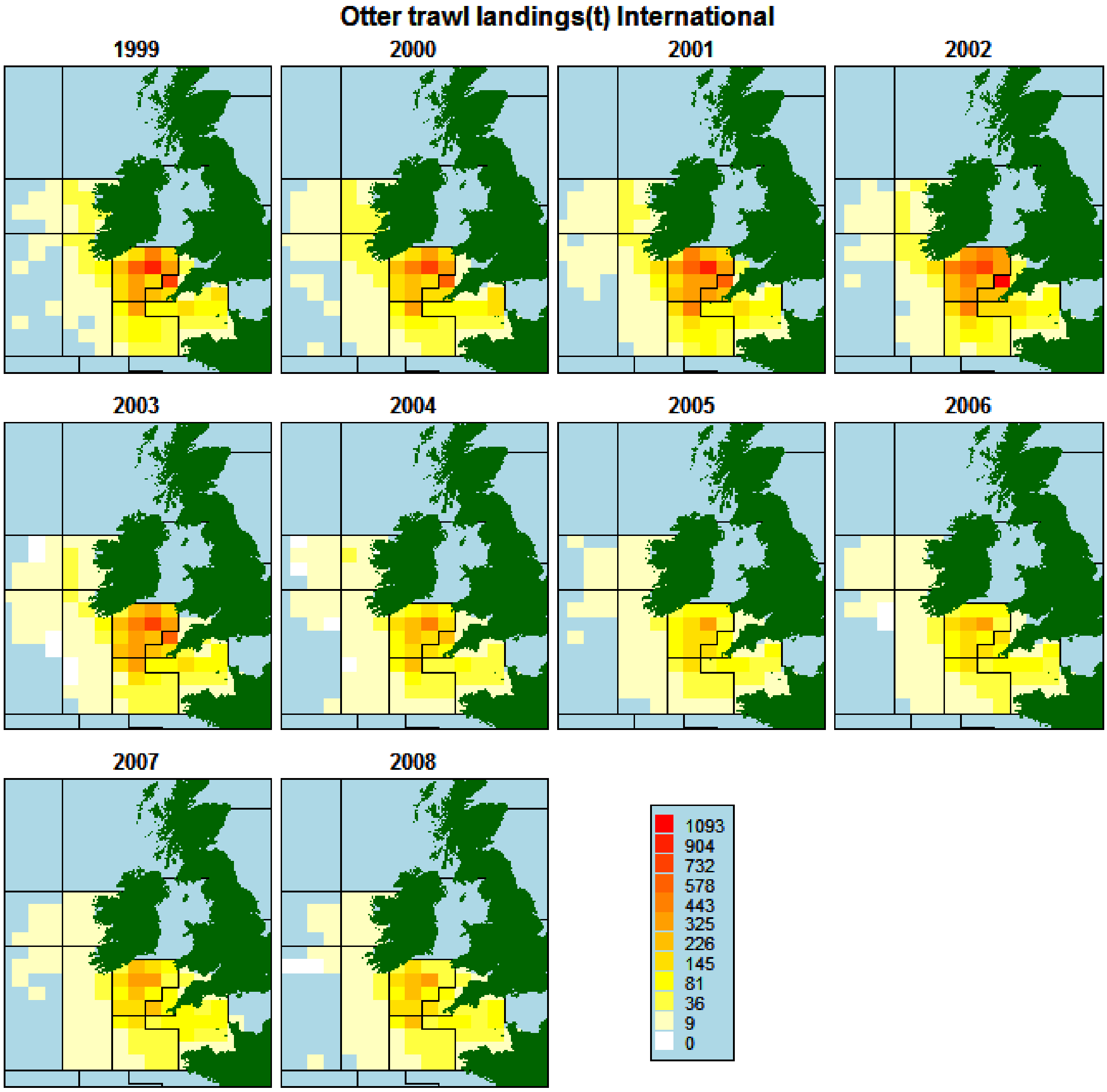


Figure 7.2.4. Cod in VII e–k Distribution of landings by otter trawlers in the TAC area.

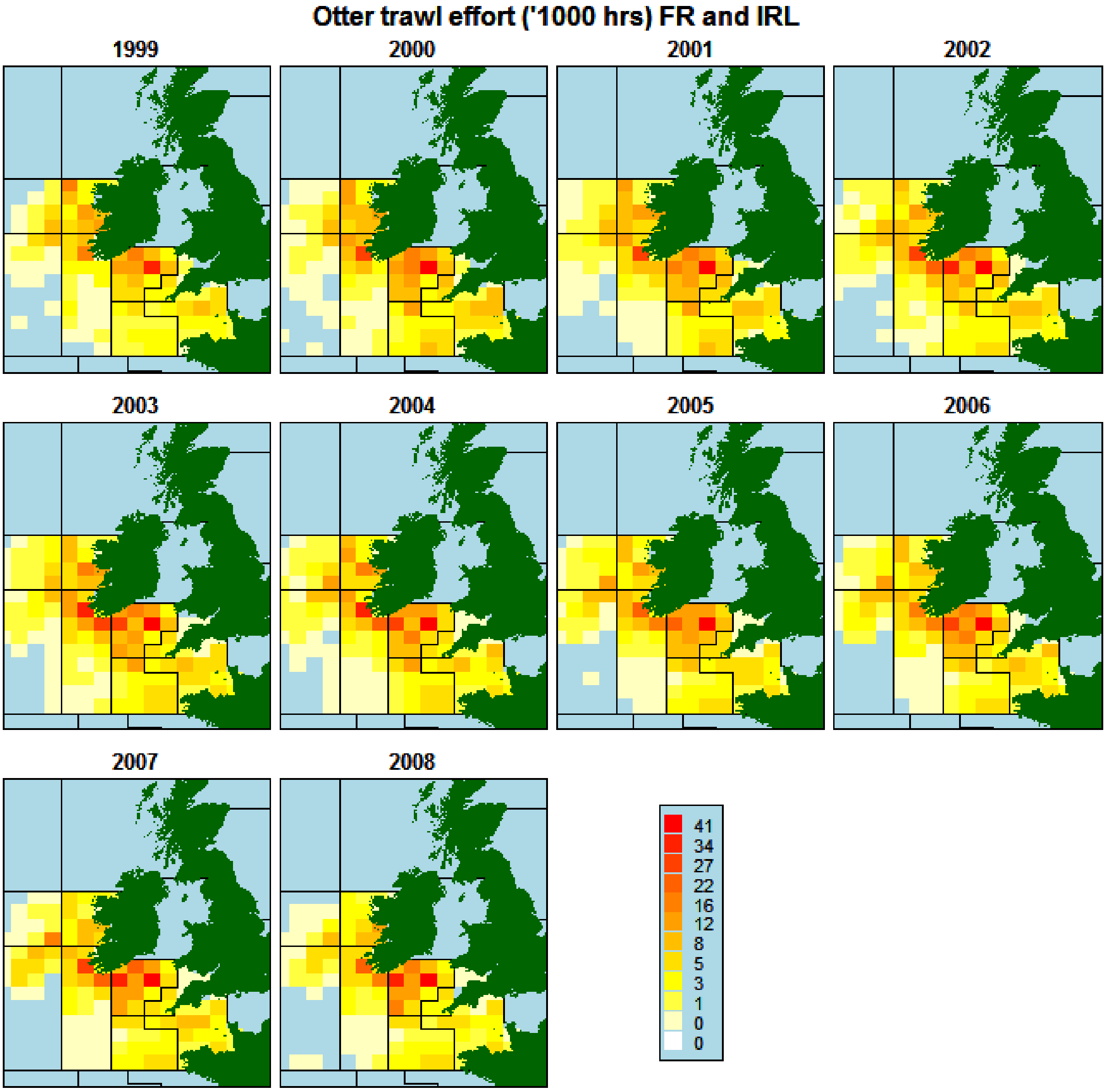


Figure 7.2.5. Cod in VII e–k. Distribution of effort by French and Irish otter trawlers in the TAC area.

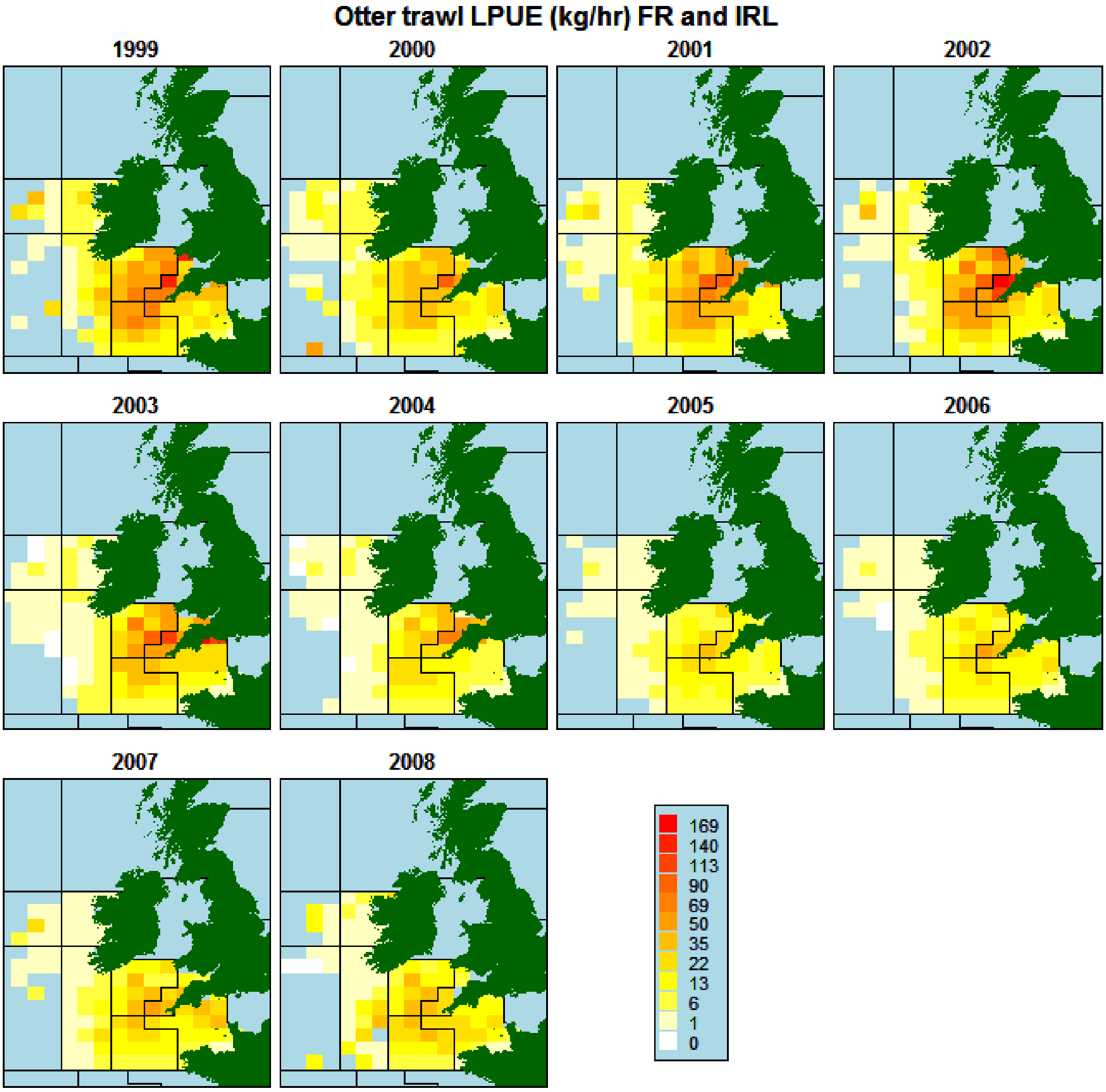


Figure 7.2.6. Cod in VII e–k. Distribution of lpues by French and Irish otter trawlers in the TAC area.

7.3 Cod in Divisions VIIb, c

Type of assessment: No assessment

The nominal landings are given in Table 7.3.1.

Table 7.3.1 Nominal Landings (t) of Cod in Division VIIb, c for 1995–2008.

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
France	91	115	71	44	…[1]	46	38	54	33	13
Germany	-	-	3	-	-	-	-	-		
Ireland	282	353	177	234	154	141	107	59	59	60
Netherlands	-	-	-	-	-	-	+	-	1	
Norway	3	1	6		11	+*	1	5		
Spain	6	3		6	2	3	1	1		
UK(E/W/NI)	25	35	37	25	4	4	2	1	8	
UK(Scotland)	66	12	7	9	1	-		1	1	10
UK										
Total	**473**	**519**	**301**	**318**	**172**	**194**	**150**	**122**	**102**	**83**

Country	2005	2006	2007	2008
France	13	1	18	10
Germany				
Ireland	32	16	11	17
Netherlands				
Norway		1	1	
Spain				
UK(E/W/NI)				
UK(Scotland)				
UK		2	2	1
Total	**45**	**20**	**32**	**28**

[1]**See VIIg-k.**

7.4 Haddock in Divisions VIIb–k

Type of assessment in 2009

Update.

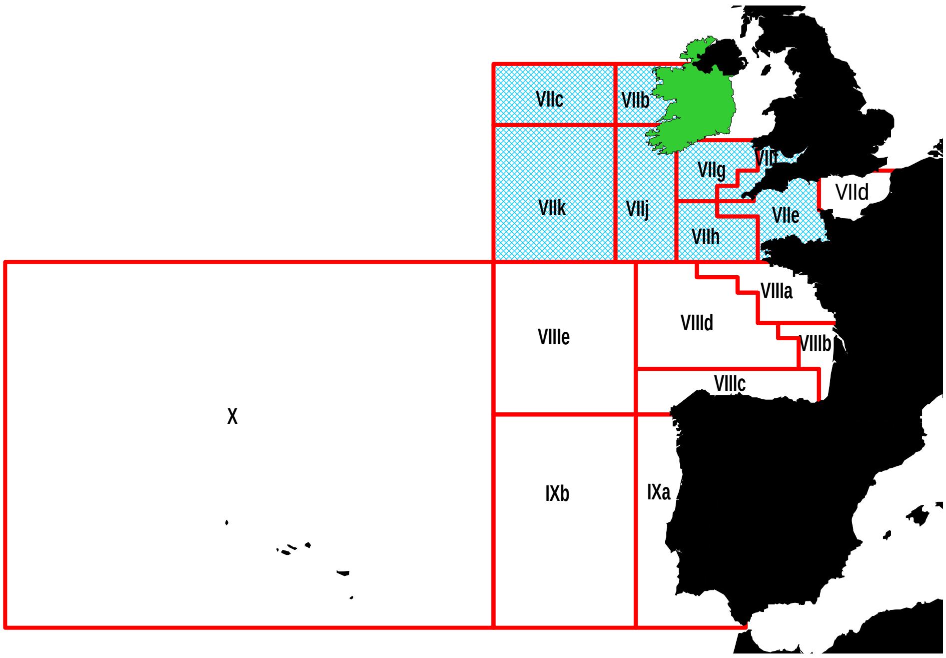
ICES advice applicable to 2008 and 2009

Last year's advice remains unchanged: "Future catches and SSB will be highly dependent on the strength of incoming year classes and their discard mortality. No strong recruitment has been observed since 2002 and estimated recruitment for 2006 is the lowest since 1997. In this context the stock should be managed by ensuring that fishing effort is not allowed to increase."

7.4.1 General

Stock description and management units

The basis for the stock assessment area VIIb–k is described in detail in the Stock Annex. The TAC for haddock is set for all of Subarea VIIb–k, VIII, IX and X, which does not correspond to the stock assessment area (VIIb–k). However, official international landings from VIII, IX and X have been less than 2% of all landings in the TAC area in most years since 1973.



Red Boxes-TAC/Management Areas   Blue Shading– Assessment Area.

Management applicable to 2008 and 2009

TAC table 2008

Species: Haddock *Melanogrammus aeglefinus*		Zone: VII, VIII, IX and X; EC waters of CECAF 34.1.1 HAD/7/3411
Belgium	129	
France	7 719	
Ireland	2 573	
United Kingdom	1 158	
EC	11 579	
TAC	11 579	Precautionary TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 does not apply. Article 5(2) of Regulation (EC) No 847/96 applies.

Special conditions

Within the limits of the abovementioned quotas, no more than the quantities given below may be taken in zone:

	VIIa (HAD/*07A)
Belgium	20
France	90
Ireland	536
United Kingdom	592
EC	1 238

When reporting to the Commission the uptake of their quotas, Member States shall specify quantities taken in ICES zone VIIa. Landings of haddock caught in ICES zone VIIa shall be prohibited when the totality of such landings exceeds 1 238 tonnes.

TAC table 2009

Species: Haddock *Melanogrammus aeglefinus*		Zone: VIIb-k, VIII, IX and X; EC waters of CECAF 34.1.1 (HAD/7X7A34)
Belgium	129	
France	7 719	
Ireland	2 573	
United Kingdom	1 158	
EC	11 579	
TAC	11 579	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

In 2009, a separate TAC was set for VIIa haddock (1424 t); previously a separate allocation for VIIa existed within the TAC for VII, VIII, IX and X.

Fishery in 2008

The nominal landings and Working Group estimates of the landings and discards are given in Table 7.4.1. There is a large difference between the provisional official landings and the WG estimates in 2008. This difference is mainly as a consequence of

French WG estimates of 4553 t which contrast to the French official landings of 3056 t. A large amount of French landings data was entered only after the official landings were submitted. France, the UK and Ireland provided minor revisions to the landings figures for 2006. The 2007 landings figure of 6368 t was revised to 6510 t. The 2008 landings were estimated to be 7013 t.

Before 2002 the TAC was well in excess of the landings in the TAC area. During 2002, 2003 and 2004 the TAC was reduced to less than 10 000 t and it appeared to be restrictive. (WGSSDS05 provided some qualitative evidence that misreporting was now a problem). Since 2005 the TAC has been between 11 520 t and 11 579 t and the landings in the TAC area have been less than 70% of the TAC. The 2008 working group landings in VIIb-k were 7013 t and the official landings in the remainder of the TAC area were 28 t so the landings in 2008 also appear to be well below the TAC.

Length compositions of landings were available for haddock landed into Ireland, France and the UK in 2007 (Table 7.4.2; Figure 7.4.1). Length distributions of all fleets are similar although the Irish OTB fleet in VIIg and VIIj seem to have landed relatively more small haddock (around 30 cm).

7.4.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1

Discards

Discard length distributions for 2008 are shown in Figure 7.4.2. Irish otter trawl discard data were raised to the national level using the number of trips as auxiliary variable as described in the stock annex. The numbers of OTB discard trips by year and métier are given in Table 7.4.3a and the total number of OTB trips is given in Table 7.4.3b. Irish discard data from VIIgj were used to estimate international discards by using the ratio of the international effort in VIIe–k to the Irish effort in VIIgj (Table 7.4.3c). Figure 7.4.3 shows the Irish discard numbers-at-age and the numbers-at-age raised to international levels.

Landings

Landings numbers-at-age were raised using the procedure described in the stock annex. Catch numbers-at-age are given in Table 7.4.4a, landings numbers-at-age are given in Table 7.4.4b and discard numbers-at-age in Table 7.4.4c. Despite uncertainty about the quality of the discard data, it is possible to track strong year classes in both the discards and the landings-at-age matrices. Figure 7.4.4 shows the age compositions of the catches, the figure shows that discards account for a large proportion of the catch numbers up to age 3.

Mean catch weights-at-age are given in Table 7.4.5a, stock weights (including discards) are given in Table 7.4.5b.

Biological

The assumptions of natural mortality and maturity are described in the stock annex. The maturity ogive used in the assessment is knife-edged at-age 2. Irish Q1 survey data from 2004–2008 in VIIbgj (WD 2) suggested a similar maturity ogive for females but also indicated that a significant number of males mature before the age of two.

Surveys and commercial tuning fleets

The surveys are described in the stock annex. Available survey indices and tuning fleet data are given in Table 7.4.6. Survey data tuning-series were made available by

Ireland, the UK, and France. Commercial tuning fleets were made available by Ireland and France.

The standardized indices are given by year in Figure 7.4.5 and by cohort in Figure 7.4.6. In addition to the indices that were used in the assessment, the Irish Groundfish Survey (IR-GFS) indices in VIIb and VIIj are shown. The EVHOE survey is noisy and has a strong year-effect in 2000 but on further analysis does demonstrate patterns that are consistent with other surveys, particularly for ages 0, 2, 3 and 4.

Commercial cpue

Effort and lpue data are given in Table 7.4.7 and Figure 7.4.7.

Other relevant data

No specific issues were raised by the industry on VIIb–k haddock.

7.4.3 Historical stock development

Model used: eXtended Survival Analysis (XSA)

Software used: FLR, VPA95

Exploratory data analysis and the assessment were carried out using FLR under R version 2.4.1 with packages FLCore 1.4–3, FLAssess 1.4.1, FLXSA 1.4–2 and FLEDA 1.4–2. The final assessment was also run using the Lowestoft VPA95 software.

Data screening

The general approach to data screening and analysis was followed in addition to the data exploration tools available in the FLR package FLEDA. The results of the data screening are available in the folder 'Data\Stock\had7b–kExploratory runs' on the SharePoint.

Final update assessment

Input data types and characteristics:

Type	Name	Year range	Age range
Caton	Catch in tonnes	1993-2008	0-8+
Canum	Catch-at-age in numbers	1993-2008	0-8+
Weca	Weight-at-age in the catch	1993-2008	0-8+
West	Weight-at-age at spawning time.	1993-2008	0-8+
Mprop	Proportion of M before spawning	1993-2008	0-8+
Fprop	Proportion of F before spawning	1993-2008	0-8+
Matprop	Proportion mature-at-age	1993-2008	0-8+
Natmor	Natural mortality	1993-2008	0-8+

A plusgroup of 8+ was used. Age group 0 was included in the assessment data to allow inclusion of 0-group indices in the XSA runs. However, catch numbers-at-age 0 were set to zero to avoid spurious F-shrinkage effects at this age.

Model Options:

Option	Setting
Ages catch dep stock size	None
Q plateau	4
Taper	No
F shrinkage SE	1.5
F shrinkage year range	5
F shrinkage age range	3
Fleet SE threshold	0.3
Prior weights	No

Tuning data:

Type	Name	Year range	Age range
Survey	UK7efghjWCS	1996-2004	Not used
Survey	FR7fghjEVHOE	1997-present	0-5
Survey	IR7bjWCGFS	1999-2002	Not used
Survey	IR7gSAGFS	1999-present	0-5
Survey	IR7bIGFS	2003-present	Not used
Survey	IR7jIGFS	2003-present	Not used
Commercial	IR7bjOTB	1995-present	2-7
Commercial	FR7fghGAD	2002-present	2-6

The XSA diagnostics are given in Table 7.4.8. The fishing mortality is quite variable. The catchability residuals are given in Figure 7.4.8, the residuals are relatively large and some year effects are apparent.

The weighting applied to the terminal survivor estimates is shown in Figure 7.4.9. The Irish 7bjOTB fleet dominates weighting for the older ages. The French Gadoid fleet takes a lot of the weighting-at-ages 2 and 3 and the youngest ages are dominated by the survey. F-shrinkage does not account for much of the weighting in any of the ages. Agreement on the terminal survivor estimates appears to be reasonable.

The retrospective analysis was run back to 2004. The results are shown in Figure 7.4.10. Recruitment in 2006 and 2007 was revised upwards, but estimates of F and SSB revealed little retrospective pattern in recent years. The tuning fleets consist mainly of short time-series which might account for a larger retrospective changes in 2004 and 2005 than in more recent years.

Comparison with previous assessments

The XSA settings have not changed since 2007 and revisions to previous years' data were minor. The perception of the stock has not changed significantly.

State of the stock

The stock summary is given in Table 7.4.9 and Figure 7.4.11. Following good recruitment in 1999, 2001 and 2002 the SSB and catch increased, however, as a consequence of high discarding, the landings did not increase in line with the increased stock levels. Recruitment also has been relatively high in 2007 and 2008 and the 2008 catch has increased, but most of these catches were also discarded.

7.4.4 Short-term projections

Recruitment for 2009–2011 was estimated as 45 906 (GM 93–08; thousands). Input data for the short-term forecast are given in Table 7.4.10. Landings and discard numbers and weights were supplied separately. Table 7.4.11 gives the management options.

Estimates of the relative contribution of recent year classes to the 2010 landings and 2011 SSB are displayed in Table 7.4.12. The assumed GM recruitment accounts for 3% of the landings in 2010 and 33% of the SSB in 2011.

7.4.5 Medium-term projection

Medium-term projections were not attempted.

7.4.6 Biological reference points

Precautionary approach reference points

It is not possible to derive precautionary reference points for this stock from the short time-series of information available.

Yield-per-recruit analysis

A yield-per-recruit analysis was performed using the settings given in the stock annex. The results are given in Table 7.4.12 and Figure 7.4.12. Despite reservations about the quality of the assessment (see Section 7.4.8), it is clear that $F_{bar(2\text{-}5)}$, which is 0.61, is well above F_{max} (0.19) and $F_{0.1}$ (0.13).

At present levels of F, nearly half the potential yield is discarded.

7.4.7 Management plans

No management plan for VIIbk haddock has been agreed or proposed.

7.4.8 Uncertainties and bias in assessment and forecast

The sampling levels of landings for countries supplying data for 2008 are given in Table 2.1. Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment approaches, although the assessment is contingent on the accuracy of the landings statistics.

Sampling levels for discarding are low, resulting in a high level of variability. Discards appear to account for more than half of the catch weight in some years and it is therefore very important that they are taken into account. France and the UK have collected discard data in recent years and WD3 provides a comparison of the French and Irish discarding data.

The method of raising discards data used here has a few undesirable features. First, the data are only from the Irish OTB fleet and this fleet is not the largest component of the overall fishery, although otter trawlers in general do account for most of the haddock VIIb–k fishery. Second, a small number of discard trips was raised to account for a very large component of the catch data. The level of variability is unknown but likely to be high. Finally, raising data to international levels using effort, assumes that discard rates per hour trawled of the Irish OTB fleet are similar to all other fleets. It is known that the lpue of the French gadoid fleet is much higher than that of the other fleets so it is likely that the dpue is different as well. The French fleets mainly use >=100 mm mesh size whereas the Irish fleets use both 80 mm and 100 mm mesh. Nevertheless, the discard-at-age matrix did allow tracking of cohorts and there does seem to be merit in including them in the assessment, despite the reservations outlined above.

7.4.9 Recommendation for next Benchmark

Review group comments

- Inclusion of discards is important for this stock although there are doubts about the precision and accuracy of the discard data
- With the extension of discard programmes fleets other than the Irish, a revised assessment including new fleets should be considered

Recommendations for future work

It is unlikely that the precision and accuracy of the historical discard data can be improved significantly by further analysis and until the time-series of international discards is long enough and of sufficient quality, no benchmark assessment will be proposed. However the following issues can be explored in lieu of the next benchmark.

- Methods of including the French discard data into the assessment need to be investigated and bias in the historical discard (before French data became available) data needs to be investigated and addressed. A first step towards this goal is presented in WD3, which concludes that the Irish fleets catch and discard more 1-year-old haddock than the French fleets. The current procedure of raising the Irish discard numbers-at-age is therefore likely to overestimate the number of 1-year-olds.
- The two survey tuning fleets (EVHOE and SAGFS) demonstrate very good agreement on the trends in the 0-group (Figure 7.4.13). The new Irish Groundfish Survey in VIIb and VIIj (IRGFS; not used in the analysis) generally agrees with the other surveys except in 2005. It is believed that a significant amount of recruitment takes place in VIIb and the north of VIIj, these Divisions are not covered by the EVHOE or SAGFS indices, therefore it would be worth considering including the IRGFS index at the next benchmark assessment.
- EVHOE tuning fleet data from 1997 to 2000 are based on Irish survey age–length keys. The time-series is now sufficiently long to omit these years.
- Commercial tuning fleets might be improved by selecting a subset of vessels that have a consistent spatial and temporal effort and catch composition over a significant period of the time-series. This would require a detailed analysis of vessel behaviour.

7.4.10 Management considerations

Haddock are caught in mixed demersal fisheries in the Celtic Sea and management should take this into account.

Recruitment is highly variable with SSB increasing rapidly after good recruitment. However, large numbers of haddock under the MLS of 30 cm are caught and discarded. As a consequence of high levels of discarding, the fleets have not been able to benefit from the increased biomass that follows strong recruitment; although the catches increase substantially after good recruitment, landings remained roughly the same since the start of the time-series. Recruitment appears to have been above-average in 2007 and 2008 and discarding levels have already increased in 2008 and are likely to remain high in the near future.

An increase in mesh size to reduce discarding is likely to be beneficial to this stock and could increase the yield considerably. Reduced selectivity on younger ages would decrease discarding and would promote stock increase when strong year classes occur. In order to minimize discards, it would be preferable to match the selection characteristics of gears used with on-board selection.

Table 7.4.1. Nominal landings (t) of haddock in VIIb–k, officially reported to ICES and total landings used by the Working Group.

	Official landings						Un-	Used by WG		
Year	Belgium	France	Ireland	UK	Others	Total	allocated	Landings	Discards	Catch
1984	0	3328	646	403	549	4926				
1985	4	2438	794	175	565	3976				
1986	6	2279	317	245	86	2933				
1987	12	2380	314	273	0	2979				
1988	64	3275	275	409	0	4023				
1989	117	3412	323	295	27	4174				
1990	22	2110	461	318	31	2942				
1991	18	1508	1020	250	97	2893				
1992	21	1461	1073	306	26	2887				
1993	51	1839	1262	256	0	3408	-60	3348	1193**	4541
1994	123	2788	908	240	17	4076	55	4131	1193**	5324
1995	189	2964	966	266	83	4468	2	4470	472	4942
1996	133	4527	1468	439	86	6653	103	6756	1394	8150
1997	246	6581	2789	569	85	10270	557	10827	2176	13003
1998	142	3674	2788	444	312	7360	308	7668	357	8025
1999	51	2725	2034	278	159	5247	-365	4882	648	5530
2000	90	3088	3066	289	123	6656	755	7411	7255	14666
2001	165	4842	3608	422	665	9702	-1070	8632	2050	10682
2002	132	4348	2188	315	106	7089	-686	6403	7024	13427
2003	118	5781	1867	393	82	8241	-95	8146	8234	16380
2004	136	6130	1715	313	159	8453	128	8581	5377	13958
2005	167	4174	2037	292	197	6867	-219	6648	2565	9213
2006	99	3190	1875	275	209	5648	-265	5383	1776	7159
2007	119	4142	1930	386	52	6629	-119	6510	3292	9802
2008*	107	3056	1794	566	0	5524	1489	7013*	9454	16467

* preliminary

** No discard data available, the avereage effort for **1995-1999** was used to estimate discards

Table 7.4.2. Length frequency distributions ('000) of the landings of haddock in VIIb–k in 2008. FR GAD is the French gadoid fleet, IRL OTB is the Irish otter trawl fleet, UK trawl includes all trawl gears except beam trawl.

	FR GAD VIIfgh	IRL OTB VIIb	IRL OTB VIIg	IRL OTB VIIj	UK Trawl VIIe-k	UK Beam VIIe-k
Length (cm)	Landings 2187	Landings 209	Landings 581	Landings 378	Landings 466	Landings 73
23	0.0	0.0	0.0	0.3	0.0	0.0
24	0.0	0.0	0.1	2.6	0.0	0.0
25	0.0	0.0	0.0	5.3	0.0	0.1
26	0.0	0.0	0.3	12.2	0.0	0.0
27	0.0	0.0	0.7	16.5	0.0	0.0
28	8.8	0.7	4.7	21.7	6.3	0.1
29	24.5	4.3	12.0	41.9	5.6	0.3
30	86.8	8.4	28.3	66.3	23.4	1.3
31	176.9	14.1	50.9	58.3	44.1	3.9
32	227.4	18.6	63.6	49.2	63.7	4.8
33	222.0	22.7	80.2	36.8	72.9	6.2
34	255.1	22.0	75.9	29.0	74.6	6.3
35	234.8	22.7	71.0	28.8	66.9	6.7
36	248.4	19.2	73.5	30.3	64.3	6.2
37	262.1	19.6	53.0	29.5	59.1	6.6
38	275.4	20.4	41.4	28.5	65.6	5.6
39	207.1	20.8	40.5	23.0	51.8	5.4
40	215.8	17.2	37.6	22.0	41.9	5.1
41	205.9	14.8	34.1	20.5	39.0	5.0
42	157.8	11.8	25.8	19.2	30.5	4.1
43	129.9	10.5	23.9	18.1	18.7	3.8
44	116.6	10.0	20.6	12.5	22.7	3.4
45	73.6	7.5	17.9	15.6	9.3	3.0
46	53.0	6.0	15.3	12.3	10.0	2.9
47	53.6	6.3	13.2	13.5	10.8	2.2
48	42.3	4.2	10.9	13.6	3.5	1.6
49	40.2	3.9	10.6	9.6	5.0	1.3
50	28.5	4.2	8.6	6.3	2.9	1.5
51	28.5	3.9	8.1	8.5	2.6	1.1
52	14.7	3.0	6.8	3.8	1.0	0.7
53	14.8	2.2	7.0	3.6	1.5	0.9
54	9.6	4.2	6.1	2.3	0.1	0.3
55	7.9	1.8	4.3	2.2	0.7	0.5
56	5.8	2.1	4.1	2.6	0.0	0.7
57	7.4	1.6	3.1	1.0	0.0	0.7
58	8.6	1.8	3.3	1.5	1.5	0.3
59	3.2	1.8	2.4	0.5	1.7	0.3
60	2.7	1.0	2.3	1.1	0.0	0.3
61	3.3	0.6	1.9	1.1	0.0	0.5
62	0.7	0.9	1.7	0.8	0.0	0.3
63	1.0	0.6	1.5	0.3	0.4	0.3
64	1.4	0.7	1.3	0.1	0.0	0.1
65	0.7	0.3	1.0	0.6	0.0	0.1
66	0.8	0.3	0.9	0.0	0.0	0.1
67	0.6	0.4	0.6	0.4	0.0	0.2
68	0.7	0.4	1.3	0.0	0.0	0.1
69	0.4	0.0	0.9	0.0	0.0	0.0
70	0.8	0.0	0.8	0.3	0.0	0.3
71	0.4	0.2	0.4	0.1	0.0	0.0
72	0.7	0.3	1.1	0.3	0.0	0.3
73	0.9	0.0	0.5	0.0	0.0	0.0
74	0.0	0.2	0.3	0.4	0.4	0.1
75	0.4	0.0	0.3	0.0	0.0	0.0
76	0.0	0.0	0.2	0.0	0.0	0.0
77	0.0	0.0	0.1	0.3	0.0	0.0
78	0.1	0.0	0.1	0.0	0.0	0.0
79	0.0	0.0	0.0	0.0	0.0	0.0
80	0.0	0.0	0.1	0.0	0.0	0.0
81	0.0	0.0	0.1	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.3	0.0	0.0

Table 7.4.3. Overview of the number of OTB (otter trawl) discard trips, the total number of OTB trips and the raising factor used to raise the Irish discard data to international discards.

a). Number of Irish OTB discard trips by year and metier

Metier	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
OTB VIIb Neph	1	1	0	5	2	2	1	1	2	1	5	6	4	1	0	5	37
OTB VIIbc Dem	0	3	0	0	1	0	0	0	0	0	1	0	0	0	2	1	8
OTB VIIck Neph	1	1	0	0	1	1	2	0	0	0	0	0	0	0	1	1	8
OTB VIIg Dem	3	3	0	0	5	2	1	0	0	0	2	10	7	1	4	1	39
OTB VIIgfh Neph	4	6	0	2	1	1	1	1	2	2	2	2	3	0	10	4	41
OTB VIIj Dem	1	1	2	4	0	2	2	0	2	0	7	3	6	1	2	2	35
OTB VIIj Neph	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	6
Other gears VIIbk	1	0	0	1	3	4	0	0	0	0	3	5	3	0	0	2	22
Total discard trips	11	15	2	12	13	12	7	2	6	3	22	28	25	3	19	16	196

b). Total number of Irish OTB trips by year and Division

Metier	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
OTB VIIb	1352	860	949	1267	1156	1192	1115	941	1468	1333	973	788	990	942	15326
OTB VIIg	1834	1763	1913	1979	1342	1408	1474	1732	1773	1891	2337	2308	2825	2843	27422
OTB VIIj	2181	1808	1916	1976	838	1136	1699	1756	2405	2049	1675	1411	2248	2157	25255
Total OTB VIIbgj	5367	4431	4778	5222	3336	3736	4288	4429	5646	5273	4985	4507	6063	5942	68003

c). Effort (per 1000h) and the raising factor used to raise the Irish VIIgj discard data to international discards

Fleet	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
IRL OTB VIIb	56*	56*	65	41	50	64	62	63	61	47	64	60	47	40	41	37	817
IRL OTB VIIgj	138*	132*	157	130	148	162	92	125	137	168	198	189	198	185	217	192	2376
International VIIe-k**	413	366	394	361	441	413	397	400	413	428	415	384	376	348	389	333	5933
Raising Factor (INT 7ek/IRL 7	3.00	2.78	2.50	2.77	2.97	2.55	4.31	3.19	3.01	2.54	2.09	2.03	1.90	1.88	1.79	1.73	2.50

* Average of 1995-99

** Includes IRL OTB VIIgj, FR GAD VIIfgh and UK Trawl VIIe-k

Table 7.4.4. (a) Catch numbers-at-age of haddock in VIIb–k. (b) Landings numbers-at-age. (c) Discard numbers-at-age. Strong year classes are highlighted.

a) Haddock VIIbk Catch numbers at age

0	1	2	3	4	5	6	7	8	9	10	
585	3586	4799	1049	822	259	130	130	42	3	0	#1993
577	4583	4422	965	468	299	66	25	63	0	0	#1994
12766	3857	1265	1090	462	581	338	161	44	0	0	#1995
351	6385	11870	1248	668	265	275	126	71	10	10	#1996
903	7012	15351	3404	703	581	239	130	33	42	22	#1997
425	1242	3798	6232	846	302	252	179	73	56	6	#1998
531	3263	3076	1568	1646	245	80	44	14	3	0	#1999
5677	38744	9725	935	551	589	134	23	14	2	0	#2000
1061	10977	10189	1276	298	296	298	51	29	7	0	#2001
13280	21504	11011	4547	822	44	88	73	19	5	2	#2002
11319	25752	18294	2392	1299	112	42	48	41	10	0	#2003
1535	4421	15881	5742	947	652	50	12	16	3	0	#2004
1346	3952	4017	6026	1964	436	114	4	13	3	0	#2005
6398	4566	4314	1987	2270	376	64	7	0	0	0	#2006
2538	6819	10250	2871	508	832	149	29	3	2	0	#2007
2917	30510	12490	5203	949	215	356	65	11	1	0	#2008

b) Haddock VIIbk Landings numbers at age

0	1	2	3	4	5	6	7	8	9	10	
9	494	3311	954	815	257	130	130	42	3	0	#1993
0	1491	2934	870	461	297	66	25	63	0	0	#1994
25	2237	1185	1090	462	581	338	161	44	0	0	#1995
0	2399	10373	1206	648	260	275	126	71	10	10	#1996
0	1581	12102	3119	694	580	239	130	33	42	22	#1997
3	640	3264	6199	846	302	252	179	73	56	6	#1998
0	622	2585	1560	1646	245	80	44	14	3	0	#1999
28	4676	2344	587	535	589	134	23	14	2	0	#2000
11	3998	8036	1053	282	295	298	51	29	7	0	#2001
1	872	4216	3354	760	39	88	73	19	5	2	#2002
16	665	8293	1998	1149	112	42	48	41	10	0	#2003
4	117	5870	4540	881	573	50	12	16	3	0	#2004
0	783	833	4166	1884	436	114	4	13	3	0	#2005
0	831	3313	1431	2106	376	64	7	0	0	0	#2006
0	653	6198	2566	503	827	149	29	3	2	0	#2007
0	1524	3837	4186	910	215	356	65	11	1	0	#2008

c) Haddock VIIbk Discatd numbers at age

0	1	2	3	4	5	6	7	8	9	10	
577	3092	1488	95	7	2	0	0	0	0	0	#1993
577	3092	1488	95	7	2	0	0	0	0	0	#1994
12740	1620	81	0	0	0	0	0	0	0	0	#1995
351	3986	1497	42	20	5	0	0	0	0	0	#1996
903	5430	3249	285	9	1	0	0	0	0	0	#1997
423	602	534	33	0	0	0	0	0	0	0	#1998
531	2642	491	8	0	0	0	0	0	0	0	#1999
5649	34067	7381	348	17	0	0	0	0	0	0	#2000
1050	6980	2153	224	17	1	0	0	0	0	0	#2001
13279	20632	6795	1193	62	5	0	0	0	0	0	#2002
11303	25087	10001	395	150	0	0	0	0	0	0	#2003
1531	4304	10011	1203	65	79	0	0	0	0	0	#2004
1346	3170	3183	1860	80	0	0	0	0	0	0	#2005
6398	3735	1001	556	165	0	0	0	0	0	0	#2006
2538	6166	4052	306	5	5	0	0	0	0	0	#2007
2917	28986	8653	1016	40	0	0	0	0	0	0	#2008

Table 7.4.5. (a) Mean catch weights-at-age (including discards) (b) Mean stock weights-at-age (including discards). A 3-year running average was applied.

a) Haddock VIIbk Catch weights at age

0	1	2	3	4	5	6	7	8	9	10	
0.000	0.184	0.340	0.554	0.847	1.395	1.693	2.130	2.593	2.325	2.325	#1993
0.000	0.228	0.486	0.836	1.153	1.422	1.990	2.399	2.673	2.593	2.325	#1994
0.000	0.284	0.698	0.932	0.964	1.052	1.284	2.040	2.495	2.673	2.593	#1995
0.000	0.184	0.353	0.682	1.120	1.379	1.450	1.850	2.105	1.835	1.415	#1996
0.000	0.184	0.427	0.845	1.224	1.415	1.453	0.965	1.451	0.706	1.570	#1997
0.000	0.268	0.344	0.663	1.024	1.325	1.558	1.915	2.106	1.544	2.044	#1998
0.000	0.211	0.430	0.661	1.094	1.406	2.267	2.594	2.559	1.575	1.544	#1999
0.000	0.174	0.467	0.949	1.663	1.826	2.308	2.486	2.213	2.449	1.575	#2000
0.000	0.233	0.500	0.987	1.792	1.777	1.705	2.297	1.669	1.386	2.449	#2001
0.000	0.211	0.407	0.715	1.052	1.669	1.671	1.504	1.532	1.589	1.840	#2002
0.000	0.197	0.410	0.778	1.185	1.429	1.800	1.705	1.589	2.143	3.045	#2003
0.000	0.217	0.424	0.722	1.173	1.276	1.855	1.806	1.876	3.092	1.950	#2004
0.000	0.241	0.365	0.643	1.014	1.256	1.946	2.667	1.881	2.185	2.708	#2005
0.000	0.281	0.492	0.495	0.895	1.486	2.118	2.619	4.022	4.019	2.185	#2006
0.000	0.230	0.454	0.635	0.881	1.193	1.630	1.487	3.427	1.448	5.779	#2007
0.000	0.191	0.448	0.655	0.848	1.140	1.267	1.655	1.745	2.551	2.873	#2008

b) Haddock VIIbk Stock weights at ahe

0	1	2	3	4	5	6	7	8	9	10	
0.073	0.190	0.362	0.659	0.866	1.581	2.010	2.114	3.779	3.779	3.779	#1993
0.080	0.252	0.441	0.766	0.956	1.536	1.864	2.142	3.403	3.779	3.779	#1994
0.075	0.245	0.438	0.821	1.147	1.386	1.720	1.998	2.833	3.403	3.779	#1995
0.080	0.238	0.454	0.935	1.265	1.484	1.712	1.961	2.484	2.833	3.403	#1996
0.071	0.174	0.342	0.803	1.233	1.422	1.676	2.044	2.542	2.484	2.833	#1997
0.071	0.180	0.366	0.670	1.071	1.311	1.782	2.198	2.231	2.542	2.484	#1998
0.074	0.184	0.362	0.631	1.086	1.456	2.050	2.363	2.324	2.231	2.542	#1999
0.082	0.188	0.429	0.767	1.330	1.691	2.224	2.373	2.363	2.324	2.324	#2000
0.091	0.195	0.408	0.842	1.374	1.710	1.893	2.224	2.373	2.363	2.324	#2001
0.062	0.198	0.399	0.819	1.368	1.671	1.895	1.893	2.224	2.647	2.409	#2002
0.060	0.204	0.367	0.723	1.199	1.556	1.944	1.895	1.893	3.145	2.647	#2003
0.056	0.211	0.352	0.683	1.225	1.626	2.315	1.968	1.927	3.147	3.145	#2004
0.074	0.231	0.375	0.588	1.085	1.555	2.172	2.421	2.676	3.151	3.147	#2005
0.075	0.236	0.387	0.564	0.967	1.448	2.110	2.564	3.343	2.752	4.182	#2006
0.076	0.222	0.409	0.573	0.870	1.361	1.820	2.203	3.315	3.343	4.179	#2007
0.081	0.206	0.402	0.612	0.851	1.260	1.682	1.824	2.953	3.315	3.315	#2008

Table 7.4.6. Tuning data available for haddock in VIIB–k. The tuning data used in the final assessment is highlighted in grey.

```
HADDOCK VIIb-k, WGSSDS 2008, TUNING DATA
114
IR-7b-OT : Irish Otter Trawl in 7B - effort, nos-at-age per 1000h
1995    2008

1       1       0       1

0       10

65.3    0.0     0.0     20.5    104.3   76.1    105.3   62.0    29.6    8.1     0.0
        0.0     #1995
41.5    0.0     19.4    93.2    30.2    30.0    17.9    21.5    9.4     5.1     0.8
        0.8     #1996
49.5    0.0     8.3     195.2   116.9   29.6    31.9    19.1    13.5    4.1     5.3
        8.4     #1997
63.5    0.0     9.8     147.4   290.7   68.1    37.7    34.6    25.0    9.5     8.4
        0.9     #1998
62.0    0.0     0.4     193.6   225.9   190.9   49.6    12.4    6.0     2.3     0.7
        0.0     #1999
57.7    0.0     41.3    57.2    22.2    56.8    98.5    31.2    7.5     6.9     0.7
        0.0     #2000
60.7    0.0     20.2    289.1   72.8    13.9    42.5    60.4    7.4     8.2     2.0
        0.0     #2001
46.8    0.26    3.9     38.9    95.2    28.6    4.3     17.3    17.6    4.8     1.3
        0.6     #2002
64.0    0.0     2.2     21.7    42.2    66.8    15.1    9.0     10.6    10.4    2.5
        0.1     #2003
60.4    0.0     0.6     43.7    68.3    59.8    79.6    11.0    3.2     4.8     0.3
        0.2     #2004
47.4    0.0     9.7     60.8    64.4    57.4    32.7    2.0     1.6     1.0     0.3
        0.0     #2005
39.7    0.0     20.9    120.5   108.9   50.7    7.2     9.3     0.0     0.0     0.0
        0.0     #2006
40.7    0.0     0.0     63.5    64.9    45.3    69.5    14.9    7.9     0.0     0.0
        0.0     #2007
37.3    0.0     0.0     37.6    96.6    63.3    33.3    62.4    12.2    3.1     0.2
        0.0     #2008
IR-7j-OT : Irish Otter Trawl in 7J - effort, nos-at-age per 1000h
1995    2008

1       1       0       1

0       10

93.6    3.56    323.20  92.20   37.70   1.40    0.50    0.00    0.00    0.00    0.00
        0.00    #1995
70.2    0.00    146.90  464.10  24.00   9.90    3.20    1.60    0.00    0.00    0.00
        0.00    #1996
83.2    0.00    136.40  929.00  190.90  38.60   26.40   6.70    1.50    0.00    0.00
        0.00    #1997
```

```
89.6    0.34    69.00   287.70  515.60  48.00   7.30    4.30    3.00    1.60    0.00
        0.00    #1998
40.6    0.00    8.50    119.20  52.10   61.20   3.20    1.60    1.80    0.60    0.00
        0.00    #1999
64.1    0.00    100.10  80.40   30.60   26.20   37.00   4.90    0.00    0.00    0.00
        0.00    #2000
67.7    0.4     347.9   523.0   62.7    21.1    10.4    6.3     1.4     0.1     0.0
        0.0     #2001
90.4    0.2     38.9    495.4   322.3   36.0    3.9     7.3     3.2     0.6     0.0
        0.0     #2002
111.3   0.7     26.6    318.3   125.7   150.1   23.0    3.6     4.1     2.6     0.0
        0.0     #2003
92.0    0.0     7.8     204.5   207.1   84.4    34.4    2.4     0.8     0.6     0.3
        0.0     #2004
73.9    0.1     2.3     32.2    207.1   152.6   61.2    9.6     0.0     0.0     0.0
        0.0     #2005
65.9    0.0     32.4    117.6   111.7   222.8   44.3    5.4     0.9     0.0     0.0
        0.0     #2006
80.5    0.0     28.1    148.6   152.6   41.9    157.8   16.6    2.1     0.6     0.0
        0.2     #2007
66.3    0.0     176.4   232.2   120.1   74.2    22.5    38.2    8.2     0.5     0.0
        0.1     #2008
IR-7bj-OT : Irish Otter Trawl in 7B&J - effort, nos-at-age per 1000h
1995    2008

1       1       0       1

0       10

158.9   3.56    323.20  112.70  142.00  77.60   105.80  62.00   29.60   8.10    0.00
        0.00    #1995
111.7   0.00    166.30  557.40  54.10   39.90   21.10   23.10   9.40    5.10    0.80
        0.80    #1996
132.7   0.00    144.70  1124.2  307.80  68.10   58.20   25.80   15.00   4.10    5.30
        8.40    #1997
153.1   0.34    78.80   435.10  806.30  116.10  45.10   39.00   28.00   11.20   8.40
        0.90    #1998
102.7   0.00    8.90    312.80  277.90  252.10  52.80   13.90   7.80    3.00    0.70
        0.00    #1999
121.7   0.00    141.30  137.60  52.80   83.00   135.50  36.10   7.50    6.90    0.70
        0.00    #2000
128.4   0.4     368.1   812.0   135.6   35.0    52.9    66.7    8.8     8.3     2.0
        0.0     #2001
137.2   0.5     42.9    534.2   417.5   64.6    8.3     24.6    20.8    5.4     1.3
        0.6     #2002
175.2   0.7     28.8    340.0   167.9   216.9   38.1    12.6    14.7    13.0    2.5
        0.1     #2003
152.4   0.0     8.4     248.2   275.3   144.2   114.0   13.4    4.0     5.4     0.6
        0.2     #2004
121.3   0.1     12.1    92.9    271.6   210.1   93.9    11.7    1.6     1.0     0.3
        0.0     #2005
105.5   0.0     53.3    238.1   220.6   273.6   51.5    14.7    0.9     0.0     0.0
        0.0     #2006
```

```
121.2   0.0     28.1    212.0   217.5   87.2    227.3   31.5    10.0    0.6     0.0
        0.2     #2007
103.6   0.0     176.4   269.8   216.7   137.5   55.9    100.6   20.4    3.6     0.2
        0.1     #2008   580.3 t
IR-7g-ISCSGFS : Irish Sea Celtic Sea GFS (VIIg; Prime stations only) - effort,
nos-at-age per 30min
1997    2002

1       1       0.8     0.9

0       4

1       18.9    11.7    15.2    2.4     2.4     #1997

1       241.6   23.6    5.6     0.8     0.2     #1998

1       2465.2  6.6     0.4     0.4     0.1     #1999

1       1191.4  710.6   0.9     0.0     0.0     #2000

1       1200.9  34.5    13.7    0.0     0.0     #2001
1       560.9   119.9   8.5     2.8     0.2     #2002
IR-7bj-WCGFS : Irish Autumn WCGFS  - effort, nos-at-age per min
1993    2002
1       1       0.75    0.79
0       6
1901    6647    1307    86      52      7       6       0       #1993
2386    47261   727     111     68      5       7       0       #1994
2210    239176  6136    17      6       2       3       0       #1995
2248    37211   9305    333     141     28      22      0       #1996
2396    661     8679    526     249     88      120     0       #1997
2486    12340   601     685     451     50      31      0       #1998
2304    53123   808     22      66      7       18      0       #1999
2400    57484   14036   28      22      6       22      0       #2000
1107    45261   10419   6230    209     173     364     302     #2001
1301    141437  17366   2026    849     7       5       27      #2002
UK-7efghj-WCGFS-1gp : Standardised no <= 26 cm as proxy for 1-gp
1992    2001
1       1       0.15    0.25
1       1
1       1.7     #1992
1       19.8    #1993
1       33.4    #1994
1       20.8    #1995
1       145.9   #1996
1       26.7    #1997
1       7.1     #1998
1       9.3     #1999
1       19.6    #2000
1       15.6    #2001
UK-7efghj-WCGFS : Aged component - effort, nos-at-age per min
1998    2004
1       1       0.15    0.25
```

```
1       6
3744    380.3   245.8   170.3   51.0    9.5     10.9    #1998   Cirolana
3823    580.2   18.5    8.0     37.9    14.5    1.0     #1999   Cirolana
4092    1639.0  33.0    1.5     1.5     11.2    1.0     #2000   Cirolana
3700    949.9   335.5   33.1    0.0     1.5     4.5     #2001   Cirolana
3387    3995.1  317.5   100.8   13.8    2.1     0.0     #2002   Cirolana
2326    13655   947.1   75.3    45.7    4.6     0.0     #2003   Cirolana
1689    3334.1  7174.4  410.7   56.4    18.7    4.0     #2004   Cefas Endeavour
FR-7fghj-EVHOE: THALASSA - effort, nos-at-age per 30min
1997    2008
1       1       0.75    1
0       5
1       6.38    10.49   1.53    0.10    0.07    0.00    #1997
1       10.72   8.85    1.38    1.82    0.44    0.13    #1998
1       102.68  57.65   1.70    0.58    0.32    0.16    #1999
1       26.03   15.50   0.17    0.03    0.04    0.02    #2000
1       188.39  16.98   3.12    0.29    0.01    0.00    #2001
1       281.02  12.38   7.49    5.53    0.31    0.00    #2002
1       46.57   228.87  11.61   0.77    0.10    0.01    #2003
1       83.49   3.25    9.52    1.24    0.11    0.03    #2004
1       111.84  26.13   1.26    2.36    0.49    0.10    #2005
1       14.74   8.67    1.04    0.20    0.34    0.17    #2006
1       101.33  8.63    2.17    0.67    0.10    0.35    #2007
1       83.60   27.94   1.83    0.62    0.15    0.05    #2008
FR-7fgh-GAD : French Gadoid Trawlers in VIIfgh FU05 - effort, nos-at-age per
1000h
2002    2008
1       1       0       1
1       9
178.7   267.5   1518.8  1435.8  17.3    5.1     3.9     1.2     0.0     0.0
        #2002
144.2   124.8   3434.6  787.5   313.0   9.3     2.3     0.8     0.1     0.3
        #2003
119.4   0.0     2901.3  1909.1  219.5   102.0   4.5     0.1     0.1     1.0
        #2004
101.0   284.2   256.4   1353.4  457.6   109.0   24.8    1.0     4.8     0.0
        #2005
79.2    212.5   808.2   212.2   534.1   79.3    4.9     0.1     0.0     0.0
        #2006
83.9    69.9    2260.4  772.9   93.0    124.4   24.9    1.8     0.9     1.1
        #2007
70.0    415.7   1137.3  1601.4  235.5   22.1    46.2    3.7     0.6     0.0
        #2008
IR-7g-SAGFS : VIIg, Irish Sea Celtic Sea GFS +Irish Groundfish Survey (IBTS 4th
Qtr) - effort, nos-at-age per 10km2
1999    2008
1       1       0.8     0.9
0       8
10      4894    129     17      17      5       1       0       0       0
        #1999   ISCSGFS
10      1549    3038    25      0       0       0       0       0       0
        #2000   ISCSGFS
```

10 26150 1676 122 12 0 0 0 0 0
#2001 ISCSGFS
10 14484 2402 272 37 3 0 0 3 3
#2002 ISCSGFS
10 2819 6393 453 11 6 0 0 0 0
#2003 IBTS Q4
10 11248 1853 1302 78 6 3 0 0 0
#2004 IBTS Q4
10 12470 2204 140 106 16 1 0 0 0
#2005 IBTS Q4
10 3387 2102 240 21 6 2 1 0 0
#2006 IBTS Q4
10 9395 795 325 62 2 3 0 0 0
#2007 IBTS Q4
10 8871 3148 109 29 7 0 3 0 0
#2008 IBTS Q4
IR-7g-GFS : Irish Groundfish Survey in VIIg (IBTS 4th Qtr) - Haddock no.-@-age
2003 2008
1 1 0.79 0.92
0 7
832 3042 6975 489 11 6 0 0 0 #2003
980 14567 2400 1687 101 7 4 0 0 #2004
845 15997 2594 173 125 20 1 0 0 #2005
1046 5098 3163 361 32 9 3 1 0 #2006
1168 15557 1316 539 102 3 4 0 0 #2007
1139 12644 4487 156 41 9 0 4 0 #2008
IR-7j-GFS : Irish Groundfish Survey in VIIj (IBTS 4th Qtr) - Haddock no.-@-age
2003 2008
1 1 0.79 0.92
0 7
780 4592 16281 640 74 20 1 0 0 #2003
720 5175 1620 1395 44 7 4 1 0 #2004
881 1474 1273 240 286 36 6 2 0 #2005
901 2636 262 124 53 50 7 0 0 #2006
874 22831 2116 192 71 20 36 1 0 #2007
873 14056 4934 222 20 15 6 6 3 #2008
IR-7gj-GFS : Irish Groundfish Survey in VIIg & j (IBTS 4th Qtr) - Haddock no.-@-age
2003 2008
1 1 0.79 0.92
0 7
1612 7708 23095 1212 88 27 1 1 0 #2003
1740 19162 4533 3109 183 15 10 1 0 #2004
1726 16119 5196 433 413 56 6 2 0 #2005
1947 7776 3433 416 87 75 10 1 0 #2006
2042 38414 3527 611 171 26 38 1 0 #2007
2012 26721 9403 376 62 25 5 11 3 #2008
IR-7b-GFS : Irish Groundfish Survey in VIIb (IBTS 4th Qtr) - Haddock no.-@-age
2003 2008
1 1 0.79 0.92
0 8
757 11834 34773 2793 874 313 6 1 2 7
#2003

728	31311	2960	6688	925	372	196	46	2	1
	#2004								
724	3737	7082	964	2299	188	37	5	0	0
	#2005								
700	8823	2303	2471	614	421	39	16	7	0
	#2006								
734	56350	2383	770	747	434	392	26	9	0
	#2007								
653	10948	11622	398	148	172	98	273	54	4
	#2008								

Table 7.4.7. Lpue of haddock and effort for Irish Otter trawls, the French gadoid fleet and effort only for UK fleets. Lpue in kg/hour and effort in hours fishing.

	IRL OTB VIIb		IRL OTB VIIg		IRL OTB VIIj		FR GAD VIIfgh		JK Bean VIIe-k	UK Trawl VIIe-k
	LPUE	Effort	LPUE	Effort	LPUE	Effort	LPUE	Effort	Effort	Effort
1983							2.18	115379	135344	82054
1984							2.02	85790	131465	86722
1985							2.83	92012	152487	90298
1986							1.64	119664	135738	84748
1987							3.20	144186	177118	84267
1988							7.27	221164	194882	89148
1989							5.28	247929	198156	84140
1990							2.23	201349	207576	99492
1991							1.94	179381	203196	76712
1992							3.74	190784	196065	86397
1993							4.23	213508	208421	61903
1994							7.95	181031	220023	53743
1995	6.47	65423	1.48	63560	2.36	93688	9.12	184067	243136	52270
1996	4.51	41496	5.36	60041	3.36	70237	15.36	170141	260817	60509
1997	5.51	49560	5.82	65105	9.12	83187	19.58	226015	264814	66707
1998	7.00	63560	4.09	72298	6.49	89610	11.62	189457	254590	62114
1999	6.51	62047	2.34	51657	4.53	40609	5.05	206601	251431	98350
2000	5.05	62758	10.43	60604	4.68	64626	8.86	170292	258962	104088
2001	4.92	60725	8.34	69427	8.34	67659	16.39	190482	272662	85338
2002	3.42	46793	3.28	77689	6.49	90446	13.61	176678	249480	83023
2003	2.56	63959	3.28	86791	4.34	111267	22.01	144180	282097	72303
2004	3.13	60446	3.45	96991	3.94	91957	31.41	119444	273871	75681
2005	3.32	47399	4.42	124395	4.59	73920	21.48	101027	270347	76361
2006	3.58	39698	4.16	119227	5.07	65856	17.74	79214	252001	83308
2007	4.73	40718	4.10	136525	4.80	80485	22.62	83904	239921	87683
2008	5.45	37265	4.57	125605	5.69	66349	31.22	70044	216529	71100

Table 7.4.8. XSA diagnostics for haddock in VIIb–k.

```
Lowestoft VPA Version 3.1

   17/05/2009  15:07

 Extended Survivors Analysis

 HADDOCK VIIb-k  WGCSE 2009      COMBSEX         PLUSGROUP
 cpue data from file had7bktu.txt

 Catch data for  16 years. 1993 to 2008. Ages  0 to   8.


      Fleet                            First    Last    First   Last    Alpha
Beta
                                year     year     age     age
IR-7bj-OT : Irish O     1995    2008    2       7       0       1
FR-7fghj-EVHOE: THA     1997    2008    0       5       0.75    1
FR-7fgh-GAD : Frenc     2002    2008    2       6       0       1
IR-7g-SAGFS : VIIg      1999    2008    0       5       0.8     0.9

 Time series weights :
      Tapered time weighting not applied

 Catchability analysis :
      Catchability independent of stock size for all ages

      Catchability independent of age for ages >=    4

 Terminal population estimation :
      Survivor estimates shrunk towards the mean F of the final   5 years or the   3
oldest ages.
      S.E. of the mean to which the estimates  are shrunk =   1.500
      Minimum  standard  error  for  population  estimates  derived  from  each  fleet  =
.300
      Prior weighting not applied
 Tuning converged after   27 iterations
 Regression weights

        1       1       1       1       1       1       1       1       1       1

 Fishing mortalities

    Age 1999    2000    2001    2002    2003    2004    2005    2006    2007    2008

0       0       0       0       0       0       0       0       0       0       0
1       0.188   0.976   0.431   0.459   0.52    0.366   0.238   0.151   0.275
        0.613
2       0.971   1.405   0.758   1.079   0.931   0.722   0.673   0.443   0.59
        1.232
3       0.676   0.938   0.679   0.963   0.724   0.889   0.674   0.868   0.603
        0.691
```

4	0.68	0.536	0.93	1.444	0.833	0.721	0.913	0.585	0.565	0.407
5	0.486	0.554	0.626	0.324	0.775	1.592	0.9	0.429	0.439	0.498
6	0.469	0.542	0.611	0.38	0.591	1.016	1.805	0.304	0.3	0.34
7	0.387	0.236	0.407	0.29	0.368	0.33	0.189	0.48	0.218	0.206

XSA population numbers (Thousands)

AGE

YEAR	0	1	2	3	4	5	6	7
1999	83900	21000	5470	3530	3690	703	236	152
2000	42300	68700	14200	1700	1470	1530	354	121
2001	78800	34700	21200	2860	544	703	720	169
2002	85700	64500	18400	8130	1190	176	308	320
2003	19500	70200	33400	5130	2540	230	104	172
2004	25200	16000	34100	10800	2040	905	86.6	47.2
2005	44100	20600	9060	13600	3630	812	151	25.7
2006	38300	36100	13300	3790	5670	1190	270	20.3
2007	89900	31300	25400	7010	1300	2590	635	163
2008	64700	73600	19500	11500	3140	606	1360	385

Estimated population abundance at 1st Jan 2009

	0	52900	32600	4650	4730	1710	301	795

Taper weighted geometric mean of the VPA populations:

	37900	28700	14800	5280	2040	838	373	156

Standard error of the weighted Log(VPA populations) :

	0.6767	0.6806	0.606	0.6017	0.5443	0.6722	0.7597	0.9379

Log catchability residuals.

Fleet : IR-7bj-OT : Irish O

Age	1995	1996	1997	1998
0	No data for this fleet at this age			
1	No data for this fleet at this age			
2	-0.36	0.57	0.59	0.74
3	-0.38	-0.73	0.42	0.56
4	-0.64	-1.06	-0.21	0.04
5	0.09	-1.08	-0.1	0.17
6	0.39	-0.26	-0.47	0.38
7	0.01	-0.13	0.02	0.3

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	No data for this fleet at this age									
1	No data for this fleet at this age									

2	1.37	-0.41	0.66	0.44	-0.91	-1.19	-0.64	-0.04	-0.88	0.05
3	0.96	-0.03	0.23	0.36	-0.43	-0.47	-0.58	0.71	-0.17	-0.47
4	0.47	0.05	0.29	0.26	0.23	0.13	0.24	0.06	0.24	-0.1
5	0.48	0.51	0.32	-0.34	0.87	1.05	0.93	-0.12	0.45	0.69
6	0.23	0.64	0.52	0.21	0.47	1.03	0.87	0.05	-0.18	0.39
7	0.06	0.01	-0.14	-0.04	0.02	0.14	-0.01	-0.07	-0.01	0

Mean log-catchability and standard error of ages with catchability

independent of year-class strength and constant w.r.t. time

Age	2	3	4	5	6	7
Mean Log q	-8.335	-7.7293	-7.3802	-7.3802	-7.3802	-7.3802
S.E(Log q)	0.757	0.5398	0.4078	0.6403	0.5267	0.1093

Regression statistics :

Ages with q independent of year-class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.84	-1.411	7.21	0.19	14	1.34	-8.33
3	1.22	-0.734	7.53	0.49	14	0.67	-7.73
4	1.04	-0.177	7.37	0.66	14	0.44	-7.38
5	1.06	-0.233	7.12	0.58	14	0.63	-7.1
6	1.4	-2.251	7.54	0.73	14	0.51	-7.08
7	0.99	0.392	7.34	0.99	14	0.11	-7.37

Fleet : FR-7fghj-EVHOE: THA

Age	1995	1996	1997	1998
0	99.99	99.99	-0.67	-1.11
1	99.99	99.99	0.17	0.49
2	99.99	99.99	-0.98	0.11
3	99.99	99.99	-1.54	0.65
4	99.99	99.99	-0.43	1.28
5	99.99	99.99	99.99	1.15

6 No data for this fleet at this age

7 No data for this fleet at this age

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	-0.04	-0.73	0.63	0.95	0.63	0.96	0.69	-1.2	-0.12	0.02
1	1.41	-0.4	-0.1	-1.01	1.87	-1.04	0.68	-1.06	-0.81	-0.2
2	1.01	-1.88	0.08	1.37	1.09	0.68	-0.06	-0.83	-0.62	0.04
3	0.46	-1.55	-0.03	2.13	0.41	0.28	0.51	-0.51	-0.15	-0.65
4	0.2	-1.09	-1.14	1.96	-0.46	-0.24	0.84	-0.26	-0.03	-0.64

5 0.99 -1.81 99.99 99.99 -0.41 0.03 0.74 0.47 0.43 -0.01

6 No data for this fleet at this age

7 No data for this fleet at this age

Mean log-catchability and standard error of ages with catchability

independent of year-class strength and constant w.r.t. time

Age	0	1	2	3	4	5
Mean Log q	-6.4919	-6.9683	-8.0628	-8.4044	-8.78	-8.78
S.E(Log q)	0.7834	0.9688	0.9584	1.006	0.9363	0.915

Regression statistics :

Ages with q independent of year-class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	0.76	0.904	7.47	0.6	12	0.6	-6.49
1	1.17	-0.33	6.41	0.28	12	1.18	-6.97
2	1.04	-0.069	8	0.26	12	1.04	-8.06
3	0.6	1.521	8.52	0.59	12	0.57	-8.4
4	0.86	0.359	8.61	0.39	12	0.84	-8.78
5	1.14	-0.243	8.86	0.31	9	1.09	-8.6

Fleet : FR-7fgh-GAD : Frenc

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	99.99	99.99	99.99	-0.22	0.16	0.07	-0.88	0.02	0.41	0.44
3	99.99	99.99	99.99	-0.08	-0.11	0.29	-0.2	-0.45	0.05	0.5
4	99.99	99.99	99.99	-1.89	0.22	0.23	0.63	0.45	0.1	0.26
5	99.99	99.99	99.99	-1.66	-0.92	0.61	0.69	0.03	-0.35	-0.42
6	99.99	99.99	99.99	-2.46	-1.6	-0.38	1.23	-1.33	-0.62	-0.56
7	No data for this fleet at this age									

Mean log-catchability and standard error of ages with catchability

independent of year-class strength and constant w.r.t. time

Age	2	3	4	5	6

Mean Log q	-6.8925	-6.3116	-6.8127	-6.8127	-6.8127
S.E(Log q)	0.4505	0.3184	0.852	0.8898	1.4584

Regression statistics :

Ages with q independent of year-class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.61	2.188	8.08	0.86	7	0.21	-6.89
3	0.7	1.75	7.11	0.87	7	0.19	-6.31
4	0.49	2.098	7.32	0.77	7	0.33	-6.81
5	0.63	1.967	6.88	0.85	7	0.43	-7.1
6	1.11	-0.187	7.85	0.38	7	1.4	-7.63

Fleet : IR-7g-SAGFS : VIIg

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	-0.87	-1.34	0.87	0.19	0.04	1.16	0.71	-0.45	-0.29	-0.02
1	-2.19	0.45	0.08	-0.16	0.79	0.9	0.71	0.03	-0.7	0.11
2	-1.02	-1.22	-0.58	0.63	0.42	1.28	0.33	0.29	0.07	-0.21
3	-0.06	99.99	-0.2	0.12	-0.83	0.53	0.42	0.24	0.48	-0.7
4	-0.51	99.99	99.99	0.76	0.17	0.3	0.86	-0.84	-0.49	-0.25
5	-0.63	99.99	99.99	99.99	99.99	1.16	-0.42	-0.51	-0.87	99.99
6	No data for this fleet at this age									
7	No data for this fleet at this age									

Mean log-catchability and standard error of ages with catchability

independent of year-class strength and constant w.r.t. time

Age	0	1	2	3	4	5
Mean Log q	-4.1029	-4.8728	-6.064	-6.8311	-7.6449	-7.6449
S.E(Log q)	0.7805	0.9108	0.7689	0.498	0.6219	0.8567

Regression statistics :

Ages with q independent of year-class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	1.36	-0.531	1.67	0.21	10	1.11	-4.1
1	0.76	0.585	6.25	0.42	10	0.72	-4.87
2	0.57	1.878	7.63	0.71	10	0.39	-6.06
3	0.84	0.605	7.15	0.66	9	0.43	-6.83
4	1.84	-1.055	7.47	0.21	8	1.14	-7.64
5	2.31	-0.675	9.09	0.08	5	2.01	-7.9

```
 Terminal year survivor and F summaries :

 Age  0   Catchability constant w.r.t. time and dependent on age
 Year class = 2008
 Fleet                  Estimated          Int        Ext          Var     N
Scaled    Estimated
                        Survivors          s.e        s.e         Ratio
         Weights           F
IR-7bj-OT : Irish O     1       0       0       0       0       0       0
FR-7fghj-EVHOE: THA     53791   0.815   0       0       1       0.502   0
FR-7fgh-GAD : Frenc     1       0       0       0       0       0       0
IR-7g-SAGFS : VIIg      52096   0.819   0       0       1       0.498   0
  F shrinkage mean      0       1.5                             0       0
 Weighted prediction :
 Survivors              Int           Ext           N       Var      F
 at end of year    s.e        s.e                  Ratio
52940   0.58    0.02    2       0.028   0

 Age  1   Catchability constant w.r.t. time and dependent on age

 Year class = 2007
 Fleet                  Estimated          Int        Ext          Var     N
Scaled    Estimated
                        Survivors          s.e        s.e         Ratio
         Weights           F
IR-7bj-OT : Irish O     1       0       0       0       0       0       0
FR-7fghj-EVHOE: THA     28051   0.634   0.038   0.06    2       0.422   0.685
FR-7fgh-GAD : Frenc     1       0       0       0       0       0       0
IR-7g-SAGFS : VIIg      28956   0.622   0.196   0.32    2       0.439   0.67
  F shrinkage mean      75480   1.5                             0.139   0.312
 Weighted prediction :
 Survivors              Int           Ext           N       Var      F

 at end of year    s.e        s.e                  Ratio

32644   0.44    0.19    5       0.444   0.613

 Age  2   Catchability constant w.r.t. time and dependent on age
 Year class = 2006
 Fleet                  Estimated          Int        Ext          Var     N
Scaled    Estimated
                        Survivors          s.e        s.e         Ratio
         Weights           F
IR-7bj-OT : Irish O     4875    0.784   0       0       1       0.117   1.199
FR-7fghj-EVHOE: THA     2383    0.54    0.38    0.7     3       0.209   1.748
FR-7fgh-GAD : Frenc     7187    0.482   0       0       1       0.311   0.945
IR-7g-SAGFS : VIIg      3103    0.497   0.139   0.28    3       0.253   1.535
  F shrinkage mean      11652   1.5                             0.11    0.678
 Weighted prediction :
 Survivors              Int           Ext           N       Var      F

 at end of year    s.e        s.e                  Ratio
```

```
4651    0.29    0.21    9       0.73    1.232

 Age  3   Catchability constant w.r.t. time and dependent on age

 Year class = 2005
 Fleet                   Estimated          Int        Ext          Var     N
Scaled    Estimated
                         Survivors          s.e        s.e         Ratio
         Weights            F
IR-7bj-OT : Irish O     2696    0.469   0.168   0.36    2       0.168   1.01
FR-7fghj-EVHOE: THA     3325    0.503   0.377   0.75    4       0.109   0.882
FR-7fgh-GAD : Frenc     7663    0.286   0.037   0.13    2       0.452   0.479
IR-7g-SAGFS : VIIg      3357    0.379   0.292   0.77    4       0.234   0.877
   F shrinkage mean     4144    1.5                             0.036   0.759
 Weighted prediction :
 Survivors              Int           Ext           N       Var      F
 at end of year    s.e        s.e                  Ratio
4729    0.19    0.16    13      0.84    0.691

 Age  4   Catchability constant w.r.t. time and dependent on age

 Year class = 2004
 Fleet                   Estimated          Int        Ext          Var     N
Scaled    Estimated
                         Survivors          s.e        s.e         Ratio
         Weights            F
IR-7bj-OT : Irish O     1532    0.328   0.023   0.07    3       0.328   0.445
FR-7fghj-EVHOE: THA     1434    0.494   0.327   0.66    5       0.107   0.469
FR-7fgh-GAD : Frenc     1854    0.279   0.057   0.21    3       0.308   0.381
IR-7g-SAGFS : VIIg      2141    0.351   0.221   0.63    5       0.229   0.337
   F shrinkage mean     799     1.5                             0.028   0.73
 Weighted prediction :
 Survivors              Int           Ext           N       Var      F

 at end of year    s.e        s.e                  Ratio

1710    0.17    0.09    17      0.522   0.407

 Age  5   Catchability constant w.r.t. time and age (fixed at the value for age)  4

 Year class = 2003
 Fleet                   Estimated          Int        Ext          Var     N
Scaled    Estimated
                         Survivors          s.e        s.e         Ratio
         Weights            F
IR-7bj-OT : Irish O     462     0.322   0.17    0.53    4       0.394   0.352
FR-7fghj-EVHOE: THA     281     0.551   0.13    0.24    6       0.136   0.526
FR-7fgh-GAD : Frenc     200     0.327   0.152   0.46    4       0.268   0.679
IR-7g-SAGFS : VIIg      271     0.386   0.203   0.53    5       0.158   0.541
   F shrinkage mean     149     1.5                             0.045   0.836
 Weighted prediction :
 Survivors              Int           Ext           N       Var      F
```

```
 at end of year    s.e        s.e                    Ratio

301     0.19    0.11    20      0.57    0.498

Age   6   Catchability constant w.r.t. time and age (fixed at the value for age)  4

 Year class = 2002
 Fleet                  Estimated          Int        Ext          Var     N
Scaled    Estimated
                        Survivors          s.e        s.e         Ratio
         Weights            F
IR-7bj-OT : Irish O     980     0.3     0.171   0.57    5       0.483   0.284
FR-7fghj-EVHOE: THA     1135    0.543   0.205   0.38    6       0.093   0.25
FR-7fgh-GAD : Frenc     673     0.33    0.14    0.42    5       0.225   0.391
IR-7g-SAGFS : VIIg      572     0.382   0.317   0.83    6       0.159   0.447
   F shrinkage mean     257     1.5                             0.04    0.811
 Weighted prediction :
 Survivors              Int           Ext           N       Var      F
 at end of year    s.e        s.e                    Ratio
795     0.19    0.11    23      0.595   0.34

 Age   7   Catchability constant w.r.t. time and age (fixed at the value for age)  4

 Year class = 2001
 Fleet                  Estimated          Int        Ext          Var     N
Scaled    Estimated
                        Survivors          s.e        s.e         Ratio
         Weights            F
IR-7bj-OT : Irish O     248     0.23    0.055   0.24    6       0.774   0.212
FR-7fghj-EVHOE: THA     440     0.623   0.137   0.22    6       0.042   0.126
FR-7fgh-GAD : Frenc     285     0.405   0.182   0.45    5       0.091   0.188
IR-7g-SAGFS : VIIg      318     0.444   0.275   0.62    6       0.066   0.169
   F shrinkage mean     113     1.5                             0.026   0.418
 Weighted prediction :
 Survivors              Int           Ext           N       Var      F

 at end of year    s.e        s.e                    Ratio

257     0.19    0.06    24      0.325   0.206
```

Table 7.4.9. Stock Summary for haddock in VIIb–k

Year	Recruits age 0	TotBio	SSB	Landings	Yield/ SSB	Fbar 2-5
1993	14206	15468	11436	3348	0.293	0.502
1994	35624	19018	13237	4131	0.312	0.420
1995	54688	23378	12087	4470	0.370	0.396
1996	22150	31272	18837	6756	0.359	0.571
1997	9841	25050	21196	10827	0.511	0.815
1998	25654	18965	15693	7668	0.489	0.778
1999	83909	20276	10207	4882	0.478	0.703
2000	42324	29661	13248	7411	0.559	0.858
2001	78822	28988	15041	8632	0.574	0.748
2002	85691	35446	17371	6403	0.369	0.953
2003	19488	35745	20271	8146	0.402	0.815
2004	25212	28618	23832	8581	0.360	0.981
2005	44066	25346	17297	6555	0.379	0.790
2006	38272	26602	15175	5383	0.355	0.581
2007	89884	34516	20703	6510	0.314	0.549
2008	64661	41941	21537	7013	0.326	0.707

Table 7.4.10. Input values for short-term forecast.

MFDP version 1a
Run: HAD
Time and date: 17:11 15/05/2009
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

2009

Age	N	M	Mat	PF	PM	SWt
0	45906	0.2	0	0	0	7.73E-02
1	52940	0.2	0	0	0	0.221333
2	32644	0.2	1	0	0	0.399333
3	4651	0.2	1	0	0	0.583
4	4729	0.2	1	0	0	0.896
5	1710	0.2	1	0	0	1.356333
6	301	0.2	1	0	0	1.870667
7	795	0.2	1	0	0	2.197
8	304	0.2	1	0	0	3.203667

CATCH

Age	Sel	CWt	DSel	DCWt
0	0	0	0	0.076
1	0.028145	0.352	0.318188	0.222
2	0.358585	0.489333	0.396748	0.457667
3	0.573331	0.619333	0.147336	0.514
4	0.497483	0.899667	2.15E-02	0.3
5	0.454785	1.275	8.81E-04	6.87E-02
6	0.314667	1.671667	0	0
7	0.301667	1.920333	0	0
8	0.301667	2.895	0	0

2010

Age	N	M	Mat	PF	PM	SWt
0	45906	0.2	0	0	0	7.73E-02
1	.	0.2	0	0	0	0.221333
2	.	0.2	1	0	0	0.399333
3	.	0.2	1	0	0	0.583
4	.	0.2	1	0	0	0.896
5	.	0.2	1	0	0	1.356333
6	.	0.2	1	0	0	1.870667
7	.	0.2	1	0	0	2.197
8	.	0.2	1	0	0	3.203667

CATCH

Age	Sel	CWt	DSel	DCWt
0	0	0	0	0.076
1	0.028145	0.352	0.318188	0.222
2	0.358585	0.489333	0.396748	0.457667
3	0.573331	0.619333	0.147336	0.514
4	0.497483	0.899667	2.15E-02	0.3
5	0.454785	1.275	8.81E-04	6.87E-02
6	0.314667	1.671667	0	0
7	0.301667	1.920333	0	0
8	0.301667	2.895	0	0

2011

Age	N	M	Mat	PF	PM	SWt
0	45906	0.2	0	0	0	7.73E-02
1	.	0.2	0	0	0	0.221333
2	.	0.2	1	0	0	0.399333
3	.	0.2	1	0	0	0.583
4	.	0.2	1	0	0	0.896
5	.	0.2	1	0	0	1.356333
6	.	0.2	1	0	0	1.870667
7	.	0.2	1	0	0	2.197
8	.	0.2	1	0	0	3.203667

CATCH

Age	Sel	CWt	DSel	DCWt
0	0	0	0	0.076
1	0.028145	0.352	0.318188	0.222
2	0.358585	0.489333	0.396748	0.457667
3	0.573331	0.619333	0.147336	0.514
4	0.497483	0.899667	2.15E-02	0.3
5	0.454785	1.275	8.81E-04	6.87E-02
6	0.314667	1.671667	0	0
7	0.301667	1.920333	0	0
8	0.301667	2.895	0	0

Input units are thousands and kg - output in tonnes

Table 7.4.11. Management options table.

MFDP version 1a
Run: HAD
Time and date: 17:11 15/05/2009
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

2009

Biomass	SSB	"CATCH" FMult	Landings FBar	Yield	Discards FBar	Yield	Total Yield
40855	25587	1.0000	0.4710	8104	0.1416	6951	15055

2010								2011	
Biomass	SSB	"CATCH" FMult	Landings FBar	Landing Yield	Discards FBar	Discard Yield	Total Yield	Biomass	SSB
40404	28536	0.0000	0.0000	0	0.0000	0	0	57402	45533
.	28536	0.1000	0.0471	1188	0.0142	808	1996	54902	43033
.	28536	0.2000	0.0942	2305	0.0283	1567	3872	52554	40685
.	28536	0.3000	0.1413	3354	0.0425	2283	5637	50348	38479
.	28536	0.4000	0.1884	4339	0.0566	2956	7295	48275	36406
.	28536	0.5000	0.2355	5266	0.0708	3591	8857	46326	34457
.	28536	0.6000	0.2826	6138	0.0850	4189	10327	44493	32625
.	28536	0.7000	0.3297	6958	0.0991	4753	11711	42770	30901
.	28536	0.8000	0.3768	7730	0.1133	5285	13015	41148	29279
.	28536	0.9000	0.4239	8457	0.1275	5787	14244	39621	27752
.	28536	1.0000	0.4710	9141	0.1416	6261	15402	38183	26314
.	28536	1.1000	0.5182	9786	0.1558	6709	16495	36829	24960
.	28536	1.2000	0.5653	10393	0.1699	7132	17525	35553	23685
.	28536	1.3000	0.6124	10966	0.1841	7531	18497	34351	22482
.	28536	1.4000	0.6595	11506	0.1983	7910	19416	33217	21349
.	28536	1.5000	0.7066	12015	0.2124	8267	20282	32148	20279
.	28536	1.6000	0.7537	12496	0.2266	8606	21102	31139	19270
.	28536	1.7000	0.8008	12950	0.2408	8927	21877	30187	18318
.	28536	1.8000	0.8479	13379	0.2549	9231	22610	29288	17419
.	28536	1.9000	0.8950	13784	0.2691	9519	23303	28439	16570
.	28536	2.0000	0.9421	14167	0.2832	9792	23959	27637	15768

Input units are thousands and kg - output in tonnes

Table 7.4.12. Yield-per-recruit summary table.

MFYPR version 2a
Run: HAD
Time and date: 17:12 15/05/2009
Yield per results

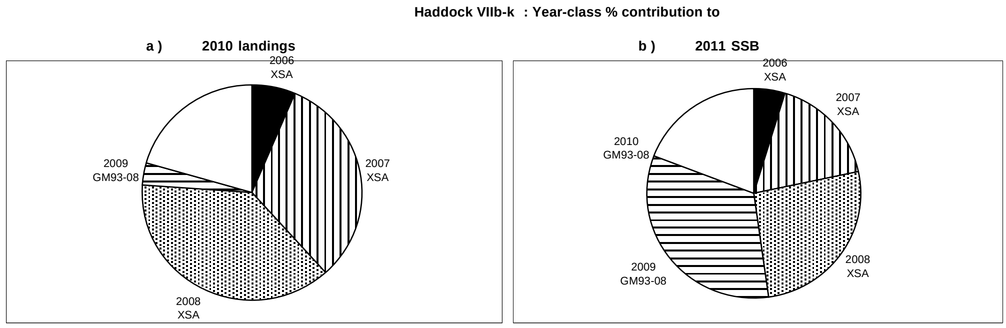
"CATCH" FMult	Landings Fbar	CatchNos	Landing Yield	Discards Fbar	CatchNos	Discard Yield	Total Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	5.5167	6.4212	3.6979	6.1626	3.6979	6.1626
0.1000	0.0471	0.1053	0.1302	0.0142	0.0528	0.0189	0.1491	4.7297	4.5931	2.9110	4.3346	2.9110	4.3346
0.2000	0.0942	0.1697	0.1915	0.0283	0.0997	0.0353	0.2268	4.1765	3.3957	2.3577	3.1371	2.3577	3.1371
0.3000	0.1413	0.2090	0.2165	0.0425	0.1416	0.0495	0.2660	3.7743	2.5879	1.9556	2.3293	1.9556	2.3293
0.4000	0.1884	0.2322	0.2222	0.0566	0.1793	0.0619	0.2841	3.4738	2.0294	1.6551	1.7708	1.6551	1.7708
0.5000	0.2355	0.2452	0.2180	0.0708	0.2131	0.0727	0.2907	3.2438	1.6349	1.4251	1.3763	1.4251	1.3763
0.6000	0.2826	0.2513	0.2090	0.0850	0.2437	0.0821	0.2911	3.0640	1.3509	1.2453	1.0923	1.2453	1.0923
0.7000	0.3297	0.2530	0.1980	0.0991	0.2714	0.0903	0.2883	2.9208	1.1427	1.1021	0.8842	1.1021	0.8842
0.8000	0.3768	0.2518	0.1865	0.1133	0.2966	0.0975	0.2840	2.8047	0.9876	0.9860	0.7290	0.9860	0.7290
0.9000	0.4239	0.2487	0.1752	0.1275	0.3195	0.1038	0.2790	2.7092	0.8701	0.8905	0.6116	0.8905	0.6116
1.0000	0.4710	0.2443	0.1645	0.1416	0.3406	0.1094	0.2739	2.6294	0.7798	0.8107	0.5212	0.8107	0.5212
1.1000	0.5182	0.2392	0.1547	0.1558	0.3599	0.1143	0.2690	2.5620	0.7092	0.7432	0.4507	0.7432	0.4507
1.2000	0.5653	0.2336	0.1457	0.1699	0.3777	0.1186	0.2643	2.5042	0.6534	0.6855	0.3948	0.6855	0.3948
1.3000	0.6124	0.2278	0.1376	0.1841	0.3941	0.1224	0.2600	2.4543	0.6085	0.6355	0.3499	0.6355	0.3499
1.4000	0.6595	0.2219	0.1302	0.1983	0.4093	0.1258	0.2560	2.4106	0.5719	0.5919	0.3134	0.5919	0.3134
1.5000	0.7066	0.2161	0.1236	0.2124	0.4234	0.1288	0.2524	2.3721	0.5418	0.5534	0.2832	0.5534	0.2832
1.6000	0.7537	0.2104	0.1175	0.2266	0.4365	0.1314	0.2489	2.3379	0.5165	0.5192	0.2580	0.5192	0.2580
1.7000	0.8008	0.2048	0.1120	0.2408	0.4488	0.1338	0.2458	2.3073	0.4952	0.4886	0.2366	0.4886	0.2366
1.8000	0.8479	0.1994	0.1070	0.2549	0.4603	0.1359	0.2429	2.2797	0.4769	0.4610	0.2184	0.4610	0.2184
1.9000	0.8950	0.1942	0.1025	0.2691	0.4710	0.1377	0.2402	2.2546	0.4611	0.4359	0.2026	0.4359	0.2026
2.0000	0.9421	0.1892	0.0983	0.2832	0.4811	0.1394	0.2377	2.2318	0.4474	0.4131	0.1888	0.4131	0.1888

Reference point	F multiplier	Absolute F
Landings Fbar(2-5)	1.0000	0.4710
Discards Fbar(2-5)	1.0000	0.1416
Catches Fbar(2-5)	1.0000	0.6126
FMax	0.3967	0.1868
F0.1	0.2756	0.1298
F35%SPR	0.3272	0.1541

Table 7.4.13. Haddock VIIbk. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes.

Year-class	2006	2007	2008	2009	2010
Stock No. (thousands) of 0 year-olds	38272	89884	64661	45906	45906
Source	XSA	XSA	XSA	GM93-08	GM93-08
Status Quo F:					
% in 2009 landings	13.3	45.5	5.0	0.0	-
% in 2010	6.5	31.9	37.9	3.1	0.0
% in 2009 SSB	10.6	50.9	0.0	0.0	-
% in 2010 SSB	5.8	25.7	42.9	0.0	0.0
% in 2011 SSB	4.7	17.0	26.1	33.0	0.0

GM : geometric mean recruitment



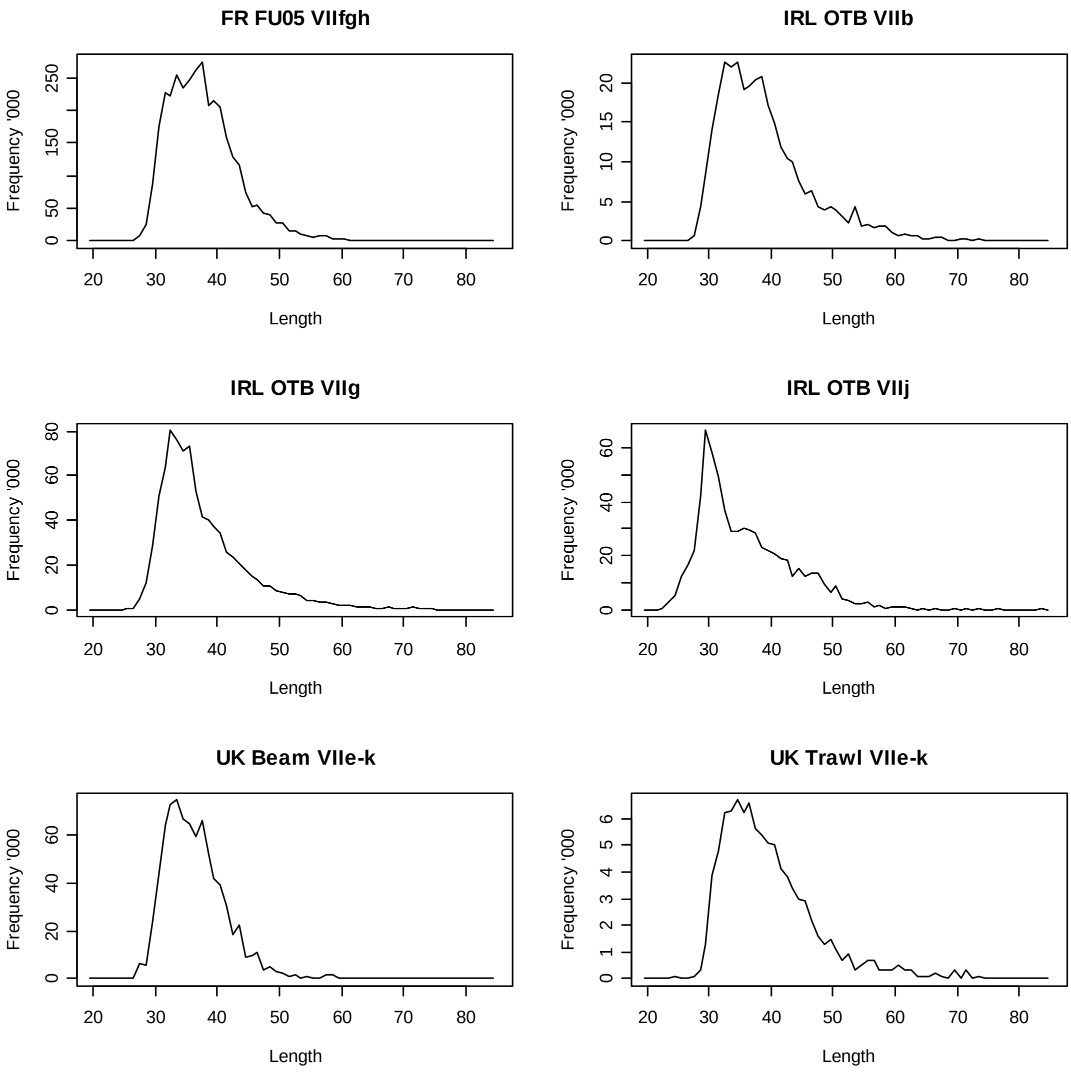


Figure 7.4.1. Length distributions of the landings of haddock in VIIb–k in 2007. FR FU05 is the French Gadoid fleet; IRL OTB is the Irish otter trawl fleet; UK beam is the UK beam trawl fleet and UK trawl is all trawls except beam trawls.

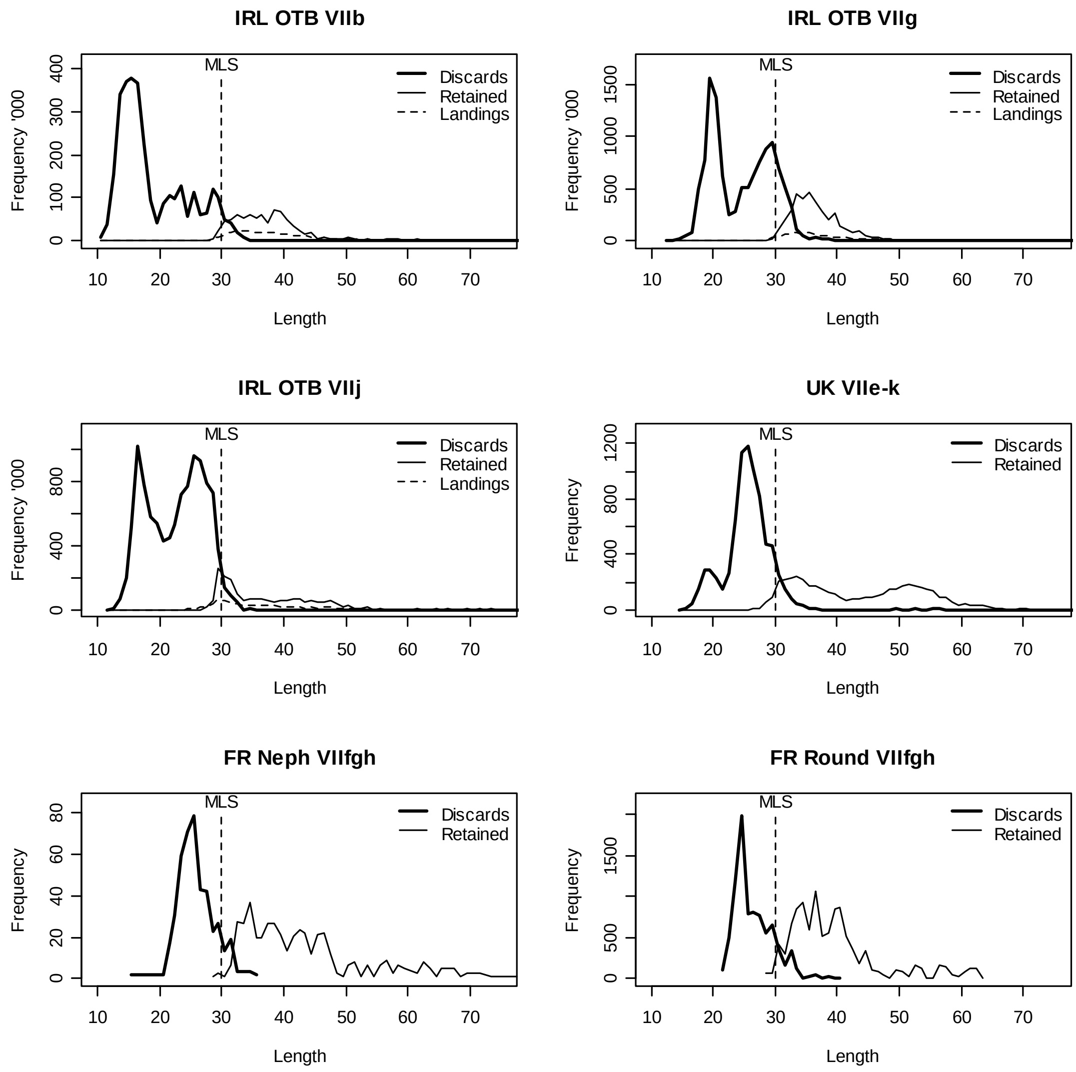


Figure 7.4.2. Length distributions of discards and the retained catch of haddock in VIIb–k for Irish otter trawl, French *Nephrops* and roundfish fleets and UK fleets. Irish data were raised to total numbers, the length distributions of the landings (from port sampling) is given for comparison.

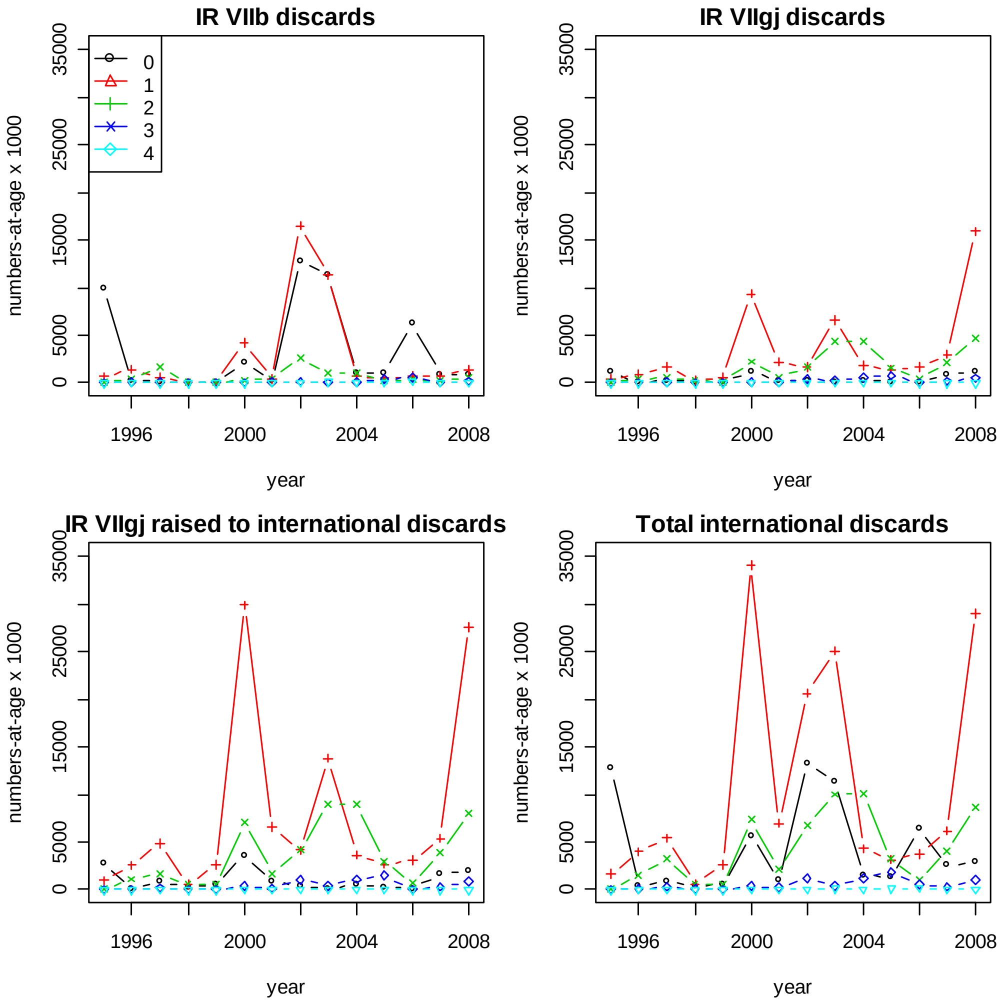


Figure 7.4.3. Numbers-at-age of Irish Discards of haddock in VIIb and VIIgj. The Irish discards in VIIgj were raised to international levels using effort as auxiliary variable.

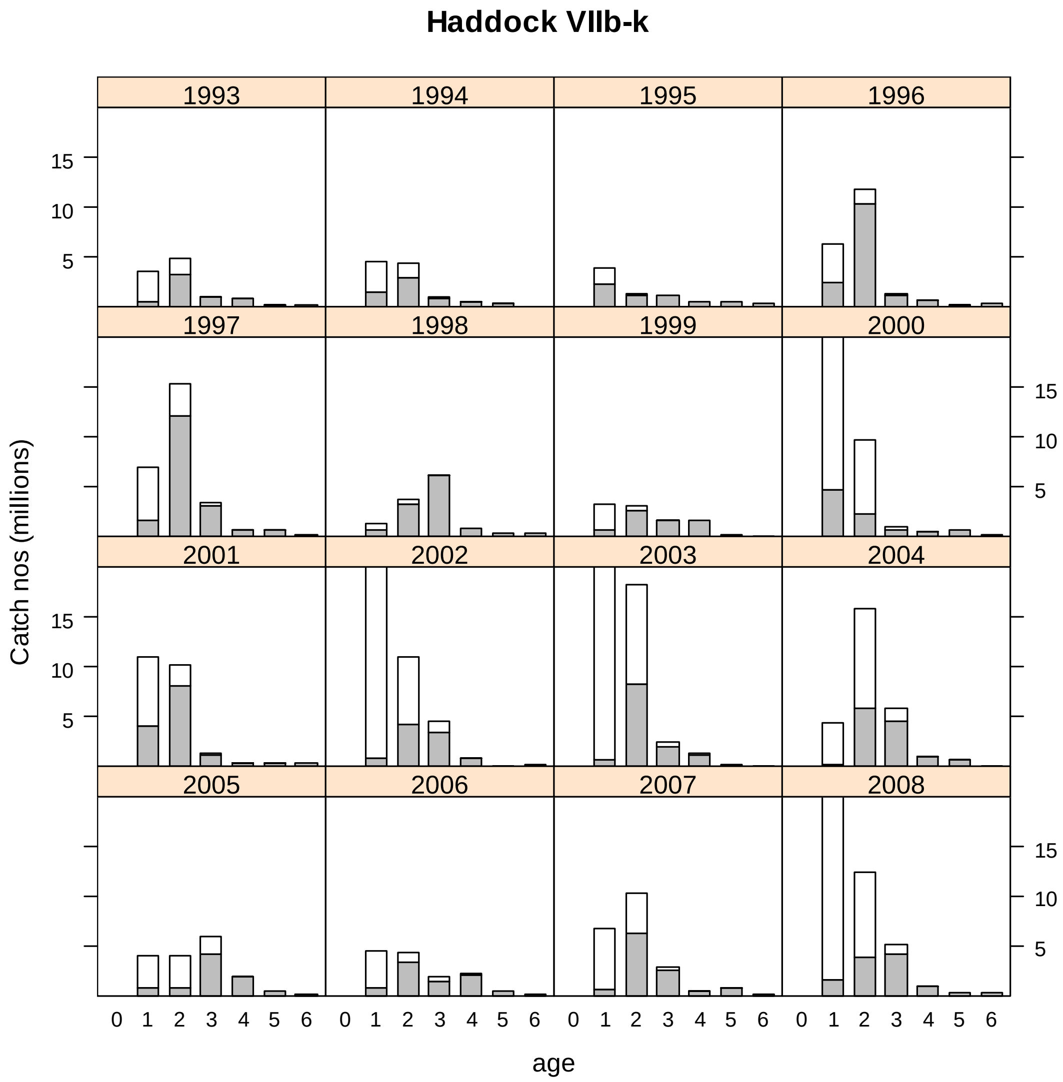


Figure 7.4.4. Age composition of the landings (grey) and discards (white).

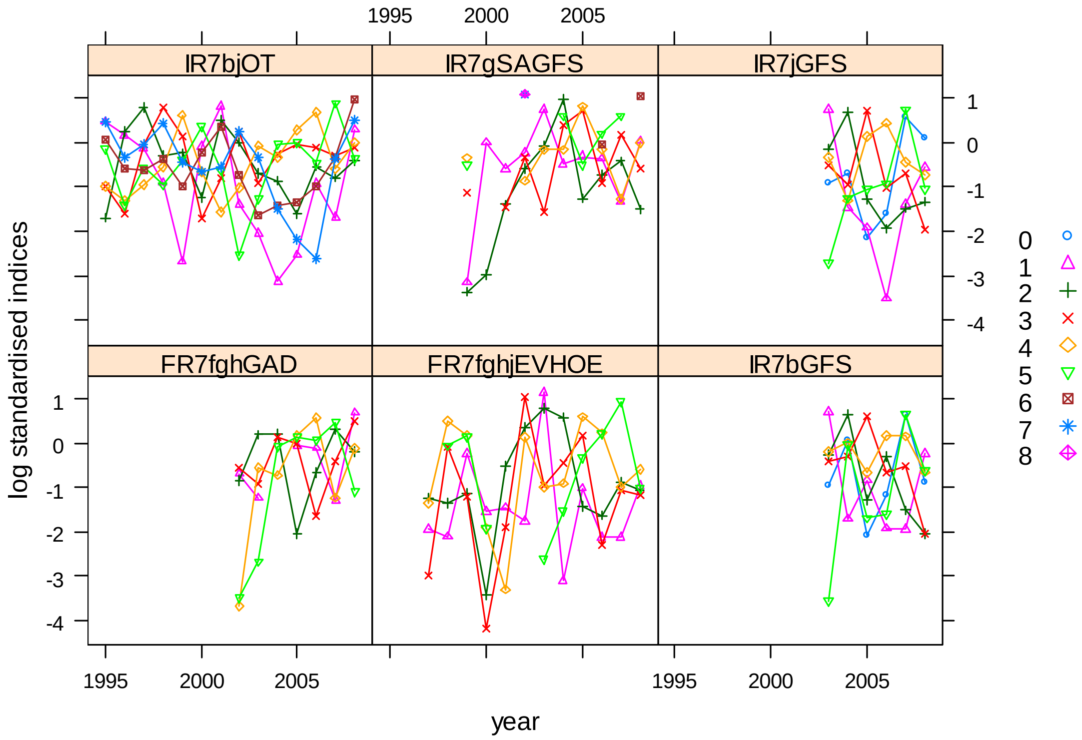


Figure 7.4.5. Log standardized indices of tuning fleets by year. The IR7bGFS and IR7jGFS were not used in the assessment. See stock annex for a description of the fleets.

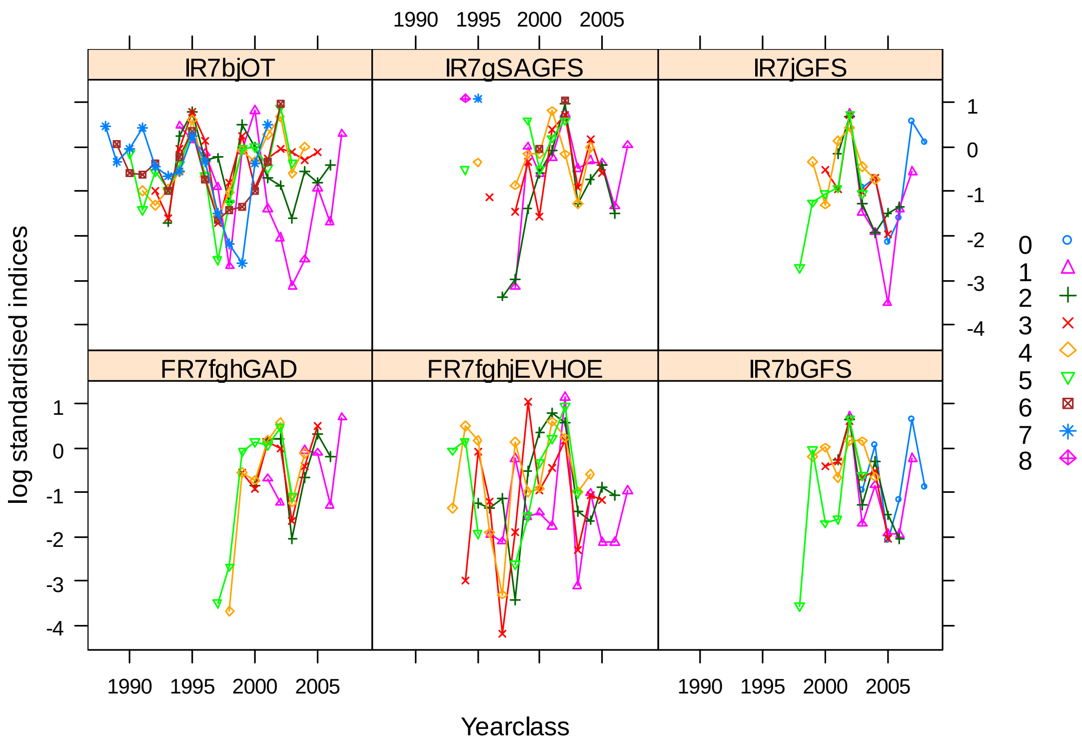


Figure 7.4.6. Log standardized indices of tuning fleets by year. The IR7bGFS and IR7gjGFS were not used in the assessment. See stock annex for a description of the fleets.

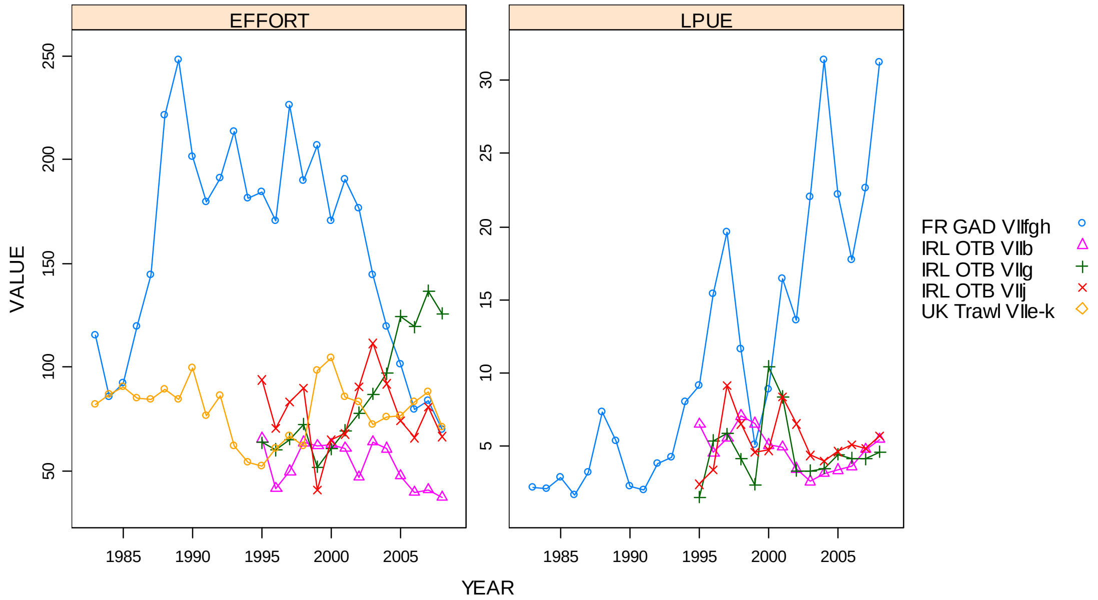


Figure 7.4.7. Lpue of haddock and effort for Irish Otter trawl fleets, the French gadoid fleet and effort only for UK trawl (all trawl gears except beam trawl) fleet.

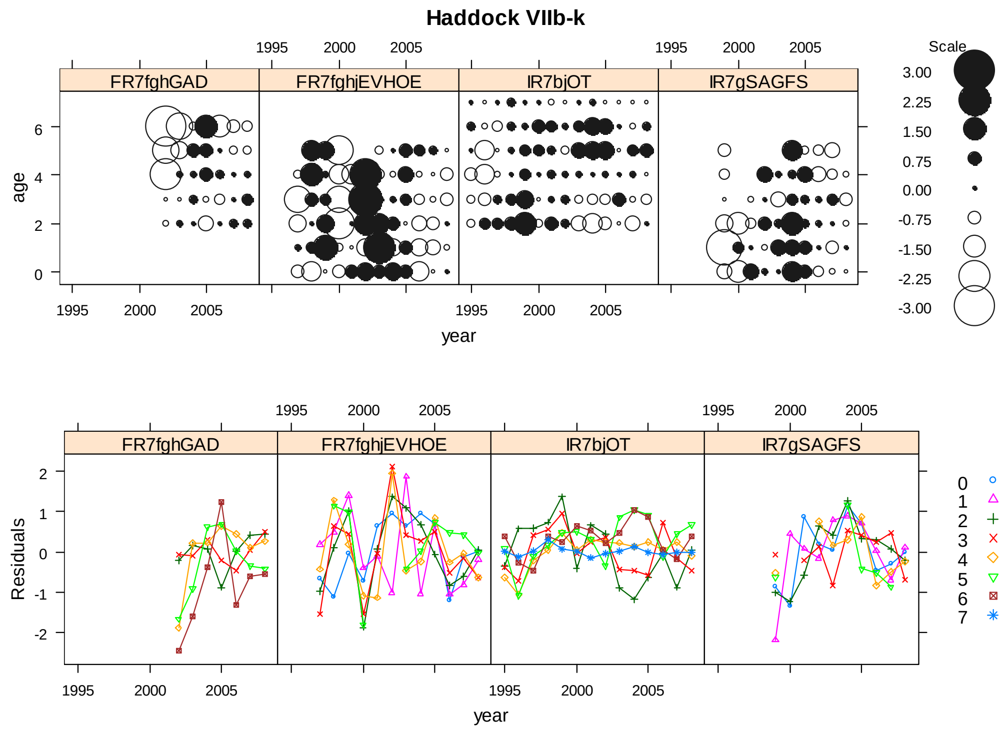


Figure 7.4.8. Log catchability residual plots of the tuning fleets used in the assessment.

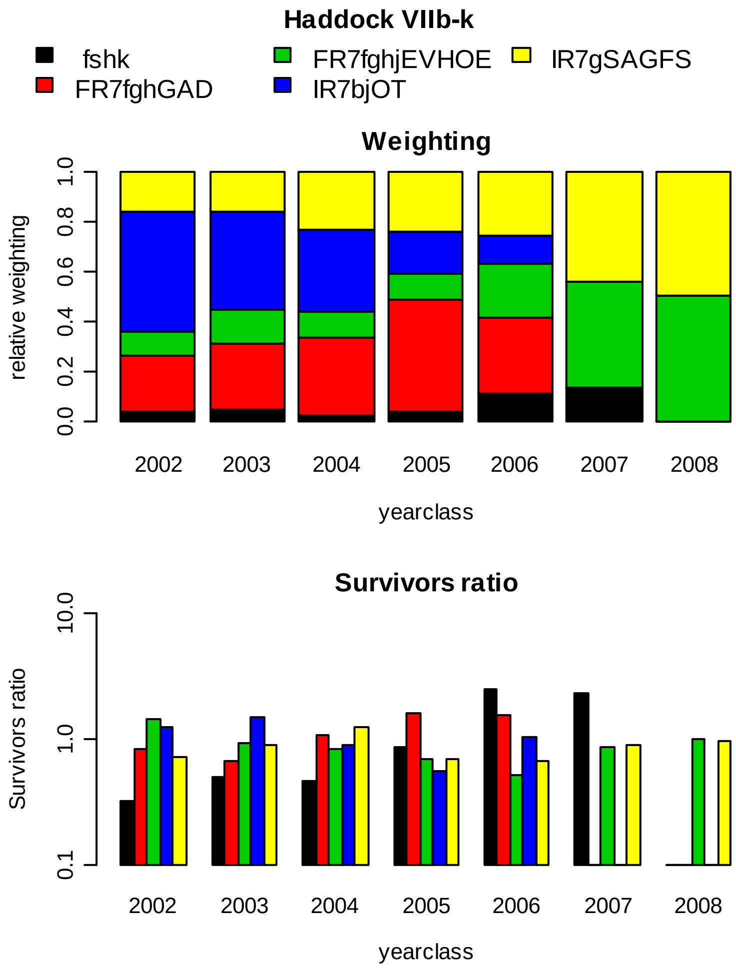


Figure 7.4.9. Scaled weights and survivor estimates. Note that the survivors' ratio is plotted on a log scale.

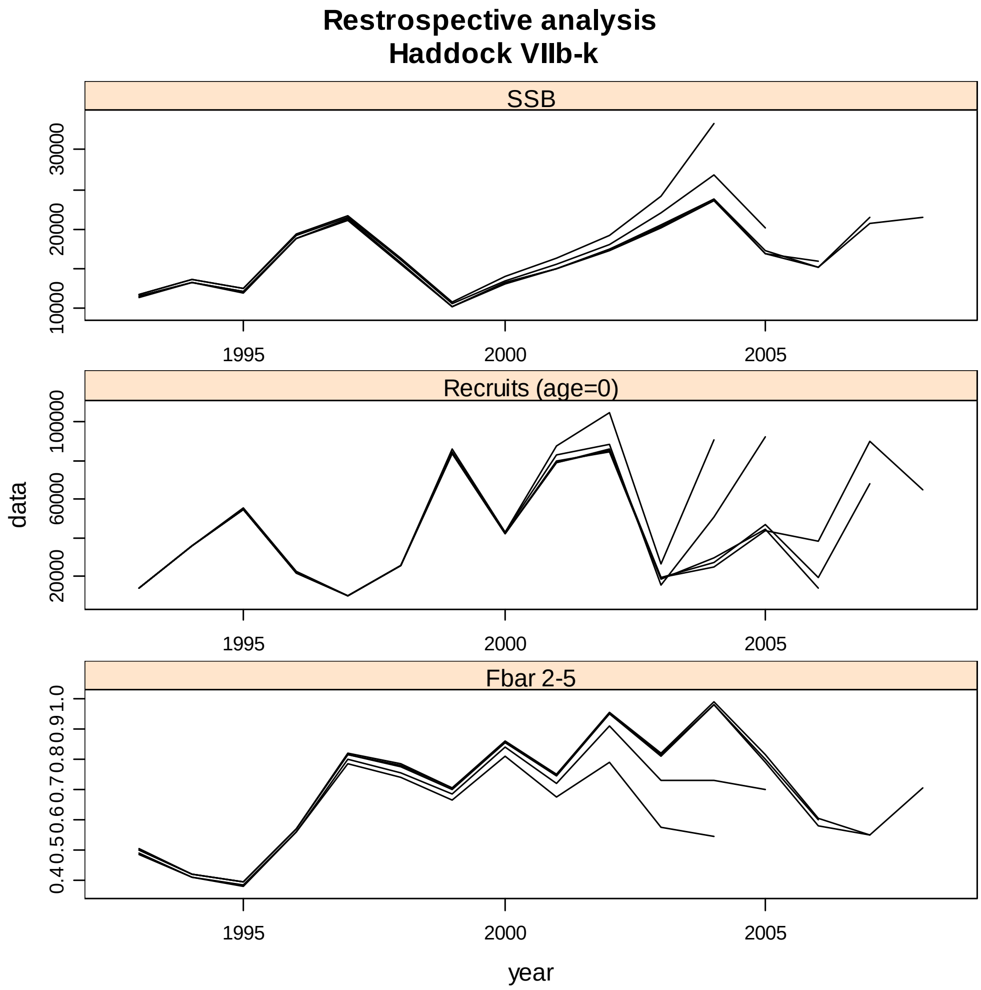


Figure 7.4.10. Retrospective XSA analysis.

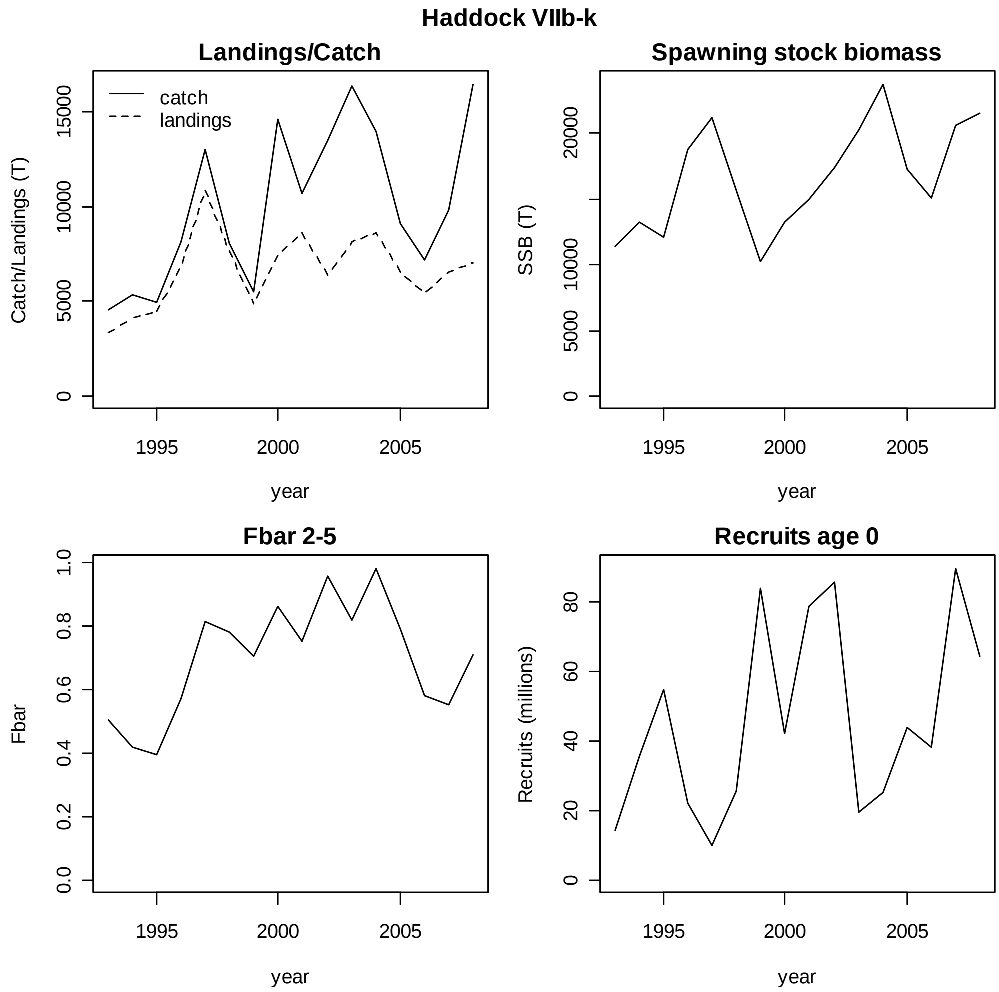
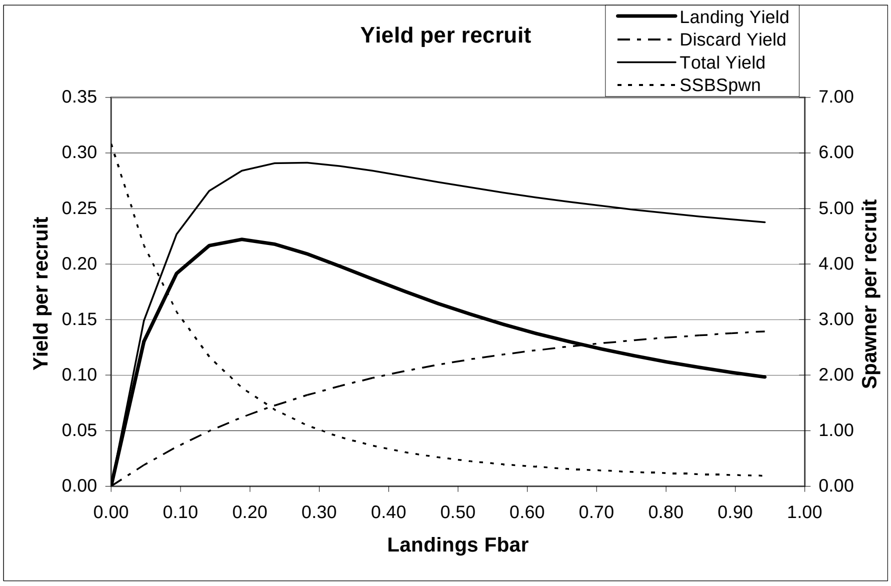


Figure 7.4.11. Stock summary plot.



MFYPR version 2a
Run: HAD
Time and date: 17:12 15/05/2009

Reference point	F multiplier	Absolute F
Landings Fbar(2-5)	1.0000	0.4710
Discards Fbar(2-5)	1.0000	0.1416
Catch F-bar(2-5)	1.0000	0.6126
FMax	0.3967	0.1868
F0.1	0.2756	0.1298
F35%SPR	0.3272	0.1541

Weights in kilograms

Figure 7.4.12. Yield-per-recruit and SSB for a range of landings Fbar.

Figure 7.4.13. Survey indices of recruitment-at-age 0. The EVHOE and SAGFS were used as tuning fleets. The IR GFS fleets are currently not used.

7.5 *Nephrops* in Division VIIb (Aran Grounds, FU17)

Type of assessment in 2009

UWTV based assessment using WKNEPH 2009 protocol as described in the stock annex. Further description on the background is presented in Section 7.5.2.

ICES advice applicable to 2008

Exploitation boundaries in relation to precautionary limits/considerations

This stock was not reviewed in 2008; the advice for 2008 is equivalent to that previously expressed by ICES. "*There are no exploitation boundaries for this stock. Although the total reported landings appear relative stable for FUs 16, 17, 18, and 19 combined (~3500 t), there have been large changes in fishing effort and landings for individual stocks. Furthermore, landings may be unreliable for some countries. This may lead to unbalanced exploitation of stocks and overfishing. ICES therefore advises that these Nephrops fisheries should be constrained to recent levels of effort at an appropriate geographical scale (FU).*"

ICES advice applicable to 2009

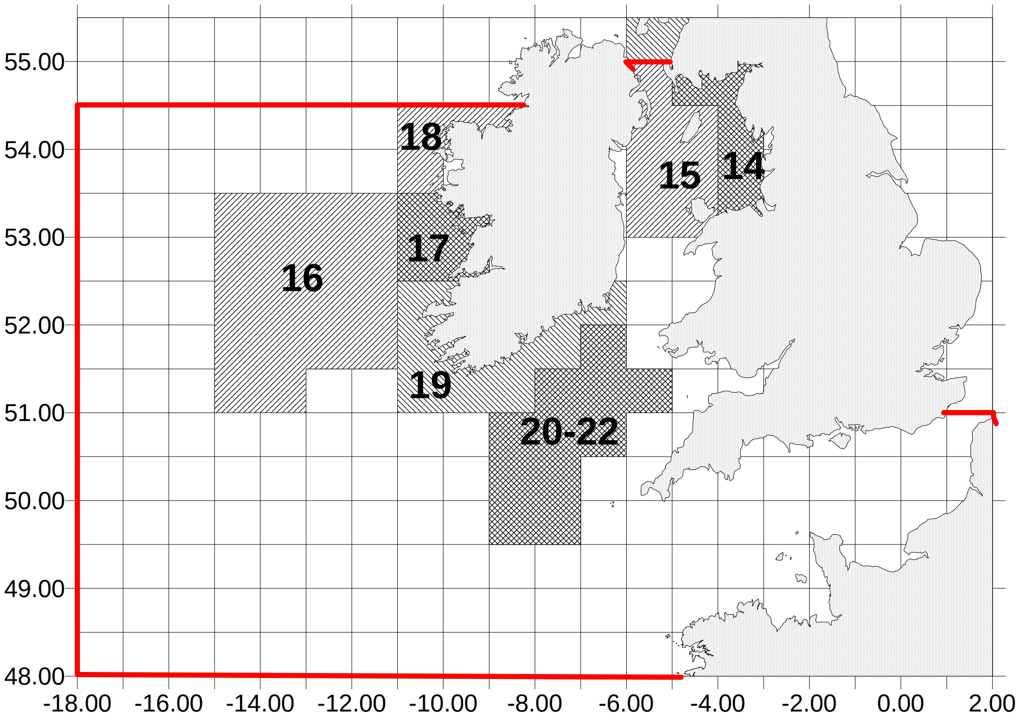
Exploitation boundaries in relation to precautionary limits/considerations

"*The current fishery appears sustainable. Therefore, ICES recommends that Nephrops fisheries should not be allowed to increase relative to 2007. This corresponds to landings of no more than 900 tonnes for the Aran Grounds (FU 17).*"

7.5.1 General

Stock description and management units

The Aran Grounds *Nephrops* stock (FU17) covers ICES rectangles 34–35 D9–E0 within VIIb. This stock is included as part of the TAC area VII *Nephrops* which includes the following stocks: Irish Sea East and West (FU14, FU15), Porcupine Bank (FU16), North-West Irish Coast (FU18), South-East and South-West Irish Coast (FU19) and the Celtic Sea (FU20–22).



The TAC for Subarea VII is bounded by the red line. The FUs with the TAC area are shaded.

The TAC is set for Subarea VII which does not correspond to the stock area. There is no evidence that the individual functional units belong to the same stock. The 2009 TAC is 24 650t, 2% less than the 2008 TAC. No FU17 specific restrictions in TAC apply thus, up to 100% of the Area VII TAC could, in theory be taken within FU17.

Management applicable to 2008 and 2009

TAC in 2008

Species: Norway lobster *Nephrops norvegicus*		Zone: VII NEP/07.
Spain	1 509	
France	6 116	
Ireland	9 277	
United Kingdom	8 251	
EC	25 153	
TAC	25 153	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TAC in 2009

Species: Norway lobster *Nephrops norvegicus*		Zone: VII (NEP/07.)
Spain	1 479	
France	5 994	
Ireland	9 091	
United Kingdom	8 086	
EC	24 650	
TAC	24 650	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

The MLS implemented by EC is set at 25 mm CL *i.e.* 8.5 cm total length and this regulation is applied by the Irish and UK fleets whereas a more restrictive regulation adopted by the French Producers' Organisations (35 mm CL *i.e.* 11.5 cm total length) is applied by the French trawlers.

Ecosystem aspects

This section is detailed in Stock Annex.

Fishery description

Since 1996 the Republic of Ireland fleet had over 99% of the landings from this FU. A description of the fleet is given in the Stock Annex. 54 Irish vessels reported landings from this FU in 2008. This is about 12% increase compared with the number of vessels reporting in 2007. However, only 26 of these vessels reported landings in excess of 10 t. The majority of these vessels are based in the port of Ros-a-Mhíl. Typical vessel length is 13–38 m and engine power ranges from 120–870 kW. The majority of the landings are made with 80 mm mesh. Fishing trips usually last 3-7 days. The most recent change in the fishery is the proportion of twinrig vessels, which has increased to over 90% of the fleet in the past ten years. In 2008 the fuel crisis meant that some vessels started to minimize their fuel costs by restricting trawling to the dawn and dusk period when the *Nephrops* emerge from their burrows.

The majority of the landings come from the grounds to the west and southwest of the Aran Islands known as the 'back of the Aran's ground' (See Stock Annex). The fishery on the Aran Grounds operates throughout the year, weather permitting with a seasonal trend (Figure 7.5.7).

7.5.2 Data

Sampling of landings and discards resumed in 2008 after a break of two years (2006–2007) in the sampling programme. This break was as a result of non-cooperation with sampling by the fishing industry. Sampling levels are also detailed Section 2 (Table 2.1). Historical data availability and quality is reported in Stock Annex (Section B).

Landings

The reported landings time-series is shown in Figure 7.5.1and Table 7.5.1. The reported Irish landings from FU17 have fluctuated around 800 t in the recent years. There is concern about the accuracy of reported landings statistics for *Nephrops* by Irish vessels as a result of restrictive quotas and various misreporting practices. The introduction of sales notes and increased control and enforcement since 2007 should improve the accuracy of reported landings data. The TAC was increased in 2007 and 2008 this has led to an increase in reported landings and lpue. The 2008 landings increased by 14% from 2007 to 1050 t .This is fourth highest in the time-series.

Commercial cpue

Effort data for this FU is available from 1995 for the Irish otter trawl *Nephrops* directed fleet. In 2008 this fleet accounted for ~90% of the landings and compared with an average of 70% over the time period. These data have not been standardized to account for vessel or efficiency changes during the time period. Effort has declined somewhat from 2003–2006 but increased in 2007 and 2008 (Table 7.5.2.). Landings-per-unit effort (lpues) have been fluctuating around an average of 39 kg/hr with an increase to the highest (60 kg/hr) in the time-series in 2007. A slight decrease occurred in 2008 to 58 kg/hr (Figure 7.5.2).

Discarding

Before 2001 there was no discard sampling and it was thought that *Nephrops* discarding in this fishery was relatively low. Since 2001 discard rates have been estimated using unsorted catch and discards sampling (as described in the Stock Annex). Discard rates range between 15 to 23% of total catch-by-weight and 25–34% of total catch by number (Table 7.5.3). Discard rate of females tends to be higher as a consequence of the smaller average size. There is no information on discard survival rate in this fishery. No estimates of discards were available from 2006 and 2007 as a consequence of the non cooperation of the fishing industry with sampling programmes.

Biological sampling

Sampling programme resumed in 2008 and was deemed to be of high quality. The mean size of whole *Nephrops* (> 35 mm) in Irish landings has remained stable between

1995 and 2000 for both sexes (Figure 7.5.3 and Table 7.5.4). The mean size of *Nephrops* in the catch has remained relatively stable since 2001.

The sex ratio in the landings is slightly male biased (Figure 7.5.4).The sex ratios do demonstrate some variability over time. In 2004 and 2005 there was a decline in proportion of males, however, this is more linked to poor temporal coverage of sampling in those years.

There is no change to other biological parameter as described in the annex.

Abundance indices from UWTV surveys

Previously, ICES have recommended that UWTV surveys could provide useful fishery-independent data on the status of poorly assessed *Nephrops* stocks. Since 2002 Ireland has conducted underwater television surveys on the Aran grounds and adjacent *Nephrops* grounds in FU 17 (Stock Annex and WD 12). WKNEPH 2009 concluded that this survey could be used as an absolute index of abundance for this stock provided the bias (see text table below) was taken into account. This direct use of the survey is in lieu of alternative assessment approaches. These bias sources are not easily estimated and are largely based on expert opinion. In the Aran grounds the largest source of perceived bias is the "edge effect".

FU	Area	Edge effect	Detection rate	Species identification	Occupancy	Cumulative bias
17	Aran	1.35	0.9	1.05	1	1.3

The blanked krigged contour plot and posted point density data are shown in Figure 7.5.5. The krigged contours correspond very well to the observed data. The results indicate the densities increased from 2002–2004 when very high densities were apparent throughout the ground. Densities subsequently decreased to the lowest levels observed in 2006 but then increased in 2007 to levels observed at the beginning of the survey-series. In 2008 the mean density decreased to 0.58 n/m2 the lowest observed in the time-series. In general the densities are higher towards the western side of the ground rather and there is a notable trend towards lower densities towards the east.

The summary statistics from this geostatistical analysis are given in Table 7.5.5 and plotted in Figure 7.5.6. The 2008 estimate of 515 million burrows is the lowest to date but the estimates have fluctuated fairly widely to date since the survey commenced. The estimation variance of the survey estimates is not presented but is probably relatively low (CVs <10%). This is based on the observation at WKNEPH09 that the CV in a similar survey in the Irish Sea 2008 was less than 3%.

Random stratified estimates are given for the smaller Slyne Head and Galway Bay grounds. Currently the spatial extent of these other grounds not well estimated. The size of these grounds is small relative to very large Aran grounds.

As in previous years the relationship between commercial lpue in autumn and spring commercial fishery and survey abundance was explored in Figure 7.5.7. The results also suggest that there is a negative relationship between survey abundance in June and lpue in autumn and a positive relationship with the fishery in the subsequent spring. The reasons for this are not yet fully understood.

7.5.3 Assessment

The assessment approach used by WGCSE is consistent with that set out in the stock annex. Several exploratory SCAs (Separable cohort analysis) (see WKNEPH, 2009) were carried out at WGCSE in an attempt to derive suitable reference points for this stock. These used 2008 sampling data only and several different growth and mortality parameters assumptions. The results of these exploratory SCAs are not presented as the model fit was not good. WKNEPH 2009 also failed to get an adequate SCA model fit. This may be as a consequence of some inappropriate growth and mortality assumptions or because of using only 2008 data in the analysis. This should be reinvestigated next year when the 2009 sampling data becomes available in an attempt to get stock specific long-term reference points.

7.5.4 Short-term forecasts

Forecast inputs and historical estimates of mean weight in landings and harvest ratios are presented in Table 7.5.6. Mean in the landings weight since 2002 has varied between 18–23grs. The estimate harvest ratio has also varied a lot, 3–13% with 2008 being the highest observed.

A prediction of landings for 2010 was made for the Aran Grounds Functional Unit using the approach agreed at the Benchmark Workshop and as outlined in the Section 3.5. Table 7.5.7 displays landings predictions at various harvest ratios, including those equivalent to fishing within the range of $F_{0.1}$ to F_{max} for other *Nephrops* stocks. The 2008 harvest ratio for the Aran grounds increased in 2008 and is slightly above potential F_{max} levels.

7.5.5 Biological reference points

As discussed above in Section 7.5.3. SCA based reference points could not be estimated for this stock. The range of $F_{0.1}$ to F_{max} for other *Nephrops* stocks is presented as an alternative in Table 7.5.7.

7.5.6 Management strategies

As yet there are no explicit management strategies for this stock but there have been some discussions among the fishing industry and scientists about developing a long-term strategy for the management of the Aran fishery. Sustainable utilization of the *Nephrops* stock will probably form the cornerstone of any management strategy for this fishery.

7.5.7 Uncertainties and bias in assessment and forecast

There are several key uncertainties and bias sources in the method proposed (these are discussed further in WKNEPH 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that was more accurate but no more precise (WKNEPH 2009). The survey estimates themselves are likely to be fairly precisely estimated given the homogeneous distribution of burrow density and the modelling of spatial structuring. The cumulative bias estimates for FU17 are largely based on expert opinion. The precision of these cannot yet be characterized. Ultimately there still remains a degree of subjectivity in the production of UWTV indices.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. For FU17 deterministic estimates of the mean weight in the landings and discard rates for 2008 have been used because sampling data were not available for the previous 2 years. Historical data suggest parameters have been variable in the past (Table 7.5.6). In future years the uncertainty in these key parameters should be estimated.

Landings data are assumed to be accurate. Since 2007 the introduction of "buyers and sellers legislation" in Ireland is thought to have improved the accuracy of the reported landings.

Finally, the catch options developed do not have any additional catches for the smaller Slyne or Galway Bay grounds. This is likely to cause a small (<3%) underestimate in the catch options for FU17 as a whole.

7.5.8 Recommendation for next Benchmark

This stock was benchmarked in 2009. WKNEPH 2009 suggested several areas to be addressed before the next benchmark. Currently there is no recommended time frame for another benchmark. It may be possible to investigate stock specific reference points outside a full benchmark procedure.

7.5.9 Management considerations

In conclusion, the trends from the fishery (landings, effort lpue, mean size, etc.) appear to be relatively stable although landings and lpue have increased in 2007 and 2008 this may have been in response to a less restrictive quota and increased control and enforcement. Conversely, the UWTV abundance and mean density estimates should large fluctuations in burrow abundance and harvest rates. This suggests that the *Nephrops* population at current exploitation and recruitment rates is rather dynamic. A new survey point should be available after June 2009 which will provide a more up to date prognosis of stock status. The use of the most up to date survey information should be considered for this stock.

In recent years several newer vessels specialising in *Nephrops* fishing have participated in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates. With the introduction of increasingly restrictive days-at-sea limits in VIIa and VIa in 2009 it is likely that further effort will be displace towards the Aran and other *Nephrops* grounds where effort control has not been put in place. Management measures should be established to prevent unsustainable increases in effort and catch for this stock.

The 2008 survey estimate is the lowest observed to date and is ~60% of the time-series average. This, coupled with the lack of an effective way of limiting effort or landings from the Aran Grounds, is a cause for some concern.

Table 7.5.1. *Nephrops* in FU17 (Aran grounds). Landings in tonnes by country.

		FU 17		
Year	France	Rep. of Ireland	UK	Total
1974	477			477
1975	822			822
1976	131			131
1977	272			272
1978	481			481
1979	452			452
1980	442			442
1981	414			414
1982	210			210
1983	131			131
1984	324			324
1985	207			207
1986	147			147
1987	62			62
1988	14	814		828
1989	27	317		344
1990	30	489		519
1991	11	399		410
1992	11	361		372
1993	11	361	0	372
1994	18	707	4	729
1995	91	774	1	866
1996	2	519	4	525
1997	2	839	0	841
1998	9	1401	0	1410
1999	0	1140	0	1140
2000	1	879	0	880
2001	1	912	0	913
2002	2	1152	0	1154
2003	0	933	0	933
2004	0	525	0	525
2005	0	778	0	778
2006	0	637	0	637
2007	0	913	0	913
2008	0	1050	0	1050

Table 7.5.2. ***Nephrops*** **in FU17 (Aran grounds). Irish effort and lpue for** ***Nephrops*** **directed fleet.**

	Irish Nephrops Directed Fleet		
Year	Effort (Hrs)	Landings (tonnes)	lpue (kg/hr)
1995	15306	530	35
1996	9109	311	34
1997	15763	478	30
1998	21909	926	42
1999	19546	743	38
2000	17131	547	32
2001	18700	600	32
2002	18565	861	46
2003	19922	732	37
2004	12899	381	30
2005	14900	729	46
2006	10798	559	52
2007	13608	815	60
2008	16676	963	58

Table 7.5.3. ***Nephrops*** **in FU17 (Aran grounds). Landings and discard weight and number by year and sex.**

	Female		Male		Both sexes
Year	Landings (t)	Discards (t)	Landings (t)	Discards (t)	% Discard
2001	312	109	601	138	21%
2002	423	96	729	99	14%
2003	237	89	688	98	17%
2004	267	71	259	45	18%
2005	323	106	441	86	20%
2006					
2007			No Sampling		
2008	324	100	552	159	23%

	Female Numbers '000s		Male Numbers '000s		Both sexes
Year	Landings	Discards	Landings	Discards	% Discard
2001	18,665	12,161	29,949	13,250	34%
2002	23,105	9,374	31,256	8,326	25%
2003	14,530	9,577	29,538	8,744	29%
2004	16,109	7,068	12,930	4,282	28%
2005	20,280	11,383	21,828	8,967	33%
2006					
2007			No Sampling		
2008	15,699	13,226	31,182	8,350	32%

Table 7.5.4. ***Nephrops*** **in FU17 (Aran grounds). Mean size trends for catches and whole landings by sex.**

	Catches		Catches		Whole Landings			
	<35 mm CL		>35 mm CL		<35 mm CL		>35 mm CL	
Year	Males	Females	Males	Females	Males	Females	Males	Females
1995	na	na	na	na	32.0	31.8	38.3	37.0
1996	na	na	na	na	31.1	32.1	37.8	37.4
1997	na	na	na	na	31.9	32.0	37.8	37.4
1998	na	na	na	na	31.3	31.7	38.0	37.2
1999	na	na	na	na	31.3	32.3	38.0	37.1
2000	na	na	na	na	32.0	31.4	38.4	36.3
2001	28.9	27.5	38.0	37.3	na	na	na	na
2002	30.7	29.1	38.2	37.2	na	na	na	na
2003	30.5	27.4	38.2	38.0	na	na	na	na
2004	29.3	28.3	37.3	37.5	na	na	na	na
2005	28.9	27.7	37.8	37.2	na	na	na	na
2006	No Sampling							
2007								
2008	27.4	29.7	36.8	37.8	na	na	na	na

na = not available

Table 7.5.5. ***Nephrops*** **in FU17 (Aran grounds). Results summary table for geostatistical analysis of UWTV survey.**

Ground	Year	Number of stations	Mean Density (No./M2)	Domain Area (m2)	Geostatistical abundance estimate (million burrows)
Aran	2002	49	0.81	943	793
	2003	42	0.85	943	825
	2004	64	1.44	937	1408
	2005	70	1.11	931	1089
	2006	67	0.66	932	640
	2007	71	0.88	942	854
	2008	62	0.57	842	515

Results summary table for empirical statistical analysis of UWTV survey.

Ground	Year	Number of stations	Mean Density (No./m2)	Area Surveyed (m)	Burrow count	Standard Deviation	95%CI	CV
Galway Bay	2002	7	1.58	1,299	2,017	0.37	0.34	9%
	2003	3	1.60	591	941	0.29	0.73	11%
	2004	9	0.73	2,312		0.42	0.32	19%
	2005	4	1.67	661	1,625	0.20	0.32	6%
	2006	3	0.98	540	1,107	0.27	0.67	16%
	2007	5	1.14	890	992	0.24	0.29	9%
	2008	10	0.42	1,907	859	0.31	0.22	23%
Slyne Grounds	2002	5	0.85	1,216	1,027	0.19	0.23	10%
	2003	0	-	-	-	-	-	-
	2004	3	0.68	827	531	0.27	0.66	23%
	2005	3	0.55	531	294	0.05	0.13	6%
	2006	3	0.41	526	210	0.20	0.49	28%
	2007	4	0.63	838	547	0.31	0.49	24%
	2008	0	-	-	-	-	-	-

***random stratified estimates are given for the Slyne Head and Galway Bay grounds.**

Table 7.5.6. *Nephrops* in FU17 (Aran Grounds). Forecast inputs (highlighted) and historical estimates of mean weight in landings and harvest ratio.

Year	Geostatistical abundance estimate (million burrows)	Landings	Numbers Landed	Numbers Discarded	Retained Rate	Mean weight in landings	HR (Removals/ Abundance)*
2002	793	1,152	54,451	17,734	75%	0.021	9%
2003	825	933	44,068	18,320	71%	0.021	7%
2004	1408	525	29,039	11,353	72%	0.018	3%
2005	1089	778	42,109	20,353	67%	0.018	6%
2006	640	637	No Sampling				
2007	854	913					
2008	515	1,050	46,543	21,523	68%	0.023	13%

*** Assuming a 10% discard survival**

Table 7.5.7. *Nephrops* in FU17 (Aran Grounds). Short-term forecast management option table giving catch options for 2010.

			Implied fishery	
	Harvest rate	Survey Index (millions)	Retained number (millions)	Landings (tonnes)
	0%	396	0	0
	2%	"	6	126
	4%	"	11	252
	6%	"	17	379
$F_{0.1}$ for other *Nephrops* stocks is in this range	8%	"	22	505
	10%	"	28	631
	12%	"	34	757
F_{max} for other *Nephrops* stocks is in this range	13%	"	36	820
	14%	"	39	883
	15%	"	42	946
	16%	"	45	1,009
	17%	"	48	1,072
F Current	16.7%	"	47	1,050

		Basis
Landings Mean Weight (KG)	0.0226	Sampling 2008
Survey Overestimate Bias	1.30	WKNEPH 2009
Survey Numbers (Millions)	515	UWTV Survey 2008
Prop. Retained by the Fishery	0.71	Sampling 2008

Figure 7.5.1 *Nephrops* in FU 17 (Aran Grounds)
Landings in tonnes by country

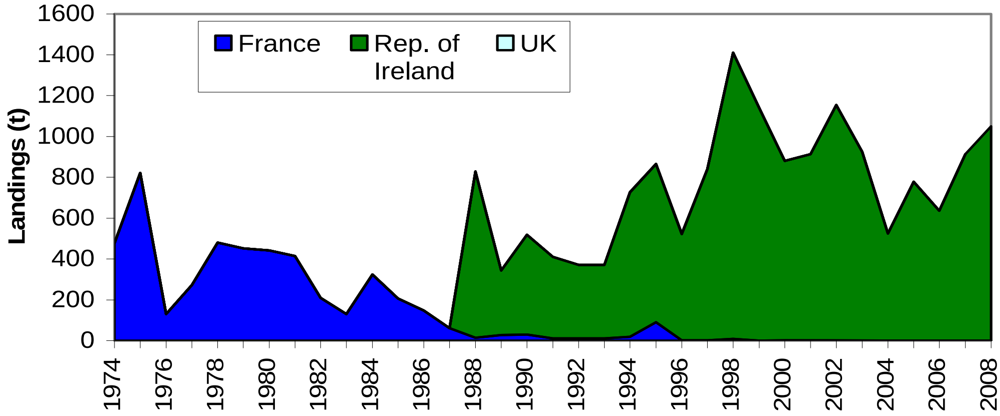
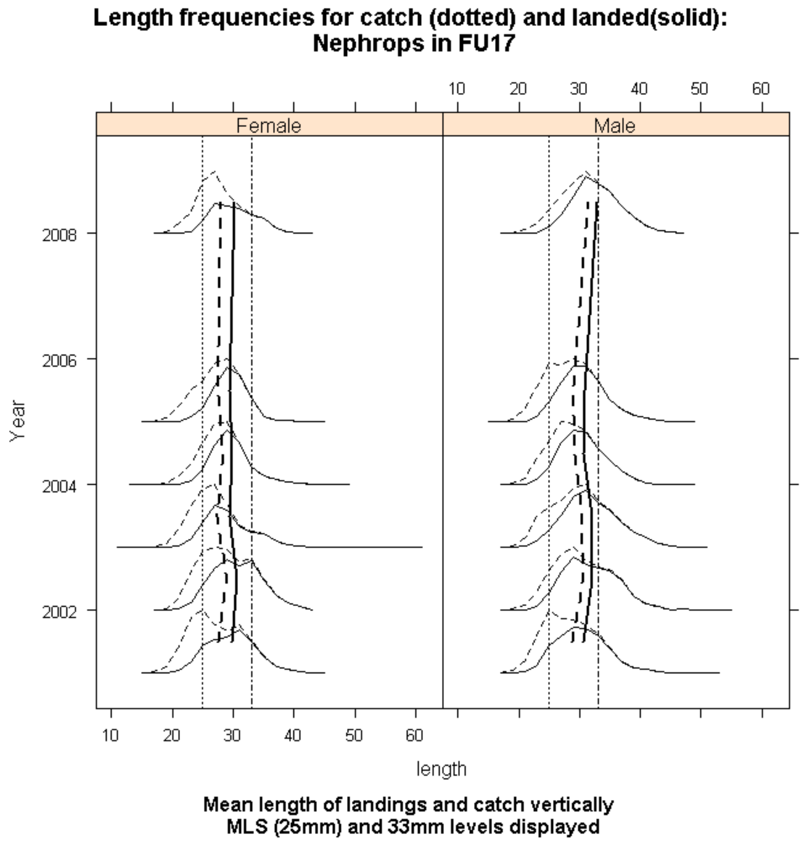


Figure 7.5.2. *Nephrops* in FU17 (Aran grounds). Landings in tonnes by country.



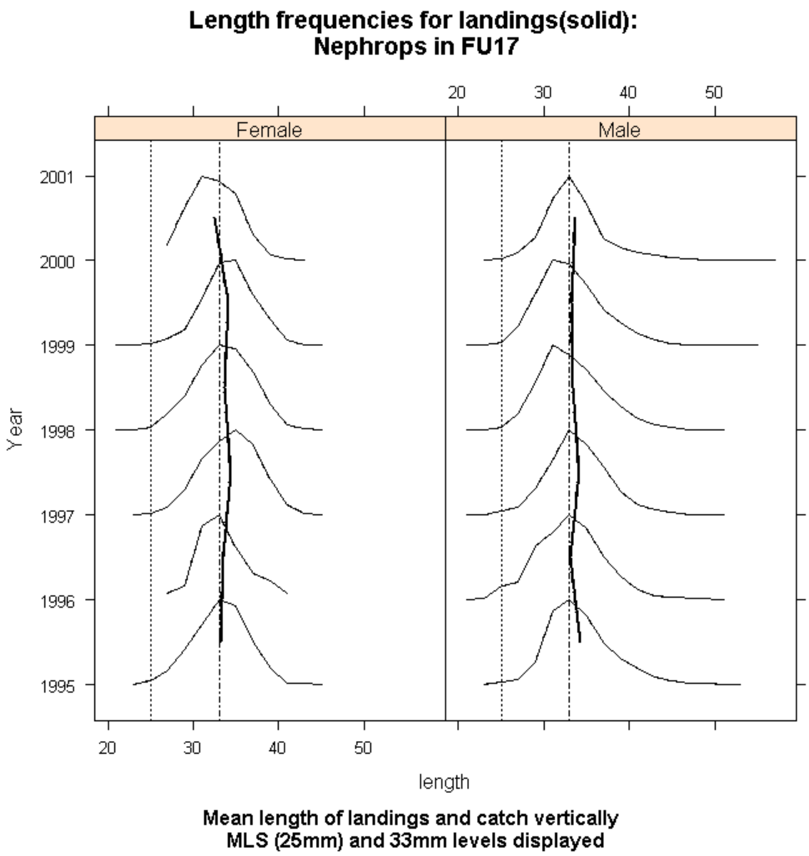


Figure 7.5.3 ***Nephrops*** **FU17 Aran Grounds. Length distributions in the catches 2001–2005, 2008 and in the landings 1995–2001.**

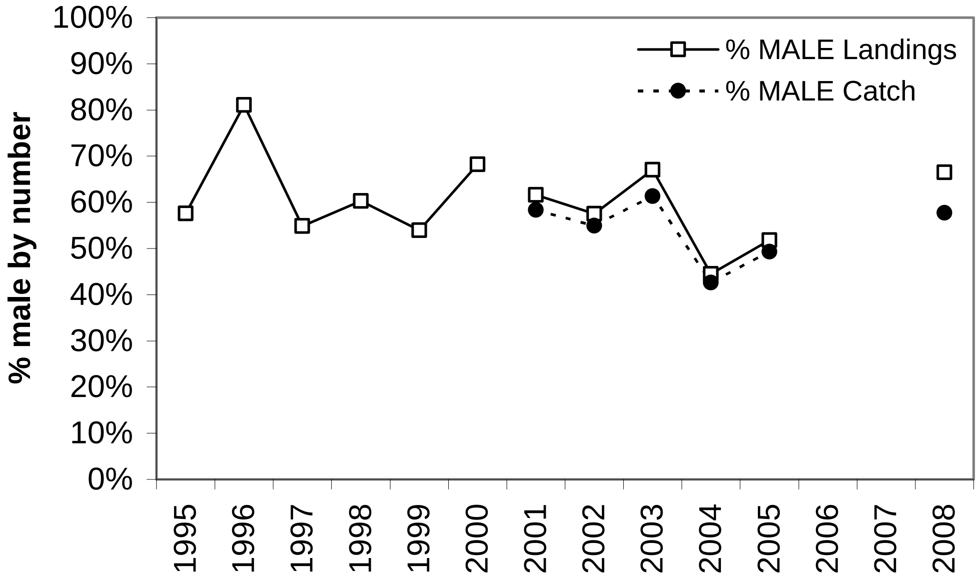


Table 7.5.4. ***Nephrops*** **in FU17 (Aran grounds). Sex ratio of whole landings (1995–2000), landings (2001–2008) and catch (2001–2008).**

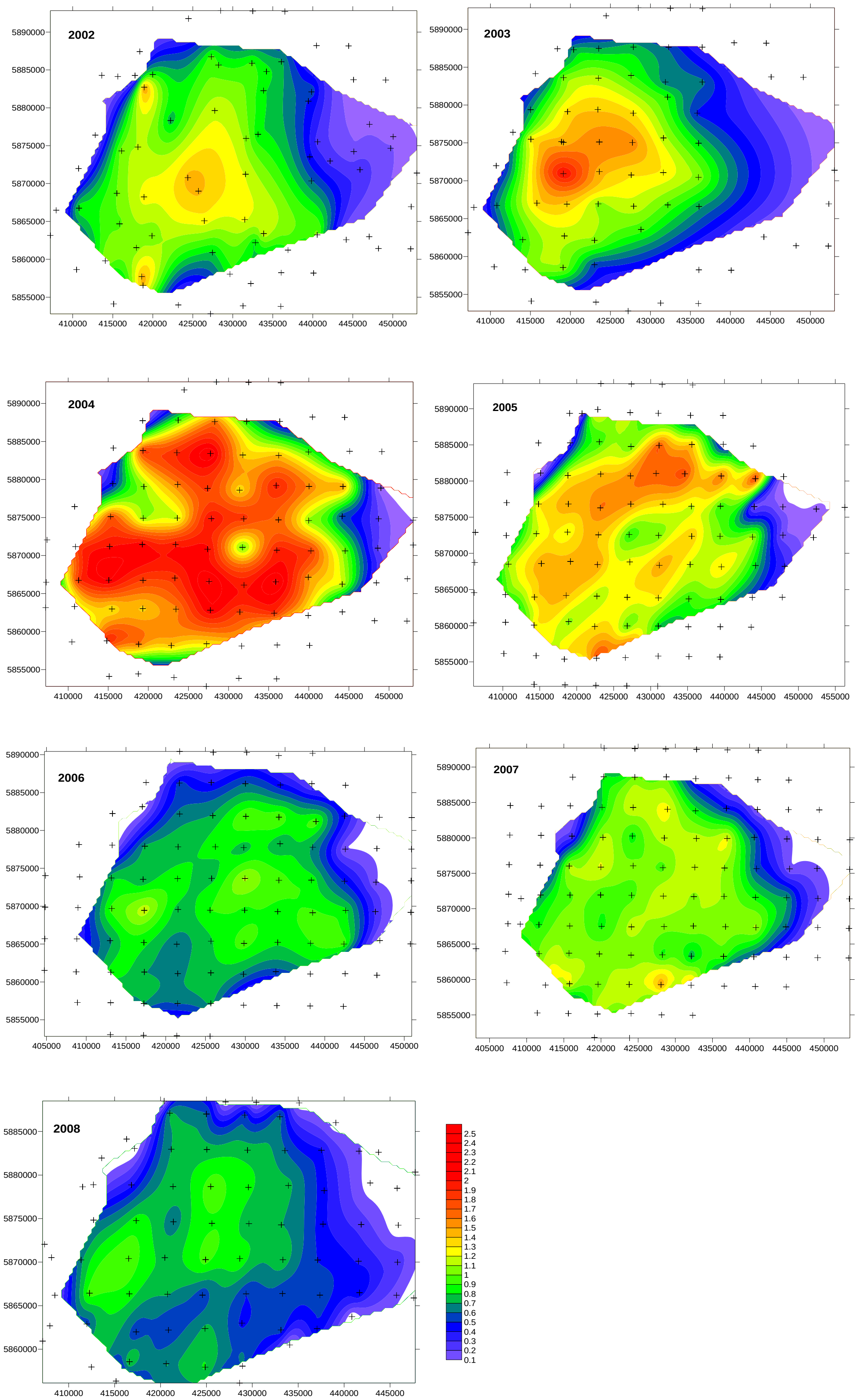


Table 7.5.5. *Nephrops* in FU17 (Aran grounds). Contour plots of the krigged density estimates for the Aran Grounds UWTV surveys from 2002–2008.

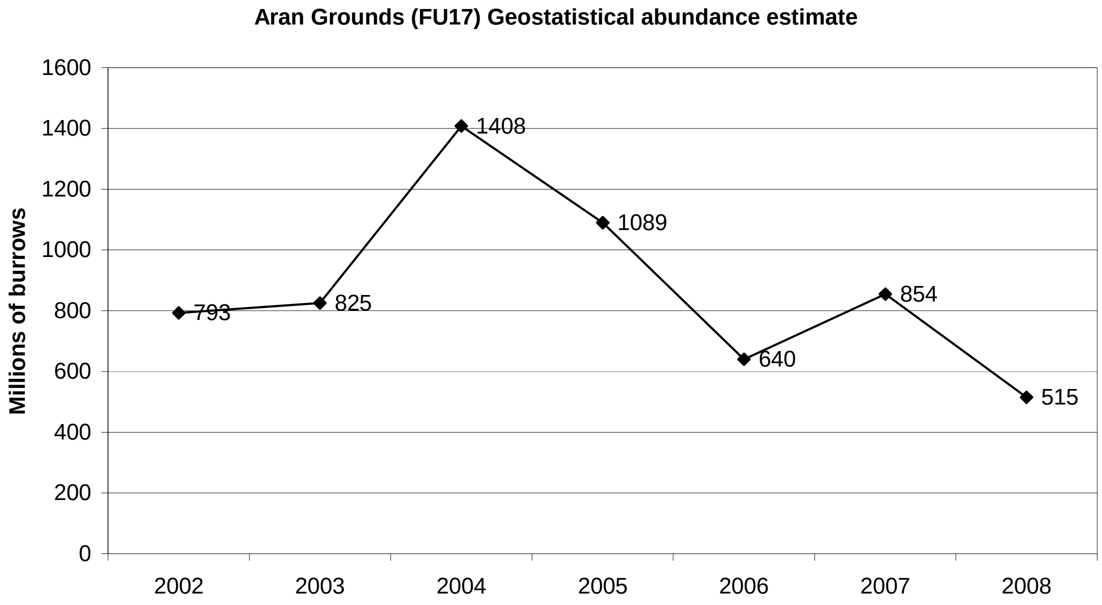


Figure 7.5.6. ***Nephrops*** **FU17 Aran Grounds.**

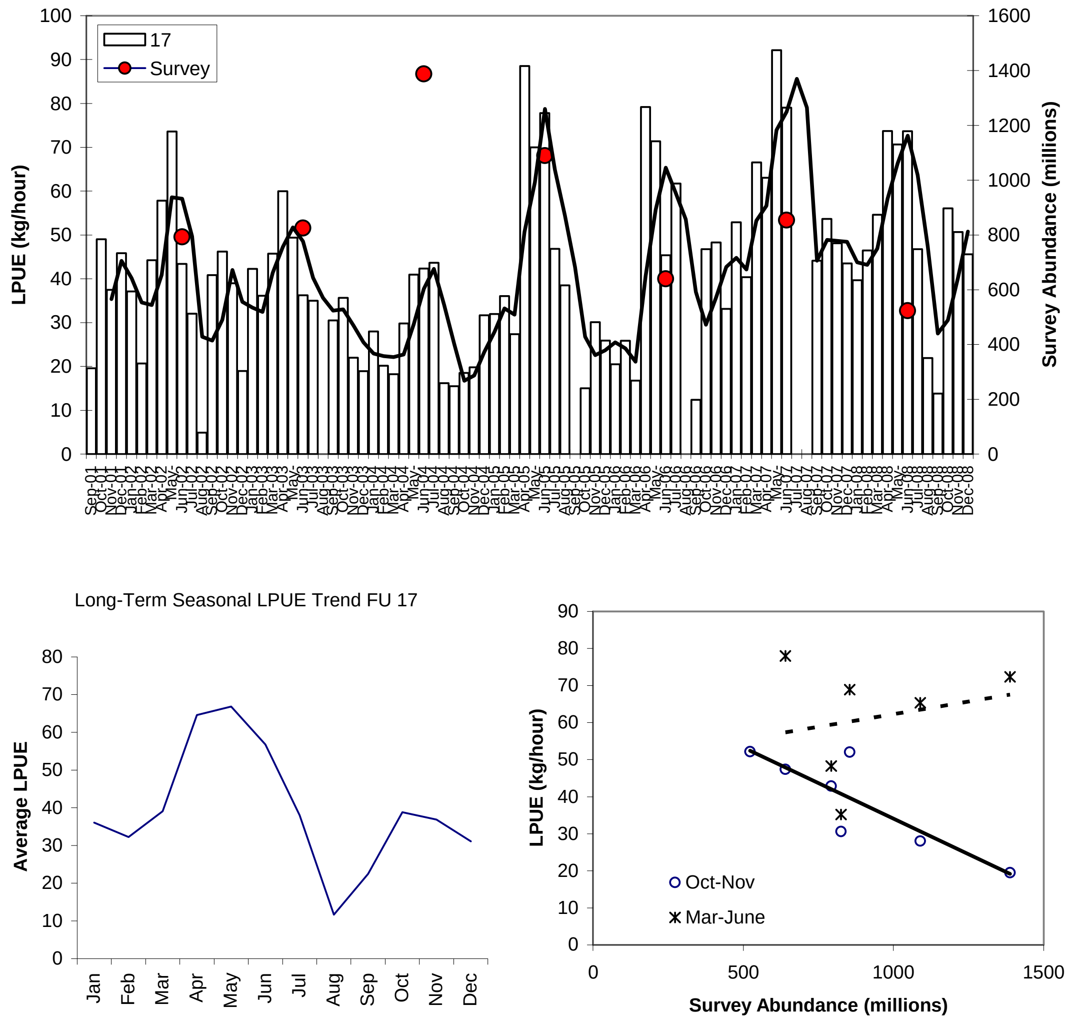


Figure 7.5.7. ***Nephrops*** **FU17 Aran Grounds. a) The monthly lpue from FU17 and survey abundance index b) mean standardized long-term (1995–2008) seasonal trend in lpue for FU17 and c) the relationship between lpues for two time periods and survey abundance estimates.**

7.6 *Nephrops* in Division VIIb,c,j,k (Porcupine Bank, FU16)

Type of assessment in 2009

The ToRs proposed that no new advice should be prepared for this stock in 2009. This year the Working Group updated the fishery information, survey data and other indicators for *Nephrops* in Division VIIbcjk. All data and indicators suggest that the stock status has continued to deteriorate. This lead the WG to recommend to ACOM that new Advice should be issued in 2009.

ICES advice applicable to 2008

There are no exploitation boundaries for these stocks. Although the total reported landings appear to be increasing (~10%) and are around average for the available series, for FUs 16,17,18 and 19 combined (~3900 t), there have been large changes in fishing effort and landings for individual stocks. It is also likely that landings may be unreliable for some countries. This may lead to unbalanced exploitation of stocks and overfishing. ICES therefore advises that these *Nephrops* fisheries should be constrained to recent levels of effort at an appropriate geographical scale (FU).

At present, as there is no explanation of the increasing trend of the landing mean sizes; WG recommends a spatial analysis of the disaggregated data. This study should be conducted on the origin of fleet landings (which ICES rectangle came from) and on which part of the population is exploited.

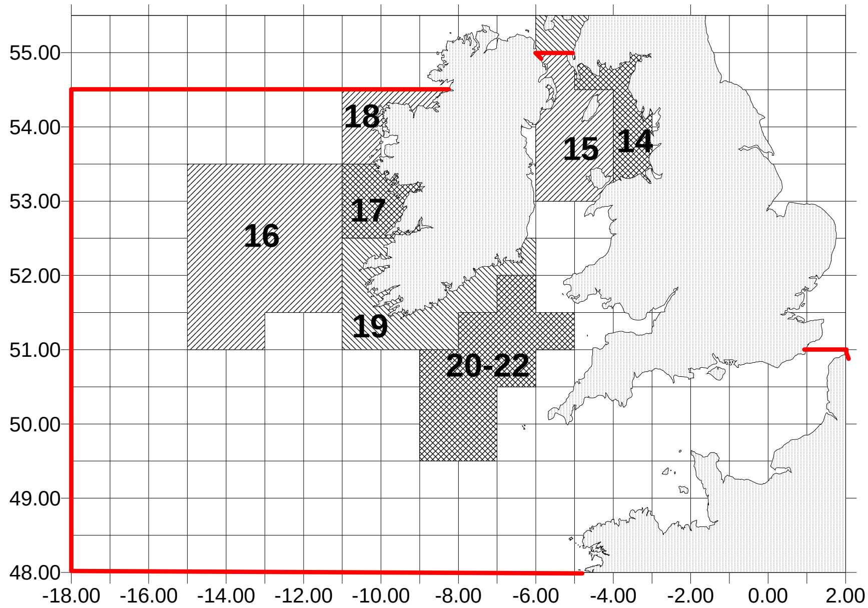
ICES advice applicable to 2009

Because of the apparent low recruitment and the recent expansion of the fishery there is an associated increased exploitation. ICES recommends reduction in the exploitation rate and restricting catches in 2009 to no more than 1000 t, which corresponds to the catch level before the expansion of the fishery (2000–2003). The fishery should not be allowed to expand again unless it can be demonstrated that it is sustainable.

7.6.1 General

Stock description and management units

The TAC area is Subarea VII. The Functional Unit for assessment includes some parts of the following ICES Divisions VIIb, c, j, and k. The exact stock area is shown on the map below and includes the following ICES Statistical rectangles: 31–36 D5–D6; 32–35 D7–D8.



The TAC for Subarea VII is bounded by the red line. The FUs with the TAC area are shaded.

Management applicable to 2008 and 2009

TAC in 2008

Species: Norway lobster *Nephrops norvegicus*		**Zone:** VII NEP/07.
Spain	1 509	
France	6 116	
Ireland	9 277	
United Kingdom	8 251	
EC	25 153	
TAC	25 153	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TAC in 2009

Species: Norway lobster *Nephrops norvegicus*		Zone: VII (NEP/07.)
Spain	1 479	
France	5 994	
Ireland	9 091	
United Kingdom	8 086	
EC	24 650	
TAC	24 650	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

The following TCMs are in place for *Nephrops* in VII (excluding VIIa) after EC 850/9 in operation since 2000:

> Minimum Landing Sizes (MLS); total length >85 mm, carapace length >25 mm, tail length >46 mm. Although it is legal to land smaller prawns from this fishery, marketing restrictions imposed by producer organizations in France mean smaller *Nephrops* (< 35 mm CL or 115 mm whole length) are not retained in this fishery.
>
> Mesh Size Restrictions; Towed gears targeting *Nephrops* having at least 35% by weight of this species on board will require 70 mm diamond mesh plus an 80 mm square mesh panel as a minimum or having less than 30% by weight of *Nephrops* on board will require 80 mm diamond mesh.

Fishery in 2008

The *Nephrops* fisheries in this area are seasonal and rather sporadic, mainly targeting *Nephrops* when available and when weather conditions are good. At other times the vessels switch to other fisheries.

Total international landings (Table 7.6.1) in 2008 were the lowest observed and of similar magnitude to landings in 2000 and 2003.

Landings for the TAC area (Subarea VII) are undershot. UK and Irish national quotas are restrictive but uptake by France and Spain is well below their quotas as a result of changes in relative landings from different FUs within this TAC area.

There is discarding of small and maturing female *Nephrops* in this fishery as a result of lower market price but there are no reliable estimates of this during the time-series. Discarding patterns are known to vary between countries.

7.6.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1.

Length compositions of annual landings are available from Spain (1986–2008), France (1995–2007) and Ireland (1995–2005 and 2008). No sampling was possible in 2006 and 2007 for Ireland as a result of the withdrawal of cooperation with scientific sampling programmes by the fishing industry. Sampling in Ireland resumed in 2008 (Table 2.1). There was no sampling in France in 2008 as a consequence of low landings. Sampling intensity in Spain was extremely low in 2008 (only 2 samples).

Sampling of *Nephrops* in this area is hampered by several factors:

- The remote nature of the fishery.
- Trips are long duration sometimes fishing in multiple areas.
- An increasing proportion of the landings are landed frozen or graded at sea.
- There is reluctance from fishers and processors to allow sampling of landings as a consequence of high value of the larger *Nephrops* and the risk of damage to individuals during sampling.

These issues need to be resolved as current sampling intensity is insufficient to get precise and accurate length structure data of the catches.

Despite the low sampling intensity in recent years, the trends in indicators such as length and sex ratio are consistent across all countries and in the survey.

Landings

Data on the mean size (carapace length, CL) of male and female *Nephrops* in the landings are available from Spain, France and Ireland (Table 7.6.2, Figure 7.6.1). The longest time-series are from Spain and, prior to 2003, these have been quite stable at between 39 and 43 mm CL for the males, and between 34 and 38 mm CL for the females. Since 2002 there has been an increasing trend in the mean size in the landings. Mean *Nephrops* sizes in French landings also demonstrate an increasing trend for females with the highest mean lengths in 2007 (~44 mm). Mean sizes in the landings of Irish trawlers are more variable but clearly demonstrate a rise in the mean size of males landed from 2003 on.

Raised frequency distributions of the sampled landings by sex are given in Figure 7.6.2. This also shows significant changes in the last 4–5 years with a shift towards larger individuals in the landings and few individuals at smaller sizes.

It is difficult to extract other useful signals in the length–frequency distributions plot, so for males a number of indicators were calculated (Figure 7.6.3). These included a recruitment proxy (% of males < 32 mm CL), and percentage of larger individuals (>50 mm CL) in the sampled landings. An exploitation proxy was calculated using the slope of ln(CL) vs. ln(Numbers) between 41–56 mm CL i.e. the slope of downward limb on the Right-Hand-Side of the length–frequency distribution.

These indicators suggest the following: recruitment has fluctuated in the past and recruitment in the last five years has probably been very weak. The fishery now exploits a larger proportion of larger individuals than ever before in the time-series. The exploitation proxy reveals an increasing trend (i.e. steepness) since the early 2000s, suggesting a reducing spread of the length–frequency distribution as mean length in the landings has increased.

Discards

There are no estimates of discards for this stock but the intra-country differences in size structure of the landings suggest different on-board selection patterns (mesh size used is similar across fleets).

Biological

In the most recent years there has been a large change in sex ratio in the landings and survey catches (Figure 7.6.4). The change in sex ratio in the landings is strongly influenced by the re-availability of data from Irish fishery which lands a greater proportion of female *Nephrops* than either the French or Spanish fleet. The survey also reveals larger proportions of females in the catches in the last few years.

There are no changes to other biological parameters for this stock and they are not relevant to the current trends based assessment.

Surveys

The only fishery-independent source of data is from the Spanish Porcupine trawl survey. Further information on this survey is provided in the IBTS report (ICES, 2009) and in previous IBTS reports. Catchability of *Nephrops* in trawl surveys is typically an issue because of variable emergence patterns of *Nephrops* from their burrows (ICES, 2007). However, this stock (FU16) is found in deep water where animals are known to emerge mainly during the day. So, survey hauls are only conducted during the day and the survey is scheduled for the same time each year, thus minimizing variability because of emergence patterns. In addition, the *Nephrops* stock in this area is widely distributed and at relatively low densities over a large area, such that catchability is less variable than for those stocks in shallower water.

In spite of using the same gear design as in previous years, in the 2008 survey there were differences in the mean vertical and door spread of the gear during the survey (WD10). This may have contributed to the lower catch rates in 2008. Distribution of *Nephrops* catches and biomass in Porcupine surveys between 2001 and 2008 are shown in Figure 7.6.5. It is clear that *Nephrops* biomass and numbers in the survey is decreasing steadily (Figure 7.6.6).

The size structure of the catches in the survey demonstrates two things: a much lower mean size than in the commercial fleets and an increasing trend in mean size for both sexes (Table 7.6.2, Figure 7.6.7).

Commercial cpue

The *Nephrops* fishery on the Porcupine Bank is both seasonal and opportunistic with increased targeting during periods of high *Nephrops* emergence and good weather.

Effort and lpue data are not standardized, and hence do not account for vessel capacity, efficiency, seasonality or other factors that may bias perception of lpue and abundance trends over the longer term. These data are presented by country in Table 7.6.3 and Figure 7.6.8. Note: Irish and French effort is in hours Spanish effort is power adjusted and is reported in thousands of day*BHP/100.

The effort index for the Spanish fleet (all gears) operating in Porcupine demonstrates a steady decline from the 1970s until the early 1990s. Since then Spanish effort has declined more gradually. *Nephrops* lpue data for the Spanish fleet (all gears) demonstrates a general declining trend until 2003. In 2004 and 2005 lpue increased rapidly, probably because of increased targeting of *Nephrops*, before declining again in the more recent years.

Fishing effort for French *Nephrops* vessels[1] has fluctuated widely with peaks in the mid 1980s and through the late 1990s. Effort in 2008 was the lowest in the series. Lpue data for the French fleet in FU16 were high in the 1980s but declined with fluctuations to a series low in 2008.

---

1 where *Nephrops* constituted 10% of the landed value.

Fishing effort data for the Irish otter trawl *Nephrops* directed fleet[2]. Increased rapidly over the period 2003–2007 before declining again in 2008. Irish lpue has fluctuated but with a general declining trend.

7.6.3 Stock assessment

The assessment is based on multiple lines of evidence from several indicators. The available data includes commercial landings compositions for males and females from the main fleets. Catch rates and length distributions from the Spanish Porcupine Bank survey (2001–2008,) along with lpue and effort data for the main fleets.

Comparison with previous assessments

The assessment is based on similar indicators to those used in 2008. The additional data demonstrates a continued deterioration in stock status.

This year further information was provided from the Spanish Porcupine survey including spatial and size distributions of catches and gear parameters (WD10). This fishery-independent information has proven increasingly important for this stock.

State of the stock

The state of the stock is uncertain. Effort and landings trends indicate that fishing mortality has been high in the last number of years. Fishery independent survey information indicated that recruitment has been very weak since 2004 and the stock has declined to low levels.

Landings per unit effort (lpue) demonstrate a generally declining trend in most fleets over the time-series available. Mean size indicators in all commercial fleets and a survey indicate large increases in mean size for both sexes in the past five years. There has been a large change in sex ratio in the survey catches and fishery landings with female *Nephrops* accounting for a larger proportion. Landings have declined by 57% between 2007 and 2008.

7.6.4 Short-term projections

There is no possibility to forecast catches in the short term using the available stock indicators.

7.6.5 Medium-term projection

Not carried out.

7.6.6 Biological reference points

There are no reference points defined or agree for this stock.

7.6.7 Management plans

There is no management plan for this stock.

---

[2] A threshold of 30% of *Nephrops* in reported landings by trip is used to identify the landing and effort of this fleet.

7.6.8 Uncertainties and bias in assessment and forecast

There is unknown discarding/highgrading practices for *Nephrops* fleets in this area but all fleets display similar recent increases in mean size. All information points to poor recruitment and an increasing reliance of the fishery on larger individuals with a high female component.

7.6.9 Recommendation for next Benchmark

There needs to be improved sampling of catches for this stock. Sampling levels are currently low and several factors complicate sampling (see Section 7.6.2).

In the short term the survey may be the most appropriate method of monitoring stock status. The development of full analytical assessment would require better growth information and an improvement in sampling of catches. Spatially explicit landings and effort data, either by rectangle or at finer resolution (see WD 1) by gear from all countries would also be useful.

Currently there are no plans to benchmark this stock before 2012.

7.6.10 Management considerations

Nephrops on the Porcupine Bank are fished in relatively deep waters over a widespread area where they occur at low abundance. Given the sedentary nature of *Nephrops* populations closed areas may be an appropriate management tool to recover the stock.

Productivity of deep-water *Nephrops* stocks is generally lower than those in shelf waters, though individual *Nephrops* grow to relatively large sizes and attain high market prices. Other deep-water *Nephrops* stocks off the Spanish and Portuguese coast have collapsed and have been subject to recovery measures for several years e.g. FUs 25, 26, 27 and 31.

Landings, lpues and effort for all fleets declined in the early 2000s, probably reflecting a decline in stock abundance. There was a substantial increase in landings and lpue in 2004 and 2005 indicating some signs of a stock increase, but since 2006 these indicators reveal a large decrease causing renewed concern about stock status. All the size distribution information demonstrates a large increase in the size of *Nephrops* in this area. This is considered to be because of the combined effects of weak recruitment in recent years and the growth of a good year class that entered the commercial fishery in 2002. The combined effect of increased targeting and weak recruitment in recent years has resulted in a sudden deterioration in stock status.

7.6.11 References

ICES 2007. Report of the Workshop on the use of UWTV surveys for determining abundance in *Nephrops* stocks throughout European waters (WKNEPHTV). ICES CM: 2007/ACFM: 14 Ref: LRC, PGCCDBS.

Table 7.6.1. Porcupine Bank (FU16): Landings (tonnes) by country, 1965–2008.					
Year	France	Rep. of Ireland	Spain	UK	Total
1965	514				514
1966	0				0
1967	441				441
1968	441				441
1969	609				609
1970	256				256
1971	500		1444		1944
1972	0		1738		1738
1973	811		2135		2946
1974	900		1894		2794
1975	0		2150		2150
1976	6		1321		1327
1977	0		1545		1545
1978	2		1742		1744
1979	14		2255		2269
1980	21		2904		2925
1981	66		3315		3381
1982	358		3931		4289
1983	615		2811		3426
1984	1067		2504		3571
1985	1181		2738		3919
1986	1060		1462	69	2591
1987	609		1677	213	2499
1988	600		1555	220	2375
1989	324	350	1417	24	2115
1990	336	169	1349	41	1895
1991	348	170	1021	101	1640
1992	665	311	822	217	2015
1993	799	206	752	100	1857
1994	1088	512	809	103	2512
1995	1234	971	579	152	2936
1996	1069	508	471	182	2230
1997	1028	653	473	255	2409
1998	879	598	405	273	2155
1999	1047	609	448	185	2290
2000	351	227	213	120	910
2001	425	369	270	158	1222
2002	369	543	276	139	1327
2003	131	306	333	108	878
2004	289	494	588	126	1497
2005	397	752	799	208	2157
2006	462	731	571	201	1964
2007	302	1059	496	146	2003
2008	26	561	234	41	861

Table 7.6.2. Porcupine Bank (FU16): Mean sizes (mm CL) of male and female *Nephrops* in Spanish, French and Irish landings and the Spanish Porcupine Groundfish survey 1981–2008.

Year	Spain		Rep. Of Ireland		France		Porcupine Survey	
	Landings		Landings		Landings		Catch	
	Males	Females	Males	Females	Males	Females	Males	Females
1981	39.9	34.5	-	-	-	-	-	-
1982	40.9	34.8	-	-	-	-	-	-
1983	40.8	34.0	-	-	-	-	-	-
1984	39.7	33.1	-	-	-	-	-	-
1985	38.7	33.5	-	-	-	-	-	-
1986	40.7	36.4	-	-	-	-	-	-
1987	39.3	35.0	-	-	-	-	-	-
1988	40.7	38.3	-	-	-	-	-	-
1989	40.5	36.8	-	-	-	-	-	-
1990	41.0	36.1	-	-	-	-	-	-
1991	39.4	34.5	-	-	-	-	-	-
1992	39.2	34.1	-	-	-	-	-	-
1993	41.6	36.1	-	-	-	-	-	-
1994	40.8	36.5	-	-	-	-	-	-
1995	41.3	36.6	40.7	36.5	43.2	38.3	-	-
1996	41.6	35.1	34.6	35.3	41.7	38.9	-	-
1997	39.7	34.8	35.9	34.5	41.9	38.4	-	-
1998	41.1	34.6	37.2	35.6	41.9	38.4	-	-
1999	41.5	35.7	36.6	33.7	43.1	39.1	-	-
2000	41.1	34.8	na	na	45.3	40.5	-	-
2001	41.1	36.3	37.8	35.4	45.4	39.4	35.5	28.4
2002	39.7	35.3	36.1	38.5	45.3	40.3	37.0	31.2
2003	41.4	37.8	44.5	36.2	46.2	38.9	39.2	31.4
2004	43.5	38.5	43.5	35.7	46.4	41.5	39.4	30.0
2005	43.4	38.1	46.9	40.6	45.9	41.0	44.6	33.3
2006	43.9	38.0	na	na	48.9	41.4	43.6	34.5
2007	43.7	41.0	na	na	48.3	43.8	45.4	37.4
2008	51.0	40.6	43.3	37.5	na	na	48.0	38.2

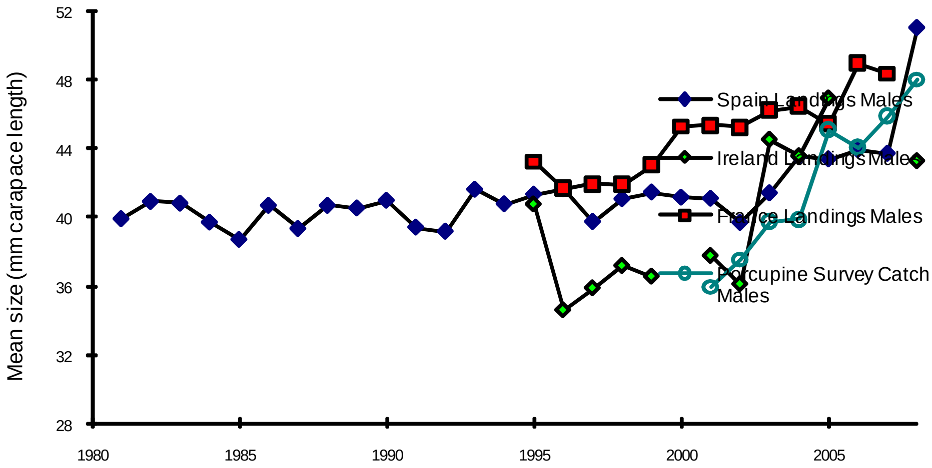
Table 7.6.3. *Nephrops* Porcupine Bank (FU16)

Landings and effort for the various different fleets exploiting the stock 1971–2008.

Year	Spanish fleet			French Nep fleet[1]			Irish Nep Fleet[2]		
	Landings	Effort		Landings	Effort	LPUE (>10%)	Landings	Effort	LPUE
	Tonnes	day*BHP/100 (x1000)	T/day * BHP/100	Tonnes	('000's Hrs)	(kg/hr)	Tonnes	('000's Hrs)	(kg/hr)
1971	1444	159	9						
1972	1738	188	9						
1973	2135	181	12						
1974	1894	192	10						
1975	2150	229	9						
1976	1321	187	7						
1977	1545	196	8						
1978	1742	166	11						
1979	2255	157	14						
1980	2904	163	18						
1981	3315	143	23						
1982	3931	138	29						
1983	2811	108	26	615	18	35			
1984	2504	114	22	1067	30	35			
1985	2738	115	24	1181	33	36			
1986	1462	95	15	1060	28	38			
1987	1677	105	16	609	24	26			
1988	1555	109	14	600	22	27			
1989	1417	105	14	324	14	23			
1990	1349	96	14	336	15	23			
1991	1021	85	12	348	19	18			
1992	822	59	14	665	32	21			
1993	752	49	15	799	36	22	206		
1994	809	50	16	1088	38	28	512		
1995	579	48	12	1234	42	30	971	15	41
1996	471	43	11	1069	41	26	508	8	42
1997	473	42	11	1028	41	25	653	11	35
1998	405	43	10	879	40	22	598	10	42
1999	448	37	12	889	43	21	609	9	35
2000	213	30	7	313	23	16	227	2	31
2001	270	29	9	366	24	17	369	8	30
2002	276	31	9	324	18	22	543	10	38
2003	333	38	9	130	7	19	296	7	26
2004	588	32	18	232	9	25	494	16	21
2005	799	30	27	380	15	26	628	24	30
2006	571	39	15	446	22	21	683	28	25
2007	496	35	14	297	17	20	977	36	27
2008	234	24	10	25	4	7	534	20	26

[1] = Vessels where <10% of landed value was Nephrops; [2] = Vessels where 30% of the landed weight was Nephrops

Figure 7.6.1 ***Nephrops*** **in FU 16 (Porcupine Bank)**
Landings mean sizes by sex and country
and in mean size in the catch for the Porcupine survey



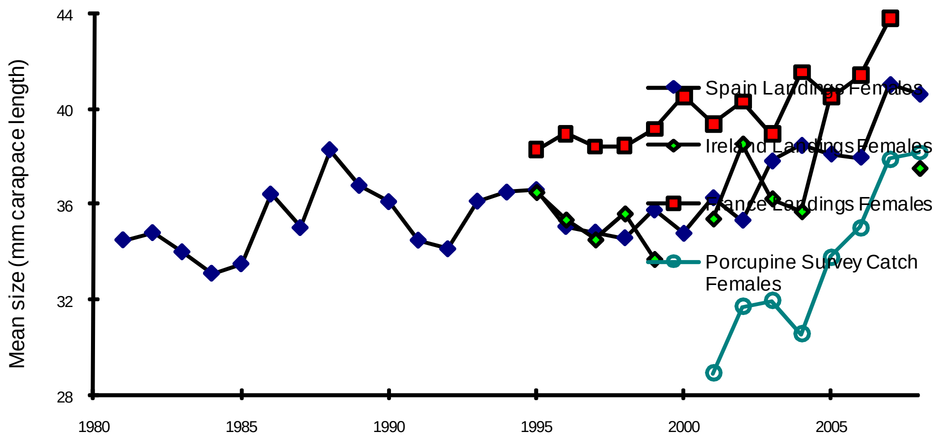


Figure 7.6.2 ***Nephrops*** **in FU 16 (Porcupine Bank)**
Female and Male landings length distributions

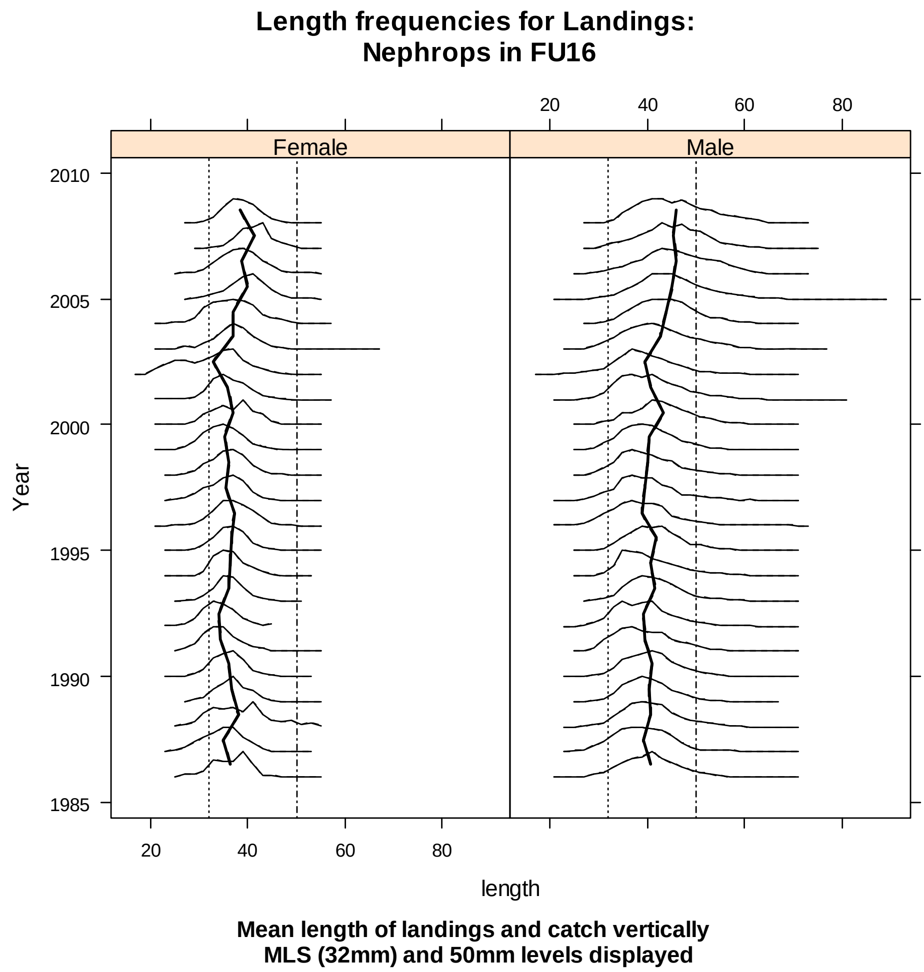
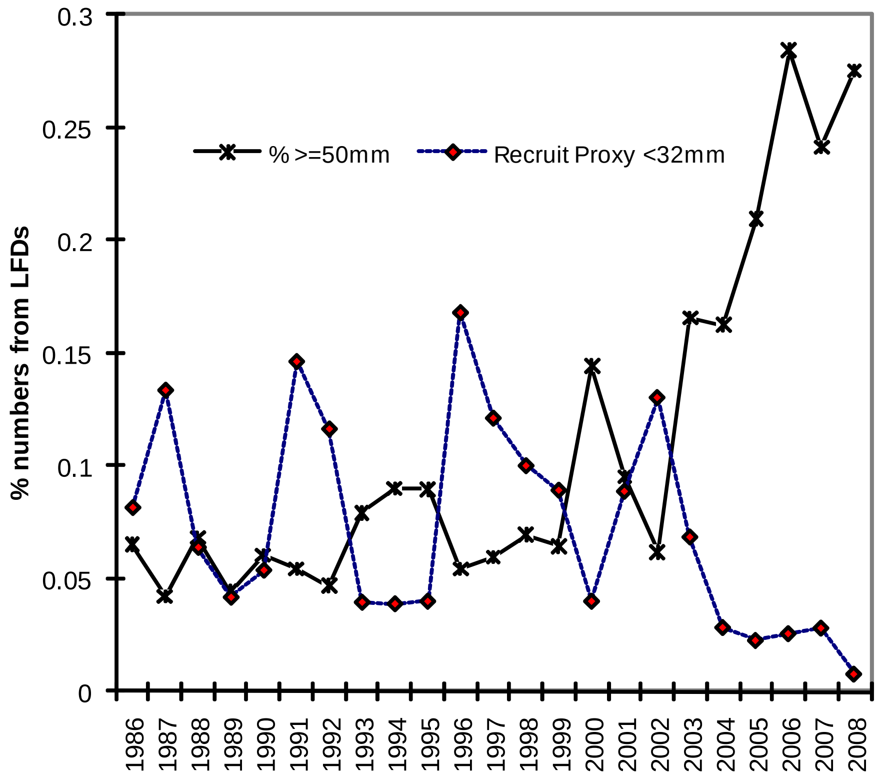


Figure 7.6.3 ***Nephrops*** **in FU 16 (Porcupine Bank)**
Trends in various indicators from Male length frequency data



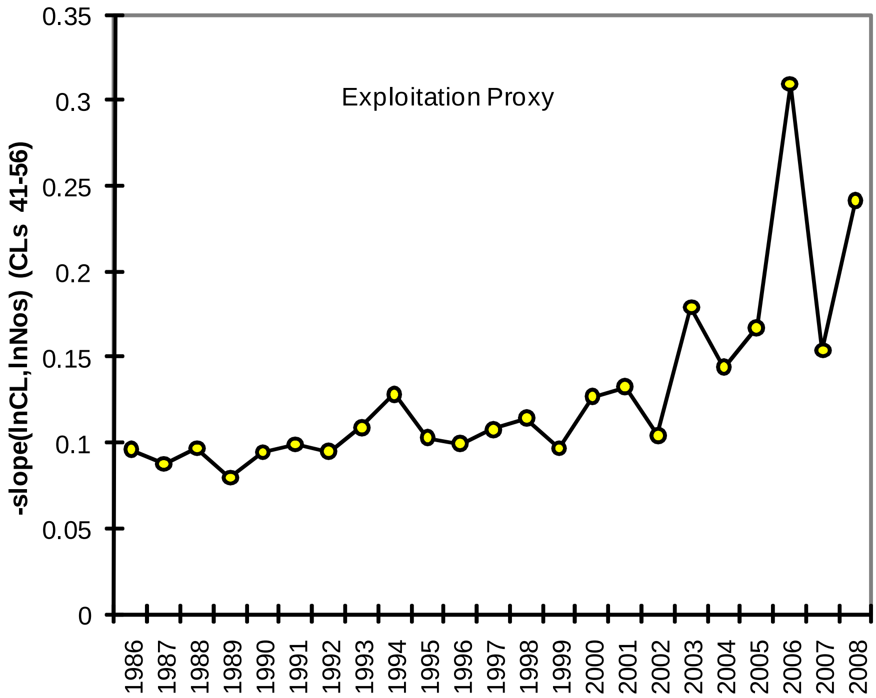
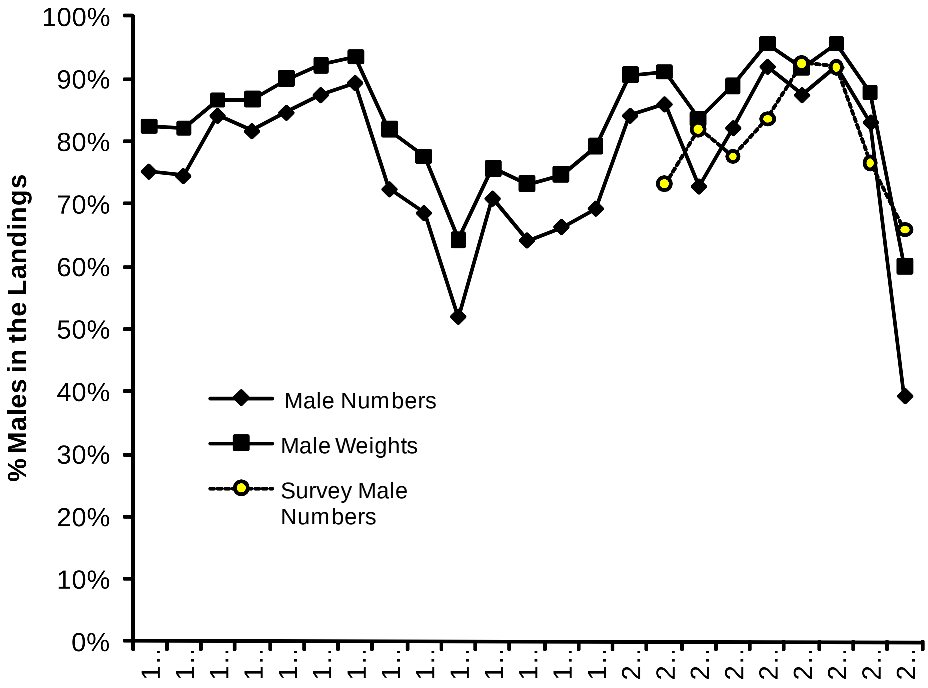


Figure 7.6.4 *Nephrops* in FU 16 (Porcupine Bank)
Sex Ratio of Landings and survey catches



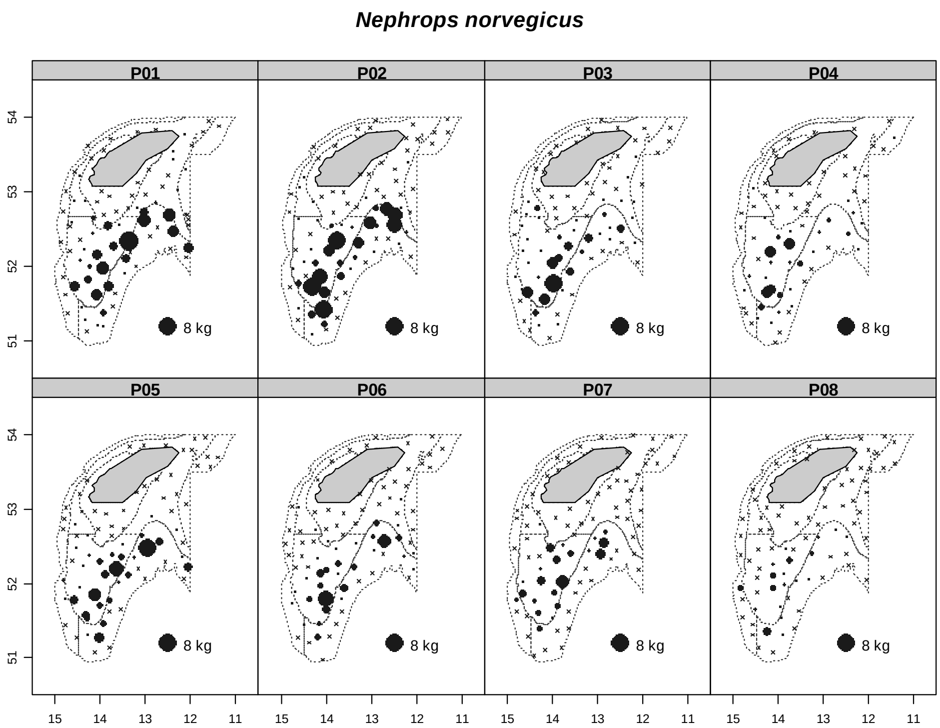


Figure 7.6.5. ***Nephrops*** **in FU16 (Porcupine Bank). Distribution of** ***Nephrops norvegicus*** **catches in biomass in Porcupine surveys between 2001 and 2008.**

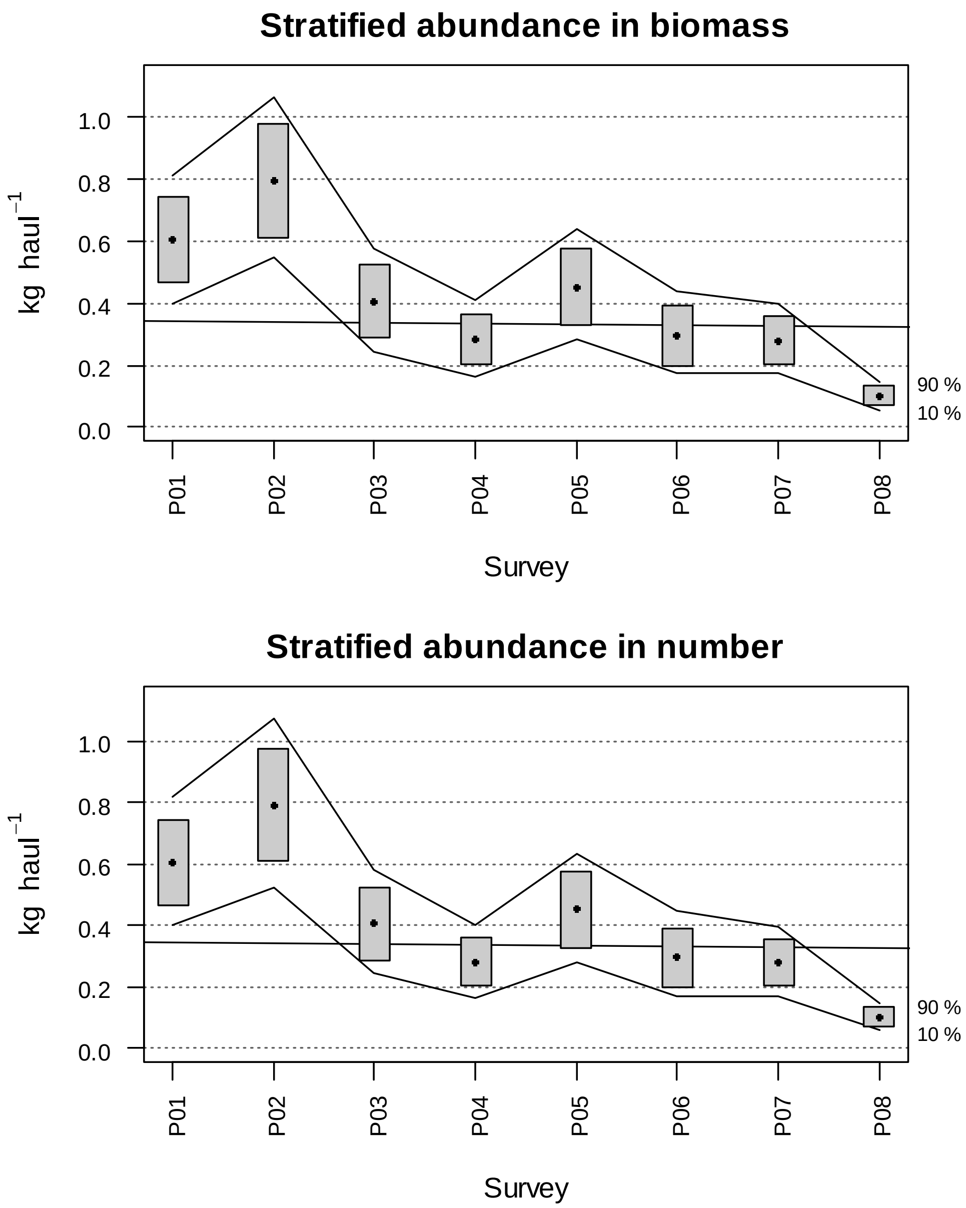


Figure 7.6.6. ***Nephrops*** **in FU16 (Porcupine Bank). Changes in** ***Nephrops norvegicus*** **biomass and number stratified indices during Porcupine survey time-series (2001–2008). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (**α**=0.80, bootstrap iterations=1000).**

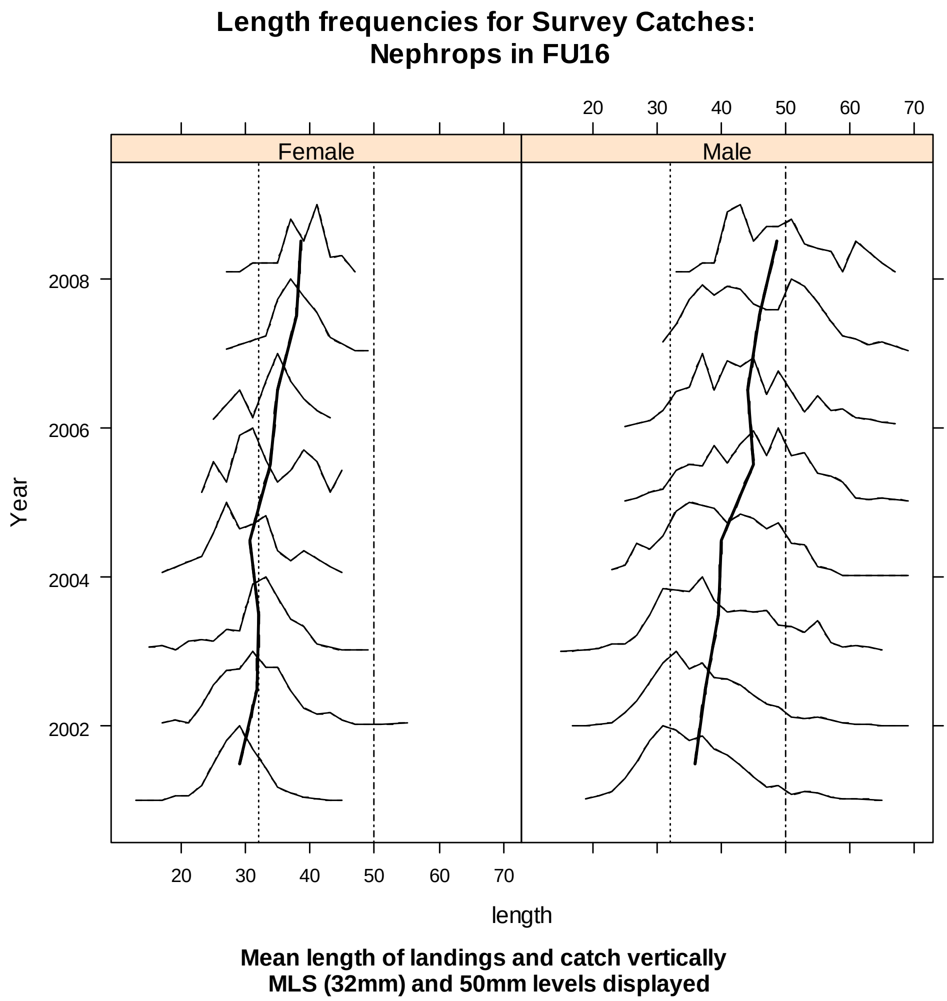
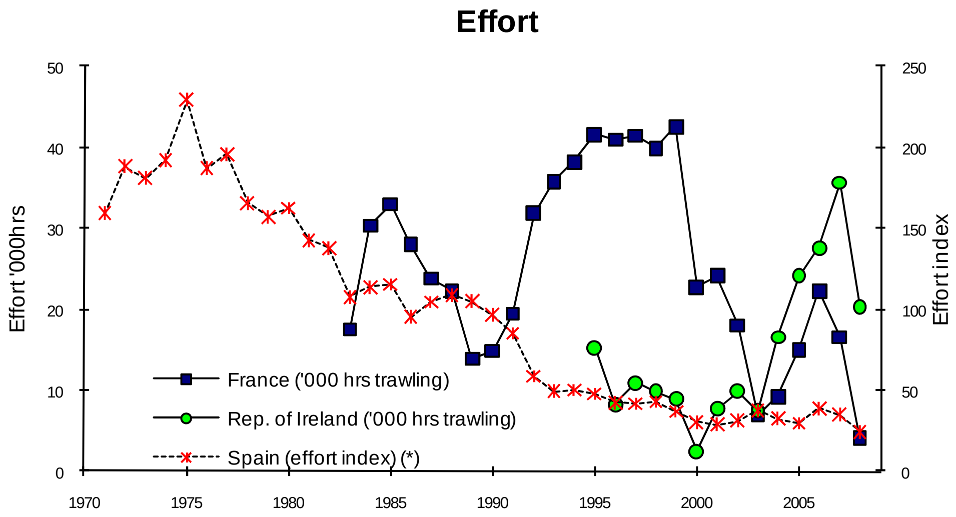


Figure 7.6.7. ***Nephrops*** **in FU16 (Porcupine Bank). Female and Male Porcupine Survey length distributions**



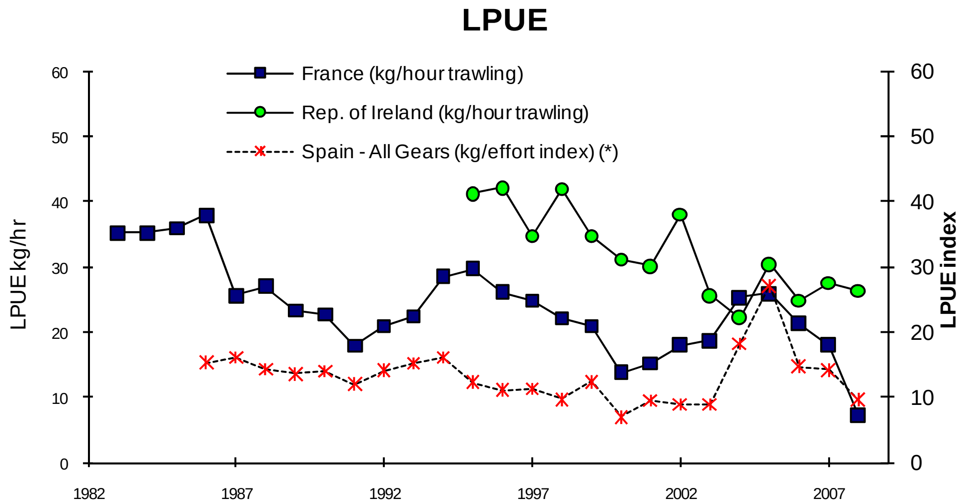


Figure 7.6.8. ***Nephrops*** **in FU16 (Porcupine Bank). Effort and lpue trends for fleets. (*) The Spanish effort index is based on a combination of hours at sea and average engine power. Irish and French effort and lpue is unstandardized.**

7.7 *Nephrops* in the Celtic Sea (FU20–22)

ICES description: VIIfgh

Functional Units: Celtic Sea, VIIfgh (FU20–22)

Main changes in the assessment methodology compared with last year: no major change compared with 2008. Since 2006, method for discard derivation investigated (Stock Annex).

In 2005, the FU20–22 *Nephrops* stock was allocated to the WGSSDS (because of the predominance of cod and whiting in the bycatches), in 2009 to the WGCSE.

Type of assessment in 2009

No assessment.

Overall upwards trend mainly since the early 2000s.

ICES advice applicable to 2008

Exploitation boundaries in relation to precautionary considerations

As this stock was not reviewed in 2007, the advice for 2008 is equivalent to that previously expressed by ICES: "*Landings have been relatively stable at around 4600 t in recent years and there are no other specific concerns about recent stock development. Therefore, ICES advises that Nephrops fisheries in this area should be constrained at recent levels of effort*".

ICES advice applicable to 2009

Exploitation boundaries in relation to precautionary considerations

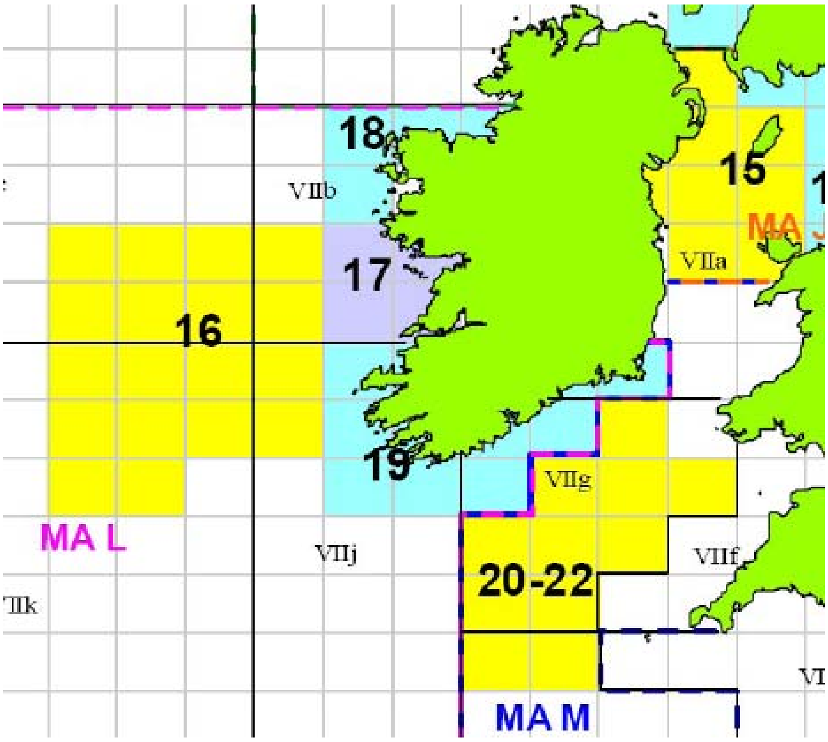
"*The current fishery appears sustainable. Therefore, ICES recommends that* Nephrops *fisheries should not be allowed to increase relative to 2007. This corresponds to landings of no more than 5300 tonnes for the Celtic Sea stock (FU20–22)*."

7.7.1 General

Stock description and management units.

The Celtic Sea *Nephrops* stock (FU20–22) is included in the whole ICES Area VII as Irish Sea East and West [FU14, FU15], Porcupine Bank [FU16], Aran Islands [FU17], North-West Irish Coast [FU18], South-East and South-West Irish Coast [FU19]. The TAC is set for Subarea VII which does not correspond to the stock area.

There is no evidence that the whole exploited area belongs to the same stock or that there are several patches linked in meta-population sense.



Management applicable in 2008 and 2009

Currently the TAC is set for Subarea VII (24 650 t for 2009 compared with 25 153 t in 2008 *i.e.* -2%). This TAC includes many *Nephrops* stocks and this may allow unrestricted catches for stocks under excessive fishing pressure where catches should be limited. Quota uptake by Ireland and UK is effectively 100% whereas quota uptake by France and Spain is less than 50% in recent years.

The MLS implemented by EC is set at 25 mm CL *i.e.* 8.5 cm total length and this regulation is applied by the Irish and UK fleets whereas a more restrictive regulation adopted by the French Producers' Organisations (35 mm CL *i.e.* 11.5 cm total length) is applied by the French trawlers.

In application of the Council Regulation (EC) N° 1459/1999, June 24th 1999, modifying the regulation (EC) N° 850/98 of the Council for the conservation of fishery resources through technical measures for the protection of juveniles, the French minimum mesh size of codend was set at 100 mm in January 2000 whereas the Irish mesh size was maintained at 80 mm.

Species: Norway lobster *Nephrops norvegicus*		Zone: VII NEP/07.
Spain	1 509	
France	6 116	
Ireland	9 277	
United Kingdom	8 251	
EC	25 153	
TAC	25 153	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

Species: Norway lobster *Nephrops norvegicus*		Zone: VII (NEP/07.)
Spain	1 479	
France	5 994	
Ireland	9 091	
United Kingdom	8 086	
EC	24 650	
TAC	24 650	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

Fishery in 2008

Landings

At WGSSDS 2008, the French landings were revised sharply downwards for 1999 (2036 t against 2745 t previously used). This revision was performed by including information of the new database "Harmonie" of statistics. The change involves notably reported fishing effort of trawlers from the FU20–22 stock (Celtic Sea) to the FU16 (Porcupine Bank) during the 2nd quarter of this year. In 2009, new revisions of French statistics were carried out by the WGCSE as following: 2078 t (instead of 2036 t) for 1999, 2848 t (instead of 2782 t) for 2000, 2626 t (instead of 2532 t) for 2001, 3154 t (instead of 3134 t) for 2002, 3595 (instead of 3510 t) for 2003, 2605 t (instead of 2511 t) for 2004, 2502 t (instead of 2490 t) for 2005, 2368 t (instead of 2397 t) for 2006, 2033 t (instead of 2082 t) for 2007. The new official statistics were generally changed upwards apart from years 2006 and 2007 while a proportion of the fishing effort for French trawlers was reallocated to the FU19 (SE and SW Irish coast).

Minor revisions were also carried out for Irish landings (2006 and 2007: 1864 t and 3213 t respectively against 1877 t and 3226 t used by WGSSDS 2008).

As described in the Stock Annex, landings are reported mainly by France and the Republic of Ireland (Figure 7.7.1; Table 7.7.1). The contribution of French landings has gradually decreased from 80–90% at the end of 1980s to 50–60% at the beginning of the 2000s. Then, in 2007 and 2008, French landings declined to less than 40% of the total reported quantities (2007: 2033 t on 5299 t; 2008: 2348 t on 6012 t; Table 7.7.1). The overall fishing profile remains typically seasonal (Table 7.7.2) with the majority of landings coming from the 2nd and 3rd quarters.

French landings increased notably by 15% from 2033 t in 2007 to 2348 t in 2008 while Irish landings increased slightly (3422 t against 3213 t: +7%). The contribution of other countries such as UK remains minor with an increasing trend in 2008. The total reported landings correspond to the highest level of the historical time-series in 2008.

88 French trawlers landed *Nephrops* from FU20–22 in 2008. Among them, 46 exceeded 10 t (more than 97% of French landings) and 5 vessels accounted for more than 20% of the total quantity harvested by France (where these vessels landings were between 90 t and 114 t). 99 Irish vessels reported landings in this area in 2008: of these, 67 reported landings in excess of 10 t, accounting for ~97% of Irish landings.

Uptake of quotas

There is not specific TAC or quota for the FU20–22 *Nephrops*, thus, the question should be examined for the whole Subarea VII. For the two main fleets operating in the Celtic Sea, the total harvested quantities on VII remained below the allowed quotas. In 2007, 6116 t were allocated to France whereas actual French landings 2007 were 2398 t largely *i.e.* 85% coming from the Celtic Sea. In 2007, 9277 t were allocated to the Republic of Ireland and 8802 t were landed (37% from the Celtic Sea). For 2008, the ICES recommended the stability of the fishing effort for the FU20–22 *Nephrops*: the fishing effort level for both main fleets did not increase between 2007 and 2008.

Discards

The increasing practice of tailing *Nephrops* for the French trawlers may affect the total discard rate of this fleet.

7.7.2 Data

Landings

Landings information by country (France and Ireland) is given in the Stock Annex. All data are presented in Figure 7.7.2 and Tables 7.7.3 to 7.7.10, 7.7.11a and 7.7.12a. The Table 7.7.13 provides information on mean size of landings by year and country.

Landings reveal significant differences between the two countries. The two ogives of selectivity through meshes are different. The evolution of the French landings had demonstrated a substantial increase of mean sizes since the beginning of 2000s (this coincides with mesh regulations cited in the Stock Annex), but a significant decrease of the mean size occurred in 2006 (41.0 mm CL for both sexes combined against 42.8 mm CL in 2005). The same trend was observed for Irish landings (29.2 mm CL against 31.1 mm CL in 2005). In 2007, a new decrease occurs for both countries (40.4 mm CL for France, 28.4 mm for Ireland).

The WGCSE 2009 point out a significantly increasing proportion of tailed individuals in French landings (Figure 7.7.3). This proportion was already high for Irish trawlers. In 2008, 20% of total French landings involved in tailed *Nephrops* (19% in 2007, 15% in 2006 and 11% in 2005; less than 5% until the beginning of 2000s). Industry explained this recent change by the economic difficulties of the vessels because of the rapidly increasing fuel prices. Tailed individuals are landed to compensate this loss for the crew participation at the total investment by trip. As the European MLS for FU20–22 *Nephrops* is fixed at 8.5 cm of total length (25 mm CL) and the MLS retained by the French Producers' Organizations is equal to 11.5 cm (35 mm CL), it was expected that tailed individuals should be comprised between these two sizes.

Before the end of 2007, the tailed *Nephrops* could not be sampled at auction and, as the sampling on-board remains difficult to apply routinely (long trip duration for French trawlers), the problem was partially tackled by apportioning tailed individuals to the smallest category of landings at auction. Since the end of 2007, new biometric relationships established during the EVHOE survey have been used (Stock Annex): they allow fitting CL vs. 2nd abdominal segment of tail by sex. The DLF of French landings for 2008 were estimated by two ways: one using the extrapolations from tails to CL, the other apportioning tails to the small category as for previous years. The resulting difference appears relevant (Figure 7.7.4): in 2008, 46 million *Nephrops* were provided by the previous method whereas 58 million were estimated by including tails (+28%). Almost 30% of landed individuals were below the French Producers' Organization MLS, but no *Nephrops* was undersized compared with European MLS. Moreover, the sex ratio seems to be affected by the tailing practice: 13% of *Nephrops* (7.4 million) were females although this percentage would be 7% (3.2 million) under the previous method. As indicated in the Table 7.7.13, the mean size of French landings for 2008 decreases at around 2.5-5 mm CL by sex when tails are involved by sampling. However, the mean CL for 2008 remains larger than the Irish one.

This result emphasizes the WGSSDS 2008 conclusion that the size composition may be overestimated when raised to the composition of entire individuals.

Discards

Sampling

The available dataset is detailed in the Stock Annex. Additional French dataset was also acquired in 2005, but it involves in only two quarters (Q3 and Q4; Stock Annex). As for landings, the Irish discard sampling began in 2002. Thus, there is no common dataset on discards between French and Irish fleets (lack of information of the Irish sampling programme for 2005-Q3, 2005-Q4, 2006-Q4, 2007-Q2). Available information on complete yearly sets (1997-FR, 2003-IRL, 2008-IRL) is given by Figure 7.7.5 and Table 7.7.14.

The notable contrast between the retained proportions on board and the spatial heterogeneity of the exploited area prevents direct comparisons of the main fleets. It is not yet possible to estimate if the inter-fleet variability of the discard rate is larger than the interannual one.

Changes in discard rate are a consequence of the strength of recruitments, increase in the MLS (which tends to increase the discards) and the gear selectivity. Other practices as stated above (tailing individuals) may affect discard rate. The relative contribution of each of these four factors remains unknown.

Back-calculation

As for the main *Nephrops* stocks, the lack of estimation of discards hampers quantitative analysis of recruitment indices, therefore, possibilities of back-calculation for discards were investigated. The proportional derivation of discards (processed by WGNEPH) was considered as unreliable because it induces lack of contrast in interannual variations of recruitment (see reports of WGSSDS since 2005). An alternative statistical approach developed since 2006 on other *Nephrops* stocks (VIIIab; Bay of Biscay; FU23–24) was also applied to the FU20–22. The main concepts of the back-calculation are detailed in Stock Annex.

All results are given in Figures 7.7.6 and 7.7.7. Tables 7.7.11b,c,d and 7.7.12b,c,d provide discard estimates, total catches and removals (using mortality rate of discards equal to 75%: Charuau *et al*., 1982).

The final results for French vessels emphasize that the simulated discard rate is notably more variable than that calculated by proportionality of landings. It is worth noting that the discard rate seems to have decreased during the time-series since the end of 1990s with some peaks over the series which can be associated to strong recruitment level (*e.g.* for years 2001 and 2003 as other information sources such as EVHOE survey indicates: Figure 7.7.8; see also Stock Annex). Moreover, during the overall time-series, some high (years 1988, 2001) or low (year 1990) values of simulated discard rates coincide with increase or decrease of lpue for 1–2 years later (Figure 7.7.9: increase in 1989–1990 and 2002–2003, decrease in 1991–1992). It should be noted that no constraint was set for back-calculations on the relationship between discard rate (year i) and lpue (years i+1/i+2). Nevertheless, the increasing proportion of tails probably modifies discard practices: this point has to be reviewed when a method of back-calculation for sizes of tails in landings should allow correcting DLF for previous years.

The Irish results indicate the better statistical adequacy of the back-calculation compared with the French results (Stock Annex). For 2002, the discard rate generated by the method is equal to 5.5% while that calculated by sampling value was 7.2% (as explained during WGSSDS 2006, the estimate provided by sampling was not used by WG because it was referred to the whole Management Area M). Moreover, for the quarters sampled by the Irish programme (Stock Annex) the descending part of the simulated curve for discards seems to be close to that estimated by sampling. However, some inconsistencies remain for the ascending part of simulated curves, thus, this method has to be further investigated.

Biological

In 2008, an experiment intending the update of maturity ogive for females was carried out during the EVHOE survey. The sampling plan of this survey is not designed for *Nephrops* (late period in the year *i.e.* November/December affecting female abundance because of burrowing), moreover the sensitive period for *Nephrops* maturity occurs during the 2nd and 3rd quarters. These data should be collected during a more adequate season; however, data sampled owing to commercial trips may be biased (selectivity of mesh size 100 mm), furthermore the long duration of French trips is an obstacle for this experiment. Other data sources as Irish experimental surveys (as explained for other species in the WD2) should be associated.

Surveys

At present abundance indices by survey are not available for this stock. Direct *Nephrops* assessment by trawling is inappropriate because of notable diurnal variations of availability which is higher during dawn and dusk. The current situation will be improved in future once a data time-series has been collected by the Irish specifically designed survey programme launched in 2006. However, the Irish and French fisheries exploited areas are different. On FU20–22, the French groundfish survey EVHOE although not focusing on *Nephrops* does provide an indication of the length distributions and the strength of recruitment (Stock Annex): good agreement between commercial French cpue and EVHOE series for the period 1997–2005 (R^2=0.65) while the relationship is sparser (R^2=0.36) when the commercial French lpue are used. An Irish groundfish survey has been carried out since 2003 giving length compositions of *Nephrops* catches. Moreover, a UK bottom-trawl survey occurred on the same area between 1984 and 2004 (see WGSSDS 2006), but only two sampling stations were within FU20–22 area.

The UWTV Irish survey since 2006 should improve available information (WD 14). The Celtic Sea UWTV survey covers only part of the *Nephrops* meta-population in the Celtic Sea there is significant biomass outside the surveyed area. An approach to estimate catch options including biomass outside the survey area needs to be developed. Improved spatially explicit fisheries data such as that presented in WD 1 of WGCSE 2009 will help in this regard. The current information from the survey-series, 2006–2008, points to a coincidence between survey indicators (highest levels on "Smalls" ground for 2006 compared with strong lpue values obtained by commercial vessels on the same area in 2007).

Commercial lpue

Between 2006 and 2007 (Figure 7.7.9; Table 7.7.15), the French fishing effort declined notably by -25% and the lpue increased (+13%) while the evolution of the same indicators for the Irish fleet was different (+31% of fishing effort and +36% of lpue). It is noticeable that the decrease of the French fishing effort was caused by the reduction of the number of trips by vessel whereas the total number of vessels remained almost stable. The trend of the Irish fishing effort involves either in increase of the fishing vessels (95 and 99 Irish trawlers were respectively listed in 2007 and 2008 compared with 80 for 2006) or an increase in the number of trips by vessel.

Between 2007 and 2008, the effort of the French trawlers decreased slightly (Figure 7.7.9; Table 7.7.15) *i.e.* 99 789 h against 101 980 h for 2007 whereas the Irish fishing effort remained stable (59 727 h against 59 899 h in 2007). Lpue of both fleets increased mainly for French trawlers (+22%: 22.6 kg/h against 18.5 kg/h for 2007) and, to a lesser degree, for Irish (+11%: 55.2 kg/h against 49.4 in 2007).

Other relevant data

Meetings with representatives of the fishing industry were held in France and Ireland prior to the WG.

French meeting underlined that the increase of lpue series since the end of 1990s may be caused by the change of the global fishing efficiency of the fleet because some old vessels were replaced by more recent ones. Fishing power analysis including spatial distribution should be undertaken on a common set of vessels with the aim of examining these effects. Furthermore, the problem of the actual size composition of tailed individuals in landings was also debated with Producers' Organisations. The possibility of European regulation such as a *numerous clauses* licence system was also debated. Moreover, taking into account the current difficulty to collect information during French commercial trips, the perspective of self-sampling applied on discarded fraction of catches was also discussed.

Irish fishing industry noticed an increase in the abundance of small *Nephrops* on the "Smalls" fishing ground over the last few years.

7.7.3 Historical stock development

For a long period, the FU20–22 *Nephrops* stock was analytically investigated by XSA. However, the *Nephrops* ageing cannot be performed routinely. The L2AGE slicing programme is usually applied on *Nephrops* stocks and allocates length classes into age groups by assuming von Bertalanffy model of individual growth. This slicing can be applied to length distributions by sex. All parameters, L∞ and K by sex, calculated mean sizes by age for each sex, natural mortality and maturity-by-sex (assumed to be knife-edged for males and s-shaped for females) and combined are given in Stock Annex.

The slicing process converting size-frequencies to age-compositions at the aim of performing XSA is often disapproved because it may induce lack of contrast between years (input set of common parameters for individual growth). Moreover, the von Bertalanffy's equation is often invalidated for crustaceans. As it would not be reasonable to expect that methods of direct age determination for *Nephrops* will be routinely available in the foreseeable future, alternative methods as CSA have to be investigated. The main current disadvantage of CSA is linked to the recruitment indices required: as the independent UWTV survey cannot yet provide consistent dataset on young year classes, the recruitment indices can be given only by annual discard indicators. Thus, no CSA investigation can be envisaged before replacing discards estimators by more reliable indices.

Comparison with previous assessments

In 2009, no assessment was performed by ICES. Only comparisons based on global indicators for the stock can be carried out. Even if there is no possibility for catch-at-age analysis regarding absolute levels of abundance of *Nephrops* in FU20–22, there is currently significant information on the relative stock state.

The current abundance indices applied for both main fleets for FU20–22 involve in commercial data (thresholds of 10% and 30% *i.e.* percentage of total landings composed from *Nephrops* respectively applied on French and Irish trawlers as tuning fleets).

In 2007, the lpue has increased substantially for the Irish fleet and slightly for the French fleet. In 2008, both lpue changed upwards mainly the French one. This has not been corrected to consider changing fishing power of fishing practices. The EVHOE also demonstrates a strong increase in catches for 2007 and 2008.

The French trawlers lpue and cpue series both have indicated a rise in stock abundance since the early 2000s suggesting that the stock is currently not recruitment overfished. However, it should be important to investigate whether the sharp Irish lpue variations correspond to actual signals for the stock or to other factors linked to fleet capacity (*e.g.* more efficient vessels switching from the Irish to the Celtic Sea). It is noticeable that the French groundfish survey EVHOE although not focusing on *Nephrops* had provided in 2007 the highest indices for this species since the beginning of the survey 10 years ago. Trenkel and Rochet, 2003 examining indicators in the French EVHOE Celtic Sea survey suggest that *Nephrops* population is increasing during recent years.

Until 2005, the mean size of landings had also increased except for 2001 when the smaller size composition suggests a stronger recruitment entry in the fishery. Nevertheless, in 2006 and 2007, mean sizes in landings for both fleets decreased. This point combined to the former UK survey on this area (suggesting a slight trend of decrease of mean sizes for some sampling reference stations: see WGSSDS 2006) could be induced either by stronger recruitment abundance than previously or by overfishing. From the end of 2007 onwards, the possibility of including tailed individuals in French sampling changes estimates of mean sizes: it is therefore necessary to compare indices after re-calculation of the mean sizes and sex ratios over the period because the tailed proportion became significant factor.

As no analytical XSA run was performed, abundance of recent recruiting year classes can be examined only by comparison of independent indicators such as discarded individuals estimated by the logistic derivation method and some surveys indices. As detailed in the Stock Annex, independent sources of information (EVHOE survey's indices, logistically derived discards for no sampled years) agree that some recent recruiting classes (mainly 2001 and probably 2002 and 2003) should be of a good level whereas it is still impossible to indicate the actual state of the more recent year classes.

Little or no change in the perception of the state of the stock has to be taken into consideration for the moment.

7.7.4 Short-term projections

No short-term projection was performed for this stock.

7.7.5 Medium-term projections

No medium-term projection was performed for this stock.

7.7.6 Biological reference points

There are no biological reference points for FU20–22 *Nephrops* stock.

7.7.7 Management plans

No specific management plan exists for this stock.

7.7.8 Uncertainties and bias in assessment and forecast

The revision of French landings, fishing effort and lpue over the recent years, underlines the heterogeneous composition of the standard pool of vessels (*e.g.* it could be divided into two separate fleets *i.e.* the one able to switch between different stocks of the Subarea VII and the other composed of less efficient trawlers limited to the Celtic Sea). Currently, misreporting does not seem to be a problem for the stock.

The investigations on discard derivation since 2006 have improved some knowledge of the actual interannual variability of the stock. Nevertheless, the French and Irish time-series remain different and were provided by applying different exploitation pattern on different areas.

The problem of high variability of landing samples between trips still remains (higher coefficients of variation at auction because of higher heterogeneity of the fished area and of long duration of trips *i.e.* 12–15 days and, therefore, less availability of samples at auction). Hence, high CV of numbers-at-sizes (20–30%) is usual. In any case, commercial samples can be extended by including the commercial part sampled on board during the DCR plan.

The sampling of tailed individuals in French landings provides valuable information, but underlines the necessity to back-calculate the actual size-composition of tailed individuals because their proportion became significant (*i.e.* 2004–2005).

Although the selectivity parameters are not significantly improved for *Nephrops* trawlers, it appears appropriate to continue the Irish discard plan and to conduct a French one on a yearly basis. For French trawlers, it should be suitable to investigate possibilities of reliable self-sampling on board. It should be interesting to examine the part of decrease of the French discard rate since the early 2000s as a consequence of the selectivity improvement from that related to some weak recruiting classes (however, size-composition of landings for 2006 and 2007 may suggest a positive signal for recruitment). Moreover, if the individual growth of this species is faster during the latter period of the compiled time-series, there would be decline of the discarded amounts with no possibility to investigate the actual recruitment level.

7.7.9 Recommendation for next Benchmark

The FU20–22 *Nephrops* stock is not analytically assessed by the WGCSE. The 2008 total official landings reach the highest level observed in the time-series available. Many quantitative explorations have been attempted in recent years (*e.g.* sampling on board, maturity ogive, discard derivation, exploration of survey data). These were handicapped by the overall spatial heterogeneity of the stock, by the different exploitation patterns for the two main fleets and by other factors such as commercial trip duration. Global indicators suggest the stock is stable or increasing. There is an urgent need to develop a more robust scientific assessment. Several data and methodological aspects should be address and explored in the next benchmark.

Biological sampling

Auction

As the French sampling of tailed *Nephrops* in the landings at auction has recently been standardized, unbiased information for LFD and sex ratio is expected.

On board

The Irish sampling on board and self sampling under the DCF will continue to provide information on discarded amounts and LFDs. For the French trawlers, self-sampling on board may be more realistic than in the past (concentration of a huge proportion of total landings in few vessels; see above § 7.7.1). Main problem is to obtain geo located samples from trips fishing in several areas.

Maturity

Re-estimation of maturity parameters requires a specifically designed experiment which should be commonly organized by France and Ireland under DCF.

Back-calculation for missing biological data

Tails

The modification of LFDs for tailed individuals has to be extended in the past years by applying probabilistic concepts combined with s-shaped quarterly curves of tailing *Nephrops* vs. size. It is intended to cover the overall period because the tailed fraction became significant (5–6 years).

Discards

After re-calculating LFD for French landings on recent years, by an analogous way as already performed by WGSSDS since 2006, LFD of discards for French trawlers should be carried out for the whole time-series integrating the change of relative selectivity for trawls in 2000 (100 mm replacing 80 mm).

Dataset on LFD of Irish landings before 2002

For the years 1995–2002, available series on Irish landings on quarterly basis was not associated to samples on DLF. In spite of spatial variability affecting size composition by fleet, the possibility to extrapolate French DLF for this period has to be investigated: before 2000, the same selectivity parameters for trawls should be used (the difference involved in MLS; § 7.7.1).

Surveys

UWTV Irish survey

The Irish UWTV survey initiated in 2006 should provide first exploitable results to tune data for this stock and could be used to directly assess stock abundance. The survey covers a restricted area that accounts for more than 2/3 of the total Irish landings. Because the Celtic Sea survey covers only part of the *Nephrops* meta-population in the Celtic Sea there is significant biomass outside the surveyed area. An approach to estimate catch options including biomass outside the survey area needs to be developed. Improved spatially explicit data such as that presented in WD 1 of WGCSE 2009 will help in this regard.

Commercial fleets

Standardisation of the French and Irish commercial landings and effort data should be carried out. The existence of official French and Irish statistics by vessel and trip (at least for the recent 10 years), allows to stratify the whole fleet in order to propose homogeneous pools for commercial tuning fleets. Spatio-temporal variability of fishing power should also be performed aiming to evaluate the effect of different decommissioning plans throughout the time–series.

7.7.10 Management considerations

Management for *Nephrops* stocks should be conducted at an appropriate geographic scale (*e.g.* Functional Unit). Because of the introduction of increasingly restrictive days-at-sea limits in VIIa and VIa in 2009 it is likely that further Irish and UK effort will be displace towards the Celtic Sea and other *Nephrops* grounds where effort control has not been put in place. Management measures should be established to prevent unsustainable increases in effort and catch for this stock.

The *Nephrops* fisheries target different areas, and *Nephrops* catches and landings demonstrate very different size structures. These fisheries also have differences in non-*Nephrops* bycatch composition. Cod, whiting, and to a lesser extent haddock are the main bycatch species.

Discarding of small *Nephrops* is substantial. The discard rate seems to have notably fluctuated between fleets or years. This demonstrates that trawls currently used to target *Nephrops* are not technically adapted to select marketable *Nephrops*. The calculation of the discard rate may be affected by the upwards trend of tailed individuals in landings. Discarding of other fish species is also a problem in *Nephrops* fishery.

The French trawlers demonstrated an overall decline during the last decade. It should be substantial to examine the evolution of the French fishing effort (decommissioning schemes associated to constraints linked to fuel prices).

In 2008, the lpue has increased for both fleets. This has not been corrected to consider changing fishing power of fishing practices.

The average landings since 2000 have been stable or ascending and there is little evidence to suggest significant changes in the status of this stock when formulating management advice.

7.7.11 References

Charuau A., Morizur Y., Rivoalen J.J. 1982. Survival of discarded *Nephrops norvegicus* in the Bay of Biscay and in the Celtic Sea. *ICES-CM-1982/B:13*.

Trenkel V.M., Rochet M.J., 2003. Performance of indicators derived from abundance estimates for detecting the impact of fishing on a fish community. *Can. J. Fish. Aquat. Sci./J. Can. Sci. Halieut. Aquat. Vol. 60, no. 1*, pp. 67–85.

Table 7.7.1. *Nephrops* FU 20–22 (Celtic Sea). Total and by country nominal landings (t) in Division VIIfgh as used by WG.

Year	France	Rep. of Ireland	UK	Other Countries1	Total reported	Unallocated	Total
1983	3667						
1984	3653						
1985	3599						
1986	2638						
1987	3080	329					
1988	2926	239					
1989	3221	784					
1990	3762	528					
1991	2651	644					
1992	3415	750					
1993	3815	770	63	0	4648	-274	4374
1994	3658	1415	68	2	5143	-274	4869
1995	3803	1575	125	2	5505	-282	5223
1996	3363	1377	86	2	4828	-217	4611
1997	2589	1552	95	4	4240	-213	4027
1998	2241	1619	64	1	3925	-90	3835
1999	2078	824	41	0	2943	-78	2865
2000	2848	1793	47	1	4689	-44	4545
2001	2626	2123	21	1	4771	-33	4738
2002	3154	1496	15	8	4673	-50	4623
2003	3595	1388	19	N/A	5002	0	5002
2004	2605	1627	36	N/A	4268	0	4268
2005	2502	2391	53	N/A	4946	0	4946
2006	2368	1864	32	N/A	4264	0	4264
2007	2033	3213	47	6	5299	0	5299
2008	2348	3422	242	N/A	6012	0	6012

[1]Other countries include Belgium.

Table 7.7.2. *Nephrops* FU 20–22 (Celtic Sea). Nominal landings (t) by quarter in Division VIIfgh as used by WG.

	French trawlers					Irish trawlers				
Year	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
1987	759	941	972	409	3080					329
1988	547	1065	683	631	2926					239
1989	411	1493	838	480	3221					784
1990	482	1765	1229	287	3762					528
1991	500	1245	518	388	2652					644
1992	681	992	1064	678	3415					750
1993	972	1598	742	504	3815					770
1994	541	1303	1052	762	3658					1415
1995	693	1631	876	604	3803	193	1137	109	136	1575
1996	674	1437	728	523	3363	268	714	330	66	1377
1997	460	1028	683	417	2589	249	971	196	136	1552
1998	642	881	456	262	2241	351	952	264	52	1619
1999	479	447	606	546	2078	214	184	105	321	824
2000	598	1261	743	246	2848	420	1154	149	71	1793
2001	422	879	667	658	2626	456	843	317	508	2123
2002	479	1211	823	641	3154	167	557	408	363	1496
2003	533	1401	1187	474	3595	202	519	478	190	1388
2004	496	981	677	452	2605	234	685	341	367	1627
2005	628	909	537	428	2502	491	1390	233	277	2391
2006	486	1024	563	295	2368	354	978	233	299	1864
2007	294	966	423	350	2033	416	1331	415	1051	3213
2008	450	794	681	424	2348	493	1606	600	723	3422

Table 7.7.3. ***Nephrops*** **in VIIfgh. Length distribution of landings by country in 2002. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3. The Irish data reported from the whole MA M (See WD 13; WGSSDS 2006).**

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
17										
18										
19		4		5				24		33
20		13		6				126		145
21		37		4				172		213
22		72		17				564		653
23		124		85		6		1124		1340
24		236		136		67	81	1804	81	2243
25		421		216		75		1533		2245
26		538		245		182		1495		2459
27		778		326		202		1110		2417
28		760	83	577		607		1516	83	3459
29	21	639		776		470		1220	21	3104
30	41	510		741		1125	242	1107	283	3483
31	47	589		1075		1685	242	1284	289	4632
32	132	565		1199		1558	242	1002	375	4325
33	140	453	83	1624	37	1551	404	995	664	4624
34	236	419	122	1654	165	1455	404	753	927	4281
35	366	326	540	1654	401	1152	678	782	1985	3913
36	503	256	995	1376	1125	599	601	512	3223	2742
37	648	221	1541	1361	706	711	823	412	3718	2705
38	797	198	1603	1156	1603	580	1146	526	5150	2460
39	847	198	2230	820	1463	341	824	270	5364	1628
40	1078	116	2901	907	1466	313	1618	270	7063	1606
41	817	47	2757	380	1028	249	1377	171	5978	847
42	1114	140	2365	322	1186	207	669	156	5334	825
43	509	12	2070	249	781	129	836	85	4196	474
44	604	47	1003	234	1076	129	771	28	3454	438
45	352	23	1157	132	605	74	612	71	2727	300
46	144		467	132	893	37	306	14	1811	183
47	179		345	15	470	97	247	14	1241	126
48	78	23	472	102	422	55	175	14	1147	195
49	87	12	133	59	202	37	55	14	477	121
50	73		242	15	158		87	14	560	29
51	48		166		126	18	95		435	18
52	32		72		120	18	94		318	18
53	30		76		45		24		175	
54	31		57		65	18	23		176	18
55	24		53		99	18	17		192	18
56	18		40		19		8		85	

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
57	11		42		9	18	15		77	18
58	11		23		8	18			42	18
59	10		12		2		1		25	
60	12		14		7	18	1		34	18
61	3		18		7		1		28	
62	4		20		1		1		26	
63	2				1		8		11	
64	2						1		2	
65	2				1				3	
66										
67										
68	1				1				2	
69										
70										
71										
72										
73										
74										
75										
TOTAL	9056	7774	21 703	17 600	14 293	13 821	12 732	19 184	57 783	58 378

Table 7.7.4. ***Nephrops*** **in VIIfgh. Length distribution of landings by country in 2003. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.**

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
17										
18				2						2
19				10						10
20		123		26		71		49		269
21		554		72		270		172		1068
22		565		169		398		198		1330
23		1444		319		596		211		2570
24		444		848		607		239		2139
25		149		1110		736		477		2473
26		2322		1836		1071		586		5815
27		319		1894		1643		514		4370
28		1666		1967		2063		948		6644
29		448		1895		2330		901		5574
30		370		1744		2543		445		5102
31	25	827		1682		1905	25	828	50	5241
32		997	47	1796	211	1809	99	1307	357	5908
33		545	47	2035		1359	99	437	146	4376
34		426	328	1565	739	1373	124	477	1191	3841
35	77	236	516	1293	1689	868	496	240	2778	2637
36	75	189	563	856	1901	509	545	254	3083	1808
37	298	189	1220	639	1478	378	595	233	3591	1440
38	323	284	1313	492	2649	390	694	206	4979	1372
39	497	95	1360	359	2745	434	694	137	5297	1025
40	828		2224	158	1496	179	620	158	5168	495
41	1024	47	2499	257	2217	219	942	69	6683	592
42	1044	95	2385	197	1409	223	697	34	5535	549
43	1096	47	2478	228	1224	112	737	27	5535	414
44	761		1734	80	1472	96	501	27	4467	203
45	751		1532	70	1229	20	459	21	3971	110
46	462	47	1692	50	1193	20	312	14	3659	131
47	298		1008	20	391	120	243	27	1941	167
48	308		674	10	313	60	204		1498	70
49	243		392	30	180	40	142	7	958	77
50	99		313	20	108	20	156		676	40
51	79		212	20	81	40	78		450	60
52	42		119	10	90		57	14	308	24
53	25		93		54		27		199	
54	12		86		18		9		126	
55	25		40		9		21		94	
56	10		33		36		3		82	
57	10		27	10	36		3		75	10

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
58	5		20						25	
59	2		13		9				25	
60										
61			7						7	
62	5								5	
63										
64										
65										
66										
67										
68										
69										
70										
71										
72										
73										
74										
75										
TOTAL	8424	12 429	22 977	23 767	22 978	22 500	8581	9258	62 959	67 953

Table 7.7.5. ***Nephrops*** **in VIIfgh. Length distribution of landings by country in 2004. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3. The missing Irish data of the 1st and 4th quarters were calculated by likelihood function as explained in WD 13.**

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
17								1		1
18		3						2		6
19		16						4		20
20		30		1		1		8		40
21		46		11		1		19		77
22		69		8				57		134
23		108		25		4		107		245
24		160		100		13		207		480
25		213		189		37		368		806
26		298		445		107		565		1414
27		390		576		286		799		2052
28		443		703		699		1091		2935
29		537		1010		1126		1360		4034
30		680		1398		1652		1521		5251
31		737		1960	73	1798		1563	73	6058
32	80	783	64	2487	254	1606		1542	398	6417
33	321	800	64	2862	363	1403		1386	748	6451
34	351	745		3030	327	1337	161	1144	838	6256
35	728	633	191	2293	689	988	183	908	1792	4823
36	618	553	318	1901	1161	708	688	738	2785	3900
37	763	443	1080	1698	871	449	1009	544	3723	3134
38	827	373	1080	1299	1161	353	596	397	3664	2422
39	537	298	1652	797	798	225	688	297	3675	1616
40	695	216	826	498	980	134	573	223	3074	1071
41	486	150	1525	447	1161	135	573	162	3745	893
42	612	105	1789	249	762	82	688	118	3852	554
43	516	68	837	161	726	57	575	79	2653	365
44	461	41	1218	74	635	59	392	59	2706	233
45	470	31	1092	50	527	30	482	46	2571	156
46	129	21	827		142	22	432	29	1530	72
47	309	16	457	50	408	24	90	17	1264	106
48	178	11	661	25	278	11	182	14	1299	61
49	178	9	352	25	282	11	123	6	935	51
50	125	5	395		149	5	69	4	739	14
51	149	4	193		145	3	54	3	541	10
52	117	2	215		126	3	58	3	516	7
53	81	2	204		114	8	81	2	479	12
54	60	2	129		37	3	61	2	287	6
55	60		64		37	3	48	3	209	6
56	36		54		37		36	3	164	3

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
57	26		54		37	16	17	3	134	19
58	18		11		26		12	3	66	3
59	3		32		4	5	10	3	48	8
60	3				15		6	1	23	1
61					15		2	1	17	1
62					11				11	
63					4				4	
64										
65							2		2	
66						3				3
67								1		1
68							2	1	2	1
69						3				3
70								1		1
71								1		1
72						3				3
73										
74										
75										
TOTAL	8938	9042	15 381	24 371	12 354	13 411	7892	15 412	44 565	62 236

Table 7.7.6. ***Nephrops*** **in VIIfgh. Length distribution of landings by country in 2005. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.**

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
17										
18				3						3
19		10		7						17
20		22		31		41		107		200
21		22		74		187		379		662
22		60		79		226		422		787
23		150		209		343	1	811	1	1513
24		543		446		759		1506		3253
25		705		1035		1074		1874		4688
26		1303		1302		1143	8	3006	8	6754
27	9	1942		2227		1712	1	2404	10	8285
28		1878		2983		1897	2	1753	2	8510
29		2122		4281		1610	1	1296	1	9310
30	9	2281		5134		1404	4	1059	13	9878
31		2427		6639		1150	21	1048	21	11264
32	70	2056		7014	8	575	70	631	148	10276
33	44	1312	10	6247	18	709	162	491	233	8759
34	131	1436		4688	58	439	471	624	660	7187
35	289	1101	69	4429	196	169	769	247	1323	5945
36	464	688	223	3546	297	140	1076	322	2060	4696
37	525	553	429	1916	515	151	1188	123	2656	2743
38	578	557	483	1985	558	62	1109	192	2728	2796
39	814	459	598	1343	761	31	934	178	3106	2011
40	658	379	615	659	696	31	731	69	2700	1137
41	735	180	617	493	545	16	589	41	2487	730
42	780	99	744	370	493	75	415	27	2432	573
43	570	159	588	110	412	23	450	14	2021	305
44	613	99	598	27	276	60	288		1775	186
45	547		746	27	247		271	14	1812	41
46	520	80	701	82	161		182		1563	163
47	400		752	27	199		135		1486	27
48	258		757		158	68	75		1248	68
49	271		677		177		49		1174	
50	241		698	41	302		34		1275	41
51	263		476		271		40		1051	
52	179		349		215		21		764	
53	153		332		198		23		707	
54	101		241		181		20		543	
55	89		193		205		16		502	
56	50		132		85		9		276	
57	58		140		73		9		280	

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
58	33		64		68		4		169	
59	31		48		48		5		133	
60	15		8		13		4		39	
61	15		9		18		1		43	
62	3		5		4				11	
63	3		3		10		1		17	
64					1				1	
65			2		1				2	
66			2		1				3	
67					1				1	
68					1				1	
69										
70					1				1	
71										
72					1				1	
73										
74										
75					1				1	
TOTAL	9519	22 620	11 307	57 455	7474	14 093	9190	18 639	37 491	112 807

Table 7.7.7. ***Nephrops*** **in VIIfgh. Length distribution of landings by country in 2006. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.**

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
17										
18						4				4
19				7		8				15
20		79		20		11		123		233
21		92		57		13		341		504
22		267		198		71		587		1123
23		563		494		124		1153		2334
24		1542		863		431		1719		4554
25		1999		1520		696		2226		6442
26		2944		3106		1339		2729		10118
27		3260		4662		1730		2892		12544
28		3247		5777	10	2059	6	2374	15	13457
29		2827		6544		1697		1453		12521
30		1950	13	6529	10	1444	11	1128	34	11051
31		1738		4693	20	1017		735	20	8183
32	18	989	26	4636	68	709	34	581	146	6916
33	53	673	13	3346	78	651	85	431	229	5102
34	152	398	208	2472	205	576	312	345	877	3791
35	286	412	312	1703	254	270	431	331	1283	2717
36	397	178	845	1205	488	274	738	264	2468	1922
37	642	124	1430	837	714	145	772	250	3558	1356
38	648	96	1963	525	1143	111	755	174	4509	906
39	788	82	1769	359	1133	92	590	141	4281	675
40	735	13	2015	280	918	20	568	97	4237	410
41	636	13	1755	265	1026	52	540	68	3957	398
42	722		1496	129	791	11	319	53	3329	193
43	674	13	1257	99	815	7	315	32	3061	152
44	486		965	86	519	11	211	38	2181	135
45	429		897	58	335	7	119	17	1781	82
46	346		696	13	468	4	119	14	1629	32
47	297	27	529	28	287		86	14	1198	69
48	262		465	7	138		48	11	913	18
49	168		248	13	138		66	2	619	16
50	87		216		117		23	5	443	5
51	71		100		115		27		313	
52	68		156	13	70		19		313	13
53	62		114		46		10		231	
54	42		72		42		9		166	
55	34		63		27		10		134	
56	33		39		23		8		105	
57	29		38		13		5		85	

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
58	17		38		12		5		71	
59	11	13	26		8		3		49	13
60	7		15		12		2		36	
61	4		10		6		1		21	
62	3		3		4		1		10	
63	1				1		1		3	
64	2		2		2				7	
65			1		1				2	
66										
67										
68										
69										
70										
71										
72										
73										
74										
75										
TOTAL	8209	23 543	17 796	50 546	10 060	13 589	6249	20 328	42 315	108 006

Table 7.7.8. *Nephrops* in VIIfgh. Length distribution of landings by country in 2007. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
17										
18										
19				29						29
20		105		147		10		204		467
21		211		354		36				601
22		494		1048		167		650		2360
23		916		2896		539		3669		8020
24		2756		3974		1308		5096		13134
25		4216		5682		2577		5667		18142
26		5318		8819		2948		5620		22705
27		6274	21	9504		3387		3055	21	22221
28		5456	21	11328		4069		3630	22	24482
29		4524		11790		4176	5	3528	5	24017
30	5	1767	42	10036		3041		4662	47	19506
31	5	916		6475		2014	5	3376	10	12781
32	15	356	64	4082	22	1192	25	3386	125	9017
33	81	105	127	2756	54	1007	45	2526	307	6395
34	161		255	1429	194	383	121	2196	731	4008
35	218	105	806	1118	517	288	226	1797	1768	3308
36	328		1125	707	862	168	301	1697	2616	2572
37	385		1804	441	1412	69	453	1248	4053	1757
38	603		1973	352	1121	49	592	1073	4290	1474
39	522		1783	293	1013	32	744	823	4063	1148
40	461		2295	321	884	39	597	548	4238	909
41	410		1490	232	766	27	646	678	3312	938
42	363		1429	72	540		515	374	2848	447
43	334		1399	116	423	16	353	349	2510	481
44	317		866	87	267	6	335	50	1784	142
45	233		973	73	278		293	75	1777	148
46	264		569	57	196	6	253	75	1282	138
47	116		328	14	98		205	50	747	64
48	136		391		72		176	50	774	50
49	91		158	14	46		126	75	421	89
50	68		160		38		86		352	
51	44		73		35		44		196	
52	34		70		19		20		142	
53	22		39		11		25	24	98	24
54	18		21		9		27		76	
55	19		17		8		6		50	
56	9		18		5		19		51	
57	7		7		2		8		24	

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
58	11		6	14	2		2		21	14
59	4		5				1		10	
60	5		6		1		2		13	
61	2		5		1		1		8	
62	2		3		1				7	
63	1		2						3	
64			1						2	
65									1	
66										
67										
68										
69										
70										
71										
72										
73										
74										
75										
TOTAL	5296	33 520	18 354	84 262	8897	27 553	6256	56 253	38 803	201 588

Table 7.7.9. ***Nephrops*** **in VIIfgh. Length distribution of landings by country in 2008. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.**

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
17										
18										
19										
20										
21				29						29
22				300						300
23				659		69		540		1268
24				1491		410		1720		3620
25		18		2583		913		3460		6974
26		958	27	4521	22	1136		5801	49	12415
27		1011	82	5463	22	1782		1557	104	9812
28	26	3760	218	6607	89	1582	10	2836	343	14785
29	4	3033	463	6502	72	2256	43	1756	582	13547
30	162	3337	742	7331	245	2116	108	1871	1256	14654
31	275	981	1042	7386	467	2969	167	1410	1951	12746
32	497	1087	1774	6716	989	3241	307	1450	3567	12494
33	752	1319	1527	4966	1372	3063	488	1509	4140	10858
34	1058	1123	1789	4878	1629	2363	721	1692	5198	10055
35	977	1462	1818	4619	1720	1221	817	1930	5332	9231
36	1167	1123	1993	3030	2116	1383	979	1211	6254	6747
37	920	677	1596	2063	1589	718	897	893	5001	4351
38	751	660	1383	1237	1525	666	1032	992	4690	3555
39	567	356	1242	925	1434	244	828	774	4071	2298
40	444	339	1148	568	965	213	750	596	3306	1715
41	465	267	946	383	856	282	619	675	2886	1607
42	383	178	671	397	595	182	566	437	2215	1194
43	367	89	607	270	368	91	378	278	1720	727
44	316	89	471	326	414		291	59	1493	474
45	371	53	342	85	245		233	158	1190	296
46	225		259	85	180		171	39	835	124
47	206		151		112		123	39	593	39
48	144		173	42	76		62	39	456	81
49	74		97	170	76		50	39	298	209
50	84		81	127	45		36	39	247	166
51	39		56	42	60		37	20	192	62
52	25		40	42	30		14		109	42
53	29		28		23		12		92	
54	11		21		16		16		65	
55	11		17		12		3		43	
56	8		12		7		1		28	
57	10		7		5		2		24	

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	F	IRL	F	IRL	F	IRL	F	IRL	F	IRL
58	12		4		1		1		17	
59	4		3		1				8	
60	1		3		1				4	
61			1						2	
62			1						1	
63			1						1	
64										
65										
66										
67										
68										
69										
70										
71										
72										
73										
74										
75										
TOTAL	10 387	21 918	20 836	73 841	17 380	26 900	9763	33 820	58 365	156 479

Table 7.7.10. ***Nephrops*** **in VIIfgh. French landings in 2008. Length distributions (1) including the data on tails and (2) using the previous method (no sampling of tails; the total tailed proportion was apportioned in the smallest category of entire** ***Nephrops*** **at auction). Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.**

	Q1		Q2		Q3		Q4		TOTAL	
CL (MM)	TAILS	NO TAILS	TAILS	NO TAILS	TAILS	NO TAILS	TAILS	NO TAILS	TAILS	NO TAILS
17										
18										
19										
20										
21										
22										
23										
24										
25										
26			27		22				49	
27			82		22				104	
28	26		218		89		10		343	
29	4	6	463		72	10	43	6	582	22
30	162	6	742	12	245		108		1256	18
31	275	19	1042	13	467		167	18	1951	50
32	497	38	1774	61	989	20	307	55	3567	174
33	752	89	1527	280	1372	30	488	146	4140	544
34	1058	247	1789	536	1629	181	721	273	5198	1236
35	977	438	1818	925	1720	441	817	450	5332	2253
36	1167	554	1993	1448	2116	941	979	753	6254	3697
37	920	668	1596	1692	1589	1422	897	863	5001	4645
38	751	647	1383	1814	1525	1682	1032	1087	4690	5231
39	567	669	1242	1583	1434	2063	828	844	4071	5159
40	444	597	1148	1558	965	1462	750	911	3306	4528
41	465	654	946	1418	856	1382	619	772	2886	4226
42	383	560	671	1027	595	1052	566	744	2215	3383
43	367	576	607	1044	368	703	378	521	1720	2845
44	316	511	471	812	414	782	291	374	1493	2480
45	371	598	342	568	245	455	233	255	1190	1876
46	225	345	259	405	180	277	171	198	835	1225
47	206	290	151	219	112	184	123	118	593	812
48	144	209	173	201	76	105	62	84	456	600
49	74	102	97	128	76	100	50	65	298	395
50	84	117	81	93	45	55	36	44	247	308
51	39	49	56	56	60	74	37	50	192	229
52	25	28	40	47	30	30	14	17	109	120
53	29	36	28	28	23	23	12	14	92	102
54	11	11	21	21	16	16	16	6	65	55

CL (MM)	Q1		Q2		Q3		Q4		TOTAL	
	TAILS	NO TAILS	TAILS	NO TAILS	TAILS	NO TAILS	TAILS	NO TAILS	TAILS	NO TAILS
55	11	13	17	17	12	12	3	3	43	46
56	8	8	12	12	7	7	1	1	28	28
57	10	12	7	7	5	5	2	2	24	27
58	12	14	4	4	1	1	1	1	17	20
59	4	4	3	3	1	1			8	8
60	1	1	3	3	1	1			4	4
61			1	1					2	2
62			1	1					1	1
63			1	1					1	1
64										
65										
66										
67										
68										
69										
70										
71										
72										
73										
74										
75										
TOTAL	10387	8117	20836	16039	17380	13516	9763	8676	58365	46348

Table 7.7.11.a *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh) landings length distributions in 1987–2008. French trawlers.

Landings CL mm/	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	57	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	53	0	36	0	0	0	0	43	0	0	0	0	0	0	0	0	0	1	0	0	0
24	0	106	0	57	0	30	0	0	43	0	0	0	0	0	0	81	0	0	0	0	0	0
25	24	289	0	0	14	0	85	0	86	0	0	0	0	0	0	0	0	0	0	0	0	0
26	88	309	0	29	53	60	19	12	109	15	0	0	0	45	0	0	0	0	8	0	0	49
27	149	490	0	143	34	111	84	23	644	20	15	0	34	23	26	0	0	0	10	0	21	104
28	684	1177	110	465	448	669	111	78	601	60	28	59	18	45	0	83	0	0	2	15	22	343
29	1104	3180	710	728	922	966	213	309	610	62	45	93	15	90	0	21	0	0	1	0	5	582
30	2030	4373	958	1241	1719	2139	393	631	1113	246	236	294	255	150	258	283	0	0	13	34	47	1256
31	2317	7579	1804	2146	3047	3212	935	1113	1074	696	542	475	469	155	606	289	50	73	21	20	10	1951
32	3640	8076	3103	2521	4057	4393	2253	2650	2486	1803	1220	1043	1171	324	1990	375	357	398	148	146	125	3567
33	4449	8059	4294	4456	6036	6608	2468	3177	3203	2699	2144	1396	1801	739	3095	664	146	748	233	229	307	4140
34	4312	8452	5210	5034	5804	6509	3757	4532	3129	4239	2186	2308	2441	1113	3766	927	1191	838	660	877	731	5198
35	6179	6948	6479	6677	5721	7896	5213	6666	4870	6136	3608	3354	3034	2115	6159	1985	2778	1792	1323	1283	1768	5332
36	5691	5137	5914	5800	4591	8225	5941	5440	4339	5583	3827	3587	3102	2554	5506	3223	3083	2785	2060	2468	2616	6254
37	5479	5084	5281	5077	3959	8066	6026	6653	7127	6995	4262	4465	3457	3381	5602	3718	3591	3723	2656	3558	4053	5001
38	4940	3623	5931	6143	3797	7579	6784	6950	7141	7410	4804	4525	3483	3354	3324	5150	4979	3664	2728	4509	4290	4690
39	3870	2383	4832	5402	3091	5528	5667	4853	5497	5691	3619	3127	2646	4471	3500	5364	5297	3675	3106	4281	4063	4071
40	4622	2590	4843	4796	2772	3386	7263	5497	6493	5277	4918	4453	3819	4316	4325	7063	5168	3074	2700	4237	4238	3306
41	2482	2302	3636	3702	2216	2745	5349	4396	4044	4225	3062	2875	2365	4108	3404	5978	6683	3745	2487	3957	3312	2886
42	2695	2462	3675	4147	2218	2919	5485	4473	4433	4096	3414	2996	2898	3889	2180	5334	5535	3852	2432	3329	2848	2215
43	1994	1645	2371	3271	2110	2429	3652	3222	3257	3205	2725	2267	1828	3223	2723	4196	5535	2653	2021	3061	2510	1720
44	1275	1274	2165	3235	1793	1680	2415	2580	3403	2115	1849	2109	1938	3006	2231	3454	4467	2706	1775	2181	1784	1493
45	1590	1231	1999	2366	1550	1636	2732	2183	2142	2086	2288	1474	1459	2688	1346	2727	3971	2571	1812	1781	1777	1190
46	1265	988	1415	2066	1229	1222	1653	1348	1747	1183	1428	1014	1045	2280	1073	1811	3659	1530	1563	1629	1282	835
47	1184	806	1151	1446	865	939	1604	1323	1635	1247	1021	1012	921	1358	934	1241	1941	1264	1486	1198	747	593
48	1182	778	858	1787	1057	966	1134	1204	1338	877	970	789	825	1115	652	1147	1498	1299	1248	913	774	456
49	767	525	708	1277	766	738	950	898	816	747	603	433	530	846	466	477	958	935	1174	619	421	298
50	834	437	565	809	527	576	981	969	972	702	733	420	461	801	438	560	676	739	1275	443	352	247
51	571	307	511	692	437	406	489	639	743	504	353	274	330	650	335	435	450	541	1051	313	196	192
52	668	353	447	786	403	278	612	571	770	510	372	253	270	458	347	318	308	516	764	313	142	109
53	526	260	315	477	303	303	365	395	635	389	286	157	220	439	251	175	199	479	707	231	98	92
54	268	205	253	387	236	191	344	462	448	294	198	110	197	277	194	176	126	287	543	166	76	65
55	391	111	148	204	128	171	276	364	262	197	110	109	144	243	137	192	94	209	502	134	50	43
56	150	107	156	95	121	96	162	191	152	141	54	76	80	155	182	85	82	164	276	105	51	28
57	129	85	118	90	48	74	93	110	176	116	81	41	53	82	103	77	75	134	280	85	24	24
58	55	49	96	91	73	68	83	154	124	56	36	28	24	104	111	42	25	66	169	71	21	17
59	92	33	74	31	12	48	93	68	49	22	8	7	15	64	94	25	25	48	133	49	10	8
60	52	4	26	26	17	24	47	71	69	17	23	13	14	55	71	34	0	23	39	36	13	4
61	7	4	22	8	0	11	19	22	22	5	8	0	11	57	39	28	7	17	43	21	8	2
62	11	10	7	21	7	9	25	9	29	20	3	0	5	11	27	26	5	11	11	10	7	1
63	6	0	12	0	1	0	5	12	13	2	0	2	0	15	0	11	0	4	17	3	3	1
64	0	0	5	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	1	7	2	0
65	16	4	5	0	0	0	6	2	3	0	0	0	0	10	0	3	0	2	2	2	1	0
66	0	0	0	0	0	2	0	2	0	0	0	0	0	5	0	0	0	0	3	0	0	0
67	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
68	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	1	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Total	**67794**	**81948**	**70215**	**77770**	**62182**	**82908**	**75824**	**74255**	**75892**	**69686**	**51080**	**45637**	**41375**	**48813**	**55498**	**57783**	**62959**	**44565**	**37491**	**42315**	**38803**	**58365**
Weights	**3080**	**2926**	**3221**	**3762**	**2652**	**3415**	**3815**	**3658**	**3803**	**3363**	**2589**	**2241**	**2078**	**2848**	**2626**	**3154**	**3595**	**2605**	**2502**	**2368**	**2033**	**2348**

Table 7.7.11.b *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh) discards length distributions in 1987–2008. French trawlers.

Total Discards

CL mm/	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10	266	4004	447	235	1423	1830	165	229	202	312	0	153	42	71	642	131	112	63	25	82	235	NOT VALIDATED METHOD FOR DISCARD DERIVATION
11	332	4555	523	283	1711	2153	206	276	251	366	0	175	53	82	726	151	134	75	30	93	254	
12	414	5175	612	341	2054	2529	258	334	313	428	0	200	66	95	820	174	160	89	35	105	274	
13	517	5871	716	411	2463	2968	323	403	389	500	0	229	83	110	925	200	191	105	42	118	295	
14	644	6648	836	493	2950	3478	403	485	483	584	0	262	104	127	1042	230	229	125	50	133	317	
15	801	7515	974	592	3526	4070	503	584	599	682	0	299	129	147	1172	264	273	148	60	150	341	
16	996	8476	1133	710	4206	4755	627	702	743	794	1	341	161	169	1317	302	325	176	71	168	367	
17	1235	9537	1316	849	5005	5543	781	842	920	923	0	387	201	195	1477	346	388	208	84	189	394	
18	1528	10703	1525	1013	5940	6447	970	1008	1137	1072	0	440	250	224	1653	396	461	245	100	212	422	
19	1886	11978	1763	1205	7026	7479	1202	1204	1402	1242	0	498	310	257	1847	452	548	289	119	238	453	
20	2319	13364	2031	1429	8278	8650	1485	1434	1725	1435	13	562	383	294	2058	514	650	340	140	266	484	
21	2840	14859	2334	1688	9712	9969	1829	1702	2115	1653	10	633	472	336	2288	584	770	400	166	298	518	
22	3461	16462	2671	1986	11337	11447	2244	2013	2583	1899	481	711	580	383	2537	662	909	468	195	332	553	
23	4193	18167	3045	2325	13160	13087	2739	2369	3141	2174	1780	795	708	435	2805	748	1070	546	229	370	590	
24	5044	19968	3457	2706	15180	14891	3323	2775	3800	2480	2046	887	861	492	3091	843	1255	634	268	410	628	
25	6020	21852	3904	3130	17390	16857	4004	3232	4568	2816	3918	985	1039	556	3395	946	1468	735	313	455	668	
26	7120	23807	4386	3595	19773	18976	4786	3739	5451	3182	3328	1089	1245	625	3716	1058	1709	847	364	503	709	
27	8336	25818	4900	4098	22303	21233	5669	4296	6451	3578	12027	1199	1478	700	4053	1179	1980	971	420	555	752	
28	9652	27865	5442	4634	24944	23607	6647	4897	7564	4001	11287	1314	1737	781	4402	1307	2282	1107	484	610	796	
29	11045	42700	6006	5194	27656	26074	7706	5536	8779	4447	8610	1432	2020	867	4763	1443	2614	1254	554	668	841	
30	12483	35105	6585	5772	57932	28601	8829	6204	10077	4914	16167	1554	2321	957	5133	1586	2974	1412	629	730	887	
31	13502	35522	7173	9559	52685	61039	9989	6889	11432	5395	7960	1678	2634	1052	5508	1734	3361	1578	711	795	935	
32	12374	22938	10988	6357	30272	35147	20679	14384	25096	5885	11377	1642	2610	1149	2611	1885	3770	1750	797	863	983	
33	6560	14262	8488	6744	23041	23628	12682	12079	16531	12121	9025	3453	3829	1248	12334	2039	4196	1927	887	932	1032	
34	4350	8576	6427	5028	11216	10924	8222	7255	5899	9287	2744	3345	2625	1779	7741	2003	4631	1932	980	1004	1081	
35	3316	5040	5029	4598	4536	6264	5866	4577	4861	5211	2639	2780	1596	2730	10810	3377	10010	4114	1831	1077	1131	
36	1854	2330	2909	2522	2042	2974	3225	1988	2062	2463	1520	1489	919	2303	6739	4282	6021	3712	2104	1151	3631	
37	1065	1219	1522	1427	937	1497	1466	1302	1702	1580	743	1024	431	1793	3380	1910	2917	1949	1169	1864	3096	
38	688	578	1070	1130	475	633	729	579	763	826	394	463	234	1018	1328	1772	2551	1255	745	1459	1436	
39	367	188	567	615	190	230	308	177	254	325	157	150	66	736	600	944	1416	573	532	735	686	
40	291	124	358	354	95	52	210	90	144	124	184	102	53	381	405	551	503	296	270	349	357	
41	98	66	158	175	31	21	73	46	49	59	74	35	17	183	186	227	373	202	68	190	149	
42	73	55	119	136	15	11	34	20	23	21	77	18	9	108	60	121	138	83	135	79	61	
43	36	18	43	67	8	4	9	10	9	10	25	7	3	50	37	47	67	36	40	41	27	
44	13	8	27	44	3	2	3	4	4	3	8	3	2	24	14	28	38	18	79	15	9	
45	13	6	15	19	1	1	1	1	2	1	9	1	1	13	4	10	17	8	22	5	5	
46	6	3	7	11	1	0	1	0	1	0	1	0	0	6	1	6	9	2	58	4	2	
47	3	2	4	5	0	0	0	0	0	0	0	0	0	1	1	2	2	2	11	1	1	
48	2	1	2	4	0	0	0	0	0	0	2	0	0	1	0	1	1	1	7	0	0	
49	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	
50	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	0	0	
53	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	2	0	0	
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	66	0	0	
61	0	0	0	0	61	0	0	0	0	0	0	29	0	0	0	0	0	0	2	0	0	
62	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	19	0	0	
63	0	8	0	10	0	2	0	0	0	0	0	0	0	0	0	0	3	0	3	0	0	
64	1	6	0	8	32	2	5	8	4	4	0	18	0	13	0	0	2	9	5	0	0	
65	0	0	0	6	25	1	0	0	0	3	0	15	0	0	0	0	2	0	6	0	0	
66	1	4	6	5	20	0	3	0	2	2	0	13	0	0	17	0	1	6	7	2	0	
67	0	3	5	4	16	1	2	4	2	2	0	11	0	8	14	0	1	5	2	2	0	
68	0	2	0	3	13	1	2	3	1	1	0	10	0	7	11	0	1	0	12	1	38	
69	0	2	3	3	11	0	1	2	1	1	0	8	0	6	9	4	1	3	2	1	34	
70	0	1	3	2	9	0	1	2	1	1	0	7	0	5	8	4	0	3	6	1	30	
71	0	1	2	2	7	0	1	1	1	1	0	6	0	4	6	3	0	2	1	1	26	
72	0	1	2	1	6	0	1	0	0	0	0	5	0	3	5	3	0	2	1	0	23	
73	0	1	1	1	4	0	0	1	0	0	0	4	0	3	4	2	0	1	1	0	20	
74	0	0	1	1	4	0	0	1	0	0	0	4	0	2	4	2	0	1	1	0	18	
75	0	0	1	1	3	0	0	1	0	0	0	3	0	2	3	1	0	1	1	0	16	
Total	**125752**	**425396**	**99536**	**81530**	**389726**	**377075**	**118210**	**93687**	**131541**	**82811**	**96612**	**30494**	**29275**	**22529**	**101702**	**34473**	**60540**	**29707**	**15119**	**17260**	**25605**	
Weights	**1995**	**5251**	**1727**	**1484**	**5819**	**5573**	**2211**	**1717**	**2389**	**1544**	**1737**	**628**	**549**	**559**	**1954**	**799**	**1440**	**717**	**443**	**417**	**646**	

Table 7.7.11.c *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh) catches length distributions in 1987–2008. French trawlers.

Total catches																						
CL mm/	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
10	266	4004	447	235	1423	1830	165	229	202	312	0	153	42	71	642	131	112	63	25	82	235	
11	332	4555	523	283	1711	2153	206	276	251	366	0	175	53	82	726	151	134	75	30	93	254	
12	414	5175	612	341	2054	2529	258	334	313	428	0	200	66	95	820	174	160	89	35	105	274	
13	517	5871	716	411	2463	2968	323	403	389	500	0	229	83	110	925	200	191	105	42	118	295	
14	644	6648	836	493	2950	3478	403	485	483	584	0	262	104	127	1042	230	229	125	50	133	317	
15	801	7515	974	592	3526	4070	503	584	599	682	0	299	129	147	1172	264	273	148	60	150	341	
16	996	8476	1133	710	4206	4755	627	702	743	794	1	341	161	169	1317	302	325	176	71	168	367	
17	1235	9537	1316	849	5005	5543	781	842	920	923	0	387	201	195	1477	346	388	208	84	189	394	
18	1528	10703	1525	1013	5940	6447	970	1008	1137	1072	0	440	250	224	1653	396	461	245	100	212	422	
19	1886	11978	1763	1205	7026	7479	1202	1204	1402	1242	0	498	310	257	1847	452	548	289	119	238	453	
20	2319	13364	2031	1429	8278	8650	1485	1434	1725	1435	13	562	383	294	2058	514	650	340	141	266	484	
21	2840	14915	2334	1696	9712	9969	1829	1702	2115	1653	10	633	472	336	2288	584	770	400	166	298	518	
22	3461	16462	2671	1986	11337	11447	2282	2013	2583	1899	481	711	580	383	2537	662	909	468	195	332	553	
23	4193	18221	3045	2360	13160	13087	2739	2369	3184	2174	1780	795	708	435	2805	748	1070	546	230	370	590	
24	5044	20074	3457	2763	15180	14921	3323	2775	3843	2480	2046	887	861	492	3091	924	1255	634	268	410	628	
25	6044	22141	3904	3130	17404	16857	4089	3232	4654	2816	3918	985	1039	556	3395	946	1468	735	313	455	668	
26	7208	24116	4386	3623	19826	19036	4805	3751	5560	3197	3328	1089	1245	670	3716	1058	1709	847	372	503	709	
27	8485	26308	4900	4241	22336	21343	5753	4319	7096	3598	12042	1199	1511	723	4079	1179	1980	971	430	555	773	
28	10337	29042	5552	5099	25392	24276	6758	4975	8166	4061	11315	1373	1755	826	4402	1391	2282	1107	486	625	817	
29	12149	45879	6716	5922	28579	27040	7919	5844	9389	4509	8655	1525	2035	957	4763	1465	2614	1254	555	668	846	
30	14513	39478	7543	7012	59651	30739	9222	6835	11190	5160	16403	1848	2575	1107	5391	1869	2974	1412	643	764	934	
31	15819	43100	8977	11705	55732	64251	10924	8002	12507	6091	8503	2153	3102	1206	6114	2023	3411	1650	731	815	944	
32	16014	31014	14092	8878	34328	39540	22932	17034	27582	7688	12597	2685	3781	1473	4601	2260	4127	2148	945	1009	1108	
33	11009	22321	12781	11200	29077	30235	15150	15256	19734	14820	11169	4849	5630	1987	15429	2703	4342	2675	1120	1161	1339	
34	8662	17028	11636	10062	17020	17434	11980	11787	9029	13525	4930	5653	5066	2892	11507	2930	5823	2770	1640	1881	1812	
35	9495	11987	11509	11275	10258	14161	11079	11244	9732	11347	6247	6134	4630	4845	16969	5362	12788	5906	3154	2361	2899	
36	7544	7468	8823	8321	6633	11198	9165	7428	6402	8046	5347	5076	4021	4857	12246	7505	9105	6497	4164	3619	6246	
37	6544	6303	6804	6504	4895	9562	7492	7954	8829	8574	5005	5488	3888	5174	8982	5628	6508	5672	3825	5422	7150	
38	5628	4201	7001	7273	4272	8212	7513	7529	7904	8236	5198	4988	3718	4372	4652	6921	7530	4919	3472	5968	5726	
39	4237	2571	5399	6018	3281	5758	5976	5030	5751	6016	3776	3276	2712	5207	4100	6309	6713	4248	3638	5016	4749	
40	4913	2714	5201	5150	2866	3438	7472	5588	6637	5402	5102	4555	3873	4697	4729	7614	5671	3370	2970	4586	4595	
41	2580	2368	3794	3877	2247	2767	5422	4442	4093	4283	3136	2910	2382	4291	3590	6204	7055	3947	2555	4147	3461	
42	2768	2517	3794	4283	2233	2930	5519	4493	4456	4117	3491	3014	2907	3997	2240	5455	5672	3935	2566	3408	2909	
43	2030	1663	2414	3338	2118	2433	3660	3232	3266	3215	2750	2274	1831	3273	2759	4243	5602	2689	2061	3103	2537	
44	1288	1282	2192	3279	1796	1681	2418	2584	3408	2118	1857	2112	1940	3030	2245	3482	4505	2724	1854	2196	1793	
45	1603	1238	2014	2385	1551	1637	2733	2185	2144	2087	2297	1474	1460	2701	1350	2736	3989	2579	1834	1787	1782	
46	1271	991	1422	2077	1230	1222	1654	1348	1748	1183	1429	1014	1045	2285	1074	1817	3668	1532	1621	1633	1284	
47	1188	808	1155	1450	865	939	1604	1323	1635	1247	1021	1012	921	1359	935	1243	1943	1265	1497	1200	748	
48	1185	780	860	1791	1057	966	1135	1205	1338	877	972	789	825	1116	652	1148	1499	1300	1256	914	774	
49	768	525	709	1279	766	738	950	898	816	747	603	433	530	847	466	477	958	935	1182	620	421	
50	835	437	565	810	527	576	981	969	972	702	734	420	461	802	438	561	676	739	1294	443	352	
51	572	307	512	693	437	406	489	639	743	504	353	274	330	650	335	435	450	541	1057	313	196	
52	668	353	447	786	403	278	612	571	770	510	372	253	270	458	347	318	308	516	812	313	142	
53	526	260	315	477	303	303	365	395	635	389	289	157	220	439	251	175	199	479	708	231	98	
54	268	205	254	387	236	191	344	462	448	294	198	110	197	277	194	176	126	287	555	166	76	
55	391	111	148	204	128	171	276	364	262	197	110	109	144	243	137	192	94	209	514	134	50	
56	150	107	156	95	121	96	162	191	152	141	54	76	80	155	182	85	82	164	280	105	51	
57	129	85	118	90	48	74	93	110	176	116	81	41	53	82	103	77	75	134	314	85	24	
58	55	49	96	91	73	68	83	154	124	56	36	28	24	104	111	42	25	66	184	71	21	
59	92	33	74	31	12	48	93	68	49	22	8	7	15	64	94	25	25	48	133	49	10	
60	52	4	26	26	17	24	47	71	69	17	23	13	14	55	71	34	7	23	105	36	13	
61	7	4	22	8	61	11	19	22	22	5	8	29	11	57	39	28	7	17	45	21	8	
62	11	10	7	21	7	9	25	9	29	20	3	25	5	11	27	26	5	11	30	10	7	
63	6	8	12	10	1	2	5	12	13	2	0	2	0	15	0	11	3	4	20	3	3	
64	1	6	5	8	32	2	5	8	4	4	0	18	0	13	3	2	2	9	6	7	2	
65	16	4	5	6	25	1	6	2	3	3	0	15	0	10	0	3	2	2	8	2	1	
66	1	4	6	5	20	2	3	2	2	2	0	13	0	5	17	0	1	6	9	2	0	
67	6	3	5	4	16	1	2	4	2	2	0	11	0	8	14	0	1	5	2	2	0	
68	0	2	5	3	13	1	2	3	1	1	0	10	0	7	11	2	1	2	13	1	38	
69	0	2	3	3	11	0	1	2	1	1	0	8	0	6	9	4	1	3	2	1	34	
70	0	1	3	2	9	0	1	2	1	1	0	7	0	5	8	4	0	3	7	1	30	
71	0	1	2	2	7	0	1	1	1	1	0	6	0	4	6	3	0	2	1	1	26	
72	0	1	2	1	6	0	1	2	0	0	0	5	0	3	5	3	0	2	2	0	23	
73	0	1	1	1	4	0	0	1	0	0	0	4	0	3	4	2	0	1	1	0	20	
74	0	0	1	1	4	0	0	1	0	0	0	4	0	2	4	2	0	1	1	0	18	
75	0	0	1	1	3	0	0	1	0	0	0	3	0	2	3	1	0	1	2	0	16	
Total	**193546**	**507344**	**169752**	**159300**	**451908**	**459983**	**194034**	**167942**	**207432**	**152496**	**147692**	**76131**	**70651**	**71342**	**157200**	**92256**	**123499**	**74272**	**52610**	**59575**	**64408**	
Weights	**5075**	**8177**	**4949**	**5246**	**8470**	**8988**	**6027**	**5376**	**6191**	**4907**	**4326**	**2870**	**2627**	**3407**	**4581**	**3953**	**5035**	**3323**	**2945**	**2785**	**2679**	

NOT VALIDATED METHOD FOR DISCARD DERIVATION

Table 7.7.11.d *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh) removals length distributions in 1987–2008. French trawlers.

Removals=Landings+dead catches (discard survival rate : 25%)

CL mm/	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10	199	3003	335	176	1068	1373	124	172	151	234	0	114	32	53	482	98	84	47	19	62	176	
11	249	3416	393	212	1283	1614	155	207	189	274	0	131	40	62	545	113	100	56	22	70	190	
12	311	3881	459	256	1541	1897	194	250	235	321	0	150	50	71	615	130	120	67	27	79	205	
13	387	4403	537	308	1847	2226	242	302	292	375	0	172	62	82	694	150	143	79	32	89	221	
14	483	4986	627	370	2212	2609	302	364	362	438	0	197	78	95	782	172	171	94	38	100	238	
15	601	5636	730	444	2644	3053	377	438	450	511	0	224	97	110	879	198	205	111	45	112	256	
16	747	6357	850	532	3155	3566	470	526	557	595	1	255	121	127	988	227	244	132	53	126	275	
17	926	7153	987	637	3754	4157	585	631	690	693	0	291	151	146	1108	260	291	156	63	142	295	
18	1146	8028	1144	760	4455	4835	727	756	853	804	0	330	187	168	1240	297	346	184	75	159	317	
19	1415	8984	1322	904	5269	5609	901	903	1051	931	0	373	232	192	1385	339	411	217	89	179	339	
20	1740	10023	1524	1072	6209	6487	1114	1075	1293	1076	10	422	287	220	1544	386	488	255	106	200	363	
21	2130	11201	1750	1273	7284	7477	1372	1277	1586	1240	7	475	354	252	1716	438	577	300	125	223	388	
22	2596	12346	2003	1490	8503	8585	1721	1510	1937	1425	361	533	435	287	1903	497	681	351	146	249	415	
23	3145	13679	2284	1779	9870	9815	2054	1777	2399	1631	1335	597	531	326	2103	561	802	409	172	277	442	
24	3783	15082	2592	2087	11385	11199	2492	2081	2893	1860	1535	665	646	369	2318	713	942	476	201	308	471	
25	4539	16678	2928	2347	13057	12643	3088	2424	3512	2112	2938	739	779	417	2546	710	1101	551	235	341	501	
26	5428	18165	3290	2725	14883	14292	3608	2816	4197	2402	2496	817	933	514	2787	794	1282	635	281	377	532	
27	6401	19853	3675	3216	16761	16035	4336	3245	5483	2704	9035	899	1142	548	3066	884	1485	728	325	416	585	
28	7924	22076	4192	3940	19156	18375	5096	3750	6275	3061	8493	1044	1321	631	3302	1064	1711	830	365	473	618	
29	9388	35204	5215	4624	21665	20521	5992	4460	7194	3397	6502	1167	1530	740	3573	1104	1960	941	416	501	636	
30	11393	30702	5897	5570	45168	23589	7015	5284	8671	3931	12362	1459	1995	868	4108	1473	2231	1059	485	582	713	
31	12444	34220	7183	9315	42561	48991	8427	6280	9649	4742	6512	1733	2444	943	4737	1589	2571	1256	554	616	711	
32	12920	25279	11345	7289	26760	30754	17762	13438	21308	6216	9753	2275	3129	1186	3948	1789	3185	1711	746	793	862	
33	9369	18756	10659	9514	23316	24328	11979	12236	15601	11790	8913	3986	4673	1675	12346	2194	3293	2193	899	928	1081	
34	7574	14884	10030	8805	14216	14703	9924	9973	7554	11204	4244	4817	4410	2447	9572	2429	4665	2287	1395	1630	1542	
35	8666	10728	10251	10126	9124	12595	9613	10099	8516	10044	5587	5439	4231	4162	14267	4518	10286	4877	2697	2091	2616	
36	7081	6885	8096	7691	6122	10455	8359	6931	5886	7431	4967	4704	3791	4281	10561	6435	7599	5569	3638	3332	5338	
37	6278	5998	6423	6147	4661	9188	7126	7629	8404	8179	4819	5232	3780	4726	8137	5151	5779	5185	3532	4956	6376	
38	5456	4057	6734	6990	4153	8053	7330	7384	7713	8029	5100	4872	3659	4118	4320	6478	6892	4605	3286	5603	5367	
39	4145	2524	5257	5864	3233	5700	5898	4986	5687	5935	3737	3239	2695	5023	3950	6072	6359	4105	3505	4832	4578	
40	4840	2683	5112	5061	2843	3425	7420	5565	6601	5370	5056	4529	3859	4602	4628	7476	5545	3296	2902	4499	4506	
41	2555	2351	3755	3833	2239	2761	5404	4431	4080	4269	3118	2901	2378	4245	3543	6148	6962	3897	2538	4099	3424	
42	2750	2504	3764	4249	2229	2927	5511	4488	4451	4112	3472	3009	2905	3970	2225	5425	5638	3914	2533	3388	2894	
43	2021	1659	2404	3321	2116	2432	3658	3229	3263	3212	2744	2273	1830	3260	2750	4231	5585	2680	2051	3092	2531	
44	1285	1280	2185	3268	1795	1681	2417	2583	3407	2117	1855	2111	1939	3024	2242	3475	4495	2720	1835	2192	1791	
45	1600	1236	2011	2380	1551	1637	2733	2184	2143	2087	2294	1474	1460	2698	1349	2734	3984	2577	1829	1785	1781	
46	1270	990	1420	2074	1229	1222	1654	1348	1748	1183	1428	1014	1045	2284	1074	1816	3666	1531	1606	1632	1283	
47	1187	808	1154	1449	865	939	1604	1323	1635	1247	1021	1012	921	1359	935	1242	1942	1265	1494	1199	747	
48	1184	779	860	1790	1057	966	1135	1204	1338	877	971	789	825	1116	652	1148	1499	1300	1254	913	774	
49	768	525	708	1278	766	738	950	898	816	747	603	433	530	847	466	477	958	935	1180	620	421	
50	835	437	565	809	527	576	981	969	972	702	733	420	461	802	438	561	676	739	1289	443	352	
51	571	307	512	693	437	406	489	639	743	504	353	274	330	650	335	435	450	541	1055	313	196	
52	668	353	447	786	403	278	612	571	770	510	372	253	270	458	347	318	308	516	800	313	142	
53	526	260	315	477	303	303	365	395	635	389	288	157	220	439	251	175	199	479	708	231	98	
54	268	205	254	387	236	191	344	462	448	294	198	110	197	277	194	176	126	287	552	166	76	
55	391	111	148	204	128	171	276	364	262	197	110	109	144	243	137	192	94	209	511	134	50	
56	150	107	156	95	121	96	162	191	152	141	54	76	80	155	182	85	82	164	279	105	51	
57	129	85	118	90	48	74	93	110	176	116	81	41	53	82	103	77	75	134	306	85	24	
58	55	49	96	91	73	68	83	154	124	56	36	28	24	104	111	42	25	66	180	71	21	
59	92	33	74	31	12	48	93	68	49	22	8	7	15	64	94	25	25	48	133	49	10	
60	52	4	26	26	17	24	47	71	69	17	23	13	14	55	71	34	5	23	88	36	13	
61	7	4	22	8	45	11	19	22	22	5	8	22	11	57	39	28	7	17	44	21	8	
62	11	10	7	21	7	9	25	9	29	20	3	19	5	11	27	26	5	11	26	10	7	
63	6	6	12	7	1	2	5	12	13	2	0	2	0	15	0	11	2	4	20	3	3	
64	1	5	5	6	24	1	3	6	3	3	0	14	0	10	3	2	2	7	5	7	2	
65	16	4	5	5	19	1	6	2	3	2	0	12	0	10	0	3	1	2	7	2	1	
66	1	3	5	4	15	2	2	2	2	2	0	10	0	5	13	0	1	4	7	2	0	
67	6	2	4	3	12	1	2	3	1	1	0	8	0	6	10	0	1	4	2	1	0	
68	0	2	5	2	10	0	1	2	1	1	0	7	0	5	9	2	1	2	10	1	29	
69	0	1	2	2	8	0	1	2	1	1	0	6	0	4	7	3	0	2	1	1	25	
70	0	1	2	2	6	0	1	1	1	1	0	5	0	4	6	3	0	2	6	1	22	
71	0	1	2	1	5	0	1	1	0	0	0	4	0	3	5	2	0	2	1	0	20	
72	0	1	1	1	4	0	0	2	0	0	0	4	0	2	4	2	0	1	1	0	17	
73	0	0	1	1	3	0	0	1	0	0	0	3	0	2	3	2	0	1	1	0	15	
74	0	0	1	1	3	0	0	1	0	0	0	3	0	2	3	1	0	1	1	0	14	
75	0	0	1	1	2	0	0	0	0	0	0	2	0	1	2	1	0	1	2	0	12	
Total	**162108**	**400995**	**144867**	**138918**	**354477**	**365714**	**164481**	**144520**	**174547**	**131794**	**123539**	**68507**	**63332**	**65710**	**131774**	**83638**	**108364**	**66845**	**48830**	**55260**	**58007**	
Weights	**4576**	**6864**	**4517**	**4875**	**7016**	**7594**	**5474**	**4946**	**5594**	**4521**	**3892**	**2712**	**2490**	**3267**	**4092**	**3753**	**4675**	**3143**	**2835**	**2680**	**2518**	**NOT VALIDATED METHOD FOR DISCARD DERIVATION**

Table 7.7.12.a *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh) landings length distributions in 2002–2008. Irish trawlers.

Landings CL mm/Year	2002	2003	2004	2005	2006	2007	2008
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	1	0	0	0	0
18	0	2	6	3	4	0	0
19	33	10	20	17	15	29	0
20	145	269	40	200	233	467	0
21	213	1068	77	662	504	601	29
22	653	1330	134	787	1123	2360	300
23	1340	2570	245	1513	2334	8020	1268
24	2243	2139	480	3253	4554	13134	3620
25	2245	2473	806	4688	6442	18142	6974
26	2459	5815	1414	6754	10118	22705	12415
27	2417	4370	2052	8285	12544	22221	9812
28	3459	6644	2935	8510	13457	24482	14785
29	3104	5574	4034	9310	12521	24017	13547
30	3483	5102	5251	9878	11051	19506	14654
31	4632	5241	6058	11264	8183	12781	12746
32	4325	5908	6417	10276	6916	9017	12494
33	4624	4376	6451	8759	5102	6395	10858
34	4281	3841	6256	7187	3791	4008	10055
35	3913	2637	4823	5945	2717	3308	9231
36	2742	1808	3900	4696	1922	2572	6747
37	2705	1440	3134	2743	1356	1757	4351
38	2460	1372	2422	2796	906	1474	3555
39	1628	1025	1616	2011	675	1148	2298
40	1606	495	1071	1137	410	909	1715
41	847	592	893	730	398	938	1607
42	825	549	554	573	193	447	1194
43	474	414	365	305	152	481	727
44	438	203	233	186	135	142	474
45	300	110	156	41	82	148	296
46	183	131	72	163	32	138	124
47	126	167	106	27	69	64	39
48	195	70	61	68	18	50	81
49	121	77	51	0	16	89	209
50	29	40	14	41	5	0	166
51	18	60	10	0	0	0	62
52	18	24	7	0	13	0	42
53	0	0	12	0	0	24	0
54	18	0	6	0	0	0	0
55	18	0	6	0	0	0	0
56	0	0	3	0	0	0	0
57	18	10	19	0	0	0	0
58	18	0	3	0	0	14	0
59	0	0	8	0	13	0	0
60	18	0	1	0	0	0	0
61	0	0	1	0	0	0	0
62	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0
66	0	0	3	0	0	0	0
67	0	0	1	0	0	0	0
68	0	0	1	0	0	0	0
69	0	0	3	0	0	0	0
70	0	0	1	0	0	0	0
71	0	0	1	0	0	0	0
72	0	0	3	0	0	0	0
73	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0
Total	**58378**	**67953**	**62236**	**112807**	**108006**	**201588**	**156479**
Weights	**1496**	**1388**	**1627**	**2391**	**1864**	**3213**	**3422**

Table 7.7.12.b *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh) discards length distributions in 2002–2008. Irish trawlers.

Total Discards CL mm/Year	2002	2003	2004	2005	2006	2007	2008
10	0	0	0	0	0	0	0
11	0	0	1	0	0	0	0
12	0	0	1	0	0	0	0
13	0	0	1	0	19	0	0
14	0	19	2	0	38	40	0
15	0	84	3	0	206	0	36
16	0	68	5	35	138	153	72
17	0	171	15	35	243	200	181
18	0	261	16	164	364	772	320
19	0	614	77	265	564	1784	745
20	0	1489	49	786	883	3919	1370
21	1	3118	94	1120	1687	7572	1859
22	3	4657	125	1512	2993	11791	2861
23	12	5158	215	2213	3393	15300	4343
24	48	4482	358	3103	4829	17669	6312
25	194	4164	498	3957	5468	17333	9622
26	1161	4026	748	5023	5758	13454	9101
27	618	2926	787	4766	6746	10606	8657
28	476	2227	751	3433	5199	10847	6632
29	238	1556	762	2667	2630	5029	4528
30	163	890	708	2001	1071	1752	3603
31	174	511	635	1051	607	541	2669
32	162	275	421	622	347	151	1637
33	103	67	304	65	166	17	910
34	61	0	107	1	64	5	622
35	34	0	92	0	0	1	54
36	19	0	9	0	0	0	27
37	10	0	5	0	0	0	0
38	5	0	3	0	0	0	0
39	3	0	2	0	0	0	0
40	1	0	1	0	0	0	0
41	1	0	1	0	0	0	0
42	0	0	1	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0
Total	**3488**	**36762**	**6799**	**32820**	**43413**	**118937**	**66161**
Weights	**49**	**333**	**99**	**371**	**451**	**1097**	**770**

Table 7.7.12.c *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh) catches length distributions in 2002–2008. Irish trawlers.

Total catches CL mm/Year	2002	2003	2004	2005	2006	2007	2008
10	0	0	0	0	0	0	0
11	0	0	1	0	0	0	0
12	0	0	1	0	0	0	0
13	0	0	1	0	19	0	0
14	0	19	2	0	38	40	0
15	0	84	3	0	206	0	36
16	0	68	5	35	138	153	72
17	0	171	15	35	243	200	181
18	0	263	21	167	368	772	320
19	33	624	97	282	579	1813	745
20	146	1758	89	987	1116	4387	1370
21	214	4186	171	1782	2191	8173	1888
22	656	5986	259	2300	4116	14151	3161
23	1352	7728	460	3726	5727	23320	5611
24	2291	6621	838	6356	9383	30802	9932
25	2439	6637	1304	8645	11910	35475	16596
26	3620	9841	2162	11777	15876	36158	21516
27	3035	7296	2839	13051	19291	32827	18469
28	3935	8871	3687	11944	18656	35329	21417
29	3343	7130	4796	11977	15151	29046	18075
30	3646	5992	5959	11879	12123	21258	18257
31	4806	5752	6693	12315	8790	13322	15415
32	4487	6183	6838	10898	7263	9168	14131
33	4728	4443	6756	8824	5268	6412	11768
34	4343	3841	6362	7188	3855	4013	10677
35	3948	2637	4915	5946	2717	3310	9285
36	2760	1808	3909	4696	1922	2573	6774
37	2715	1440	3139	2743	1356	1757	4351
38	2465	1372	2425	2796	906	1474	3555
39	1631	1025	1618	2011	675	1148	2298
40	1608	495	1072	1137	410	909	1715
41	848	592	894	730	398	938	1607
42	826	549	554	573	193	447	1194
43	475	414	366	305	152	481	727
44	438	203	234	186	135	142	474
45	300	110	156	41	82	148	296
46	183	131	72	163	32	138	124
47	126	167	107	27	69	64	39
48	195	70	61	68	18	50	81
49	121	77	51	0	16	89	209
50	29	40	14	41	5	0	166
51	18	60	10	0	0	0	62
52	18	24	7	0	13	0	42
53	0	0	12	0	0	24	0
54	18	0	6	0	0	0	0
55	18	0	6	0	0	0	0
56	0	0	3	0	0	0	0
57	18	10	19	0	0	0	0
58	18	0	3	0	0	14	0
59	0	0	8	0	13	0	0
60	18	0	1	0	0	0	0
61	0	0	1	0	0	0	0
62	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0
66	0	0	3	0	0	0	0
67	0	0	1	0	0	0	0
68	0	0	1	0	0	0	0
69	0	0	3	0	0	0	0
70	0	0	1	0	0	0	0
71	0	0	1	0	0	0	0
72	0	0	3	0	0	0	0
73	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0
Total	**61866**	**104715**	**69034**	**145627**	**151419**	**320525**	**222640**
Weights	**1545**	**1721**	**1727**	**2762**	**2315**	**4311**	**4192**

Table 7.7.12.d *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh) removals length distributions in 2002–2008. Irish trawlers.

Removals=Landings+dead catches (discard survival rate : 25%)							
CL mm/Year	2002	2003	2004	2005	2006	2007	2008
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	1	0	0	0	0
13	0	0	1	0	14	0	0
14	0	14	2	0	29	30	0
15	0	63	2	0	155	0	27
16	0	51	4	26	104	115	54
17	0	128	12	26	182	150	136
18	0	197	18	126	277	579	240
19	33	471	77	216	438	1367	559
20	145	1386	77	790	896	3407	1028
21	214	3407	148	1502	1769	6280	1423
22	655	4822	228	1921	3368	11203	2446
23	1349	6438	406	3172	4879	19495	4525
24	2279	5500	748	5580	8176	26385	8354
25	2390	5596	1179	7656	10543	31142	14190
26	3330	8834	1975	10521	14436	32795	19241
27	2881	6564	2642	11859	17604	30176	16305
28	3816	8314	3499	11085	17357	32618	19759
29	3283	6741	4606	11310	14493	27789	16943
30	3605	5769	5782	11379	11855	20820	17357
31	4763	5625	6534	12052	8638	13187	14748
32	4446	6114	6733	10743	7176	9131	13722
33	4702	4426	6680	8808	5226	6408	11540
34	4327	3841	6336	7187	3839	4012	10522
35	3939	2637	4892	5946	2717	3309	9272
36	2756	1808	3906	4696	1922	2573	6767
37	2712	1440	3138	2743	1356	1757	4351
38	2464	1372	2424	2796	906	1474	3555
39	1630	1025	1617	2011	675	1148	2298
40	1607	495	1072	1137	410	909	1715
41	847	592	894	730	398	938	1607
42	825	549	554	573	193	447	1194
43	475	414	366	305	152	481	727
44	438	203	233	186	135	142	474
45	300	110	156	41	82	148	296
46	183	131	72	163	32	138	124
47	126	167	107	27	69	64	39
48	195	70	61	68	18	50	81
49	121	77	51	0	16	89	209
50	29	40	14	41	5	0	166
51	18	60	10	0	0	0	62
52	18	24	7	0	13	0	42
53	0	0	12	0	0	24	0
54	18	0	6	0	0	0	0
55	18	0	6	0	0	0	0
56	0	0	3	0	0	0	0
57	18	10	19	0	0	0	0
58	18	0	3	0	0	14	0
59	0	0	8	0	13	0	0
60	18	0	1	0	0	0	0
61	0	0	1	0	0	0	0
62	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0
66	0	0	3	0	0	0	0
67	0	0	1	0	0	0	0
68	0	0	1	0	0	0	0
69	0	0	3	0	0	0	0
70	0	0	1	0	0	0	0
71	0	0	1	0	0	0	0
72	0	0	3	0	0	0	0
73	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0
Total	**60994**	**95525**	**67335**	**137422**	**140565**	**290791**	**206099**
Weights	**1533**	**1638**	**1702**	**2669**	**2202**	**4036**	**4000**

Table 7.7.13. *Nephrops* in VIIfgh. Mean sizes (carapace length, CL in mm) of French and Irish landings. For 2008, French values are calculated (1) including the samples involving in tailed individuals and (2) using the previous method (no sampling of tails; the total tailed proportion was apportioned in the smallest category of entire *Nephrops* at auction).

	French sampling			Irish sampling		
Year	Males	Females	Total	Males	Females	Total
1987	38.8	35.1	38.1			
1988	35.7	34.7	35.6			
1989	38.9	36.0	38.5			
1990	39.7	35.4	39.0			
1991	38.2	34.1	37.5			
1992	37.6	34.9	37.3			
1993	40.0	36.6	39.6			
1994	39.7	37.1	39.3			
1995	39.9	36.1	39.4			
1996	39.5	36.8	39.2			
1997	39.9	37.4	39.8			
1998	39.9	36.4	39.5			
1999	40.1	36.9	39.6			
2000	42.0	39.2	41.4			
2001	38.8	39.1	38.9			
2002	40.9	39.7	40.8	33.0	31.1	32.2
2003	41.5	39.8	41.4	31.1	29.1	30.2
2004	41.6	39.8	41.5	33.5	32.3	32.9
2005	43.1	40.3	42.8	30.9	30.8	30.9
2006	41.6	39.5	41.1	29.7	28.6	29.2
2007	40.7	38.7	40.4	29.3	27.3	28.5
2008	37.6	34.7	37.2	32.0	29.7	31.1
	40.1	39.6	40.1			

Table 7.7.14. ***Nephrops*** **in VIIfgh. French (year 1997) and Irish (years 2003 and 2008) programmes of discard sampling on board. Length distribution of landings (L) and discards (D) by sex (10^3). The reported size is the carapace length (CL, in mm). Conversion of CL to TS (total size) is done by multiplication by 3.3.**

	French sampling (year 1997)						Irish sampling (year 2003)						Irish sampling (year 2008)					
	males		females		Total		males		females		Total		males		females		Total	
CL	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D
14										19		19						
15								10		74		84				36		36
16				1		1		10		58		68		36		36		72
17								30		141		171				181		181
18				1		1	1	134	1	127	2	261		82		238		320
19		1				1	3	242	7	372	10	614		166		579		745
20		1		12		13	53	452	215	1038	269	1489		370		1000		1370
21				10		10	164	902	904	2216	1068	3118		988	29	871	29	1859
22		187		294		481	472	1963	858	2693	1330	4657	100	1132	200	1729	300	2861
23		630		1150		1780	1469	2503	1101	2655	2570	5158	198	1436	1070	2907	1268	4343
24		874		1172		2046	1251	2392	888	2091	2139	4482	1487	2029	2133	4283	3620	6312
25		1428		2490		3918	1209	2056	1264	2109	2473	4164	3047	2941	3927	6681	6974	9622
26		1439		1889		3328	3132	1631	2683	2396	5815	4026	5872	2978	6543	6123	12415	9101
27	15	4695		7332	15	12027	1978	1304	2392	1622	4370	2926	4794	3427	5019	5230	9812	8657
28	28	4399		6888	28	11287	3591	1030	3053	1196	6644	2227	8326	3269	6459	3363	14785	6632
29	45	3521		5089	45	8610	2568	723	3006	833	5574	1556	8300	2371	5247	2157	13547	4528
30	218	6863	19	9305	236	16167	2327	433	2775	457	5102	890	9297	1933	5358	1670	14654	3603
31	521	3140	21	4821	542	7960	2977	300	2265	211	5241	511	7208	1436	5539	1233	12746	2669
32	1155	4842	65	6535	1220	11377	3570	166	2338	109	5908	275	7155	917	5340	720	12494	1637
33	1984	3885	160	5140	2144	9025	2313	57	2063	9	4376	67	7194	586	3664	324	10858	910
34	2035	1360	152	1384	2186	2744	2371		1470		3841		7024	334	3031	288	10055	622
35	3251	1385	357	1254	3608	2639	1468		1168		2637		6584	54	2647		9231	54
36	3409	570	418	950	3827	1520	1108		700		1808		5211	27	1535		6747	27
37	3799	410	464	333	4262	743	1056		384		1440		3436		915		4351	
38	4138	205	666	189	4804	394	1140		232		1372		2994		561		3555	
39	3395	72	224	85	3619	157	891		134		1025		1928		370		2298	
40	4713	120	205	64	4918	184	404		91		495		1526		189		1715	
41	2861	33	202	41	3062	74	572		20		592		1458		150		1607	
42	3367	43	47	34	3414	77	492		57		549		1114		79		1194	
43	2678	25	47		2725	25	386		29		414		650		77		727	
44	1787	8	63		1849	8	155		48		203		433		41		474	
45	2236	7	52	2	2288	9	110				110		296				296	
46	1428	1			1428	1	131				131		124				124	
47	1021				1021		167				167		39				39	
48	954	2	16		970	2	70				70		81				81	
49	603				603		77				77		209				209	
50	733	1			733	1	40				40		166				166	
51	353				353		60				60		62				62	
52	372				372		24				24		42				42	

	French sampling (year 1997)						Irish sampling (year 2003)						Irish sampling (year 2008)					
	males		females		Total		males		females		Total		males		females		Total	
CL	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**
53	286	3			286	3												
54	198				198													
55	110				110													
56	54				54													
57	81				81		10				10							
58	36				36													
59	8				8													
60	23				23													
61	8				8													
62	3				3													
	47904	40149	3176	56463	51080	96612	37807	16335	30146	20427	67953	36762	96356	26512	60123	39649	156479	66161
%D		46		95		65		30		40		35		22		40		30

Table 7.7.15. Division VIIfgh. *Nephrops* effort and lpue data by country. The French data are calculated for otter trawlers getting at least 10% of their landings by targeting this species. The Irish data are linked to otter trawl vessels where >30% of monthly landings in live weight were *Nephrops*.

	Effort (Effective hours fishing)		LPUE (kg/h)			
	France	Rep. of Ireland	France			Rep. of Ireland
Year	Otter	Otter	Total otter	Single Otter [1,3]	Twin otter[1,3]	Otter
1983	231440		14.2	14.2		
1984	204600		15.8	15.8		
1985	202830		16.0	16.0		
1986	162510		14.9	14.9		
1987	189580		15.2	15.2		
1988	170840		16.4	16.4		
1989	179060		16.8	16.8		
1990	229470		15.6	15.6		
1991	224710		11.3	11.3		
1992	276450		11.7	11.7		
1993	268410		13.2	13.2		
1994	258490		13.5	13.5		
1995	239240	26681	14.6	14.6		46.9
1996	220120	20579	14.2	14.2	14.2	50.0
1997	187180	23255	12.6	12.5	14.4	49.2
1998	155340	25380	13.0	12.9	14.9	53.1
1999	150770	15491	10.9	10.2	10.0	41.5
2000	194150	28267	13.8	11.5	11.4	47.8
2001	170320	36205	14.6	11.4	13.3	54.6
2002	165670	29990	18.7	15.4	16.7	44.3
2003	191600	28532	18.2	16.3	15.0	34.6
2004	152700	31309	15.8	13.5	12.9	36.6
2005	146880	51031	16.0	13.0	13.2	42.0
2006	136650	45383	16.3	14.4	12.8	36.3
2007	101980	59899	18.5	15.9	14.3	49.4
2008	99789	59727	22.6	18.4	16.4	55.2

[1]The single and twin otter French lpue can be compared with the total otter indices until 1999 when the definition of the fishing effort of trawlers was changed (see note 2).

[2]Since 1999, the French statistics differentiate fishing effort calculated on the basis of the "number of fishing hours" from that deduced from the "number of use of a fishing gear".

[3]Information for single and twin trawl lpue involve in the total fishing fleet whereas aggregated indices are calculated for the otter trawlers getting at least 10% of their landings by targeting this species.

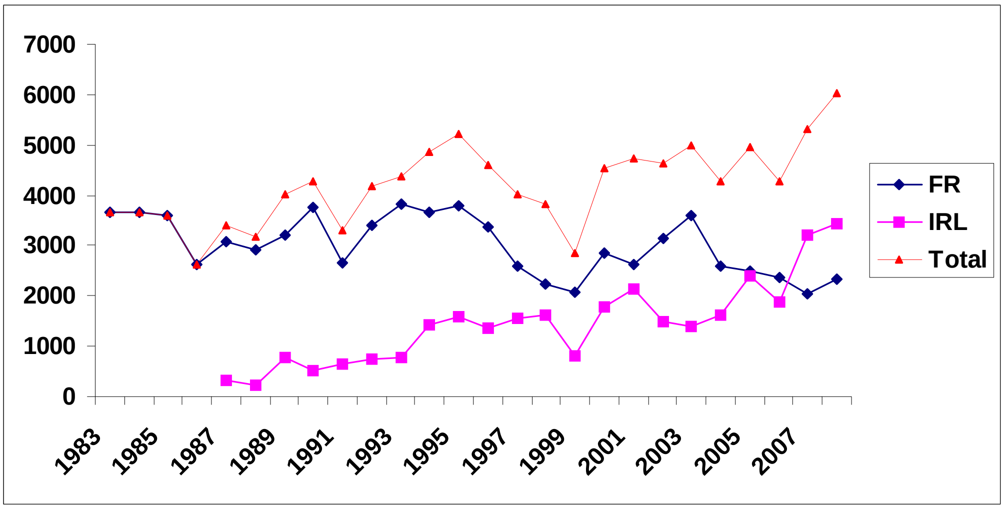


Figure 7.7.1. ***Nephrops*** **in VIIfgh. Evolution of nominal landings (t).**

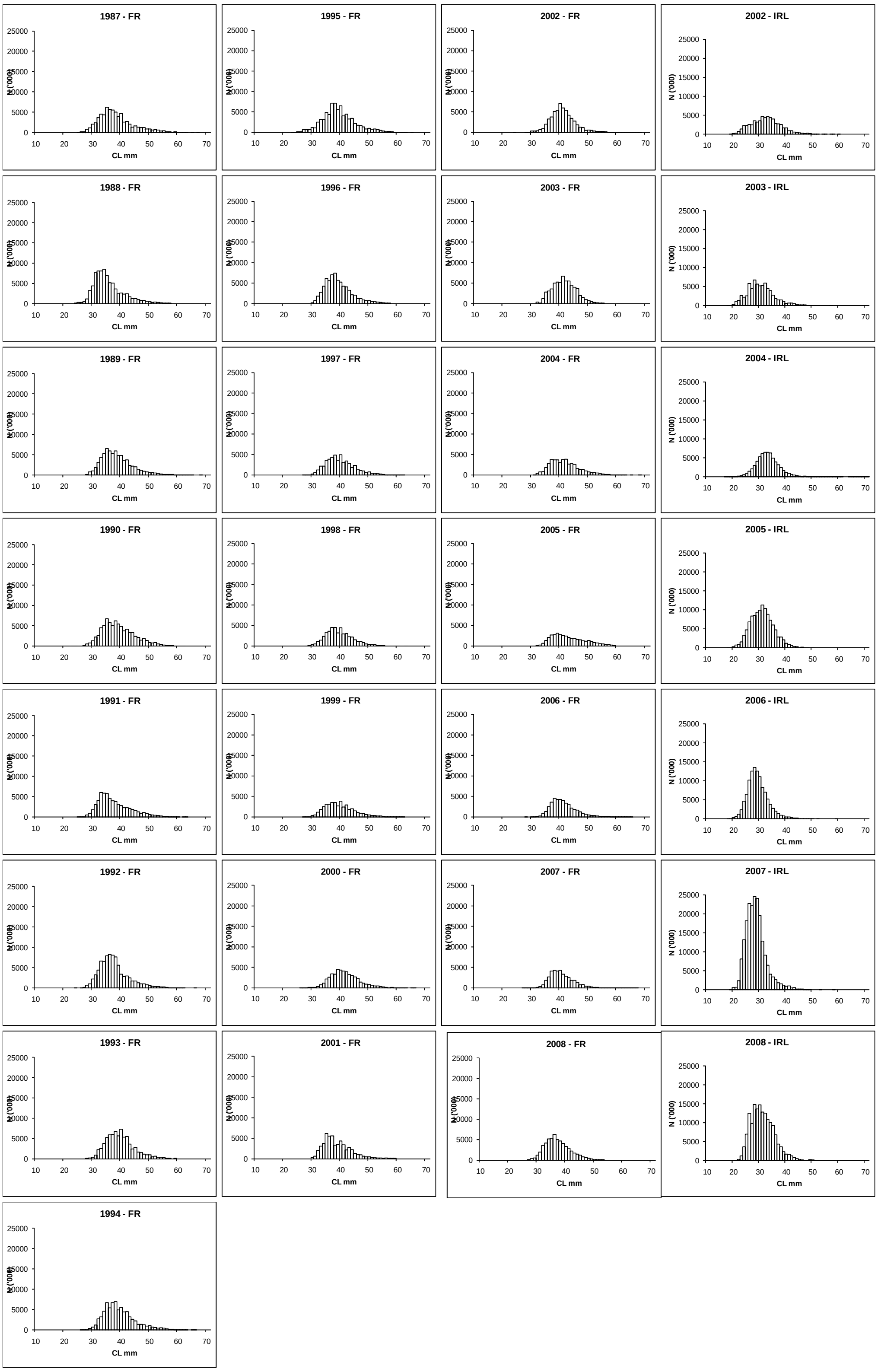


Figure 7.7.2. ***Nephrops*** **in FU 20–22 Celtic Sea (VIIfgh) landings of French trawlers (1987–2008) and of Irish trawlers (2002–2008).**

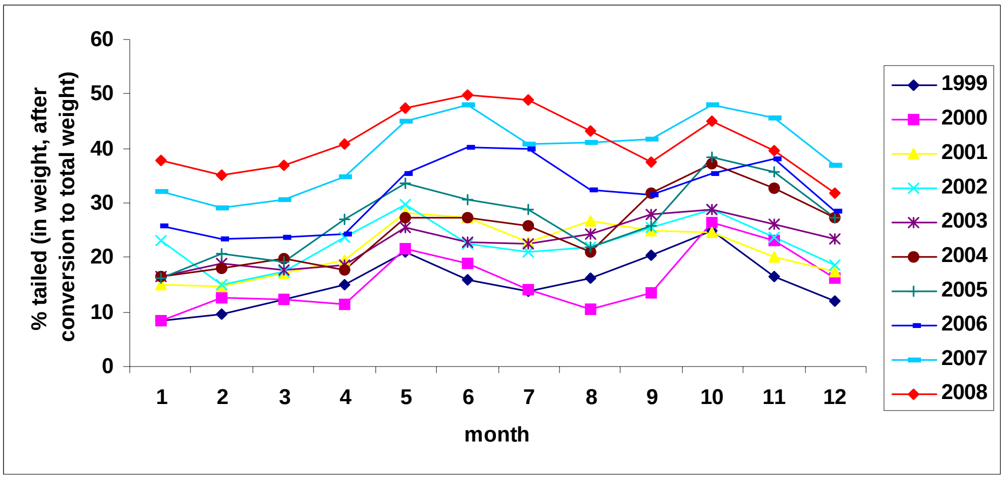


Figure 7.7.3. *Nephrops* of the Celtic Sea (VIIfgh, FU20–22). Years 1999–2008. Monthly percentages of tailed individuals in the French landings (after conversion to total weight).

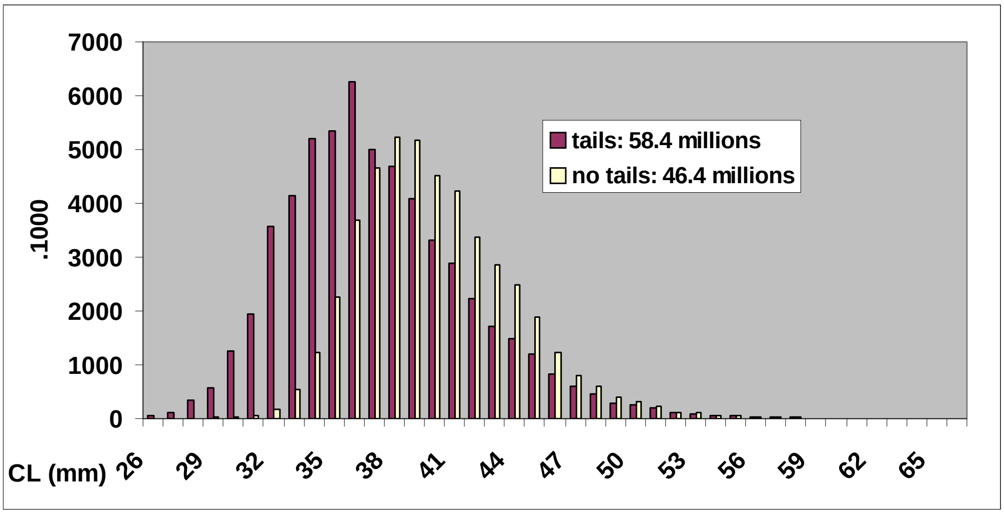


Figure 7.7.4. *Nephrops* of the Celtic Sea (VIIfgh, FU20–22). French landings for 2008. Length distributions (1) including the data on tails and (2) using the previous method (no sampling of tails; the total tailed proportion was apportioned in the smallest category of entire *Nephrops* at auction).

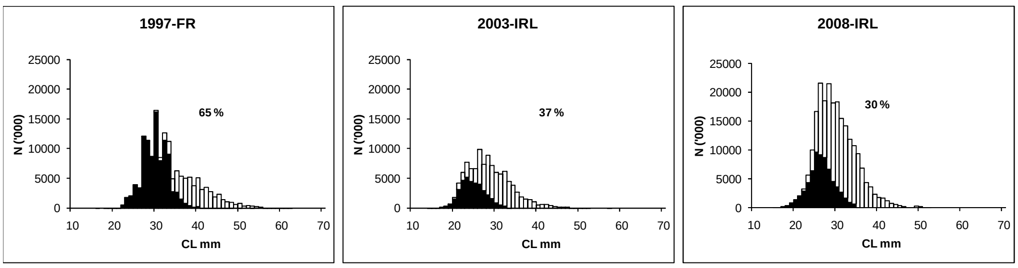


Figure 7.7.5. *Nephrops* in FU 20–22 Celtic Sea (VIIfgh). Years with complete set of discard samples: French data (1997), Irish data (2003 and 2008). Landings in white, discards in black.

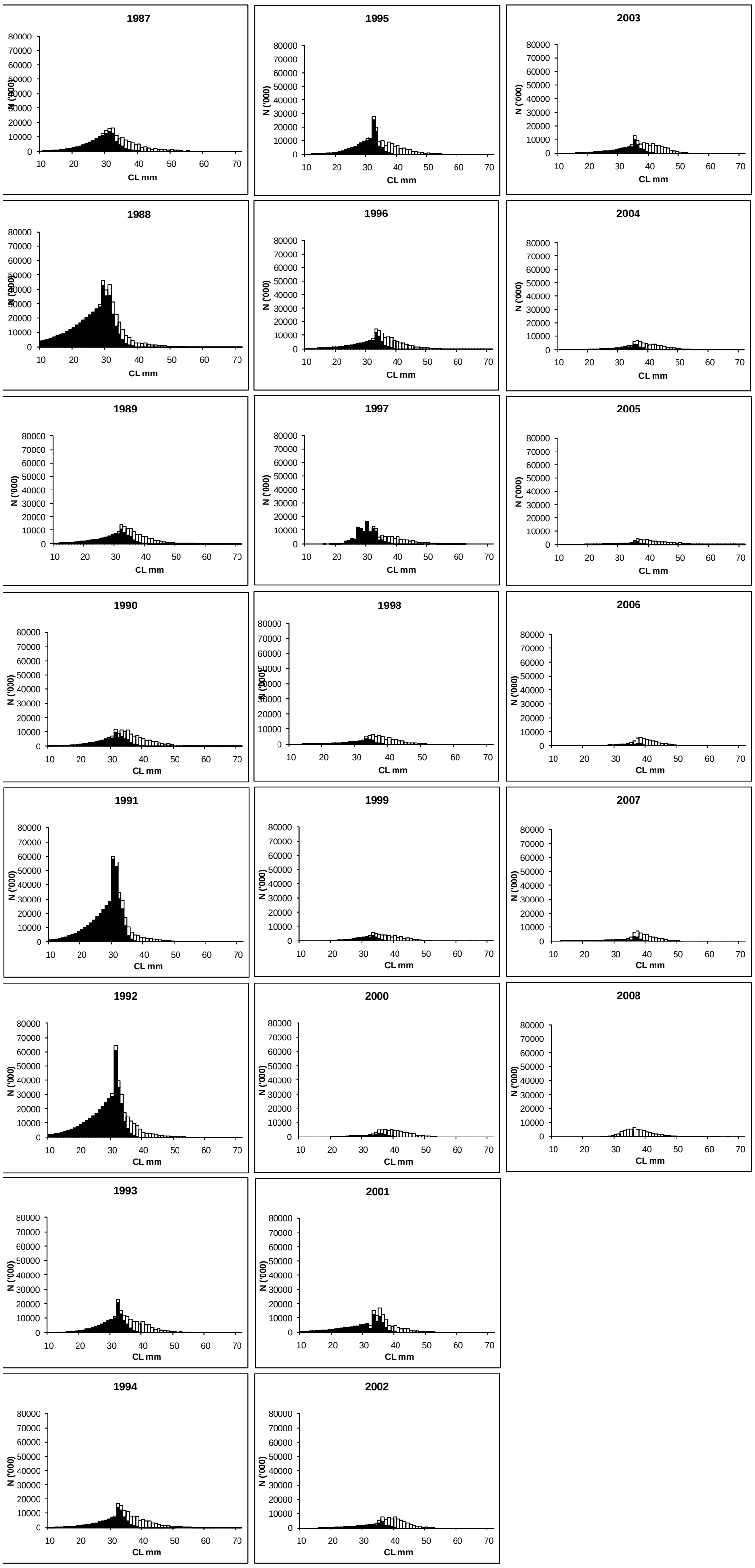


Figure 7.7.6. ***Nephrops*** **in FU 20–22 Celtic Sea (VIIfgh). Catches (landings in white and discards in black) of the French fleet. Length distributions in 1987–2008 [note: discards for 2008 are not presented as unreliable under the DLF of landings including tails].**

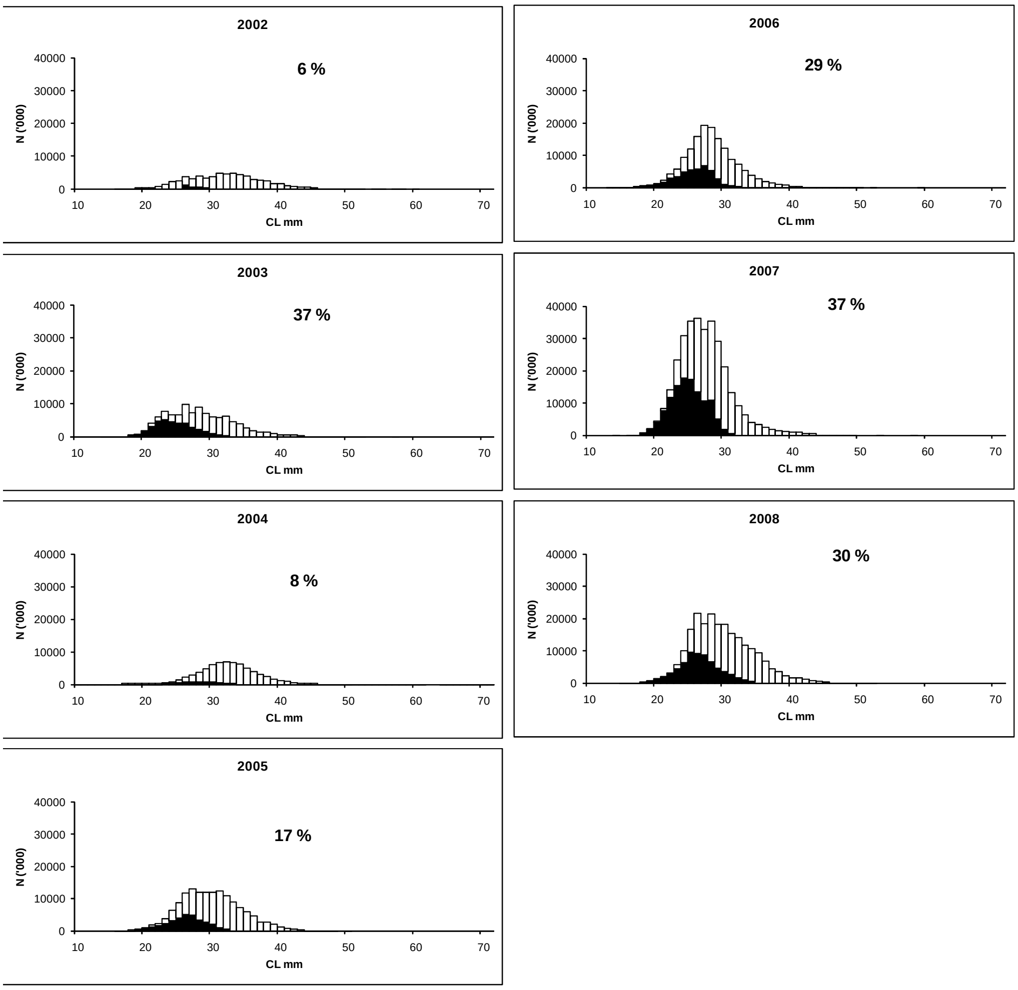


Figure 7.7.7. ***Nephrops*** **in FU 20–22 Celtic Sea (VIIfgh). Catches (landings in white and discards in black) of the Irish fleet. Length distributions in 2002–2008.**

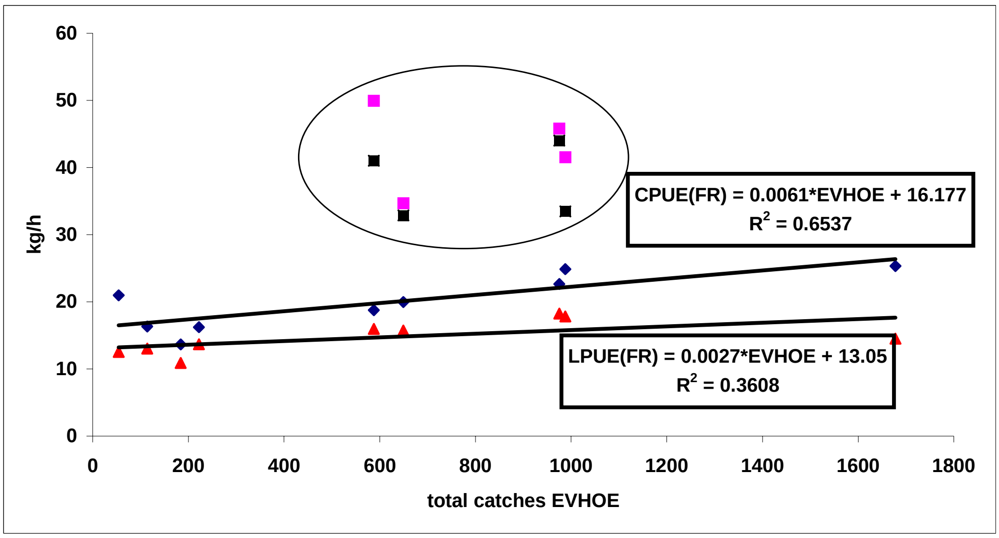


Figure 7.7.8. ***Nephrops*** **FU 20–22. Comparison of indices EVHOE and of commercial lpue and cpue for French and Irish trawlers.**

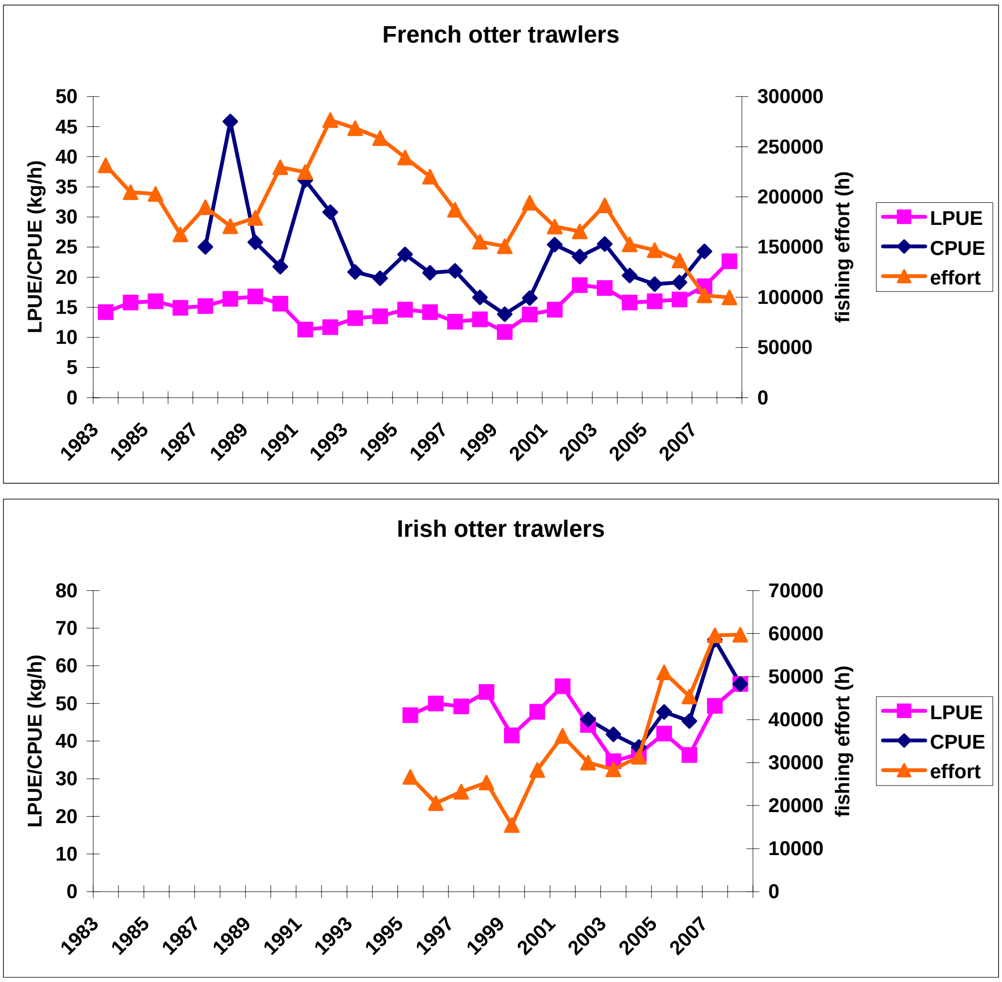


Figure 7.7.9. ***Nephrops*** **in VIIfgh. Lpue and fishing effort series for French (above) and Irish fleet (below). The cpue indices are calculated by including discard sampling on board and, failing that, by the derivation method as explained in Report (see also Stock Annex; French cpue for 2008 is not provided as the discard derivation method is not yet validated).**

7.8 *Nephrops* in Divisions VIIjg (South and SW Ireland, FU 19)

Type of assessment in 2009

No advice was required for this stock this year so the Report consists of an update to available data and text describing the fishery. No assessment or data analyses have been carried out.

ICES advice applicable to 2008

There are no exploitation boundaries for this stock. Although the total reported landings appear to be increasing (~10%) and are around average for the available series, for FUs 16,17,18 and 19 combined (~3900 t), there have been large changes in fishing effort and landings for individual stocks. It is also likely that landings may be unreliable for some countries. This may lead to unbalanced exploitation of stocks and overfishing. ICES therefore advise that these *Nephrops* fisheries should be constrained to recent levels of effort at an appropriate geographical scale (FU).

At present, as there is no explanation of the increasing trend of the landing mean sizes; WG recommends a spatial analysis of the disaggregated data. This study should be conducted on the origin of fleet landings (which ICES rectangle came from) and on which part of the population is exploited.

ICES advice applicable to 2009

This stock was reassessed in 2008 based on trends in the fishery and biological parameters. The advice for this fishery for 2009 and 2010 was that landings and effort should be constrained to recent levels of effort at an appropriate geographic scale (FU).

7.8.1 Ecosystem aspects

General comments about the species biology, bottom topography substratum and circulation are presented in annex of other *Nephrops* stocks, such as, FU20–22.

In FU19 *Nephrops* are caught on a large number of spatially discrete small inshore grounds and on some larger grounds further offshore. Of these the 'Galley ground', around the Kinsale Gas Rigs and south of Cork appear to be the most important. A map of the spatial distribution of FU19 is given in Figure 7.8.1 the FU includes *Nephrops* within the following ICES statistical rectangles; 31–33 D9–E0; 31E1; 32E1–E2; 33E2–E3.

7.8.2 Fishery description

The number of Irish vessels reporting landings in this area has increased from 28 in 2000 to 96 in 2008. Of these, only 18 reported landings in excess of 10 t and these 18 vessels accounted for 55 % of the total landings. Fleet segmentation data demonstrates that the *Nephrops* métiers in this area also have important catches of megrim and monkfish. There are also some catches of hake and the offshore parts of FU19 which is an important nursery area for juvenile hake. The Irish fleet fishing *Nephrops* in FU19 was described in detail in the 2001 WG report (ICES, 2001a). The minimum mesh size in use is 70 mm, with the average being 80 mm. French trawlers harvesting *Nephrops* on this area fish also in the Celtic Sea (FU20) and switch to the FU19 according to meteorological conditions. They have used mesh size 100 mm for codend since January 2000 (in order to not be constrained by bycatch composition) and they apply MLS of 11.5 cm (*i.e.* 35 mm CL) adopted by French Producers' Organizations larger than the European one (8.5 cm *i.e.* 25 mm CL). However, the increasing proportion of tailed individuals in French landings (as for FU20) may shift DLF for *Nephrops* to smaller sizes compared with previous years. In 2008, 24 French trawlers reported landings from FU19, but only 4 exceeded 5 t. 31 French vessels were recorded in 2007, 30 in 2006 and 35 in 2005.

7.8.3 Data

The sampling level for the species is given in Table 2.1.

7.8.4 Commercial catches and discards

Landings data for FU19 are summarized in Table 7.8.4.1. The Republic of Ireland, France and the UK report landings for FU 19. The Republic of Ireland landings have fluctuated considerably throughout the time-series, with a marked dip in 1994 (Figure 7.8.4.1.). The highest landings in the time-series were observed in 2002–2004 (>1000 t). Landings in 2005 and 2006 have been below average for the series. In 2008 landings decreased by approx 10% for the Irish fleet but were above the series average. Landings by the French fleet have fluctuated with a declining trend throughout the time-series from the highest value in 1989 of 245 t to 46 t in 2008. Landings from the UK are minor.

Effort and lpue data are available for the Irish *Nephrops* directed fleet in FU19 from 1995–2008 (Table 7.8.4.2, Figure 7.8.4.2). The effort increases substantially in 2002 this is in part because of the inclusion of smaller vessels (10–18 m) in the dataset. These vessels did not record logbook operations prior 2002. The lpue and effort series is based on the same criteria for FU16 and 17 and will be contingent on the accuracy of landings data reported in logbooks. The lpues have fluctuated between 15–30 kg/hr with a slightly declining trend. The lpues are lower than that of other FUs reflecting the smaller size of the vessels and generally more mixed nature of this fishery.

For FU18 landings information from 1993 was available to the WG only. The Republic of Ireland has taken 100% of the landings for the last seven years. The highest reported landings were in 1994 with 124 t, however, landings in recent years have been minor (1 t in 2008).

7.8.5 Biological sampling

Length–frequency data of the landings were collected on an irregular basis in the years 1996 to 1997, 1999 and 2002 to 2006. Spatial and temporal coverage is also problematic with landings from FU19 coming from several discrete grounds. In 2005 length–frequency data are only available for quarters 2 and 3. The length frequencies for the remaining quarters have been derived by raising those length frequencies observed to the quarter 1 and 4 landings figures.

The dataseries of the mean sizes of *Nephrops* in the landings of Irish trawlers is too short and inconsistent to draw definite conclusions (Table 7.8.5.1, Figure 7.8.5.1.). The mean size of males varied between 29 and 41 mm CL, and for females between 26 and 40 mm CL. There is slight increase in mean size for males in 2008. However, the dataseries is too short to provide useful information on the state of the stock.

It should be noted that as a consequence of the change in sampling methodology from 2001 onwards the profile of the length frequencies has changed as a result of inclusion of smaller individuals from the discard component.

7.8.6 Information from surveys

The UK March groundfish survey has been carried between 1984 and 2004. This survey was examined at WGHMM 2006 Section 9.3.2.3. and there is a slight indication of a decline in mean sizes of *Nephrops* compared with those observed in the late 1980s. In 2006 some indicator UWTV stations were carried out within FU19 as part of the Celtic Sea UWTV survey which mainly targets FU20–22. The heterogeneous distribution of *Nephrops* and sediment in FU19 will make accurate UWTV survey abundance estimate difficult to obtain on a regular basis.

7.8.7 Assessment

A much improved and longer historical time-series of data is needed to carry out analytical assessment of this stock. Although sampling of this stock is required under the EU data collection regulation it is difficult to obtain precise length–frequency data at the spatial resolution required to assess *Nephrops* in such a heterogeneous area where several small discrete fisheries occur. Future assessments would benefit from a higher spatial resolution of landings and effort data (possibly from VMS). Fishery independent methods such as UWTV surveys may also be useful for this FU in future.

7.8.8 Management considerations

The time-series of lpue data based on logbook data for FU19 is short and highly variable. The lpues since 2003 have been stable slightly below the average of the series. Reported landings in 2008 have been around 12% above series average.

Table 7.8.4.1 Nephrops in FU 18 and FU 19 (NW, SW and SE Ireland)
Landings in tonnes by Functional Unit

	FU 18			FU 19			
Year	Rep. of Ireland	UK	Total	France	Rep. of Ireland	UK	Total
1989				245	652	2	899
1990				181	569	4	754
1991				212	860	5	1077
1992				233	640	15	888
1993	9	1	10	229	672	4	905
1994	124	2	126	216	153	21	390
1995	24	2	26	175	507	12	695
1996	46	1	46	145	736	7	888
1997	13	2	15	93	656	7	756
1998	77	1	78	92	733	2	827
1999	15	0	16	77	499	3	579
2000	9	0	9	144	541	11	696
2001	2	0	2	111	702	2	815
2002	14	0	14	188	1130	0	1318
2003	16	0	16	165	1075	0	1239
2004	22	0	22	76	997	1	1074
2005	15	0	15	62	648	2	711
2006	14	0	14	65	675	1	741
2007	3	0	3	63	894	0	957
2008	1	0	1	46	805	15	866

Table 7.8.4.2. Ireland SW and SE coast (FU 19): Irish effort hrs and LPUE, 1993-2008.

Year	Irish Fleet		
	Nephrops trawlers (>30% landings weight)		
	Effort hrs	Landings Tonnes	LPUE Kg/hr
1995	9126	206	22.5
1996	9295	220	23.7
1997	9604	248	25.8
1998	15775	386	24.5
1999	13345	206	15.4
2000	9329	178	19.1
2001	9701	309	31.8
2002	25565	764	29.9
2003	28887	621	21.5
2004	26554	529	19.9
2005	23848	455	19.1
2006	24272	460	19.0
2007	30361	665	21.9
2008	25101	573	22.8

Table 7.8.5.1.Nephrops in FU 19 (Ireland SW and SE Coast)
Irish trawlers mean sizes data series

Year	Catches		Landings <35mm CL		Landings >35mm CL	
	Males	Females	Males	Females	Males	Females
1995	na	na	na	na	na	na
1996	34.5	31.3	31.1	29.7	38.7	38.8
1997	34.6	32.9	31.2	30.9	39.8	38.4
1998	na	na	na	na	na	na
1999	38.5	35.4	31.8	31.2	41.3	39.1
2000	na	na	na	na	na	na
2001	na	na	na	na	na	na
2002	30.4	28.8	29.7	28.8	39.9	40.5
2003	33.1	29.4	31.1	30.0	38.4	38.0
2004	32.8	28.8	32.0	30.2	39.8	37.7
2005	31.3	27.5	29.1	26.9	38.4	37.0
2006	34.4	31.7	31.4	30.4	38.9	37.7
2007	35.6	33.2	32.4	31.7	39.1	38.2
2008	36.2	33.1	32.5	31.6	38.9	38.1

na = not available

Table 7.8.4 Total Nephrops landings (in tonnes) VIIbcjk & inshore rectangles along the south and south east coast of Ireland

Year	FU 16	FU 17	FU 18	FU 19	Other Rectangles	TOTAL
1965	514	-	-	-	-	514
1966	0	-	-	-	-	0
1967	441	-	-	-	-	441
1968	441	-	-	-	-	441
1969	609	-	-	-	-	609
1970	256	-	-	-	-	256
1971	1944	-	-	-	-	1944
1972	1738	-	-	-	-	1738
1973	2946	-	-	-	-	2946
1974	2794	477	-	-	-	3271
1975	2150	822	-	-	-	2972
1976	1327	131	-	-	-	1458
1977	1545	272	-	-	-	1817
1978	1744	481	-	-	249	2474
1979	2269	452	-	-	237	2958
1980	2925	442	-	-	205	3572
1981	3381	414	-	-	382	4177
1982	4289	210	-	-	234	4733
1983	3426	131	-	-	174	3731
1984	3571	324	-	-	187	4082
1985	3919	207	-	-	194	4320
1986	2591	147	-	-	113	2850
1987	2499	62	-	-	107	2669
1988	2375	828	-	-	140	3343
1989	2115	344	-	899	134	3492
1990	1895	519	-	754	102	3270
1991	1640	410	-	1077	169	3296
1992	2015	372	-	888	409	3683
1993	1857	372	10	905	455	3599
1994	2512	729	126	390	570	4327
1995	2936	866	26	695	397	4920
1996	2230	525	46	888	623	4312
1997	2409	841	15	756	340	4361
1998	2155	1410	78	827	514	4985
1999	2132	1140	16	579	322	4189
2000	872	880	9	696	243	2701
2001	1163	913	2	815	368	3262
2002	1282	1154	14	1318	243	4012
2003	867	933	16	1239	186	3241
2004	1441	525	22	1074	161	3223
2005	2140	778	15	711	180	3824
2006	1948	637	14	658	165	3423
2007	2003	913	3	784	119	3821
2008	860	1057	1	866	104	2888

- indicate no data available (landings from all areas are only available since 1993)

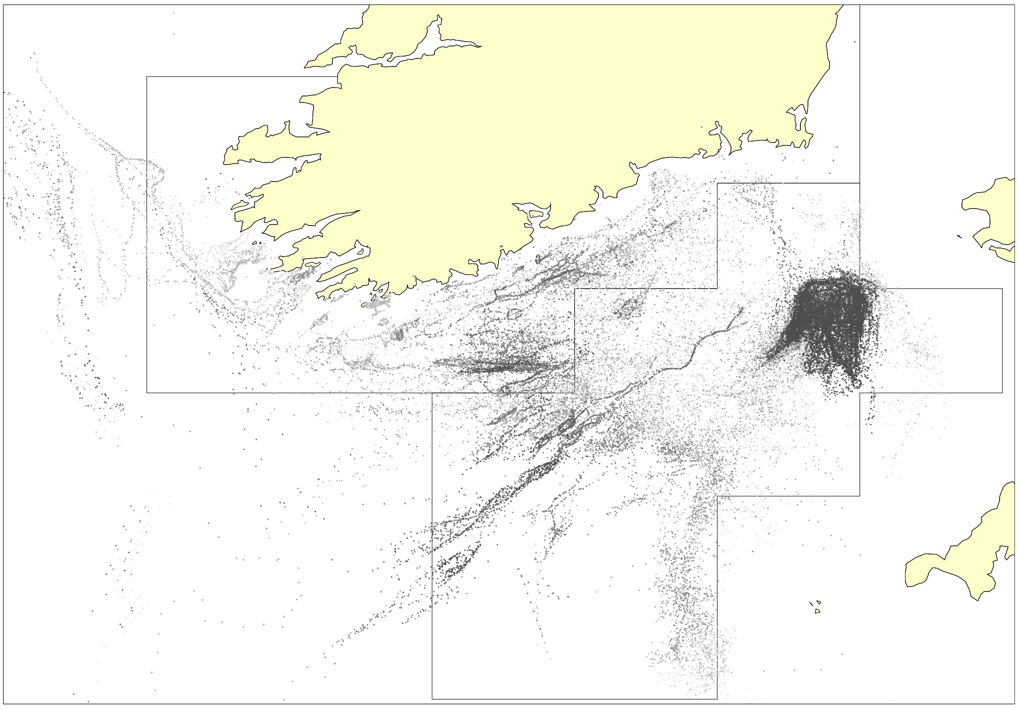


Figure 7.8.1. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). The spatial distribution of the fishery of the Irish fishery from VMS data.**

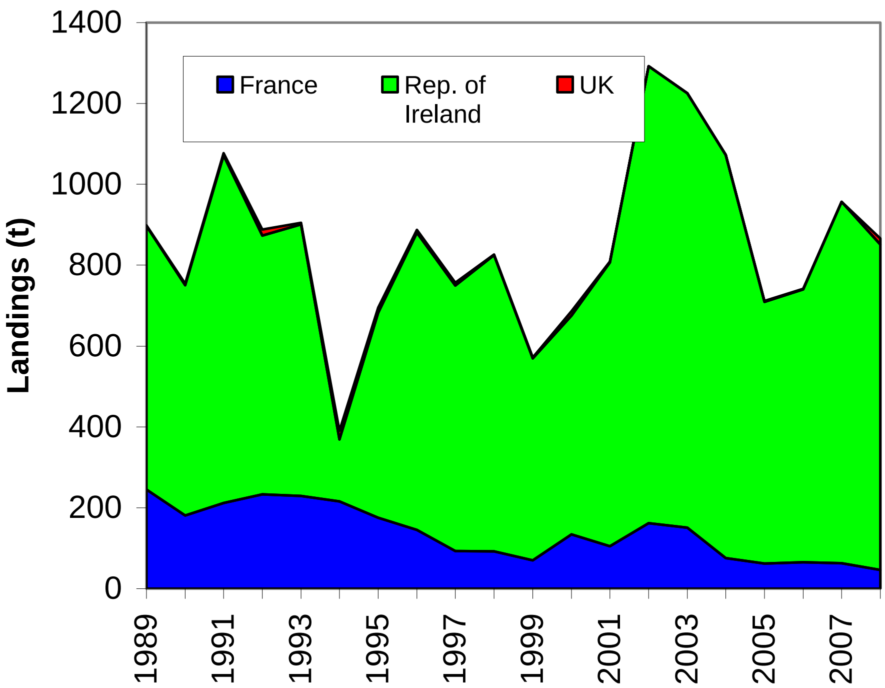
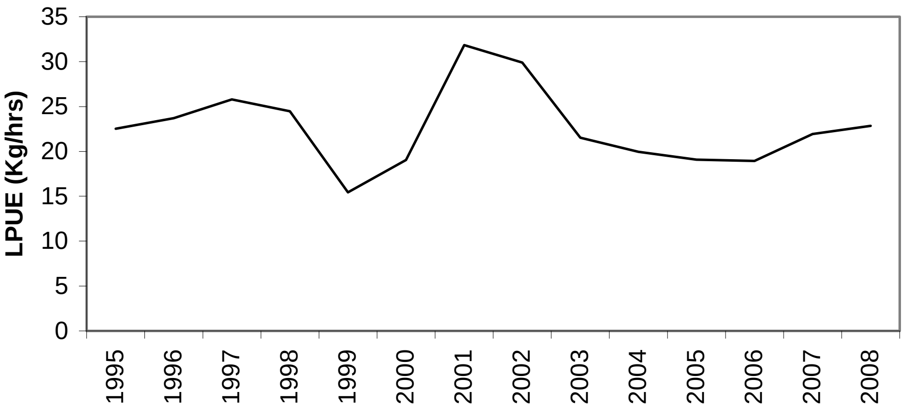


Figure 7.8.4.1. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Landings in tonnes by country.**

Figure 7.8.4.2 Nephrops in FU 19 (Ireland SW and SE Coast)

Trawl effort for Irish OTB vessels where >30% of landed weight was Nephrops

Trawl LPUE for Irish OTB vessels where >30% of landed weight was Nephrops



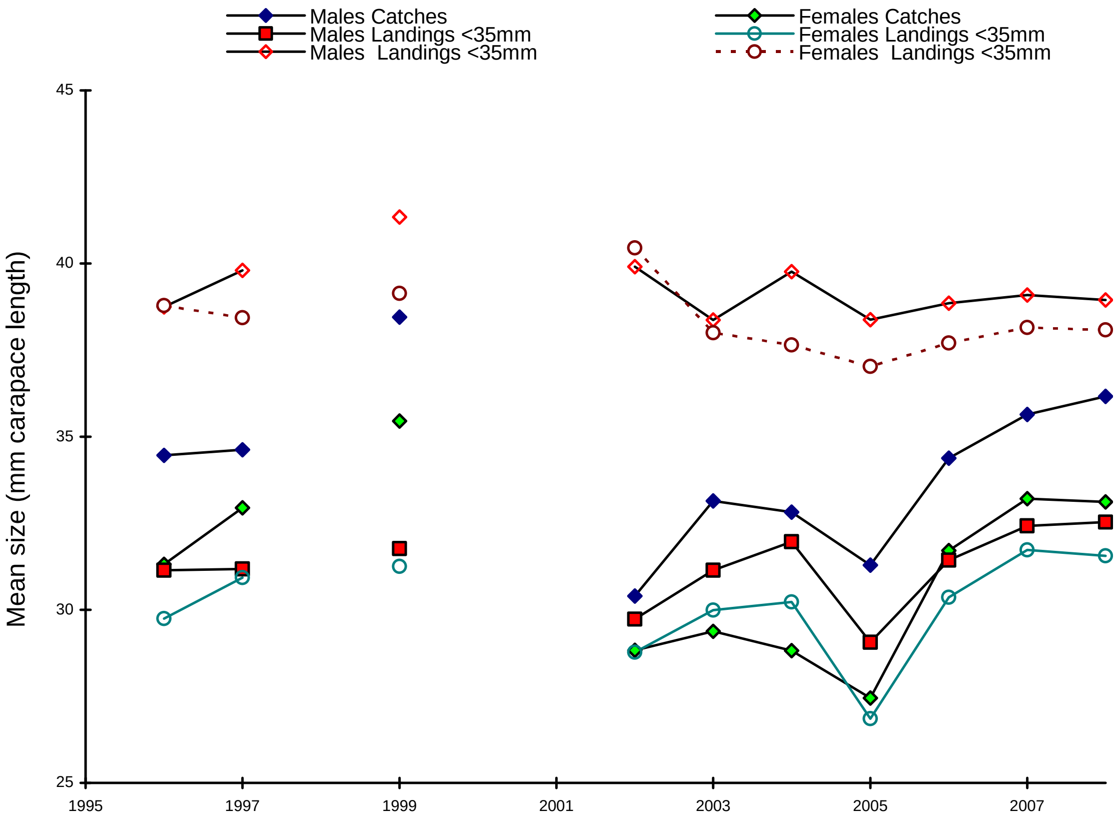


Figure 7.8.5.1. *Nephrops* in FU19 (Ireland SW and SE Coast). Mean size trends for catches and whole landings by sex.

7.9 Plaice in West of Ireland Division VII b, c

Type of assessment in 2009

No assessment was performed, however catch numbers and weights were aggregated for the Irish landings for the years 1993–2008 and these were used to perform a yield-per-recruit analysis.

7.9.1 General

Stock Identity

Plaice in VIIb are mainly caught by Irish vessels on sandy grounds in coastal areas. Plaice catches in VIIc are negligible. In VIIb there are two distinct areas where plaice are caught by Irish vessels: an area to the west of the Aran Islands and an area in the north of VIIb which extends into VIa (the Stags Ground). During 1995–2000 a large proportion of the plaice VIIbc landings were taken from the Stags Grounds (Rectangles 37D8, 37D9, 37E0 and 37E1). The landings and lpue in this area have dropped sharply since 2000, in line with a general decrease in of lpue in Division VIa. The landings and lpue on the Aran grounds appear to have been more or less stable since the start of the logbooks time-series in 1995 (WD 1). It is not known how much exchange there is between plaice on the Aran grounds and those on the Stags ground.

7.9.2 Data

The nominal landings are given in Table 7.9.1.

The remainder of Section 7.9 concerns Irish data only:

Historically, nearly all commercial plaice VIIbc samples have been taken in Ros a Mhíl, most vessels landing here are fishing on the Aran grounds. Plaice caught in the north of VIIb would most likely be landed in Killybegs, but less than 2% of the VIIbc plaice samples were taken in Killybegs, so it appears that the vast majority of the VIIbc plaice samples originated from the Aran grounds. Plaice from the Stags grounds were probably sampled as part of the VIa samples but it is difficult to determine the catch location of plaice landed in Killybegs and Greencastle as these could have originated from a number of areas within VIa.

Figure 7.9.1 shows the proportion of the Irish VIIbc landings that were taken on the Stags ground. Before 2000 more than half of the landings were from this area, in recent years around 20–40% of the landings were from the Stags grounds (source: Irish logbooks data).

Figure 7.9.2 shows that plaice landings in VIIbc were mostly taken by Otter trawlers. Up to 1998 seines took around 20% of landings but this decreased in the following years. This pattern is reflected in the sampling which suggests that the gears sampled were representative of the landings.

Data quality

Figure 7.9.3 shows the length distribution of the Irish landings in VIIbc between 1993 and 2008. Sampling in 2006 and 2007 was poor, in other years the sample numbers appear to be adequate. There are no distinct modes of strong year classes discernible.

Annual Age-Length-Keys (ALKs) were constructed (all quarters and gear types combined) and applied to the sampled length–frequency distributions. In order to estimate the uncertainty, the length and age data were resampled and the relative age distribution (proportion-at-age) was estimated for each of 250 bootstrap replications.

Individual port samples were taken as the resampling unit. Resampling on a smaller scale (individual fish) would not take account of variability between samples. Figure 7.9.4 shows the age distribution of plaice in VIIbc between 1993 and 2008. In most years the age distribution appears to be estimated reasonably well. However during 2007 the uncertainty was quite high, in 2006 there was only one length sample so no uncertainty estimate is available.

7.9.3 Historical stock development

Because the sampling was representative of the Aran grounds plaice only, it would not be appropriate to raise the data to all landings in VIIbc. Instead the Working Group estimates of the international landings were multiplied by the proportion of the landings that were taken outside the Stags grounds (the four most northerly rectangles in VIIb). The age distributions were raised to these landings (Table 7.9.2).

The estimated catch numbers-at-age are given in Table 7.9.3, catch weight-at-age is given in Table 7.9.4. There appears to be relatively little contrast (particularly weak or strong year classes) in the catch numbers. This is also illustrated by Figure 7.9.5, which shows the standardized catch proportions-at-age. Figure 7.9.6 shows the log catch numbers-at-age. The rate of decline in catch numbers through the cohorts appears to be reasonably stable. This can be further investigated by calculating the slope of the log-catch numbers (Z). Figure 7.9.7 shows the catch curve, plaice under the age of 4 are not fully selected and from age 7 onwards the data get quite noisy, therefore the slope of the log-catch numbers was estimated over ages 4 to 7 (Figure 7.9.8). It appears that Z varied between 0.5 and 1.0. During the late 1990s Z was larger than 0.7 whereas in recent years Z has been around 0.6.

Yield-per-recruit analysis

The yield-per-recruit was estimated using a method by Thompson and Bell, 1934. This method requires the selectivity to be estimated. This was done by estimating the slope of the log catch numbers for ages that are fully selected and using this slope (Z) to predict the population numbers for ages that are not fully selected. The Z was estimated on pseudo-cohorts which were standardized to take account of annual variations in the catch numbers. Figure 7.9.9 shows that plaice in VIIbc appear to be fully selected by the age of 4 and that after the age of 9 the data get very sparse. Figure 7.9.10 shows the slope of the log catch numbers. The predicted catch numbers from this slope were used to estimate the 'observed' selectivity. This was then modelled by applying a linear model after a logit transformation. The estimated selection curve is also shown in Figure 7.9.10. A natural mortality of 0.12 was assumed (based on the value used by the WG for plaice in VIIfg) and the WG maturity ogive for plaice in VIIfg was used to estimate SSB. The yield was estimated for a range of F values based on the average catch weights. Figure 7.9.11 shows the YPR curve, F_{max} is estimated to be 0.27. $F_{0.1}$ is estimated as 0.16. Recent values of Z were in the order of 0.5 to 0.6, with M=1.2 this would result in an F of 0.38-0.48. This is above F_{max} and $F_{0.1}$.

7.9.4 References

Thompson and Bell. 1934. W.F. Thompson and F.H. Bell, Biological statistics of the Pacific halibut fishery. 2. Effect of changes in intensity upon total yield and yield per unit of gear, Rep. Int. Fish. (Pacific Halibut) Comm. 8 (1934), p. 49.

Table 7.9.1 Plaice in Divisions VIIb, c (Southwest Ireland). Nominal landings (t) 1973–2008 as officially reported to ICES.

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981
Denmark	-	-	-	-	-	-	2	-	-
France	60	45	10	9	4	16	6	12	9
Ireland	124	106	153	133	135	122	117	142	135
Spain	-	-	-	-	-	-	-	65	58
UK - Eng+Wales+N.Irl.	.	.	.	.	.	.	.	.	.
UK - England & Wales	1	1	-	-	-	-	-	-	4
UK - Scotland	-	-	-	-	-	-	-	-	-
Total	185	152	163	142	139	138	125	219	206

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990
Denmark	-	-	-	-	-	-	-	-	-
France	8.00	37	2	10	11	13	9	1	11
Ireland	122	108	110	150	114	153	157	159	130
Spain	22	7	-	-	-	-	-	-	-
UK - Eng+Wales+N.Irl.	.	.	.	.	.	.	.	1	2
UK - England & Wales	4	-	3	7	5	1	2	.	.
UK - Scotland	-	-	3	-	-	-	-	13	90
Total	156	152	118	167	130	167	168	174	233

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999
Denmark	-	-	-	-	-	-	-	-	-
France	9	3	2	1	5	1	3	-	.
Ireland	179	180	191	200	239	248	206	160	157
Spain	-	-	-	-	-	-	-	-	-
UK - Eng+Wales+N.Irl.	-	6	1	2	1	2	-	1	-
UK - England & Wales	.	.	.	.	.	.	.	.	.
UK - Scotland	3	3	2	3	1	-	-	-	2
UK									
Total	191	192	196	206	246	251	209	161	159
Unallocated						-11	4	22	13
WG Ewstimate						240	213	183	172

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
Denmark	-	-	-	-	-	.			
France	31	8	17	8	16	12	11	12	8
Ireland	99	70	51	56	39	25	20	23	20
Spain	-	-	-	2	1	.	1		
UK - Eng+Wales+N.Irl.	-	-	2	-	-	.			
UK - England & Wales	.	.	.	.	.	.			
UK - Scotland	-	-	-	-	-	.			
UK							0		
Total	130	78	70	66	56	37	32	35	28
Unallocated	-22	9	1	6	-1	1	-1	-1	7
WG Ewstimate	108	87	71	72	55	38	30	34	35

Table 7.9.2. Landings of plaice from the Stags grounds (the four most northerly rectangles in VIIb: 37D8, 37D9, 37E0 and 37E1) were excluded from the analysis as these were poorly sampled and the lpue trends in this area match those of VIa more closely than those in the rest of VIIbc. The proportion of Irish landings reported in VIIbc that were outside the Stags grounds was used to adjust the WG estimates of the landings.

Year	WG landings	Proportion outside 37D8 37D9 37E0 37E1	Landings outside 37D8 37D9 37E0 37E1
1993	196	0.75*	50
1994	206	0.75*	52
1995	246	0.82	45
1996	240	0.73	65
1997	213	0.69	66
1998	183	0.74	47
1999	172	0.60	68
2000	108	0.37	68
2001	87	0.31	60
2002	71	0.28	51
2003	72	0.17	60
2004	55	0.14	48
2005	38	0.36	24
2006	30	0.17	25
2007	34	0.32	23
2008	35	0.13	30

***average 1995–1998.**

Table 7.9.3. Catch numbers-at-age for plaice in VIIbc (excl VIIb north).

	1	2	3	4	5	6	7	8	9	10	11	12+
1993	0	12	49	50	19	10	10	0	0	0	0	0
1994	0	18	67	47	17	8	5	4	1	0	0	0
1995	0	7	29	54	19	10	4	2	1	0	0	0
1996	0	18	53	52	33	19	4	3	0	0	2	1
1997	0	38	61	55	23	9	4	2	1	0	0	1
1998	0	9	41	46	26	8	4	1	1	0	0	0
1999	1	20	54	55	25	17	5	4	0	0	0	0
2000	0	18	82	63	29	9	5	2	0	0	0	0
2001	0	27	77	65	20	11	3	1	1	0	0	0
2002	0	8	41	42	28	11	6	3	2	1	0	0
2003	0	20	45	48	26	17	6	5	0	1	0	0
2004	0	4	39	41	26	19	11	4	1	1	0	1
2005	0	2	22	20	11	12	3	1	0	1	0	0
2006	0	6	30	31	11	7	5	0	0	0	0	0
2007	0	11	18	17	8	8	3	0	0	0	0	0
2008	1	11	32	22	16	6	4	1	0	0	0	0

Table 7.9.4. Weight-at-age for plaice in VIIbc (excl VIIb north).

	1	2	3	4	5	6	7	8	9	10	11	12+
1993	0.048	0.184	0.251	0.299	0.393	0.497	0.784					
1994	0.116	0.213	0.249	0.299	0.377	0.422	0.612	0.978	0.594	0.596		
1995	0.081	0.246	0.295	0.325	0.393	0.472	0.613	0.760	1.307			
1996	0.177	0.238	0.293	0.329	0.383	0.487	0.403	0.452			1.228	0.818
1997	0.060	0.255	0.304	0.345	0.406	0.479	0.556	0.532	0.594	0.678	1.615	1.022
1998	0.213	0.262	0.288	0.309	0.401	0.463	0.562	0.670	1.082	0.724	1.569	1.106
1999	0.227	0.252	0.284	0.342	0.462	0.579	0.585	0.647			2.038	1.872
2000		0.258	0.271	0.315	0.395	0.478	0.621	0.748	1.045	1.351		2.016
2001	0.677	0.202	0.255	0.304	0.351	0.419	0.474	0.967	0.603			
2002	1.097	0.229	0.265	0.305	0.361	0.468	0.552	0.719	1.435	1.712	1.038	
2003		0.252	0.308	0.322	0.388	0.444	0.587	0.677	0.532	0.748	1.612	
2004		0.207	0.252	0.307	0.344	0.355	0.433	0.575	0.544	0.795		1.200
2005		0.244	0.259	0.303	0.337	0.363	0.502	0.589	0.767	0.786		
2006		0.259	0.269	0.280	0.306	0.282	0.293					
2007		0.252	0.273	0.351	0.401	0.497	0.646	0.731	1.160	0.761		
2008	0.224	0.251	0.291	0.306	0.336	0.411	0.440	0.605	0.501	0.822	0.958	

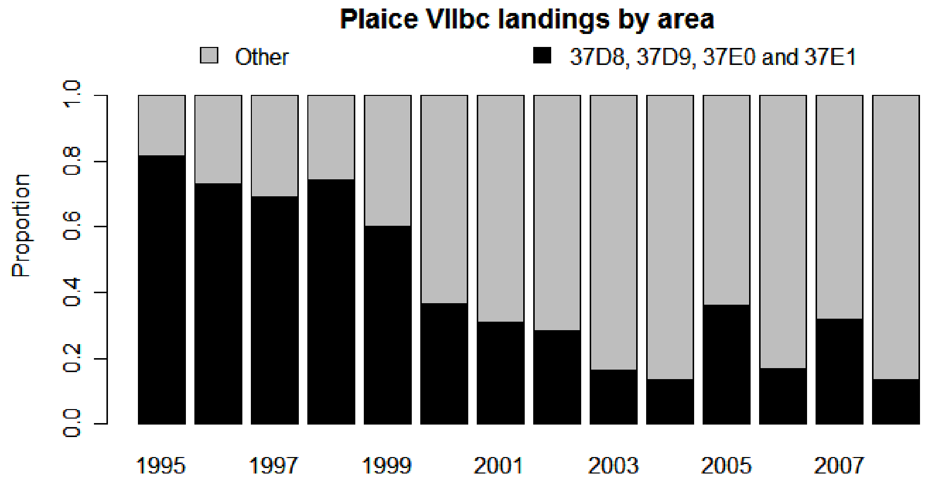


Figure 7.9.1. Irish operational landings by area, rectangles 37D8, 37D9, 37E0 and 37E1 are the most northerly rectangles in VIIb (the Stags). A significant proportion of the landings were taken on the Stags grounds but less than 2% of the sampling took place in ports near these grounds.

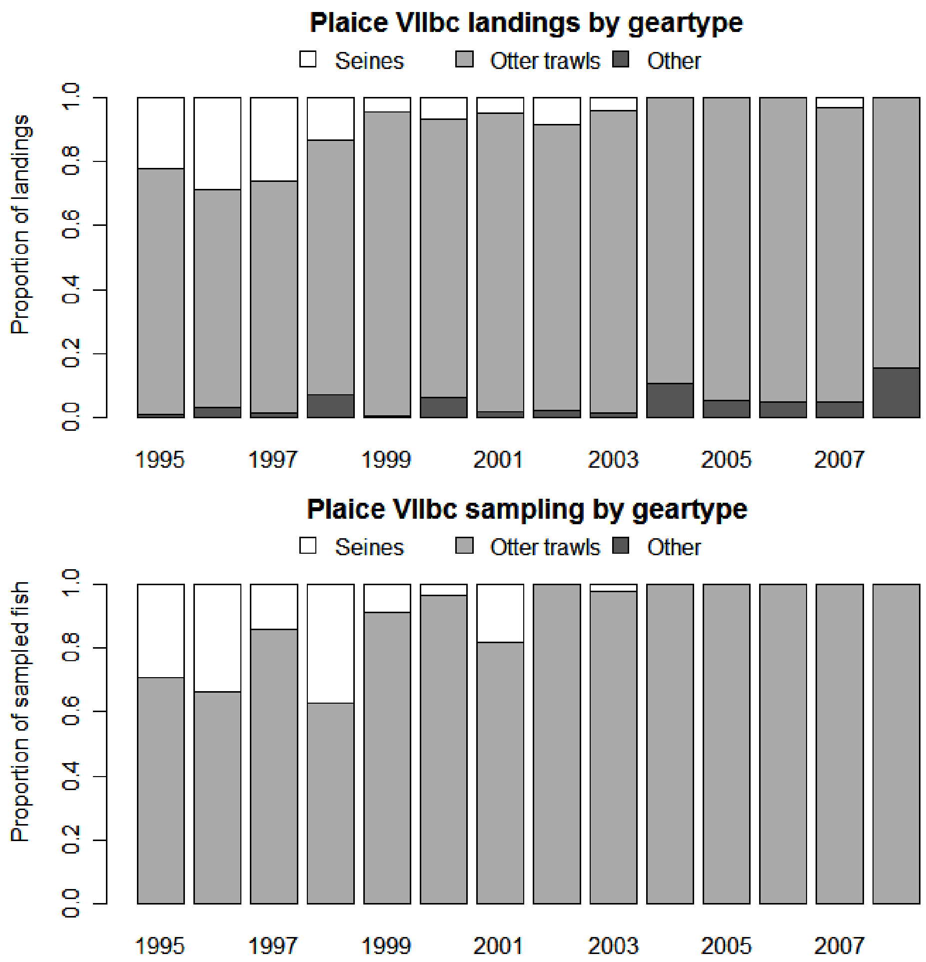


Figure 7.9.2. Irish Operational landings of plaice in VIIbc by geartype (top) and number of fish measured by geartype (bottom). The sampling appears to be representative of the geartypes in the fishery.

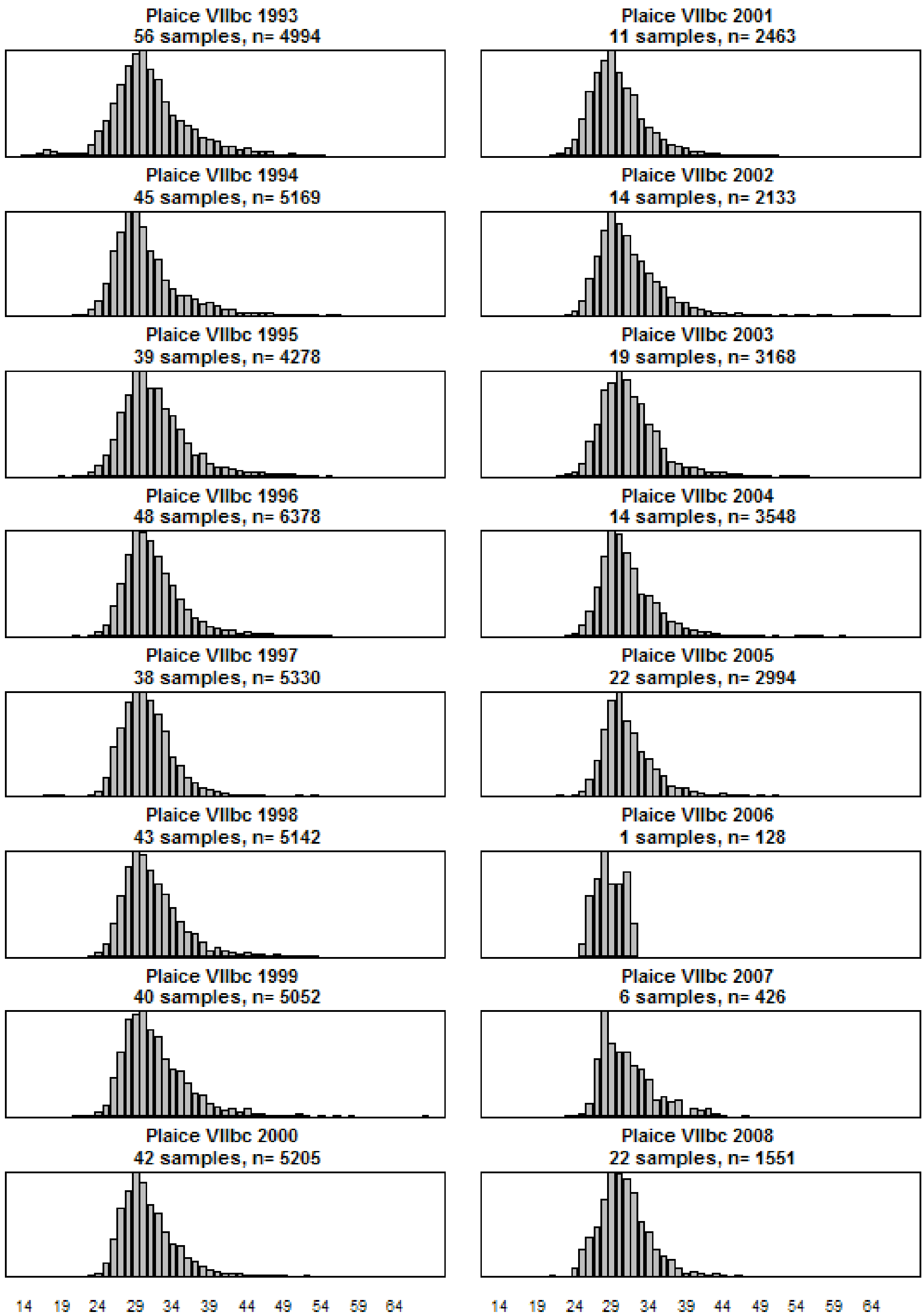


Figure 7.9.3. Length–frequency distribution of the Irish landings of plaice in VIIbc between 1993 and 2008. All gears and quarters combined. Sampling was poor during 2006 and 2007.

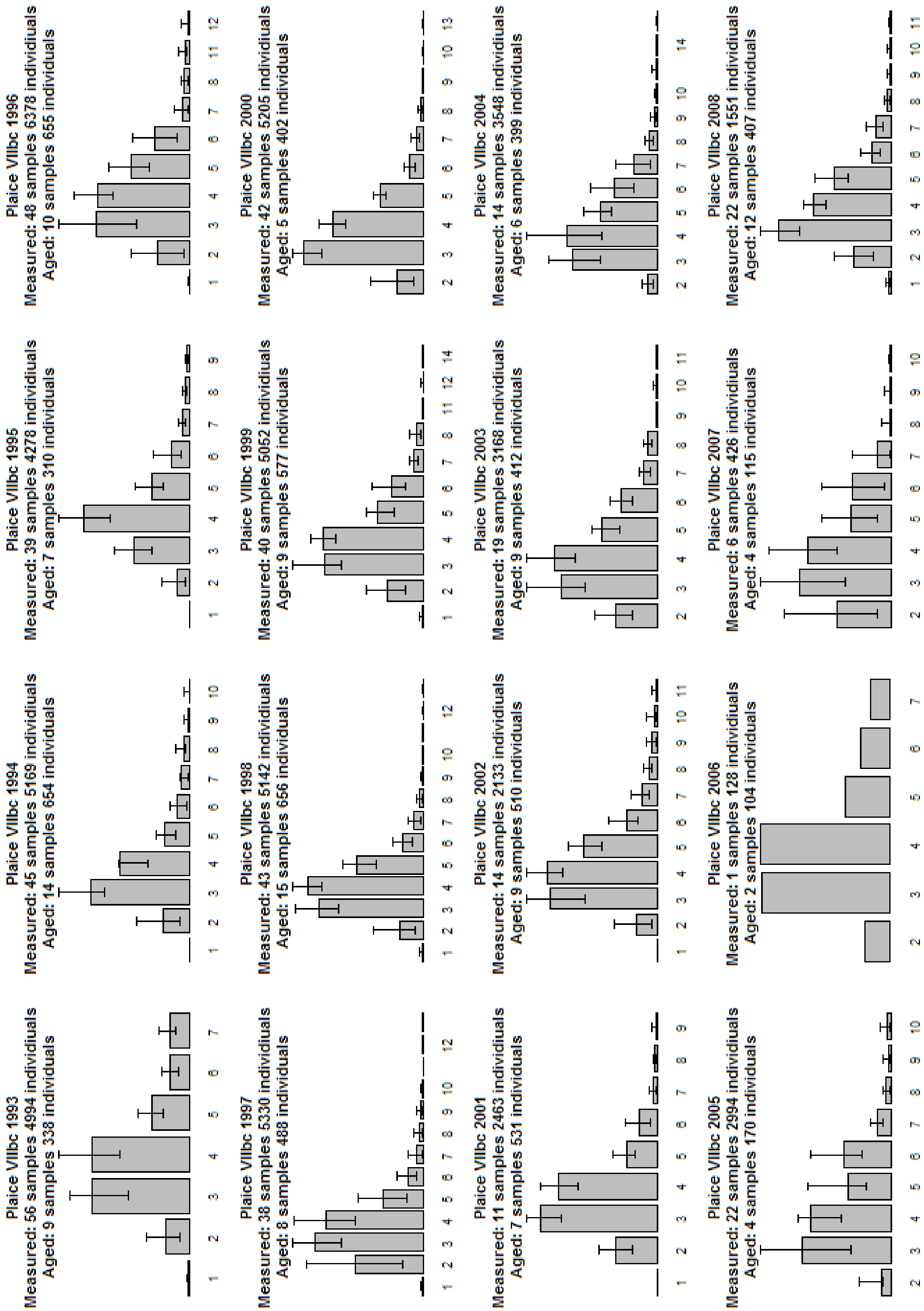


Figure 7.9.4. Relative age distribution of plaice in VIIbc between 1993 and 2008. All gears and quarters combined. The error bars represent the 95% confidence limits (bootstrap estimates). No error estimates are available for 2006 as there was only one length sample during that year.

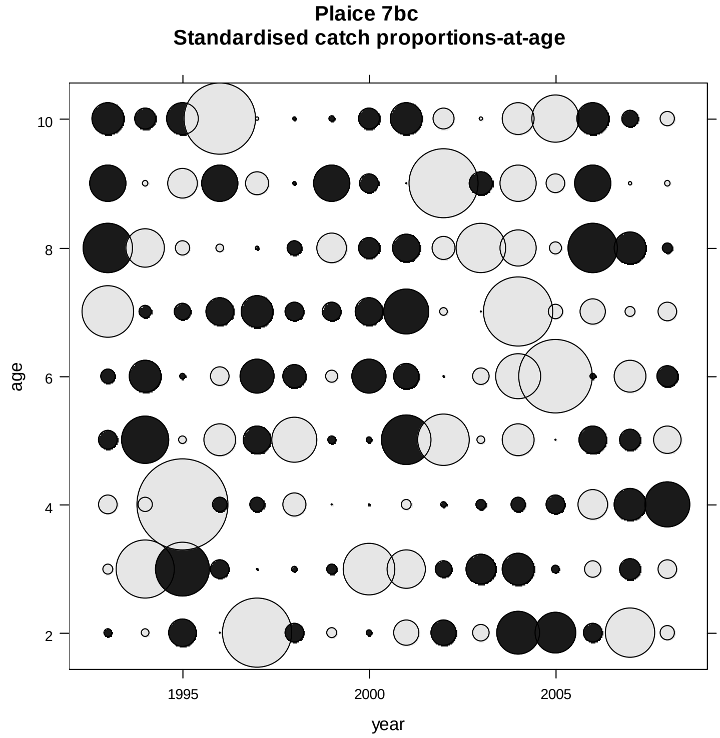


Figure 7.9.5. Standardised catch proportions-at-age for plaice in VIIbc. Grey bubbles represent higher-than-average catch-at-age and black bubbles represent lower-than-average catch-at-age.

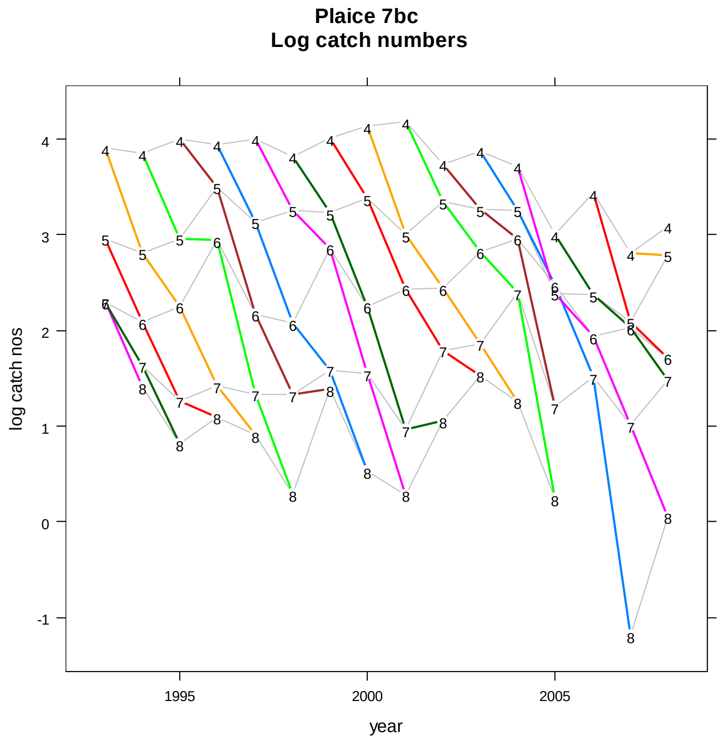


Figure 7.9.6. Log catch numbers-at-age (ages 4–8).

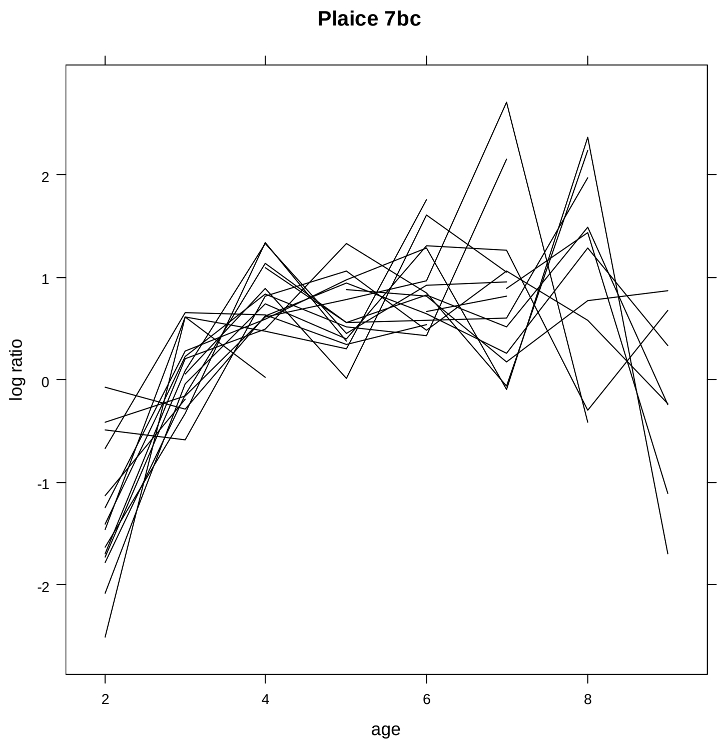


Figure 7.9.7. Catch curve of plaice in VIIbc. Plaice from the age of 4 appear to be fully selected; the data get quite noisy from the age of 7 onwards.

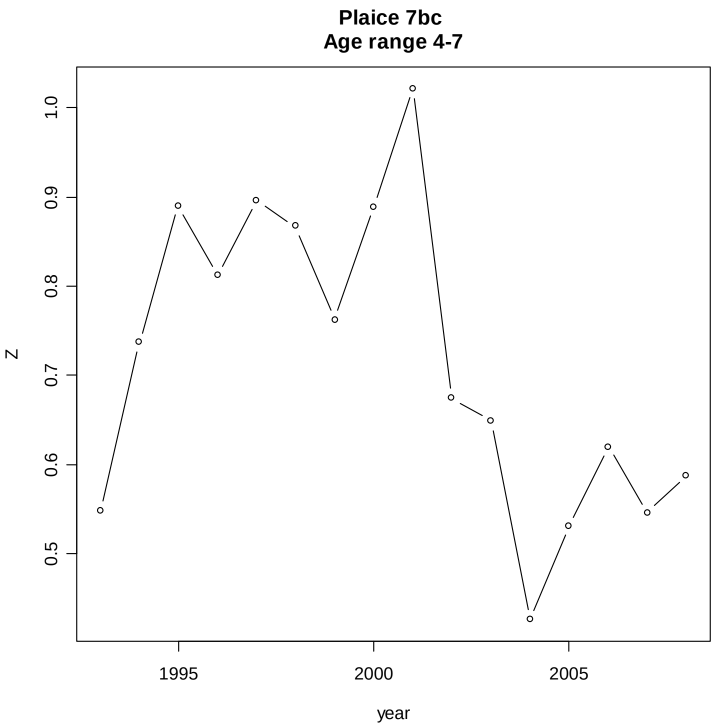


Figure 7.9.8. Z estimated over pseudo-cohorts as the slope of the log catch numbers.

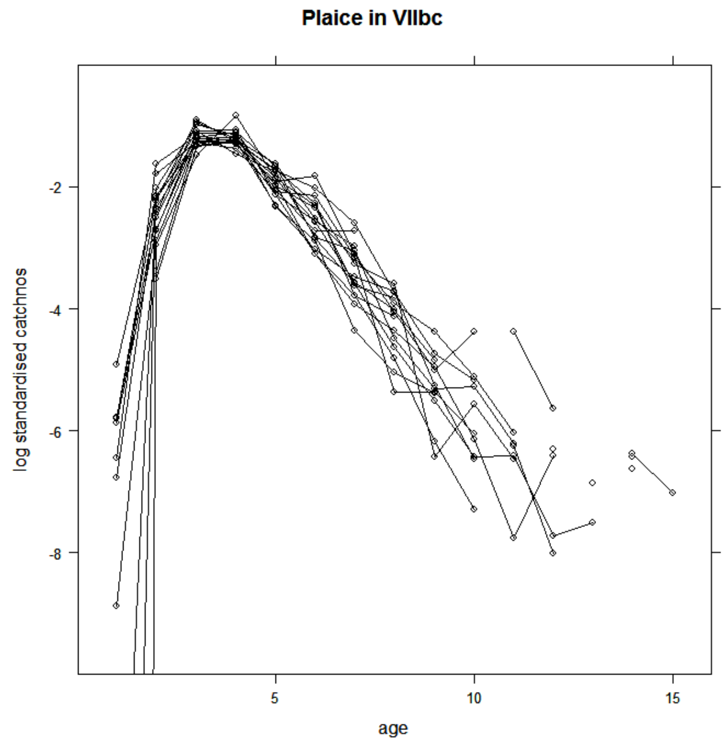


Figure 7.9.9 log catch numbers (standardized by year). Fish appear to be fully selected from the age of 4.

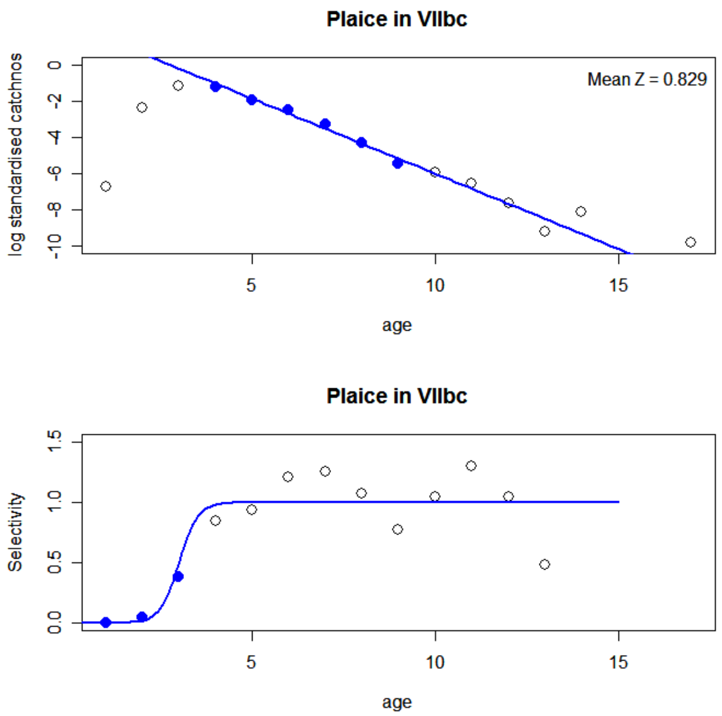


Figure 7.9.10. Selectivity was modelled by fitting a line through the mean log standardized catch numbers of ages 4 to 9 to predict the expected catch numbers for ages 1 to 3 if these were fully selected. The proportions of observed divided by expected catch number were taken as the 'observed' selectivity. This was then modelled using a logit transformation.

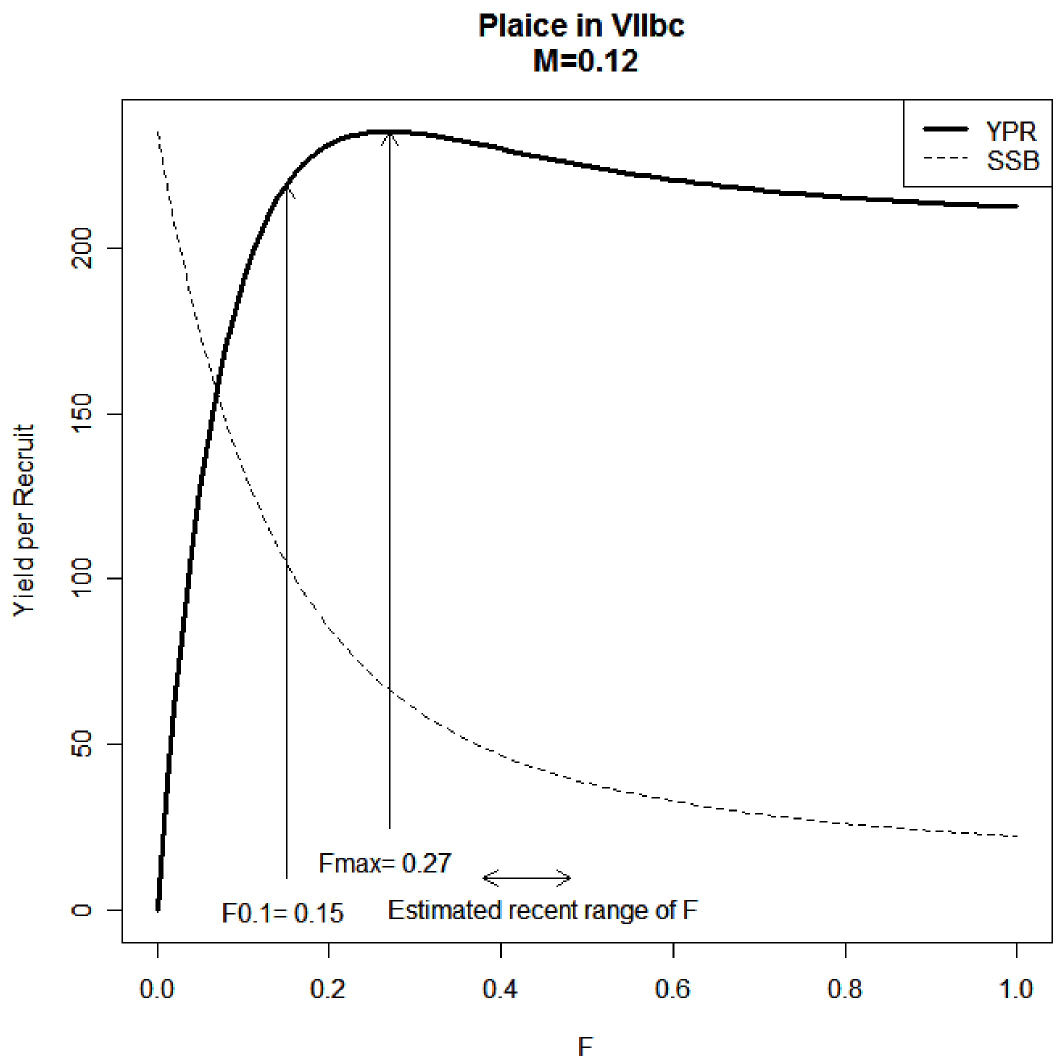


Figure 7.9.11. YPR analysis using the Thompson-Bell approach. Recent estimates of Z were between 0.5–0.6 which translates to an F of 0.38–0.48

7.10 Plaice in Divisions VIIf,g (Celtic Sea)

Type of assessment in 2009

Update, no changes to the assessment.

ICES advice applicable to 2009

Exploitation boundaries in relation to precautionary considerations: a 75% reduction in F is needed to increase SSB to around $\mathbf{B}_{pa}$ in 2010. This corresponds to landings of less than 170 t in 2009.

ICES advice applicable to 2008

Exploitation boundaries in relation to precautionary considerations: a 60% reduction in F is needed to increase SSB to around $\mathbf{B}_{pa}$ in 2009. This corresponds to landings of less than 240 t in 2008.

If the advised large reduction in F is not achievable in the short term, ICES urges a Recovery plan to be developed. This plan should include a sustained reduction of fishing mortality to rebuild the stock above $\mathbf{B}_{pa}$ in the medium term. Catch and effort reductions are required to promote such a reduction in fishing mortality. Since 2000 the estimated landings have been below the TACs. Nevertheless, according to the catch forecast the predicted landings in 2007 at *status quo* fishing mortality are much higher than the agreed TAC for 2007.

7.10.1 General

Stock description and management units

A TAC is in place for ICES Areas VIIf&g which corresponds to the stock area.

Management applicable to 2008 and 2009

TACs and quotas set for 2008

Species: Plaice *Pleuronectes platessa*		**Zone:** VIIf and VIIg PLE/7FG.
Belgium	77	
France	139	
Ireland	202	
United Kingdom	73	
EC	491	
TAC	491	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TACs and quotas set for 2009

L 22/76 EN Official Journal of the European Union 26.1.2009

Species: Plaice *Pleuronectes platessa*		Zone: VIIf and VIIg (PLE/7FG.)
Belgium	59	
France	107	
Ireland	200	
United Kingdom	56	
EC	422	
TAC	422	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

Fishery in 2008

The main fishery is concentrated on the Trevose Head ground off the north Cornwall coast and around Land's End. Although plaice are taken throughout the year, heaviest landings are in March, after the peak of spawning, with a second peak in September. The fisheries taking plaice in the Celtic Sea mainly involve vessels from Belgium, France, England and Wales. In 2008 Belgium reported 50% of officially reported landings, the UK 17%, France 17%, and Ireland the remaining 17%. The estimated total international landings for 2008 were 438 t, 11% below the TAC (491 t) and 16% below the *status quo* prediction given by last year's assessment (524 t).

Although the current assessment indicates a decline in F in recent years, it is unclear as to whether this is linked to the Trevose Head spring fishery closure. Discards are considered to be significant but are currently not quantified.

7.10.2 Data

Landings

National landings data and estimates of total landings used by the WG are given in Table 7.10.1. Minor revisions were reported to Irish landings data for 2007 and to French landings data for 2002, 2004, 2005 and 2007.

Discards

Indications are that discard rates, although variable, may be substantial in some fleets/periods. Total raised discard information is available for some fleets, and data raised to sampled vessels for others, but the WG has not yet been able to analyse these data. For this update assessment, discard data were excluded pending a more thorough examination at the next Benchmark workshop.

Data from 2008 discard sampling programmes are summarized in Figures 7.10.3a, b and c. A revision to the Irish discard data for 2007 was made and is shown in Figure 7.10.3b.

Biological

Annual length compositions for 2008 are given in Table 7.10.4, and length compositions for UK (E&W) landings for the last ten years are presented in Figure 7.10.4.

Following minor revisions to landings data for previous years (see above), the international age compositions and weights-at-age have been amended.

Quarterly age compositions for 2008 were available for Belgium, Ireland and UK (E&W), representing approximately 71% of the total landings. Methods for the derivation of international catch numbers-at-age and for the calculation of catch and stock weights-at-age are fully described in the Stock Annex, Section B.1 and B.2.

Parameter estimates for the in-year smoothing of catch and stock weights in 2008 are as follows:

Wt = 0.3813 + 0.0687*(age)+0.0117*(age 2) ($R^2 = 0.98$)

Catch weights-at-age are plotted as mid-year, and stock weights-at-age are interpolated from the fitted curve at 1st January.

The age compositions of landings for the last 10 years are shown in Figure 7.10.5. Catch numbers and weights-at-age in the catch and stock are given in Tables 7.10.5–7.10.7. As in previous assessments, numbers-at-age 1 have been replaced by zero values; see Section B.1 in the Stock Annex.

A natural mortality estimate of 0.12 was applied to all ages and to all years, as previously. The maturity ogive used in this update assessment was derived in 1997 and was applied to all years. Further details of the derivation of these can be found in Section B.2 of the Stock Annex.

Surveys

Indices of abundance given by the UK (E&W) beam trawl survey in VIIf (UK-BCCSBTS-S), the Irish Celtic Sea groundfish survey (IR-ISCSGFS), and the Irish Celtic Explorer IBTS survey (IRGFS) are presented in Table 7.10.8.

The UK (E&W) data indicate relatively strong 1994 and 1999 year classes. The Celtic Explorer IBTS survey-series started in 2003 and is not yet included in the assessment.

Figure 7.10.6 shows fleet log lpue by year class and illustrates the consistency of year-class estimation by the survey (and the two commercial tuning fleets). It also shows that strong year classes are well predicted by all fleets. All three fleets also predict poor year classes consistently. Figure 7.10.7 shows fleet log lpue by year and illustrates that there is little indication of any serious year effects.

Commercial cpue

Effort and lpue data were available for the UK (E&W) beam trawl, UK (E&W) otter trawl, Irish otter trawl, beam trawl and seine fleets, Belgian beam trawl and the UK September beam trawl survey (Tables 7.10.2, 7.10.3 and Figures 7.10.1, 7.10.2).

Commercial lpue data appear to demonstrate a general pattern of steep decline since the high levels in the early 1990s, with a further decline in recent years followed by an increase in 2007 and 2008 for beam trawlers in VIIf and a smaller increase in 2007 and 2008 for otter trawlers in VIIg east.

UK (E&W) beam trawl effort levels have declined in both VIIf and VIIg from the high levels observed in 1999–2001; effort in VIIf in 2008 was at the lowest level since 1984. UK (E&W) otter trawl effort levels for VIIf and VIIg have demonstrated a general decline since 1990, with an upturn in VIIf since 2000.

Irish otter trawl effort has steadily increased since 1999, whereas beam trawl display a less pronounced increase over the time-series prior to 2008, when a substantial drop is seen relative to effort in 2007, and the seine fleet demonstrates only a weak trend upward.

Commercial fleet tuning data consist of UK (E&W) beam trawl (UK-CSBT) and UK (E&W) otter trawl (UK-CSOT) data, and these are given in Table 7.10.9, along with the survey data used for tuning.

Other relevant data

Other than the rectangle closures, there were no early closures of the fishery for plaice in 2008. There is relatively little information on the level of landings misreporting on this stock, although it is not considered to be a problem. Reports from industry suggest that the main issues affecting the fishery in VIIf&g were displacement of effort as a consequence of the rectangle closures and the restrictions on the use of 80 mm mesh west of 7°W (Trebilcock and Rozarieux, 2009).

7.10.3 Stock assessment

Section 1.4.1 outlines the general approach adopted at this year's Working Group meeting, and the specific approach for this stock is given in the Stock Annex.

Data screening

A separable analysis was carried out to screen the catch-at-age data; no anomalies were apparent (results are available in the 'Exploratory runs' folder).

Final update assessment

The tuning data available, and the subset used in the assessment, are given in Table 7.10.9. No exploratory XSA runs were carried out for this update assessment.

Final settings, used since 2005, are detailed below:

			2009 XSA
Fleets	UK-CSBT	90–08	4–8
UK-CSOT		89–08	4–8
UK-BCCSBTS-S		90–08	1–5
Taper			No
Taper range			-
Ages catch dep. Stock size			1–5
Q plateau			7
F shrinkage se			2.5
	year range		5
	age range		4
Fleet threshold se			0.5
Age range			1–9+
Age 1 catch numbers			Set to zero
F bar age range			3–6

XSA diagnostics from the final run are given in Table 7.10.10 and log-catchability residuals plotted in Figure 7.10.8. Survivor estimates for ages 4 and above are reasonably consistent between fleets. The standard error threshold clearly operates on the commercial fleet data, maintaining relatively even weighting up to age 5, after which the survey contribution sharply declines reflecting the lack of data for older ages. The survey contributes around 40% of the weight to estimates of survivors at-age 1, with the remainder coming from P-shrinkage. At ages 2 and 3 the survey provides around 65% of the weighting. F-shrinkage is negligible throughout.

The residuals for the UK beam trawl survey (Figure 7.10.8) demonstrate apparent cohort and age effects, in contrast to the commercial datasets for older ages. The Working Group considered this to be as a result of the heavy discarding of the youngest age classes, resulting in these fish being absent from commercial data. The survey estimates of these age classes are probably a true reflection of their strength within the fishery. There are some year-effects apparent in the otter trawl fleet data, but these are relatively small.

The retrospective analysis (Figure 7.10.9) reveals a tendency to underestimate recent terminal F values, and to overestimate SSB. Although there appears to be a pattern of overestimating recruitment, this may be partly as a result of discarding and population shrinkage, which will tend to pull recruit estimates towards the mean during periods of low recruitment.

Fishing mortalities and population numbers from the final XSA run are given in Tables 7.10.11 and 7.10.12 and the summary in Table 7.10.13. Fishing mortality in 2008 is estimated to have been at 0.37, which is the lowest in the time-series.

SSB in 2008 is estimated at 1243 t suggesting that SSB may have risen above B_{lim} (1100 t) for the first time since 2001. However, the retrospective analysis suggests that this estimate of SSB is an overestimation. If the pattern of overestimation continues, the estimate of SSB in 2008 will likely reduce to approximately the value of B_{lim} in next year's assessment (see regression between initial SSB estimate (x) and first revision (y) from retrospective analysis, y = 0. 895x, see analysis of bias in p7fgRetroBias.xls copied to the 'Explanatory Runs' folder).

Comparison with previous assessments

The current assessment suffers from a retrospective pattern, when compared with results from previous assessments, which is evident in SSB, fishing mortality and recruitment (Figure 7.10.13).

State of the stock

A summary of the time-series of XSA results is given in Table 7.10.13 and Figure 7.10.10. Fishing mortality has fluctuated without trend since 1977 but has declined sharply since 2004. The most recent value should be viewed with caution as the retrospective pattern implies that these may be revised upwards in next year's assessment.

SSB rose to a high level throughout the 1980s, following a series of above-average recruitments, but has declined since 1990. SSB is estimated to have been below B_{pa} (1800 t) since 1997, and SSB was below B_{lim} (1100 t) between 2002 and 2007. In 2008, SSB is estimated to be 1243 t, i.e. about 10% above B_{lim}, but this initial estimate is typically revised downward by ~10% in the following year's assessment as a consequence of the retrospective pattern present in the stock (Figure 7.10.9).

With the exception of the 1994 year class, all recruitments-at-age 1 since 1992 have been below the long-term arithmetic average (4.4 million).

7.10.4 Short-term projections

Estimating year-class abundance

The XSA estimate of the 2006 year class (3.5 million 1 year olds in 2007) has been revised upwards from last year's estimate (2.9 million). The 2007 year class is estimated at 2.9 million 1 year olds in 2008; the sources of this estimate are detailed in the Table below. Recruitment estimates for subsequent years were derived from a short-term geometric mean ($GM_{1989-07}$, 2.9 million).

Working group estimates of year-class strength used for prediction can be summarized as follows:

Recruitment-at-age 1:

Year class	Thousands	Basis	Surveys	Commercial	Shrinkage
2006	3533	XSA	65%	-	35%
2007	2869	XSA	42%		58%
2008	2879	GM (89–07)			
2009	2879	GM (89–07)			

The input values for the catch forecast (using the MFDP software) are given in Table 7.10.14. The F at-age values used were calculated as the mean of the XSA values from 2006–2008, unscaled. Catch and stock weights-at-age were also the mean of the period 2006–2008. Stock numbers-at-age in 2009 for ages 2 and older were obtained from the XSA. SSB values are calculated for 1 January.

Table 7.10.15 gives the management option table from the *status quo* catch prediction, and short-term results are shown in Figure 7.10.12. Assuming *status quo* F (F_{sq} = 0.41) implies landings of 575 t in 2009 and 610 t in 2010. (The TAC for 2009 is 422 t.). SSB is predicted to rise from 1388 t in 2009 to 1492 t in 2010 and 1540 t in 2011. These results are discussed further in Section 7.10.10.

The detailed output for the *status quo* F forecast by age group is given in Table 7.10.15, and the estimated contributions of recent year classes to the predicted catches and SSBs are given in Table 7.10.17. The assumptions of $GM_{1989-07}$ recruitment are predicted to contribute 10% to the landings in 2010 and 29% to SSB in 2011.

The stock and recruitment scatterplot is given in Figure 7.10.11; it should be recalled that the unknown mortality from discarding would have an impact on the stock–recruitment relationship.

The recruitment of Celtic Sea plaice and neighbouring stocks appear to respond to negatively to sea temperature anomalies (Fox *et al*., 2000). However, compared with fisheries on some other species (e.g. cod), those on plaice are less dependent on the incoming year class. Therefore, the incorporation of temperature data into plaice stock dynamic models will probably not have a large impact on short-term projections, but may allow medium to long-term forecasts to be made under varying environmental scenarios.

7.10.5 Medium-term projection

Not carried out.

7.10.6 Biological reference points

Precautionary approach reference points

The Working Group's current approach to reference points is outlined in Section 1.4.4. Current reference points are detailed below:

F_{lim}	No proposal
F_{pa}	No proposal

B_{lim}	1100 t	basis:	B_{loss} (B78, WG98)
B_{pa}	1800 t	basis:	B_{lim} . exp(1.645*0.3)

SSB is currently below B_{pa} and at F_{sq} will remain below B_{pa} in the short term.

B_{loss} (1010 t, 1978) is considered stable. The estimate of SSB in 1978 has not been revised in the last 9 assessments of this stock. Further details can be found in Section G of the Stock Annex. A general discussion on target reference points is given in Section 1.

Yield-per-recruit analysis

Results for yield and SSB per recruit (using program MFYPR), conditional on the recent exploitation pattern, are given in Table 7.10.18 and Figure 7.10.12. F_{max} is given by a reference F of 0.30, around 74% of F_{sq}, and similar to last year's estimate (0.27). Long-term yield and SSB (at F_{sq} and assuming GM_{89-07} recruitment = 2.9 million) are given as 650 t and 1630 t respectively.

7.10.7 Management plans

There is no management plan for Celtic Sea plaice.

This WG has in the past provided a number of scenarios for potential management plans for Celtic Sea plaice (ICES, 2006). These analyses indicated that an F in the range 0.25 to 0.56 would be sustainable. This is also consistent with sustainable fishing for VIIfg sole. The WG believes that such an approach to management could be phased in using effort reduction in conjunction with technical conservation measures.

7.10.8 Uncertainties in assessment and forecast

Sampling

Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment approaches, and associated CVs of some national catch-at-age datasets are available in the Stock Annex**.** The sampling levels for those countries supplying information are given in Table 2.1.

Discards

Estimates of discarding are not included in this assessment. However, data from discard sampling indicates that rates are high for this stock in some seasons/fleets (Figures 7.10.3a, b and c) and their non-inclusion may represent a major deficiency in the assessment. The composition of the fleets and therefore the gear types employed in the fishery demonstrate fluctuations over time, so it is likely that the discard rates observed in the fishery now are not applicable to periods earlier in the time-series. From 2003 onwards, discard sampling for Ireland, Belgium, France and UK (E&W) has been improved under the Data Collection Regulation.

Consistency

The trends and estimates of fishing mortality, SSB and recruitment in this assessment are consistent with last year’s assessment (Figure 7.10.13). Last year’s assessment estimated F in 2007 at 0.40; this year it has been revised upwards to 0.45. Last year’s assessment estimated SSB in 2007 to be 999 t; this estimate has been revised downwards to around 910 t this year.

Misreporting

Misreporting has been considered a potential problem for this stock in earlier years. However, misreporting of catches across ICES Divisions is thought to be minor. The *status quo* forecast indicates landings around 30% in excess of the TAC for 2009. It should be noted that although total reported landings for this stock in recent years remain below the TAC, fleets may be restricted by their individual quota allocation.

7.10.9 Recommendation for next Benchmark

YEAR	CANDIDATE STOCK	SUPPORTING JUSTIFICATION	SUGGESTED TIME	INDICATE EXPERTISE NECESSARY AT BENCHMARK MEETING.
2009	VIIf,g Plaice	Biological interactions with adjacent stocks; in particular Irish Sea plaice (Dunn and Pawson 2002) The lack of discard data in the assessment The need to review the tuning data included in the assessment as additional survey data are becoming available and the age ranges of all tuning datasets should be re-inspected Need to reconsider the assessment model setting being used as the power model is only indicated by one of the fleets There is also a retrospective bias in SSB, F and recruitment, which should be examined Review the new maturity data, which has become available from sampling carried out under the EU DCR	2011	Expert group members

7.10.10 Management considerations

The SSB of this stock is estimated to have been below B_{lim} (1100 t) since 2002, but the SSB is now estimated to have been 1243 t in 2008. However, the retrospective plot (and regression analysis of the bias, see *Final Update Assessment* above) indicates that this is expected to be revised next year to around B_{lim}. The *status quo* catch forecast implies that SSB will continue rise above B_{lim} to 1390 t in 2009, 1490 t in 2010 and 1540 t in 2011, assuming GM_{89-07} recruitment levels. Despite the use of a recent GM recruitment level, catch forecasts in recent years have been overly optimistic, e.g. last year's forecast indicated landings of 524 t in 2008, whereas the landings value used by the WG this year was 438 t. The level of fishing mortality in the last three years appears to have been at the lowest level for the time-series, which is consistent with the reductions in effort in the beam trawl fleets. Landings in 2009 are this year predicted to be 575 t, well above the TAC of 422 t.

The high level of discarding indicated for some fleets in this fishery would suggest a mismatch between the mesh size employed in the fishery and the size of the fish being landed on the market. Increases in the mesh size of the gear should result in fewer discards and ultimately, in increased yield from the fishery. The results of studies presented to the 2004 WG (ICES, 2004) indicate that this would also benefit the sole VIIf,g stock without decreasing sole landings in the long term.

Regulations and their effects

Technical measures in force for this stock are minimum mesh sizes, minimum landing size, and restricted areas for certain classes of vessels. Technical regulations regarding allowable mesh sizes for specific target species, and associated minimum landing sizes, came into force on 1 January 2000 (Section 2.1). The minimum landing size for plaice in Divisions VIIf,g is currently 27 cm.

Since 2005, ICES rectangles 30E4, 31E4, and 32E3 have been closed during the first quarter (Council Regulations 27/2005, 51/2006, 41/2007, 40/2008 and 43/2009) with the intention of reducing fishing mortality on cod. There is evidence that this closure has redistributed effort to other areas. Many vessels (particularly beam trawlers from the UK and Belgium) fished close to the borders of the closed rectangles during the closure, and fished intensively inside the rectangles when they were reopened. Information from the UK reveals that plaice can be caught in areas outside the closed area with the same catch rates. Fishing mortality has decreased since 2005, and the closure may have been one of the contributing factors.

7.10.11 References

Dunn M.R. and M.G Pawson. 2002. The stock structure and migrations of plaice populations on the west coast of England and Wales. Journal of Fish Biology **61**, 360–393.

Fox C.J., B.P. Planque, and C.D. Darby. 2000. Synchrony in the recruitment time-series of plaice (*Pleuronectes platessa* L) around the United Kingdom and the influence of sea temperature. Journal of Sea Research **44**, 159–168.

ICES. 2006. Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks (WGSSDS), 27 June–6 July 2006, ICES Headquarters, Denmark. ICES CM 2006/ACFM:33. 694 pp.

ICES, 2004. Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks (WGSSDS), 29 June–8 July 2004, Oostende, Belgium. ICES CM 2005/ACFM:03. 543 pp.

Trebilcock P. and N. de Rozarieux, 2009. National Federation Fishermen's Organisation Annual Fisheries Reports. Cornish Fish Producers Organisation / Seafood Cornwall Training Ltd, March 2009.

Table 7.10.1 **Plaice in divisions VIIf&g**
Nominal landings (t) as reported to ICES, and total landings as used by the working group

National landings as estimated by the working group 1977 - 1985; as reported to ICES and total landings as used by the working group 1986 onwards

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Belgium	214	196	171	372	365	341	314	283	357	665	581	617	843	794	836	371
UK (Engl. & Wales)	150	152	176	227	251	196	279	366	466	529	496	629	471	497	392	302
France	365	527	467	706	697	568	532	558	493	878	708	721	1089	767	444	504
Ireland	28	0	49	61	64	198	48	72	91	302	127	226	180	160	155	180
N. Ireland												1				
Netherlands										9						
Scotland	0	0	0	7	0	0	0	0	0	1				1		5
Total	757	875	863	1373	1377	1303	1173	1279	1407	2384	1912	2194	2583	2219	1827	1362
Unallocated	0	0	0	0	0	0	-27	-69	345	-693	-11	-78	-432	-137	-326	-174
Total as used by WG	757	875	863	1373	1377	1303	1146	1210	1752	1691	1901	2116	2151	2082	1501	1188

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	542	350	346	410	594	540	371	224	241	248	221	212	168	172	194	187
UK (Engl. & Wales)	290	251	284	239	258	176	170	134	136	105	127	87	55	88	61	63
France	373	298	254	246	329	298		287	262	186	165	145	132	106	104	62
Ireland	89	82	70	83	78	135	115	76	45	79	51	45	44	48	58	63
N. Ireland																
Netherlands																
Scotland	9	1	2													
Total reported	1303	982	956	978	1259	1149	656	721	684	618	564	489	399	414	417	375
Unallocated	-189	88	72	-26	-42	-82	312	-3	30	24	30	21	-13	-10	-7	63
Total as used by WG	1114	1070	1028	952	1217	1067	968	718	714	642	594	510	386	404	410	438

Table 7.10.2 VIIfg Plaice : LPUE for UK(E&W) fleets

	LANDINGS PER UNIT EFFORT (LPUE)						LANDINGS/EFFORT DATA				ADDITIONAL EFFORT DATA			
	RECT. GROUP VIIf (grp 1)		RECT. GROUP VIIg EAST (grp 2)		RECT. GROUP VIIg WEST (grp 3)		RECT GROUP VIIf (grp1)				VIIg (East)		VIIg (West)	
							otter trawl catch		Beam trawl catch		Otter	Beam	Otter	Beam
YEAR	TRAWL	BEAM TRAWL	TRAWL	BEAM TRAWL	TRAWL	BEAM TRAWL	tonnes	000s hr fished	tonnes	000s hr fished	000s hr fished	000s hr fished	000s hr fished	000s hr fished
1972	7.70		4.97		1.15		361.82	45.72			6.01		0.74	
1973	7.54		2.75		34.92		353.95	45.28			3.59		0.05	
1974	4.99		1.22		0.00		198.12	38.94			2.03		0.00	
1975	4.88		4.07		0.75		173.01	33.53			10.35		0.04	
1976	4.54		2.70		2.13		112.09	25.61			5.21		0.04	
1977	4.06		1.76		0.00		102.81	27.16			5.36		0.04	
1978	4.19	3.06	2.24	0.00	0.00	0.00	117.74	27.08	7.58	2.50	6.73	0.00	0.00	0.00
1979	5.31	3.62	3.34	2.19	0.00	0.00	125.81	23.84	6.30	1.96	4.54	0.13	0.00	0.00
1980	5.91	4.27	4.03	7.15	2.46	0.00	162.29	26.43	17.65	4.31	2.67	0.10	0.60	0.00
1981	5.36	3.50	3.20	3.13	1.05	5.23	126.27	24.10	23.72	6.24	7.78	0.78	4.78	0.10
1982	4.82	5.10	1.14	6.73	0.06	5.57	92.65	19.20	55.42	9.95	7.50	1.86	2.56	0.58
1983	6.05	3.92	2.66	5.24	0.00	4.88	108.76	17.61	47.72	12.35	5.33	6.82	0.00	0.80
1984	6.15	6.41	4.90	7.49	0.00	4.14	160.64	23.16	99.01	13.55	4.35	4.31	0.00	2.06
1985	6.98	6.38	5.09	8.05	2.61	7.10	188.06	25.24	146.73	18.69	5.72	5.14	0.57	1.41
1986	6.62	5.22	4.28	10.62	1.44	11.31	142.84	21.18	90.44	20.72	7.72	4.31	0.82	0.68
1987	6.60	4.32	6.46	10.79	0.86	10.66	199.03	24.43	145.37	38.76	9.87	4.83	0.83	0.92
1988	10.04	8.53	7.32	9.95	1.97	14.42	205.56	20.09	204.58	25.62	9.96	2.18	0.43	0.88
1989	7.40	5.63	6.36	9.67	4.35	16.42	130.67	17.61	96.05	20.26	8.13	3.72	0.25	0.26
1990	4.16	3.93	2.43	6.80	2.70	5.34	97.82	22.56	157.15	30.77	10.55	4.89	0.45	4.32
1991	2.87	3.58	2.22	2.83	1.17	2.94	56.52	18.57	193.27	40.81	6.25	12.39	0.91	2.52
1992	2.78	2.26	2.32	2.54	1.68	2.08	44.82	16.00	91.34	35.78	5.22	16.61	8.42	2.59
1993	2.72	2.84	1.43	2.28	1.77	1.41	38.14	13.79	107.43	39.64	4.43	18.44	0.94	2.73
1994	2.71	2.47	2.18	3.07	0.83	4.14	23.36	9.48	84.97	37.03	3.03	9.48	0.24	1.94
1995	2.93	2.66	2.23	3.34	3.35	2.22	26.38	8.46	96.28	37.59	2.61	11.60	0.46	2.16
1996	2.63	2.05	1.91	1.84	0.38	0.77	23.60	8.67	81.18	39.78	4.60	8.70	1.68	3.91
1997	2.41	1.90	1.89	2.33	1.30	0.48	20.47	8.14	83.68	43.00	5.18	12.67	1.90	2.56
1998	1.59	1.54	1.24	0.93	0.33	0.69	10.94	7.13	85.06	47.84	5.09	10.45	1.55	2.81
1999	2.59	1.63	1.99	0.67	0.35	0.68	11.99	5.69	85.44	50.87	1.97	26.00	3.86	5.47
2000	2.29	1.00	3.10	0.68	0.19	0.60	10.98	4.05	53.46	51.19	2.56	17.53	2.34	3.36
2001	2.25	1.07	2.53	0.87	0.32	0.68	9.78	4.42	53.31	49.32	2.71	19.95	2.68	1.55
2002	1.31	1.14	3.70	1.49	0.54	0.27	6.81	6.10	37.93	37.53	1.54	6.19	2.49	0.93
2003	1.67	1.17	0.82	1.25	0.29	0.09	15.83	9.94	47.73	40.71	0.55	11.87	1.73	2.40
2004	1.28	1.16	0.93	0.51	0.18	0.22	12.44	9.42	40.06	32.37	3.03	14.25	2.03	2.42
2005	0.81	0.75	0.13	0.51	0.01	0.07	9.5	12.09	22.25	27.73	0.30	9.57	2.35	1.67
2006	1.53	0.88	0.47	0.91	0.05	0.03	19.78	12.97	13.99	18.57	0.31	10.48	3.47	1.16
2007	1.07	1.95	1.45	0.85	0.1	0.56	11.85	10.66	18.10	15.37	0.41	6.79	3.49	0.19
2008*	1.27	2.95	1.69	0.8	0.01	0.1	13.21	10.13	18.79	13.83	1.58	3.84	3.65	0.08

* Provisional

Table 7.10.3 **VIIfg Plaice : LPUE and effort for Irish and Belgian fleets in VIIf,g**

	IR-OTB-7G			IR-SCC-7G		
Year	**Landings (t)**	**Effort (000 hr)**	**LPUE (kg/h)**	**Landings (t)**	**Effort (000 hr)**	**LPUE (kg/h)**
1995	94.23	63.56	1.48	9.55	6.43	1.49
1996	133.66	60.04	2.23	14.20	9.73	1.46
1997	119.84	65.10	1.84	38.79	16.13	2.40
1998	96.72	72.30	1.34	21.38	14.94	1.43
1999	60.05	51.66	1.16	10.40	8.01	1.30
2000	28.78	60.60	0.47	11.40	9.90	1.15
2001	23.82	69.43	0.34	10.93	16.33	0.67
2002	42.30	77.69	0.54	16.42	20.86	0.79
2003	26.35	86.79	0.30	13.80	20.91	0.66
2004	26.62	96.99	0.27	5.04	19.38	0.26
2005	22.78	124.40	0.18	6.46	14.81	0.44
2006	24.58	118.36	0.21	5.10	14.79	0.34
2007	30.38	135.41	0.22	4.76	15.81	0.30
2008	39.07	125.60	0.31	8.38	11.65	0.72

	IR-TBB-7G			IR-GN-7G		
Year	**Landings (t)**	**Effort (000 hr)**	**LPUE (kg/h)**	**Landings (t)**	**Effort (000 hr)**	**LPUE (kg/h)**
1995	37.92	20.78	1.83	0.90	4.33	0.21
1996	53.02	26.76	1.98	1.35	5.51	0.24
1997	94.59	28.25	3.35	1.17	1.51	0.78
1998	122.13	35.25	3.46		0.00	
1999	25.80	40.87	0.63	0.48	5.47	0.09
2000	12.62	37.03	0.34	2.54	7.03	0.36
2001	4.80	39.71	0.12	0.30	4.46	0.07
2002	7.08	31.62	0.22	0.36	5.86	0.06
2003	9.37	49.26	0.19	0.20	10.97	0.02
2004	6.17	54.86	0.11	0.33	12.05	0.03
2005	9.49	49.65	0.19	0.12	10.89	0.01
2006	14.40	60.35	0.24	0.09	7.76	0.01
2007	20.35	54.85	0.37	0.32	8.83	0.04
2008	14.04	36.73	0.38	0.01	13.21	0.00

	BELGIAN Beam Trawl VIIfg		
Year	**Landings (t)**	**Effort (000 hr)**	**LPUE (kg/h)**
1996	356.89	53.27	6.70
1997	474.71	57.36	8.28
1998	443.38	57.79	7.67
1999	410.22	55.11	7.44
2000	230.63	51.34	4.49
2001	274.84	54.90	5.01
2002	259.80	49.60	5.24
2003	215.95	62.73	3.44
2004	207.27	78.73	2.63
2005	153.73	64.50	2.38
2006	134.44	50.28	2.67
2007	139.39	45.72	3.05
2008	106.29	28.71	3.70

Table 7.10.4 CELTIC SEA PLAICE.
Annual length distribution by fleet 2009

Length (cm)	UK (England & Wales) Beam trawl	UK (England & Wales) All gears (exc beam)	Ireland All gears	Belgium All gears
19			23	
20				
21				
22			3	
23		115	76	
24	83	344	379	
25	843	1019	1460	275
26	1940	3486	3682	13069
27	7362	10374	8272	77977
28	9259	14856	13915	109588
29	9628	18729	20749	65583
30	9469	14623	19674	57616
31	7451	13436	17548	45339
32	6201	8394	17592	27030
33	5199	6935	14334	12880
34	3776	5506	11475	14071
35	2819	3712	8041	6514
36	1834	3164	7376	4709
37	1783	1714	5079	5454
38	1269	1300	5336	3723
39	823	1446	3831	2091
40	671	897	2304	1328
41	523	714	2172	1262
42	408	224	1809	1543
43	267	192	1236	287
44	208	299	1164	268
45	124	259	816	100
46	122	194	639	705
47	66	276	691	91
48	66	152	486	100
49	55	14	423	23
50	65	83	266	46
51	31	25	161	
52	16		180	
53	4	15	157	68
54	7	60	61	
55	14	8	52	
56	18		116	
57	21	3	33	23
58	13		57	
59	6		11	
60			35	
61	10		40	
62			8	
63				
64				
Total	72454	112568	171762	451763

Table 7.10.5. VIIfg Plaice: Catch numbers-at-age.

Run title : CELTIC SEA PLAICE,2009 WG,COMBSEX,PLUSGROUP.

At 1/05/2009 11:04

Table 1 Catch numbers-at-age Numbers*10**-3

YEAR	1977	1978
AGE		
1	0	0
2	989	851
3	426	903
4	411	291
5	105	136
6	72	76
7	37	47
8	59	23
+gp	75	98
TOTALNUM	2174	2425
TONSLAND	757	875
SOPCOF %	101	103

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	877	1921	822	300	750	704	1461	703	434	967
3	673	1207	2111	1180	560	918	2503	2595	1883	2099
4	638	658	681	955	827	343	393	1332	1812	1568
5	72	146	109	443	372	373	102	156	772	612
6	70	21	54	86	92	209	177	59	156	413
7	34	16	53	51	44	70	62	48	22	65
8	8	16	11	14	27	41	25	32	125	16
+gp	46	32	44	60	23	42	38	24	76	73
TOTALNUM	2418	4017	3885	3089	2695	2700	4761	4949	5280	5813
TONSLAND	863	1373	1377	1303	1146	1210	1752	1691	1901	2116
SOPCOF %	102	101	100	101	100	100	100	100	100	100

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	797	164	279	800	1019	428	488	812	420	426
3	3550	2078	1072	526	1179	936	572	734	1318	921
4	1807	2427	1193	357	284	730	743	514	929	849
5	741	655	578	471	139	164	334	219	272	287
6	160	242	179	275	185	117	117	137	121	96
7	98	86	94	80	115	86	57	59	60	82
8	24	70	78	21	61	92	48	37	20	39
+gp	23	46	79	96	59	64	131	96	82	56
TOTALNUM	7200	5768	3552	2626	3041	2617	2490	2608	3222	2756
TONSLAND	2151	2082	1501	1188	1114	1070	1028	952	1217	1067

SOPCOF %	100	100	101	100	100	101	101	100	100	100

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	243	320	651	170	239	126	201	331	130	270
3	982	606	371	661	571	578	327	458	513	342
4	802	482	323	543	465	428	265	140	340	443
5	372	203	199	183	150	261	134	134	104	146
6	116	145	108	113	85	46	73	76	76	47
7	45	53	62	65	34	27	24	50	46	29
8	27	22	23	24	26	15	14	12	26	11
+gp	69	32	28	28	24	17	16	15	13	15
TOTALNUM	2656	1862	1763	1786	1593	1498	1054	1217	1249	1303
TONSLAND	968	718	714	642	594	510	386	404	410	438
SOPCOF %	100	100	103	100	100	100	101	101	100	101

Table 7.10.6. VIIfg Plaice: Catch weights-at-age.

Run title : CELTIC SEA PLAICE,2009 WG,COMBSEX,PLUSGROUP.
At 1/05/2009 11:04

Table 2 Catch weights-at-age (kg)

YEAR	1977	1978
AGE		
1	.0780	.1940
2	.2050	.2580
3	.3230	.3230
4	.4300	.3890
5	.5280	.4570
6	.6150	.5250
7	.6930	.5950
8	.7600	.6660
+gp	.8762	.8435
SOPCOFAC	1.0053	1.0265

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	.0760	.1180	.1850	.1510	.1780	.2760	.1350	.0000	.1290	.2600
2	.2030	.2380	.2550	.2450	.2740	.3240	.2510	.1600	.2080	.2880
3	.3250	.3540	.3300	.3390	.3690	.3840	.3630	.3010	.2880	.3250
4	.4400	.4670	.4120	.4330	.4640	.4550	.4700	.4340	.3680	.3700
5	.5500	.5760	.5000	.5260	.5590	.5380	.5720	.5590	.4490	.4230
6	.6520	.6820	.5950	.6200	.6540	.6330	.6700	.6770	.5300	.4840
7	.7490	.7840	.6950	.7140	.7490	.7390	.7630	.7870	.6120	.5540
8	.8390	.8820	.8020	.8080	.8440	.8570	.8510	.8890	.6940	.6330
+gp	1.0653	1.1812	1.1824	1.0948	1.1579	1.2661	1.0036	1.1033	.8632	.8887
SOPCOFAC	1.0226	1.0136	1.0043	1.0126	.9997	1.0003	1.0048	.9997	1.0034	1.0026

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	.1020	.2400	.2000	.1480	.1720	.1450	.2200	.2220	.1810	.1880
2	.1760	.2700	.2600	.2570	.2470	.2400	.2640	.2600	.2480	.2480
3	.2550	.3090	.3270	.3620	.3260	.3310	.3190	.3090	.3180	.3160
4	.3370	.3580	.4000	.4640	.4070	.4200	.3820	.3680	.3920	.3900
5	.4230	.4160	.4810	.5630	.4920	.5060	.4560	.4380	.4690	.4710
6	.5140	.4830	.5670	.6580	.5800	.5890	.5390	.5190	.5500	.5590
7	.6080	.5600	.6610	.7500	.6710	.6700	.6320	.6090	.6340	.6550
8	.7060	.6460	.7610	.8390	.7650	.7470	.7350	.7110	.7230	.7570
+gp	.9932	.9097	1.0465	1.0399	1.0061	.9077	1.0351	.9946	.9972	1.1417
SOPCOFAC	1.0007	1.0010	1.0115	1.0023	1.0031	1.0138	1.0104	1.0002	1.0010	1.0030

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE										
1	.0960	.1450	.2480	.1320	.1830	.1400	.1760	.2570	.1630	.3160

2	.1880	.2260	.2990	.2020	.2400	.2040	.2290	.2610	.2120	.2930
3	.2790	.3090	.3540	.2780	.3050	.2730	.2930	.2840	.2670	.2950
4	.3690	.3940	.4140	.3580	.3800	.3470	.3660	.3260	.3300	.3200
5	.4570	.4810	.4780	.4440	.4630	.4260	.4490	.3860	.3990	.3700
6	.5450	.5700	.5470	.5350	.5560	.5110	.5420	.4650	.4760	.4450
7	.6310	.6610	.6200	.6310	.6570	.6020	.6450	.5630	.5600	.5430
8	.7160	.7530	.6970	.7330	.7670	.6970	.7570	.6800	.6510	.6660
+gp	1.0022	1.0422	.9739	1.0376	1.0235	.9414	1.0386	.9749	.8497	.9135
SOPCOFAC	1.0021	1.0050	1.0277	1.0010	1.0037	1.0015	1.0118	1.0086	1.0038	1.0104

Table 7.10.7. VIIfg Plaice: Stock weights-at-age.

Run title : CELTIC SEA PLAICE,2009 WG,COMBSEX,PLUSGROUP.
At 1/05/2009 11:04

Table 3 Stock weights-at-age (kg)

YEAR	1977	1978
AGE		
1	.1120	.0860
2	.2160	.1700
3	.3150	.2520
4	.4060	.3340
5	.4920	.4140
6	.5700	.4930
7	.6420	.5700
8	.7070	.6460
+gp	.8389	.8218

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	.1070	.1090	.0820	.0960	.1030	.2560	.0750	.0000	.0890	.2490
2	.2120	.2170	.1670	.1920	.2060	.2980	.1930	.0870	.1680	.2730
3	.3130	.3220	.2570	.2880	.3070	.3520	.3070	.2320	.2480	.3050
4	.4120	.4260	.3500	.3830	.4080	.4180	.4170	.3690	.3280	.3460
5	.5070	.5280	.4470	.4790	.5070	.4950	.5210	.4980	.4080	.3950
6	.5990	.6280	.5480	.5740	.6060	.5840	.6210	.6190	.4890	.4530
7	.6890	.7270	.6530	.6680	.7040	.6850	.7170	.7330	.5710	.5180
8	.7750	.8230	.7620	.7630	.8010	.7970	.8080	.8390	.6530	.5930
+gp	1.0148	1.1318	1.1290	1.0492	1.1136	1.1897	.9646	1.0635	.8219	.8373

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	.0660	.2280	.1730	.0920	.1350	.0970	.2010	.2070	.1490	.1610
2	.1390	.2540	.2290	.2030	.2090	.1930	.2410	.2400	.2140	.2170
3	.2150	.2880	.2930	.3100	.2860	.2860	.2900	.2840	.2820	.2810
4	.2950	.3320	.3630	.4140	.3660	.3760	.3490	.3380	.3540	.3520
5	.3800	.3860	.4400	.5140	.4500	.4630	.4180	.4020	.4300	.4300
6	.4680	.4480	.5230	.6110	.5360	.5480	.4960	.4770	.5090	.5140
7	.5600	.5200	.6130	.7050	.6250	.6300	.5850	.5630	.5920	.6060
8	.6570	.6020	.7100	.7950	.7180	.7090	.6820	.6590	.6780	.7050
+gp	.9380	.8537	.9870	1.0002	.9544	.8723	.9712	.9302	.9476	1.0787

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE										
1	.0490	.1050	.2240	.0990	.1580	.1100	.1530	.2620	.1420	.3360
2	.1420	.1850	.2730	.1670	.2100	.1710	.2010	.2570	.1870	.3010
3	.2340	.2680	.3260	.2390	.2710	.2380	.2600	.2700	.2390	.2910

4	.3240	.3520	.3840	.3170	.3410	.3090	.3280	.3030	.2980	.3040
5	.4130	.4380	.4460	.4010	.4200	.3860	.4060	.3530	.3640	.3420
6	.5010	.5250	.5120	.4890	.5080	.4680	.4940	.4230	.4370	.4050
7	.5880	.6150	.5830	.5830	.6050	.5560	.5920	.5120	.5170	.4910
8	.6730	.7070	.6580	.6820	.7110	.6490	.7000	.6190	.6040	.6020
+gp	.9622	.9934	.9283	.9794	.9582	.8869	.9709	.8956	.7964	.8309

Table 7.10.8. VIIfg plaice: Survey abundance indices.

UK Sept beam trawl survey (UK-BCCSBTS-S) (No/100km).

Year/Age	0	1	2	3	4	5
1993	3.4	101.8	90.3	36.6	2.0	3.9
1994	122.3	107.2	31.6	15.8	7.9	1.2
1995	1.0	239.6	89.9	16.7	3.0	6.8
1996	8.1	223.7	288.1	30.8	1.0	2.6
1997	7.0	225.4	102.1	34.5	4.3	1.8
1998	5.0	236.5	125.5	46.8	8.9	2.0
1999	162.2	152.6	79.6	29.0	19.7	7.0
2000	84.7	339.6	63.2	31.3	6.6	5.5
2001	35.6	211.4	156.1	15.8	8.7	4.2
2002	0.9	136.7	175.1	80.5	5.9	6.1
2003	60.7	98.4	80.5	61.0	21.8	2.7
2004	163.9	258.5	33.4	27.1	13.4	2.2
2005	2.6	192.5	75.2	20.9	8.1	10.9
2006	80.5	85.8	102.0	34.2	9.6	1.8
2007	34.8	150.4	92.3	47.3	15.1	1.7
2008	6.3	140.7	217.0	47.7	15.7	4.8

Irish Sea Celtic Sea (ISCSGFS) (No/30min towed).

Age	0	1	2	3	4	5	6
1997	6.1	37	35	12	3.8	1.4	0.4
1998	5	23	29	10	3.5	1.1	0.4
1999	0.4	92	79	18	3.2	0.5	0.3
2000	56	696	361	8.5	7.1	0.4	0.2
2001	0.2	9.5	30	20.1	6.3	7.3	3.1
2002	4	80	85	48	10.9	4.7	0.2

Irish Groundfish survey Celtic Explorer -IBTS Q4 (IRGFS) (No/60min towed).

Age	1	2	3	4	5	6	7
2003	0.00	3.25	6.06	2.67	0.58	0.22	0.07
2004	0.12	0.37	1.90	3.12	1.22	0.80	0.06
2005	2.77	4.47	5.89	1.35	0.64	0.21	0.21
2006	0.17	6.02	4.59	1.26	1.03	0.63	0.69
2007	0.10	2.62	8.53	3.49	1.13	0.46	0.41
2008	0.37	5.95	5.58	3.79	1.00	0.42	0.26

Table 7.10.9. VIIfg plaice: Tuning data available to the Working Group. (Figures used in the assessment shown in bold).

UK (E+W) BEAM TRAWL VIIF.
1990 2008 Thousands of hours, numbers in thousands.
1 1 0 1
1 8

30.8	0.0	1.6	68.2	159.5	46.3	26.6	11.0	9.2
40.8	9.4	22.6	74.4	141.5	87.1	29.0	15.1	14.1
35.8	1.6	39.9	27.3	32.0	46.7	27.4	7.5	2.3
39.6	1.0	40.9	139.5	25.0	15.5	24.6	15.1	7.3
37	12.6	31.7	52.4	49.1	9.2	9.1	7.6	9.8
37.6	1.0	28.3	30.0	39.5	29.7	9.9	5.8	6.4
39.8	0.0	74.6	53.8	13.6	13.6	12.8	3.8	4.4
43	0.6	40.7	112.3	23.7	8.4	6.7	4.5	0.7
47.8	2.7	54.1	73.9	63.1	17.5	3.6	4.3	2.7
50.8	0.8	22.1	64.2	52.5	25.8	7.7	2.4	1.9
51.2	0.6	11.9	26.0	26.9	17.8	12.7	4.9	1.8
49.3	2.8	42.5	27.7	27.5	17.7	10.1	5.9	2.4
37.5	0.5	19.4	40.3	16.5	7.6	7.2	3.7	2.0
40.7	1.6	27.7	43.2	33.8	9.9	4.9	3.4	2.4
32.4	0.9	12.2	34.5	25.8	17.5	3.4	2.5	2.0
27.7	1.5	12.0	9.1	12.7	7.5	5.0	1.9	1.1
18.6	0.6	10.2	17.7	4.5	4.4	3.0	1.6	0.4
15.4	0.5	9.3	24.6	12.0	3.2	2.0	1.4	0.6
13.8	0.2	10.8	16.1	18.1	5.2	1.9	1.4	0.9

UK(E+W) OTTER TRAWL VIIF

1989 2008   Thousands of hours, numbers in thousands.

1 1 0 1

1 8

17.6	0.8	91.2	256.0	62.0	23.1	7.4	5.1	0.4
22.6	0.1	6.4	97.0	129.1	34.2	13.3	4.1	4.4
18.6	5.2	13.6	46.9	78.8	36.9	16.5	4.4	5.0
16.0	3.6	68.2	14.6	12.5	18.5	8.5	1.4	0.4
13.8	1.3	25.3	42.1	8.8	3.9	6.3	4.1	2.7
9.5	4.2	11.7	20.5	15.1	2.7	3.1	1.4	1.7
8.5	5.1	37.8	18.2	14.5	5.5	1.6	0.8	0.7
8.7	0.0	35.8	20.6	4.3	3.4	2.5	1.0	1.1
8.1	0.4	16.5	33.7	5.5	1.2	0.7	0.4	0.1
7.1	0.4	7.8	11.0	8.6	2.0	0.5	0.7	0.2
5.7	1.0	8.3	12.2	7.9	3.8	0.9	0.2	0.1
4.1	0.5	9.3	11.4	6.5	2.5	1.3	0.4	0.1
4.4	1.4	11.1	4.9	4.0	2.4	1.3	0.6	0.2
6.1	0.0	4.4	8.3	2.9	1.5	1.1	0.5	0.2
9.9	0.6	11.9	16.2	9.3	2.1	1.3	0.9	0.6
9.4	0.3	4.3	14.3	10.4	5.8	0.9	0.5	0.3
12.1	1.5	10.0	5.4	5.5	2.8	1.5	0.5	0.3
13.0	0.7	12.8	23.3	6.8	6.4	4.5	2.3	0.6
10.6	0.2	5.2	14.8	7.4	2.2	1.4	1.0	0.5
10.1	0.3	5.8	16.5	8.2	2.4	1.6	1.1	0.6

Table 7.10.9 (cont.)

```
E+W B/T Survey
1990 2008   (Effort in Km towed, Numbers caught; all stations)
1 1 0.75 0.85  (Revised 2008 – Indices automated 1995 on)
1 5
```

69.86	161	215	64	15	6
123.41	841	33	65	21	12
125.08	487	307	13	5	15
127.67	120	107	44	2	5
120.82	127	40	20	11	1
114.9	275	103	19	3	8
118.6	265	342	37	1	3
114.9	259	117	40	5	2
114.9	272	144	54	10	2
118.6	181	94	34	23	8
118.6	403	75	37	8	7
118.6	251	185	19	10	5
118.6	162	208	95	7	7
118.6	117	95	72	26	3
114.9	297	38	31	15	3
118.6	228	89	25	10	13
118.6	102	121	41	11	2
118.6	178	109	56	18	2
118.6	167	257	57	19	6

Table 7.10.9 (cont.)

```
IR-ISCSGFS : Irish Sea Celtic Sea GFS (VIIg) - Plaice number per 30 min towed
(Prime stations only)
1997 2002
1 1 0.8 0.9
0 6
```

6.1	37	35	12	3.8	1.4	0.4
5	23	29	10	3.5	1.1	0.4
0.4	92	79	18	3.2	0.5	0.3
56	696	361	8.5	7.1	0.4	0.2
0.2	9.5	30	20.1	6.3	7.3	3.1
4	80	85	48	10.9	4.7	0.2

```
IRGFS : Irish Groundfish Survey (IBTS 4th qtr VIIg)
2003 2008
1 1 0.79 0.92
2 7
```

832	45	84	37	8	3	1
980	6	31	51	20	13	1
845	63	83	19	9	3	3
1046	105	80	22	18	11	12
1168	51	166	68	22	9	8
1139	113	106	72	19	8	5

```
IR-OTB : Irish VIIg Otter trawl (First provided to 2007WG)
2004 2008
1 1 1 1
2 10
```

0.00	3.25	6.06	2.67	0.58	0.22	0.07
0.12	0.37	1.90	3.12	1.22	0.80	0.06
2.77	4.47	5.89	1.35	0.64	0.21	0.21
0.17	6.02	4.59	1.26	1.03	0.63	0.69
0.10	2.62	8.53	3.49	1.13	0.46	0.41
0.37	5.95	5.58	3.79	1.00	0.42	0.26

Fleets removed from the historical series:

Belgium beam trawl series - no data since 1999.

UK(E&W) March Groundfish survey (WCGFS) – plaice catches low, new vessel and last survey of the series in 2004.

Table 7.10.10 XSA Diagnostics

```
Lowestoft VPA Version 3.1

   1/05/2009  10:55

 Extended Survivors Analysis

 CELTIC SEA PLAICE,2009 WG,COMBSEX,PLUSGROUP.
 Cpue data from file c:\Temp\ple7fg\vpa files\P7ftun3.dat

 Catch data for  32 years. 1977 to 2008. Ages  1 to   9.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 UK (E+W) BEAM TRAWL ,   1990, 2008,   4,     8,   .000,  1.000
 UK(E+W) OTTER TRAWL ,   1989, 2008,   4,     8,   .000,  1.000
 E+W BT Survey (stand,   1990, 2008,   1,     5,   .750,   .850


 Time series weights :

      Tapered time weighting not applied


 Catchability analysis :

      Catchability dependent on stock size for ages <    6

         Regression type = C
         Minimum of   5 points used for regression
         Survivor estimates shrunk to the population mean for ages <  6


      Catchability independent of age for ages >=    7


 Terminal population estimation :

      Survivor estimates shrunk towards the mean F
      of the final   5 years or the   4 oldest ages.

      S.E. of the mean to which the estimates  are shrunk =   2.500

      Minimum standard error for population
      estimates derived from each fleet =    .500

      Prior weighting not applied


 Tuning had not converged after   30 iterations

 Total absolute residual between iterations
 29 and  30 =     .00047

 Final year F values
 Age         ,      1,      2,      3,      4,      5,      6,      7,      8
 Iteration 29,  .0000,  .0960,  .2482,  .4878,  .3797,  .3450,  .3213,  .1587
 Iteration 30,  .0000,  .0960,  .2482,  .4878,  .3797,  .3449,  .3212,  .1586


 Regression weights
       , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

 Fishing mortalities
    Age,  1999,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008

      1,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000
      2,  .139,  .191,  .276,  .093,  .148,  .124,  .118,  .151,  .072,  .096
      3,  .631,  .545,  .322,  .452,  .461,  .573,  .486,  .387,  .334,  .248
      4,  .880,  .667,  .570,  .987,  .603,  .685,  .510,  .358,  .503,  .488
      5,  .759,  .516,  .581,  .677,  .740,  .743,  .425,  .476,  .450,  .380
      6,  .648,  .691,  .519,  .703,  .708,  .474,  .425,  .413,  .496,  .345
      7,  .803,  .632,  .646,  .620,  .428,  .453,  .452,  .532,  .431,  .321
      8, 1.158, 1.104,  .551,  .516,  .492,  .312,  .403,  .394,  .533,  .159
```

Table 7.10.10 (cont.) XSA Diagnostics

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8
1999	2.20E+03	1.98E+03	2.23E+03	1.45E+03	7.43E+02	2.59E+02	8.68E+01	4.24E+01
2000	3.23E+03	1.95E+03	1.53E+03	1.05E+03	5.35E+02	3.09E+02	1.20E+02	3.45E+01
2001	2.29E+03	2.87E+03	1.43E+03	7.88E+02	4.79E+02	2.83E+02	1.37E+02	5.66E+01
2002	2.08E+03	2.03E+03	1.93E+03	9.19E+02	3.95E+02	2.37E+02	1.49E+02	6.38E+01
2003	1.30E+03	1.84E+03	1.64E+03	1.09E+03	3.04E+02	1.78E+02	1.04E+02	7.13E+01
2004	2.17E+03	1.15E+03	1.41E+03	9.17E+02	5.29E+02	1.29E+02	7.78E+01	6.03E+01
2005	2.84E+03	1.92E+03	9.03E+02	7.05E+02	4.10E+02	2.23E+02	7.10E+01	4.39E+01
2006	2.26E+03	2.52E+03	1.52E+03	4.92E+02	3.75E+02	2.38E+02	1.29E+02	4.01E+01
2007	3.53E+03	2.00E+03	1.92E+03	9.14E+02	3.05E+02	2.07E+02	1.39E+02	6.74E+01
2008	2.87E+03	3.13E+03	1.65E+03	1.22E+03	4.90E+02	1.73E+02	1.12E+02	8.03E+01

Estimated population abundance at 1st Jan 2009

0.00E+00	2.54E+03	2.52E+03	1.14E+03	6.64E+02	2.97E+02	1.08E+02	7.19E+01

Taper weighted geometric mean of the VPA populations:

3.83E+03	3.44E+03	2.48E+03	1.32E+03	5.69E+02	2.74E+02	1.38E+02	7.07E+01

Standard error of the weighted Log(VPA populations) :

.5558	.5533	.5740	.5692	.5577	.5328	.5738	.7424

Table 7.10.10 (cont.) XSA Diagnostics

Log catchability residuals.

Fleet : UK (E+W) BEAM TRAWL

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	99.99	.07	.27	.18	.14	.05	.03	-.58	-.56	-.05
5	99.99	.03	.06	.11	-.08	-.12	.23	-.13	-.35	-.12
6	99.99	.89	.41	.14	.39	-.19	.40	.31	-.37	-.71
7	99.99	-.05	.92	-.29	-.02	-.13	-.10	.38	-.03	.01
8	99.99	.16	.33	-.17	.05	.12	.21	.07	-.19	.25

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	.00	-.21	.09	-.09	.06	.23	.05	-.08	.16	.23
5	-.11	-.10	.05	-.09	.30	.26	-.02	-.01	.11	.00
6	-.30	.04	-.15	.07	-.13	-.05	-.08	-.26	-.30	-.13
7	-.29	.01	.11	-.24	-.07	.15	.13	-.21	-.28	.00
8	.33	.46	.05	-.09	-.01	.12	.04	-.49	-.35	-.18

Mean log-catchability and standard error of ages with catchability independent of year-class strength and constant w.r.t. time

Age	6	7	8
Mean Log q	-6.7836	-6.7961	-6.7961
S.E(Log q)	.3627	.2823	.2449

Regression statistics :

Ages with q dependent on year-class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
4	.70	2.585	6.94	.81	19	.24	-6.89
5	.65	4.031	6.67	.89	19	.16	-6.86

Ages with q independent of year-class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	.69	2.680	6.43	.82	19	.22	-6.78
7	1.06	-.437	6.90	.75	19	.31	-6.80
8	.92	1.124	6.57	.92	19	.22	-6.76

Table 7.10.10 (cont.) XSA Diagnostics

Fleet : UK(E+W) OTTER TRAWL

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	-.03	.15	.39	-.09	-.04	.07	.27	-.52	-.58	-.24
5	.01	.08	.06	.06	-.34	-.08	.10	-.07	-.59	-.33
6	-.27	.55	.68	-.18	.12	.14	.11	.24	-.91	-.74
7	-.07	-.52	.69	-.95	-.05	-.24	-.38	.78	-.57	.31
8	-.06	-.05	.30	-.90	.33	-.06	-.30	.42	-.25	-.23

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	.10	.46	.28	-.22	-.01	.32	-.17	.24	-.10	-.28
5	.07	.26	.31	-.02	.16	.35	-.18	.45	.05	-.35
6	-.22	.32	.26	.03	.00	-.09	-.41	.55	-.24	.06
7	-.38	.25	.46	-.37	.23	.00	-.17	.72	-.02	.29
8	-.21	.31	.20	-.26	.23	-.32	-.22	.49	.06	-.06

Mean log-catchability and standard error of ages with catchability independent of year-class strength and constant w.r.t. time

Age	6	7	8
Mean Log q	-6.8269	-7.0110	-7.0110
S.E(Log q)	.4042	.4668	.3324

Regression statistics :

Ages with q dependent on year-class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
4	.78	1.709	6.77	.77	20	.29	-6.67
5	.70	2.298	6.68	.76	20	.27	-6.81

Ages with q independent of year-class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	.83	1.025	6.63	.67	20	.34	-6.83
7	1.42	-1.607	7.83	.45	20	.64	-7.01
8	.95	.461	6.91	.84	20	.32	-7.04

Table 7.10.10 (cont.) XSA Diagnostics

Fleet : E+W BT Survey (stand

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	99.99	.52	1.18	.49	-.96	-1.12	-.31	-.08	.06	.53
2	99.99	.74	-.73	.22	-.49	-.83	-.40	.24	-.28	.03
3	99.99	.62	.79	-1.28	-.28	-1.20	-.99	-.50	-.38	.21
4	99.99	.50	.47	-.95	-2.09	.00	-1.54	-3.11	-.88	-.13
5	99.99	-.01	-.20	.40	-.15	-1.23	.40	-.41	-.48	-.71
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	-.04	.64	.36	-.13	-.09	.68	.02	-.83	-.53	-.41
2	.06	-.06	.29	.62	.15	-.07	.04	.02	.12	.35
3	-.13	.26	-.84	1.24	1.03	.18	.18	.24	.38	.46
4	1.37	-.06	.44	.25	1.52	1.04	.48	.80	1.05	.83
5	.33	.36	.21	.78	.32	-.20	1.12	-.45	-.26	.21
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year-class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	1.33	-.791	6.97	.25	19	.62	-7.22
2	.76	.838	7.67	.43	19	.42	-7.62
3	1.39	-.858	8.48	.22	19	.75	-8.23
4	1.43	-.707	9.86	.14	19	1.25	-9.02
5	.91	.301	8.75	.39	19	.57	-9.00

Table 7.10.10 (cont.) XSA Diagnostics

```
Terminal year survivor and F summaries :

 Age  1   Catchability dependent on age and year-class strength

 Year class = 2007

 Fleet                    Estimated    Int       Ext    Var    N Scaled  Estimated
                          Survivors    s.e       s.e   Ratio     Weights    F
 UK (E+W) BEAM TRAWL           1.   .000       .000    .00   0  .000     .000
 UK(E+W) OTTER TRAWL           1.   .000       .000    .00   0  .000     .000
 E+W BT Survey (stand      1690.   .646       .000    .00   1  .423     .000

   P shrinkage mean        3435.    .55                         .577     .000

   F shrinkage mean           0.   2.50                         .000     .000

 Weighted prediction :

 Survivors        Int      Ext    N    Var     F
 at end of year   s.e      s.e        Ratio
      2545.       .42      .54    2   1.282   .000


Age  2   Catchability dependent on age and year-class strength

 Year class = 2006

 Fleet                    Estimated    Int       Ext    Var    N Scaled  Estimated
                          Survivors    s.e       s.e   Ratio     Weights    F
 UK (E+W) BEAM TRAWL           1.   .000       .000    .00   0  .000     .000
 UK(E+W) OTTER TRAWL           1.   .000       .000    .00   0  .000     .000
 E+W BT Survey (stand      2564.   .395       .426   1.08   2  .646     .095

   P shrinkage mean        2483.    .57                         .337     .098

   F shrinkage mean        1951.   2.50                         .018     .123

 Weighted prediction :

 Survivors        Int      Ext    N    Var     F
 at end of year   s.e      s.e        Ratio
      2525.       .32      .20    4    .616   .096

 Age  3   Catchability dependent on age and year-class strength

 Year class = 2005

 Fleet                    Estimated    Int       Ext    Var    N Scaled  Estimated
                          Survivors    s.e       s.e   Ratio     Weights    F
 UK (E+W) BEAM TRAWL           1.   .000       .000    .00   0  .000     .000
 UK(E+W) OTTER TRAWL           1.   .000       .000    .00   0  .000     .000
 E+W BT Survey (stand      1080.   .357       .345    .97   3  .641     .261

   P shrinkage mean        1321.    .57                         .341     .218

   F shrinkage mean         567.   2.50                         .018     .450

 Weighted prediction :

 Survivors        Int      Ext    N    Var     F
 at end of year   s.e      s.e        Ratio
      1143.       .30      .21    5    .687   .248
```

Table 7.10.10 (cont.) XSA Diagnostics

```
Age  4   Catchability dependent on age and year-class strength

 Year class = 2004

 Fleet                     Estimated    Int       Ext    Var    N Scaled  Estimated
                           Survivors    s.e       s.e   Ratio     Weights    F
 UK (E+W) BEAM TRAWL           834.   .500       .000    .00   1  .208     .406
 UK(E+W) OTTER TRAWL           504.   .500       .000    .00   1  .208     .603
 E+W BT Survey (stand          794.   .342       .151    .44   4  .299     .423

   P shrinkage mean            569.    .56                        .272     .550

   F shrinkage mean            591.   2.50                        .014     .534

 Weighted prediction :

 Survivors        Int      Ext    N    Var     F
 at end of year   s.e      s.e        Ratio
       664.       .24      .10    8    .413   .488


 Age  5   Catchability dependent on age and year-class strength

 Year class = 2003

 Fleet                     Estimated    Int       Ext    Var    N Scaled  Estimated
                           Survivors    s.e       s.e   Ratio     Weights    F
 UK (E+W) BEAM TRAWL           315.   .364       .077    .21   2  .261     .361
 UK(E+W) OTTER TRAWL           230.   .364       .123    .34   2  .261     .469
 E+W BT Survey (stand          395.   .327       .134    .41   5  .259     .298

   P shrinkage mean            274.    .53                        .209     .406

   F shrinkage mean            179.   2.50                        .010     .570

 Weighted prediction :

 Survivors        Int      Ext    N    Var     F
 at end of year   s.e      s.e        Ratio
       297.       .20      .08   11    .421   .380


 Age  6   Catchability constant w.r.t. time and dependent on age

 Year class = 2002

 Fleet                     Estimated    Int       Ext    Var    N Scaled  Estimated
                           Survivors    s.e       s.e   Ratio     Weights    F
 UK (E+W) BEAM TRAWL           103.   .304       .073    .24   3  .399     .359
 UK(E+W) OTTER TRAWL           119.   .304       .055    .18   3  .399     .318
 E+W BT Survey (stand          101.   .329       .137    .42   5  .191     .366

   F shrinkage mean             68.   2.50                        .011     .505

 Weighted prediction :

 Survivors        Int      Ext    N    Var     F
 at end of year   s.e      s.e        Ratio
       108.       .18      .05   12    .276   .345
```

Table 7.10.10 (cont.) XSA Diagnostics

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK (E+W) BEAM TRAWL	67.	.282	.079	.28	4	.442	.343
UK(E+W) OTTER TRAWL	81.	.282	.159	.56	4	.442	.288
E+W BT Survey (stand	61.	.347	.159	.46	5	.105	.368
F shrinkage mean	46.	2.50				.011	.461

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
72.	.18	.07	14	.393	.321

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK (E+W) BEAM TRAWL	51.	.261	.062	.24	5	.460	.187
UK(E+W) OTTER TRAWL	65.	.261	.122	.47	5	.460	.150
E+W BT Survey (stand	150.	.349	.144	.41	5	.071	.067
F shrinkage mean	22.	2.50				.009	.385

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
61.	.17	.09	16	.523	.159

Table 7.10.11 VIIfg plaice: Fishing Mortalities.

Run title : CELTIC SEA PLAICE,2009 WG,COMBSEX,PLUSGROUP.
At 1/05/2009 11:04

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality-(F) at-age

YEAR	1977	1978
AGE		
1	.0000	.0000
2	.3501	.3347
3	.5445	.5648
4	.8499	.8152
5	.4485	.6925
6	.6853	.6196
7	.6003	1.2891
8	.6493	.8593
+gp	.6493	.8593
FBAR 3- 6	.6320	.6730

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.2376	.3387	.1954	.1927	.2920	.0957	.1881	.1125	.0654	.1010
3	.4376	.5382	.6922	.4295	.5928	.6311	.5152	.5352	.4457	.4594
4	.9283	.9295	.6043	.7116	.5516	.8180	.5528	.5182	.8149	.7493
5	.4329	.5022	.3374	.9383	.6079	.4689	.5524	.4010	.5865	.6528
6	.8666	.1962	.3175	.4416	.4530	.7549	.3857	.6558	.8122	.6562
7	.5671	.4390	.9594	.5074	.3860	.6765	.4734	.1554	.4936	.8883
8	.7025	.5191	.5573	.6531	.5018	.6832	.4932	.4343	.6805	.7408
+gp	.7025	.5191	.5573	.6531	.5018	.6832	.4932	.4343	.6805	.7408
FBAR 3- 6	.6664	.5415	.4879	.6303	.5513	.6682	.5015	.5275	.6648	.6294

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.1402	.0665	.1659	.2236	.3161	.1946	.1599	.2050	.1407	.1656
3	.5794	.5842	.7072	.4839	.5384	.4862	.3912	.3483	.5385	.4677
4	.8349	.9291	.7208	.4880	.4762	.6890	.8219	.6636	.9027	.7303
5	.9023	.7617	.5301	.6351	.3232	.5061	.7166	.5511	.8252	.7149
6	.3167	.7756	.4337	.4700	.4990	.4495	.7549	.6624	.6124	.7140
7	.2852	.2559	.7199	.3196	.3326	.4143	.3736	1.0244	.6235	1.0370
8	.9056	.3089	.3541	.3086	.3912	.4398	.3901	.4027	1.1471	1.0059
+gp	.9056	.3089	.3541	.3086	.3912	.4398	.3901	.4027	1.1471	1.0059
FBAR 3- 6	.6583	.7626	.5979	.5192	.4592	.5327	.6711	.5563	.7197	.6567

Table 7.10.11 (cont.) VIIfg plaice: Fishing Mortalities.

Run title : CELTIC SEA PLAICE,2009 WG,COMBSEX,PLUSGROUP.
At 1/05/2009 11:04

Table 8 Fishing mortality-(F) at-age

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	FBAR 06-08
AGE											
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.1393	.1913	.2759	.0929	.1483	.1238	.1178	.1506	.0715	.0960	.1061
3	.6310	.5448	.3219	.4517	.4615	.5728	.4861	.3867	.3340	.2482	.3230
4	.8801	.6666	.5704	.9873	.6027	.6848	.5101	.3585	.5032	.4878	.4498
5	.7586	.5163	.5809	.6766	.7399	.7435	.4248	.4759	.4503	.3797	.4353
6	.6481	.6912	.5191	.7029	.7081	.4738	.4248	.4134	.4957	.3449	.4180
7	.8030	.6321	.6462	.6195	.4281	.4532	.4516	.5325	.4313	.3212	.4283
8	1.1582	1.1041	.5514	.5158	.4918	.3116	.4029	.3941	.5326	.1586	.3618
+gp	1.1582	1.1041	.5514	.5158	.4918	.3116	.4029	.3941	.5326	.1586	
FBAR 3- 6	.7295	.6047	.4981	.7046	.6280	.6187	.4614	.4086	.4458	.3651	

Table 7.10.12 VIIfg plaice: Population numbers.

```
Run title : CELTIC SEA PLAICE,2009 WG,COMBSEX,PLUSGROUP.
At  1/05/2009  11:04

               Terminal Fs derived using XSA (With F shrinkage)

   Table 10    Stock number-at-age (start of year)              Numbers*10**-3
   YEAR       1977    1978

   AGE
     1         3582    4965
     2         3555    3177
     3         1077    2222
     4          762     554
     5          309     289
     6          154     175
     7           87      69
     8          131      42
   +gp          166     179
    TOTAL      9823   11671

   YEAR       1979    1980    1981    1982    1983    1984    1985    1986    1987    1988

   AGE
     1         8004    5546    2050    3546    9234   10200    7909    8211   12054    7294
     2         4403    7099    4919    1818    3145    8190    9047    7015    7283   10691
     3         2016    3079    4487    3588    1330    2083    6601    6648    5560    6051
     4         1120    1154    1594    1992    2071     652     983    3497    3452    3158
     5          218     393     404     773     867    1058     255     501    1847    1356
     6          128     125     211     256     268     419     587     130     298     911
     7           83      48      91     136     146     151     175     354      60     117
     8           17      42      27      31      73      88      68      96     269      32
   +gp           96      83     109     132      62      89     103      72     162     147
    TOTAL     16086   17570   13892   12271   17195   22931   25728   26526   30985   29757

   YEAR       1989    1990    1991    1992    1993    1994    1995    1996    1997    1998

   AGE
     1         3050    2185    4781    4501    2898    3953    5245    3831    3341    2238
     2         6469    2706    1938    4240    3992    2570    3506    4652    3398    2964
     3         8571    4987    2245    1456    3007    2581    1876    2650    3361    2618
     4         3390    4259    2466     982     796    1557    1408    1125    1659    1740
     5         1324    1305    1492    1064     534     438     693     549     514     597
     6          626     476     540     779     500     343     234     300     281     200
     7          419     404     194     311     432     269     194      98     137     135
     8           43     280     278      84     200     275     158     119      31      65
   +gp           41     183     280     382     193     190     429     306     126      93
    TOTAL     23933   16785   14214   13798   12552   12176   13743   13630   12849   10649
```

Table 7.10.12 (cont.) VIIfg plaice: Population numbers.

Run title : CELTIC SEA PLAICE,2009 WG,COMBSEX,PLUSGROUP.
At 1/05/2009 11:04

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number-at-age (start of year) Numbers*10**-3

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	GMST 77-07	AMST 77-07
AGE													
1	2202	3233	2287	2077	1299	2169	2837	2256	3533	2869	0	3881	4566
2	1985	1953	2867	2028	1842	1152	1924	2516	2001	3133	2545	3508	4101
3	2227	1532	1430	1930	1639	1409	903	1517	1920	1652	2525	2539	3023
4	1455	1051	788	919	1090	917	705	492	914	1219	1143	1341	1593
5	743	535	479	395	304	529	410	375	305	490	664	584	685
6	259	309	283	237	178	129	223	238	207	173	297	281	327
7	87	120	137	149	104	78	71	129	139	112	108	139	166
8	42	34	57	64	71	60	44	40	67	80	72	71	95
+gp	105	50	70	72	66	66	52	49	33	106	141		
TOTAL	9105	8817	8398	7873	6593	6508	7168	7614	9119	9835	7496		

Table 7.10.13 VIIfg plaice: Summary.

Run title : CELTIC SEA PLAICE,2009 WG,COMBSEX,PLUSGROUP.,

At 1/05/2009 11:04

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 3- 6
1977	3582	2345	1169	757	.6473	.6320
1978	4965	2131	1010	875	.8662	.6730
1979	8004	3238	1323	863	.6524	.6664
1980	5546	4078	1789	1373	.7676	.5415
1981	2050	3200	1792	1377	.7682	.4879
1982	3546	3256	2054	1303	.6343	.6303
1983	9234	3684	1939	1146	.5910	.5513
1984	10200	7106	2299	1210	.5264	.6682
1985	7909	5553	2637	1752	.6643	.5015
1986	8211	4191	2818	1691	.6001	.5275
1987	12054	6050	3252	1901	.5847	.6648
1988	7294	8824	3809	2116	.5555	.6294
1989	3050	5040	3149	2151	.6831	.6583
1990	2185	5288	3394	2082	.6135	.7626
1991	4781	4356	2759	1501	.5440	.5979
1992	4501	3823	2499	1188	.4754	.5192
1993	2898	3483	2020	1114	.5514	.4592
1994	3953	3124	1937	1070	.5523	.5327
1995	5245	3978	1969	1028	.5221	.6711
1996	3831	3824	1790	952	.5317	.5563
1997	3341	3346	1773	1217	.6865	.7197
1998	2238	2939	1663	1067	.6414	.6567
1999	2202	2000	1367	968	.7080	.7295
2000	3233	2026	1170	718	.6136	.6047
2001	2287	2605	1247	714	.5726	.4981
2002	2077	1773	1055	642	.6088	.7046
2003	1299	1803	1046	594	.5678	.6280
2004	2169	1459	874	510	.5833	.6187
2005	2837	1687	821	386	.4699	.4614
2006	2256	2165	878	404	.4603	.4086
2007	3533	1947	910	410	.4504	.4458
2008	2869	3188	1243	438	.3523	.3651
Arith. Mean	4481	3547	1858	1110	.5952	.5866
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 7.10.14 VIIfg plaice : Catch forecast input data

MFDP version 1a
Run: Update
Time and date: 10:51 05/05/2009
Fbar age range: 3-6

2009

Age	***N***	***M***	***Mat***	***PF***	***PM***	***SWt***	***Sel***	***CWt***
1	2879	0.12	0	0	0	0.247	0.000	0.245
2	2545	0.12	0.26	0	0	0.248	0.106	0.255
3	2525	0.12	0.52	0	0	0.267	0.323	0.282
4	1143	0.12	0.86	0	0	0.302	0.450	0.325
5	664	0.12	1	0	0	0.353	0.435	0.385
6	297	0.12	1	0	0	0.422	0.418	0.462
7	108	0.12	1	0	0	0.507	0.428	0.555
8	72	0.12	1	0	0	0.608	0.362	0.666
9	141	0.12	1	0	0	0.841	0.362	0.913

2010

Age	***N***	***M***	***Mat***	***PF***	***PM***	***SWt***	***Sel***	***CWt***
1	2879	0.12	0	0	0	0.247	0.000	0.245
2	.	0.12	0.26	0	0	0.248	0.106	0.255
3	.	0.12	0.52	0	0	0.267	0.323	0.282
4	.	0.12	0.86	0	0	0.302	0.450	0.325
5	.	0.12	1	0	0	0.353	0.435	0.385
6	.	0.12	1	0	0	0.422	0.418	0.462
7	.	0.12	1	0	0	0.507	0.428	0.555
8	.	0.12	1	0	0	0.608	0.362	0.666
9	.	0.12	1	0	0	0.841	0.362	0.913

2011

Age	***N***	***M***	***Mat***	***PF***	***PM***	***SWt***	***Sel***	***CWt***
1	2879	0.12	0	0	0	0.247	0.000	0.245
2	.	0.12	0.26	0	0	0.248	0.106	0.255
3	.	0.12	0.52	0	0	0.267	0.323	0.282
4	.	0.12	0.86	0	0	0.302	0.450	0.325
5	.	0.12	1	0	0	0.353	0.435	0.385
6	.	0.12	1	0	0	0.422	0.418	0.462
7	.	0.12	1	0	0	0.507	0.428	0.555
8	.	0.12	1	0	0	0.608	0.362	0.666
9	.	0.12	1	0	0	0.841	0.362	0.913

Input units are thousands and kg - output in tonnes

Table 7.10.15 VIIfg plaice : management option table - status quo forecast

MFDP version 1a
Run: Update
CELTIC SEA PLAICE,2009 WG, Forecast Inputs
Time and date: 10:51 05/05/2009
Fbar age range: 3-6

2009 Biomass	SSB	FMult	FBar	Landings
2937	1388	1.0000	0.4065	575

2010 Biomass	SSB	FMult	FBar	Landings	2011 Biomass	SSB
3000	1492	0.0000	0.0000	0	3650	2105
.	1492	0.1000	0.0407	72	3578	2038
.	1492	0.2000	0.0813	140	3508	1974
.	1492	0.3000	0.1220	207	3441	1912
.	1492	0.4000	0.1626	271	3377	1852
.	1492	0.5000	0.2033	333	3314	1795
.	1492	0.6000	0.2439	392	3254	1740
.	1492	0.7000	0.2846	450	3196	1687
.	1492	0.8000	0.3252	505	3141	1636
.	1492	0.9000	0.3659	559	3087	1587
.	1492	1.0000	0.4065	610	3035	1540
.	1492	1.1000	0.4472	660	2985	1495
.	1492	1.2000	0.4878	708	2937	1451
.	1492	1.3000	0.5285	755	2891	1409
.	1492	1.4000	0.5691	799	2846	1369
.	1492	1.5000	0.6098	843	2803	1330
.	1492	1.6000	0.6504	884	2762	1292
.	1492	1.7000	0.6911	925	2721	1256
.	1492	1.8000	0.7317	964	2683	1221
.	1492	1.9000	0.7724	1001	2645	1188
.	1492	2.0000	0.8131	1037	2609	1156

Input units are thousands and kg - output in tonnes

Table 7.10.16 VIIfg plaice : forecast detailed results - status quo projection

MFDP version 1a
Run: Update
Time and date: 10:51 05/05/2009
Fbar age range: 3-6

Year:	2009	F multiplier:	1	Fbar:	0.4065				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0	0	0	2879	710	0	0	0	0
2	0.106	242	62	2545	632	662	164	662	164
3	0.323	659	186	2525	673	1313	350	1313	350
4	0.4498	392	128	1143	345	983	297	983	297
5	0.4353	222	85	664	234	664	234	664	234
6	0.418	96	44	297	125	297	125	297	125
7	0.4283	36	20	108	55	108	55	108	55
8	0.3618	21	14	72	44	72	44	72	44
9	0.3618	40	37	141	119	141	119	141	119
Total		1707	575	10374	2937	4240	1388	4240	1388

Year:	2010	F multiplier:	1	Fbar:	0.4065				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0	0	0	2879	710	0	0	0	0
2	0.106	242	62	2553	634	664	165	664	165
3	0.323	530	149	2030	541	1056	282	1056	282
4	0.4498	556	181	1621	489	1394	421	1394	421
5	0.4353	216	83	647	228	647	228	647	228
6	0.418	123	57	381	161	381	161	381	161
7	0.4283	57	32	173	88	173	88	173	88
8	0.3618	18	12	62	38	62	38	62	38
9	0.3618	38	34	132	111	132	111	132	111
Total		1780	610	10479	3000	4509	1492	4509	1492

Year:	2011	F multiplier:	1	Fbar:	0.4065				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0	0	0	2879	710	0	0	0	0
2	0.106	242	62	2553	634	664	165	664	165
3	0.323	531	150	2037	543	1059	282	1059	282
4	0.4498	447	145	1304	393	1121	338	1121	338
5	0.4353	306	118	917	324	917	324	917	324
6	0.418	120	55	371	156	371	156	371	156
7	0.4283	73	41	223	113	223	113	223	113
8	0.3618	29	19	100	61	100	61	100	61
9	0.3618	34	31	120	101	120	101	120	101
Total		1784	622	10504	3035	4575	1540	4575	1540

Input units are thousands and kg - output in tonnes

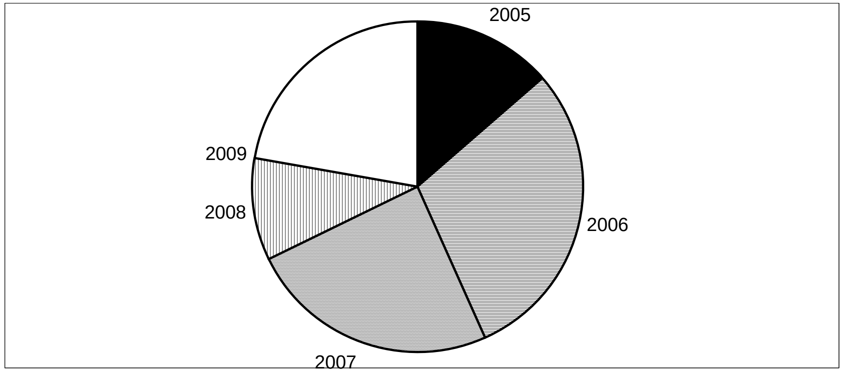
Table 7.10.17 Plaice in VIIfg
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2005	2006	2007	2008	2009
Stock No. (thousands) of 1 year-olds	2256	3533	2869	2879	2879
Source	XSA	XSA	XSA	GM89-07	GM89-07
Status Quo F:					
% in 2009 landings	22.2	32.3	10.8	0.0	-
% in 2010	13.6	29.7	24.4	10.2	0.0
% in 2009 SSB	21.4	25.2	11.8	0.0	-
% in 2010 SSB	15.3	28.2	18.9	11.0	0.0
% in 2011 SSB	10.1	21.0	21.9	18.3	10.7

GM : geometric mean recruitment

Plaice in VIIfg : Year-class % contribution to

a) 2010 landings



b) 2011 SSB

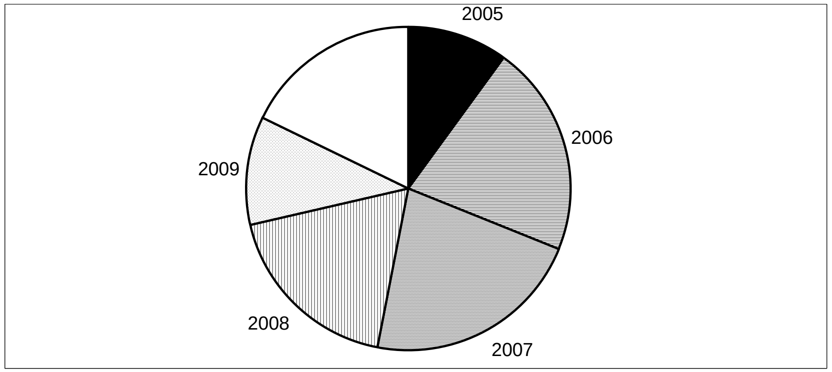


Table 7.10.18 VIIfg plaice : Yield per recruit

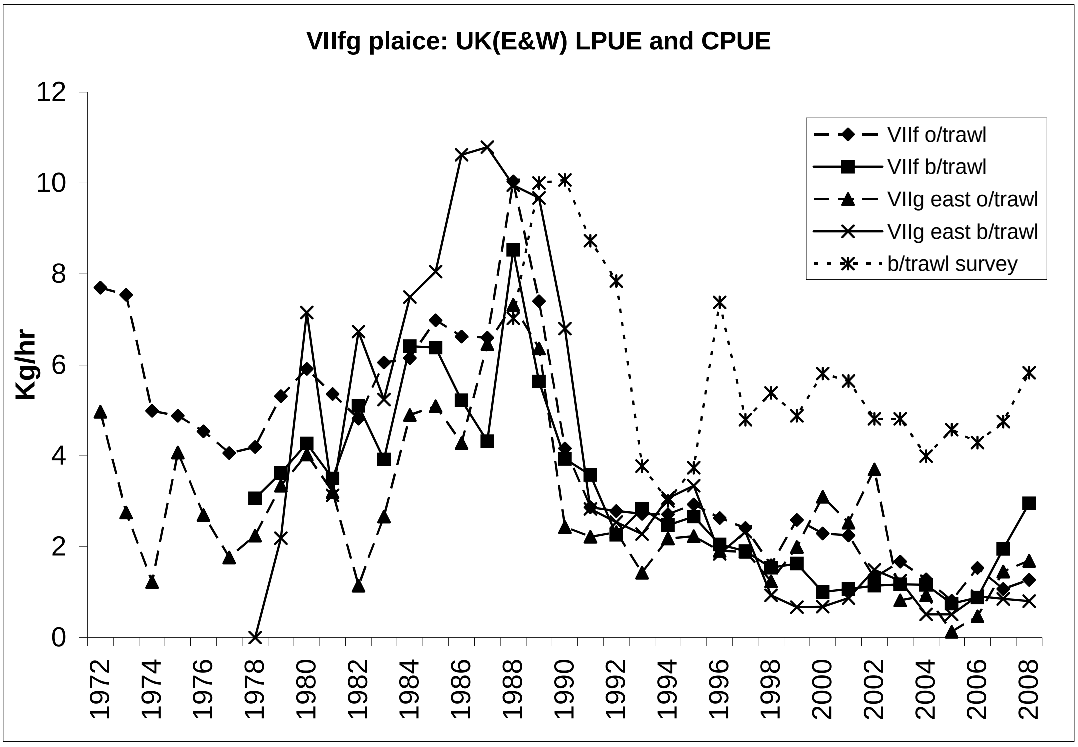
MFYPR version 2a
Run: Update
Time and date: 11:16 05/05/2009
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpw
0.0000	0.0000	0.0000	0.0000	8.8433	4.6938	6.7118	4.1540	6.7118	4.1540
0.1000	0.0407	0.1979	0.1148	7.1965	3.4286	5.0730	2.8911	5.0730	2.8911
0.2000	0.0813	0.3197	0.1711	6.1841	2.6827	4.0685	2.1474	4.0685	2.1474
0.3000	0.1220	0.4018	0.2001	5.5024	2.2026	3.3945	1.6695	3.3945	1.6695
0.4000	0.1626	0.4608	0.2151	5.0140	1.8746	2.9135	1.3436	2.9135	1.3436
0.5000	0.2033	0.5050	0.2227	4.6480	1.6404	2.5548	1.1115	2.5548	1.1115
0.6000	0.2439	0.5394	0.2262	4.3640	1.4674	2.2778	0.9405	2.2778	0.9405
0.7000	0.2846	0.5668	0.2274	4.1374	1.3360	2.0582	0.8110	2.0582	0.8110
0.8000	0.3252	0.5893	0.2274	3.9527	1.2337	1.8802	0.7107	1.8802	0.7107
0.9000	0.3659	0.6080	0.2267	3.7991	1.1526	1.7332	0.6314	1.7332	0.6314
1.0000	0.4065	0.6238	0.2256	3.6694	1.0870	1.6099	0.5676	1.6099	0.5676
1.1000	0.4472	0.6374	0.2245	3.5584	1.0333	1.5052	0.5156	1.5052	0.5156
1.2000	0.4878	0.6492	0.2234	3.4623	0.9885	1.4151	0.4726	1.4151	0.4726
1.3000	0.5285	0.6595	0.2223	3.3781	0.9508	1.3369	0.4365	1.3369	0.4365
1.4000	0.5691	0.6687	0.2213	3.3038	0.9186	1.2684	0.4060	1.2684	0.4060
1.5000	0.6098	0.6769	0.2203	3.2376	0.8909	1.2079	0.3798	1.2079	0.3798
1.6000	0.6504	0.6842	0.2195	3.1782	0.8667	1.1541	0.3573	1.1541	0.3573
1.7000	0.6911	0.6909	0.2188	3.1246	0.8455	1.1059	0.3376	1.1059	0.3376
1.8000	0.7317	0.6969	0.2182	3.0759	0.8268	1.0625	0.3203	1.0625	0.3203
1.9000	0.7724	0.7025	0.2176	3.0315	0.8101	1.0232	0.3051	1.0232	0.3051
2.0000	0.8131	0.7076	0.2171	2.9907	0.7951	0.9875	0.2915	0.9875	0.2915

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.4065
FMax	0.7429	0.302
F0.1	0.334	0.1358
F35%SPR	0.362	0.1472

Weights in kilograms

Figure 7.10.1 Celtic Sea Plaice (VIIf&g): UK(E&W) LPUE and effort by fleet



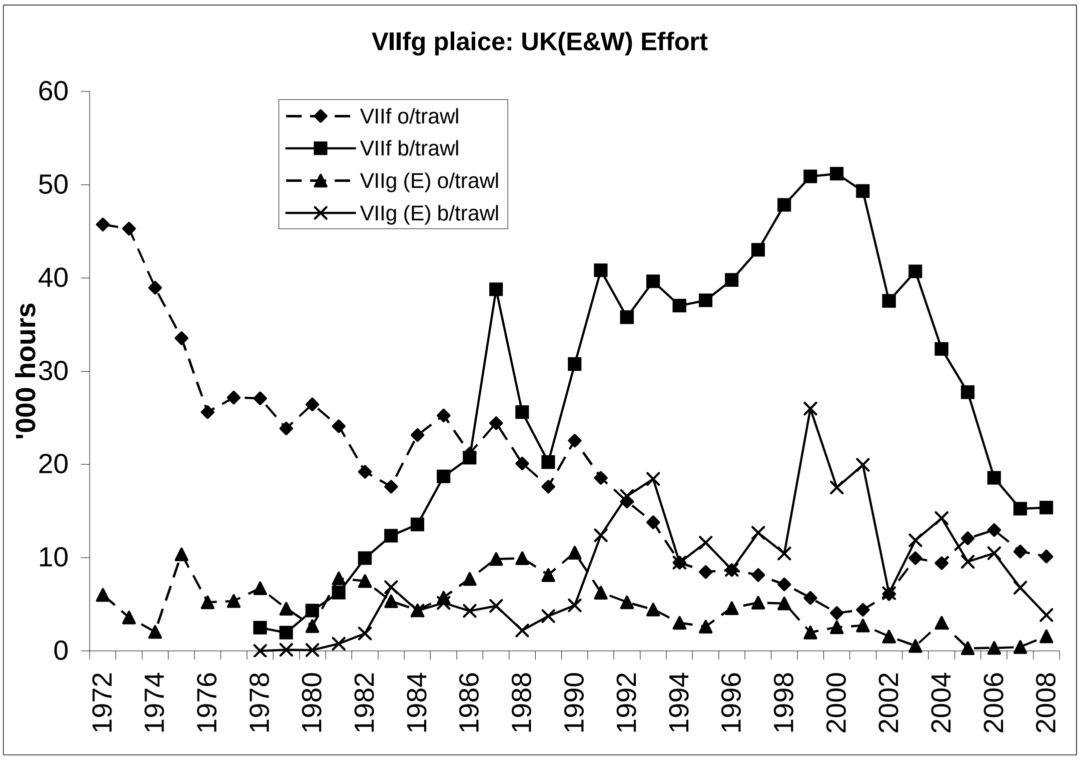
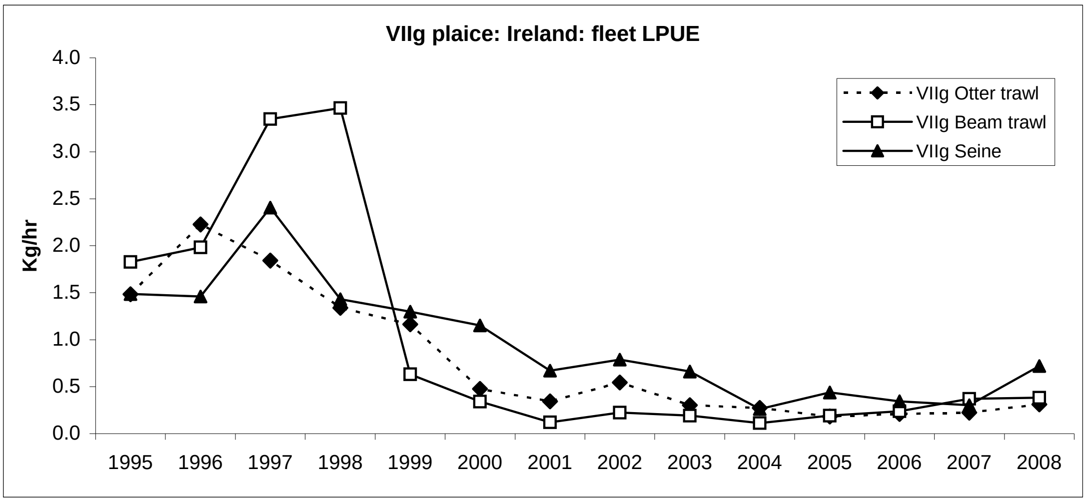
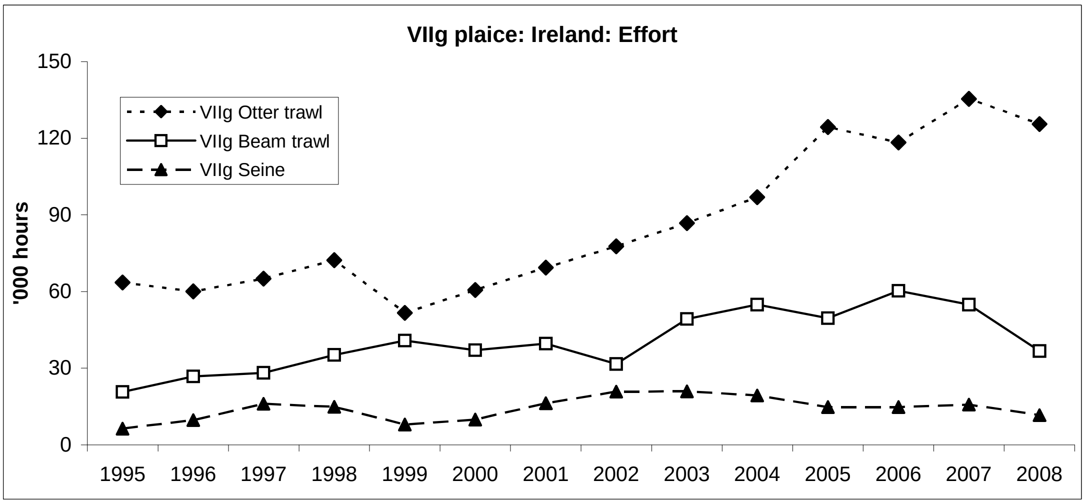


Figure 7.10.2 Celtic Sea Plaice (VIIf&g): Ireland and Belgium: LPUE and effort by fleet





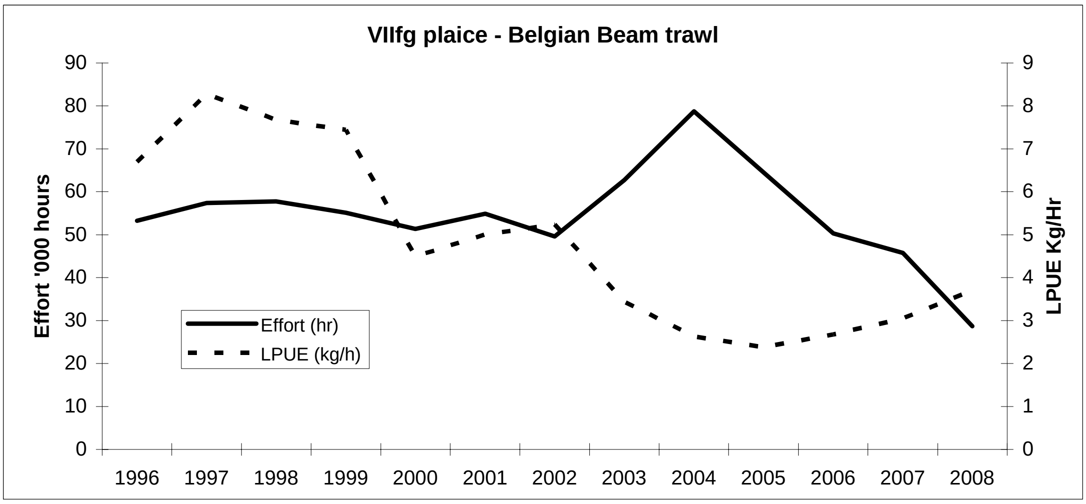


Figure 7.10.3a **France Discard sampling results in 2008: raised to sampled trips**
Otter trawl

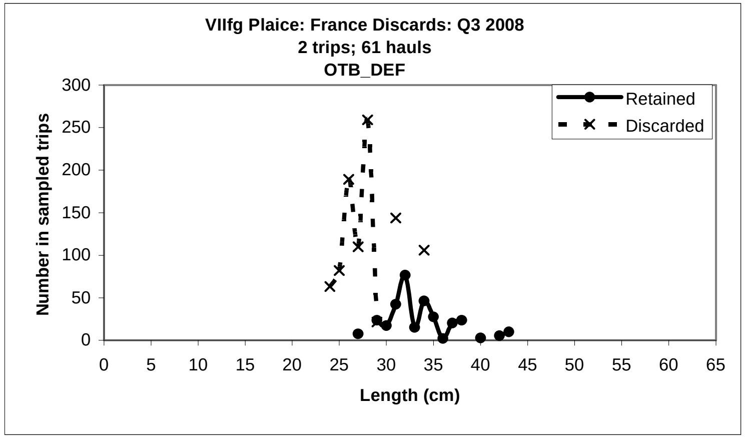
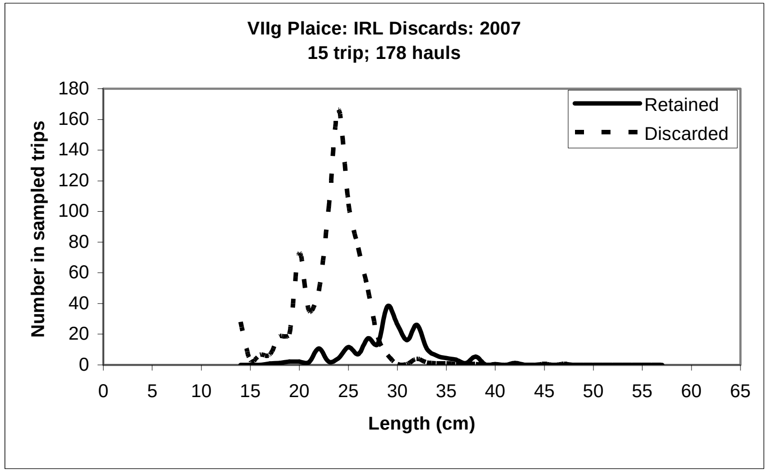


Figure 7.10.3b **IRL Discard sampling results in 2007 and 2008: raised to sampled trips** **Otter trawl**



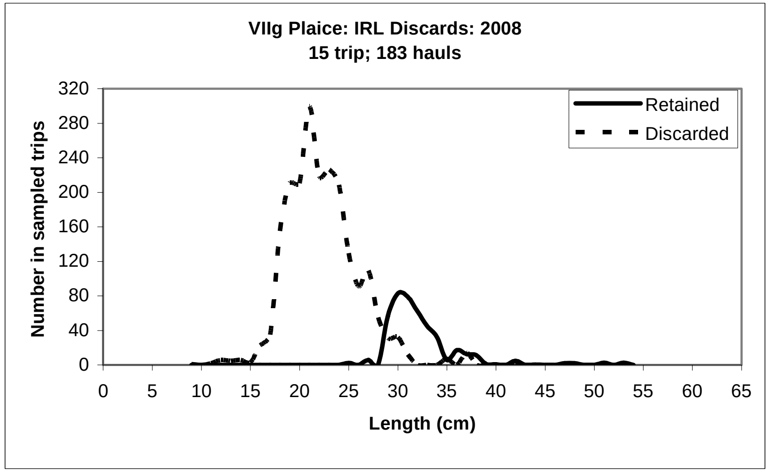


Figure 7.10.3c Plaice VIIfg UK(E&W) Discard sampling results in 2008: raised to sampled trips All gears

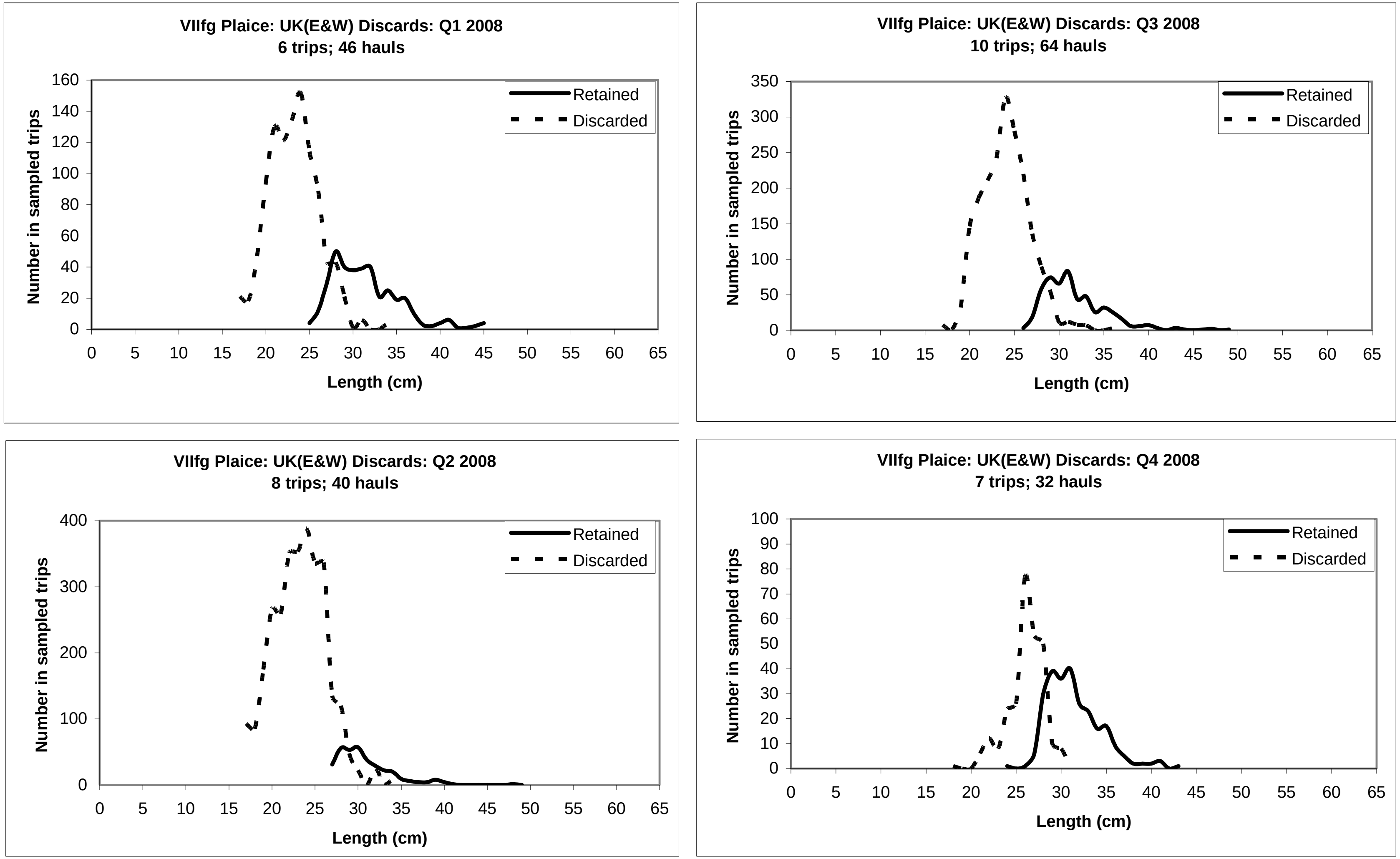


Figure 7.10.4 Plaice in Division VIIf&g
Length distributions of UK (England & Wales) landings from 1999 to 2008

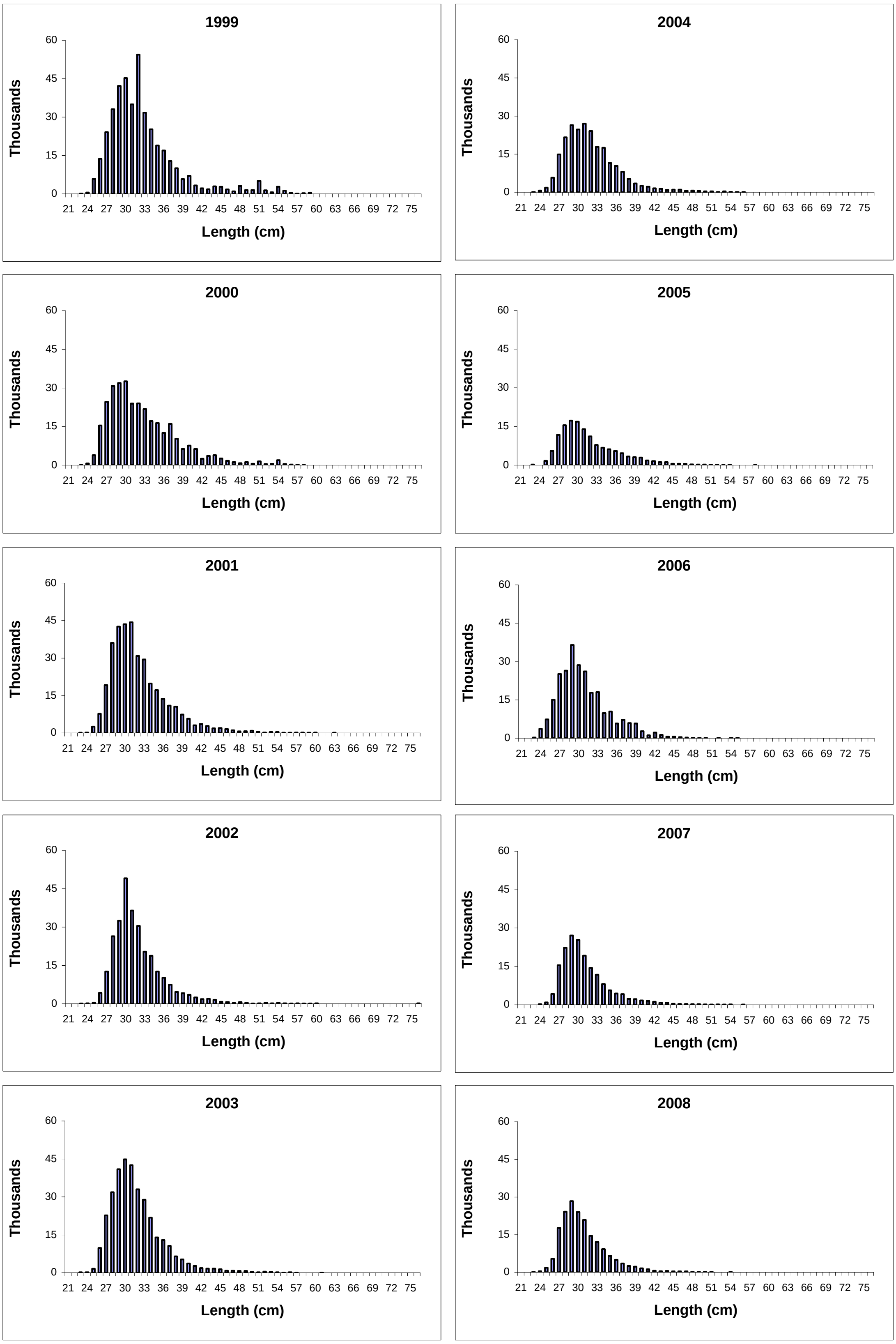
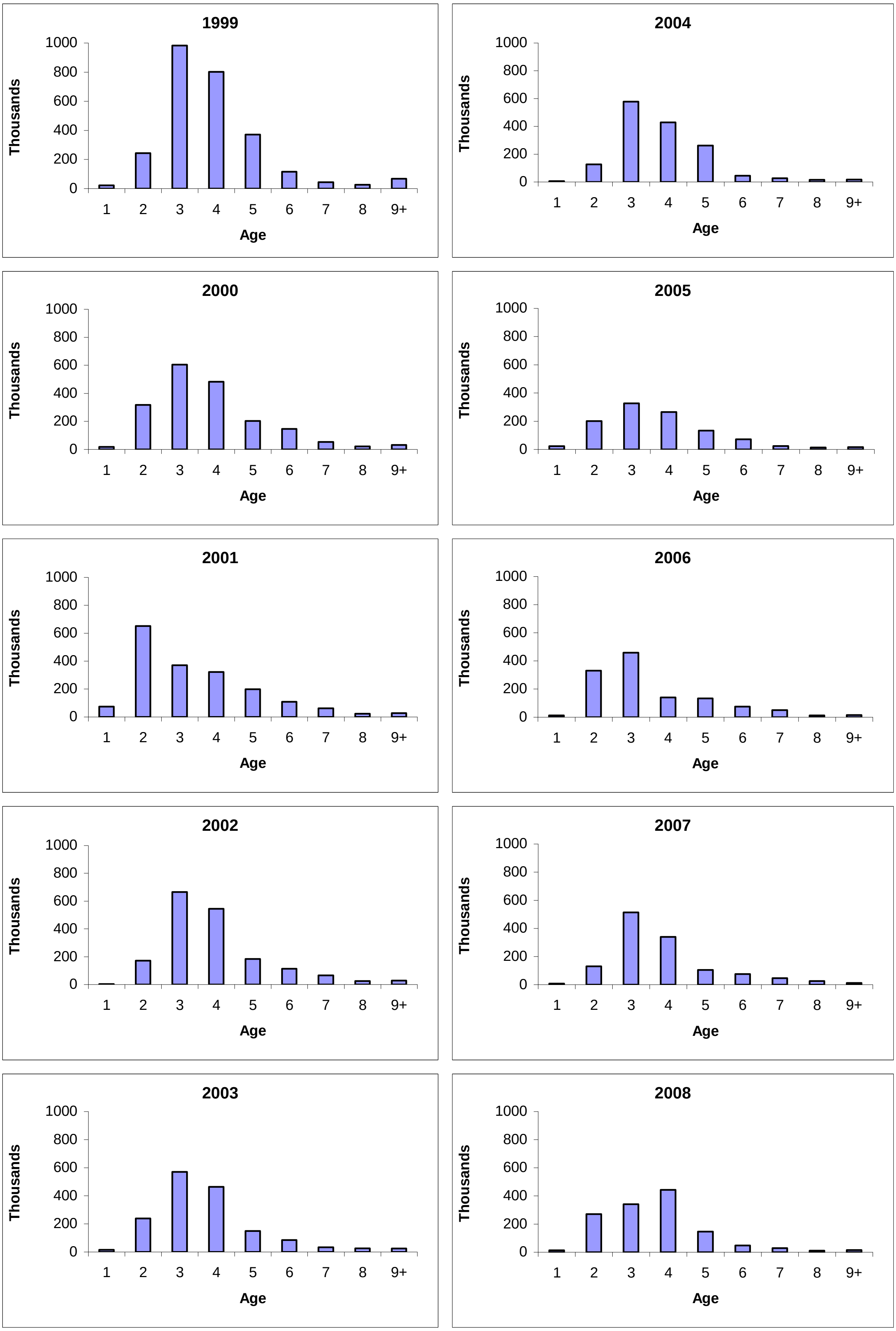


Figure 7.10.5 Plaice in Division VIIf+g
Age Compositions of landings from 1999 to 2008



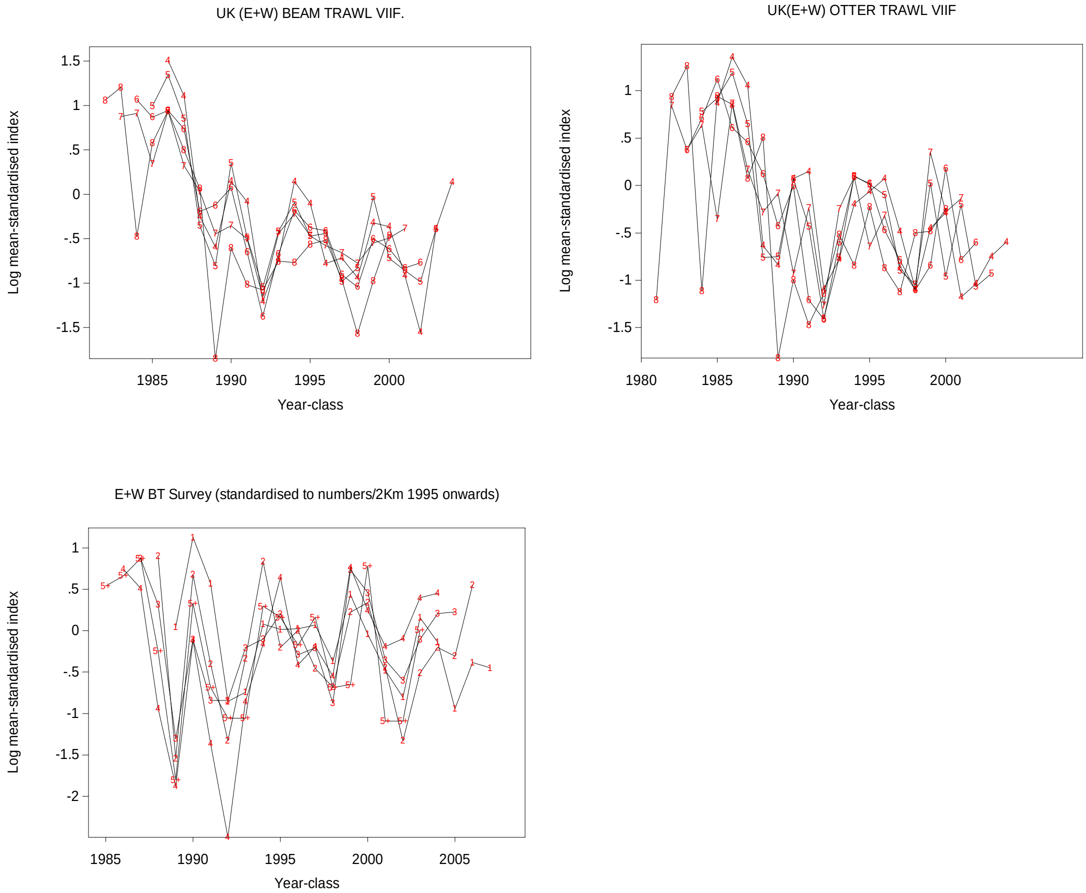


Figure 7.10.6 Fleet log cpue by year-class (Surba).

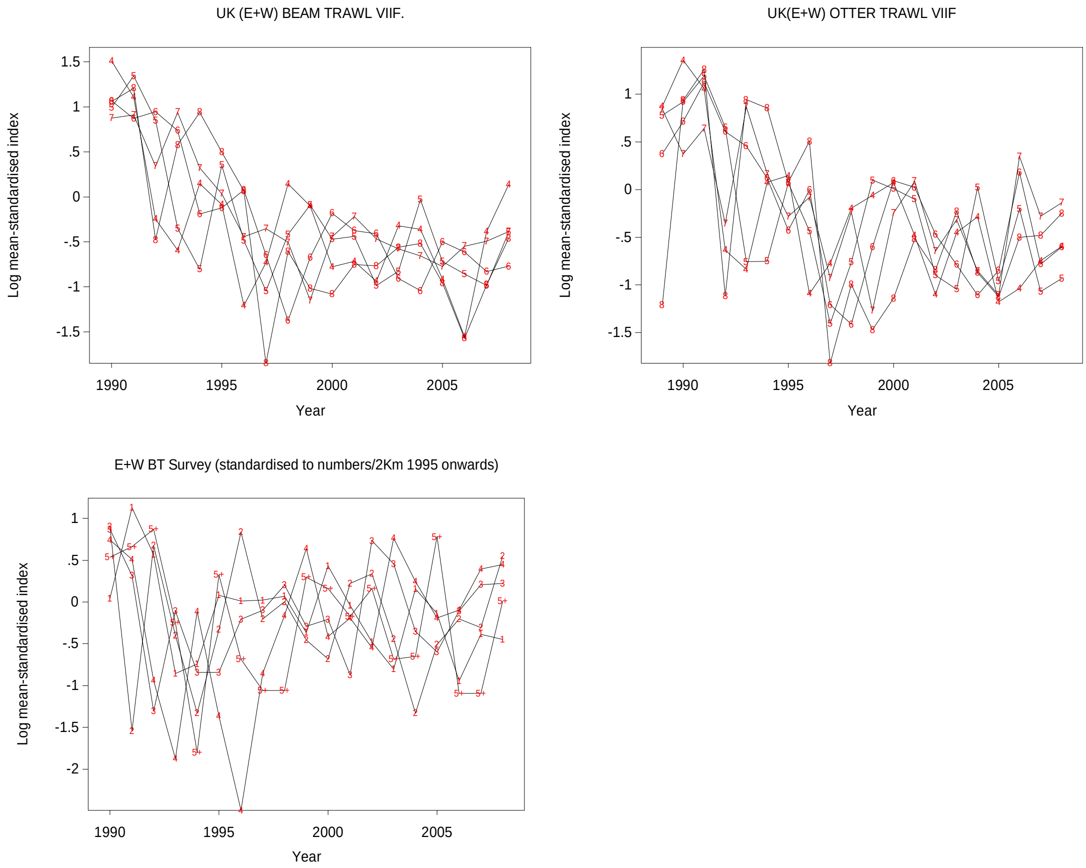


Figure 7.10.7 Fleet log cpue by year (Surba).

Figure 7.10.8: VIIf&g Plaice fleet log catchability residuals from the final run

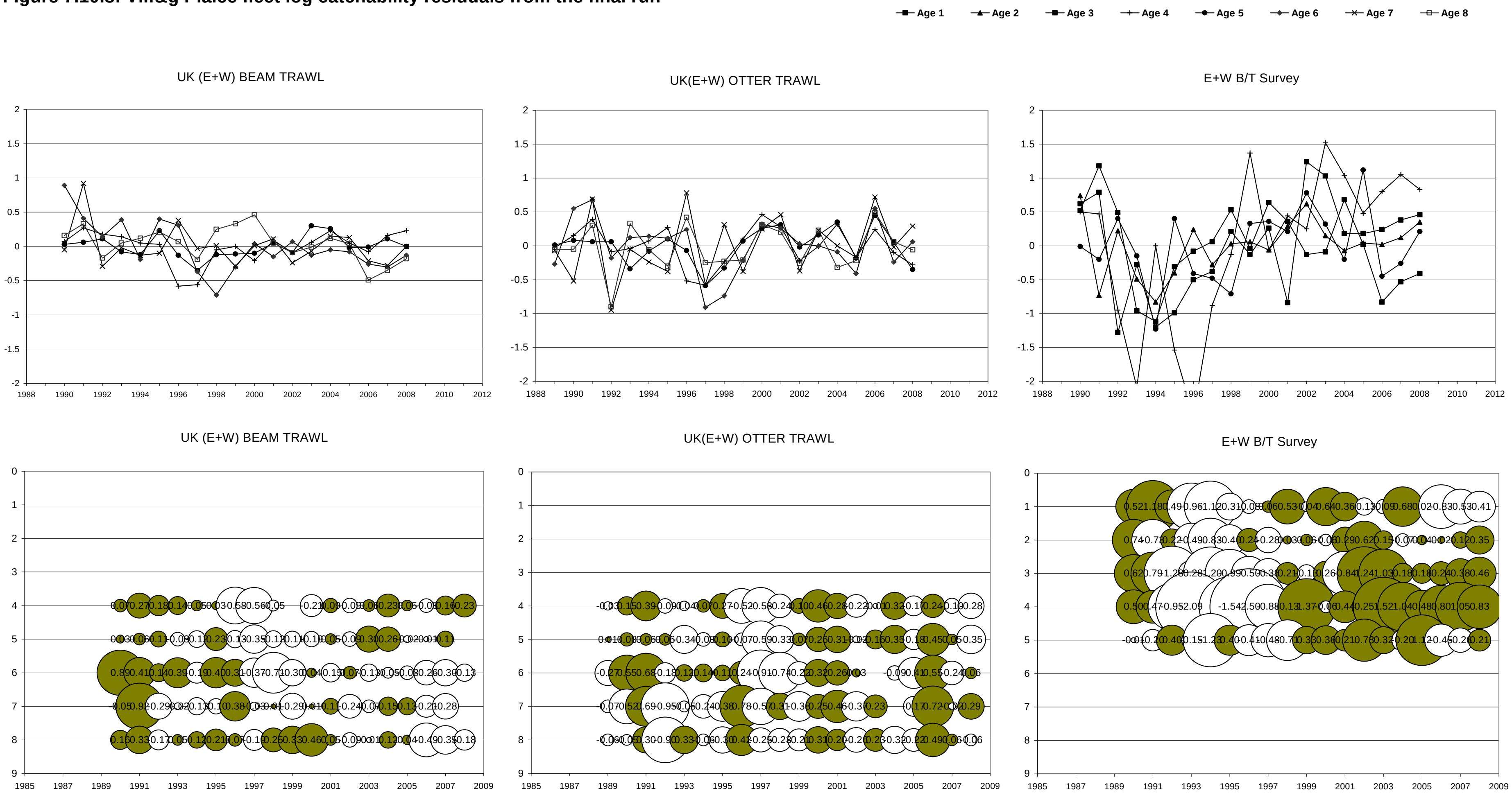
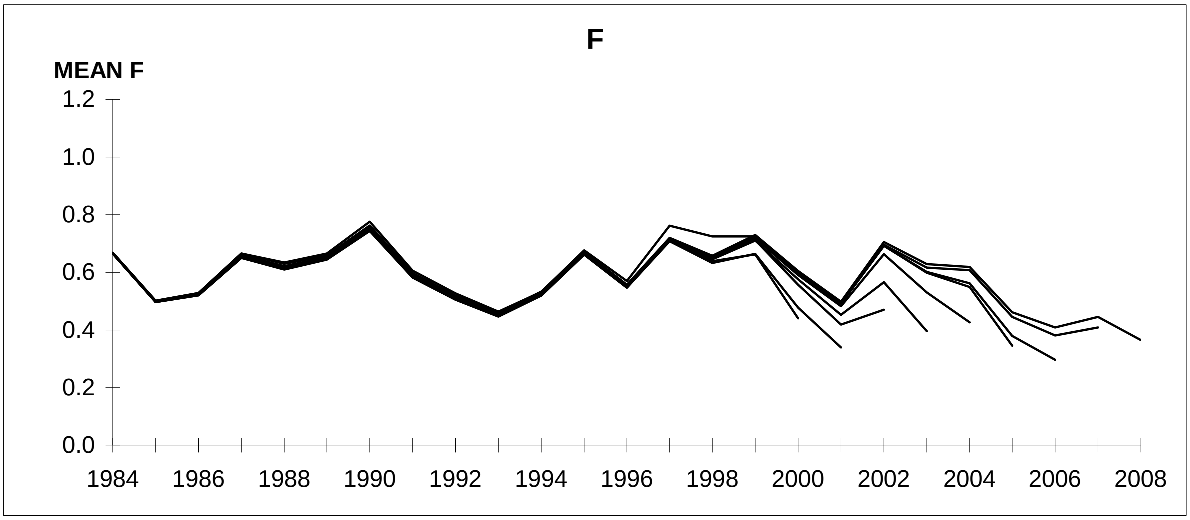


Figure 7.10.9 VIIf&g PLAICE RETROSPECTIVE XSA (Shrinkage SE=2.5)



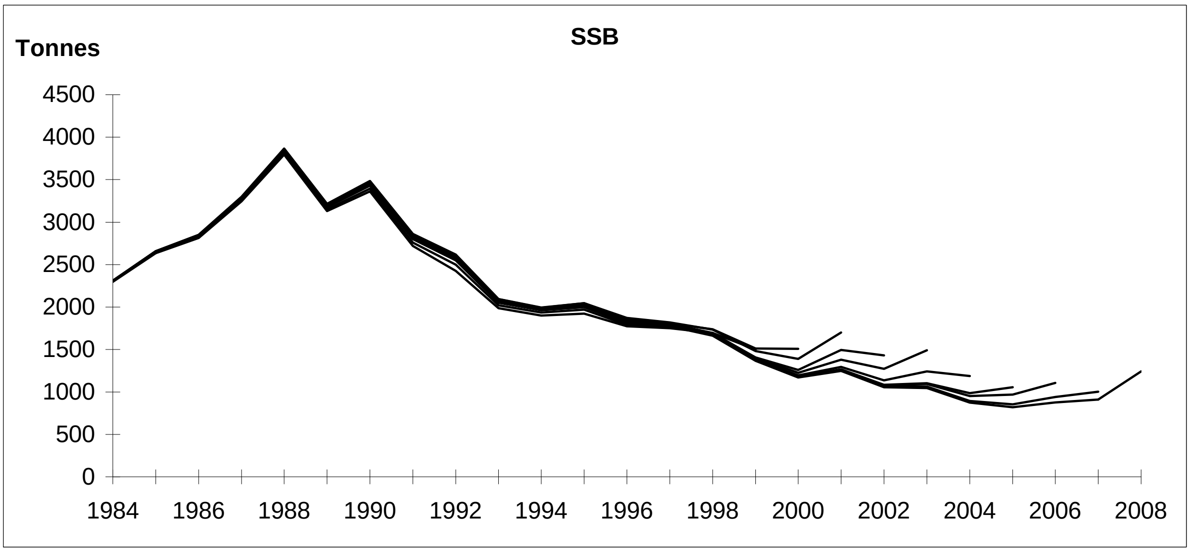
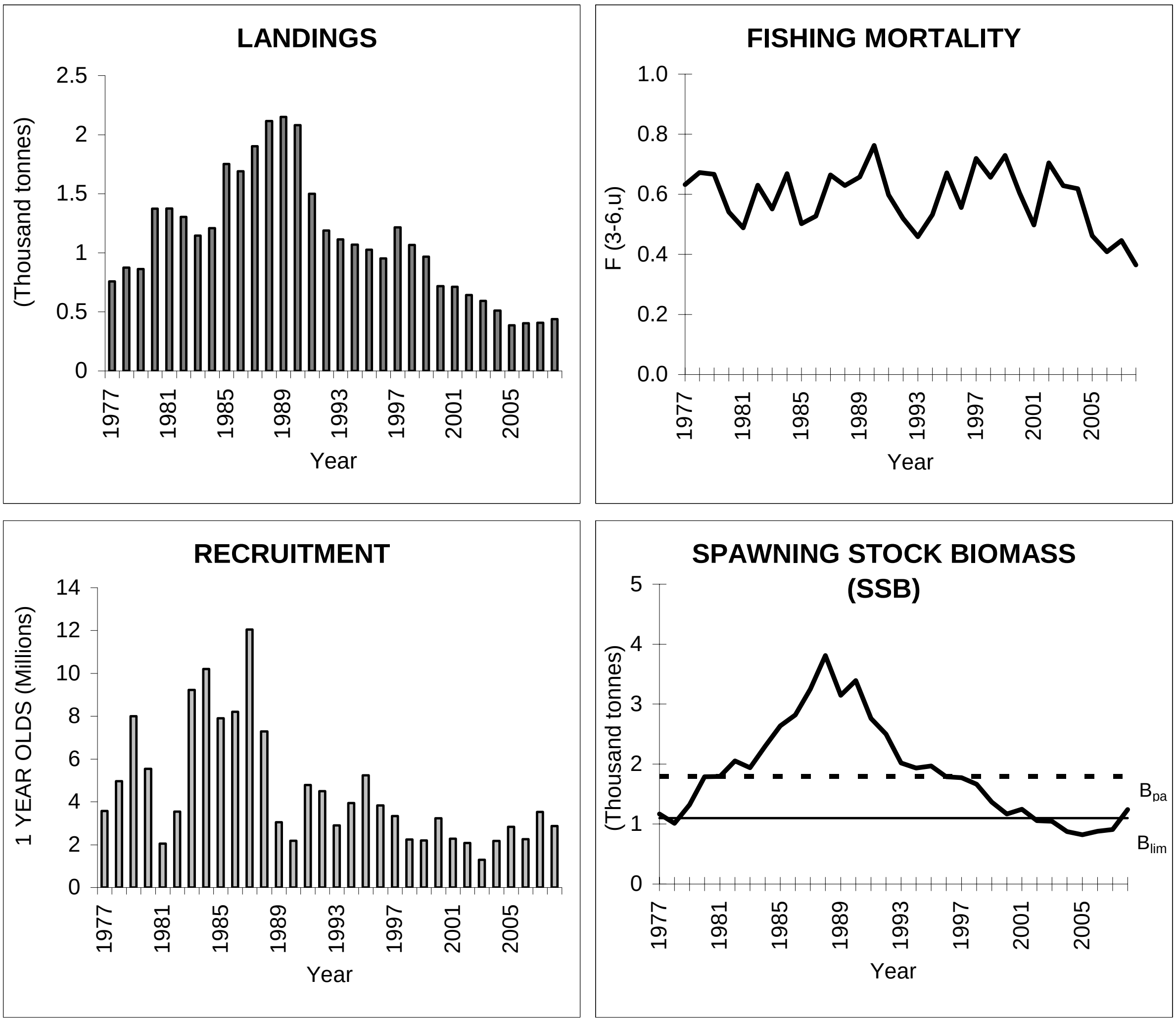


Figure 7.10.10 **Plaice in Division VIIfg**



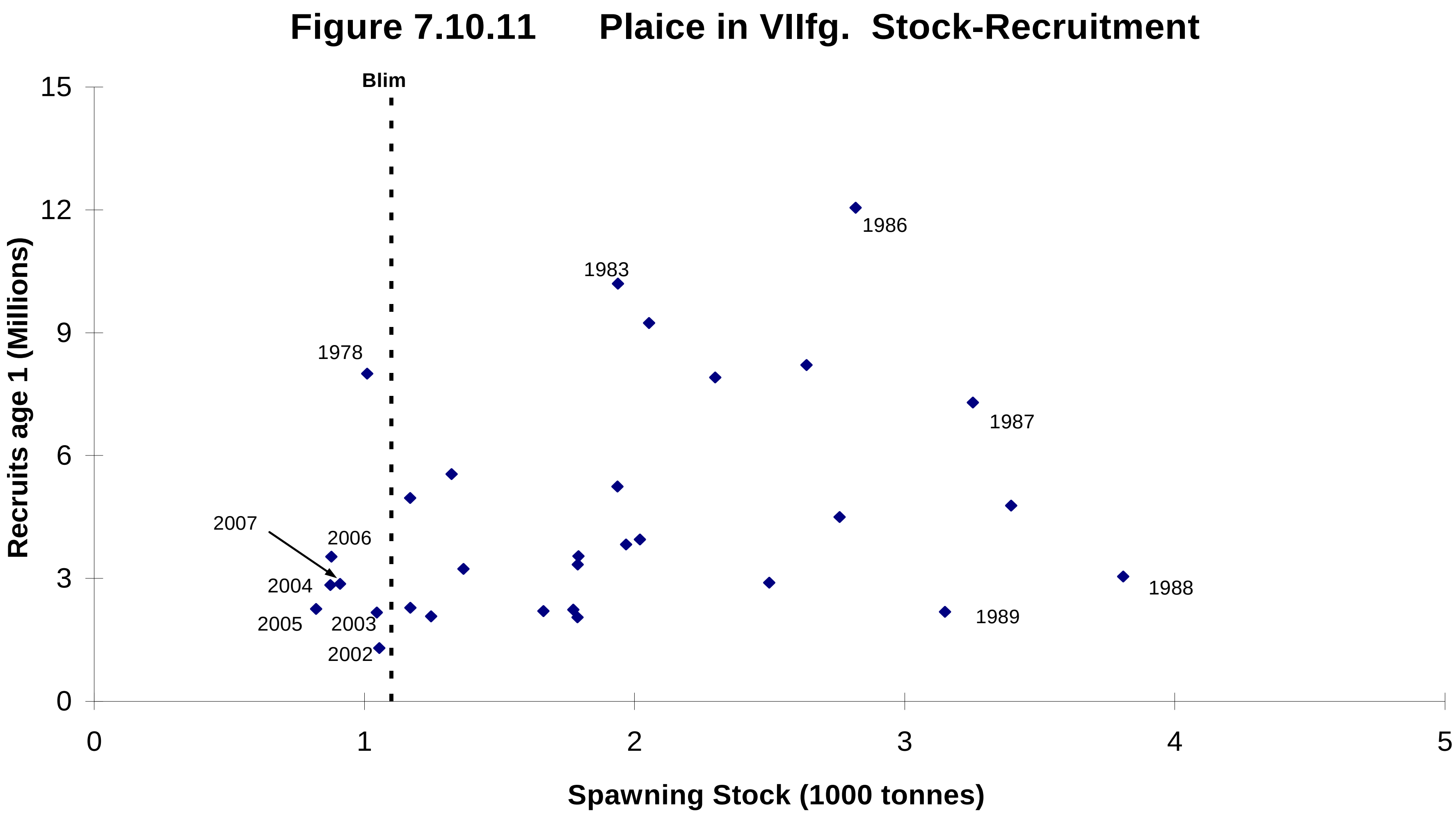
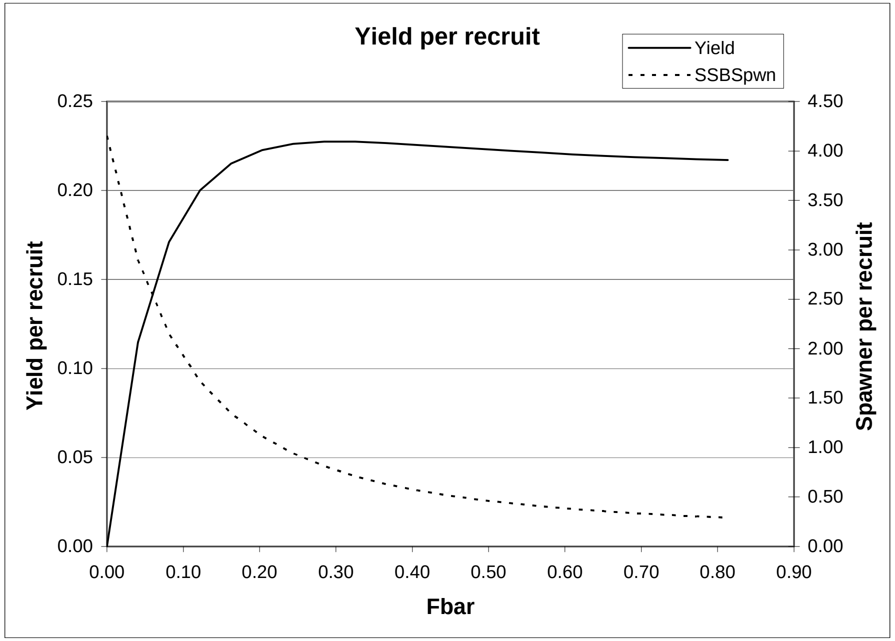
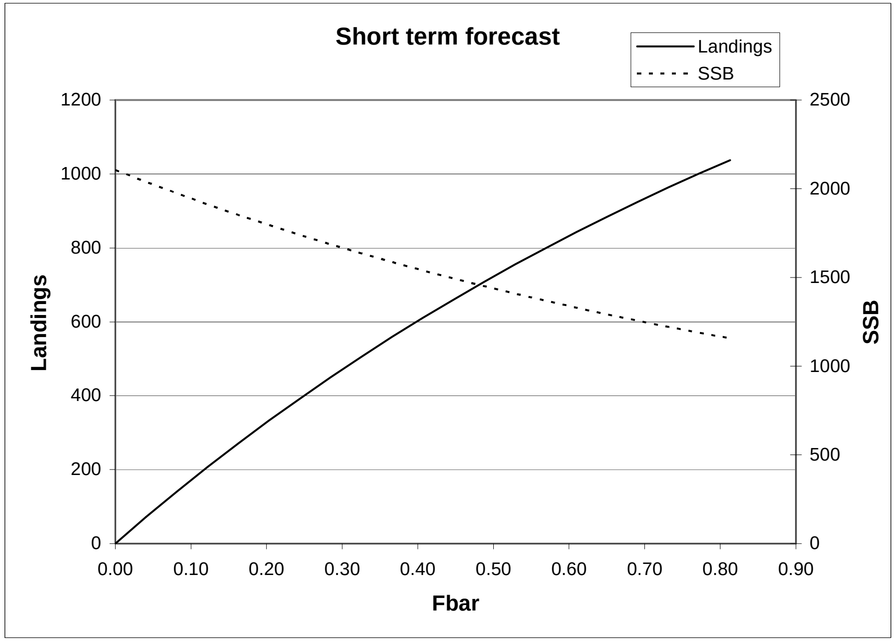


Figure 7.10.11 Plaice in VIIfg. Stock-Recruitment
Blim
Recruits age 1 (Millions)
Spawning Stock (1000 tonnes)
0
3
6
9
12
15
0
1
2
3
4
5
1986
1983
1978
1987
2007
2006
2004
1988
2005
2003
1989
2002

Figure 7.10.12 VIIfg Plaice : Yield per recruit and short term forecast results





MFYPR version 2a
Run: Update
Time and date: 11:16 05/05/2009

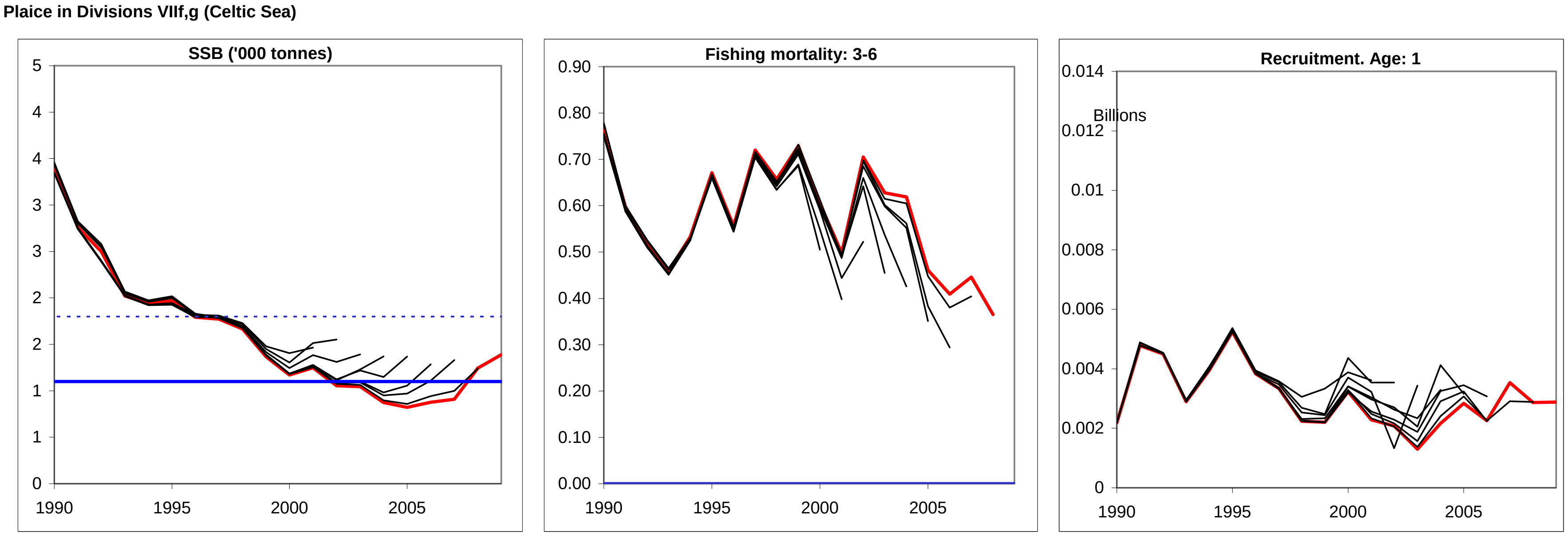
Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.4065
FMax	0.7429	0.3020
F0.1	0.3340	0.1358
F35%SPR	0.3620	0.1472

Weights in kilograms

MFDP version 1a
Run: Update
CELTIC SEA PLAICE,2009 WG, Forecast Inputs
Time and date: 10:51 05/05/2009
Fbar age range: 3-6

Input units are thousands and kg - output in tonnes

Figure 7.10.13 Plaice VIIf,g: Plot of historical ICES assessments



* the 2009 assessment is in red

7.11 Plaice in the Southwest of Ireland (ICES Divisions VIIh–k)

Type of assessment in 2009

No assessment was performed, however catch numbers and weighs were aggregated for the Irish landings for the years 1993–2008 and these were used to perform a yield-per-recruit analysis.

7.11.1 General

Stock Identity

Plaice in VIIj are mainly caught by Irish vessels on sandy grounds off counties Kerry and west Cork. Plaice catches in VIIk are negligible. VIIh is also considered part of the stock for assessment purposes but there is no evidence to suggest that this is actually the same stock.

7.11.2 Data

The nominal landings are given in Table 7.11.1.

Most non-Irish landings were from VIIh which is likely to be a different stock. Because age data were only available for Irish landings (which were mainly from VIIjk) the remainder of Section 7.11 concerns Irish data only in VIIjk.

Sampling

Figure 7.11.1 shows that plaice landings in VIIjk were mostly taken by Otter trawlers. This is reflected in the sampling.

Data quality

Figure 7.11.2 shows the length distribution of the Irish landings in VIIjk between 1993 and 2008. Sample numbers appear to be adequate. There are no distinct modes of strong year classes discernible. One sample was removed (420-DEM196); it contained 192 plaice at 27 cm and no other length classes. In 1994 and 1995 a considerable number of small plaice (<20 cm) appeared in the samples. The most likely explanation for this is that discard fish were mistakenly entered as landings and were therefore excluded from the analysis. The age data for 1995 were considered insufficient and for this year the combined age data for 1993–1996 were used.

Annual Age–Length-Keys (ALKs) were constructed (all quarters and gear types combined) and applied to the sampled length frequency distributions. In order to estimate the uncertainty, the length and age data were resampled and the relative age distribution (proportion-at-age) was estimated for each of 250 bootstrap replications. Individual port samples were taken as the resampling unit. Resampling on a smaller scale (individual fish) would not take account of variability between samples. Figure 7.11.3 shows the age distribution of plaice in VIIjk between 1993 and 2008. In most years the age distribution appears to be estimated reasonably well.

7.11.3 Historical stock development

Because plaice in VIIh were not sampled, it would not be appropriate to raise the data to all landings in VIIhjk. Instead, the official International landings figures for VIIjk were used to raise the age distributions (Table 7.11.2).

The estimated catch numbers-at-age are given in Table 7.11.3, catch weight-at-age is given in Table 7.11.4. There appears to be relatively little contrast (particularly weak or strong year classes) in the catch numbers. This is also illustrated by Figure 7.11.4, which shows the standardized catch proportions-at-age. Figure 7.11.5 shows the log catch numbers-at-age. The rate of decline in catch numbers through the cohorts appears to be reasonably stable. This can be further investigated by calculating the slope of the log-catch numbers (Z). Figure 7.11.6 shows the catch curve, plaice under the age of 4 are not fully selected and from age 7 onwards the data get quite noisy, therefore the slope of the log-catch numbers was estimated over ages 4 to 7 (Figure 7.11.7). It appears that Z varied between 0.5 and 1.2. The estimate for Z appears to be quite variable.

Yield-per-recruit

The yield-per-recruit was estimated using a method by Thompson and Bell, 1934. This method requires the selectivity to be estimated. This was done by estimating the slope of the log catch numbers for ages that are fully selected and using this slope (Z) to predict the population numbers for ages that are not fully selected. The Z was estimated on pseudo-cohorts which were standardized to take account of annual variations in the catch numbers. Figure 7.11.8 shows that plaice in VIIjk appear to be fully selected by the age of 4 and that after the age of 9 the data get very sparse. Figure 7.11.9 shows the slope of the log catch numbers. The predicted catch numbers from this slope were used to estimate the 'observed' selectivity. This was then modelled by applying a linear model after a logit transformation. The estimated selection curve is also shown in Figure 7.11.9. A natural mortality of 0.12 was assumed (based on the value used by the WG for plaice in VIIfg) and the WG maturity ogive for plaice in VIIfg was used to estimate SSB. The yield was estimated for a range of F values based on the average catch weights. Figure 7.11.10 shows the YPR curve, F_{max} is estimated to be 0.24. $F_{0.1}$ is estimated as 0.14. Recent values of Z ranged from 0.6 to 1.2, with M=0.12 this would result in an F of between 0.48 and 1.08. This is well above F_{max} and $F_{0.1}$

7.11.4 References

Thompson and Bell, 1934 W.F. Thompson and F.H. Bell, Biological statistics of the Pacific halibut fishery. 2. Effect of changes in intensity upon total yield and yield per unit of gear, Rep. Int. Fish. (Pacific Halibut) Comm. 8 (1934), p. 49.

Table 7.11.1. Plaice in Divisions VII h–k (Southwest Ireland). Nominal landings (t), 1987–2008, as officially reported to ICES.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995
Belgium*	250	245	403	301	252	246	344	197	235
Denmark	1	1	1	-	-	-	-	-	-
France	85	135	229	77	173	90	64	48	60
Ireland	300	369	454	338	478	477	383	271	321
Netherlands	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-
UK - Eng+Wales+N.Irl.	.	.	73	88	287	264	218	258	282
UK - England & Wales	246	433	.	.	.	.	.	.	.
UK - Scotland	-	1	-	1	1	6	7	1	4
Un. Sov. Soc. Rep.	-	-	-	-	-	.	.	.	.
Total	882	1184	1160	805	1191	1083	1016	775	902
Unallocated							-361	-198	-360
WG estimate							655	577	542

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004
Belgium	304	442	335	45	4	27	69	20	67
Denmark	-	-	-	-	-	-	-	-	-
France	48	69	49	.	54	50	45	33	34
Ireland	305	344	286	299	200	160	155	127	91
Netherlands	52	-	13	1	2	-	-	-	-
Spain	-	-	-	1	5	3	2	6	6
UK - Eng+Wales+N.Irl.	154	138	106	82	75	73	59	56	36
UK - England & Wales	.	.	.	.	.	.	.	.	.
UK - Scotland	1	1	1	1	1	-	-	-	-
Un. Sov. Soc. Rep.	.	.	.	.	.	.	.	.	.
Total	864	994	790	428	341	313	330	242	234
Unallocated	-411	-349	-346	-22	-42	-52	-17	-25	-13
WG estimate	453	645	444	406	299	261	313	217	221

Country	2005	2006	2007	2008
Belgium	32	22	7	25
Denmark				
France	20	37	30	12
Ireland	90	65	72	72
Netherlands	.			
Spain	.	1	13	
UK - Eng+Wales+N.Irl.	28	18	20	12
UK - England & Wales	.			
UK - Scotland	.			
Un. Sov. Soc. Rep.	.			
Total	170	143	142	121
Unallocated	-6	4	-22	14
WG estimate	164	147	120	135

* Belgian Landings highlighted include VIIg

Table 7.11.2. Official landings of plaice in VIIjk.

YEAR	BEL	FRA	IRE	ESP	UK	TOTAL
1993	.	8	383	-	46	437
1994	.	6	251	-	60	317
1995	.	12	317	-	90	419
1996	.	3	295	-	38	336
1997	.	6	337	-	32	375
1998	.	8	282	-	16	306
1999	42	0	296	<0.5	15	353
2000	4	16	195	5	9	229
2001	-	16	157	3	6	182
2002	14	21	155	2	5	197
2003	4	7	125	6	9	151
2004	<0.5	5	87	6	6	104
2005	-	4	88	-	2	94
2006	-	6	63	1	1	71
2007	-	9	72	11	2	94
2008*		4	72		1	77

*** Preliminary data**

Table 7.11.3. Catch numbers-at-age for plaice in VIIjk.

	1	2	3	4	5	6	7	8	9	10	11	12+
1993	0	92	624	479	115	45	23	10	6	2	0	1
1994	5	89	342	262	83	46	19	8	5	2	1	0
1995	3	197	635	349	107	36	16	7	3	1	2	0
1996	0	77	316	229	127	37	23	5	1	0	0	0
1997	0	166	277	268	119	42	19	4	0	0	0	9
1998	0	46	355	164	103	38	26	10	4	3	0	0
1999	11	143	312	201	65	37	18	11	9	2	2	8
2000	2	74	161	190	64	36	7	5	3	2	0	2
2001	1	55	165	145	46	6	22	2	9	0	0	0
2002	0	54	155	172	54	42	44	12	4	2	0	1
2003	0	74	165	65	29	6	15	11	2	2	1	0
2004	7	31	121	91	27	12	2	2	4	1	1	0
2005	1	25	71	77	48	22	13	4	0	1	0	1
2006	0	17	41	53	38	12	7	1	1	0	2	0
2007	0	47	136	61	22	17	4	2	0	0	0	0
2008	1	53	103	68	20	5	2	1	0	0	0	0

Table 7.11.4. Weight-at-age for plaice in VIIjk.

	1	2	3	4	5	6	7	8	9	10	11	12+
1993		0.197	0.256	0.306	0.417	0.582	0.750	0.933	1.159	1.534		1.969
1994	0.151	0.250	0.304	0.368	0.460	0.563	0.708	0.871	1.029	1.308	1.372	1.753
1995	0.229	0.237	0.272	0.325	0.390	0.520	0.647	0.825	1.190	1.459	1.568	
1996	0.100	0.299	0.379	0.431	0.463	0.512	0.528	0.494	0.595	2.322		2.302
1997	1.112	0.295	0.339	0.430	0.483	0.654	0.808	0.938				1.319
1998		0.249	0.308	0.419	0.529	0.690	0.779	0.757	0.941	1.192	2.201	
1999	0.218	0.289	0.354	0.417	0.596	0.627	0.840	0.881	1.170	1.731	2.121	1.135
2000	0.119	0.274	0.348	0.420	0.486	0.610	0.805	1.113	1.437	1.088		1.737
2001	0.214	0.242	0.325	0.405	0.514	0.642	0.792	0.552	1.177			
2002		0.211	0.296	0.328	0.415	0.498	0.567	0.701	1.014	1.098		1.532
2003		0.274	0.356	0.402	0.482	0.575	0.737	0.881	1.048	1.872	1.257	
2004	0.128	0.258	0.309	0.341	0.448	0.550	0.633	0.635	0.900	1.137	1.328	1.803
2005	0.174	0.238	0.276	0.324	0.381	0.459	0.731	0.949		1.222	1.534	2.020
2006		0.272	0.319	0.370	0.438	0.520	0.794	0.895	0.790	0.395	1.878	
2007		0.239	0.281	0.354	0.433	0.482	0.573	0.727	1.394	0.837	1.266	
2008	0.293	0.239	0.282	0.336	0.358	0.530	0.756	0.399	1.106	1.576		1.485

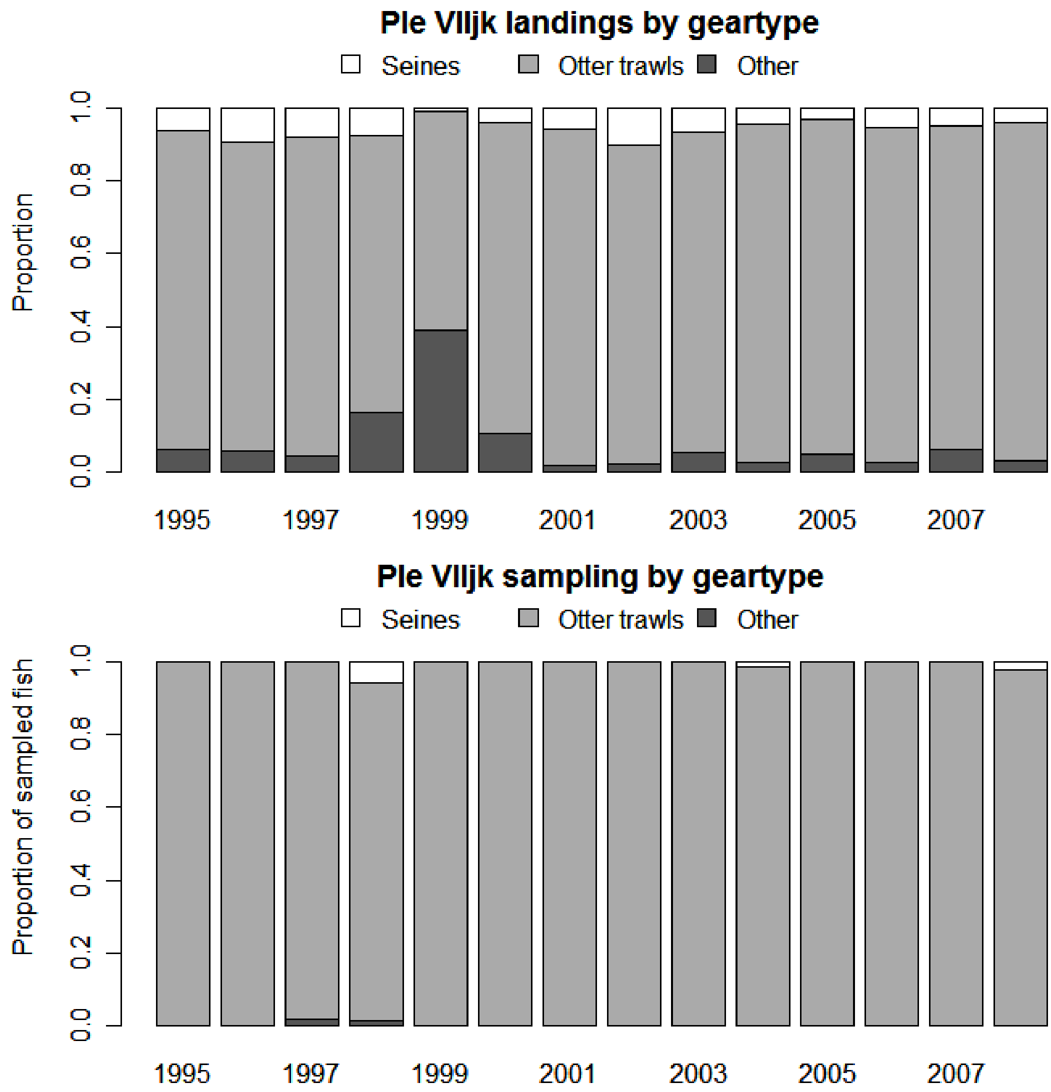


Figure 7.11.1. Irish Operational landings of plaice in VIIjk by geartype (top) and number of fish measured by geartype (bottom). The sampling appears to be representative of the geartypes in the fishery.

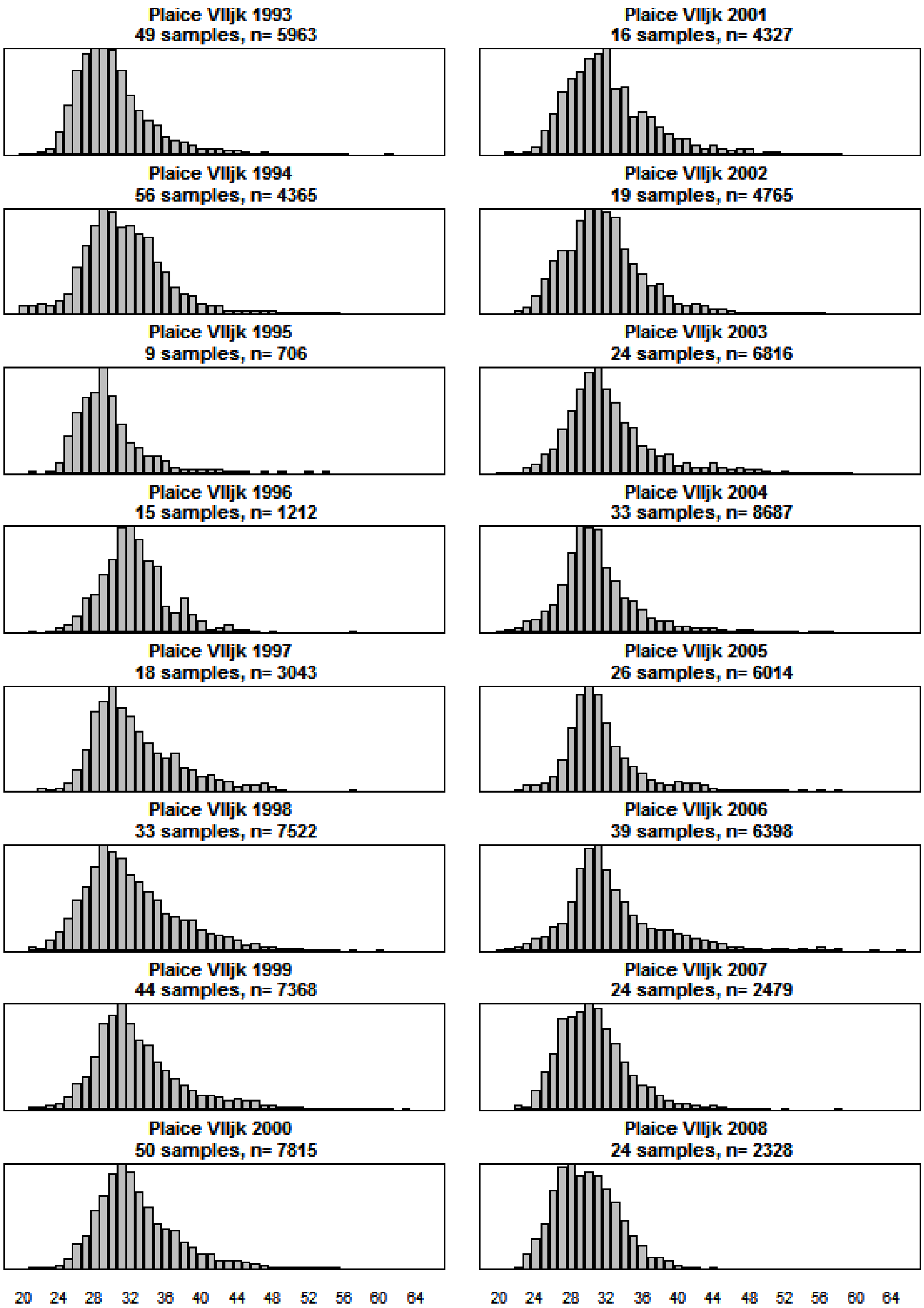


Figure 7.11.2. Length frequency distribution of the Irish landings of plaice in VIIjk between 1993 and 2008. All gears and quarters combined. Sampling was poor during 2006 and 2007.

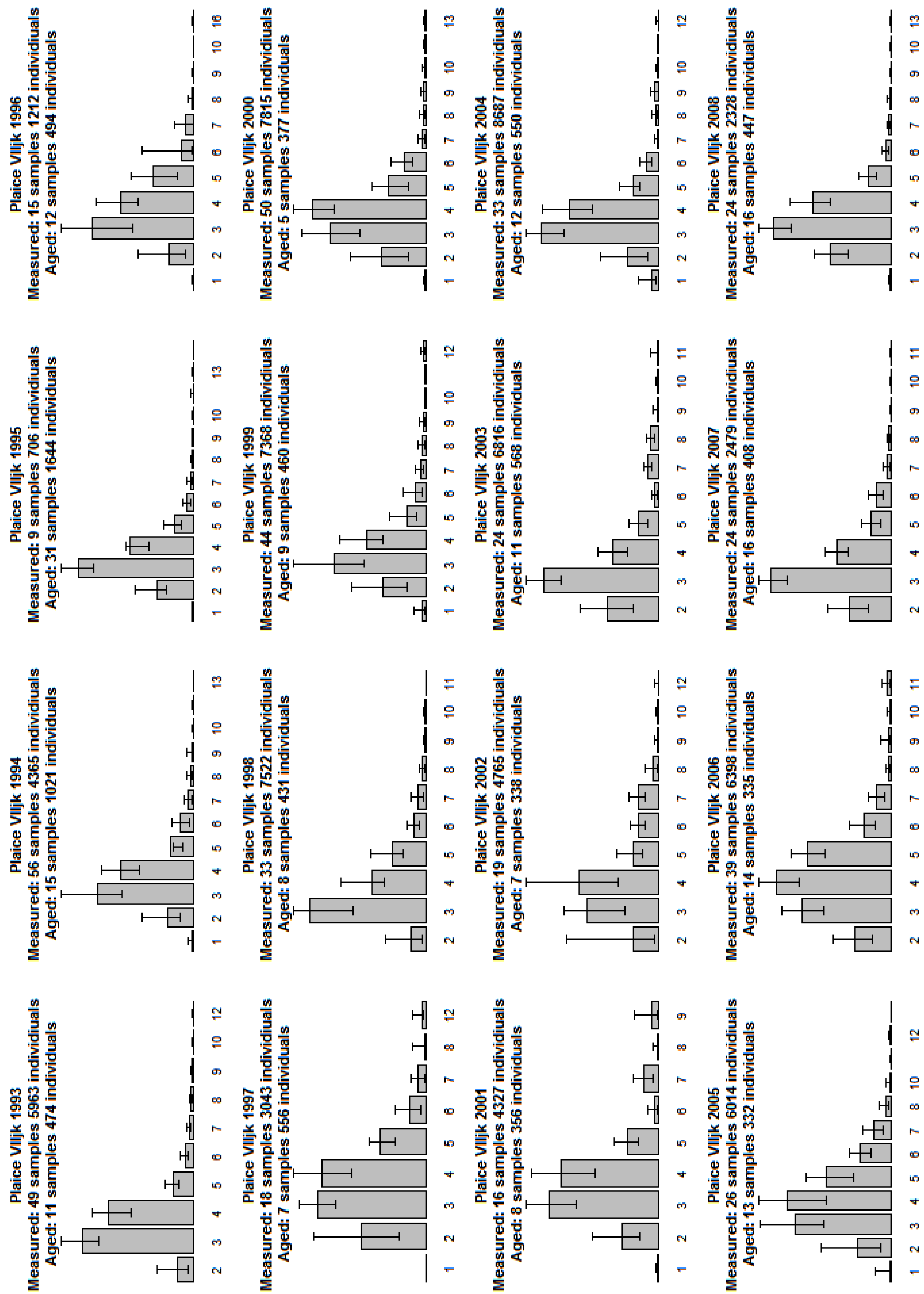


Figure 7.11.3. Relative age distribution of plaice in VIIjk between 1993 and 2008. All gears and quarters combined. The error bars represent the 95% confidence limits (bootstrap estimates). The age data for 1995 were considered insufficient and for this year the combined age data for 1993–1996 were used.

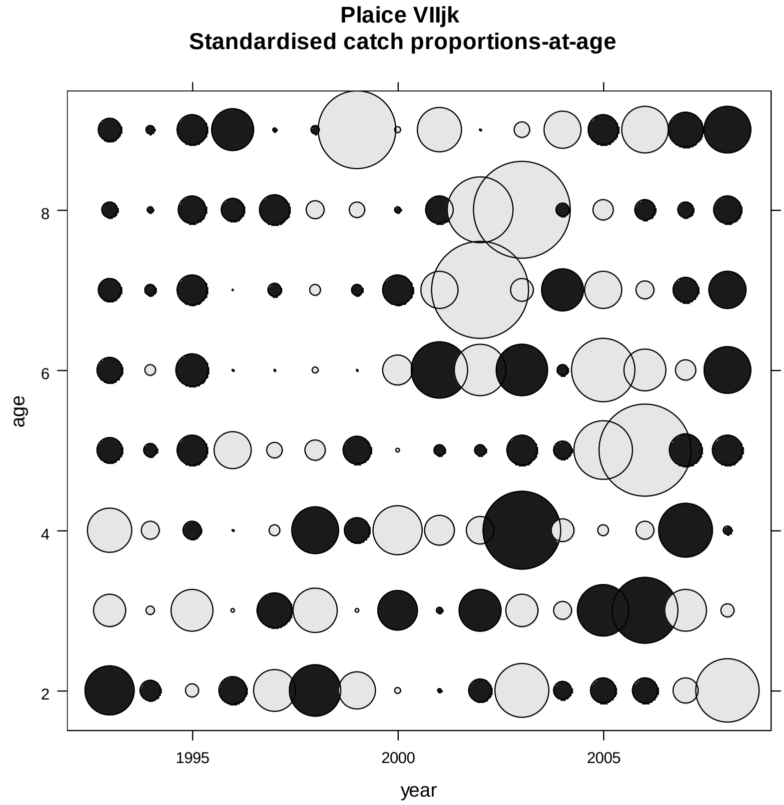


Figure 7.11.4. Standardised catch proportions-at-age for plaice in VIIjk. Grey bubbles represent higher-than-average catch-at-age and black bubbles represent lower-than-average catch-at-age.

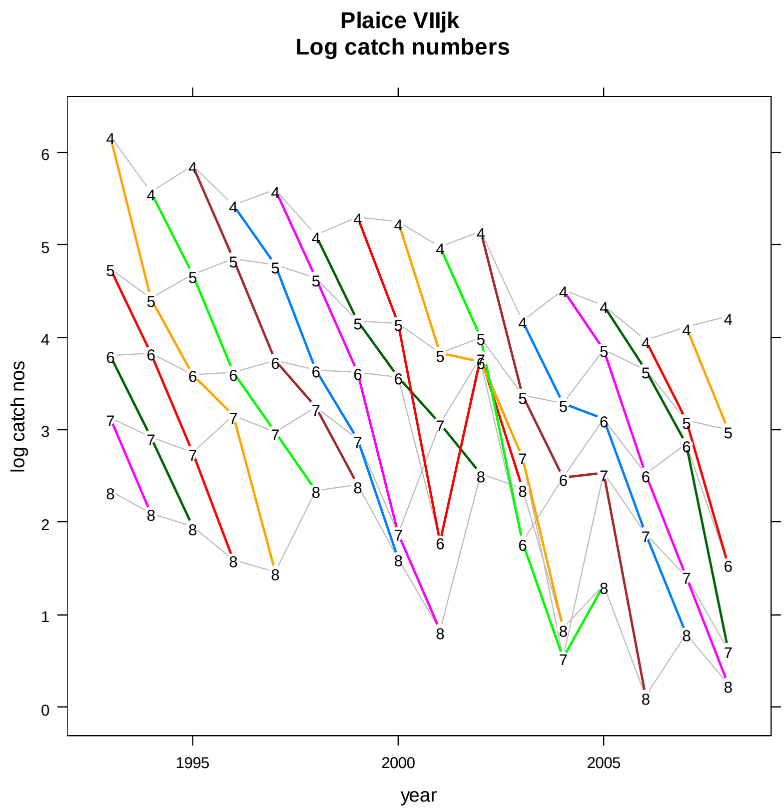


Figure 7.11.5. Log catch numbers-at-age (ages 4–8).

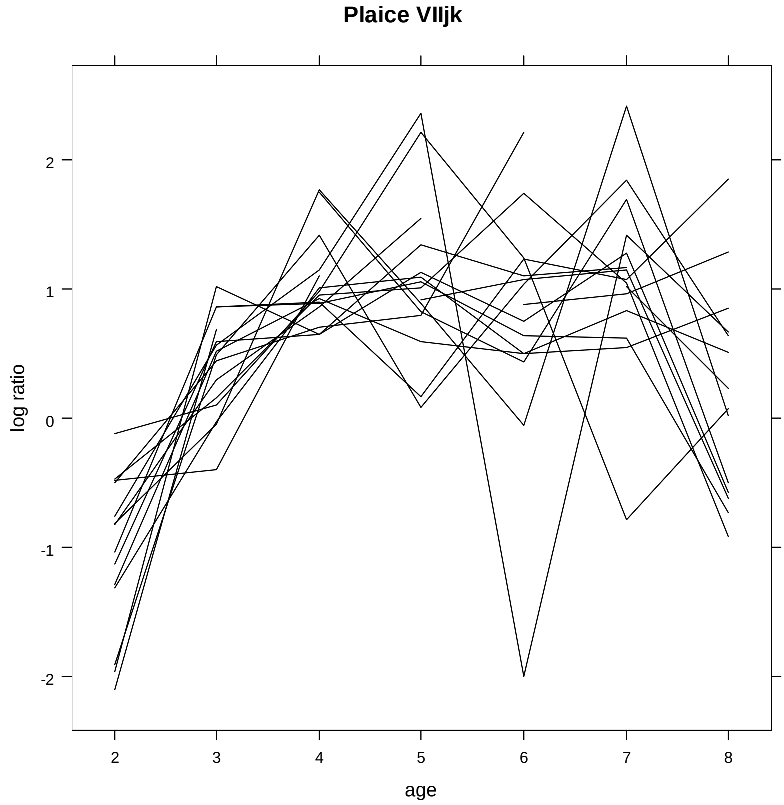


Figure 7.11.6. Catch curve of plaice in VIIbc. Plaice from the age of 4 appear to be fully selected; the data get quite noisy from the age of 7 onwards.

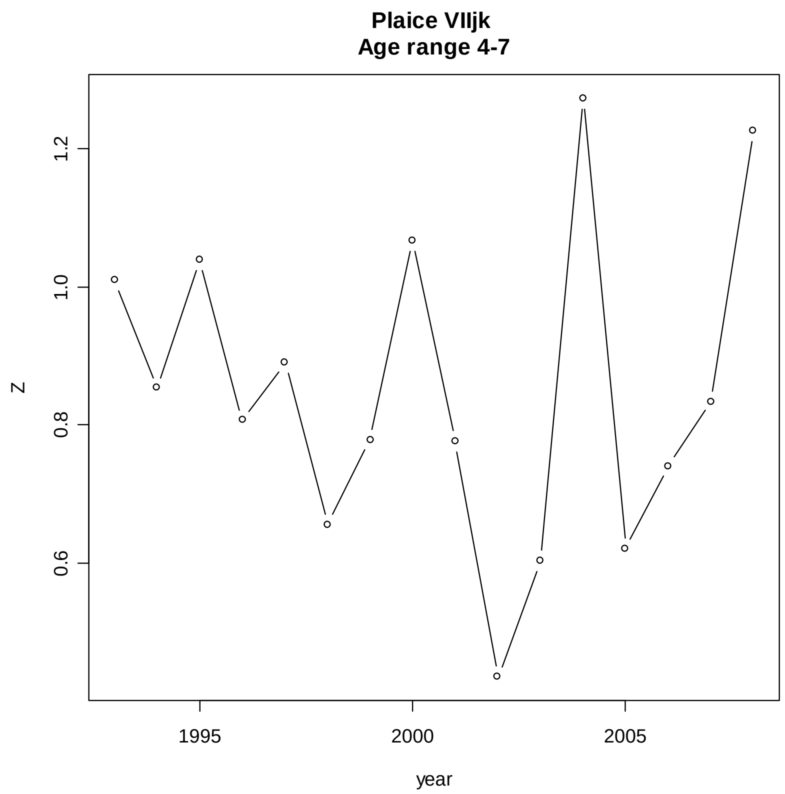


Figure 7.11.7. Z estimated over pseudo-cohorts as the slope of the log catch numbers.

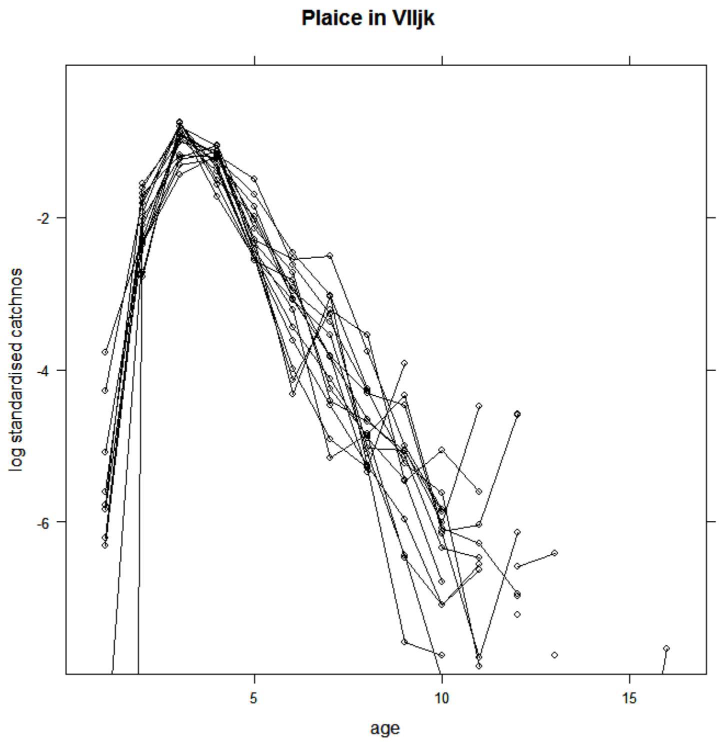


Figure 7.11.8 log catch numbers (standardized by year). Fish appear to be fully selected from the age of 4.

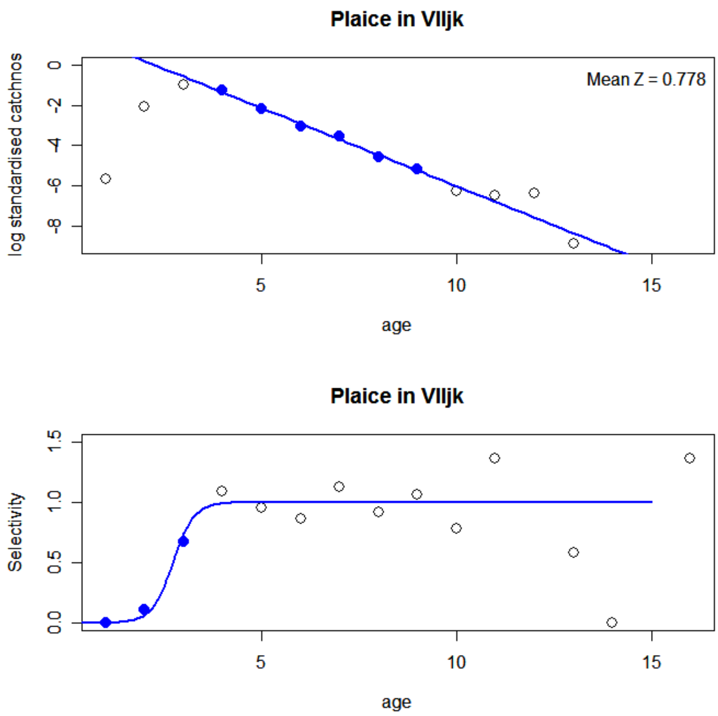


Figure 7.11.9. Selectivity was modelled by fitting a line through the mean log standardized catch numbers of ages 4 to 9 to predict the expected catch numbers for ages 1 to 3 if these were fully selected. The proportions of observed divided by expected catch number were taken as the 'observed' selectivity. This was then modelled using a logit transformation.

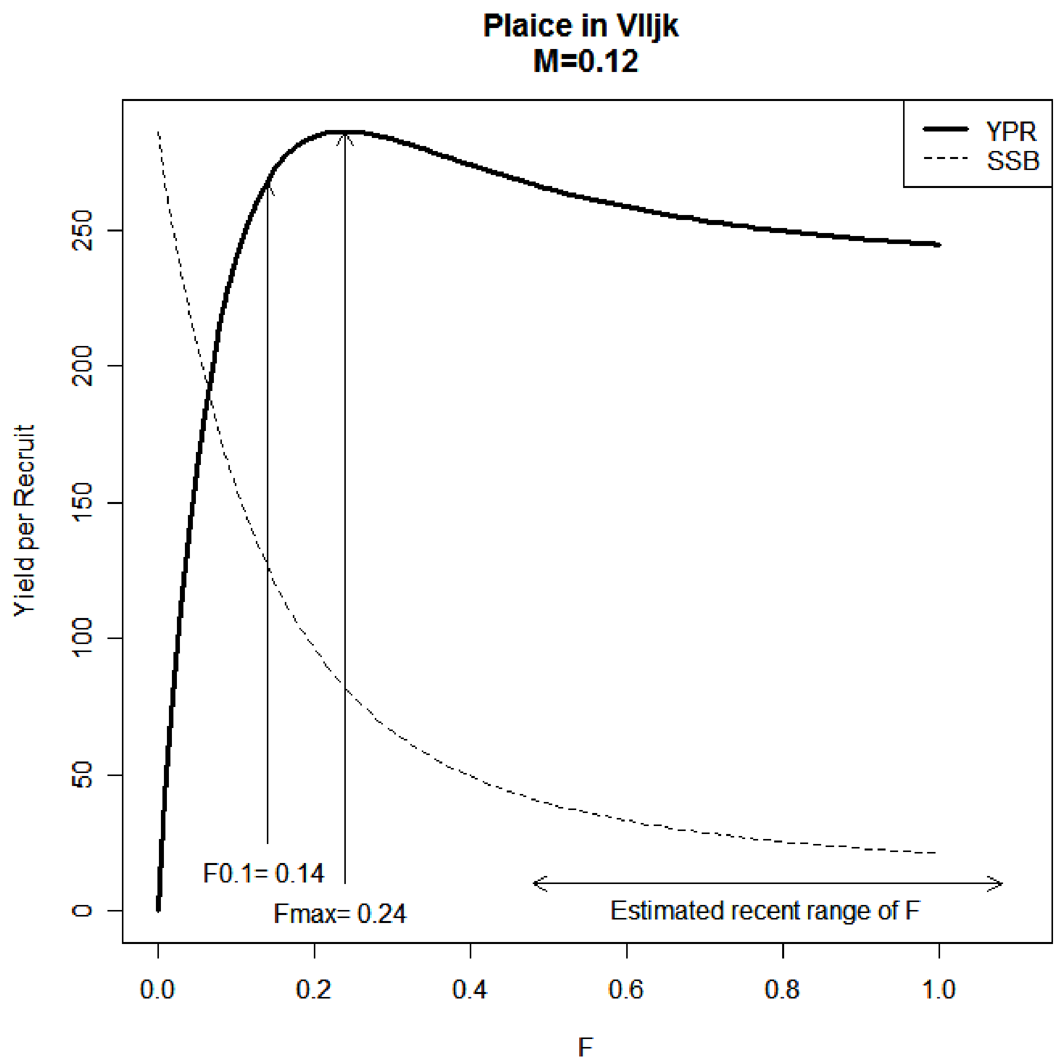


Figure 7.11.10. YPR analysis using the Thompson-Bell approach. Recent estimates of Z were between 0.5 and 1.2 which translates to an F of 0.48 to 1.08.

7.12 Sole in West of Ireland Division VIIb, c

Type of assessment in 2009

No assessment was performed, however catch numbers and weighs were aggregated for the Irish landings for the years 1993–2008 and an exploratory data analysis was performed.

7.12.1 General

Stock Identity

Sole in VIIb are mainly caught by Irish vessels on sandy grounds in coastal areas. Sole catches in VIIc are negligible. In VIIb there are two distinct areas where sole are caught: an area to the west of the Aran Islands and an area in the north of VIIb which extends into VIa (the Stags Ground). The landings and lpue of Sole in VIIbc appear to have been more or less stable since the start of the logbooks time-series in 1995 (WD1). It is not known how much exchange there is between sole on the Aran grounds and those on the Stags ground.

7.12.2 Data

The nominal landings are given in Table 7.12.1.

The remainder of Section 7.12 concerns Irish data only:

Historically, nearly all commercial sole VIIbc samples have been taken in Ros a Mhíl, most vessels landing here are fishing on the Aran grounds. Sole caught in the north of VIIb would most likely be landed in Killybegs, but less than 3% of the VIIbc sole samples were taken in Killybegs so it appears that the vast majority of the VIIbc sol samples originated from the Aran grounds. Sole from the Stags grounds were probably sampled as part of the VIa samples but it is difficult to determine the catch location of sole landed in Killybegs and Greencastle as these could have originated from a number of areas within VIa.

Figure 7.12.1 shows the proportion of the Irish sole VIIbc landings that were taken on the Stags ground. At the start of the time-series (1995) around 40% of the sole VIIbc landings were from the Stags grounds, this figure has slowly decreased to less than 10% in 2008 (source: Irish logbooks data).

Figure 7.12.2 shows that sole landings in VIIbc were mostly taken by Otter trawlers. This is reflected in the sampling.

Data quality

Figure 7.12.3 shows the length distribution of the Irish landings in VIIbc between 1993 and 2008. No sole samples were taken in 2007 and only 48 fish were measured in 2008, in other years the sample numbers appear to be adequate. In some years distinct modes of strong year classes are discernible but cohorts cannot easily be followed though the years.

Annual Age–Length-Keys (ALKs) were constructed (all quarters and gear types combined) and applied to the sampled length frequency distributions. For 2005 and 2007 an average ALK was used (based on data from 2003–2008) because age data were sparse in those years. Numbers-at-age in 2006 were interpolated from the log-transformed catch numbers of 2005 and 2007.

In order to estimate the uncertainty, the length and age data were resampled and the relative age distribution (proportion-at-age) was estimated for each of 250 bootstrap replications. Individual port samples were taken as the resampling unit. Resampling on a smaller scale (individual fish) would not take account of variability between samples. Figure 7.12.4 shows the age distribution of sole in VIIbc between 1993 and 2008. Prior to 2003 the age distribution appears to be reasonable well estimated, however in recent years sample numbers were quite low, resulting in poor precision.

7.12.3 Historical stock development

Because the sampling was representative of the Aran grounds sole only, it would not be appropriate to raise the data to all landings in VIIbc. Instead the Working Group estimates of the international landings were multiplied by the proportion of the landings that were taken outside the Stags grounds (the four most northerly rectangles in VIIb). The age distributions were raised to these landings (Table 7.12.2).

The estimated catch numbers-at-age are given in Table 7.12.3, catch weight-at-age is given in Table 7.12.4. It is possible to track particularly weak or strong year classes in the catch numbers matrix; this is also illustrated by Figure 7.12.5, which shows the standardized catch proportions-at-age. Figure 7.12.6 shows the log catch numbers-at-age the rate of decline in catch numbers appears to be quite noisy which casts some doubts on the quality of the data.

Table 7.12.1. Sole in Divisions VII b, c (Southwest Ireland). Nominal landings (t), 1973–2008, as officially reported to ICES.

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981
France	-	25	7	6	3	3	6	9	6
Ireland	12	12	19	44	14	16	13	24	47
Spain	19	16	30	25	1	-	11	1	-
UK - Eng+Wales+N.Irl.	.	.	.	.	.	.	.	.	.
UK - England & Wales	-	-	-	-	-	-	-	-	-
Total	31	53	56	75	18	19	30	34	53

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990
France	5	9	3	6	8	2	2	-	-
Ireland	55	40	17	44	29	39	34	38	41
Spain	-	-	-	-	-	-	-	-	-
UK - Eng+Wales+N.Irl.	.	.	.	.	.	.	.	-	-
UK - England & Wales	1	-	-	-	-	-	1	.	.
Total	61	49	20	50	37	41	37	38	41
Unallocated									
WG estimate									

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999
France	5	2	1	1	2	2	3	-	.
Ireland	46	43	59	60	59	52	51	49	68
Spain	-	-	-	-	-	-	-	-	-
UK - Eng+Wales+N.Irl.	-	-	-	-	-	-	1	-	-
UK - England & Wales	.	.	.	.	.	.	.	.	.
Total	51	45	60	61	61	54	55	49	68
Unallocated			0	9	-2	3	0	17	4
WG estimate			60	70	59	57	55	66	72

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
France	13	11	14	24	24	7	12	7	6
Ireland	65	53	50	50	49	38	31	34	31
Spain	-	-	-	-	-	.	.		
UK - Eng+Wales+N.Irl.	-	-	-	-	-	.	.		
UK - England & Wales	.	.	.	.	.	.	.		
Total	78	64	64	74	73	45	43	41	37
Unallocated	-10	-4	-3	-10	-4	-1	0	1	3
WG estimate	68	60	61	64	69	44	43	42	40

Table 7.12.2. Landings of sole from the Stags grounds (the four most northerly rectangles in VIIb: 37D8, 37D9, 37E0 and 37E1) were excluded from the analysis as these were poorly sampled and the lpue trends in this area match those of VIa more closely than those in the rest of VIIbc. The proportion of Irish landings reported in VIIbc that were outside the Stags grounds was used to adjust the WG estimates of the landings.

Year	WG landings	Proportion outside 37D8 37D9 37E0 37E1	Landings outside 37D8 37D9 37E0 37E1
1993	60	0.50	30
1994	70	0.50	35
1995	59	0.37	22
1996	57	0.47	27
1997	55	0.66	36
1998	66	0.61	40
1999	72	0.77	55
2000	68	0.79	54
2001	60	0.78	47
2002	61	0.83	51
2003	64	0.84	54
2004	69	0.89	61
2005	44	0.75	33
2006	43	0.86	37
2007	42	0.78	33
2008	40	0.93	37

***average 1995–1998.**

Table 7.12.3. Catch numbers-at-age for sole in VIIbc (excl VIIb north).

	2	3	4	5	6	7	8	9	10	11	12	13+
1993	0	13	31	13	6	6	4	1	1	1	1	2
1994	0	4	23	20	8	6	4	5	2	1	2	5
1995	0	2	8	16	8	2	3	2	2	1	1	2
1996	1	3	6	7	10	8	3	2	2	2	3	11
1997	2	8	5	21	8	11	10	1	2	2	2	10
1998	4	15	20	10	18	10	10	7	3	2	1	7
1999	2	34	55	27	10	18	7	10	6	1	1	6
2000	1	30	48	32	17	6	7	5	2	2	2	4
2001	6	19	28	25	16	10	9	9	5	3	1	3
2002	13	45	42	24	15	7	6	3	1	1	0	0
2003	0	13	15	25	19	13	11	6	8	7	5	21
2004	1	2	15	11	23	17	16	7	4	8	10	34
2005	0	6	12	14	14	11	10	4	4	4	3	12
2006		2	11	14	14	13	8	8	5	4	4	14
2007	0	7	11	13	12	9	9	5	5	4	3	12
2008		3	13	11	4	18	20	3	7	4		3

Table 7.12.4. Weight-at-age for Sole in VIIbc (excl VIIb north).

	2	3	4	5	6	7	8	9	10	11	12	13+
1993	0.079	0.203	0.309	0.417	0.458	0.542	0.560	0.635	0.848	0.812	0.733	0.786
1994	0.100	0.255	0.346	0.378	0.457	0.532	0.595	0.551	0.693	0.683	0.736	0.685
1995	0.156	0.368	0.394	0.427	0.442	0.519	0.502	0.611	0.609	0.773	0.642	0.772
1996	0.124	0.251	0.281	0.369	0.421	0.449	0.456	0.515	0.537	0.612	0.592	0.682
1997	0.137	0.171	0.284	0.362	0.401	0.453	0.475	0.491	0.690	0.537	0.636	0.752
1998	0.129	0.195	0.235	0.327	0.363	0.460	0.476	0.530	0.685	0.562	0.616	0.786
1999	0.178	0.160	0.230	0.319	0.379	0.389	0.430	0.441	0.543	0.695	0.712	0.669
2000	0.249	0.187	0.268	0.338	0.422	0.559	0.549	0.573	0.624	0.590	0.712	0.739
2001	0.125	0.182	0.230	0.292	0.379	0.468	0.474	0.481	0.668	0.714	0.880	0.893
2002	0.146	0.197	0.297	0.378	0.525	0.606	0.636	0.629	0.640	0.662	0.919	
2003	0.170	0.164	0.228	0.296	0.337	0.351	0.459	0.536	0.503	0.459	0.549	0.557
2004	0.121	0.168	0.278	0.313	0.367	0.366	0.418	0.442	0.416	0.487	0.422	0.560
2005	0.157	0.173	0.230	0.286	0.324	0.340	0.401	0.445	0.446	0.424	0.419	0.492
2006	0.158	0.173	0.237	0.306	0.341	0.357	0.424	0.480	0.468	0.446	0.453	0.537
2007	0.204	0.166	0.216	0.297	0.343	0.347	0.437	0.493	0.495	0.454	0.464	0.511
2008		0.379	0.251	0.406	0.433	0.387	0.458	0.524	0.700	0.437		0.642

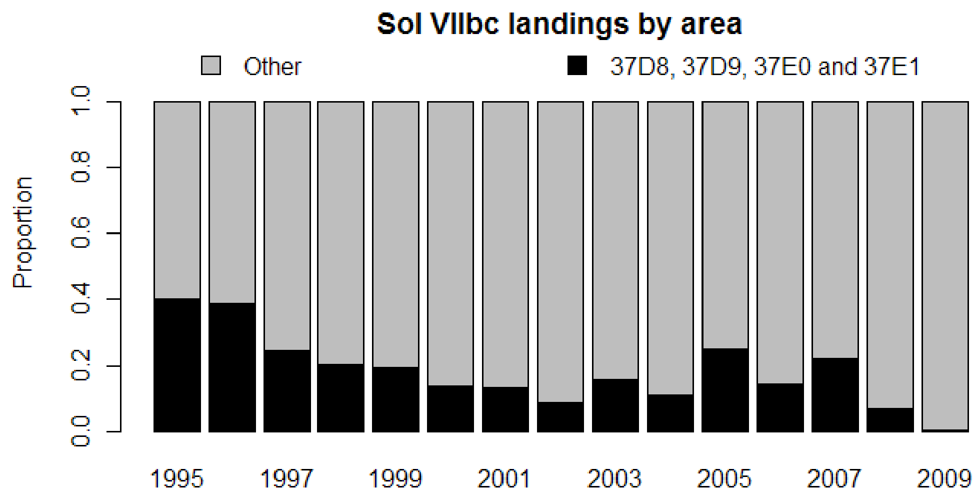


Figure 7.12.1. Irish operational landings by area, rectangles 37D8, 37D9, 37E0 and 37E1 are the most northerly rectangles in VIIb (the Stags). A significant proportion of the landings were taken on the Stags grounds but less than 2% of the sampling took place in ports near these grounds.

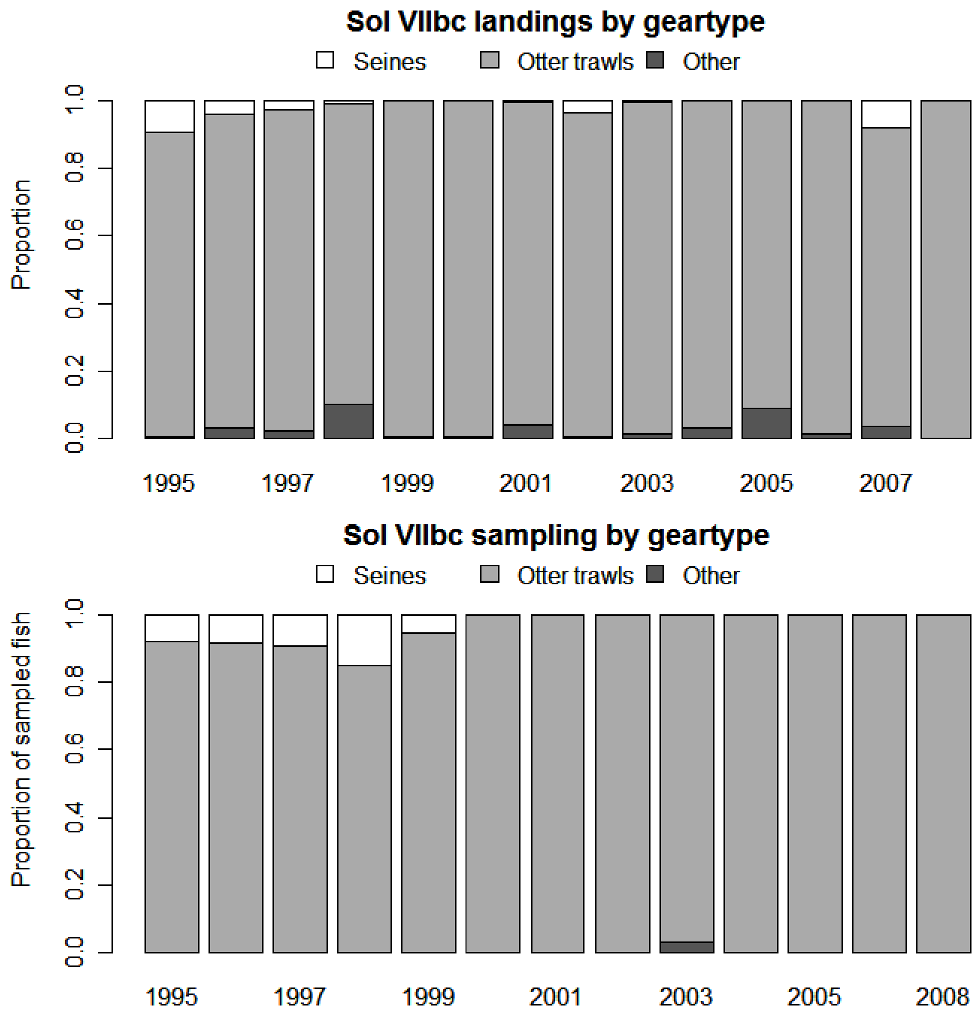


Figure 7.12.2. Irish Operational landings of Sole in VIIbc by geartype (top) and number of fish measured by geartype (bottom). The sampling appears to be representative of the geartypes in the fishery.

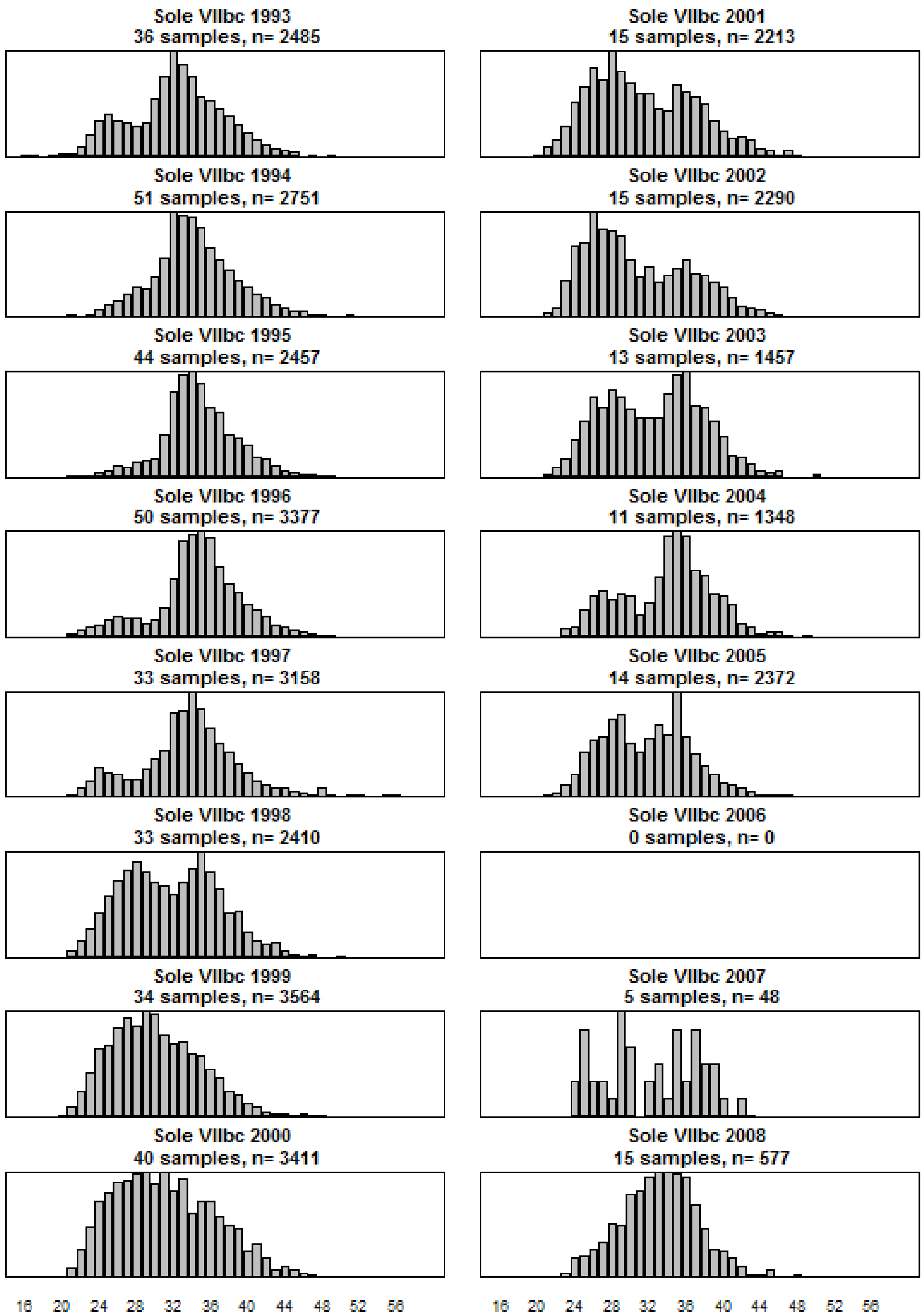


Figure 7.12.3. Length–frequency distribution of the Irish landings of Sole in VIIbc between 1993 and 2008. All gears and quarters combined. Sampling was poor during 2006 and 2007.

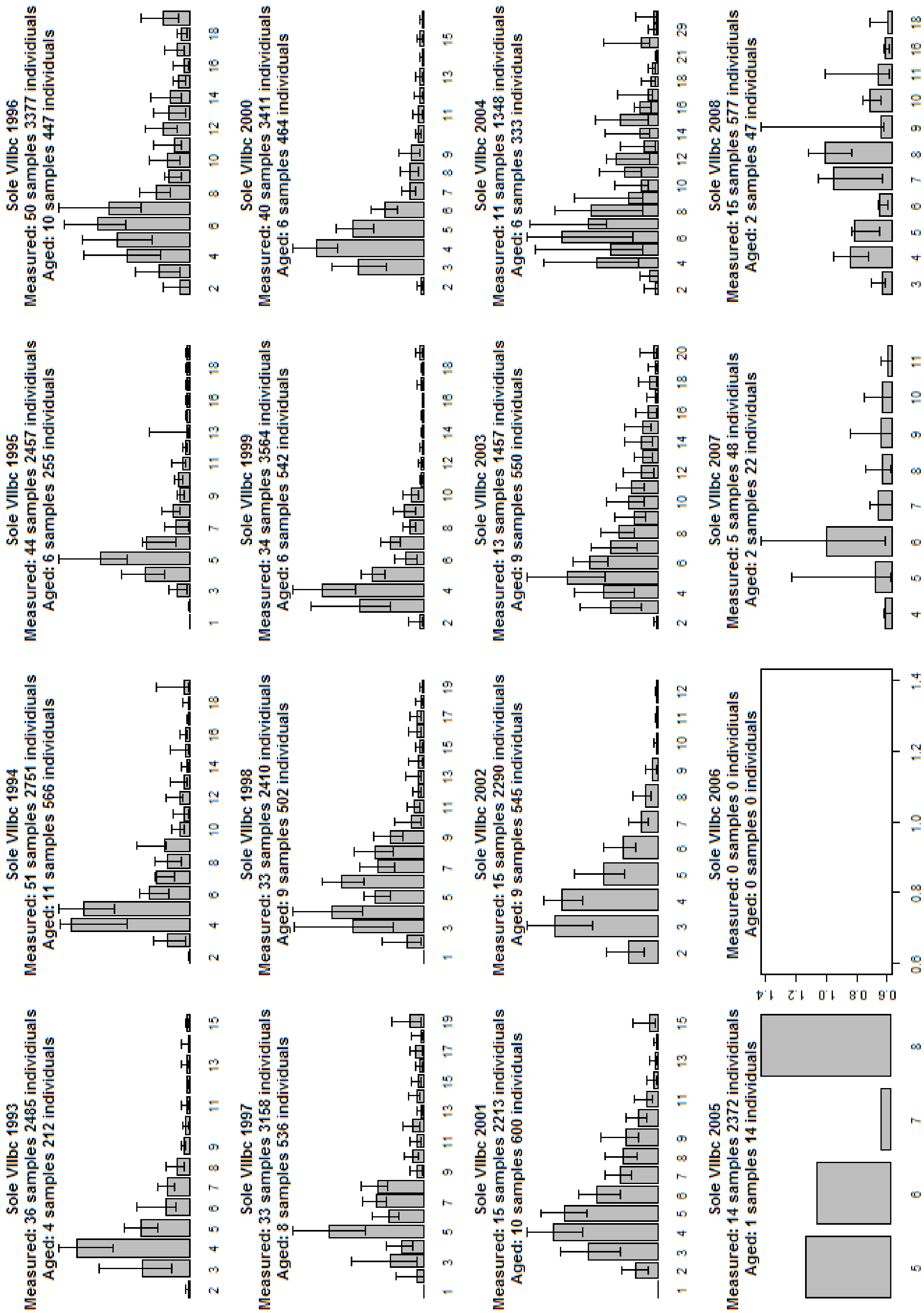


Figure 7.12.4. Relative age distribution of Sole in VIIbc between 1993 and 2008. All gears and quarters combined. The error bars represent the 95% confidence limits (bootstrap estimates). No error estimates are available for 2006 as there was only one length sample during that year.

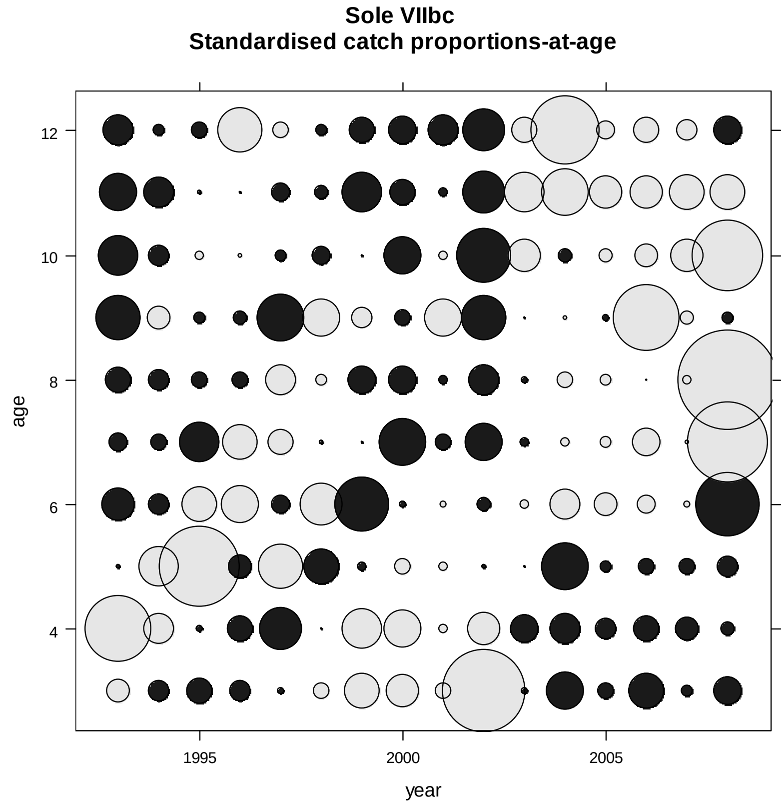


Figure 7.12.5. Standardised catch proportions-at-age for Sole in VIIbc. Grey bubbles represent higher-than-average catch-at-age and black bubbles represent lower-than-average catch-at-age.

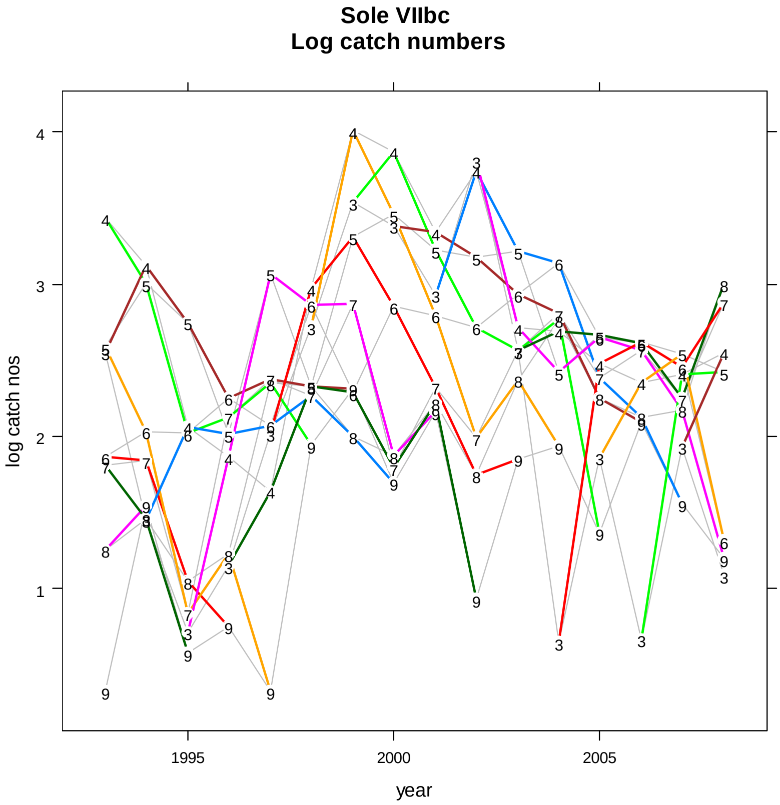


Figure 7.12.6. Log catch numbers-at-age (ages 4–8).

7.13 Sole in Divisions VIIfg, Celtic Seas Stock

Type of assessment in 2008: Update

ICES advice applicable to 2008

In the advice for 2008 ICES considered the stock as having full reproductive capacity and being harvested sustainably.

Single-stock exploitation boundaries

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

Target reference points have not been agreed for this stock. A candidate for a target reference point which is consistent with taking high long-term yields and achieving a low risk of depleting the productive potential of the stock may be identified in the range of $F_{0.1}$ (0.11) and F_{max} (0.23). There is no gain in yield having a target above this level. The risk to the stock at this level of fishing mortalities appears to be very low in the medium term.

Exploitation boundaries in relation to precautionary limits

F should be kept below F_{pa}, corresponding to landings of less than 1000 tonnes in 2008. This is expected to keep the stock above B_{pa}.

ICES advice applicable to 2009

In the advice for 2009 ICES considered the stock as having full reproductive capacity and being harvested sustainably.

Single-stock exploitation boundaries

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects.

The current fishing mortality (2007) is estimated to be 0.33, which is above the rate expected to lead to high long-term yields and low risk of stock depletion.

Exploitation boundaries in relation to precautionary limits

F should be kept below F_{pa}, corresponding to landings of less than 1090 tonnes in 2009. This is expected to keep the stock above B_{pa}.

Conclusion on exploitation boundaries

In the present situation with a stock that is above B_{pa} and a fishing mortality below F_{pa}, there is no long-term gain in yield to increase fishing mortality. ICES therefore recommends limiting landings in 2009 to no more than 940 t.

7.13.1 General

Stock description and management units

A TAC is in place for ICES Divisions VIIfg. These divisions do correspond to the stock area. The basis for the stock assessment area VIIfg is described in detail in the Stock Annex.

Management applicable to 2008 and 2009

Management of sole in VIIfg is by TAC and technical measures. The agreed TACs in 2008 and 2009 are presented in the text Tables below. Technical measures in force for this stock are minimum mesh sizes and minimum landing size (24 cm). National regulations also restricted areas for certain types of vessels.

Species: Common sole *Solea solea*		Zone: VIIf and VIIg SOL/7FG.
Belgium	603	
France	60	
Ireland	30	
United Kingdom	271	
EC	964	
TAC	964	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

Species: Common sole *Solea solea*		Zone: VIIf and VIIg (SOL/7FG.)
Belgium	621	
France	62	
Ireland	31	
United Kingdom	279	
EC	993	
TAC	993	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

Three rectangles in the Celtic Sea (30E4, 31E4 and 32E3) were closed during the first quarter of 2005, and in February-March 2006, 2007 and 2008. A derogation has permitted beam trawlers to fish in March 2005. The effects of this closure have been discussed in WGSSDS and ACFM 2007. No new information was available at the time of the update working group.

Fishery in 2008

The Working Group estimated the total international landings at 800 t in 2008 (Table 7.13.1), which is about 17% below the 2008 TAC (964 t) and also 17% below last year's forecast of 969 t.

Early in the time-series officially reported landings included Divisions VIIg–k for some countries and their total was higher than the WG estimate. Since 1999 official landings correspond to Divisions VIIfg, and the total is lower than the Working Group estimate. During the period 2002–2004 the difference between the two estimates was substantial. This was mainly as a consequence of area misreporting, which was taken into account in the Working Group estimates.

7.13.2 Data

Landings

French landings submitted to the Working Group for 2007 were revised upward by 7% to 87 t. The 2007 values for the numbers-at-age were therefore also updated. Total landings now amount to 945 t instead of 938 t (Table 7.13.1).

Annual length compositions for 2007 are given by fleet in Table 7.13.2. Length distributions of the total Belgian and UK (England and Wales) landings for the last ten years are plotted in Figure 7.13.1. Belgian lands a greater proportion of small fish compared with the UK (England and Wales).

Quarterly numbers and weight-at-age data are available for the Belgian and UK landings (approx. 90% of the total landings). Catch weights-at-age were calculated, weighted by national catch numbers-at-age, then quadratically smoothed in year (using age = 1.5, 2.5, etc.) and SOP-corrected. For 2007, the quadratic fit used for the 2007revised dataset was:

$W(t) = -0.0267 + (0.07*(AGE)) - (0.0015*(AGE)^2)$ $R2 = 0.88$

The quadratic fit used for 2008 was:

$W(t) = +0.0093 + (0.0612*(AGE)) - (0.0012*(AGE)^2)$ $R2 = 0.90$

Further details on raising procedures are given in the Stock Annex.

Stock weights-at-age were the first quarter catch weights of the Belgian and the UK beam trawl fleets and smoothed by fitting a quadratic fit:

$W(t) = +0.0112 + (0.0517*(AGE)) - (0.0002*(AGE)^2)$ $R2 = 0.98$

Catch numbers-at-age are given in Table 7.13.3, and weights-at-age in the catch and the stock are given in Tables 7.13.4-5. Age compositions over the last ten years are plotted in Figure 7.13.2. The standardized catch proportion-at-age is presented in Figure 7.13.3.

Sampling levels for those countries providing age compositions are given in Table 1.3.1.

Discards

The available discard data indicate that discarding of sole is usually minor. In 2007and 2008, discarding of sole in the UK fleet was estimated at about 3% and 1% respectively. Discard rates of sole in the Belgian beam trawl fleet were available to the Working Group in 2004–2005, and were about 5% of the total sole catches. Length distributions of retained and discarded catches of sole for 2007 and 2008 from samples taken on board UK vessels are given in Figure 7.13.4.

Biological

Natural mortality was assumed to be 0.1 for all ages and years. The maturity ogive is based on samples taken during the UK (E&W) beam trawl survey of March 1993 and 1994 and is applied to all years of the assessment (See also stock annex).

The proportion of M and F before spawning was set to zero.

Surveys

Standardised abundance indices for the UK beam trawl survey (UK-BCCSBTS-S) are displayed in Table 7.13.6 and Figure 7.13.5. Abundance-at-age 0 is highly variable and not used further on. The UK-survey appears to track the stronger year classes reasonably well from most of the ages. The internal consistency plot indicates also a reasonable fit for most of the age-range (Figure 7.13.6).

Commercial lpue

Available estimates of effort and lpue are presented in Tables 7.13.7–8 and Figure 7.13.7.

Belgian beam trawl (BEL-BEAM) effort was at highest levels in 2004–2005. During these years effort shifted from the Eastern English Channel (VIId) to the Celtic Sea because of days at sea limitations in the former area. In 2006, these restrictions had been lifted and effort decreased back to similar levels compared with the early 2000s. The sharp effort reduction in 2008 may be a combined result of the unrestricted effort regime in VIId and the high fuel prices. Lpue peaked in 2002. After a sharp decline to its record low in 2004, lpue has been increasing gradually to its second highest value in the time-series.

The effort from the UK (E&W) beam trawl fleet (UK-CSBT) has declined sharply since the early 2000s to a record low in 2008. Lpue in the 1990s and 2000s was stable, but at lower levels compared with the period before. In 2007, lpue increased considerably and gave a similar value for 2008.

Irish effort and lpue data are also presented. The main target species in the Irish fisheries are megrim, anglerfish, etc. The vessels usually operate on fishing grounds in the Western Celtic Sea with lower sole densities.

The internal consistency plots for the 2 commercial lpue series, used in the assessment (UKCSBT and BELBEAM), demonstrate high consistencies for the entire age-range (Figure 7.13.8–9).

Other relevant data

Reports from UK industry suggest that the main issues affecting the fishery in VIIfg were displacement of effort as a consequence of the rectangle closures and the restrictions on the use of 80 mm mesh west of 7°W (Trebilcock and Rozarieux, 2009).

No additional information was received from the Belgian, French and Irish industries.

7.13.3 Stock assessment

The method used to assess Celtic Sea sole is XSA, using one survey and two commercial tuning-series (Table 7.13.9). It should be noted that the year range of the Belgian commercial beam trawl tuning fleet only covers 1971 up to 2003 (see also Section 7.13.9. recommendation for next Benchmark).

Data screening

Adding the 2008 data to the different time-series, together with the French landings revisions for 2007 did not cause any additional anomalies compared with previous years. The “single fleet runs”, “separable VPA”, etc. that are usually used to screen the data of this stock are therefore not presented in this Report, but are available in the ’Exploratory runs folder’. This folder also contains a comparison plot of SSB, R and F of last year’s final assessment and of the same assessment but with the French landings revisions and small revised tuning dataseries of the UK beam trawl survey (UK-BCCSBTS-S) for 2007. The output was very similar for both assessments.

The catchability residuals for the final XSA are shown in Figure 7.13.10 and the XSA tuning diagnostics are given in Table 7.13.10. There is a year effect in 2007 and 2008 for the UK beam trawl fleet (UK-CSBT, positive residuals) and for the UK beam trawl survey (UK-BCCSBTS-S, negative residuals), indicating a conflicting signal between these two fleets.

In this year's assessment the estimates for the recruiting year class 2007 were estimated solely by the UK beam trawl survey UKBCCSBTSS (Figure 7.13.11). The survivor estimates of the two prominent fleets (the UK-BCCSBTSS survey and the UK-CSBT commercial fleet) which have at least 90% of the weighting for all the ages differ somewhat from each other for ages 2, 3 and 4. The Working Group was not able to clarify that particular issue. The different estimates from the 2 fleets do not generate a retrospective bias and therefore probably balance off each other in the assessment. The Working Group also assumed that the Trevose closure, a change in special distribution of the UK beam trawl fleet and the ending of the Belgian tuning series in 2003, may have an influence on the divergence in survivor estimates from both dominant tuning-series.

F shrinkage gets low weights for all ages (<4%). The weighting of the survey decreases for the older ages as the commercial UK-CSBT fleet is given more weight (Figure 7.13.11).

Final update assessment

The final settings used in this year's assessment (and since 2006) are as detailed below:

	2009 ASSESSMENT		
Fleets	Years	Ages	α-β
BEL-BEAM commercial	71-03	2-9	0-1
UK-CSBT commercial	91-08	2-9	0-1
UK-BCCSBTS-S survey	88-08	1-9	0.75-0.85
-First data year	1971		
-Last data year	2008		
-First age	1		
-Last age	10+		
Time series weights	None		
-Model	Mean q model all ages		
-Q plateau set at-age	7		
-Survivors estimates shrunk towards mean F	5 years / 5 ages		
-s.e. of the means	1.5		
-Min s.e. for pop. Estimates	0.3		
-Prior weighting	None		

Retrospective patterns for the final run are shown in Figure 7.13.12. SSB is generally underestimated and fishing mortality overestimated.

The final XSA output is given in Table 7.13.11 (fishing mortalities) and Table 7.13.12 (stock numbers). A summary of the XSA results is given in Table 7.13.13 and trends in yield, fishing mortality, recruitment and spawning-stock biomass are shown in Figure 7.13.13.

Comparison with previous assessment

Figure 7.13.14 gives the historical performance of this stock. The trends in SSB, F and R are rather consistent from year to year. However, some major revisions in the estimates were made in the period just after 1998. The underlying cause was the occurrence of the exceptional strong year class of 1998. In addition, a power model was used in the assessment at that time, which revised that year class substantially.

With the addition of the 2008 data, estimates of fishing mortality and SSB for the most recent years were revised slightly. For example, last year fishing mortality and SSB in 2007 were estimated to be 0.33 and 3176 t. In this year's assessment, the 2007 estimates have been revised downwards by 7% (fishing mortality) and upwards by 5% (SSB). Recruitment in 2007 was revised downward by 40%.

State of the stock

Trends in landings, SSB, F(4–8) and recruitment are presented Table 7.13.13 and Figure 7.13.13.

During the eighties fishing mortality increased for this stock. In the following decades fishing mortality fluctuated around this higher level. However fishing mortality has decreased since the late 1990s and was estimated to be 0.27 in 2008.

Recruitment has fluctuated around 5 million recruits with occasional strong year classes. The 1998 year class is estimated to be the strongest in the time-series. Although the assessment estimates the 2007 year class at-age one of the same magnitude, the Working Group decided to wait for confirmation in next year's assessment given the successive revision of the 1998 year-class size. Therefore it was decided to adjust this estimate for use in the prediction (see Section 7.13.4).

SSB is estimated to have declined continuously from the highest value of 8000 t in 1971 to the lowest observed in the time-series in 1998. The exceptional year class of 1998 has increased SSB to above the long-term average. However, as the influence of this year class on SSB wanes, SSB declines again to below average, but still above B_{pa}.

7.13.4 Short-term projections

The 2006 year class was estimated to be around 3.0 million fish at-age 1, which is below average and is about 40% lower than estimated last year. The XSA survivor estimate for this year class was used for further prediction.

The 2007 year class was estimated by the XSA to be 14.7 million one year olds, which is close to the strongest observed. The retrospective analysis demonstrates that strong year classes have been revised downward, especially in the second year of estimation. Therefore, the Working Group decided that an adjustment should be made to the estimate for that year class. The second estimate of the year class for all available year classes has been plotted against the initial estimate. A linear fit indicates that the value of the 2007 year class (14.7 million fish), as estimated by the XSA is likely to be revised downward to 7.7 million by next year's assessment. Therefore the Working Group decided to use that estimate in the prediction. As the 2007 year class is used as 2-year-old fish in the prediction, natural mortality (0.1) has been deducted, resulting in a value of 6967 for 2-year-old fish at the start of 2009 (Regression and calculations in ICES files 'Exploratory runs folder').

The long-term GM_{71-06} recruitment (5.0 million) was assumed for the 2008 and subsequent year classes.

The Working Group estimates of year-class strength used for prediction can be summarized as follows:

Year class	At age in 2009	XSA		Source
2006	3	2276		XSA
2007	2	6967*		Bias correction regression
2008	1	-	4970	GM 1971–2006
2009 & 2010	recruits	-	4970	GM 1971–2006

*** adjusted XSA value**

Population numbers at the start of 2009, estimated for ages 3 and older, were taken from the XSA output.

Fishing mortality was set as the mean over the last three years. Weights-at-age in the catch and in the stock are averages for the years 2006–2008. Input data are displayed in Table 7.13.14. Results are presented in Table 7.13.15 (management options) and Table 7.13.16 (detailed output).

Assuming *status quo* F, implies a catch in 2009 of around 870 t (the agreed TAC is 993 t) and a catch of 916 t in 2010. Assuming *status quo* F will result in a SSB of 3090 t in 2010 and 3250 t in 2011.

Assuming *status quo* F, the proportional contributions of recent year classes to the predicted landings and SSB are given in Table 7.13.17. The assumed GM recruitment accounts for about 7% of the landings in 2010 and about 12% of the 2011 SSB. The corrected XSA estimate for year class 2007 accounts for 27% of the landings in 2010 and 26% of SSB in 2011.

There are no known specific environmental drivers known for this stock.

7.13.5 Medium-term projection

No medium-term forecasts were carried out for this stock.

7.13.6 Biological reference points

The Working Group's current approach to reference points is outlined in Section 1.4.4. Current biological reference points are given in the text Table below:

Reference points	ACFM 98 onwards
F_{lim}	0.52 (based on F_{loss}, WG98)
F_{pa}	0.37 (F_{lim} x 0.72)
B_{lim}	Not defined
B_{pa}	2200 t (based on B_{loss} (1991), WG98)

The WG has on several occasions repeated that the basis for setting the reference points is not valid anymore (see also previous Working Group reports), but the proposed revisions have never been approved by ACFM/ACOM.

Yield-per-recruit results, long-term yield and SSB, conditional on the present exploitation pattern and assuming *status quo* F in 2008, are given in Table 7.13.18 and Figure 7.13.15. F_{max} is estimated to be 0.25. Long-term yield and SSB (using GM recruitment and F_{sq}) are estimated to be 885 t and 3120 t respectively.

7.13.7 Management plans

There are no explicit management plans for Celtic Sea sole.

In 2006, the Working Group presented results from a series of medium-term scenarios, carried out in conjunction with VIIfg plaice, to simulate some possible management plans for the two stocks Results indicated that an F in the range 0.27 to 0.49 in the long term would maintain yield at or above 95% of that given by F_{max}, while posing a low probability (<5%) of SSB falling below B_{lim}. The RG in 2007 noted however that F_{max} as estimated by the WG in 2006 and 2007 changed by 15%, indicating a possible change in the exploitation pattern. Three year average exploitation patterns were calculated and are given in Figure 7.13.16. The results suggest that the results of the analysis carried out in 2006 can still be used.

7.13.8 Uncertainties and bias in assessment and forecast

Sampling

The major fleets fishing for VIIfg sole are sampled. Sampling is considered to be at a reasonable level (Table 1.3.1).

Discards

Discard estimates, which are low (Figure 7.13.4) are not included in the assessment.

Surveys

The key uncertainty of the forecast is the size of the incoming recruitment (year class 2007) which is estimated to account for 27% of the landings in 2010 and 26% of the SSB in 2011. The UK-BCCSBTS-S survey, which is solely responsible for the recruiting estimates, has been able to track year-class strength rather well in the past. However, the strong year classes have been revised downward in previous assessments and therefore the estimated of the very strong 2007 year class has been corrected for possible bias (see 'Exploratory runs folder').

Consistency

Figure 7.13.14 gives the historical performance of this stock. The trends in SSB, F and R are rather consistent from year to year. However, some major revisions in the estimates were made in the period just after 1998. The underlying cause was the occurrence of the exceptional strong year class of 1998. In addition, a power model was used in the assessment at that time, which revised that year class substantially.

With the addition of the 2008 data, estimates of fishing mortality and SSB for the most recent years were revised slightly. For example, last year fishing mortality and SSB in 2007 were estimated to be 0.33 and 3176 t. In this year's assessment, the 2007 estimates have been revised downwards by 7% (fishing mortality) and upwards by 5% (SSB). Recruitment in 2007 was revised downward by 40%.

Misreporting

Area misreporting is known to have been considerable over the period 2002–2004. This was as a result of a combination of the good 1998 year class still being an important part of the catch composition and more restrictive TACs. The area misreporting has been corrected for the years 2002–2006 (method explained in the report of WGSSDS 2007). Since 2007 the area misreporting that could be estimated was negligible (see stock annex).

7.13.9 Recommendation for next Benchmark

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting
2009	VIIf,g sole	A need to update the Belgian commercial tuning series. The Belgian beam trawl tuning series is only used up to 2003, mainly because the estimation of the corresponding lpue series could not be calculated correctly. At the 2009 WKFLAT a possible way of calculating Belgian beam trawl lpue for Division VIId was proposed, using a more realistic horsepower correction method. The proposed method should be investigated, not only for the Belgian beam trawl lpue but also for the UK beam trawl lpue in Division VIIfg, which are the two commercial fleets used in this assessment. A need to investigate the spatial distribution of the major Celtic sea fleets and possible impacts of the Trevose closure.	2012	Expert group members

7.13.10 Management considerations

There is no apparent stock/recruitment relationship for this stock (see Figure in 'Exploratory runs folder') and no evidence of reduced recruitment at low levels of SSB.

SSB has declined almost continuously from 1991 to 2000, increased subsequently as a consequence of the strong 1998 year class, and has slowly declined since.

The Celtic Sea is an area without days-at-sea limitations for demersal fisheries. In this context and given that many demersal vessels are very mobile, changes in effort measures in areas other than the Celtic Sea, can influence the effort regime in the Celtic Sea (cfr. increased effort in Celtic Sea for Belgian beamers during 2004–2005 when days at sea limitations were in place for the Eastern English Channel).

7.13.11 References

Trebilcock P. and N. de Rozarieux. 2009. National Federation Fishermen's Organisation Annual Fisheries Reports. Cornish Fish Producers Organisation/Seafood Cornwall Training Ltd, March 2009.

ICES. 2009. Report of the Benchmark and Data Compilation Workshop for Flatfish (WKFLAT 2009), 6–13 February 2009, Copenhagen, Denmark. ICES CM 2009/ACOM:31. 192 pp.

Table 7.13.1 - Celtic Sea Sole (ICES Divisions VIIfg). Official Nominal landings and data used by the Working Group (t)

Year	Belgium	Denmark	France	Ireland	UK(E.&W,NI.)	UK(Scotland)	Netherlands	Total-Official	Unallocated	Used by WG
1986	1039 *	2	146	188	611	-	3	1989	-389	1600
1987	701 *	-	117	9	437	-	-	1264	-42	1222
1988	705 *	-	110	72	317	-	-	1204	-58	1146
1989	684 *	-	87	18	203	-	-	992	0	992
1990	716 *	-	130	40	353	0	-	1239	-50	1189
1991	982 *	-	80	32	402	0	-	1496	-389	1107
1992	543 *	-	141	45	325	6	-	1060	-79	981
1993	575 *	-	108	51	285	11	-	1030	-102	928
1994	619 *	-	90	37	264	8	-	1018	-9	1009
1995	763 *	-	88	20	294	-	-	1165	-8	1157
1996	695 *	-	102	19	265	0	-	1081	-86	995
1997	660 *	-	99	28	251	0	-	1038	-111	927
1998	675 *	-	98	42	198	-	-	1013	-138	875
1999	604	-	61	51	231	0	-	947	65	1012
2000	694	-	74	29	243	-	-	1040	51	1091
2001	720	-	77	35	288	-	-	1120	48	1168
2002	703	-	65	32	318	+	-	1118	227	1345
2003	715	-	124	26	342	+	-	1207	185	1392
2004	735	-	79	33	283	-	-	1130	119	1249
2005	648	-	104	34	217	-	-	1003	41	1044
2006	578	-	48	36	232	-	-	894	52	946
2007	581.8	-	85	31.9	244.3	-	-	943	2	945
2008 [1]	462	-	39.08	27.82	218.9	-	-	748	52	800

1 Preliminar

* including VIIg-k

Table 7.13.2 - Sole in VIIfg. Annual length distributions by fleet

	UK (England & Wales)		Belgium	Ireland*
Length (cm)	Beam trawl	All but beam	All gears	All gears
17				2
18				2
19				1
20				1
21				12
22	41		6869	32
23	1914		32666	64
24	11133	1458	85219	98
25	22244	787	163591	199
26	32618	3753	189743	354
27	43102	7575	161800	446
28	49460	7977	171468	513
29	47394	10275	130879	518
30	45965	6563	132413	442
31	35672	5186	83765	376
32	36730	6824	78464	363
33	32414	5627	73528	374
34	31411	5412	62423	351
35	23692	2960	61890	317
36	24615	3151	39480	274
37	21853	2239	44114	201
38	19381	2715	33550	209
39	14563	1402	19977	147
40	12624	1469	26538	98
41	11903	1333	10100	86
42	7932	760	12153	68
43	6933	542	7025	43
44	4547	218	4089	46
45	2530	750	1875	26
46	2340	0	2224	15
47	1305	218	1541	
48	1033	396	93	
49	329		71	
50	133		85	
51	423		28	
52	46			
53				
54				
55				
56				
57				
58				
59				
60				
Total	546279	79591	1637661	5678

* Distributions from sample only

Table 7.13.3 - Sole in VIIfg. Catch numbers at age (in thousands)

Run title : CELTIC SEA SOLE,2009 WG,COMBSEX,PLUSGROUP
At 13/05/2009 15:10

AGE	1971	1972	1973	1974	1975	1976	1977	1978		
1	0	0	0	0	0	0	0	0		
2	386	541	364	155	119	312	314	318		
3	270	902	1882	438	287	834	438	741		
4	1341	314	748	863	336	560	349	339		
5	625	670	305	411	638	611	271	154		
6	433	329	352	209	304	559	244	159		
7	537	213	119	239	110	261	404	99		
8	763	232	110	97	102	131	120	198		
9	376	314	116	109	67	197	28	71		
+gp	1220	730	644	541	372	463	365	174		
TOTALNUM	5951	4245	4640	3062	2335	3928	2533	2253		
TONSLAND	1861	1278	1391	1105	919	1350	961	780		
SOPCOF %	100	100	100	100	100	100	100	100		
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0	0	0	0	0	0	0	0	0	0
2	328	657	602	342	647	672	196	494	318	526
3	560	972	675	831	1078	846	1473	1296	957	464
4	747	876	792	309	729	606	766	1173	797	879
5	208	584	399	467	284	542	565	526	577	441
6	154	180	377	280	349	184	296	358	273	387
7	197	62	150	207	225	277	100	193	205	127
8	124	96	120	92	192	106	140	87	100	78
9	153	100	94	111	52	47	73	103	61	67
+gp	169	352	380	326	320	274	240	328	179	268
TOTALNUM	2640	3879	3589	2965	3876	3554	3849	4558	3467	3237
TONSLAND	954	1314	1212	1128	1373	1266	1328	1600	1222	1146
SOPCOF %	100	100	100	100	100	100	100	100	100	100
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0	0	0	0	0	0	0	0	0	0
2	479	277	1458	433	354	295	129	177	245	197
3	1164	994	690	1700	863	790	1156	1035	890	932
4	601	1176	658	644	1104	739	1098	904	599	724
5	621	399	496	409	332	864	420	424	400	297
6	237	452	151	253	186	283	483	229	252	171
7	188	138	156	61	161	149	133	192	127	108
8	82	115	55	59	63	65	112	57	126	51
9	24	50	46	28	83	42	65	43	45	52
+gp	102	129	162	89	99	146	109	106	106	87
TOTALNUM	3498	3730	3872	3676	3245	3373	3705	3167	2790	2619
TONSLAND	992	1189	1107	981	928	1009	1157	995	927	875
SOPCOF %	100	100	100	100	100	100	100	100	100	100
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0	0	0	0	0	0	0	0	0	0
2	608	1721	704	29	119	425	271	685	335	211
3	1718	1480	1918	1465	697	1721	855	1330	865	447
4	834	683	860	2202	1134	792	837	715	743	552
5	282	241	436	660	1860	794	473	576	474	558
6	143	60	242	249	402	721	398	163	325	274
7	80	56	65	95	223	114	348	148	157	196
8	31	43	39	54	80	60	48	178	145	75
9	23	19	26	36	26	34	41	44	184	108
+gp	44	51	81	51	75	49	43	51	70	171
TOTALNUM	3763	4354	4371	4841	4616	4710	3314	3890	3298	2592
TONSLAND	1012	1091	1168	1345	1392	1249	1044	946	945	800
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 7.13.4 - Sole in VIIfg. Catch weights at age (kg)

Run title : CELTIC SEA SOLE,2009 WG,COMBSEX,PLUSGROUP
At 13/05/2009 15:10

	1971	1972	1973	1974	1975	1976	1977	1978		
1	0.039	0.106	0.081	0.063	0.046	0.114	0.098	0.068		
2	0.106	0.147	0.143	0.137	0.132	0.167	0.169	0.154		
3	0.167	0.186	0.202	0.205	0.212	0.218	0.235	0.234		
4	0.222	0.226	0.258	0.270	0.286	0.268	0.297	0.309		
5	0.272	0.264	0.311	0.329	0.355	0.316	0.355	0.378		
6	0.315	0.302	0.361	0.385	0.417	0.363	0.409	0.441		
7	0.352	0.340	0.408	0.436	0.473	0.409	0.460	0.499		
8	0.383	0.376	0.452	0.483	0.523	0.453	0.506	0.551		
9	0.408	0.413	0.493	0.525	0.567	0.496	0.548	0.598		
+gp	0.440	0.538	0.602	0.624	0.672	0.665	0.668	0.720		
SOPCOFAC	1.000	1.001	1.001	1.000	1.000	0.999	1.000	0.998		
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0.023	0.048	0.078	0.061	0.085	0.019	0.089	0.046	0.048	0.074
2	0.132	0.144	0.154	0.156	0.173	0.131	0.170	0.144	0.146	0.157
3	0.232	0.234	0.225	0.243	0.255	0.235	0.246	0.236	0.236	0.235
4	0.321	0.316	0.292	0.324	0.330	0.330	0.317	0.321	0.320	0.309
5	0.401	0.392	0.355	0.397	0.398	0.416	0.383	0.400	0.396	0.378
6	0.471	0.461	0.414	0.462	0.459	0.494	0.444	0.471	0.466	0.442
7	0.531	0.523	0.469	0.521	0.514	0.562	0.500	0.536	0.528	0.502
8	0.581	0.579	0.519	0.572	0.561	0.622	0.552	0.594	0.584	0.557
9	0.622	0.627	0.565	0.617	0.602	0.673	0.598	0.645	0.632	0.608
+gp	0.664	0.720	0.665	0.704	0.679	0.772	0.703	0.748	0.740	0.739
SOPCOFAC	1.001	0.999	1.000	0.999	1.000	0.999	1.002	1.000	1.001	0.999
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.013	0.049	0.054	0.073	0.057	0.081	0.068	0.027	0.074	0.079
2	0.109	0.134	0.150	0.147	0.134	0.151	0.147	0.124	0.156	0.163
3	0.198	0.214	0.239	0.216	0.207	0.216	0.220	0.214	0.234	0.244
4	0.280	0.291	0.320	0.281	0.275	0.276	0.288	0.296	0.307	0.320
5	0.355	0.363	0.393	0.342	0.338	0.331	0.351	0.372	0.376	0.393
6	0.424	0.430	0.459	0.398	0.396	0.380	0.409	0.439	0.440	0.462
7	0.487	0.494	0.516	0.451	0.450	0.425	0.462	0.500	0.500	0.528
8	0.543	0.553	0.566	0.499	0.500	0.465	0.510	0.552	0.555	0.589
9	0.592	0.609	0.608	0.543	0.545	0.500	0.553	0.598	0.605	0.647
+gp	0.691	0.747	0.674	0.640	0.645	0.563	0.643	0.677	0.707	0.781
SOPCOFAC	0.999	0.999	1.000	1.000	0.999	1.000	0.998	1.001	1.000	0.999
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0.015	0.078	0.066	0.054	0.123	0.066	0.068	0.085	0.075	0.098
2	0.122	0.166	0.148	0.130	0.171	0.130	0.145	0.139	0.139	0.155
3	0.222	0.248	0.225	0.202	0.218	0.194	0.219	0.192	0.200	0.209
4	0.315	0.322	0.296	0.271	0.266	0.256	0.288	0.245	0.258	0.260
5	0.400	0.390	0.363	0.336	0.313	0.317	0.354	0.297	0.313	0.310
6	0.478	0.451	0.425	0.399	0.361	0.377	0.415	0.349	0.365	0.356
7	0.549	0.506	0.482	0.457	0.408	0.435	0.473	0.400	0.414	0.401
8	0.613	0.553	0.533	0.513	0.454	0.493	0.528	0.451	0.460	0.443
9	0.670	0.594	0.579	0.564	0.501	0.549	0.578	0.501	0.503	0.482
+gp	0.766	0.665	0.677	0.705	0.638	0.722	0.692	0.618	0.609	0.545
SOPCOFAC	1.001	1.000	0.995	1.000	1.002	1.000	1.000	0.999	1.000	1.004

Table 7.13.5 - Sole in VIIfg. Stock weights at age (kg)

Run title : CELTIC SEA SOLE,2009 WG,COMBSEX,PLUSGROUP
At 13/05/2009 15:10

	1971	1972	1973	1974	1975	1976	1977	1978
1	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.09
2	0.076	0.113	0.113	0.113	0.113	0.113	0.145	0.113
3	0.136	0.157	0.142	0.159	0.141	0.160	0.174	0.167
4	0.190	0.222	0.203	0.221	0.215	0.210	0.236	0.257
5	0.239	0.298	0.263	0.305	0.295	0.269	0.366	0.36
6	0.406	0.351	0.334	0.450	0.353	0.354	0.392	0.413
7	0.472	0.352	0.322	0.448	0.593	0.432	0.454	0.521
8	0.389	0.593	0.400	0.464	0.423	0.462	0.505	0.508
9	0.346	0.417	0.539	0.624	0.465	0.425	0.907	0.56
+gp	0.583	0.601	0.582	0.671	0.711	0.728	0.701	0.7826

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
2	0.113	0.113	0.113	0.113	0.113	0.118	0.113	0.113	0.113	0.113
3	0.163	0.157	0.159	0.164	0.175	0.173	0.175	0.180	0.153	0.158
4	0.255	0.238	0.232	0.255	0.262	0.274	0.268	0.273	0.242	0.233
5	0.392	0.354	0.306	0.356	0.370	0.429	0.472	0.398	0.361	0.363
6	0.437	0.394	0.385	0.487	0.488	0.517	0.433	0.462	0.473	0.466
7	0.485	0.622	0.462	0.543	0.633	0.641	0.462	0.546	0.468	0.687
8	0.595	0.556	0.551	0.610	0.606	0.613	0.480	0.636	0.587	0.687
9	0.657	0.704	0.737	0.766	0.464	0.836	0.944	0.890	0.820	0.676
+gp	0.696	0.771	0.663	0.856	0.823	0.978	0.798	0.844	0.838	0.818

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
2	0.113	0.113	0.113	0.113	0.148	0.113	0.113	0.104	0.113	0.113
3	0.152	0.164	0.179	0.184	0.196	0.135	0.143	0.186	0.178	0.195
4	0.227	0.247	0.230	0.265	0.267	0.227	0.233	0.284	0.276	0.282
5	0.308	0.369	0.356	0.388	0.392	0.329	0.335	0.387	0.386	0.371
6	0.465	0.476	0.536	0.498	0.470	0.430	0.441	0.486	0.495	0.454
7	0.546	0.523	0.376	0.751	0.492	0.521	0.540	0.573	0.598	0.529
8	0.526	0.753	0.859	0.754	0.576	0.599	0.629	0.647	0.689	0.593
9	0.542	0.847	0.735	0.475	0.636	0.661	0.705	0.708	0.766	0.644
+gp	0.752	0.973	0.679	0.896	0.727	0.757	0.845	0.808	0.892	0.732

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
2	0.110	0.062	0.113	0.113	0.158	0.116	0.149	0.143	0.117	0.151
3	0.204	0.169	0.187	0.189	0.205	0.176	0.213	0.188	0.177	0.200
4	0.317	0.306	0.312	0.289	0.258	0.248	0.275	0.235	0.236	0.249
5	0.433	0.434	0.434	0.403	0.317	0.329	0.337	0.284	0.294	0.298
6	0.541	0.534	0.538	0.512	0.381	0.415	0.399	0.334	0.350	0.349
7	0.635	0.603	0.619	0.609	0.449	0.502	0.459	0.386	0.406	0.400
8	0.712	0.648	0.680	0.691	0.521	0.587	0.520	0.441	0.460	0.453
9	0.772	0.677	0.725	0.757	0.594	0.667	0.579	0.496	0.513	0.506
+gp	0.853	0.707	0.784	0.873	0.811	0.869	0.740	0.641	0.662	0.603

Table 7.13.6 - Sole in VIIfg. Indices of abundance (No/100km) for UK-BCCSBTS-S survey

	0	1	2	3	4	5	6	7	8	9
1988	30	81	326	49	19	5	**0**	0	0	0
1989	144	222	331	176	20	15	7	4	2	2
1990	30	385	313	50	16	4	7	3	0	0
1991	32	241	517	67	17	15	4	0	2	2
1992	4	394	260	139	30	18	10	1	2	1
1993	3	169	320	43	19	1	2	2	1	1
1994	1	333	387	99	14	7	7	0	0	2
1995	27	124	222	52	11	6	12	1	1	1
1996	3	150	211	54	23	6	2	3	1	2
1997	32	433	180	18	11	12	4	3	5	0
1998	90	770	411	50	9	7	4	2	1	5
1999	24	2464	250	32	14	5	4	4	1	0
2000	13	916	1356	31	22	5	**0**	2	1	1
2001	22	379	599	259	20	7	5	2	0	2
2002	8	663	238	127	102	12	6	2	3	0
2003	12	392	530	47	26	47	8	3	3	0
2004	55	750	377	87	13	19	37	4	2	0
2005	37	343	225	32	14	6	4	14	1	2
2006	11	273	201	39	13	7	**0**	2	10	0
2007	88	357	108	43	14	11	6	3	3	12
2008	5	1039	104	13	15	6	8	3	3	4
Geomean	17	378	299	55	18	8	2	2	2	2
Mean	32	518	356	72	21	11	6	3	2	2

Table 7.13.7 - Sole in VIIfg. Indices of effort.

	England & Wales		Belgium		Ireland		
Year	Otter trawl	Beam trawl[1]	Beam trawl[2]	Beam trawl[4]	Otter trawl[3]	Scottish seine[4]	Beam trawl[4]
1971			11.06				
1972	45.72		8.44				
1973	45.28		17.39				
1974	38.94		18.83				
1975	33.53		16.38				
1976	25.61		28.07				
1977	27.16		24.11				
1978	27.08		18.09				
1979	23.84		18.90				
1980	26.43		29.02				
1981	24.10		35.39				
1982	19.20		28.77				
1983	17.61		34.95				
1984	23.16		33.48				
1985	25.24	18.70	40.49				
1986	21.18	20.72	52.46				
1987	24.43	38.76	37.26				
1988	20.09	25.62	42.92				
1989	17.61	20.26	53.58				
1990	22.56	30.77	40.27				
1991	18.57	40.81	18.05				
1992	16.00	35.78	25.47				
1993	13.79	39.64	31.27				
1994	9.48	37.03	38.35				
1995	8.46	37.59	47.81		63.56	6.43	20.78
1996	8.67	39.78	47.63	53.27	60.04	9.73	26.76
1997	8.14	43.00	51.98	57.36	65.10	16.13	28.25
1998	7.13	47.84	52.11	57.79	72.30	14.94	35.25
1999	5.69	50.87	55.03	55.11	51.66	8.01	40.87
2000	4.05	51.19	56.05	51.34	60.60	9.90	37.03
2001	4.42	49.32	52.06	54.90	69.43	16.33	39.71
2002	6.10	37.53	43.24	49.60	77.69	20.86	31.62
2003	9.94	40.71	42.81	62.73	86.79	20.91	49.26
2004	9.42	32.37		78.73	96.99	19.38	54.86
2005	12.09	27.73		64.50	124.40	14.81	49.65
2006	12.97	18.57		50.28	119.23	14.79	60.48
2007	10.66	15.37		45.72	136.53	15.82	55.86
2008	10.13	13.83		28.71	125.61	11.65	36.73

[1]Division VIIf only - Fishing hours (x10^3) corrected for fishing power
[2]Fishing hours (x 10^3) corrected for fishing power using P = 0.000204 BHP^1.23
[3]Division VIIg only - Fishing hours (x10^3)
[4]Fishing hours (x10^3)

Table 7.13.8 - Sole in VIIfg. LPUE

	UK	England & Wales			Belgium		Ireland		
	BT Survey[4]	Otter trawl[1]	Otter trawl[1]	Beam trawl[1]	Beam trawl[2]	Beam trawl[5]	Otter trawl[5]	Scottish sein[5]	Beam trawl[5]
Year	Division VIIfg	Division VIIf	Division VIIg[3]	Division VIIf	Division VIIfg	Division VIIfg	Division VIIg	Division VIIg	Division VIIg
1971	-			-	47.92				
1972	-	2.42	2.11	-	37.06				
1973	-	2.45	0.98	-	39.47				
1974	-	2.10	1.83	-	37.81				
1975	-	1.82	1.79	-	31.41				
1976	-	2.02	1.30	-	30.50				
1977	-	1.84	1.21	-	27.90				
1978	-	1.82	1.17	13.99	23.35				
1979	-	1.80	1.15	14.83	33.19				
1980	-	1.86	1.55	18.99	29.73				
1981	-	1.45	0.60	13.58	24.03				
1982	-	1.73	0.56	11.79	25.93				
1983	-	2.22	1.14	13.50	22.18				
1984	-	1.53	1.70	13.59	20.78				
1985	-	1.55	1.55	12.52	17.94				
1986	-	1.38	0.99	10.94	17.83				
1987	-	0.94	1.15	7.31	17.32				
1988	71.14	0.62	0.27	4.39	15.29				
1989	135.18	0.99	0.87	5.38	11.33				
1990	90.67	0.76	0.67	5.98	15.64				
1991	122.88	0.69	0.85	4.80	24.24				
1992	115.79	1.00	1.25	4.14	18.57				
1993	75.42	0.55	0.25	4.80	15.21				
1994	107.77	0.90	0.27	4.26	13.94				
1995	72.50	0.96	0.87	4.52	13.62		0.40	0.62	0.81
1996	70.15	0.66	0.52	3.94	11.27	11.45	0.73	0.05	0.88
1997	81.66	0.86	0.52	3.28	9.96	9.68	0.42	0.23	1.16
1998	135.41	0.60	0.40	2.67	10.12	9.64	0.48	0.11	1.11
1999	168.46	0.91	0.74	3.21	11.26	12.14	0.17	0.09	0.50
2000	236.43	0.49	1.85	3.36	11.90	13.77	0.19	0.05	0.26
2001	154.79	1.14	2.13	4.02	13.25	13.60	0.27	0.55	0.15
2002	118.11	0.78	3.60	5.64	18.71	17.80	0.43	0.29	0.14
2003	123.93	0.57	0.00	5.23	19.48	11.40	0.12	0.03	0.20
2004	149.65	0.60	0.19	5.75		9.17	0.18	0.02	0.20
2005	76.26	0.76	0.26	4.94		9.78	0.14		0.28
2006	68.96	1.16	0.60	5.97		10.70	0.11	0.05	0.26
2007	80.95	0.78	1.00	9.87		11.74	0.13	0.02	0.20
2008	115.96	0.82	0.86	9.46		14.51	0.12	0.02	0.29

[1]Kg/hr corrected for GRT.
[2]Kg/hr corrected for fishing power using P = 0.000204 BHP^1.23
[3]Division VIIg (East).
[4]Kg/100km
[5]Kg/hour

Table 7.13.9 - Sole in VIIfg. Tuning series

All the indices presented are used in the assessment

BEL-BEAM		Belgium Beam trawl (Effort = Corrected formula)												
	1971	2003												
	1	1	0	1										
	2	14												
11.06		111	77	384	179	124	154	218	108	32	107	76	21	40
8.44		132	220	76	163	80	52	57	76	39	23	14	38	14
17.39		179	926	368	150	173	58	54	57	108	32	23	21	45
18.83		102	287	565	270	136	156	64	79	90	75	38	39	37
16.38		69	167	195	370	176	64	59	39	33	29	37	18	23
28.07		199	533	357	391	357	167	84	125	40	17	21	51	35
24.11		220	307	244	190	170	283	84	20	35	39	36	18	52
18.09		173	403	185	84	86	54	108	38	11	21	61	8	9
18.9		222	379	506	141	104	133	84	103	35	12	16	4	6
29.02		438	647	583	389	119	45	63	66	92	22	25	16	10
35.39		429	481	565	286	268	107	86	67	86	74	33	13	13
28.77		245	594	221	334	200	148	66	80	54	19	41	16	25
34.95		363	605	409	159	196	127	108	29	44	32	15	12	12
33.48		372	467	334	300	102	153	59	26	26	16	24	19	18
40.49		52	909	471	372	208	75	104	46	68	15	29	16	10
52.46		377	900	823	359	230	140	49	58	65	29	50	6	9
37.23		247	664	438	344	191	119	47	29	20	4	14	2	16
42.92		362	293	603	250	197	77	51	36	26	19	19	13	16
53.58		244	680	428	471	179	145	62	13	24	10	19	3	17
40.27		231	742	663	181	240	70	59	17	26	12	2	4	12
18.05		1028	380	225	131	29	26	9	7	13	8	4	1	2
25.47		327	1062	376	210	98	14	14	7	9	5	0	0.3	2
31.27		296	615	629	161	81	75	38	36	19	4	2	1	1
38.35		205	524	523	530	176	71	20	15	16	11	6	5	7
47.81		77	827	838	277	250	78	48	21	17	8	1	5	2
47.63		104	737	579	258	130	88	29	17	9	12	3	3	0
51.98		193	661	377	241	143	74	55	23	16	18	7	3	2
52.11		166	771	608	188	100	84	33	25	21	8	6	10	7
55.03		493	1286	622	189	66	36	11	14	5	3	1	3	0
56.05		1509	1174	435	124	20	16	14	6	2	9	3	1	1
52.06		621	1445	710	307	174	38	16	11	11	6	17	1	1
43.24		0	1292	1704	570	163	56	27	15	1	1	1	4	0.6
42.81		16	538	929	1273	315	160	50	19	12	2	7	1	3
UK-CSBT		UK(E+W) VIIf Beam trawl												
	1991	2008												
	1	1	0	1										
	2	14												
40.81		52	98	189	171	60	67	23	20	16	13	5	4	4
35.78		18	220	103	83	69	22	21	10	13	5	3	1	1
39.64		6	83	198	77	50	41	11	24	9	5	4	3	4
37.03		23	80	59	116	36	31	19	11	15	8	5	4	4
37.59		16	87	73	56	105	24	30	23	8	8	4	5	3
39.78		22	96	128	70	45	52	15	13	12	4	9	5	2
43		10	60	86	69	53	27	39	11	11	5	5	3	2
47.48		13	101	73	77	50	17	13	20	7	6	4	2	1
50.87		31	203	107	52	50	28	13	6	10	4	2	1	0
51.19		72	152	150	75	27	28	19	9	4	8	2	2	2
49.32		37	272	99	89	48	19	17	11	9	3	7	1	2
37.53		11	149	375	90	63	28	18	14	9	6	4	3	1
40.71		18	101	176	369	77	45	18	6	7	3	4	1	2
32.37		19	91	65	113	179	34	27	15	7	3	5	1	1
27.73		27	78	126	55	60	115	15	14	4	5	2	2	1
18.57		16	86	94	103	32	39	69	13	8	4	2	2	1
15.37		18	77	89	77	82	32	41	76	8	8	4	2	3
15.83		12	76	100	67	52	54	19	32	42	10	5	2	3
UK-BCCSBTS-S		UK(E+W) VIIf Corystes (automated indices since 1995)												
	1988	2008												
	1	1	0.75	0.85										
	1	9												
74.120		60	242	36	14	4	0	0	0	0				
91.909		204	304	162	18	14	6	4	2	2				
69.858		269	219	35	11	3	5	2	0	0				
123.410		297	638	83	21	18	5	0	3	2				
125.078		493	325	174	37	23	12	1	2	1				
127.672		207	436	52	28	3	2	2	1	1				
120.816		424	430	133	23	11	9	0	0	3				
114.886		142	255	60	13	7	14	1	1	1				
118.592		178	251	64	27	7	3	4	1	3				
114.886		498	207	21	13	14	5	3	6	0				
114.886		885	472	57	11	9	5	2	1	5				
118.592		2922	297	38	16	7	4	5	1	0				
118.592		1086	1608	37	26	6	0	2	1	1				
118.592		449	711	307	23	9	6	2	0	2				
118.592		786	283	151	121	14	7	2	3	0				
118.592		465	628	55	30	56	9	3	3	0				
114.886		862	434	99	15	22	42	4	3	0				
118.592		407	267	38	16	7	5	17	1	2				
118.592		324	238	47	16	8	0	2	12	0				
118.592		424	128	51	16	13	7	3	4	14				
118.592		1232	124	15	18	7	9	4	3	5				

Table 7.13.10 - Sole VIIfg - XSA diagnostics

Lowestoft VPA Version 3.1

13/05/2009 15:09

Extended Survivors Analysis

CELTIC SEA SOLE 2009WG COMBSEX PLUSGROUP

CPUE data from file SOL7FTUN.txt

Catch data for 38 years. 1971 to 2008. Ages 1 to 10.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
BEL-BEAM	1971	2008	2	9	0	1
UK-CSBT	1991	2008	2	9	0	1
UK-BCCSBTS-S	1988	2008	1	9	0.75	0.85

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 47 iterations

1

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0	0	0	0	0	0	0	0	0	0
2	0.119	0.142	0.111	0.008	0.021	0.096	0.055	0.145	0.103	0.085
3	0.546	0.417	0.208	0.314	0.249	0.407	0.253	0.366	0.246	0.174
4	0.619	0.385	0.404	0.347	0.379	0.437	0.314	0.31	0.319	0.22
5	0.633	0.32	0.402	0.548	0.49	0.441	0.45	0.33	0.31	0.374
6	0.517	0.233	0.541	0.374	0.676	0.316	0.367	0.244	0.279	0.264
7	0.496	0.347	0.377	0.373	0.596	0.361	0.221	0.201	0.348	0.241
8	0.524	0.481	0.385	0.545	0.546	0.277	0.226	0.151	0.277	0.248
9	0.526	0.628	0.532	0.651	0.487	0.417	0.276	0.297	0.205	0.304

1

XSA population numbers (Thousands)

YEAR	AGE 1.00E+00	2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00	8.00E+00	9.00E+00
1999	1.51E+04	5.68E+03	4.29E+03	1.90E+03	6.32E+02	3.72E+02	2.15E+02	7.99E+01	5.91E+01
2000	7.80E+03	1.37E+04	4.56E+03	2.25E+03	9.26E+02	3.04E+02	2.01E+02	1.18E+02	4.28E+01
2001	4.10E+03	7.06E+03	1.07E+04	2.72E+03	1.39E+03	6.09E+02	2.18E+02	1.28E+02	6.62E+01
2002	6.75E+03	3.71E+03	5.71E+03	7.89E+03	1.64E+03	8.39E+02	3.21E+02	1.35E+02	7.91E+01
2003	5.40E+03	6.11E+03	3.33E+03	3.78E+03	5.05E+03	8.60E+02	5.22E+02	2.00E+02	7.09E+01
2004	5.88E+03	4.88E+03	5.42E+03	2.35E+03	2.34E+03	2.80E+03	3.96E+02	2.60E+02	1.05E+02
2005	5.88E+03	5.32E+03	4.02E+03	3.26E+03	1.37E+03	1.36E+03	1.85E+03	2.50E+02	1.79E+02
2006	3.98E+03	5.32E+03	4.56E+03	2.82E+03	2.16E+03	7.92E+02	8.53E+02	1.34E+03	1.80E+02
2007	3.03E+03	3.60E+03	4.16E+03	2.86E+03	1.87E+03	1.40E+03	5.62E+02	6.31E+02	1.04E+03
2008	1.47E+04	2.74E+03	2.94E+03	2.94E+03	1.88E+03	1.24E+03	9.61E+02	3.59E+02	4.33E+02

Estimated population abundance at 1st Jan 2009

0	13300	2280	2230	2140	1170	864	683	254

Taper weighted geometric mean of the VPA populations:

5050	4450	3650	2450	1470	882	537	338	218

Standard error of the weighted Log(VPA populations) :

0.3839	0.3408	0.3394	0.3616	0.4235	0.4944	0.6056	0.7876	0.9722

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Log catchability residuals.

Fleet : BEL-BEAM

Age	1971	1972	1973	1974	1975	1976	1977	1978
1	No data for this fleet at this age							
2	0.23	0.13	0.54	0.11	-0.15	0.55	0.21	0.38
3	-0.48	0.18	0.38	-0.1	-0.34	0.4	0.15	0.08
4	0.26	-0.16	0.13	-0.05	-0.31	-0.02	-0.02	0.06
5	0.32	0.14	0.19	0.14	0	0.26	-0.08	-0.46
6	0.13	0.3	-0.09	0.5	0.27	-0.18	0.08	-0.21
7	0.5	-0.01	-0.3	0.12	0.37	0.15	0.18	-0.39
8	0.31	0.21	-0.42	-0.01	-0.45	0.57	-0.01	-0.17
9	0.02	-0.1	-0.18	0.15	-0.1	0.07	-0.27	-0.23

Age	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	No data for this fleet at this age									
2	0.41	1.18	0.54	0.22	0.45	0.17	-1.66	-0.09	0.42	0.05
3	0.08	0.05	0.21	0.12	-0.02	-0.19	-0.06	0.01	-0.16	-0.54
4	0.41	0.27	-0.09	-0.15	-0.25	-0.34	-0.13	-0.09	0	-0.19
5	0.13	0.2	-0.14	0.05	-0.24	0.02	0.12	-0.04	0	-0.05
6	0.05	-0.04	0.2	0.21	-0.18	-0.1	0.07	0.11	0.38	-0.02
7	0.62	-0.87	0.17	0.41	0.14	0.22	-0.07	0.05	0.68	0.02
8	0.3	-0.16	-0.14	0.36	0.5	-0.08	0.19	-0.27	-0.13	0.57
9	0.02	-0.01	0.09	0.42	-0.21	-0.29	-0.06	-0.08	0.16	0.04

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	-0.31	0.09	1.61	0.79	0.41	-0.16	-1.11	-0.77	-0.44	-0.91
3	-0.48	0.18	0.41	0.42	0.29	-0.2	0.1	0.25	0.07	0
4	-0.15	0.13	0.08	0.31	-0.03	0.23	0.42	0.18	-0.08	0.44
5	-0.1	-0.04	0	0.24	-0.18	0.19	0.04	0.04	0.02	-0.07
6	0.09	0.22	-0.35	0.02	-0.33	0.36	-0.03	0.03	0.21	-0.09
7	0.19	0.2	-0.45	-0.85	0.23	-0.07	0.1	-0.32	0.21	0.66
8	0.17	0.26	-0.41	-0.96	0.45	-0.73	-0.01	-0.26	-0.25	0.16
9	-0.3	-0.16	-0.39	-0.46	0.31	0	-0.27	-0.3	0.08	-0.42

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	No data for this fleet at this age									
2	0.03	0.26	0.09	99.99	-3.27	99.99	99.99	99.99	99.99	99.99
3	0.2	-0.03	-0.7	0.05	-0.31	99.99	99.99	99.99	99.99	99.99
4	0.1	-0.55	-0.17	-0.2	-0.04	99.99	99.99	99.99	99.99	99.99
5	0.04	-0.92	-0.3	0.39	0.06	99.99	99.99	99.99	99.99	99.99
6	-0.47	-1.61	0.08	-0.2	0.58	99.99	99.99	99.99	99.99	99.99
7	-0.45	-1.28	-0.4	-0.22	0.45	99.99	99.99	99.99	99.99	99.99
8	-0.63	-0.82	-0.74	-0.01	0.23	99.99	99.99	99.99	99.99	99.99
9	-0.09	-0.58	-0.38	-0.01	0.27	99.99	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-6.3713	-5.1035	-4.8846	-4.9145	-4.9786	-5.0653	-5.0653	-5.0653
S.E(Log q)	0.8635	0.2848	0.2317	0.2418	0.3738	0.4498	0.4177	0.2527

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.97	0.08	6.44	0.15	32	0.85	-6.37
3	1.06	-0.396	4.92	0.58	33	0.31	-5.1
4	1.07	-0.578	4.69	0.71	33	0.25	-4.88
5	0.85	1.95	5.28	0.84	33	0.2	-4.91
6	0.76	2.363	5.39	0.76	33	0.27	-4.98
7	0.82	1.745	5.28	0.74	33	0.36	-5.07
8	0.9	1.289	5.2	0.83	33	0.36	-5.14
9	0.93	2.007	5.18	0.96	33	0.21	-5.16
1							

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Fleet : UK-CSBT

Age		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	1	No data for this fleet at this age									
	2	99.99	99.99	0.38	0.12	-1.15	0.26	0.12	0.42	-0.64	-0.79
	3	99.99	99.99	0.08	0.34	-0.12	-0.21	-0.07	0.23	-0.31	-0.11
	4	99.99	99.99	0.58	0.16	0.06	-0.43	-0.3	0.34	0.12	-0.1
	5	99.99	99.99	0.57	0.09	-0.04	-0.18	-0.2	0.03	0.07	0.24
	6	99.99	99.99	0.42	0.19	-0.2	-0.34	0.2	0.01	0.26	0.17
	7	99.99	99.99	0.37	-0.05	0.07	-0.18	-0.15	0.02	0.08	-0.16
	8	99.99	99.99	0.4	-0.2	-0.34	-0.06	0.45	-0.06	0.28	0.01
	9	99.99	99.99	0.53	0.24	0.35	0.41	0.74	0.29	0.22	0.14

Age		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	1	at this age									
	2	-0.09	-0.12	-0.11	-0.45	-0.53	0.01	0.41	0.33	1.01	0.84
	3	0.26	-0.15	-0.49	-0.13	-0.09	-0.38	-0.15	0.27	0.38	0.66
	4	-0.1	-0.04	-0.6	-0.09	-0.17	-0.44	-0.01	0.25	0.37	0.38
	5	-0.05	-0.22	-0.37	-0.19	-0.01	-0.22	-0.25	0.27	0.3	0.16
	6	0.19	-0.36	-0.3	-0.15	0.08	-0.19	-0.38	-0.13	0.45	0.08
	7	0.07	0.06	-0.36	-0.09	-0.08	0.04	-0.19	-0.11	0.37	0.28
	8	0.3	0.26	0.06	0.42	-0.06	0.19	-0.22	-0.01	0.47	0.22
	9	-0.17	0.6	0.36	0.75	-0.15	0.58	0.07	0.39	0.55	0.58

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-8.9395	-6.9379	-6.3708	-6.029	-5.8356	-5.7511	-5.7511	-5.7511
S.E(Log q)	0.5587	0.299	0.3177	0.2425	0.265	0.1942	0.2765	0.4578

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age		Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
	2	1.34	-0.735	9.1	0.22	18	0.76	-8.94
	3	1.32	-1.211	6.51	0.48	18	0.39	-6.94
	4	1.06	-0.274	6.29	0.59	18	0.35	-6.37
	5	1.01	-0.045	6.02	0.81	18	0.25	-6.03
	6	1.05	-0.363	5.8	0.8	18	0.28	-5.84
	7	0.95	0.627	5.76	0.92	18	0.19	-5.75
	8	1.01	-0.091	5.64	0.87	18	0.26	-5.63
	9	0.92	1.026	5.34	0.91	18	0.25	-5.39
	1							

Fleet : UK-BCCSBTS-S

Age		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
	1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-1.36
	2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.01
	3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.3
	4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.16
	5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.24
	6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
	7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
	8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
	9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	1	-0.17	-0.46	-0.21	0.23	-0.66	0.38	-0.64	-0.64	0.12	0.55
	2	0.27	0.37	0.13	0.09	0.28	0.31	0.07	0.07	-0.29	0.21
	3	1.06	0.11	0.47	0.55	-0.07	0.78	0.16	0.47	-0.62	0.13
	4	0.52	-0.1	0.14	0.77	-0.21	0.35	-0.17	0.65	0.17	0.11
	5	0.31	-0.16	0.58	0.91	-1.13	-0.33	-0.01	0.04	0.91	0.6
	6	0.4	0.09	0.19	0.54	-1.26	0.5	0.49	-0.39	0.39	0.37
	7	0.48	0.54	99.99	-0.74	-0.38	99.99	-0.7	0.08	0.69	0.66
	8	0.62	99.99	0.97	-0.17	-0.18	99.99	-0.28	-0.15	1.18	0.32
	9	1.69	99.99	0.85	0.38	-0.23	1.72	0.29	1.48	99.99	1.58

Age		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	1	0.84	0.51	0.27	0.33	0.03	0.59	-0.19	-0.03	0.52	0
	2	-0.36	0.47	0.29	-0.07	0.24	0.18	-0.45	-0.49	-0.76	-0.53
	3	-0.51	-0.7	0.39	0.4	-0.12	0.14	-0.67	-0.5	-0.42	-1.35
	4	0.09	0.22	-0.08	0.47	-0.16	-0.3	-0.69	-0.55	-0.56	-0.55
	5	0.51	-0.28	-0.21	0.17	0.39	0.22	-0.42	-0.83	-0.22	-0.79
	6	0.2	99.99	0.13	-0.17	0.3	0.4	-1	99.99	-0.76	-0.4
	7	1.22	0.25	0.19	-0.2	-0.1	0.31	0.07	-1.31	-0.37	-0.71
	8	0.62	0.19	99.99	1.21	0.82	0.37	-0.76	-0.01	-0.26	0
	9	99.99	1.33	1.51	99.99	99.99	99.99	0.31	99.99	0.44	0.37

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4	5	6	7	8	9
Mean Log q	-7.1761	-7.1918	-8.4789	-9.0707	-9.198	-9.0109	-9.279	-9.279	-9.279
S.E(Log q)	0.5338	0.3444	0.5842	0.4103	0.5508	0.5473	0.6281	0.6281	1.1526

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	0.73	1.411	7.56	0.59	21	0.38	-7.18
2	0.77	1.473	7.48	0.69	21	0.26	-7.19
3	0.81	0.614	8.44	0.36	21	0.48	-8.48
4	1.48	-1.39	9.68	0.3	21	0.59	-9.07
5	1.27	-0.815	9.73	0.32	21	0.71	-9.2
6	1.3	-0.897	9.72	0.36	18	0.72	-9.01
7	1.88	-2.02	12.16	0.25	18	1.09	-9.28
8	1.39	-1.365	10.43	0.45	17	0.77	-9.01
9	1.8	-2.214	11.14	0.41	13	1.05	-8.38
1							

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 2007

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-BEAM	1	0	0	0	0	0	0
UK-CSBT	1	0	0	0	0	0	0
UK-BCCSBTS-S	13317	0.546	0	0	1	1	0
F shrinkage mean	0	1.5				0	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
13317	0.55	0	1	0	0

1

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2006

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-BEAM	1	0	0	0	0	0	0
UK-CSBT	5265	0.574	0	0	1	0.203	0.037
UK-BCCSBTS-S	1821	0.296	0.477	1.61	2	0.764	0.105
F shrinkage mean	2288	1.5				0.032	0.084

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2276	0.26	0.34	4	1.326	0.085

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-BEAM	1	0	0	0	0	0	0
UK-CSBT	4624	0.271	0.143	0.53	2	0.495	0.088
UK-BCCSBTS-S	1091	0.266	0.314	1.18	3	0.485	0.329
F shrinkage mear	1192	1.5				0.02	0.305

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2233	0.19	0.35	6	1.877	0.174

1

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2004

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-BEAM	1	0	0	0	0	0	0
UK-CSBT	3119	0.211	0.011	0.05	3	0.55	0.156
UK-BCCSBTS-S	1351	0.228	0.068	0.3	4	0.434	0.328
F shrinkage mear	1240	1.5				0.015	0.353

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2139	0.15	0.16	8	1.042	0.22

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2003

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-BEAM	1	0	0	0	0	0	0
UK-CSBT	1513	0.178	0.055	0.31	4	0.626	0.301
UK-BCCSBTS-S	751	0.218	0.195	0.9	5	0.358	0.535
F shrinkage mear	1062	1.5				0.016	0.405

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1171	0.14	0.14	10	1	0.374

1

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 2002

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-BEAM	1	0	0	0	0	0	0
UK-CSBT	984	0.157	0.078	0.49	5	0.672	0.235
UK-BCCSBTS-S	666	0.21	0.133	0.63	6	0.315	0.33
F shrinkage mear	568	1.5				0.013	0.378

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
864	0.13	0.08	12	0.671	0.264

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-BEAM	26	0.877	0	0	1	0.007	2.103
UK-CSBT	844	0.146	0.114	0.78	6	0.711	0.2
UK-BCCSBTS-S	435	0.212	0.184	0.87	7	0.269	0.357
F shrinkage mean	450	1.5				0.012	0.346

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
683	0.12	0.14	15	1.149	0.241

1

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-BEAM	187	0.3	0	0	1	0.044	0.324
UK-CSBT	271	0.141	0.108	0.76	7	0.744	0.234
UK-BCCSBTS-S	215	0.241	0.081	0.33	7	0.199	0.287
F shrinkage mean	207	1.5				0.013	0.296

Weighted prediction :

Survivors **at end of year**	Int s.e	Ext s.e	N	Var Ratio	F
254	0.12	0.07	16	0.593	0.248

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-BEAM	289	0.209	0.035	0.17	3	0.085	0.304
UK-CSBT	316	0.138	0.137	0.99	8	0.699	0.282
UK-BCCSBTS-S	212	0.227	0.221	0.98	9	0.203	0.396
F shrinkage mean	332	1.5				0.013	0.27

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
289	0.11	0.1	21	0.901	0.304

Table 7.13.11 - Sole in VIIfg. Fishing mortality

Run title : CELTIC SEA SOLE,2009 WG,COMBSEX,PLUSGROUP
At 13/05/2009 15:10

	1971	1972	1973	1974	1975	1976	1977	1978
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.083	0.068	0.104	0.055	0.042	0.130	0.073	0.083
3	0.146	0.252	0.314	0.158	0.122	0.398	0.243	0.220
4	0.380	0.225	0.304	0.207	0.157	0.329	0.256	0.268
5	0.390	0.295	0.316	0.243	0.208	0.417	0.234	0.154
6	0.305	0.325	0.222	0.331	0.255	0.254	0.260	0.187
7	0.402	0.216	0.167	0.207	0.259	0.322	0.262	0.143
8	0.336	0.269	0.148	0.178	0.115	0.492	0.215	0.177
9	0.249	0.200	0.187	0.191	0.161	0.300	0.163	0.170
+gp	0.249	0.200	0.187	0.191	0.161	0.300	0.163	0.170
FBAR 4-8	0.362	0.266	0.231	0.233	0.199	0.363	0.245	0.186

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.072	0.244	0.147	0.085	0.167	0.122	0.050	0.107	0.125	0.113
3	0.185	0.280	0.375	0.276	0.372	0.305	0.378	0.465	0.277	0.241
4	0.320	0.432	0.344	0.262	0.368	0.328	0.441	0.519	0.515	0.392
5	0.234	0.394	0.317	0.311	0.363	0.454	0.511	0.546	0.461	0.531
6	0.203	0.290	0.422	0.342	0.359	0.376	0.426	0.629	0.538	0.570
7	0.331	0.106	0.371	0.384	0.450	0.477	0.320	0.483	0.808	0.456
8	0.238	0.237	0.272	0.364	0.652	0.351	0.417	0.450	0.439	0.740
9	0.181	0.274	0.342	0.385	0.320	0.286	0.385	0.546	0.581	0.525
+gp	0.181	0.274	0.342	0.385	0.320	0.286	0.385	0.546	0.581	0.525
FBAR 4-8	0.265	0.292	0.345	0.333	0.438	0.397	0.423	0.525	0.552	0.538

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.132	0.091	0.219	0.128	0.097	0.081	0.045	0.064	0.073	0.043
3	0.345	0.393	0.302	0.380	0.357	0.289	0.452	0.524	0.457	0.383
4	0.494	0.616	0.434	0.453	0.403	0.520	0.723	0.681	0.581	0.737
5	0.469	0.632	0.506	0.467	0.395	0.560	0.559	0.602	0.648	0.565
6	0.538	0.658	0.460	0.464	0.355	0.610	0.623	0.600	0.783	0.564
7	0.532	0.613	0.438	0.302	0.536	0.474	0.573	0.478	0.701	0.826
8	0.532	0.643	0.466	0.261	0.514	0.380	0.701	0.456	0.588	0.600
9	0.466	0.642	0.509	0.407	0.624	0.683	0.716	0.564	0.702	0.454
+gp	0.466	0.642	0.509	0.407	0.624	0.683	0.716	0.564	0.702	0.454
FBAR 4-8	0.513	0.632	0.461	0.389	0.441	0.509	0.636	0.563	0.660	0.658

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	FBAR 06-08
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.119	0.142	0.111	0.008	0.021	0.096	0.055	0.145	0.103	0.085	0.111
3	0.546	0.417	0.208	0.314	0.249	0.407	0.253	0.366	0.247	0.174	0.262
4	0.619	0.385	0.404	0.347	0.379	0.438	0.314	0.310	0.319	0.220	0.283
5	0.633	0.320	0.402	0.548	0.490	0.441	0.450	0.330	0.310	0.374	0.338
6	0.517	0.233	0.541	0.374	0.676	0.316	0.367	0.244	0.279	0.264	0.262
7	0.496	0.347	0.377	0.373	0.596	0.361	0.221	0.201	0.348	0.241	0.264
8	0.524	0.481	0.385	0.545	0.546	0.277	0.226	0.151	0.277	0.248	0.225
9	0.527	0.628	0.532	0.651	0.487	0.417	0.276	0.297	0.205	0.304	0.269
+gp	0.527	0.628	0.532	0.651	0.487	0.417	0.276	0.297	0.205	0.304	
FBAR 4-8	0.558	0.353	0.422	0.437	0.538	0.367	0.316	0.247	0.306	0.269	

Table 4.3.12 - Sole in VIIfg. Stock numbers at age (start of year, in thousand)

Run title : CELTIC SEA SOLE,2009 WG,COMBSEX,PLUSGROUP
At 13/05/2009 15:10

	1971	1972	1973	1974	1975	1976	1977	1978
1	9596	4270	3383	3399	2970	5190	4633	5490
2	5116	8683	3864	3061	3076	2688	4696	4192
3	2093	4262	7342	3150	2622	2670	2135	3951
4	4458	1637	2999	4853	2434	2100	1623	1515
5	2035	2758	1183	2002	3570	1882	1367	1136
6	1732	1247	1858	780	1420	2624	1122	979
7	1707	1155	815	1346	507	996	1842	783
8	2813	1034	843	624	991	354	653	1283
9	1792	1819	715	658	473	800	196	477
+gp	5800	4221	3961	3259	2620	1874	2550	1166
TOTAL	37143	31087	26963	23133	20684	21178	20817	20972

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	3532	5129	4857	4887	6786	4702	5650	3154	5734	4486
2	4968	3196	4641	4394	4422	6140	4255	5112	2854	5189
3	3490	4183	2267	3627	3651	3386	4916	3663	4156	2280
4	2870	2625	2860	1409	2491	2278	2259	3047	2082	2850
5	1049	1886	1542	1835	981	1561	1485	1315	1642	1126
6	882	751	1151	1016	1216	618	897	806	690	937
7	735	651	508	683	653	768	384	530	389	364
8	614	478	530	317	421	377	432	252	296	157
9	972	438	341	366	200	198	240	257	145	172
+gp	1072	1538	1373	1070	1224	1154	787	816	425	686
TOTAL	20184	20876	20072	19604	22045	21182	21303	18953	18412	18247

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	3717	8604	4198	4453	4425	3408	3319	4047	5471	6280
2	4059	3363	7785	3799	4030	4004	3084	3003	3662	4950
3	4195	3217	2780	5657	3025	3309	3342	2668	2549	3080
4	1622	2688	1966	1859	3502	1917	2243	1925	1429	1460
5	1743	896	1314	1153	1069	2118	1031	985	882	724
6	599	986	431	717	654	652	1095	534	488	417
7	479	317	462	246	408	415	321	531	265	202
8	209	255	155	270	165	216	234	164	298	119
9	68	111	121	88	188	89	134	105	94	150
+gp	287	285	425	279	223	308	223	257	220	250
TOTAL	16977	20722	19637	18521	17689	16437	15025	14218	15357	17632

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	GMST 71-06	AMST 71-06
1	15116	7797	4101	6753	5399	5883	5880	3977	3025	14717*	0***	4970	5297
2	5682	13678	7055	3710	6111	4885	5323	5320	3599	2738	13317**	4541	4835
3	4292	4563	10739	5714	3330	5416	4016	4559	4163	2938	2276	3654	3897
4	1901	2249	2721	7893	3777	2350	3263	2820	2860	2944	2233	2422	2610
5	632	926	1385	1644	5047	2339	1373	2157	1872	1881	2139	1453	1605
6	372	304	609	839	860	2797	1361	792	1404	1243	1171	862	979
7	215	201	218	321	522	396	1845	853	562	961	864	527	640
8	80	118	128	135	200	260	250	1339	631	359	683	332	474
9	59	43	66	79	71	105	179	180	1042	433	254	204	339
+gp	112	114	205	111	204	150	187	208	396	684	745		
TOTAL	28462	29994	27228	27200	25520	24581	23676	22206	19552	28896	23681		

* Replaced with 7700
** Replaced with 6967
*** Replaced with GM = 4970

Table 7.13.13 - Sole in VIIfg. Summary

Run title : CELTIC SEA SOLE,2009 WG,COMBSEX,PLUSGROUP
At 13/05/2009 15:10

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4-8
1971	9596	9473	8007	1861	0.232	0.362
1972	4270	7971	6314	1278	0.202	0.266
1973	3383	6615	5282	1391	0.263	0.231
1974	3399	6676	5656	1105	0.195	0.233
1975	2970	5866	5012	919	0.183	0.199
1976	5190	5372	4346	1350	0.311	0.363
1977	4633	5923	4660	961	0.206	0.245
1978	5490	5070	3750	780	0.208	0.186
1979	3532	5084	3874	954	0.246	0.265
1980	5129	5233	4011	1314	0.328	0.292
1981	4857	4589	3414	1212	0.355	0.345
1982	4887	4799	3549	1128	0.318	0.333
1983	6786	5127	3650	1373	0.376	0.438
1984	4702	5365	3908	1266	0.324	0.397
1985	5650	4783	3301	1328	0.402	0.423
1986	3154	4615	3362	1600	0.476	0.525
1987	5734	3728	2512	1222	0.486	0.552
1988	4486	3895	2701	1146	0.424	0.538
1989	3717	3238	2104	992	0.472	0.513
1990	8604	3875	2397	1189	0.496	0.632
1991	4198	3591	2119	1107	0.522	0.461
1992	4453	3848	2438	981	0.402	0.389
1993	4425	3827	2469	928	0.376	0.441
1994	3408	3256	2248	1009	0.449	0.509
1995	3319	3079	2148	1157	0.539	0.636
1996	4047	3052	2073	995	0.480	0.563
1997	5471	2968	1816	927	0.510	0.660
1998	6280	3051	1620	875	0.540	0.658
1999	15116	4273	1816	1012	0.557	0.558
2000	7797	3881	1935	1091	0.564	0.353
2001	4101	5383	3110	1168	0.376	0.422
2002	6753	5926	4077	1345	0.330	0.437
2003	5399	5582	3741	1392	0.372	0.538
2004	5883	5115	3488	1249	0.358	0.367
2005	5880	5299	3501	1044	0.298	0.316
2006	3977	4658	3083	946	0.307	0.247
2007	3025	4461	3330	945	0.284	0.306
2008	14717*	5231	3128	800	0.2557	0.2693
Arith. Mean	5485	4836	3420	1141	0.3691	0.407
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

* Replaced with 7700

Table 7.13.14 Sole in VIIfg. Prediction input data

MFDP version 1a
Run: Sole7Fg_Fin
Time and date: 17:54 14/05/2009
Fbar age range: 4-8

Input:
F mean 06-08
Catch and stock weights are mean 06-08
Recruits age 1 in 2009,10 and 11 GM (71-06)
Recruits age 2 in 2009 is 7700 at age 1, minus natural mo

2009

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4970	0.1	0	0	0	0.090	0.000	0.086
2	6967	0.1	0.14	0	0	0.137	0.111	0.144
3	2276	0.1	0.45	0	0	0.188	0.262	0.200
4	2233	0.1	0.88	0	0	0.240	0.283	0.254
5	2139	0.1	0.98	0	0	0.292	0.338	0.307
6	1171	0.1	1	0	0	0.344	0.262	0.357
7	864	0.1	1	0	0	0.397	0.264	0.405
8	683	0.1	1	0	0	0.451	0.225	0.451
9	254	0.1	1	0	0	0.505	0.269	0.495
10	745	0.1	1	0	0	0.635	0.269	0.590

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4970	0.1	0	0	0	0.090	0.000	0.086
2	.	0.1	0.14	0	0	0.137	0.111	0.144
3	.	0.1	0.45	0	0	0.188	0.262	0.200
4	.	0.1	0.88	0	0	0.240	0.283	0.254
5	.	0.1	0.98	0	0	0.292	0.338	0.307
6	.	0.1	1	0	0	0.344	0.262	0.357
7	.	0.1	1	0	0	0.397	0.264	0.405
8	.	0.1	1	0	0	0.451	0.225	0.451
9	.	0.1	1	0	0	0.505	0.269	0.495
10	.	0.1	1	0	0	0.635	0.269	0.590

2011

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4970	0.1	0	0	0	0.090	0.000	0.086
2	.	0.1	0.14	0	0	0.137	0.111	0.144
3	.	0.1	0.45	0	0	0.188	0.262	0.200
4	.	0.1	0.88	0	0	0.240	0.283	0.254
5	.	0.1	0.98	0	0	0.292	0.338	0.307
6	.	0.1	1	0	0	0.344	0.262	0.357
7	.	0.1	1	0	0	0.397	0.264	0.405
8	.	0.1	1	0	0	0.451	0.225	0.451
9	.	0.1	1	0	0	0.505	0.269	0.495
10	.	0.1	1	0	0	0.635	0.269	0.590

Input units are thousands and kg - output in tonnes

Table 7.13.15 - Sole in VIIfg. Management option table

MFDP version 1a
Run: Sole7Fg_Fin
CELTIC SEA SOLE,2009WG ,COMBSEX,PLUSGROUP
Time and date: 17:54 14/05/2009
Fbar age range: 4-8

2009				
Biomass	SSB	FMult	FBar	Landings
4647	3067	1.0000	0.2742	869

2010					2011	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
4710	3093	0.0000	0.0000	0	5733	4179
.	3093	0.1000	0.0274	103	5619	4074
.	3093	0.2000	0.0548	203	5509	3972
.	3093	0.3000	0.0823	300	5402	3873
.	3093	0.4000	0.1097	395	5297	3777
.	3093	0.5000	0.1371	488	5195	3683
.	3093	0.6000	0.1645	578	5096	3591
.	3093	0.7000	0.1920	666	4999	3502
.	3093	0.8000	0.2194	751	4904	3416
.	3093	0.9000	0.2468	835	4813	3331
.	3093	1.0000	0.2742	916	4723	3249
.	3093	1.1000	0.3016	995	4636	3169
.	3093	1.2000	0.3291	1073	4551	3092
.	3093	1.3000	0.3565	1148	4468	3016
.	3093	1.4000	0.3839	1221	4387	2942
.	3093	1.5000	0.4113	1293	4309	2870
.	3093	1.6000	0.4388	1363	4232	2800
.	3093	1.7000	0.4662	1431	4157	2732
.	3093	1.8000	0.4936	1497	4085	2666
.	3093	1.9000	0.5210	1561	4014	2601
.	3093	2.0000	0.5485	1624	3945	2538

Input units are thousands and kg - output in tonnes

Fmult corresponding to Fpa = 1.35

.	3093	1.35	0.3702	1185	4427	2979

Bpa = 2 200 t

Table 7.13.16 - Sole in VIIfg. Detailed results

MFDP version 1a
Run: Sole7Fg_Fin
Time and date: 17:54 14/05/2009
Fbar age range: 4-8

Year:	2009	F multiplier:	1	Fbar:	0.274				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.000	0	0	4970	447	0	0	0	0
2	0.111	697	101	6967	954	975	134	975	134
3	0.262	501	100	2276	429	1024	193	1024	193
4	0.283	525	133	2233	536	1965	472	1965	472
5	0.338	585	179	2139	625	2096	612	2096	612
6	0.262	257	92	1171	403	1171	403	1171	403
7	0.264	191	77	864	343	864	343	864	343
8	0.225	131	59	683	308	683	308	683	308
9	0.269	57	28	254	128	254	128	254	128
10	0.269	167	99	745	473	745	473	745	473
Total		3112	869	22302	4647	9778	3067	9778	3067

Year:	2010	F multiplier:	1	Fbar:	0.274				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.000	0	0	4970	447	0	0	0	0
2	0.111	450	65	4497	616	630	86	630	86
3	0.262	1242	249	5642	1063	2539	478	2539	478
4	0.283	372	95	1584	380	1394	335	1394	335
5	0.338	416	128	1523	445	1492	436	1492	436
6	0.262	304	108	1381	475	1381	475	1381	475
7	0.264	180	73	815	324	815	324	815	324
8	0.225	115	52	601	271	601	271	601	271
9	0.269	111	55	493	249	493	249	493	249
10	0.269	155	92	691	439	691	439	691	439
Total		3346	916	22197	4710	10036	3093	10036	3093

Year:	2011	F multiplier:	1	Fbar:	0.274				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.000	0	0	4970	447	0	0	0	0
2	0.111	450	65	4497	616	630	86	630	86
3	0.262	801	161	3642	686	1639	309	1639	309
4	0.283	923	235	3927	942	3456	829	3456	829
5	0.338	295	91	1080	315	1059	309	1059	309
6	0.262	216	77	983	338	983	338	983	338
7	0.264	212	86	961	382	961	382	961	382
8	0.225	109	49	567	256	567	256	567	256
9	0.269	98	48	434	219	434	219	434	219
10	0.269	184	109	819	521	819	521	819	521
Total		3289	920	21880	4723	10547	3249	10547	3249

Input units are thousands and kg - output in tonnes

Table 7.13.17 **Sole VIIf,g**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			2005	2006	2007	2008	2009
Stock No. (thousands) of 1 year-olds			3977	3025	7700	4970	4970
Source			XSA	XSA	Estimate	GM71-06	GM71-06
Status Quo F:							
% in	2009	landings	15.3	11.5	11.6	0.0	-
% in	2010	landings	14.0	10.4	27.2	7.1	0.0
% in	2009	SSB	15.4	6.3	4.4	0.0	-
% in	2010	SSB	14.1	10.8	15.5	2.8	0.0
% in	2011	SSB	10.4	9.5	25.5	9.5	2.6

GM : geometric mean recruitment

Sole VIIf,g : Year-class % contribution to

a) 2010 landings **b) 2011 SSB**

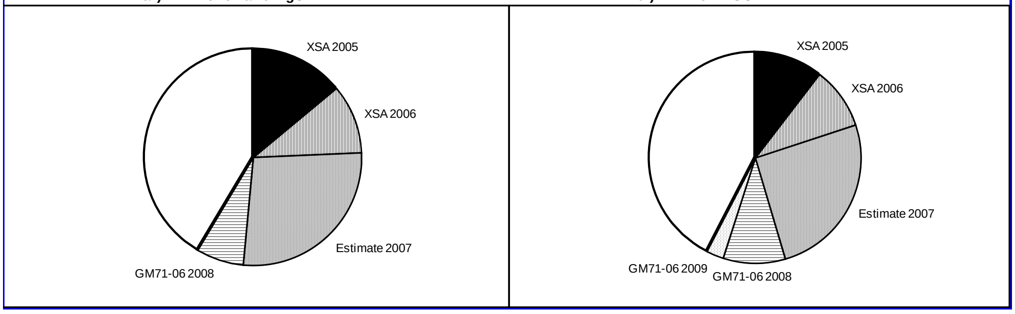


Table 7.13.18 - Sole in VIIfg. Yield per recruit summary table

MFYPR version 2a
Run: Sole7Fg_Fin_Yield
Time and date: 18:35 14/05/2009
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.000	0.000	0.000	10.508	4.334	8.178	4.028	8.178	4.028
0.1000	0.027	0.183	0.076	8.683	3.258	6.361	2.954	6.361	2.954
0.2000	0.055	0.302	0.119	7.496	2.580	5.183	2.277	5.183	2.277
0.3000	0.082	0.385	0.144	6.662	2.119	4.358	1.818	4.358	1.818
0.4000	0.110	0.447	0.159	6.045	1.789	3.749	1.490	3.749	1.490
0.5000	0.137	0.495	0.168	5.570	1.543	3.283	1.246	3.283	1.246
0.6000	0.165	0.533	0.173	5.193	1.356	2.914	1.060	2.914	1.060
0.7000	0.192	0.563	0.176	4.887	1.208	2.616	0.914	2.616	0.914
0.8000	0.219	0.589	0.178	4.634	1.091	2.370	0.798	2.370	0.798
0.9000	0.247	0.610	0.178	4.421	0.995	2.165	0.704	2.165	0.704
1.0000	0.274	0.629	0.178	4.240	0.916	1.990	0.627	1.990	0.627
1.1000	0.302	0.645	0.178	4.083	0.850	1.841	0.562	1.841	0.562
1.2000	0.329	0.658	0.177	3.946	0.794	1.711	0.508	1.711	0.508
1.3000	0.357	0.671	0.176	3.827	0.747	1.598	0.462	1.598	0.462
1.4000	0.384	0.681	0.175	3.720	0.706	1.499	0.423	1.499	0.423
1.5000	0.411	0.691	0.173	3.626	0.671	1.410	0.389	1.410	0.389
1.6000	0.439	0.700	0.172	3.541	0.640	1.332	0.359	1.332	0.359
1.7000	0.466	0.708	0.171	3.464	0.613	1.261	0.333	1.261	0.333
1.8000	0.494	0.715	0.170	3.394	0.589	1.198	0.311	1.198	0.311
1.9000	0.521	0.721	0.169	3.331	0.567	1.140	0.290	1.140	0.290
2.0000	0.549	0.727	0.168	3.273	0.548	1.088	0.273	1.088	0.273

Reference point	F multiplier	Absolute F
Fbar(4-8)	1.000	0.274
FMax	0.921	0.253
F0.1	0.423	0.116
F35%SPR	0.430	0.118

Weights in kilograms

Figure 7.13.1 - Sole in VIIfg. Dotted lines give the length distributions of UK (England and Wales) landings; solid lines of Belgian landings

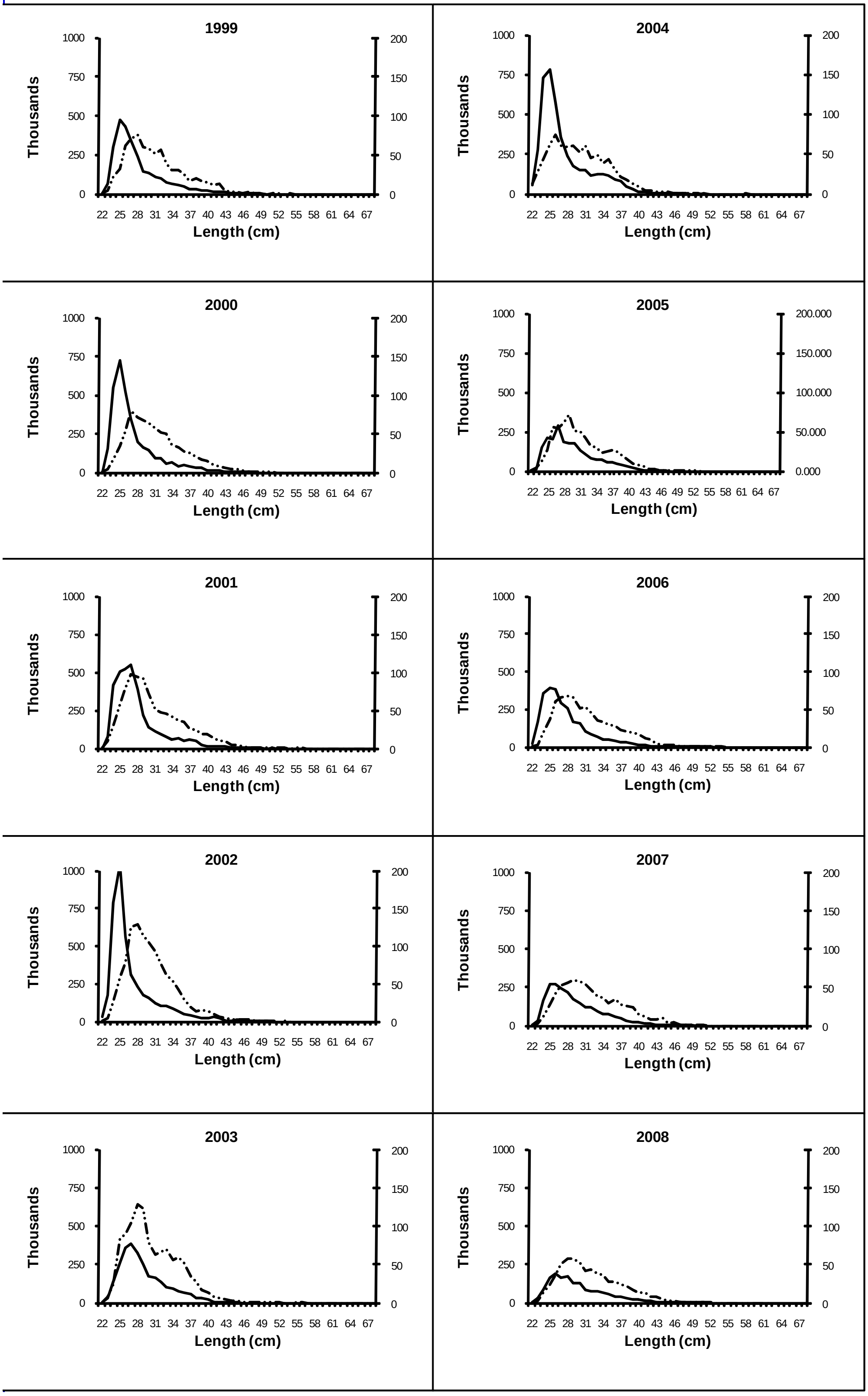


Figure 7.13.2 - Sole in VIIfg. Age composition of landings

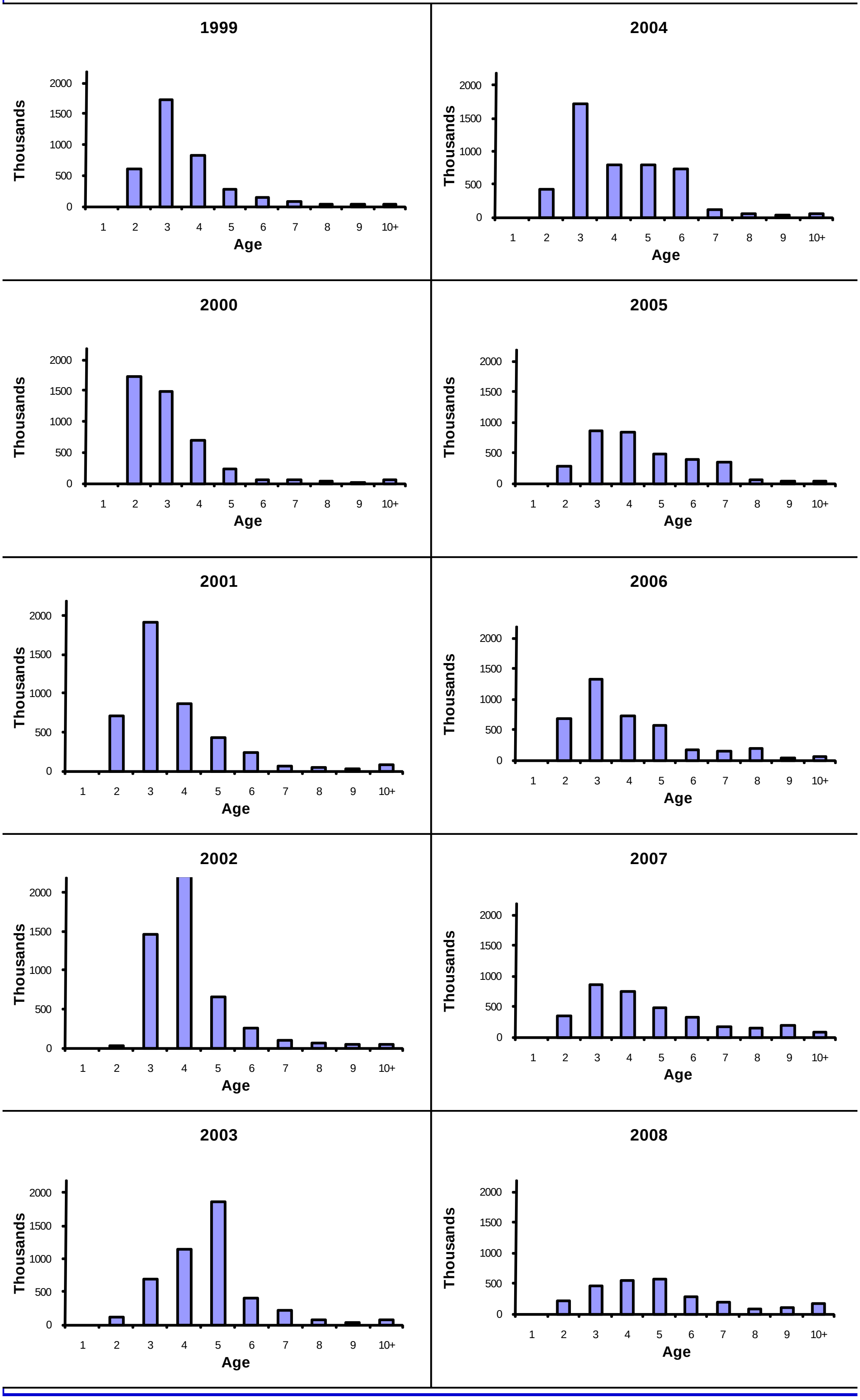


Figure 7.13.3 - Sole in VIIfg - standardised catch proportion

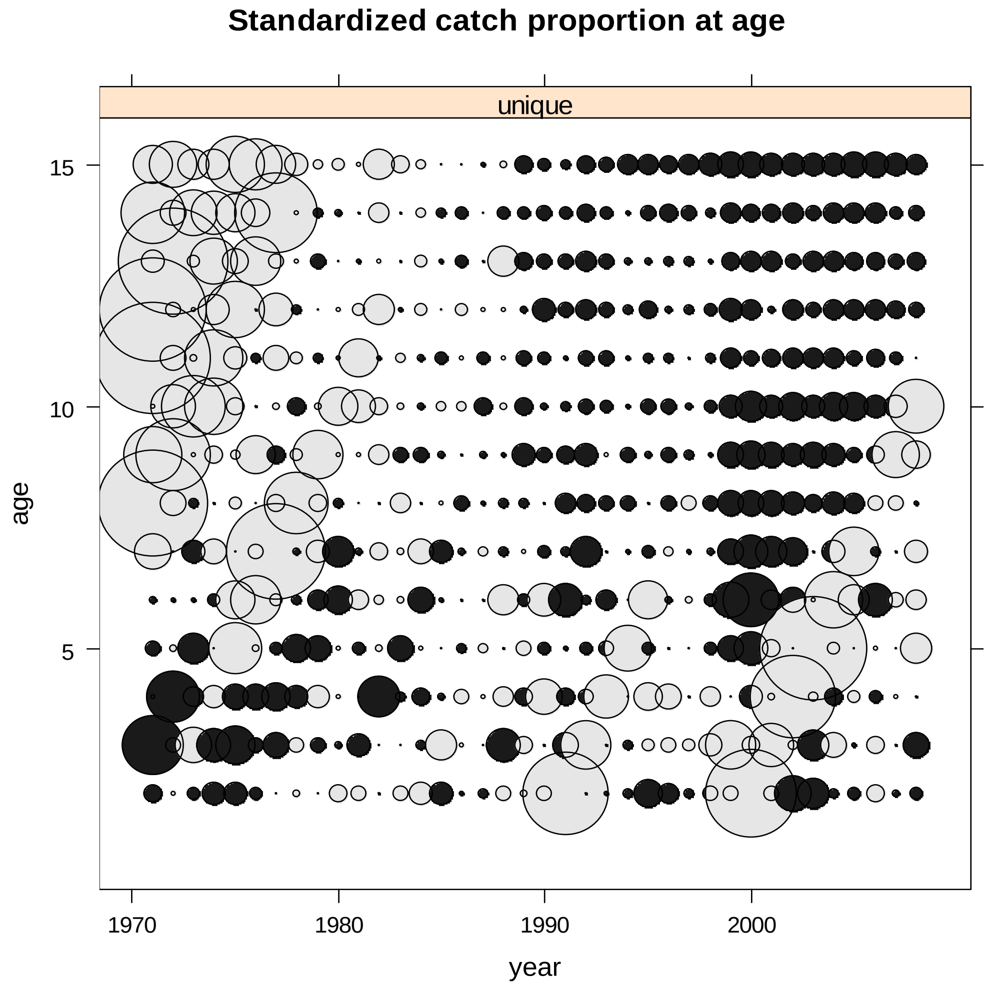
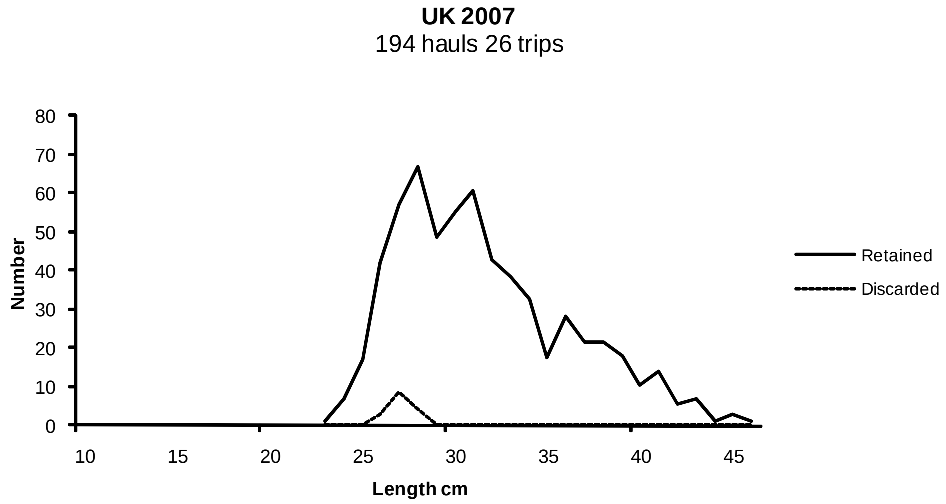
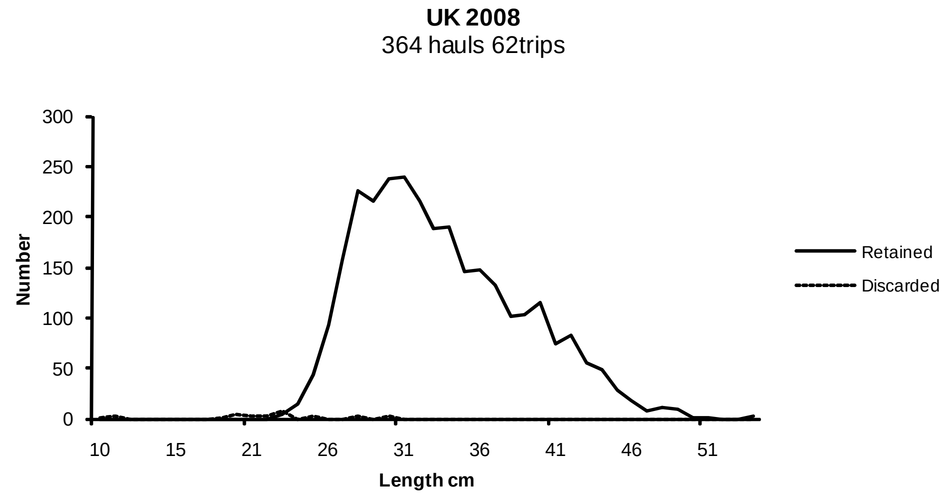
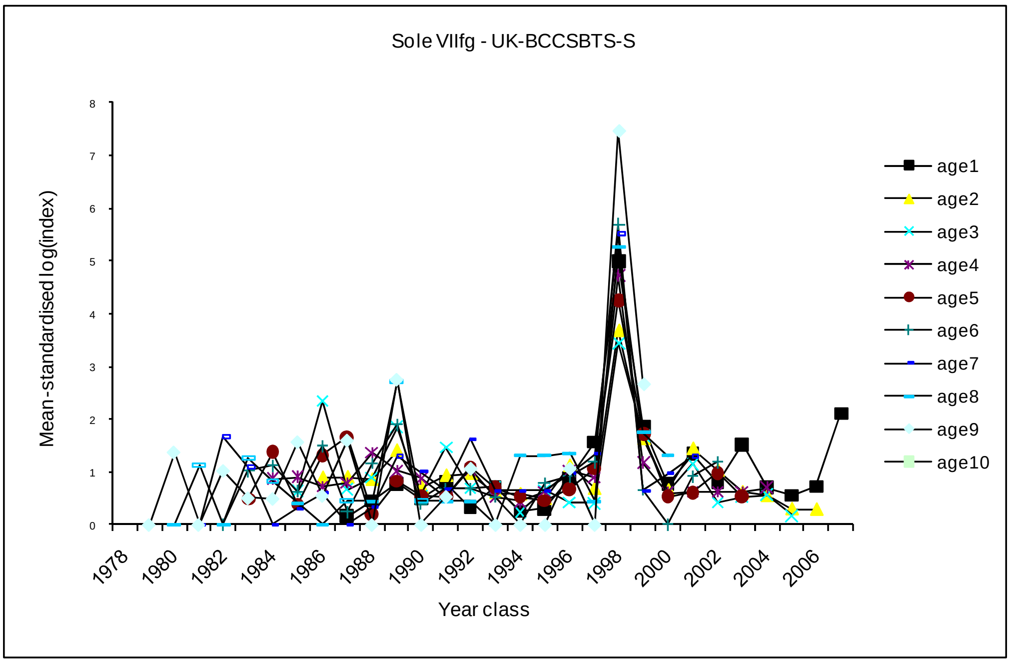


Figure 7.13.4 - Sole VIIfg - Length distributions of discarded and retained fish







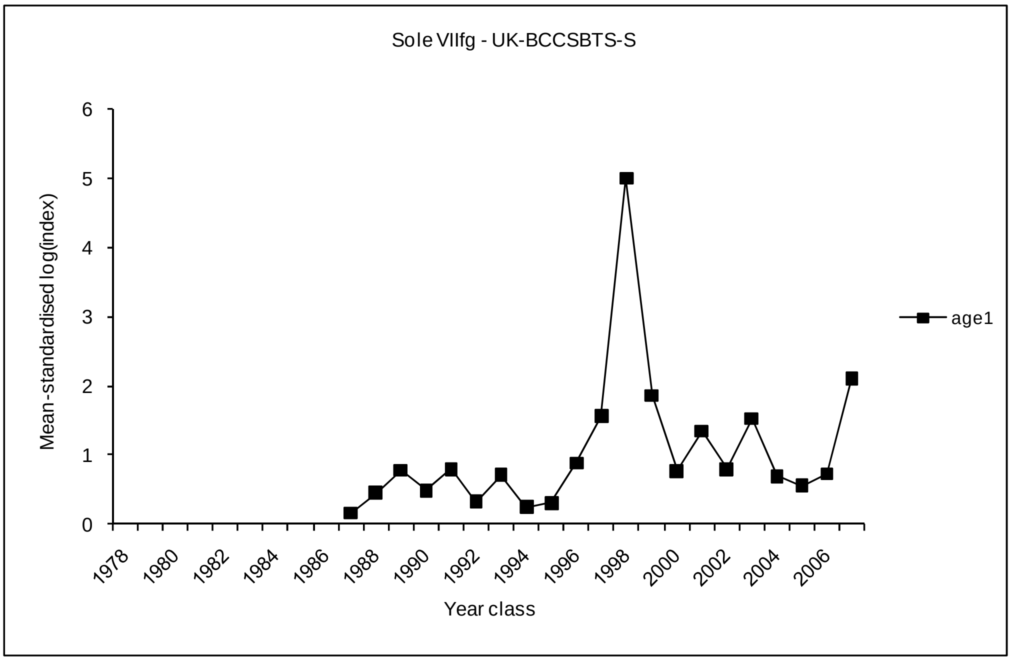


Figure 7.13.5. Sole VIIfg; Mean-standardized index of UK (E&W) VIIfg Corystes survey.

Figure 7.13.6 - Sole in VIIfg - Consistency plot UK-BCCSBTS-S survey

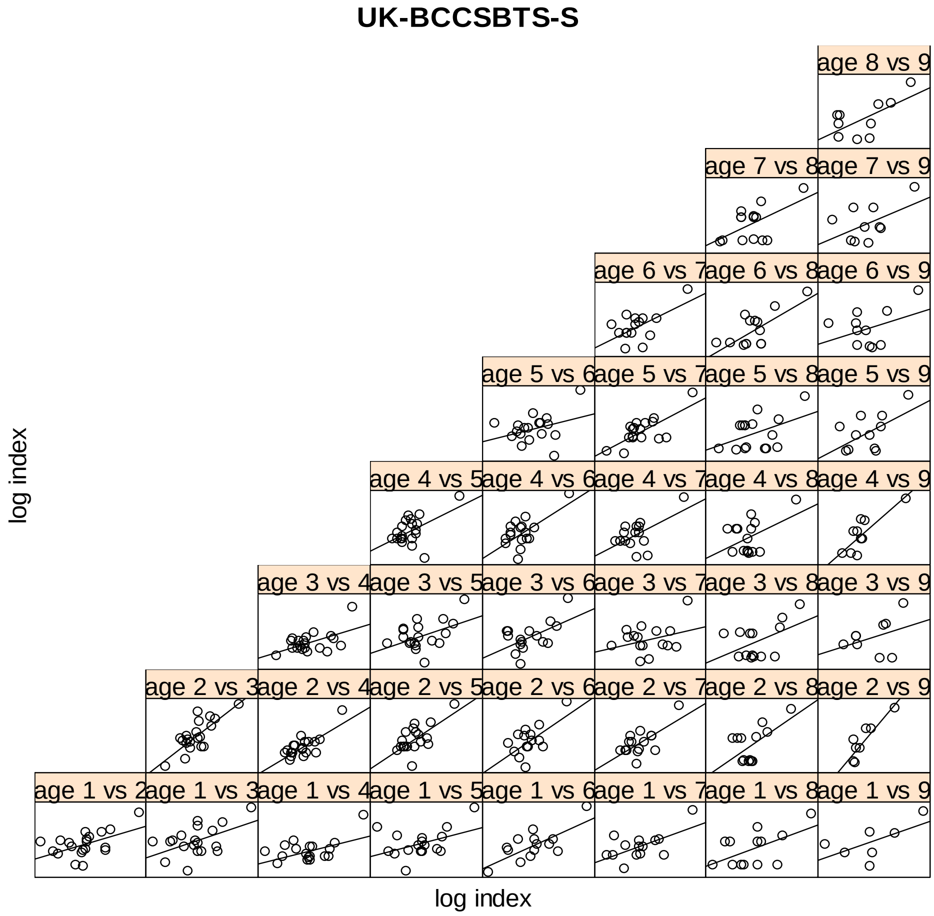
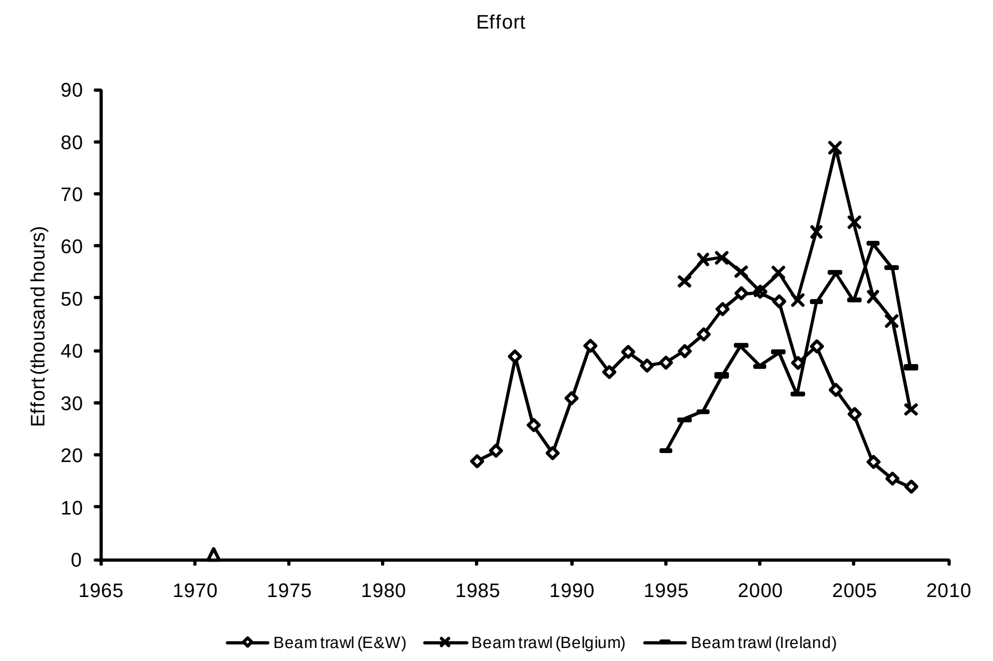


Figure 7.13.7 - Sole in VIIfg. Effort (in thousand hours, GRT corrected in case of E&W beam trawl fleet) and LPUE (in kg/hour; or in kg/100km in case of UK-BCCSBTS-S survey) for three beam trawl fleets and one survey.



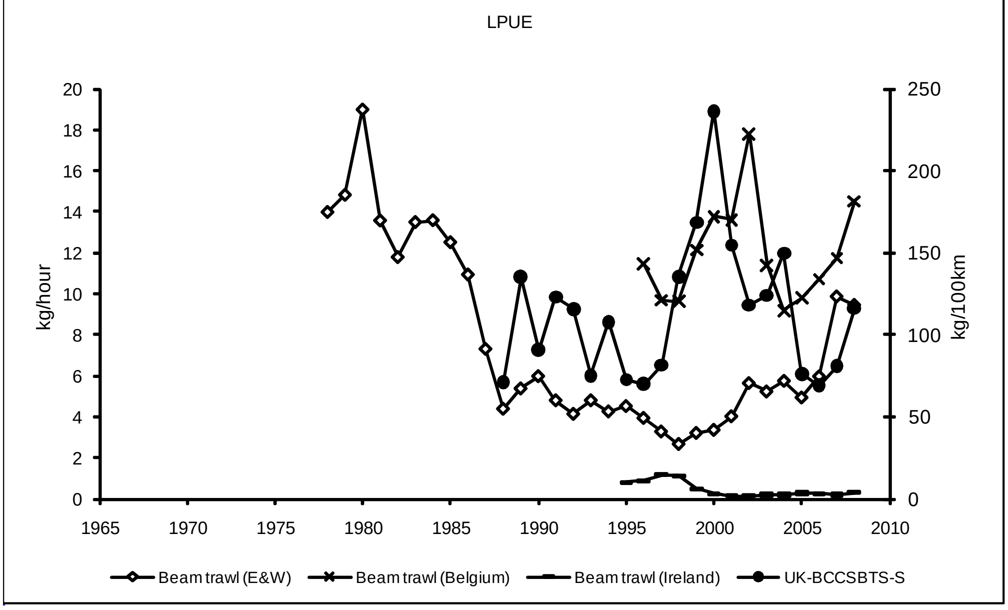


Figure 7.13.8 - Sole in VIIfg - Consistency plot Uk beam trawl

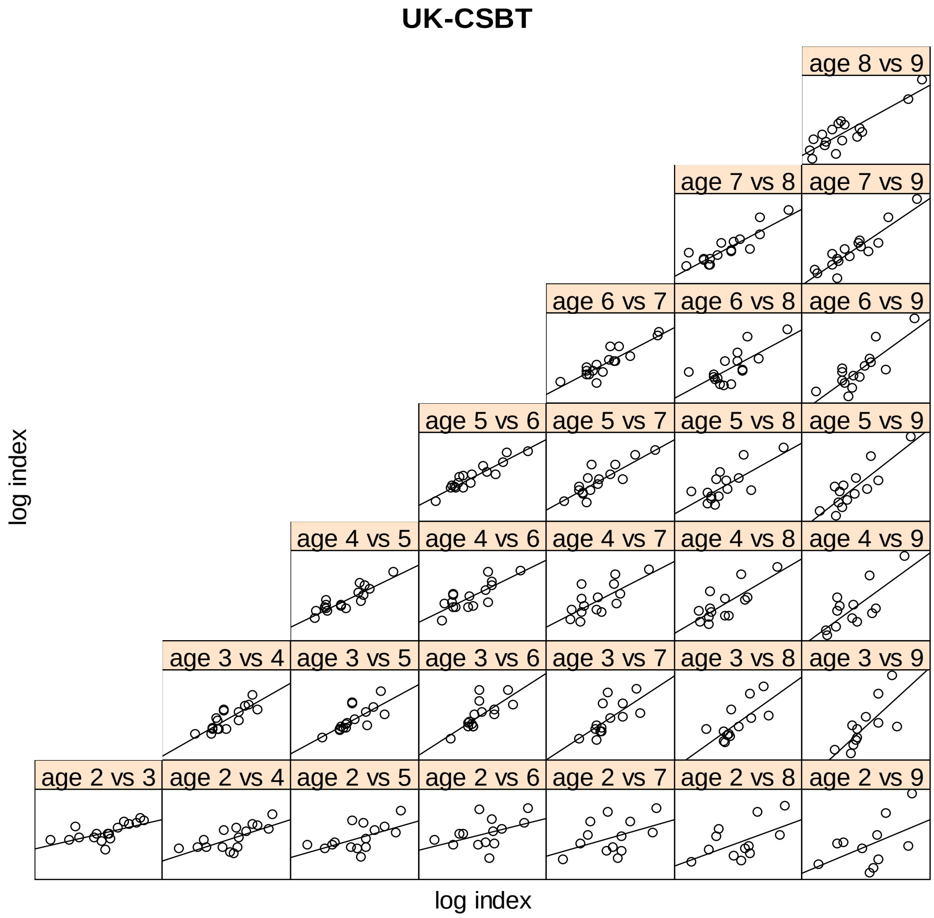


Figure 7.13.9 - Sole in VIIfg - Consistency plot Belgian beam trawl

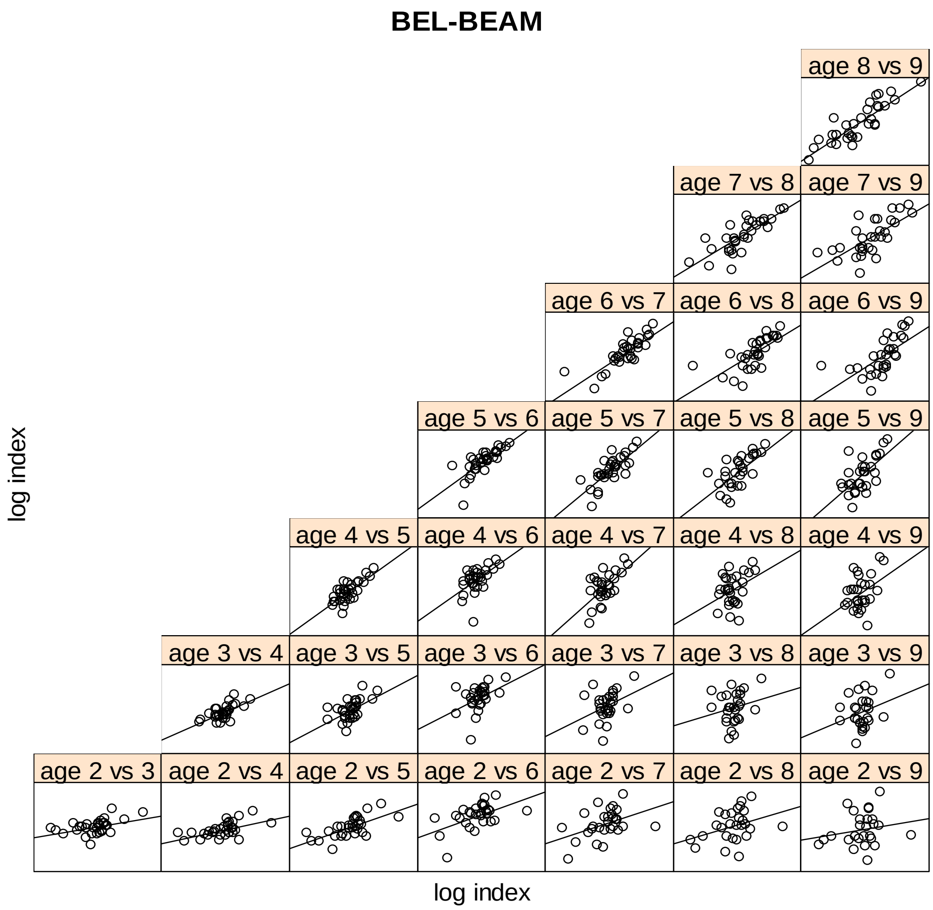
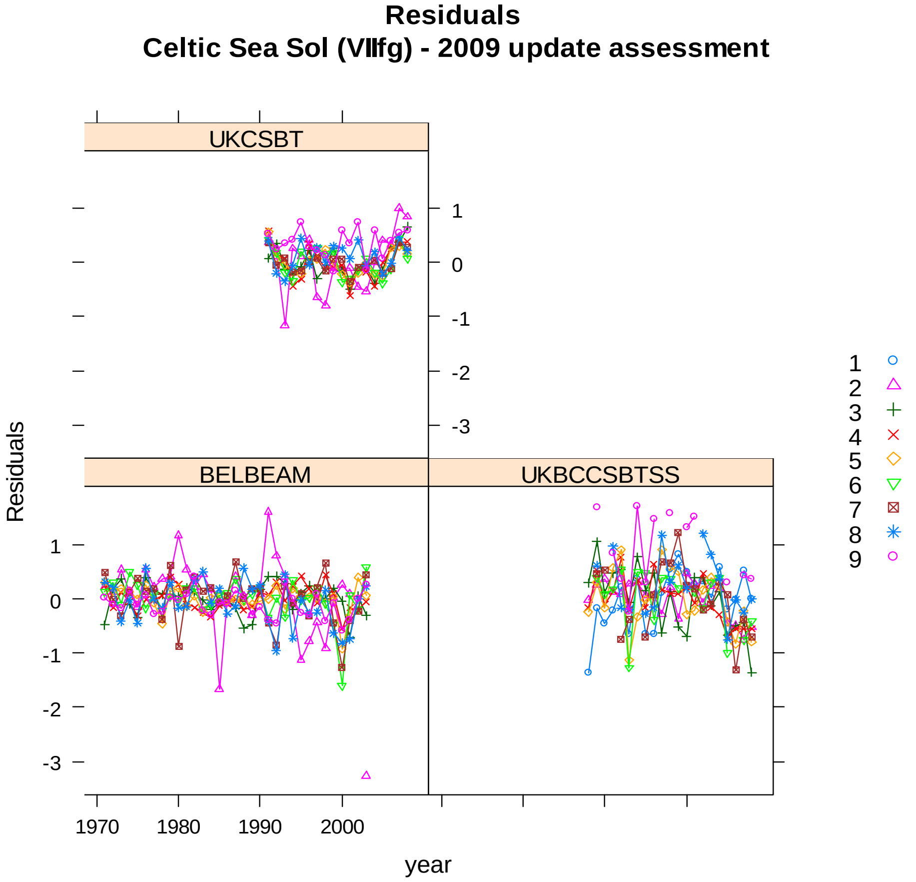


Figure 7.13.10 - Sole in VIIfg. Catchability residuals for final XSA run



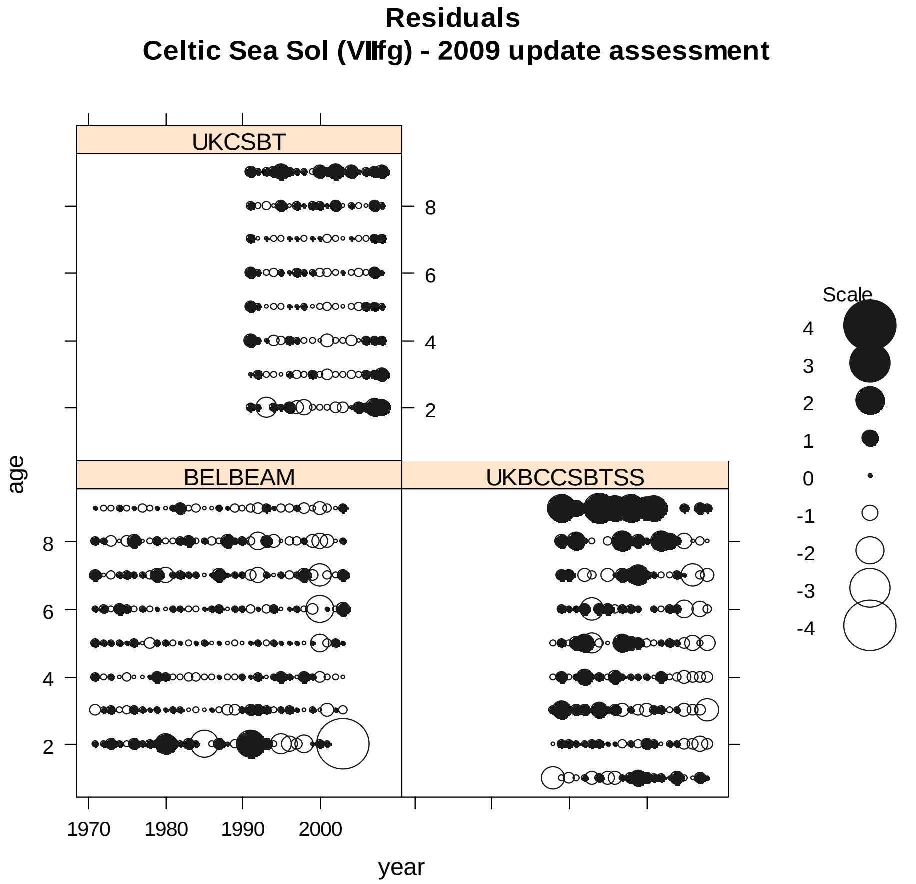


Figure 7.13.11 - Sole in VIIfg. Estimates of survivors from different fleets and shrinkage, as well as their different weighting in the final XSA-run

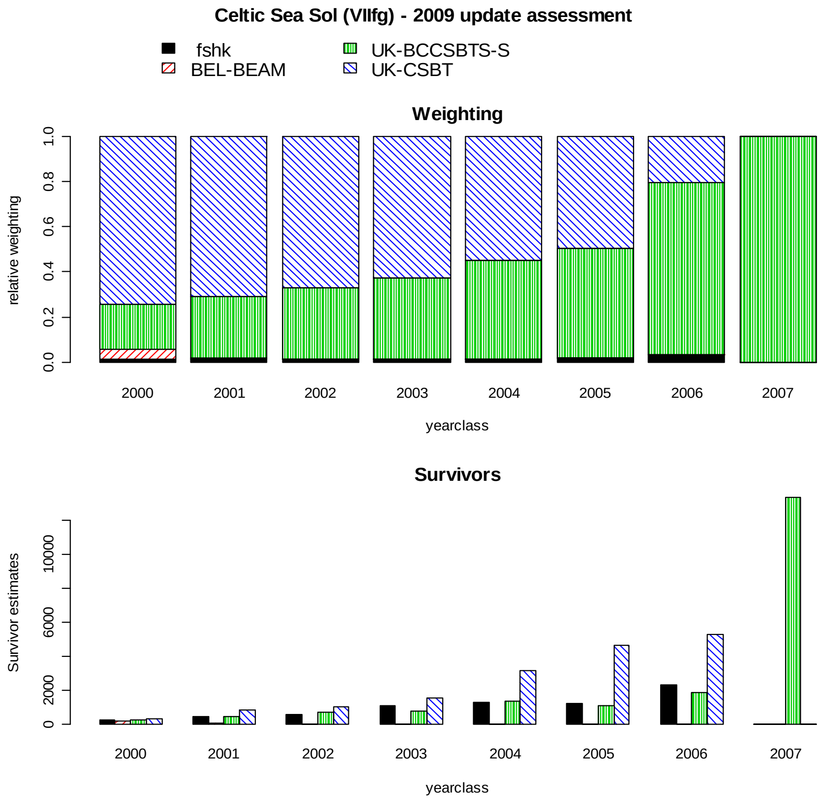
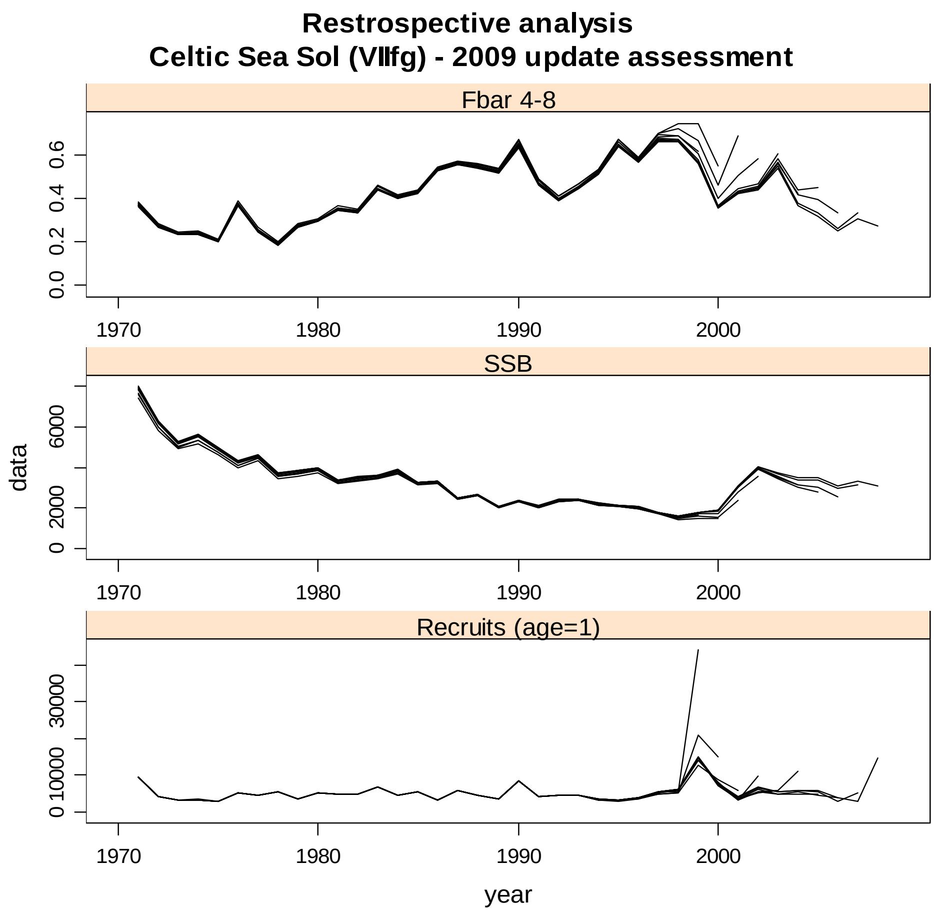


Figure 7.13.12 - Sole VIIf,g retrospective XSA analysys (shinkage SE=1.5)



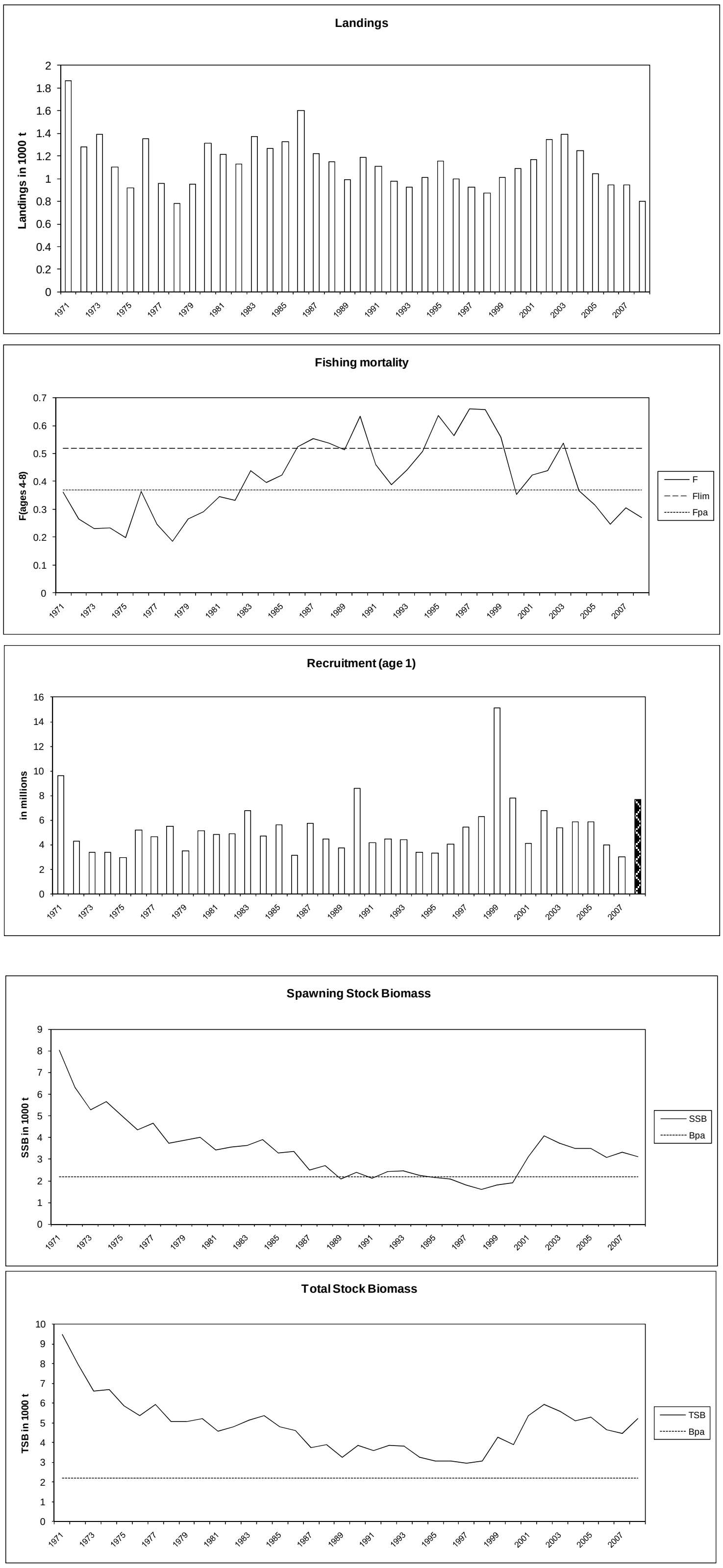


Figure 7.13.13. Sole in VIIfg. Summary plots.

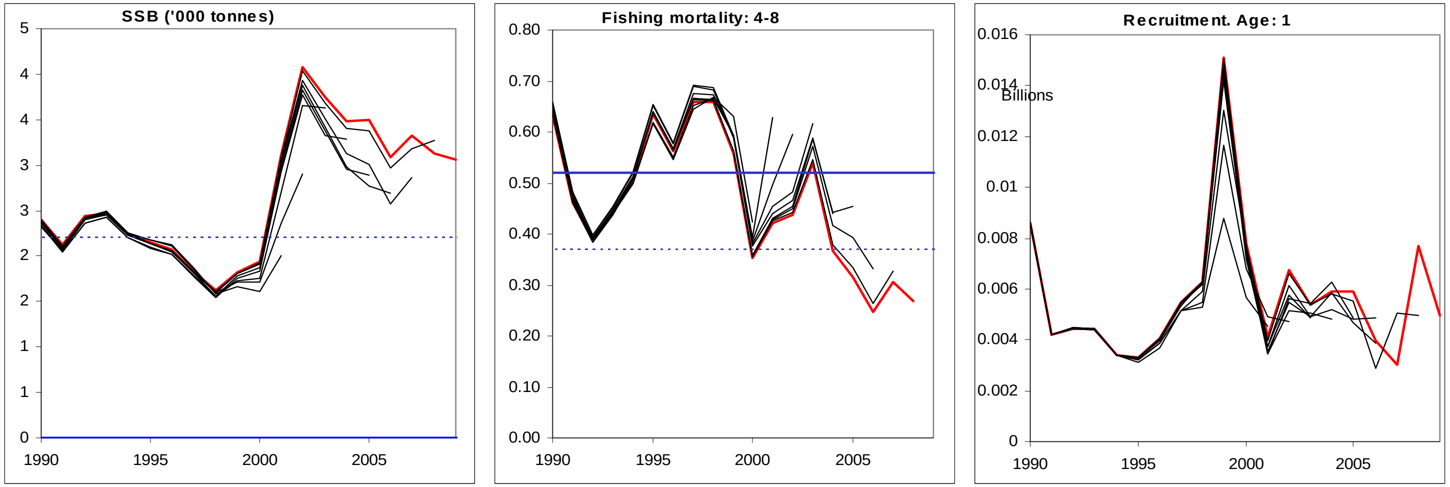
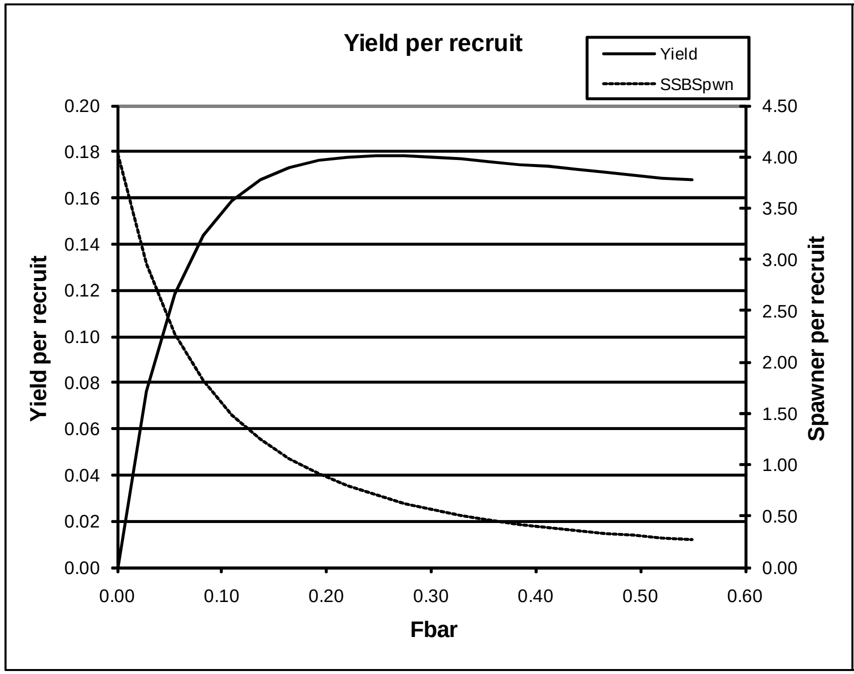
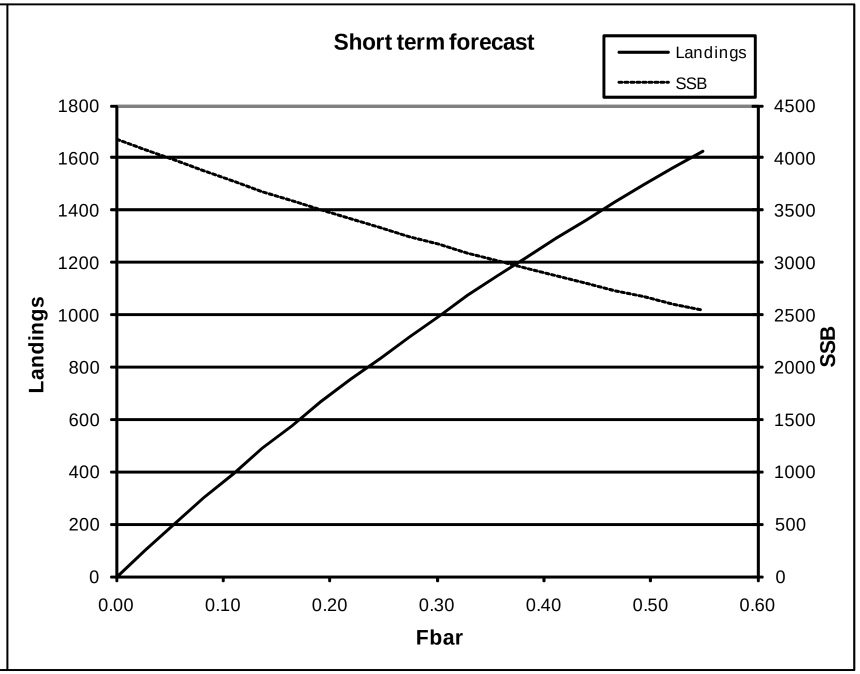


Figure 7.13.14. Sole in VIIfg. Quality control plots. Historical performance.

Figure 7.13.15 - Sole in VIIfg Yield per recruit and short term forecast plots





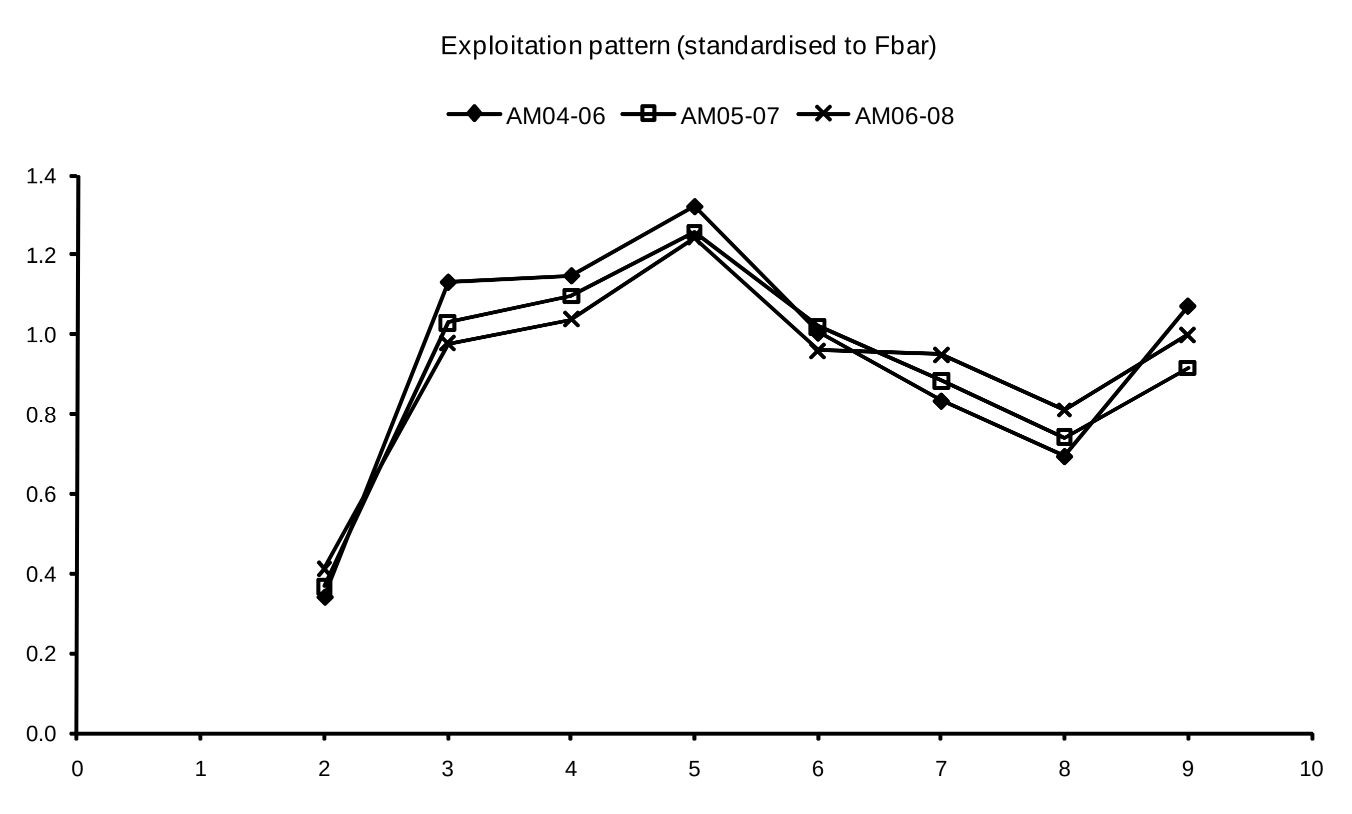
MFYPR version 2a
Run: Sole7Fg_Fin_Yield
Time and date: 18:35 14/05/2009

Reference point	F multiplier	Absolute F
Fbar(4-8)	1.0000	0.2742
FMax	0.9214	0.2527
F0.1	0.4228	0.1160
F35%SPR	0.4298	0.1179

MFDP version 1a
Run: Sole7Fg_Fin
CELTIC SEA SOLE,2009WG ,COMBSEX,PLUSGROUP
Time and date: 17:54 14/05/2009
Fbar age range: 4-8

Input units are thousands and kg - output in tonnes

Figure 7.13.16 - Sole in VIIfg. Three year average exploitation pattern, standardised to Fbar (4-8)



7.14 Sole in the Southwest of Ireland (ICES Divisions VIIh–k)

Type of assessment in 2009

No assessment was performed, however catch numbers and weighs were aggregated for the Irish landings for the years 1993–2008 and these were used to perform a yield-per-recruit analysis.

7.14.1 General

Stock identity

Sole in VIIj are mainly caught by Irish vessels on sandy grounds off counties Kerry and west Cork. Sole catches in VIIk are negligible. VIIh is also considered part of the stock for assessment purposes but there is no evidence to suggest that this is actually the same stock.

7.14.2 Data

The nominal landings are given in Table 7.14.1.

Most non-Irish landings were from VIIh which is likely to be a different stock. Because age data were only available for Irish landings (which were mainly from VIIjk) therefore the remainder of Section 7.14 concerns Irish data only in VIIgjk.

Sampling

Figure 7.14.1 shows that sole landings in VIIjk were mostly taken by Otter trawlers. This is reflected in the sampling.

Data quality

Figure 7.14.2 shows the length distribution of the Irish landings in VIIjk between 1993 and 2008. Sample numbers appear to be adequate. In some years distinct modes of strong year classes are discernible but cohorts cannot easily be tracked.

Annual Age–Length-Keys (ALKs) were constructed (all quarters and gear types combined) and applied to the sampled length–frequency distributions. In order to estimate the uncertainty, the length and age data were resampled and the relative age distribution (proportion-at-age) was estimated for each of 250 bootstrap replications. Individual port samples were taken as the resampling unit. Resampling on a smaller scale (individual fish) would not take account of variability between samples. Figure 7.14.3 shows the age distribution of sole in VIIjk between 1993 and 2008. The precision of the age distributions varies somewhat between years.

7.14.3 Historical stock development

Because sole in VIIh were not sampled, it would not be appropriate to raise the data to all landings in VIIhjk. Instead, the official International landings figures for VIIjk were used to raise the age distributions (Table 7.14.2).

The estimated catch numbers-at-age are given in Table 7.14.3, catch weight-at-age is given in Table 7.14.4. It is possible to track some strong and weak year classes in the catch numbers-at-age matrix. This is also illustrated by Figure 7.14.4, which shows the standardized catch proportions-at-age. Figure 7.14.5 shows the log catch numbers-at-age. The rate of decline in catch numbers through the cohorts appears to be reasonably stable. This can be further investigated by calculating the slope of the log-catch numbers (Z). Figure 7.14.6 shows the catch curve, sole under the age of 4 are not fully selected and from age 10 onwards the data get quite noisy, therefore the slope of the log-catch numbers was estimated over ages 4 to 9 (Figure 7.14.7). Z estimates varied mostly between 0.2 and 0.6.

Yield-per-recruit

The yield-per-recruit was estimated using a method by Thompson and Bell, 1934. This method requires the selectivity to be estimated. This was done by estimating the slope of the log catch numbers for ages that are fully selected and using this slope (Z) to predict the population numbers for ages that are not fully selected. The Z was estimated on pseudo-cohorts which were standardized to take account of annual variations in the catch numbers. Figure 7.14.8 shows that sole in VIIjk appear to be fully selected by the age of 5 and that after the age of 10 the data get very sparse. Figure 7.14.9 shows the slope of the log catch numbers. The predicted catch numbers from this slope were used to estimate the 'observed' selectivity. This was then modelled by applying a linear model after a logit transformation. The estimated selection curve is also shown in Figure 7.14.9. A natural mortality of 0.1 was assumed (based on the value used by the WG for sole in VIIfg) and the WG maturity ogive for sole in VIIfg was used to estimate SSB. The yield was estimated for a range of F values based on the average catch weights. Figure 7.14.10 shows the YPR curve, F_{max} is estimated to be 0.31. $F_{0.1}$ is estimated as 0.13. Recent values of Z ranged between 0.2 and 0.5, with M=1.0 this would result in an F of 0.1 to 0.4. This suggests that this stock is not severely overexploited.

7.14.4 References

Thompson and Bell. 1934. W.F. Thompson and F.H. Bell, Biological statistics of the Pacific halibut fishery. 2. Effect of changes in intensity upon total yield and yield per unit of gear, Rep. Int. Fish. (Pacific Halibut) Comm. 8 (1934), p. 49.

Table 7.14.1. Sole in Divisions VII h–k (Southwest Ireland). Nominal landings (t), 1973–2008, as officially reported to ICES.

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981
Belgium	406	369	210	638	519	290	384	522	576
Denmark	-	-	-	-	-	-		-	-
France	390	143	207	19	103	23	29	27	107
Ireland	108	116	97	152	126	73	109	162	195
Netherlands	4	15	2	33	140	60	-	-	
Spain	190	153	152	131	26	1	8	2	
UK - Eng+Wales+N.Irl.	.	.	.	.	.	.	.	.	.
UK - England & Wales	6	5	24	11	12	11	18	42	83
UK - Scotland	-	-	-	-	-	-	-	-	-
Total	1104	801	692	984	926	458	548	755	961

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990
Belgium	471	411	474	318	442	271	254	252	353
Denmark	-	-	-	-	-	-	-	-	-
France	104	176	120	25	38	44	53	84	66
Ireland	172	176	156	201	188	168	182	206	266
Netherlands		51	194	280	3		-	-	-
Spain		38					-	-	-
UK - Eng+Wales+N.Irl.	.	.	.	.	.	.	.	177	144
UK - England & Wales	108	129	151	200	261	193	166	.	.
UK - Scotland	-	-	-	-	-	-	-	-	-
Total	855	981	1095	1024	932	676	655	719	829

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999
Belgium	358	312	317	338	433	375	368	346	101
Denmark	-	-	-	-	-	-	-	-	-
France	55	43	44	42	47	50	58	74	.
Ireland	306	255	237	184	243	183	203	221	207
Netherlands	-	-	-	-	-	70	-	7	1
Spain	-	-	-	-	-	-	-	-	-
UK - Eng+Wales+N.Irl.	234	215	209	172	192	148	113	111	97
UK - England & Wales	.	.	.	.	.	.	.	.	.
UK - Scotland	-	2	5	2	-	-	-	-	-
UK									
Total	953	827	812	738	915	826	742	759	406
Unallocated						-383	-178	-336	-25
WG estimate						443	564	423	381

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	8	13	154	170	157	90	36	31	10
Denmark	-	-	-	-	-	.			
France	79	103	108	138	108	93	92	78	44
Ireland	111	125	130	105	111	98	63	78	71
Netherlands	10	-	-	-	-	.	1		
Spain	-	-	1	-	-				
UK - Eng+Wales+N.Irl.	95	111	124	78	79	112			
UK - England & Wales	.	.	.	.	.	.			
UK - Scotland	-	-	-	-	-	.			
UK							87	91	79
Total	303	352	517	491	455	393	279	278	204
Unallocated	26	-27	-87	-246	-165	-67	-7	-1	22
WG estimate	329	325	430	245	290	326	272	277	225

Table 7.14.2. Official landings of sole in VIIjk.

YEAR	BEL	FRA	IRE	ESP	UK	TOTAL
1993	-	1	237	.	8	246
1994	-	0	176	.	2	178
1995	-	3	232	.	6	241
1996	-	2	163	.	1	166
1997	-	2	187	.	2	191
1998	-	9	208	.	2	219
1999	96	0	199	.	1	296
2000	8	6	103	.	0	117
2001	7	13	114	.	0	134
2002	69	23	121	.	0	213
2003	48	20	82	.	0	150
2004	2	7	78	.	0	87
2005	-	7	70	<0.5	0	77
2006	-	11	49	-	1	61
2007	-	9	74	.	0	83
2008*		4	68		0	73

*** Preliminary data**

Table 7.14.3. Catch numbers-at-age for sole in VIIjk.

	2	3	4	5	6	7	8	9	10	11	12	13	14+
1993	33	218	224	77	56	57	32	21	12	11	5	5	14
1994	23	117	130	69	41	22	19	11	12	13	11	4	27
1995	0	279	81	174	117	51	15	15	4	22	8	8	6
1996	12	46	116	80	53	54	31	8	5	6	10	3	33
1997	39	161	84	110	43	41	38	16	1	0	4	3	17
1998	23	137	113	59	93	40	43	34	9	5	3	5	32
1999	51	179	218	187	67	77	30	28	19	2	11	1	19
2000	40	96	83	42	29	16	21	11	17	6	3	0	5
2001	65	115	53	49	38	22	22	14	9	4	2	5	8
2002	13	139	183	66	38	39	15	8	24	8	21	5	31
2003	2	54	93	128	76	45	18	4	5	9	14	0	9
2004	7	18	92	48	36	19	14	6	8	1	7	1	20
2005	10	34	47	65	17	38	21	9	4	4	0	4	14
2006	13	29	30	28	38	18	16	11	6	4	1	1	11
2007	1	45	36	30	45	42	21	16	10	3	4	1	8
2008	1	24	85	40	20	19	24	10	7	5	3	3	6

Table 7.14.4. Weight-at-age for sole in VIIjk.

	2	3	4	5	6	7	8	9	10	11	12	13	14+
1993	0.154	0.221	0.275	0.342	0.412	0.455	0.511	0.496	0.628	0.567	0.761	0.499	0.706
1994	0.143	0.233	0.278	0.346	0.421	0.453	0.514	0.552	0.610	0.632	0.632	0.583	0.737
1995		0.194	0.322	0.362	0.338	0.370	0.493	0.452	0.722	0.579	0.401	0.297	0.592
1996	0.138	0.169	0.230	0.307	0.435	0.421	0.505	0.587	0.613	0.711	0.755	0.643	0.698
1997	0.133	0.200	0.281	0.334	0.409	0.526	0.618	0.592	0.679		0.692	0.846	0.922
1998	0.137	0.223	0.281	0.357	0.379	0.448	0.515	0.554	0.455	0.646	0.497	0.641	0.805
1999	0.152	0.192	0.308	0.345	0.400	0.426	0.461	0.575	0.578	0.657	0.449	0.896	0.764
2000	0.180	0.211	0.255	0.396	0.413	0.471	0.502	0.487	0.505	0.584	0.555		0.632
2001	0.164	0.228	0.295	0.337	0.394	0.481	0.548	0.529	0.587	0.800	0.540	0.739	0.726
2002	0.203	0.198	0.255	0.305	0.470	0.490	0.473	0.655	0.732	0.724	0.627	0.616	0.895
2003	0.168	0.191	0.295	0.321	0.328	0.376	0.369	0.572	0.501	0.545	0.475		0.596
2004	0.095	0.200	0.198	0.294	0.313	0.353	0.287	0.581	0.632	0.498	0.595	0.498	0.724
2005	0.128	0.168	0.198	0.249	0.382	0.317	0.340	0.445	0.524	0.467		0.488	0.613
2006	0.160	0.180	0.206	0.257	0.298	0.354	0.354	0.377	0.456	0.377	0.612	0.438	0.718
2007	0.154	0.207	0.267	0.281	0.328	0.341	0.377	0.394	0.449	0.447	0.418	0.554	0.522
2008	0.144	0.204	0.235	0.275	0.304	0.338	0.338	0.394	0.389	0.448	0.559	0.450	0.681

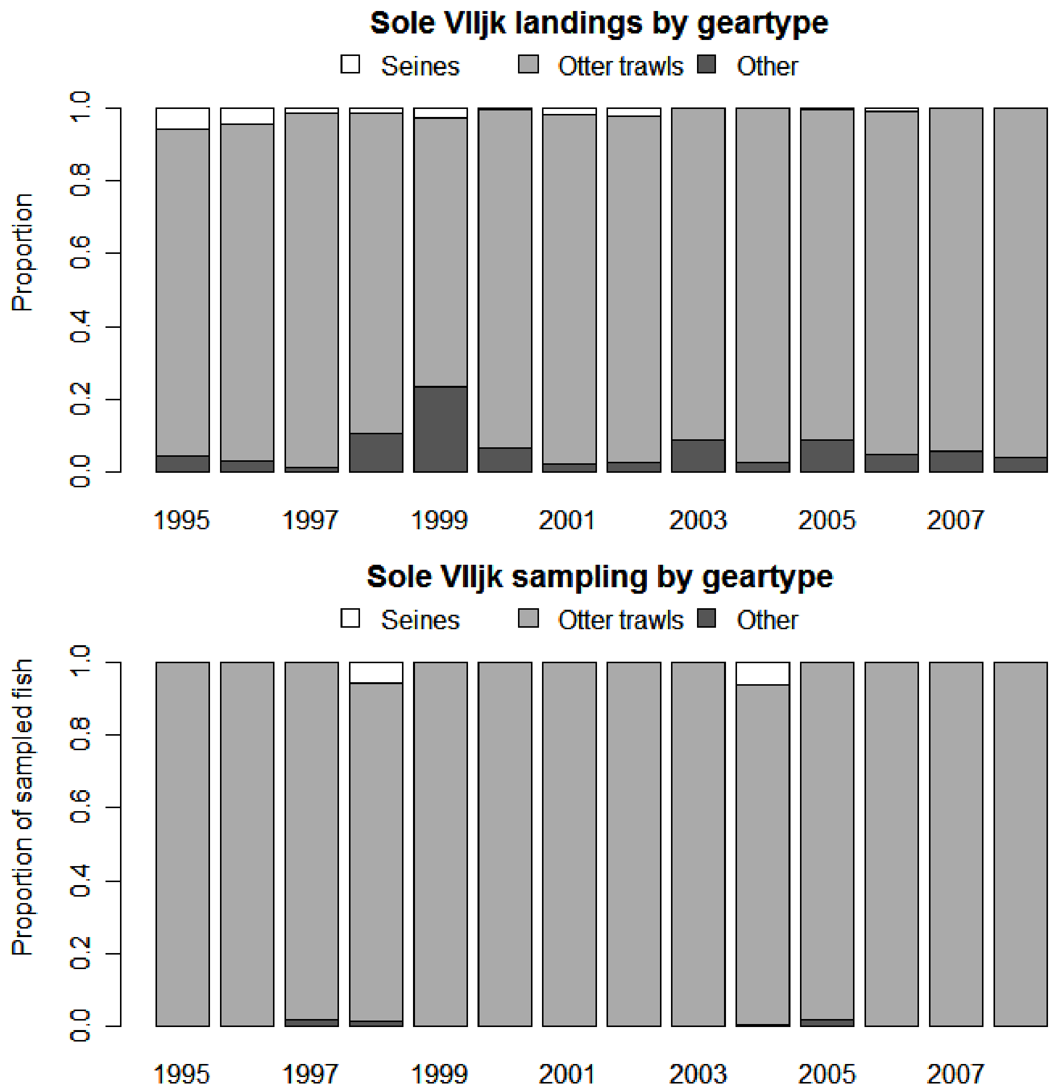


Figure 7.14.1. Irish Operational landings of sole in VIIjk by geartype (top) and number of fish measured by geartype (bottom). The sampling appears to be representative of the geartypes in the fishery.

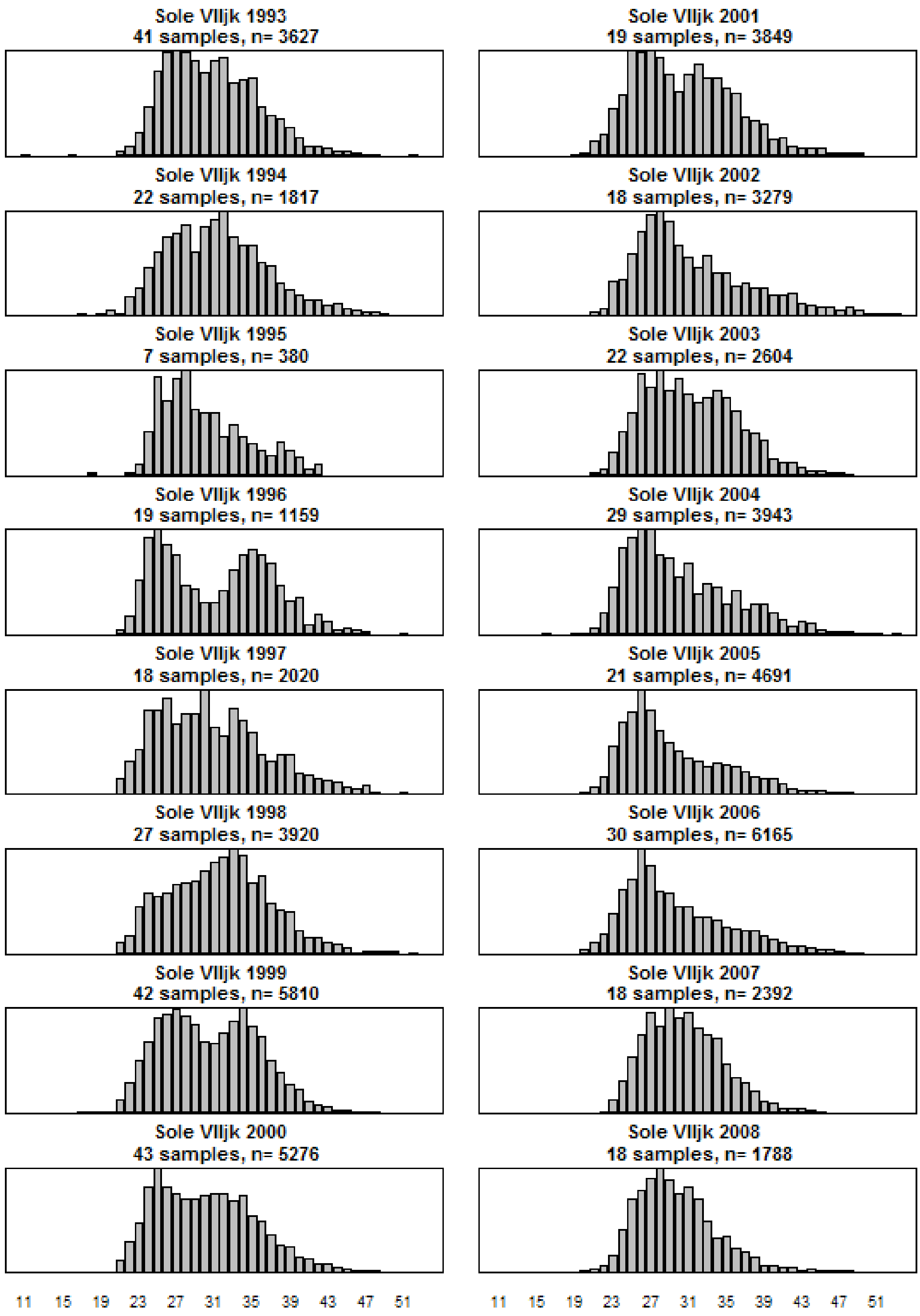


Figure 7.14.2. Length–frequency distribution of the Irish landings of sole in VIIjk between 1993 and 2008. All gears and quarters combined. Sampling was poor during 2006 and 2007.

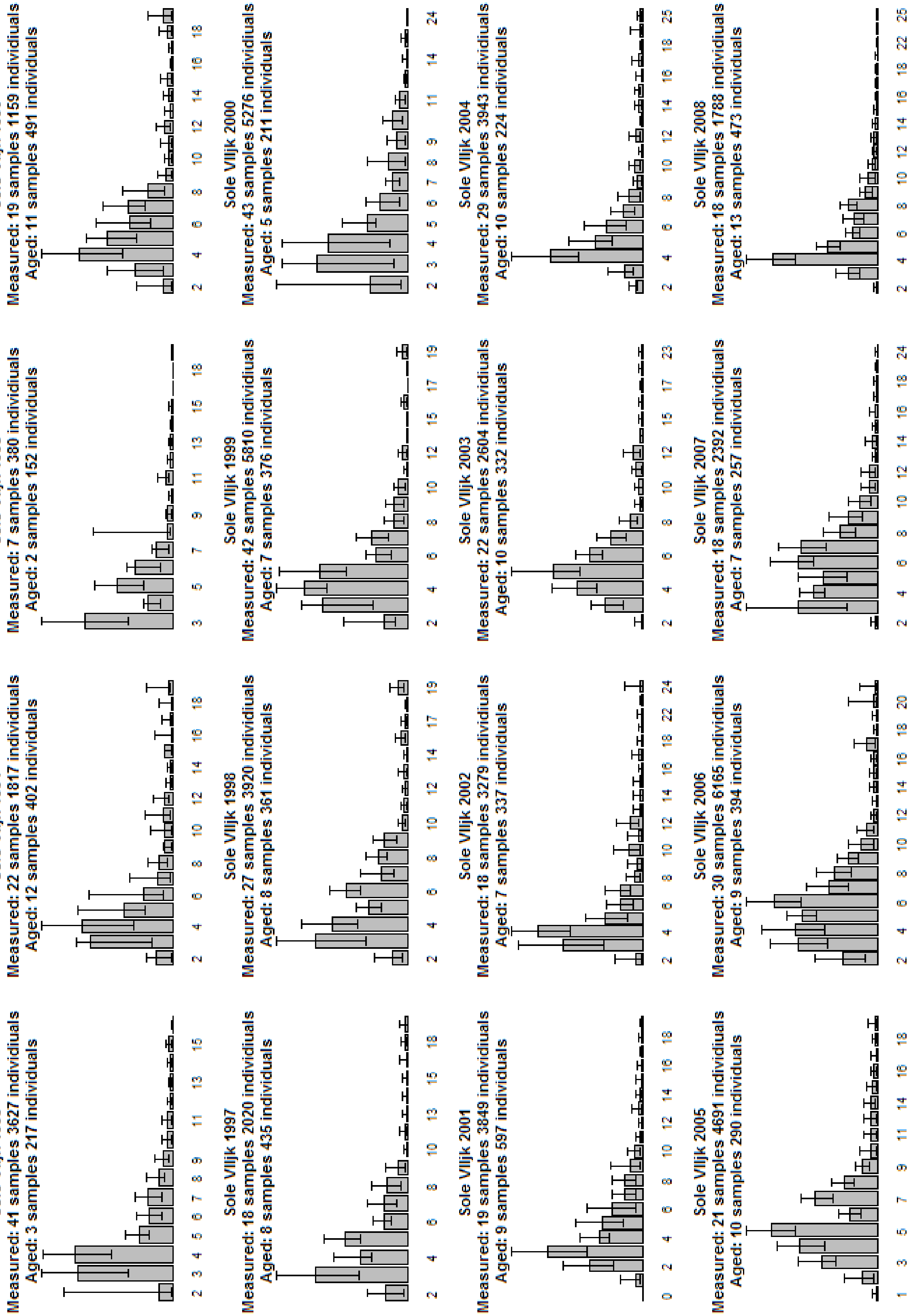


Figure 7.14.3. Relative age distribution of sole in VIIjk between 1993 and 2008. All gears and quarters combined. The error bars represent the 95% confidence limits (bootstrap estimates). No error estimates are available for 2006 as there was only one length sample during that year.

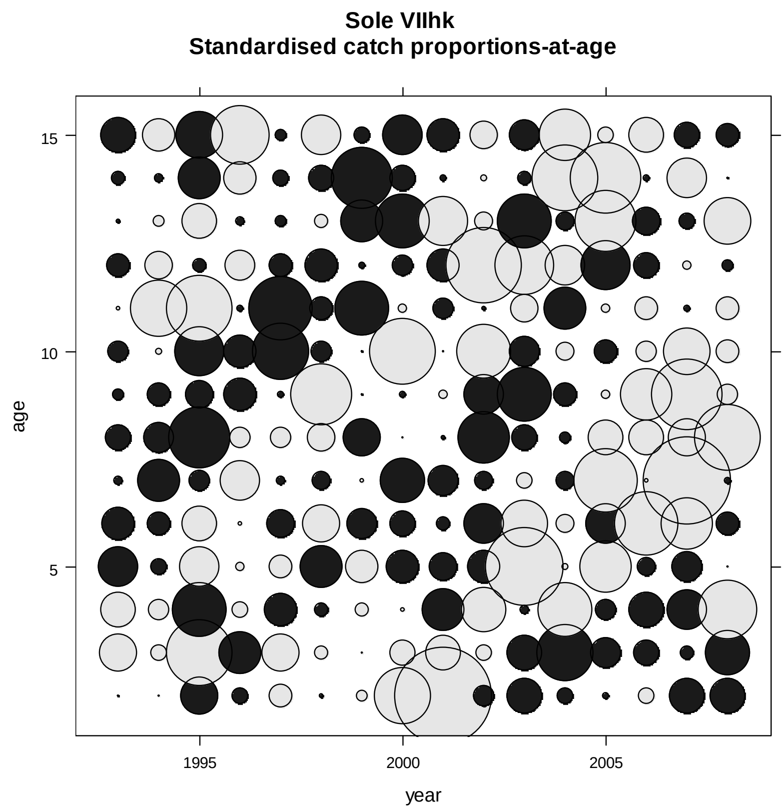


Figure 7.14.4. Standardised catch proportions-at-age for sole in VIIjk. Grey bubbles represent higher-than-average catch-at-age and black bubbles represent lower-than-average catch-at-age.

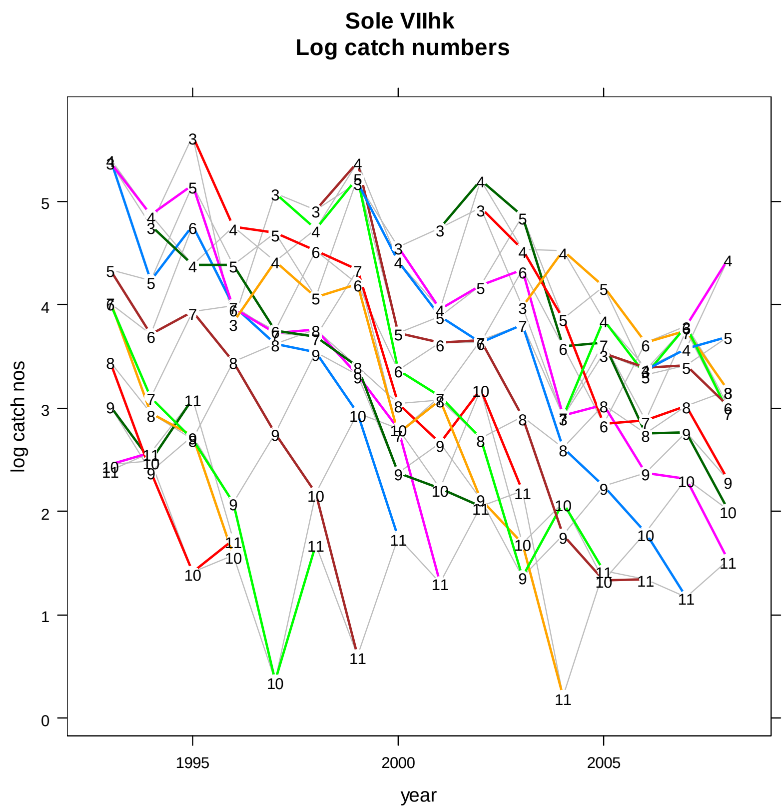


Figure 7.14.5. Log catch numbers-at-age (ages 4–8).

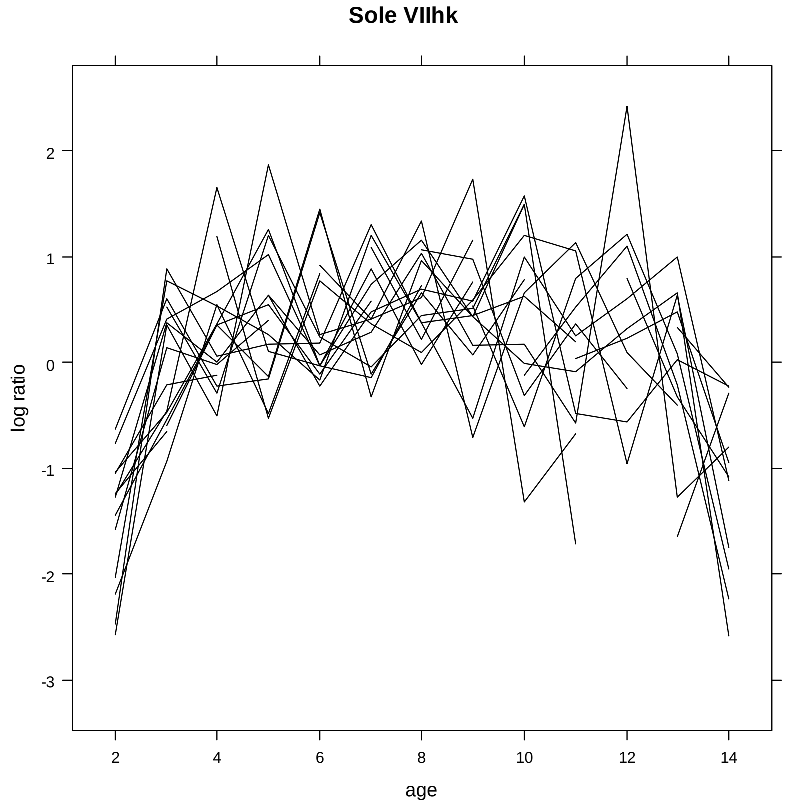


Figure 7.14.6. Catch curve of plaice in VIIbc. Plaice from the age of 4 appear to be fully selected; the data get quite noisy from the age of 7 onwards.

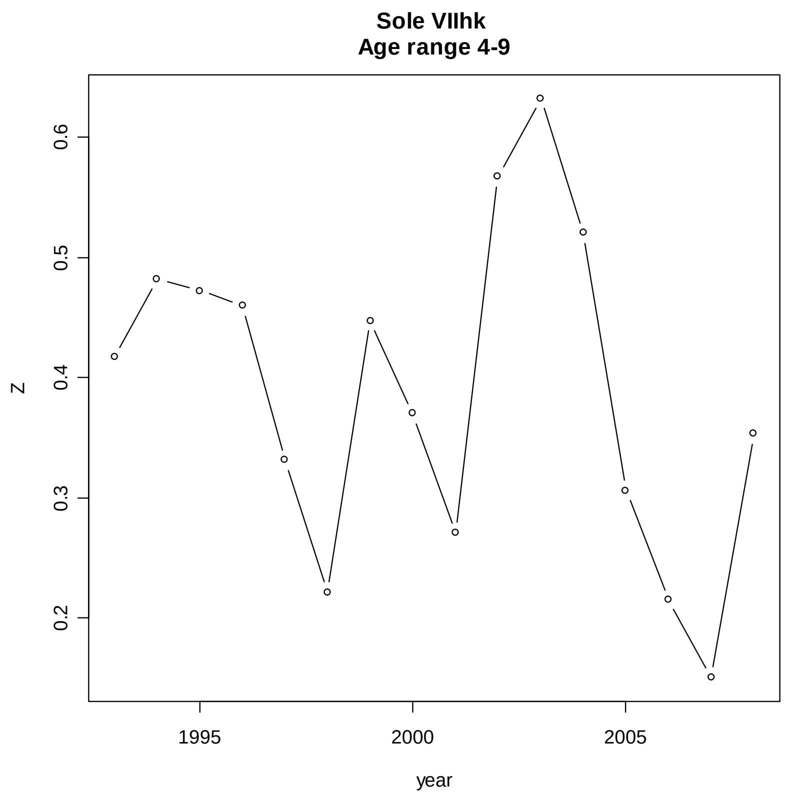


Figure 7.14.7. Z estimated over pseudo-cohorts as the slope of the log catch numbers.

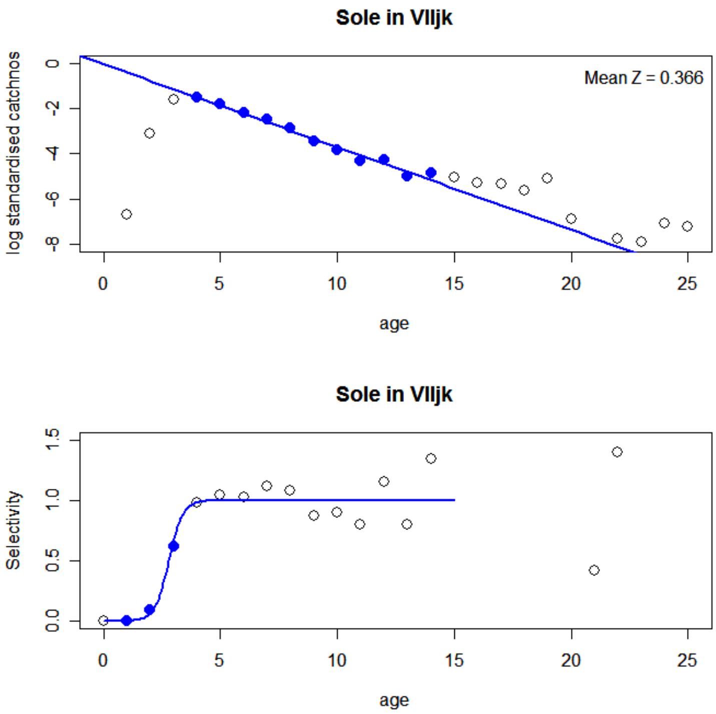


Figure 7.14.8 Selectivity was modelled by fitting a line through the mean log standardized catch numbers of ages 4 to 14 to predict the expected catch numbers for ages 1 to 3 if these were fully selected. The proportions of observed divided by expected catch number were taken as the 'observed' selectivity. This was then modelled using a logit transformation.

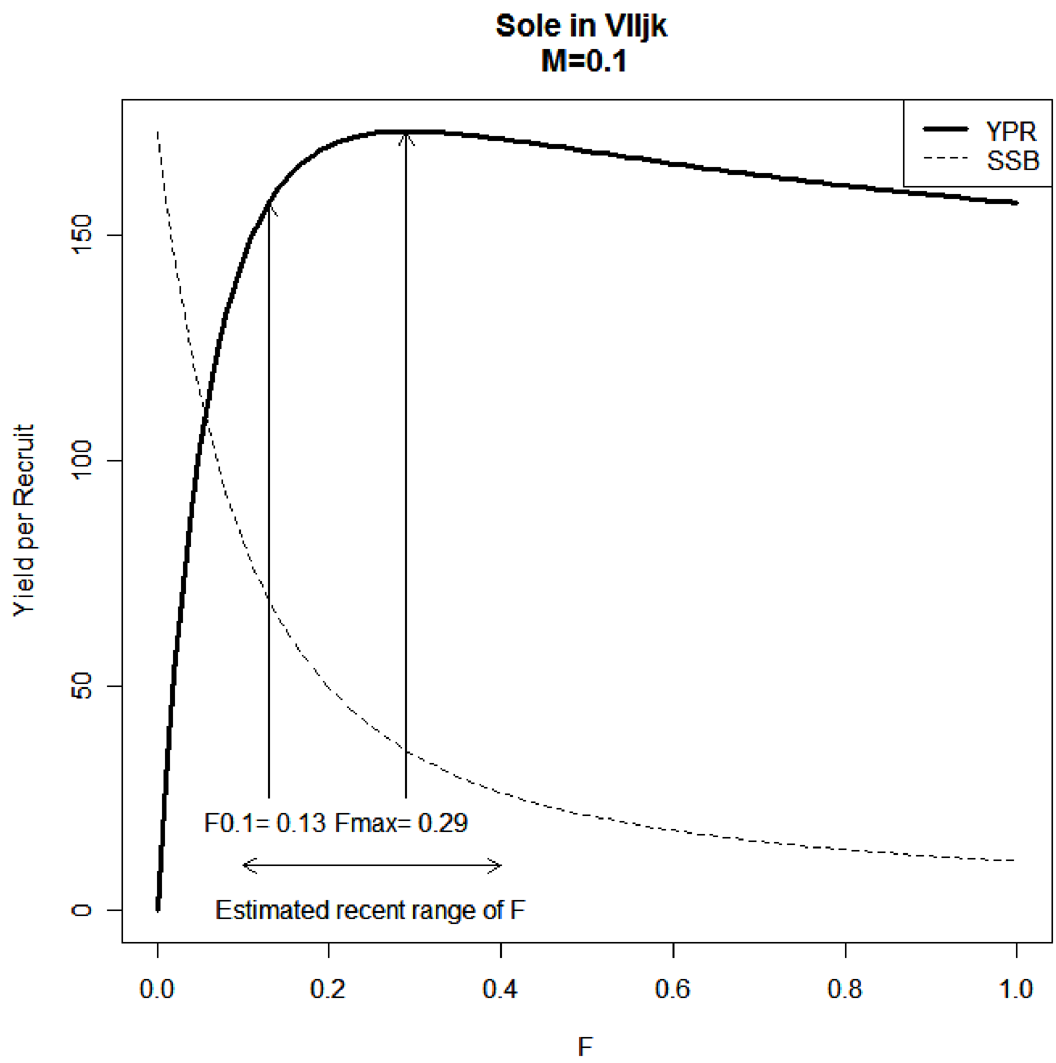


Figure 7.14.9. YPR analysis using the Thompson-Bell approach. Recent estimates of Z were between 0.2 and 0.5 which translates to an F of 0.1 to 0.4

7.15 Whiting in Division VIIe–k

Type of assessment in 2009

Update assessment. Same Advice as Last Year.

ICES advice applicable to 2008

Exploitation boundaries in relation to precautionary limits: The current estimates of fishing mortality and SSB are uncertain, but SSB demonstrates a decreasing trend while recruitment is low. In order to reverse this trend, ICES considers that fishing mortality should be reduced. However, ICES cannot quantify the required reduction in fishing mortality.

ICES advice applicable to 2009

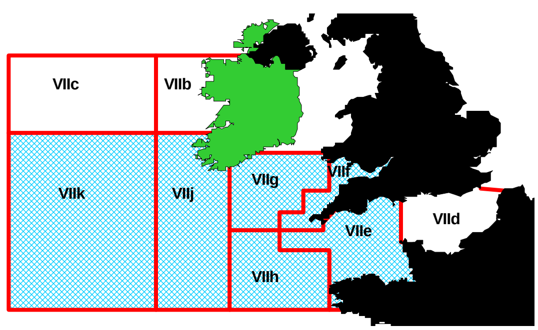
Exploitation boundaries in relation to precautionary limits: The current estimates of fishing mortality and SSB are uncertain, but SSB demonstrates a decreasing trend while recruitment is low. In order to reverse this trend, ICES considers that fishing mortality should be reduced. However, ICES cannot quantify the required reduction in fishing mortality.

In addition, ICES offers the following consideration: surveys do indicate that the 2007 year class may be strong. Management measures should be introduced in the Celtic Sea to reduce discarding of this year class in order to maximize its contribution to future yield and SSB.

7.15.1 General

Stock description and management units

The TAC for whiting is set for Divisions VIIb,c,d,e,f,g,h,j and k (although VIIj was missing from Council Regulation (EC) No 43/2009, and omitted from Council Regulation (EC) No 40/2008 and No 41/2007). This assessment area does not correspond to the TAC area. Whiting in VIIb,c are not assessed and whiting in VIId are included in the WDNSSK assessment of the North Sea stock. Any management measures implemented for this stock should be consistent with the assessment area.



Red Boxes-TAC/Management Areas **Blue Shading– Assessment Area**

The 2009 TAC for whiting VIIb–k has been reduced from the previous TAC of 19 940 t which had been set annually since 2006. This TAC has not been considered restrictive, with officially reported VIIe–k landings totalling 4928t in 2008. There is some recent information of overreporting (where haddock were reported as whiting) in some fleets for the years when haddock quotas were restrictive. It is not possible for the WG to evaluate the scale of this problem and the assessment is largely based on landings as reported in logbooks. The introduction of buyers and sellers legislation in 2007 should improve future landings statistics.

Species: Whiting *Merlangius merlangus*		Zone: VIIb, VIIc, VIId, VIIe, VIIf, VIIg, VIIh and VIIk (WHG/7X7A.)
Belgium	163	
France	9 999	
Ireland	4 918	
The Netherlands	81	
United Kingdom	1 788	
EC	16 949	
TAC	16 949	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

Fishery in 2009

ICES officially reported landings for Divisions VIIe–k and landings as used by the Working Group are given in Table 7.15.1. There is a discrepancy between the ICES officially reported landings and those reported to the WG for 2008 of ~800 t. The majority of this stems from higher WG reported French landings. It is believed by the WG that official French whiting landings from Divisions VIIe–k have been wrongly assigned to VIIbc, which are far higher than the normal range for this area and those reported to the WG. In 2008 international landings are the lowest in the time-series, ~5700 t.

Minimal revisions (<100 t) to 2007 landings were submitted to the WG. ICES Official landings increased by ~670 t, primarily resulting from French revisions. Landings from the Netherlands, Spain, UK Scotland and the Channel Islands have also now been reported (combined <100 t).

The TAC for this stock has been in excess of recent landings. The level of misreporting of this stock is not known and underreporting has previously been considered unlikely to have been a significant source of unaccounted mortality of whiting in the assessment. There has been some recent information of overreporting (where haddock were reported as whiting) in some fleets for some years when haddock quotas were restrictive. It is not possible for the WG to evaluate the scale of this problem currently.

The VIIe–k whiting stock is primarily targeted by otter trawlers and to a lesser extent Scottish seines and beam trawls. Otter trawlers utilize two mesh size ranges to 70–89 mm and 100–119 mm. Effort of trawlers utilizing these two mesh size ranges has remained relatively stable within the Celtic Sea as a whole, however effort of the larger mesh range has declined within VIIf and VIIg over recent years. These mesh ranges have different species selectivity patterns. There are several main species groups are targeted by otter trawlers catching whiting, as part of a targeted mixed gadoid fishery and as bycatch within the *Nephrops* and hake, anglerfish, and megrim fisheries. Beam trawlers operate to the eastern side of the assessment area, VIIe–h where small quantities of whiting are taken as a bycatch species in flatfish, anglerfish, and ray target fisheries. The spatial distributions of landings by country in 2008 are given in Figure 7.15.1. French landings demonstrate a wide spatial distribution, greater focus of which is within ICES rectangles 31E3, 30E4 and 29E7. Irish catches are primarily from within VIIg and to a lesser extent VIIj. Irish catches exhibit the same spatial and temporal focus as French landings. The majority of UK landings are from otter trawlers in VIIe, and focused within 29E5 and 29E6.

7.15.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1.

Landings

National landings and numbers-at-age data were aggregated for the area VIIe–k, following methodology described in the stock annex. Nations provided minor revisions to 2007 data, in addition to provisional 2008 data. Minor revisions were also made to 2005 and 2002. The sampling levels for the landings are presented in Table 2.1.

The length compositions from various fleets for 2008 are displayed in Table 7.15.2 and Figure 7.15.2. The landings length distributions of the Irish otter trawl, UK and French fleets, which account for the majority of the landings, are similar. Scottish seine fleets land a similar distribution fish compared with otter trawl fleets, while the beam trawler lands larger fish.

The international catch numbers-at-age are given in Table 7.15.3 and Figure 7.15.3. It is possible to track strong year classes in the landings-at-age matrices. Age group 0 was included in the assessment data to allow inclusion of 0-group indices in the XSA, although no landings at this age were recorded in most years. Very small landings of 0-group whiting were not included in the catch-at-age data-file to avoid spurious F-shrinkage effects at this age. Mean weights-at-age in the catch and stock (Tables 7.15.4 and 7.15.5) were derived as previously and the methodology is described in the stock annex. The stock weights are shown in Figure 7.15.4. There is some variability particularly at older ages. There is some indication of an increasing trend in landings weights-at-age, particularly at-age 4 and above in recent years.

Discards

Discard data are available from the Irish fishery since 1994 (ICES: SGDBI, 2002), from French sampling in 1991, 1997, and 2005–2008, and for the UK (E&W) fisheries from 2001–2008. These data are not used in the assessment as the data available does not cover the full time-series of landings-at-age-data, and historically sampled fleets may not be representative of the main fleets involved in the fishery. Furthermore, there is a need to examine and agree the best raising practice for the various fleets. Discard rates are high and variable and it is not clear if current sampling intensity will obtain precise enough annual estimates to support an assessment method where catch numbers are assumed to be exact as in XSA.

A summary of the 2008 discard sampling and discard rates is presented in Table 7.15.6. At the time of the Working Group not all French discard data were available and those provided should not be used to produce discard rates. Discard rates of the Irish and UK data, although variable, are similar to the range observed in 2007.

Discarded whiting length distributions from 2008 Irish and French otter trawlers, and all UK gears were made available to the WG (Figure 7.15.5). The available data indicate that discarding rates are substantial and occurs above the 27 cm MLS. The discard L_{50}'s for most countries/fleets is around 27–28 cm.

Age compositions for Irish discard data were provided for otter trawlers in VIIg and VIIj for 2003–2008 indicating discarding from age 0 up to age 8 in some years. Substantial discarding of ages 1 and 2 occurs for most years (Figure 7.15.6). Discard numbers-at-age have not yet been calculated for other fleets.

Biological

Mean stock weights- and numbers-at-age data were calculated, following methodology described in the stock annex.

Natural mortality was assumed to be 0.2 over all age groups and years.

Available data on maturity-at-age are described in the Stock Annex. Since 2006 the knife edge maturity ogive has been replaced with indices calculated based on data from the UK WCGFS but a fixed vector is still used. Recent maturity sampling by Ireland and the UK on dedicated surveys confirms the use of this ogive but is in-sufficient to provide annual data.

AGE	0	1	2	3	4	5+
Maturity	0	0.39	0.90	0.99	0.99	1.00

The proportions of F and M before spawning were both set to zero to reflect the SSB calculation date of January 1st.

Surveys

Time-series of standardized abundance indices for ages 0–3 from the 7 available research surveys are displayed in Table 7.15.7. Four fishery-independent survey indices including 2008 data were available to the WG. Further details of these surveys are given in WGSSDS 2008 Table 1.3.3. The strong 1999 year class is evident in all surveys. The complete time-series and ages available from these surveys are given in the tuning fleet information available to the Working Group (Table 7.15.8).

Internal consistency of the surveys was examined, pairwise scatterplots of log numbers-at-age were examined, bearing in mind that the correlations may be impacted by changed in fishing mortality. Plots for the 3 surveys included in the assessment are provided in Figure 7.15.7. Year effects were examined with mean log standardized plots of indices by age and year (Figure 7.15.8). Cohort tracking was examined with mean log standardized plots of indices by age and cohort (Figure 7.15.9).

The FR-EVHOE survey log indices scatterplots display reasonable positive correlation with adjacent ages but demonstrate some noise up to age 4. The mean log standardized indices by year display a year effect in 2006 and by cohort demonstrates good tracking of stronger year classes. The UK-WCGFS also demonstrated inconsistencies between years in the log-index scatterplots but reasonably consistent catch-curves. The mean log standardized index by year demonstrated some evidence of positive catchability in the last three years of the survey (2002–2004) and cohort tracking in the mean standardized index up to then was very noisy in the last 3 years. These years were not included in the final assessment.

The log-indices for the Irish VIIg swept-area survey reveal some positive correlation for younger ages. The mean log standardized index by year demonstrated some slight year effect in 2003 which was the first year of the new series. The mean standardized index by year demonstrated good tracking of the strong 1999 year class to age 7 with the exception of age 4 in 2003. Although the source data were checked, this is probably an anomaly of the year effect in 2003. This point has been removed from recent assessments to ensure the survey gets higher scaled weight in further runs. This compromise is not ideal but given the short time-series of the survey and apparently good performance otherwise the WG considered that the survey should be a good index for this stock.

Commercial cpue

Estimates of commercial lpue, from 1995 to 2008, were available for the Irish otter trawl, Scottish seine, and beam trawl fleets operating in Divisions VIIg and VIIj (Table 7.15.9 and Figure 7.15.10). The effort-series is raw effort in hours uncorrected for changes in vessel power or changes in species targeting (i.e. métier compositions). The recent above average Irish VIIg otter board landings and lpue ended in 2008, with lpue one third of 2007 levels. Effort however continues to follow the recent elevated levels. The elevated effort in VIIg has been associated with the displacement, and subsequent relocation of effort in response to restrictive management in other areas particularly VIa and VIIa. Lpue for these fleets had remained relatively stable up until around 2002/3. The VIIj otter trawl fleet demonstrates slight declines in landings and effort to those of 2007, with stable lpue. There is a sharp decline in lpue for the IR-7G-SSC and IR-7J-SSC during the available time-series, with lowest values around 2004. Since when, these two fleets are demonstrating increasing lpues, although landings by these two fleets are low. Effort and lpue data for the Irish beam trawls (TBB) operating in VIIg and VIIj are also included in Table 7.15.9 but is not plotted as landings, effort and lpue are minimal.

Estimates of commercial lpue, up to and including 2008, were also available for French gadoid trawlers and French *Nephrops* trawlers operating in Divisions VIIf,g (Table 7.15.9 and Figure 7.15.10). Fishing effort in the FR-GADOID fleet has been declining since 1989, while the effort in the FR-NEPHROPS has declined since 1992. The FR-GADOID fleet's lpue increased to historically high levels in 1994 and 1995 but has declined since. Sharp increases in lpue for the French gadoid fleet occurred in both 1998 and 2005, since which lpue has declined. Lpue for the FR-NEPHROPS fleet peaked in the mid-1990s, having declined since to levels similar to the early 1980s. Landings, effort and lpue for both these fleets currently demonstrate the lowest levels within the time-series. Limited lpue data from France are available for Divisions VIIj–k, but they are not considered representative. The commercial tuning fleets available to the assessment are given in Table 7.15.8.

Abundance indices-at-age were available for three commercial fleets, the French gadoid, and *Nephrops* fleets, and the Irish. As with the surveys, the internal consistency of these fleets (Figure 7.15.7), any year effects (Figure 7.15.8) and cohort tracking (Figure 7.15.9) were examined. The French commercial *Nephrops* index demonstrates very good internal consistency, as does the French gadoid fleet, although consistency at-age 3 is slightly poorer. The IROTB-7g&j previously used in the assessment was not considered as a consequence of poor cohort tracking and *a priori* concerns about changes in targeting practice and fishing power because of recent fleet changes since 2002.

Other relevant data

Meetings with representatives of the fishing industry were held prior to WGCSE2009 in Ireland and UK. No specific concerns were raised about the state of this stock or its assessment. Both the Irish and UK industries perceived the stock to be at a low level during 2008.

7.15.3 Historical stock development

An XSA assessment was carried out for this stock applying the same settings as last year's update assessment, with the addition of 2008 data. The settings previously used and applied this year are detailed within the stock annex.

Data screening

The general methodology is outlined in Section 2. Preliminary investigations were carried out using FLR under R version 2.4.1. The packages FLCore 1.4–3, FLAssess 1.4.1, FLXSA 1.4–2 and FLEDA 1.4–2 were used.

Final update assessment

The update assessment was carried out with FLXSA 1.4–2 under R version 2.4.1. The tuning data available, and the subset used in the assessment, are given in Table 7.15.8. Age group 0 was included in the assessment data to allow inclusion of 0-group indices in the XSA runs. However, catch numbers at-age 0 were set to zero to avoid spurious F-shrinkage effects at this age. No exploratory runs were carried out for this update assessment. Final settings for which are detailed below:

		2008	2009
Catch date range:	Years	82-07	82-08
	Ages	0-7+	0-7+
Fbar Age Range:		2-5	2-5
Assessment Method:		XSA	XSA
Commercial Tuning Fleets:			
FR-Gadoid	Yrs		
	Ages		
FR-Gadoid Late	Yrs	93-07	93-08
	Ages	3-6	3-6
FR-Nephrops	Yrs	93-07	93-08
	Ages	3-6	3-6
IR-7g&j-OT	Yrs		
	Ages		
Survey Tuning series:			
FR-EVHOE	Yrs	97-07	97-08
	Ages	0-4	0-4

UK-WCGFS	Yrs	87-01	87-01
	Ages	1-6	1-6
UK-BCCSBTS	Yrs		
	Ages		
IR-IGFS Swept area	Yrs	99-07	99-08
	Ages	0-6	0-6
Time taper:		No	No
Q plateau age:		5	5
F shrinkage S.E:		1	1
	Num yrs	5	5
	Num ages	3	3
Fleet S.E:		0.5	0.5

The full XSA diagnostics are given in Table 7.15.10. Substantially higher survivor estimates are given by the FR-EVHOE survey than the IR-IGFS-Swept Area survey, for both the 2008 year class (age 0) and the 2007 year class (age 1). For the older ages, the estimates were variable. The French gadoid fleet generally gave higher estimates at older ages than the other tuning-series. Figure 7.15.11 shows the scaled weights received by each fleet in the assessment.

The log-catchability residuals from the XSA fit are plotted for each tuning-series in Figure 7.15.12. There are some year effects and noise in the short time-series of data. Year effects can be seen within the French commercial fleets in recent years. The Gadoid fleet displays increased catchability while the *Nephrops* fleet reveals reduced catchability suggesting a shift in the fishing patterns of this two fleets and noise in the short time-series of data.

The retrospective pattern is shown in Figure 7.15.13. The retrospective bias around the 1999 year class remains, since which it has been relatively consistent. The large recruitment given by the assessment last year has been revised downwards, with an upward revision of F.

Estimates of fishing mortality and stock numbers from the final XSA are given in Tables 7.15.11 and 7.15.12. These are summarized in Table 7.15.13 and Figure 7.15.14. The assessment this year reveals a sharp decline in fishing mortality. Further to last year's good recruitment, this year demonstrates a large recruiting class, far larger than the current perception of the 1999 recruitment.

Comparison with previous assessments

This assessment is an update of the assessment settings carried out in 2007 and 2008. There have been small revisions to 2007 landings and landings numbers-at-age which have been included in this assessment. Figure 7.15.15 shows F, SSB and recruitment from the 2008 and current year's assessment. The current assessment estimates of 2007 F are above those estimated last year, coupled with a decreased estimate of recruitment. Each of these revisions is also seen in the retrospective plot of the current assessment. This implies revisions are because of the assessments ability to predict recruitment opposed to changes in landings inputs. No forecast was carried out at the 2008 WG for this stock.

State of the stock

Trends in landings, F(2–5), SSB, and recruitment are presented in Table 7.15.13 and Figure 7.15.14. SSB displays a declining trend from 74 532 since 1995, which was temporarily halted by the strong 1999 year class. SSB has revealed a slight increase over 2007 SSB, estimated to be 26 033 t in 2008, above B_{pa}. Fishing mortality is estimated to have been increasing in recent years. The 2008 estimate of fishing mortality reveals a sharp declined.

Recruitment has been below average since 1995, following 5 years of good recruitment, with the exception of the 1999 year class. The 2007 year class is demonstrated to be above average, as is the 2008 year class. The 2008 year class is perceived by the assessment to be above that of the 1999 year class, although this is uncertain. The relationship between SSB and recruitment is poorly defined (Figure 7.15.16) and there is no evidence of reduced recruitment at lower levels of SSB.

7.15.4 Short-term projections

Estimating year-class abundance

The XSA estimate of the 2007 year class (88 million fish) was kept for the prediction. This estimate has demonstrated a strong downward revision from last year, is estimated mainly by the French EVHOE and Irish VIIg swept-area surveys with some weighting to F shrinkage. The 2008 year-class estimate has been replaced by GM recruitment over the full time-series (1982–2007) of 69 702. Subsequent year classes have been set at GM recruitment.

The Working Group estimates of year-class strength can be summarized as follows (recruitment-at-age 0):

Year class	Thousands	Basis	FR-EVHOE	IR-GFS7gSwept	Shrinkage
2006	54 198	XSA	38.4%	54.5%	7%
2007	87 966	XSA	39%	52.3%	8.8%
2008 and onwards	69 702	GM 1982-2007			

Short-term predictions

Input data for the predictions are given in Table 7.15.14. The exploitation pattern is based on the fishing mortalities averaged over 2006–2008, not scaled ($F_{2\text{-}5}$=0.906). Weights-at-age were the mean of 2006–2008. Table 7.15.15 is the management option table and Table 7.15.16 gives the detailed results. Figure 7.15.17 gives the short-term yield and SSB forecasts.

Assuming *status quo* F, catches are predicted to be around 11 460 t in 2009 and 14 110 t in 2010 (Table 7.15.16). SSB is predicted to be at 34 370 t in 2009, above B_{pa}, and increasing in 2010 to 37 670 t, with a similar level in 2011 of 37 610 t. Estimates of the relative contribution of recent year classes to the 2010 landings and 2011 SSB are displayed in Table 7.15.17. The assumed GM recruitment accounts for 22% of the landings in 2010 and 74% of the SSB in 2011.

7.15.5 Medium-term projection

No medium-term projections were carried out because this was an update assessment.

7.15.6 Biological reference points

Precautionary approach to reference points.

The Working Groups current approach to reference points is outlined in Section 2. A summary of reference point proposals to date and their technical basis is given in the Stock Annex. The reference points were not re-examined in this update assessment, those currently adopted and their basis are as follows:

F_{LIM}	No Proposal
F_{PA}	No Proposal
B_{LIM}	15 000 t ($B_{LIM} = B_{LOSS\ 1983}$, $ACFM_{1998}$)
B_{PA}	21 000 t ($B_{PA} = B_{LOSS\ 1983}$ x 1.4)

Yield-per-recruit analysis

Results of a yield-per-recruit analysis (Table 7.15.18 and Figure 7.15.17) indicate that F_{max} is 0.78, 86% of *status quo* F (0.91). Assuming *status quo* F, the current exploitation pattern, and recruitment at GM(82–07), long-term yield is estimated to be 13 703 t which is below the current TAC and SSB is at 36 364 t. No forecast was performed last year to allow comparison.

Sensitivity and risk analysis

No sensitivity and risk analysis was carried out because this was an update assessment.

7.15.7 Management plans

No management plan has been agreed or proposed.

7.15.8 Uncertainties and bias in assessment and forecast

Sampling

The sampling levels for those countries supplying data for 2008 are given in Table 2.1. Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment approaches. Sampling levels were not available by fishery/métier and the WG was therefore unable to evaluate whether or not current sampling levels are sufficient to support fishery/métier disaggregated assessment approaches.

Ageing

The strong recent cohorts passing through the fishery indicates that age estimation is consistent throughout the age range used in the assessment, although some underestimation does occur at older ages.

Discards

Discarding is a major feature of most fisheries catching whiting in the North-eastern Atlantic. The non-inclusion of discard data in the assessment could explain some of the retrospective bias problems and changing catchabilities in commercial fleets observed throughout the assessment period. The available discard data has improved in the most recent years since the implementation of the DCR sampling programmes. Data for the French *Nephrops* fleet is available for 4 years. Discard data for the main French fleet targeting whiting, the gadoid fleet, is available for 2005, 2006 and 2008; no sampling was carried out during 2007. Data for other countries is available for longer periods. It is recognized that further work is required to compile a complete time-series of discard data and evaluate raising options and uncertainty levels. There are problems with Irish discard sampling levels from late 2005 to early 2007 as a consequence of a period of non-cooperation of certain sectors of the fishing industry with discard sampling programmes. Discard data provided to the WG from 2007 is considered to be adequate. Various options have been considered by the WG to reconstruct a time-series of discard sampling for whiting but none seem entirely satisfactory. There is no substitute for improved on-board sampling of discards in all the main fleets in the Celtic Sea. The WG recommend a benchmark assessment of this stock to explore alternative methods to allow the inclusion of recent discard data.

Surveys

Currently, there are two IBTS surveys (French and Irish) covering the Celtic Sea. Although these surveys normally catch large quantities of whiting they seem prone to year effects as has been observed for this species in other areas (e.g. Irish Sea, North Sea). These surveys give very different estimates of the 2008, 2007, 2006, and 2005 year classes. This is one of the most important factors in the short-term development of the stock.

Misreporting

The level of misreporting of this stock is not known and underreporting has previously been considered unlikely to have been a significant source of unaccounted mortality of whiting in the assessment because the TAC has been in excess of recent landings. There is some recent evidence of over-reporting in some fleets but the WG was not able to quantify whether this has occurred over an extended period, or in all fleets.

Consistency

Inter-annual comparison between the results of this year's and last year's assessments (Figure 7.15.15) show consistent estimates up until 2007. Recruitment has been revised downward by 49%. The estimate of F has been revised upward by 35%. SSB estimates exhibit a small downward revision (13%).

SSB has been rescaled upwards slightly in the past when the full time-series of commercial tuning data was included in the assessment. More recently there were some problems with recruitment and SSB estimates as strong year classes during the 1990s passed through the fishery and discarded heavily. Assessments for the last few years have been reasonably consistent for SSB with some downward revisions, although F has been revised upwards slightly and the most recent recruit estimates always remains problematic.

7.15.9 Recommendation for next Benchmark

The 2008 assessment was not accepted by the Celtic Sea Review Group. No specific comments were made by the Review Group on the assessment of whiting VIIe–k.

A benchmark assessment of whiting is necessary.

Problem: The assessment of this stock has not been accepted for a number of years and considered to be indicative of trends only. The primary uncertainty of this assessment is underestimation of mortality. Currently the assessment is based on landings only. Discarding is a major feature of most fisheries catching whiting in this stock area. Mortality may therefore be grossly underestimated. This could explain some of the retrospective bias problems and changing catchabilities in commercial fleets observed throughout the assessment period.

Solution: The available discard data has improved in the most recent years since the implementation of the DCR sampling programmes. Data are now available for the main fleets operating within VIIe–k. Work is now required to compile a complete time-series of discard data, and evaluate raising options and uncertainty levels. Assessment model and settings then need to be reviewed to ensure optimum performance.

Year of last benchmark: No benchmark assessment of this species has been carried out, although exploratory analyses have been carried out in the WGSSDS up until 2007.

WGCSE 2010 should review the time-series of discard data and options for inclusion of into this assessment. Until this happens WGCSE will not propose a time frame for the next benchmark.

Expertise required: Expertise in discard raising and uncertainty methods, in addition to expertise in assessment methods permitting inclusion of discard data.

A further matter for consideration is the improvement of commercial tuning fleets by selection of vessel subsets with consistent spatial and temporal effort and catch composition over the majority of the time-series. This would require a detailed analysis of vessel behaviour.

7.15.10 Management considerations

Catches and SSB in VIIe–k whiting fluctuate considerably depending on year-class strength. Indications are that the 2007 and 2008 year classes are strong. Management measures should be considered to reduce discarding of this year class such that yield and SSB contributions can be maximized.

Technical measures applied to this stock include a minimum landing size (≥ 27 cm) and minimum mesh sizes applicable to the mixed demersal fisheries. These measures are set depending on areas and years by several regulations. Whiting are caught in directed gadoid trips and as part of mixed fisheries throughout the Celtic Sea. Discard rates are high as a consequence of the low market value of the species, particularly at smaller sizes. High-grading above the MLS to some extent is also prevalent in most fisheries. The current assessment doesn't include discard estimates. Recent selection data from FTFB should be investigated at the next benchmark workshop.

From the 1 February to the 31 March fishing activity has been prohibited within ICES rectangles: 30E4, 31E4, 32E3 (excluding within 6 nautical miles from the baseline) annually since 2005 (Council Regulations (EC): No 51/2006, No 41/2007, No 40/2008, No 43/2009) to protect the cod stock. The impact of this on whiting remains unclear but spatial distribution of landings in 2008 suggest that landings from the closed rectangles are lower than those of adjacent rectangles. Irish quarterly landings by rectangle indicate little or no landings from within these closed rectangles during the first quarter. ICES rectangle 30E4 has remained one of the best whiting harvest areas for the French fleet before and after the closure period.

There have been major changes in fleet dynamics over the period of the assessment. Effort in the French gadoid fleet has been declining since 1999. Irish otter trawl effort in VIIg,j has been stable over the last 4 years. During this period there has been a fleet modernisation and several decommissioning schemes in Ireland both within the national whitefish fleet and beam trawl fleet. A French decommissioning scheme was implemented in 2008 and a further scheme is being implemented in 2009. A reduction in the French fleet operating in VIIe–k is expected as a result.

Table 7.15.1. Whiting in Divisions VIIe–k. Nominal Landings (t) as reported to ICES, and total landings as used by the Working Group.

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Belgium	130	158	160	107	112	159	295	317	304	111	145	228	205	268
Denmark														
France	7,572	4,024	7,819	7,763	9,773	10,947	19,771	19,348	10,006	9,620	11,285	13,535	13,400	9,936
Germany										14				
Ireland	1,511	1,227	2,241	1,309	1,518	2,036	1,651	1,764	1,403	1,875	3,630	5,053	6,077	6,115
Netherlands		398		124										8
Spain													4	31
UK (E/W/NI)	1,192	986	751	910	1,098	1,632	1,326	1,829	2,023	1,393	1,776	1,624	1,803	1,724
UK(Scotland)						1	33	32	20	41	16	23	23	34
United Kingdom														
Channel Islands			2	2	2								1	1
Total	10,405	6,793	10,973	10,215	12,503	14,775	23,076	23,290	13,756	13,054	16,852	20,463	21,513	18,116
Unallocated	1,376	3,192	-135	-263	149	353	-6,535	-9,184	-248	-690	-532	-429	1,165	144
Total as used by Working Group	11,781	9,985	10,838	9,952	12,652	15,128	16,541	14,106	13,508	12,364	16,320	20,034	22,678	18,260

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008a
Belgium	449	479	448	194	171	149	129	180	218	128	127	121
Denmark												
France	11,370	11,711[a]	16,418[b]	9,077[a]	7,203[a]	7,435[a]	5,897	4,811	5,784	4,649	3,546	1,841
Germany												
Ireland	6,893	5,226	5,807	4,795	5,008	5,332	4093	4,215	5,709	4,521	4,764	2,328
Netherlands		1			5	4	9	18	60	40	64	23
Spain	24	53	21	11	9	12		76	56	70	21	
UK (E/W/NI)	1,742	1,706	1,344	1,249	943	843	758	586	471	403	569	615
UK(Scotland)	42	68	3	2	11	12	5	7		6	4	
United Kingdom												
Channel Islands		3	2	3	3	1	4				1	
Total	20,520	19,247	24,043	15,331	13,353	13,788	10,895	9,893	12,298	9,817	9,096	4,928
Unallocated	12	-2	-4,128	-466	-583	-642	-312	61	-269	-284	-148	809
Total as used by Working Group	20,532	19,245	19,915	14,865	12,770	13,146	10,583	9,954	12,030	9,533	8,948	5,737

[a]: Preliminary

[b]: Preliminary, Reported as VIIb-k

Table 7.15.2. Whiting in Divisions VIIe–k. Raised length distributions for 2008 by country and fleet (Numbers in '000s).

Length	France	UK (E+W)		Ireland				
(cm)		Beam trawl	All gears (exc beam)	Scottish Seine	Otter trawl	Beam trawl	Otter trawl	Scottish seine
	VII fgh	VIIe-k	VIIe-k	VIIg	VIIg	VIIg	VIIj	VIIj
20								
21					0.6			
22					1.6			
23					3.3			
24			0.7		7.5		0.7	
25	0.1		0.0	1.5	16.4		1.1	
26	1.0		0.9	0.0	34.3		1.6	0.7
27	6.9		4.0	19.2	76.5		8.6	1.4
28	29.2		51.3	35.4	130.3		21.9	6.3
29	62.8		87.6	50.3	171.1		33.8	6.3
30	145.9	1.8	183.2	90.2	270.2	0.0	41.3	10.5
31	226.4	4.6	184.4	110.9	314.2	0.0	52.6	7.0
32	259.0	6.0	182.3	147.9	350.2	0.2	59.5	9.8
33	274.5	10.4	207.3	146.3	327.5	0.5	44.4	7.0
34	296.5	21.0	166.6	139.0	274.6	0.6	39.0	6.3
35	243.4	17.2	128.2	118.2	236.1	0.6	42.1	5.6
36	222.7	17.1	109.8	100.6	209.4	0.7	38.9	12.6
37	210.3	11.9	66.0	68.1	132.3	0.8	38.5	10.5
38	171.5	10.5	59.9	84.3	107.0	0.9	26.8	7.7
39	152.5	8.7	55.4	35.5	85.4	0.7	21.1	12.6
40	119.0	9.4	34.5	34.0	61.5	0.6	20.8	28.1
41	97.1	7.3	25.6	42.9	41.9	0.4	18.9	21.8
42	92.8	1.7	14.9	50.2	39.1	0.3	13.7	19.7
43	77.4	4.4	15.6	47.3	28.0	0.2	12.0	17.5
44	60.5	1.7	12.7	28.1	20.7	0.1	7.3	16.8
45	57.3	0.6	11.2	5.9	10.3	0.2	7.1	8.4
46	33.0	1.7	6.5	20.7	15.9	0.1	3.4	13.3
47	37.5	1.1	4.5	20.7	7.8	0.1	4.5	9.1
48	34.2	0.7	6.0	8.9	6.1	0.1	3.9	6.3
49	18.4	1.3	2.0	16.2	3.2	0.1	4.1	8.4
50	13.8	0.2	3.5	26.6	4.8	0.0	0.7	6.3
51	15.3	0.4	3.2	16.2	3.1	0.1	1.5	9.1
52	8.6	0.2	2.1	3.0	1.3	0.0	1.5	6.3
53	6.8	0.4	2.4	1.5	2.7	0.1	0.9	1.4
54	3.8	0.0	0.9	3.0	1.4	0.0	0.6	4.9
55	3.6	0.0	0.2	4.5	0.9	0.0	0.8	4.9
56	6.4	0.0	0.5	0.0	1.1	0.0	0.7	2.8
57	1.9	0.0	0.2	0.0	0.6	0.0	0.0	2.1
58	0.8	0.2	0.2	5.9	0.7	0.0	0.2	2.1
59	1.0		0.2	0.0	0.8	0.0	0.1	3.5
60	1.5		0.2	1.5	0.7		0.4	2.1
61	1.1				0.5		0.1	0.7
62	0.1				0.1			0.7
63					0.5			0.0
64								0.7
65								0.7
66								0.0
67								1.4
68								
69								
Total N.	**2994.4**	**140.5**	**1634.8**	**1484.3**	**3002.3**	**7.6**	**575.0**	**303.9**
Total (t)	**1431.3**	**58.5**	**535.7**	**739.3**	**1037.5**	**3.8**	**229.4**	**226.2**

Table 7.15.3. Whiting in Divisions VIIe–k. Landings numbers-at-age, examples of strong year classes are highlighted.

```
An object of class "FLStock"
Slot "name":
[1] "Whiting in the Celtic Sea (VIIe-k), WGCSE 2009, COMBSEX (Updated by SD 27/04/2009)"

Slot "desc":
[1] "Whiting 7ek"

Slot "catch.n":
An object of class "FLQuant":

, , unit = unique, season = all, area = unique
```

age \ year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2624	5867	2854	3698	3769	5977	2315	602	3270	8339	4964	2304	1272	540	1345	609	1182	4163	3575	336
2	12523	9981	18645	15538	15157	19376	26780	17057	9249	11997	20513	22277	14110	15062	7473	4451	6680	10223	9357	11648
3	9862	9059	4697	8005	6465	8825	11400	24243	19509	5578	9198	17939	25384	21854	17783	11734	10938	12444	10328	11076
4	4564	3393	1815	1380	2091	2467	1962	3459	8654	11742	1420	2829	6165	14142	12850	21209	12758	8406	5468	5135
5	880	1319	618	289	553	587	409	339	749	2700	1275	526	1019	2242	5486	7322	13240	8733	2351	2061
6	41	195	128	96	60	112	70	63	62	143	435	382	135	310	775	2787	2865	6479	1993	745
7	23	10	28	33	45	60	21	25	21	3	39	172	177	92	114	720	882	1188	1845	275

age \ year	2002	2003	2004	2005	2006	2007	2008
0	0	0	0	0	0	0	0
1	1067	462	1209	768	1366	988	1337
2	5962	3599	4141	6169	6342	5598	3938
3	19658	8264	5963	8141	7631	8479	6020
4	5732	11530	6755	5008	3672	4984	2822
5	1064	1675	5978	4551	1767	1535	652
6	274	264	496	3456	1148	412	170
7	63	20	69	147	581	226	30

```
attr(,"units")
[1] "thousands"
```

Table 7.15.4. Whiting in Divisions VIIe–k. Landings weights-at-age.

```
An object of class "FLStock"
Slot "name":
[1] "Whiting in the Celtic Sea (VIIe-k), WGCSE 2009, COMBSEX (Updated by SD 27/04/2009)"

Slot "desc":
[1] "Whiting 7ek"

Slot "catch.wt":
An object of class "FLQuant":

, , unit = unique, season = all, area = unique

   year
age  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
  0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.086 0.000 0.090 0.000 0.000 0.000 0.000 0.101
  1 0.245 0.273 0.227 0.233 0.198 0.222 0.224 0.201 0.226 0.220 0.208 0.205 0.249 0.202 0.229 0.196 0.188 0.222 0.250
  2 0.279 0.328 0.286 0.335 0.277 0.284 0.303 0.281 0.260 0.291 0.289 0.286 0.300 0.275 0.266 0.277 0.270 0.298 0.326
  3 0.395 0.441 0.457 0.433 0.493 0.398 0.416 0.376 0.328 0.355 0.388 0.379 0.404 0.382 0.346 0.329 0.333 0.352 0.419
  4 0.557 0.545 0.656 0.631 0.585 0.658 0.628 0.593 0.452 0.395 0.472 0.589 0.637 0.527 0.460 0.406 0.396 0.426 0.510
  5 0.646 0.678 0.807 1.008 0.781 0.877 0.977 0.980 0.722 0.534 0.623 0.831 0.915 0.844 0.598 0.536 0.452 0.441 0.573
  6 1.193 0.731 1.060 1.157 1.469 0.897 1.322 1.444 1.083 0.834 0.739 0.963 0.982 1.124 0.616 0.714 0.567 0.497 0.585
  7 1.593 1.652 1.514 0.980 1.680 0.990 1.374 1.877 1.721 1.695 1.084 1.360 1.222 1.197 1.058 1.005 0.896 0.633 0.597

   year
age  2001  2002  2003  2004  2005  2006  2007  2008
  0 0.000 0.082 0.000 0.086 0.101 0.112 0.000 0.116
  1 0.265 0.217 0.211 0.218 0.246 0.232 0.206 0.234
  2 0.286 0.293 0.281 0.303 0.318 0.299 0.290 0.294
  3 0.393 0.363 0.369 0.376 0.396 0.414 0.389 0.377
  4 0.521 0.519 0.447 0.433 0.506 0.545 0.492 0.506
  5 0.624 0.682 0.603 0.492 0.509 0.585 0.603 0.603
  6 0.761 0.810 0.831 0.523 0.487 0.586 0.564 0.737
  7 0.820 1.022 1.149 0.754 0.595 0.707 0.673 1.037

attr(,"units")
[1] "kg"
```

Table 7.15.5. Whiting in Divisions VIIe–k. Stock weights-at-age.

```
An object of class "FLStock"
Slot "name":
[1] "Whiting in the Celtic Sea (VIIe-k), WGCSE 2009, COMBSEX (Updated by SD 27/04/2009)"

Slot "desc":
[1] "Whiting 7ek"

Slot "stock.wt":
An object of class "FLQuant":

, , unit = unique, season = all, area = unique
```

age \ year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.157	0.167	0.192	0.179	0.183	0.171	0.186	0.173	0.166	0.151	0.174	0.166	0.175	0.108	0.135	0.110	0.148	0.112	0.144
2	0.270	0.276	0.282	0.272	0.259	0.253	0.252	0.249	0.247	0.248	0.253	0.251	0.254	0.259	0.256	0.245	0.238	0.245	0.253
3	0.345	0.363	0.371	0.389	0.370	0.367	0.342	0.331	0.317	0.317	0.327	0.340	0.340	0.346	0.328	0.307	0.293	0.324	0.357
4	0.474	0.498	0.521	0.534	0.543	0.533	0.531	0.477	0.427	0.396	0.421	0.470	0.487	0.476	0.430	0.396	0.378	0.419	0.465
5	0.607	0.632	0.709	0.738	0.756	0.752	0.784	0.760	0.651	0.553	0.551	0.637	0.715	0.711	0.626	0.525	0.453	0.491	0.556
6	0.843	0.826	0.847	1.030	1.020	1.059	1.050	1.114	1.007	0.815	0.736	0.779	0.906	0.861	0.820	0.645	0.585	0.518	0.611
7	1.403	1.313	1.188	1.187	1.223	1.261	1.322	1.439	1.524	1.310	1.133	1.034	1.077	0.994	0.942	0.830	0.747	0.677	0.711

age \ year	2001	2002	2003	2004	2005	2006	2007	2008
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.182	0.193	0.187	0.167	0.163	0.177	0.204	0.246
2	0.259	0.248	0.244	0.253	0.256	0.280	0.286	0.308
3	0.370	0.361	0.332	0.333	0.346	0.390	0.404	0.402
4	0.490	0.480	0.439	0.449	0.484	0.553	0.571	0.568
5	0.612	0.627	0.560	0.541	0.535	0.624	0.678	0.697
6	0.676	0.795	0.693	0.652	0.582	0.647	0.724	0.741
7	0.802	1.009	0.886	0.892	0.765	0.832	1.075	1.274

```
attr(,"units")
[1] "kg"
```

Table 7.15.6. Whiting in Divisions VIIe–k. Summary of discard data in 2008 provided the Working Group.

				Sampling							Discard Rates	
Country	**Year**	**Quarter**	**Gear/Fleet**	**Trips**	**Hauls**	**Numbers Landed**	**Weight Landed**	**Number Discarded**	**Weight Discarded**	**Units**	**Number**	**Weight**
France	2008	All	VIIg Nephrops Otter trawl	1	58	322		83		No. & KG Sampled		
France	2008	All	VIIe-k Mixed Demersal fish Otter trawl	57	588	28612		10141		No. & KG Sampled		
UK	2008	1	All Gears	38	175	4293	1703	4058	790	Raised No. & KG Sampled	49%	32%
UK	2008	2	All Gears	31	218	3452	1237	3779	638	Raised No. & KG Sampled	52%	34%
UK	2008	3	All Gears	34	179	4315	1217	6803	1229	Raised No. & KG Sampled	61%	50%
UK	2008	4	All Gears	41	258	3632	1231	4896	1027	Raised No. & KG Sampled	57%	45%
UK	2008	All	All Gears	144	830	15691	5388	19537	3684	Raised No. & KG Sampled	55%	41%
Ireland	2008	All	Otter Trawls VIIg	15	183	22538	7804	13439	2077	No. '000s & tonnes raised to Fleet	37%	21%
Ireland	2008	All	Otter Trawls VIIj	13	103	130	55	364	65	No. '000s & tonnes raised to Fleet	74%	54%

Note. French data were not finalized at the time of the Working Group, only a partial dataset was provided. Therefore, no discard analysis should be carried out on this partially provided dataset.

Table 7.15.7. Whiting in Divisions VIIe–k. Standardised survey abundance indices of age groups 0–3.

Year	UK-WCGFS			UK-BCCSBTS-S		FR-EVHOE				IR-WCGFS				IR-ISCSGFS				IR-GFS-7g&j				IR-GFS-7g-Swept Area			
	1-gp	2-gp	3-gp	0-gp	1-gp	0-gp	1-gp	2-gp	3-gp	0-gp	1-gp	2-gp	3-gp	0-gp	1-gp	2-gp	3-gp	0-gp	1-gp	2-gp	3-gp	0-gp	1-gp	2-gp	3-gp
1987	0.36	1.61	0.16																						
1988	0.24	0.23	0.06	0.1	0.9																				
1989	0.25	0.73	0.49	0.9	1.1																				
1990	0.02	0.06	0.25	5.2	0.5																				
1991	0.21	0.01	0.01	4.4	1.4																				
1992	1.31	0.53	0.11	6.7	1.3																				
1993	4.88	0.92	0.27	10.0	1.7					1.2	2.8	4.7	5.3												
1994	8.99	1.33	0.92	2.7	1.5					16.7	0.2	0.5	0.5												
1995	0.59	5.52	1.43	2.3	1.5					23.9	2.7	0.4	0.4												
1996	0.52	1.51	1.39	4.6	1.5					0.6	0.9	0.3	0.1												
1997	0.73	0.56	0.18	10.7	0.5	31	24	9	8.5	0.4	0.1	0.3	0.0	21	38	70	223								
1998	1.19	0.77	0.53	5.3	0.5	48	15	7.9	1.2	1.8	0.6	0.1	0.0	1605	1430	300	79								
1999	0.84	0.50	0.15	15.1	1.0	261	62	18	5.1	18.1	2.4	0.1	0.0	6389	507	120	38					24175	7307	1881	633
2000	14.91	0.93	0.29	1.2	3.1	31	77	23	2.9	0.2	2.1	0.6	0.0	6062	687	104	4					6077	15835	3116	190
2001	2.49	1.35	0.24	1.7	0.5	23	35	49	8	0.4	2.1	2.9	0.3	1661	1549	838	9					4650	2836	13871	1849
2002	3.35	1.80	3.04	5.3	0.3	39	15	11	10	5.3	7.4	2.5	0.7	312	298	102	77					2468	3664	1719	1252
2003	3.20	2.51	2.48	3.9	0.1	47	58	27	20	Survey discontinued				Survey discontinued				127	88	38	11	6061	2219	1027	413
2004	2.00	1.80	0.99	10.3	0.1	28	108	31	14									295	95	48	10	9778	3444	655	321
2005	Survey discontinued			6.4	0.0	44	16	5	2									83	106	29	10	1146	3177	1573	422
2006				4.3	0.3	15	10	3	1									373	161	50	10	15260	5883	2175	707
2007				7.7	0.7	178	46	4	1									332	218	47	7	9951	8081	2718	455
2008				25.1	0.7	365	45	10	3									402	140	44	11	16344	5554	2238	475

Table 7.15.8. Whiting in Divisions VIIe–k. Available commercial and survey tuning-series, ages and years used in the assessment are highlighted in bold.

Whiting in the Celtic Sea VIIe-k Tuning data WGCSE 2009 (Sarah Davie 27/04/09)
114
FR-GADOID-Early: French Gadoid trawlers (FU5) - Effort, No. of whiting/age/1000 hours fished, Year, Live weight (t)

1983	1992									
1	1	0	1							
1	11									
1000	18325	41531	38575	15377	6184	886	51	0	0	0
	0	#1983	5742t							
1000	13779	97659	25223	9993	3362	688	82	46	22	0
	0	#1984	4598t							
1000	14948	75447	37539	6687	1506	540	189	9	0	0
	0	#1985	4514t							
1000	13417	66679	29328	9073	2310	266	183	20	3	2
	0	#1986	5049t							
1000	25446	79928	33683	10141	2358	518	161	30	36	0
	0	#1987	6859t							
1000	6738	71192	30313	5029	1040	184	45	4	2	0
	0	#1988	7921t							
1000	1539	41365	58078	7808	843	161	30	12	0	0
	0	#1989	8974t							
1000	10547	29023	60936	24967	2297	148	49	18	2	0
	0	#1990	7897t							
1000	31392	41485	18143	40085	8616	352	15	0	0	0
	0	#1991	7525t							
1000	15843	65677	28694	4589	4435	1226	132	0	0	0
	0	#1992	6460t							

FR-GADOID-late: French Gadoid trawlers (FU5) - Effort, No. of whiting/age/1000 hours fished, Year, Live weight (t)

1993	2008									
1	1	0	1							
1	11									
1000	4736	57675	**35630**	**5286**	**825**	**883**	469	40	20	6
	0	#1993	7815t							
1000	448	26922	**65786**	**18395**	**2948**	**289**	454	125	80	0
	0	#1994	9236t							
1000	86	10737	**43840**	**34895**	**7662**	**1360**	248	0	28	32
	0	#1995	9186t							
1000	8	2509	**34872**	**31293**	**13650**	**1708**	328	32	31	29
	0	#1996	6028t							
1000	0	3641	**17743**	**45915**	**14168**	**4338**	721	63	12	0
	0	#1997	7218t							
1000	3827	17367	**32394**	**25399**	**30762**	**21832**	3285	631	186	0
	0	#1998	7674t							
1000	3457	15689	**29265**	**22945**	**27790**	**19723**	2967	570	168	0
	0	#1999	9102t							
1000	4987	23934	**29232**	**15124**	**6851**	**7110**	5976	1306	132	10
	0	#2000	6053t							
1000	213	23745	**25724**	**9253**	**3440**	**1465**	593	539	114	57
	0	#2001	4624t							
1000	405	9574	**48049**	**13052**	**2399**	**816**	136	59	27	25
	0	#2002	4799t							
1000	13	2004	**15027**	**33581**	**3776**	**542**	94	48	67	13
	3	#2003	2975t							
1000	238	4747	**10190**	**18892**	**20570**	**1688**	269	17	0	0
	0	#2004	2589t							
1000	278	11772	**23815**	**15806**	**17601**	**15832**	418	54	0	0
	0	#2005	3659t							
1000	295	16943	**35200**	**15517**	**7869**	**5396**	2180	142	6	0
	0	#2006	2795t							
1000	369	13147	**23994**	**12964**	**2496**	**461**	400	460	53	0
	0	#2007	1898t							

```
1000    257     8841    14651   10665   2942    586     50      65      0       0
        0       #2008   1133t

FR-NEPHROPS-Early: French Nephrops trawlers (FU8) - Effort,  No. whiting/age/1000 hours
fished, Year, Live weight (t)

1987    1992

1       1       0       1

1       11

1000    917     3681    2247    761     176     23      18      2       6       0
        0       #1987   588t
1000    632     7960    3610    918     165     39      11      0       0       0
        0       #1988   844t
1000    131     4874    6866    1294    128     31      5       1       0       0
        0       #1989   891t
1000    321     1139    3596    2297    279     27      8       5       0       0
        0       #1990   671t
1000    1048    2312    982     1745    498     33      6       0       0       0
        0       #1991   527t
1000    1542    6078    3348    478     571     171     14      0       0       0
        0       #1992   1153t

FR-NEPHROPS-Late: French Nephrops trawlers (FU8) - Effort, No. whiting/age/1000 hours
fished, Year, Live weight (t)

1993    2008

1       1       0       1

1       11

1000    766     6928    5695    1001    163     86      74      1       2       0
        0       #1993   1356t
1000    184     6145    8313    1840    214     17      16      5       2       0
        0       #1994   1565t
1000    29      2217    7580    4802    697     91      20      0       3       3
        0       #1995   1446t
1000    2       979     5599    4992    2359    305     55      4       1       7
        0       #1996   1230t
1000    0       737     3511    10406   4124    1231    275     23      1       0
        0       #1997   1393t
1000    58      1042    2567    4299    5925    1236    239     46      2       0
        0       #1998   881t
1000    1253    4408    4764    3762    3867    3563    575     136     8       0
        0       #1999   1190t
1000    277     2381    3085    2213    923     836     959     232     23      0
        0       #2000   869t
1000    104     2948    3131    1531    557     213     106     95      36      8
        0       #2001   548t
1000    27      747     4007    1455    462     170     69      13      14      7
        0       #2002   550t
1000    5       311     1708    3944    574     95      27      7       1       0
        2       #2003   543t
1000    47      748     1090    2045    2726    233     49      6       0       0
        0       #2004   435t
1000    104     1285    1926    1133    1266    1283    54      2       0       0
        0       #2005   378t
1000    46      802     1299    591     299     187     101     12      0       0
        0       #2006   174t
1000    138     981     1159    604     137     26      19      16      5       0
        0       #2007   96t
1000    41      506     565     408     96      19      7       2       0       0
        0       #2008   54t

FR-EVHOE: Thalassa Survey - No. whiting at-age/30 min, Year

1997    2008

1       1       0.75    1

0       8
```

```
1       30.82   23.85   8.93    8.47    10.38   1.93    0.24    0.00    0.00    #1997
1       48.1    15.15   7.88    1.23    1.67    0.55    0.18    0.02    0       #1998

1       260.66  62.15   17.64   5.09    1.92    1.67    1.18    0.15    0.13    #1999

1       30.62   76.5    23.18   2.85    1.17    0.33    0.18    0.5     0.06    #2000

1       22.77   35.46   48.8    8.12    0.79    0.14    0.11    0.02    0.04    #2001

1       38.5    15.33   11      9.58    0.82    0       0       0       0       #2002

1       46.62   58.3    27.11   19.94   14.74   0.05    0.01    0       0       #2003

1       28.23   108.11  31.11   14.36   6.98    3.98    0       0       0       #2004

1       44.14   15.85   5.19    1.89    1.15    0.63    0.16    0       0       #2005

1       14.6    9.53    3.45    1.18    0.3     0.03    0       0.01    0       #2006

1       178.39  46.3    4.34    0.68    0.36    0.07    0       0       0.01    #2007

1       364.99  44.55   10.17   3.27    1.43    0.14    0       0       0.03    #2008
```

UK-WCGFS: UK (E+W) PHHT Groundfish Survey in VIIf&g - Effort mins towed, nos-at-age, Year, Vessel (final survey in 2004)

```
1987    2004
1       1       0.15    0.25
1       7
360     129         580 57       8           6  4       1       #1987   Cirolana
540     129         125 31       3           3  0       0       #1988   Cirolana
540     137         393 267      21          4  2       0       #1989   Cirolana
540     11          31  137      55          9  1       0       #1990   Cirolana
482     99          6   3        11          9  1       0       #1991   Cirolana
840     1097        441 94       28          22         6        1      #1992   Cirolana

840     4101        772 229      29          4  8       3       #1993   Cirolana
535     4809        713 490      70          17         1        3      #1994   Cirolana

1320    777.4       7282.9      1891.2    595        82.2       18.6     11.3    #1995
        Cirolana
1475    773         2225        2050      391        148        11       2       #1996
        Corystes
1519    1113        852 280      646        226        60       5       #1997   Cirolana

900     1071.5      691.5       477       343.3 104.8   13.3     12.5    #1998   Cirolana
900     760.2       453.9       139.4     52.1       47.8       90.2     30.5    #1999
        Cirolana
1038    15471.8    962.8        296.4     118.9 47.2     51       50.6    #2000   Cirolana
880     2195.3      1186.5      206.8     35.4      2  7.6      1       #2001   Cirolana
762     2551.5      1368.9      2313.6    155.9 75.7     1.2      4.4     #2002   Cirolana
863     2765.7      2169.9      2138.8    1665.8       157.9    0        0      #2003
        Cirolana
860     1716.8      1548.2      852.1     203.6        184.3    2        0      #2004
        Cefas Endeavour
```

UK-BT-SURVEY: (Sept) - Prime stations only (VIIf) Effort (km towed), numbers at-age per Km towed

```
1988    2008
1       1       0.75    0.85
0       1
74.12   6       66      #1988   Tows 15 minute duration - raised here to 30 minutes

91.91   80      104     #1989   Tows 15 minute duration - raised here to 30 minutes

69.86   363     37      #1990
123.41  540     175     #1991
125.08  839     164     #1992
127.67  1279    213     #1993
120.82  330     182     #1994
104.14  240     154     #1995
122.11  557     188     #1996
115.63  1238    56      #1997
104.7   553     49      #1998
117.11  1770    116     #1999
105.99  128     333     #2000
```

```
118.22  204     56      #2001
113.03  602     36      #2002
111.92  442     6       #2003
101.92  1053    6       #2004
119.11  760     5       #2005
120.56  520     31      #2006
118.59  910     81      #2007
119.33  2994    81      #2008

IR-GFS-7G-SweptArea: Swept Area Method - Effort in kmsq
1999    2008
1       1       0.75    0.92
0       8
10      24175   7307    1881    633     292     110     85      40      0       #1999
10      6077    15835   3116    190     35      27      8       0       0       #2000
10      4650    2836    13871   1849    222     18      22      6       0       #2001
10      2468    3664    1719    1252    127     3       9       0       0       #2002
10      6061    2219    1027    413     0       10      0       0       0       #2003
        #age 4 replaced,22
10      9778    3444    655     321     147     123     1       0       0       #2004
10      1146    3177    1573    422     169     104     163     0       0       #2005
#revised2009
10      15260   5883    2175    707     68      0       28      0       0       #2006
#revised2009
10      9951    8081    2718    455     83      23      4       0       3       #2007
#revised2009
10      16344   5554    2238    475     65      2       0       0       0       #2008

IR-7G&J-OT: Irish Otter Trawl Fleet (Areas VIIg&j) - Effort in hours, nos-@-age, Year,
Live weight (t), LPUE (kg/h)

1995    2008
1       1       0       1
1       4
157085  679     2281    1889    1333    #                               #1995
130257  164     1549    1889    905     #                               #1996
148276  170     756     1488    1247    #                               #1997
161909  180     933     980     736     #                               #1998
92195   388     960     962     449     #                               #1999
125229  619     1042    808     500     #       228     103     65      #2000   1506.6t
        12.03
137086  91      2224    1538    1046    #       412     125     48      #2001   2227.9t
        16.25
168134  291     1140    2615    613     #       86      13      6       #2002   1761.4t
        10.48
198059  147     878     1640    1195    #       155     8       0       #2003   1544.6t
        7.8
188948  133     626     1756    995     #       424     42      2       #2004   2243.8t
        11.88
198315  97      1751    2862    1233    #       1167    747     31      #2005   3730.4t
        18.81
185083  188     1900    2070    950     #       427     283     127     #2006   3008.2t
        16.25
217009  78      1063    3112    2305    #       614     141     70      #2007   3568.3t
        16.55
191953  132     866     1044    681     #       174     55      7       #2008   3568.3t
        17.55

IR-ISCSGFS: Irish Sea Celtic Sea GFS (VIIg) - Whiting #/30 min towed (Prime stations
only)
1997    2002
1       1       0.8     0.9
0       5
1       21      38      70      223     113     23      #1997
1       1605    1430    300     79      135     16      #1998
1       6389    507     120     38      17      6.3     #1999
1       6062    687     104     4.2     0.2     0.1     #2000
1       1661    1549    838     8.8     0.4     0.5     #2001
1       312     298     102     77      9.1     0.2     #2002

IR-WCGFS: Irish Autumn WCGFS  (VIIj) - Effort min. towed, #@ age, Yr
1993    2002
1       1       0.75    0.79
0       6
323     372     912     1529    1722    352     0       0       #1993
```

673	11235	123	304	344	25	0	0	#1994
651	15564	1736	229	285	29	0	0	#1995
671	406	618	189	42	59	0	0	#1996
1232	478	171	345	59	22	21	12	#1997
1310	2384	758	159	34	65	7	2	#1998
1281	23133	3013	175	45	12	2	2	#1999
1190	203	2445	664	44	6	0	0	#2000
595	218	1253	1709	169	12	2	0	#2001
606	3239	4489	1538	438	61	5	1	#2002

IR-GFS-7G: Irish Groundfish Survey in VIIg (IBTS 4th Qtr) - Whiting no. @ age (Interim indices: New Celtic Explorer series)

2003	2008							
1	1	0.79	0.92					
0	6							
832	6598	2571	1189	466	23	11	0	#2003
980	12662	4470	853	417	191	159	2	#2004
845	4078	4776	1745	483	178	107	182	#2005
1046	22967	8854	3273	1064	102	0	43	#2006
1168	16479	13382	4501	754	138	38	13	#2007
1139	23296	7916	3190	677	93	3	0	#2008

IR-GFS-7J: Irish Groundfish Survey in VIIj (IBTS 4th Qtr) - Whiting no. @ age (Interim indices: New Celtic Explorer series)

2003	2008							
1	1	0.79	0.92					
0	6							
780	227	2121	883	146	67	3	0	#2003
720	3864	1230	1675	155	27	6	4	#2004
881	455	1001	234	121	17	4	9	#2005
901	727	1141	403	31	15	3	3	#2006
874	5221	582	144	35	8	4	0	#2007
873	2468	1631	625	239	42	3	7	#2008

IR-GFS-7G&J: Irish Groundfish Survey in VIIg&j (IBTS 4th Qtr) - Whiting no. @ age (Interim indices: New Celtic Explorer series)

2003	2008							
1	1	0.79	0.92					
0	6							
1612	6836	4714	2064	582	96	12	0	#2003
1700	16710	5405	2733	570	170	115	10	#2004
1726	4761	6085	1655	573	142	75	101	#2005
1947	24194	10418	3250	637	100	3	25	#2006
2042	22609	14869	3182	508	82	39	10	#2007
2012	26990	9362	2957	734	135	6	8	#2008

Table 7.15.9. Whiting in Divisions VIIe–k. Landings (t), lpue of French and Irish fleets, and Effort ('000 h) of French, Irish and UK fleets.

	FR-Gadoid VII fg French gadoid trawlers			FR-*Nephrops* VII fg French *Nephrops* trawlers			IR-OTB-7G Irish otter trawlers VIIg			IR-OTB-7J Irish otter trawlers VIIj			UK (E&W) in VIIe-k	
													Beam	Otter
Year	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]	Effort[4]	Effort[4]
1983	5,742	109	53	470	207	2							135	82
1984	4,598	84	55	340	173	2							131	87
1985	4,514	89	51	651	185	4							152	90
1986	5,049	116	44	374	146	3							136	85
1987	6,859	137	50	588	177	3							177	84
1988	7,921	200	40	844	156	5							195	89
1989	8,974	231	39	891	159	6							198	84
1990	7,897	188	42	671	196	3							208	99
1991	7,525	167	45	527	187	3							203	77
1992	6,460	173	37	1,153	234	5							196	86
1993	7,815	201	39	1,356	223	6							208	62
1994	9,236	171	54	1,565	223	7							220	54
1995	9,186	171	54	1,446	202	7	829	64	13	1,305	94	14	243	52
1996	6,028	152	40	1,230	179	7	906	60	15	803	70	11	261	61
1997	7,218	195	37	1,393	149	9	1,066	65	16	783	83	9	265	67
1998	9,102	172	53	881	125	7	813	72	11	545	90	6	255	62
1999	9,102	191	48	1,190	130	9	946	52	18	247	41	6	251	98
2000	6,053	157	38	869	161	5	990	61	16	517	65	8	259	104
2001	4,624	174	27	548	137	4	1,286	69	19	942	68	14	273	85
2002	4,841	165	29	550	142	4	1,004	78	13	758	90	8	249	83
2003	2,975	125	24	543	161	3	1,051	87	12	494	111	4	282	72
2004	2,589	107	24	435	127	3	1,932	97	20	312	92	3	274	76
2005	3,787	93	41	378	114	3	3,445	124	28	285	74	4	270	76
2006	2,795	75	37	175	107	2	2,757	119	23	251	66	4	252	83
2007	1,898	80	24	96	75	1	3,324	137	24	273	80	3	240	88
2008*	1,133	62	18	54	70	1	1,042	126	8	233	66	4	217	71

	IR-SSC-7J Irish Scottish Seiners			IR-SSC-7G Irish Scottish Seiners			IR-TBB-7J Irish Beam Trawls			IR-TBB-7G Irish Beam Trawls		
Year	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]
1995	1,008	5	192	1,123	6	175	0	0	1	63	21	3
1996	1,100	8	135	1,534	10	158	5	1	3	33	27	1
1997	806	11	75	2,654	16	165	3	2	2	44	28	2
1998	467	7	71	2,502	15	167	5	5	1	46	35	1
1999	77	1	55	1,378	8	172	8	7	1	47	41	1
2000	187	3	54	1,187	10	120	8	7	1	64	37	2
2001	236	4	53	1,005	16	62	6	3	2	79	40	2
2002	409	9	46	1,971	21	94	6	3	2	60	32	2
2003	371	9	41	1,560	21	75	13	9	1	55	49	1
2004	314	9	34	1,038	19	54	1	2	1	33	55	1
2005	253	6	41	1,004	15	68	1	2	1	24	50	0
2006	192	5	36	912	15	62	1	2	0	19	60	0
2007	205	4	58	825	16	52	0	2	0	25	56	0
2008*	225	3	79	741	12	64	0	1	0	4	37	0

1 = LPUE calculated as landings in kg/h fishing, power corrected.
2 = Effort in hours fishing, power corrected
3 = LPUE calculated as landings in kg/h fishing.
4 = Effort in 000 hours fishing.
* Provisional

Table 7.15.10. Whiting in Divisions VIIe–k. XSA Diagnostics.

```
Lowestoft VPA Version 3.1

   5/05/2009   9:36

 Extended Survivors Analysis

 "Whiting in the Celtic Sea (VIIe-k), WGCSE 2009, COMBSEX (Updated by SD 27/04/2009)"

 cpue data from file whg7ektutrimed.txt

 Catch data for  27 years. 1982 to 2008. Ages  0 to   7.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 "FR-GADOID-late: Fre,   1993, 2008,   3,     6,   .000,  1.000
 "FR-NEPHROPS-Late: F,   1993, 2008,   3,     6,   .000,  1.000
 "FR-EVHOE: Thalassa ,   1997, 2008,   0,     4,   .750,  1.000
 "UK-WCGFS: UK (E+W) ,   1987, 2008,   1,     6,   .150,   .250
 IR-GFS-7G-SweptArea:,   1999, 2008,   0,     6,   .750,   .920


 Time series weights :

      Tapered time weighting not applied


 Catchability analysis :

      Catchability independent of stock size for all ages

      Catchability independent of age for ages >=    5


 Terminal population estimation :

      Survivor estimates shrunk towards the mean F
      of the final   5 years or the   3 oldest ages.

      S.E. of the mean to which the estimates  are shrunk =   1.000

      Minimum standard error for population
      estimates derived from each fleet =    .500

      Prior weighting not applied


 Tuning converged after   25 iterations

1

 Regression weights
       , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000


 Fishing mortalities
    Age,  1999,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008

      0,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000
      1,  .089,  .037,  .007,  .038,  .016,  .039,  .026,  .054,  .025,  .021
      2,  .364,  .295,  .160,  .168,  .173,  .199,  .288,  .307,  .324,  .131
      3,  .768,  .782,  .686,  .443,  .372,  .482,  .755,  .700,  .886,  .697
      4, 1.037,  .967, 1.274,  .975,  .510,  .596, 1.007,  .971, 1.658,  .867
      5, 1.104,  .974, 1.388, 1.054,  .891,  .546, 1.112, 1.380, 1.816, 1.136
      6,  .937,  .825, 1.016,  .670,  .837,  .733,  .720,  .991, 1.876, 1.190


1
 XSA population numbers (Thousands)

                                AGE
 YEAR ,          0,         1,        2,        3,        4,        5,        6,

 1999 ,    1.35E+05, 5.40E+04, 3.70E+04, 2.57E+04, 1.44E+04, 1.44E+04, 1.18E+04,
```

```
2000 ,    6.39E+04, 1.10E+05, 4.05E+04, 2.10E+04, 9.75E+03, 4.17E+03, 3.92E+03,
2001 ,    3.88E+04, 5.23E+04, 8.70E+04, 2.47E+04, 7.88E+03, 3.04E+03, 1.29E+03,
2002 ,    3.84E+04, 3.18E+04, 4.25E+04, 6.07E+04, 1.02E+04, 1.80E+03, 6.20E+02,
2003 ,    4.23E+04, 3.14E+04, 2.50E+04, 2.94E+04, 3.19E+04, 3.14E+03, 5.15E+02,
2004 ,    4.05E+04, 3.46E+04, 2.53E+04, 1.72E+04, 1.66E+04, 1.57E+04, 1.05E+03,
2005 ,    3.52E+04, 3.32E+04, 2.73E+04, 1.70E+04, 8.72E+03, 7.49E+03, 7.44E+03,
2006 ,    5.42E+04, 2.88E+04, 2.65E+04, 1.67E+04, 6.53E+03, 2.61E+03, 2.02E+03,
2007 ,    8.80E+04, 4.44E+04, 2.24E+04, 1.59E+04, 6.80E+03, 2.03E+03, 5.38E+02,
2008 ,    2.65E+05, 7.20E+04, 3.54E+04, 1.33E+04, 5.38E+03, 1.06E+03, 2.70E+02,

Estimated population abundance at 1st Jan 2009

   ,     0.00E+00, 2.17E+05, 5.78E+04, 2.54E+04, 5.41E+03, 1.85E+03, 2.79E+02,

Taper weighted geometric mean of the VPA populations:

   ,     7.32E+04, 5.56E+04, 4.24E+04, 2.35E+04, 8.84E+03, 2.49E+03, 5.94E+02,

Standard error of the weighted Log(VPA populations) :

   ,        .5595,    .5142,    .5225,    .6506,    .8908,   1.1590,   1.4665,
1

Log catchability residuals.


Fleet : "FR-GADOID-late: Fre

 Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
    0 , No data for this fleet at this age
    1 , No data for this fleet at this age
    2 , No data for this fleet at this age
    3 , 99.99, 99.99, 99.99, 99.99,   .24,   .09,  -.35, -1.02, -1.10,   .16
    4 , 99.99, 99.99, 99.99, 99.99,  -.32,   .13,  -.21,  -.48,  -.66,  -.60
    5 , 99.99, 99.99, 99.99, 99.99,  -.34,  -.04,   .09,  -.44,  -.64,  -.45
    6 , 99.99, 99.99, 99.99, 99.99,  -.07,   .01,   .18,  -.40,  -.63,   .68


 Age  ,  1999,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008
    0 , No data for this fleet at this age
    1 , No data for this fleet at this age
    2 , No data for this fleet at this age
    3 ,   .31,   .52,   .19,  -.19,  -.67,  -.47,   .51,   .89,   .64,   .25
    4 ,   .28,   .22,   .06,   .03,  -.36,  -.25,   .39,   .65,   .69,   .42
    5 ,   .31,   .09,  -.11,  -.08,  -.25,  -.31,   .51,   .86,   .12,   .68
    6 ,   .10,   .13,  -.26,  -.25,  -.41,  -.03,   .25,   .59,  -.22,   .46


Mean log-catchability and standard error of ages with catchability
independent of year-class strength and constant w.r.t. time


   Age ,         3,         4,         5,         6
Mean Log q,   -6.6427,   -6.1608,   -5.9770,   -5.9770,
S.E(Log q),     .5829,     .4265,     .4239,     .3695,


Regression statistics :


Ages with q independent of year-class strength and constant w.r.t. time.

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

 3,    2.69,   -3.229,       .42,     .21,     16,    1.23,   -6.64,
 4,    1.80,   -4.740,      3.47,     .72,     16,     .49,   -6.16,
 5,    1.18,   -1.581,      5.53,     .84,     16,     .48,   -5.98,
 6,     .95,     .643,      6.03,     .93,     16,     .36,   -5.97,
```

```
1


 Fleet : "FR-NEPHROPS-Late: F

  Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
     0 , No data for this fleet at this age
     1 , No data for this fleet at this age
     2 , No data for this fleet at this age
     3 , 99.99, 99.99, 99.99, 99.99,   .71,   .32,   .19,  -.55,  -.42,  -.07
     4 , 99.99, 99.99, 99.99, 99.99,   .23,   .04,   .02,  -.10,   .06,  -.17
     5 , 99.99, 99.99, 99.99, 99.99,   .22,  -.48,  -.13,  -.02,   .31,   .08
     6 , 99.99, 99.99, 99.99, 99.99,  -.22,  -.65,  -.35,   .05,   .29,  -.01


  Age  ,  1999,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008
     0 , No data for this fleet at this age
     1 , No data for this fleet at this age
     2 , No data for this fleet at this age
     3 ,   .80,   .57,   .38,  -.38,  -.54,  -.40,   .30,  -.10,  -.09,  -.71
     4 ,   .68,   .51,   .47,   .05,  -.29,  -.26,  -.03,  -.41,  -.17,  -.63
     5 ,   .51,   .27,   .24,   .45,   .04,  -.15,   .05,  -.23,  -.60,  -.56
     6 ,   .57,   .17,  -.01,   .36,   .03,   .17,  -.08,  -.59,  -.92,  -.79



 Mean log-catchability and standard error of ages with catchability
 independent of year-class strength and constant w.r.t. time


    Age ,         3,          4,          5,          6
 Mean Log q,   -8.9430,   -8.3713,   -8.1554,   -8.1554,
 S.E(Log q),     .4777,     .3453,     .3415,     .4479,




 Regression statistics :


 Ages with q independent of year-class strength and constant w.r.t. time.

 Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

  3,    1.05,    -.208,      8.88,     .60,     16,     .52,   -8.94,
  4,    1.00,    -.023,      8.37,     .83,     16,     .36,   -8.37,
  5,     .90,    1.359,      8.18,     .93,     16,     .30,   -8.16,
  6,     .82,    2.897,      8.10,     .95,     16,     .29,   -8.28,
1



 Fleet : "FR-EVHOE: Thalassa

  Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
     0 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.46,  -.16
     1 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.41,  -.82
     2 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.56,  -.55
     3 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.30, -1.47
     4 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.03, -1.17
     5 , No data for this fleet at this age
     6 , No data for this fleet at this age


  Age  ,  1999,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008
     0 ,   .82,  -.58,  -.38,   .16,   .25,  -.21,   .38, -1.16,   .86,   .48
     1 ,   .50,  -.05,  -.10,  -.42,   .91,  1.45,  -.44,  -.78,   .34,  -.18
     2 ,   .43,   .55,   .42,  -.35,  1.08,  1.23,  -.55,  -.92,  -.50,  -.28
     3 ,   .31,  -.06,   .75,  -.20,  1.19,  1.50,  -.28,  -.78, -1.12,   .47
```

```
    4 ,   .15,  -.02,   .07,  -.41,   .93,   .91,   .11,  -.98,  -.24,   .69
    5 , No data for this fleet at this age
    6 , No data for this fleet at this age



Mean log-catchability and standard error of ages with catchability
independent of year-class strength and constant w.r.t. time


   Age ,         0,         1,         2,         3,         4
Mean Log q,   -6.8874,   -7.0118,   -7.5868,   -7.9913,   -7.9909,
S.E(Log q),     .6003,     .6848,     .7129,     .8930,     .6583,




Regression statistics :


Ages with q independent of year-class strength and constant w.r.t. time.

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

 0,     .70,    1.473,      8.12,     .71,     12,     .40,   -6.89,
 1,    1.13,    -.213,      6.52,     .20,     12,     .81,   -7.01,
 2,     .93,     .131,      7.80,     .24,     12,     .69,   -7.59,
 3,    1.18,    -.253,      7.62,     .17,     12,    1.10,   -7.99,
 4,     .97,     .130,      8.04,     .58,     12,     .67,   -7.99,
1



Fleet : "UK-WCGFS: UK (E+W)

 Age  ,  1987,  1988
    0 , No data for this fleet at this age
    1 , -1.22, -1.40
    2 ,  1.34, -1.28
    3 ,   .56,  -.86
    4 ,   .06, -1.12
    5 ,  1.13,   .16
    6 ,  1.74, 99.99



 Age  ,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998
    0 , No data for this fleet at this age
    1 ,  -.18, -3.20, -1.56,  -.14,  1.29,  1.62,  -.52,  -.10,   .31,   .83
    2 ,   .05, -1.28, -3.28,  -.21,  -.16,   .29,  1.41,   .69,   .26,   .65
    3 ,   .40,  -.21, -2.38,  -.12,   .04,   .55,   .99,   .58,  -.86,   .79
    4 ,   .20,   .08, -1.37,   .64,  -.09,   .44,   .73,   .07,  -.02,   .51
    5 ,   .62,   .73,  -.44,   .39,  -.31,   .68,   .53,  -.06,   .08,  -.75
    6 ,  1.11,   .62,   .24,   .12,   .60,   .14,   .89,  -.57,  -.09, -1.33



 Age  ,  1999,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008
    0 , No data for this fleet at this age
    1 ,   .34,  2.49,  1.44, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
    2 ,   .31,   .81,   .39, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
    3 ,  -.24,   .57,   .20, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
    4 ,  -.50,   .56,  -.21, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
    5 ,  -.76,   .30, -2.29, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
    6 ,   .05,   .41,  -.18, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99



Mean log-catchability and standard error of ages with catchability
independent of year-class strength and constant w.r.t. time
```

Age ,	1,	2,	3,	4,	5,	6
Mean Log q,	-11.3522,	-11.3957,	-11.5830,	-11.6814,	-11.4935,	-11.4935,
S.E(Log q),	1.4619,	1.1905,	.8606,	.6085,	.8419,	.7946,

Regression statistics :

Ages with q independent of year-class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
1,	.60,	.857,	11.29,	.26,	15,	.88,	-11.35,
2,	.55,	1.313,	11.20,	.40,	15,	.64,	-11.40,
3,	.59,	2.205,	11.07,	.69,	15,	.45,	-11.58,
4,	.91,	.552,	11.47,	.75,	15,	.57,	-11.68,
5,	1.38,	-1.654,	12.80,	.60,	15,	1.09,	-11.49,
6,	1.44,	-2.734,	13.16,	.77,	14,	.87,	-11.23,

1

Fleet : IR-GFS-7G-SweptArea:

Age ,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	2007,	2008
0 ,	.48,	-.16,	.07,	-.55,	.25,	.77,	-1.23,	.93,	.02,	-.59
1 ,	.26,	.28,	-.72,	.06,	-.45,	-.09,	-.14,	.64,	.51,	-.36
2 ,	-.11,	.25,	.86,	-.50,	-.48,	-.92,	-.05,	.32,	.73,	-.09
3 ,	.08,	-.92,	1.12,	-.37,	-.82,	-.44,	.07,	.56,	.32,	.39
4 ,	.49,	-1.30,	1.02,	-.04,	99.99,	-.70,	.42,	-.23,	.50,	-.17
5 ,	.35,	.07,	.33,	-1.22,	-.70,	-.09,	.95,	99.99,	1.34,	-1.02
6 ,	.15,	-1.20,	1.08,	.63,	99.99,	-2.05,	1.08,	.85,	.96,	99.99

Mean log-catchability and standard error of ages with catchability
independent of year-class strength and constant w.r.t. time

Age ,	0,	1,	2,	3,	4,	5,	6
Mean Log q,	-4.3314,	-4.3240,	-4.7004,	-5.2755,	-5.6630,	-6.4385,	-6.4385,
S.E(Log q),	.6619,	.4339,	.5576,	.6392,	.7045,	.8632,	1.1977,

Regression statistics :

Ages with q independent of year-class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
0,	1.03,	-.078,	4.14,	.49,	10,	.72,	-4.33,
1,	1.04,	-.114,	4.06,	.48,	10,	.48,	-4.32,
2,	.65,	1.183,	6.71,	.59,	10,	.35,	-4.70,
3,	1.88,	-.952,	1.14,	.13,	10,	1.21,	-5.28,
4,	1.68,	-.573,	3.32,	.09,	9,	1.24,	-5.66,
5,	.74,	1.078,	6.92,	.71,	9,	.63,	-6.44,
6,	1.04,	-.081,	6.20,	.46,	8,	1.32,	-6.25,

1

Terminal year survivor and F summaries :

Age 0 Catchability constant w.r.t. time and dependent on age

```
Year class = 2008

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
"FR-GADOID-late: Fre,         1.,   .000,       .000,    .00,   0,  .000,     .000
"FR-NEPHROPS-Late: F,         1.,   .000,       .000,    .00,   0,  .000,     .000
"FR-EVHOE: Thalassa ,    348766.,   .625,       .000,    .00,   1,  .552,     .000
"UK-WCGFS: UK (E+W) ,         1.,   .000,       .000,    .00,   0,  .000,     .000
IR-GFS-7G-SweptArea:,    120256.,   .694,       .000,    .00,   1,  .448,     .000

  F shrinkage mean  ,         0.,   1.00,,,,                        .000,     .000

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
   216566.,       .46,      .53,    2,   1.140,   .000


Age  1   Catchability constant w.r.t. time and dependent on age

Year class = 2007

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
"FR-GADOID-late: Fre,         1.,   .000,       .000,    .00,   0,  .000,     .000
"FR-NEPHROPS-Late: F,         1.,   .000,       .000,    .00,   0,  .000,     .000
"FR-EVHOE: Thalassa ,     86814.,   .470,       .518,   1.10,   2,  .390,     .014
"UK-WCGFS: UK (E+W) ,         1.,   .000,       .000,    .00,   0,  .000,     .000
IR-GFS-7G-SweptArea:,     45921.,   .406,       .177,    .44,   2,  .523,     .026

  F shrinkage mean  ,     37053.,   1.00,,,,                        .088,     .032

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
    57756.,       .29,      .24,    5,    .821,   .021


1
Age  2   Catchability constant w.r.t. time and dependent on age

Year class = 2006

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
"FR-GADOID-late: Fre,         1.,   .000,       .000,    .00,   0,  .000,     .000
"FR-NEPHROPS-Late: F,         1.,   .000,       .000,    .00,   0,  .000,     .000
"FR-EVHOE: Thalassa ,     16397.,   .397,       .449,   1.13,   3,  .384,     .197
"UK-WCGFS: UK (E+W) ,         1.,   .000,       .000,    .00,   0,  .000,     .000
IR-GFS-7G-SweptArea:,     38207.,   .333,       .272,    .81,   3,  .545,     .089

  F shrinkage mean  ,     12022.,   1.00,,,,                        .070,     .260

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
    25449.,       .25,      .27,    7,   1.097,   .131


Age  3   Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
"FR-GADOID-late: Fre,      6943.,   .601,       .000,    .00,   1,  .121,     .579
"FR-NEPHROPS-Late: F,      2671.,   .500,       .000,    .00,   1,  .175,    1.112
"FR-EVHOE: Thalassa ,      4935.,   .369,       .311,    .84,   4,  .244,     .744
"UK-WCGFS: UK (E+W) ,         1.,   .000,       .000,    .00,   0,  .000,     .000
```

```
IR-GFS-7G-SweptArea:,      7189.,   .302,       .399,   1.32,   4,  .372,     .564

  F shrinkage mean  ,      6015.,   1.00,,,,                        .088,     .645

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     5407.,       .20,      .19,   11,    .953,   .697


1
Age  4   Catchability constant w.r.t. time and dependent on age

Year class = 2004

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
"FR-GADOID-late: Fre,      2966.,   .411,       .089,    .22,   2,  .223,     .621
"FR-NEPHROPS-Late: F,      1154.,   .383,       .244,    .64,   2,  .245,    1.167
"FR-EVHOE: Thalassa ,      1857.,   .378,       .351,    .93,   5,  .195,     .865
"UK-WCGFS: UK (E+W) ,         1.,   .000,       .000,    .00,   0,  .000,     .000
IR-GFS-7G-SweptArea:,      2065.,   .320,       .161,    .50,   5,  .234,     .805

  F shrinkage mean  ,      1587.,   1.00,,,,                        .103,     .959

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     1851.,       .20,      .13,   15,    .673,   .867


Age  5   Catchability constant w.r.t. time and dependent on age

Year class = 2003

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
"FR-GADOID-late: Fre,       559.,   .406,       .033,    .08,   3,  .302,     .720
"FR-NEPHROPS-Late: F,       175.,   .398,       .122,    .31,   3,  .309,    1.477
"FR-EVHOE: Thalassa ,       275.,   .360,       .333,    .93,   5,  .057,    1.147
"UK-WCGFS: UK (E+W) ,         1.,   .000,       .000,    .00,   0,  .000,     .000
IR-GFS-7G-SweptArea:,       188.,   .485,       .298,    .61,   6,  .144,    1.421

  F shrinkage mean  ,       268.,   1.00,,,,                        .187,    1.163

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
      279.,       .27,      .14,   18,    .529,  1.136


1
Age  6   Catchability constant w.r.t. time and age (fixed at the value for age)  5

Year class = 2002

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
"FR-GADOID-late: Fre,       103.,   .408,       .072,    .18,   4,  .351,     .914
"FR-NEPHROPS-Late: F,        33.,   .405,       .107,    .26,   4,  .354,    1.742
"FR-EVHOE: Thalassa ,        61.,   .357,       .428,   1.20,   5,  .022,    1.265
"UK-WCGFS: UK (E+W) ,         1.,   .000,       .000,    .00,   0,  .000,     .000
IR-GFS-7G-SweptArea:,        81.,   .366,       .383,   1.05,   6,  .041,    1.064

  F shrinkage mean  ,       104.,   1.00,,,,                        .232,     .910

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
       67.,       .31,      .14,   20,    .455,  1.190
```

Table 7.15.11. Whiting in Divisions VIIe–k. Fishing mortality (F)-at-age.

An object of class "FLStock"
Slot "name":
[1] "Whiting in the Celtic Sea (VIIe-k), WGCSE 2009, COMBSEX (Updated by SD 27/04/2009)"

Slot "desc":
[1] "Whiting 7ek"

Slot "harvest":
An object of class "FLQuant":

, , unit = unique, season = all, area = unique

year

age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0	0	0	0	0	0	0	0	0	0
1	0.106	0.137	0.080	0.097	0.074	0.063	0.030	0.025	0.084	0.110
2	0.623	0.731	0.839	0.803	0.713	0.656	0.436	0.321	0.640	0.496
3	1.048	1.441	0.965	1.169	0.984	1.347	1.099	0.927	0.754	1.080
4	1.237	1.506	1.557	0.874	1.230	1.519	1.482	1.353	1.095	1.760
5	1.386	1.985	1.518	1.302	1.150	1.775	1.283	1.266	1.420	1.418
6	1.239	1.667	1.364	1.128	1.135	0.763	1.252	0.675	0.842	1.316
7	1.239	1.667	1.364	1.128	1.135	0.763	1.252	0.675	0.842	1.316

year

age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0	0	0	0	0	0	0	0	0	0
1	0.042	0.022	0.009	0.007	0.029	0.014	0.029	0.089	0.037	0.007
2	0.428	0.267	0.178	0.139	0.123	0.127	0.212	0.364	0.295	0.160
3	0.920	0.846	0.556	0.460	0.242	0.289	0.523	0.768	0.782	0.686
4	0.928	0.837	0.818	0.706	0.545	0.508	0.588	1.037	0.967	1.274
5	1.018	1.178	0.857	0.826	0.665	0.701	0.702	1.104	0.974	1.388
6	0.956	1.040	1.220	0.701	0.782	0.883	0.664	0.937	0.825	1.016
7	0.956	1.040	1.220	0.701	0.782	0.883	0.664	0.937	0.825	1.016

year

age	2002	2003	2004	2005	2006	2007	2008
0	0	0	0	0	0	0	0
1	0.038	0.016	0.039	0.026	0.054	0.025	0.021
2	0.168	0.173	0.199	0.288	0.307	0.324	0.131
3	0.443	0.372	0.482	0.755	0.700	0.886	0.697
4	0.975	0.510	0.596	1.007	0.971	1.658	0.867
5	1.055	0.891	0.546	1.112	1.380	1.816	1.136
6	0.670	0.837	0.733	0.720	0.991	1.876	1.190
7	0.670	0.837	0.733	0.720	0.991	1.876	1.190

attr(,"units")
[1] "f"

Table 7.15.12. Whiting in Divisions VIIe–k. Stock number-at-age.

An object of class "FLStock"
Slot "name":
[1] "Whiting in the Celtic Sea (VIIe-k), WGCSE 2009, COMBSEX (Updated by SD 27/04/2009)"

Slot "desc":
[1] "Whiting 7ek"

Slot "stock.n":
An object of class "FLQuant":

, , unit = unique, season = all, area = unique

year

age	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	62046	50257	53997	71465	133030	105413	33070	54992	108342
1	28887	50799	41147	44209	58511	108916	86305	27075	45024
2	29860	21276	36282	31106	32849	44494	83765	68566	21623
3	16784	13116	8388	12835	11408	13180	18897	44349	40703
4	7108	4818	2542	2618	3265	3490	2806	5156	14374
5	1297	1690	875	439	894	781	625	522	1092
6	64	266	190	157	98	232	108	142	120
7	35	13	41	53	72	123	32	56	40

year

age	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	163244	145640	193383	107308	63205	58595	56784	65983	134636
1	88703	133653	119240	158328	87857	51748	47973	46491	54023
2	33904	65078	104934	95540	128477	71442	41150	38726	36994
3	9334	16903	34721	65756	65455	91560	51730	29664	25662
4	15672	2595	5516	12195	30868	33815	58872	31736	14389
5	3938	2207	840	1956	4406	12476	16059	29010	14439
6	216	781	653	212	680	1579	5251	6522	11771
7	4	69	289	272	199	229	1335	1983	2122

year

age	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	63911	38793	38384	42313	40540	35230	54198	87966	264513
1	110231	52326	31761	31427	34643	33191	28844	44374	72021
2	40463	87015	42537	25038	25312	27270	26480	22379	35436
3	21038	24662	60702	29431	17243	16977	16745	15941	13257
4	9750	7879	10169	31911	16619	8722	6533	6804	5379
5	4175	3035	1805	3139	15694	7494	2610	2026	1061
6	3920	1291	620	515	1055	7440	2018	538	270
7	3574	468	141	38	145	312	1003	286	47

attr(,"units")
[1] "thousands"

Table 7.15.13. Whiting in Divisions VIIe–k. Summary table.

	Recruits age 0	TotBIO	TotSSB	Landings	Yield/ssb	Fbar 2-5
1982	62,046	22,647	18,983	11,225	0.591	1.073
1983	50,257	22,821	16,987	11,781	0.694	1.416
1984	53,997	23,397	17,511	9,985	0.570	1.220
1985	71,465	23,313	17,576	10,838	0.617	1.037
1986	133,030	26,073	18,631	9,952	0.534	1.019
1987	105,413	37,566	25,013	12,652	0.506	1.325
1988	33,070	45,760	33,777	15,128	0.448	1.075
1989	54,992	39,531	34,795	16,541	0.475	0.967
1990	108,342	32,748	27,465	14,106	0.514	0.977
1991	163,244	33,327	24,224	13,508	0.558	1.189
1992	145,640	48,209	32,310	12,364	0.383	0.823
1993	193,383	61,872	47,020	16,320	0.347	0.782
1994	107,308	82,154	62,543	20,034	0.320	0.602
1995	63,205	84,021	74,532	22,678	0.304	0.533
1996	58,595	79,168	72,632	18,260	0.251	0.394
1997	56,784	67,479	62,860	20,532	0.327	0.406
1998	65,983	55,223	49,897	19,245	0.386	0.506
1999	134,636	44,081	39,341	19,915	0.506	0.818
2000	63,911	45,412	34,585	14,865	0.430	0.754
2001	38,793	48,151	39,958	12,770	0.320	0.877
2002	38,384	45,240	40,178	13,146	0.327	0.660
2003	42,313	37,915	33,482	10,583	0.316	0.486
2004	40,540	34,700	30,399	9,953	0.327	0.456
2005	35,230	31,065	26,966	12,030	0.446	0.790
2006	54,198	26,431	22,474	9,533	0.424	0.840
2007	87,966	27,849	21,584	8,947	0.415	1.171
2008	264,513	38,016	26,033	5,737	0.220	0.708
GM mean 82-07	69702					

Table 7.15.14. Whiting in Divisions VIIe–k. Prediction input data.

MFDP version 1a
Run: shorttermforecast
Time and date: 08:27 15/05/2009
Fbar age range: 2-5

Input: F Mean 06-08
Catch and stock weights are mean 06-08
Recruits age 0 in 2008,09,10 and 11 GM mean 82-07

2009

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	69702	0.2	0.00	0	0	0.000	0.000	0.076
1	57067	0.2	0.39	0	0	0.209	0.033	0.224
2	57756	0.2	0.90	0	0	0.291	0.254	0.294
3	25449	0.2	0.99	0	0	0.399	0.761	0.393
4	5407	0.2	0.99	0	0	0.564	1.165	0.514
5	1851	0.2	1.00	0	0	0.666	1.444	0.597
6	279	0.2	1.00	0	0	0.704	1.353	0.629
7	79	0.2	1.00	0	0	1.060	1.353	0.806

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	69702	0.2	0.00	0	0	0.000	0.000	0.076
1	.	0.2	0.39	0	0	0.209	0.033	0.224
2	.	0.2	0.90	0	0	0.291	0.254	0.294
3	.	0.2	0.99	0	0	0.399	0.761	0.393
4	.	0.2	0.99	0	0	0.564	1.165	0.514
5	.	0.2	1.00	0	0	0.666	1.444	0.597
6	.	0.2	1.00	0	0	0.704	1.353	0.629
7	.	0.2	1.00	0	0	1.060	1.353	0.806

2011

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	69702	0.2	0.00	0	0	0.000	0.000	0.076
1	.	0.2	0.39	0	0	0.209	0.033	0.224
2	.	0.2	0.90	0	0	0.291	0.254	0.294
3	.	0.2	0.99	0	0	0.399	0.761	0.393
4	.	0.2	0.99	0	0	0.564	1.165	0.514
5	.	0.2	1.00	0	0	0.666	1.444	0.597
6	.	0.2	1.00	0	0	0.704	1.353	0.629
7	.	0.2	1.00	0	0	1.060	1.353	0.806

Input units are thousands and kg - output in tonnes

Table 7.15.15. Whiting in Divisions VIIe–k. Management options table.

MFDP version 1a
Run: shorttermforecast
Whiting in the Celtic Sea (VIIe-k), WGCSE 2009, COMBSEX (Updated by SD 27/04/2009)
Time and date: 08:27 15/05/2009
Fbar age range: 2-5

2009 Biomass	SSB	FMult	FBar	Landings
43462	34372	1.0000	0.9061	11459

2010 Biomass	SSB	FMult	FBar	Landings	2011 Biomass	SSB
46459	37666	0.0000	0.0000	0	63711	54757
.	37666	0.1000	0.0906	1934	61316	52383
.	37666	0.2000	0.1812	3722	59106	50192
.	37666	0.3000	0.2718	5378	57064	48169
.	37666	0.4000	0.3624	6913	55176	46299
.	37666	0.5000	0.4530	8337	53427	44567
.	37666	0.6000	0.5436	9661	51806	42962
.	37666	0.7000	0.6342	10893	50302	41473
.	37666	0.8000	0.7248	12041	48904	40090
.	37666	0.9000	0.8155	13112	47603	38803
.	37666	1.0000	0.9061	14112	46391	37605
.	37666	1.1000	0.9967	15048	45261	36488
.	37666	1.2000	1.0873	15924	44206	35445
.	37666	1.3000	1.1779	16745	43219	34471
.	37666	1.4000	1.2685	17517	42295	33559
.	37666	1.5000	1.3591	18242	41430	32704
.	37666	1.6000	1.4497	18925	40618	31903
.	37666	1.7000	1.5403	19568	39855	31150
.	37666	1.8000	1.6309	20175	39137	30443
.	37666	1.9000	1.7215	20749	38461	29777
.	37666	2.0000	1.8121	21292	37824	29149

Input units are thousands and kg - output in tonnes

Table 7.15.16. Whiting in Divisions VIIe–k. Detailed results.

MFDP version 1a
Run: shorttermforecast
Time and date: 08:27 15/05/2009
Fbar age range: 2-5

Year:		2009	F multiplier:		1	Fbar:	0.9061			
Age	F		CatchNos	Yield		StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	0	0	0	0	69702	0	0	0	0	0
	1	0.033	1687	378	57067	11927	22256	4652	22256	4652
	2	0.254	11793	3471	57756	16826	51980	15144	51980	15144
	3	0.761	12446	4896	25449	10146	25195	10044	25195	10044
	4	1.165	3437	1768	5407	3050	5353	3019	5353	3019
	5	1.444	1312	783	1851	1233	1851	1233	1851	1233
	6	1.353	192	121	279	196	279	196	279	196
	7	1.353	54	44	79	84	79	84	79	84
Total			30920	11459	217590	43462	106993	34372	106993	34372

Year:		2010	F multiplier:		1	Fbar:	0.9061			
Age	F		CatchNos	Yield		StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	0	0	0	0	69702	0	0	0	0	0
	1	0.033	1687	378	57067	11927	22256	4652	22256	4652
	2	0.254	9229	2716	45200	13168	40680	11851	40680	11851
	3	0.761	17938	7056	36679	14623	36312	14476	36312	14476
	4	1.165	6186	3182	9733	5489	9635	5434	9635	5434
	5	1.444	978	584	1381	920	1381	920	1381	920
	6	1.353	246	155	358	252	358	252	358	252
	7	1.353	52	42	76	80	76	80	76	80
Total			36316	14112	220194	46459	110697	37666	110697	37666

Year:		2011	F multiplier:		1	Fbar:	0.9061			
Age	F		CatchNos	Yield		StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	0	0	0	0	69702	0	0	0	0	0
	1	0.033	1687	378	57067	11927	22256	4652	22256	4652
	2	0.254	9229	2716	45200	13168	40680	11851	40680	11851
	3	0.761	14039	5522	28705	11444	28418	11329	28418	11329
	4	1.165	8915	4586	14027	7911	13887	7832	13887	7832
	5	1.444	1761	1051	2485	1656	2485	1656	2485	1656
	6	1.353	183	115	267	188	267	188	267	188
	7	1.353	63	51	92	97	92	97	92	97
Total			35877	14419	217544	46391	108084	37605	108084	37605

Input units are thousands and kg - output in tonnes

Table 7.15.17. Whiting in Divisions VIIe–k. Stock numbers of recruits and the source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes.

Year-class	2006	2007	2008	2009	2010
Stock No. (thousands) of 0 year-olds	54198	87967	69702	69702	69702
Source	XSA	XSA	GM82-07	GM82-07	GM82-07
Status Quo F:					
% in 2009 landings	42.7	30.3	3.3	0.0	-
% in 2010	22.5	50.0	19.2	2.7	0.0
% in 2009 SSB	29.2	44.1	13.5	0.0	-
% in 2010 SSB	14.4	38.4	31.5	12.4	0.0
% in 2011 SSB	4.4	20.8	30.1	31.5	12.4

GM : geometric mean recruitment

Whiting VIIe-k : Year-class % contribution to

Table 7.15.18. Whiting in Divisions VIIe–k. Yield-per-recruit summary table.

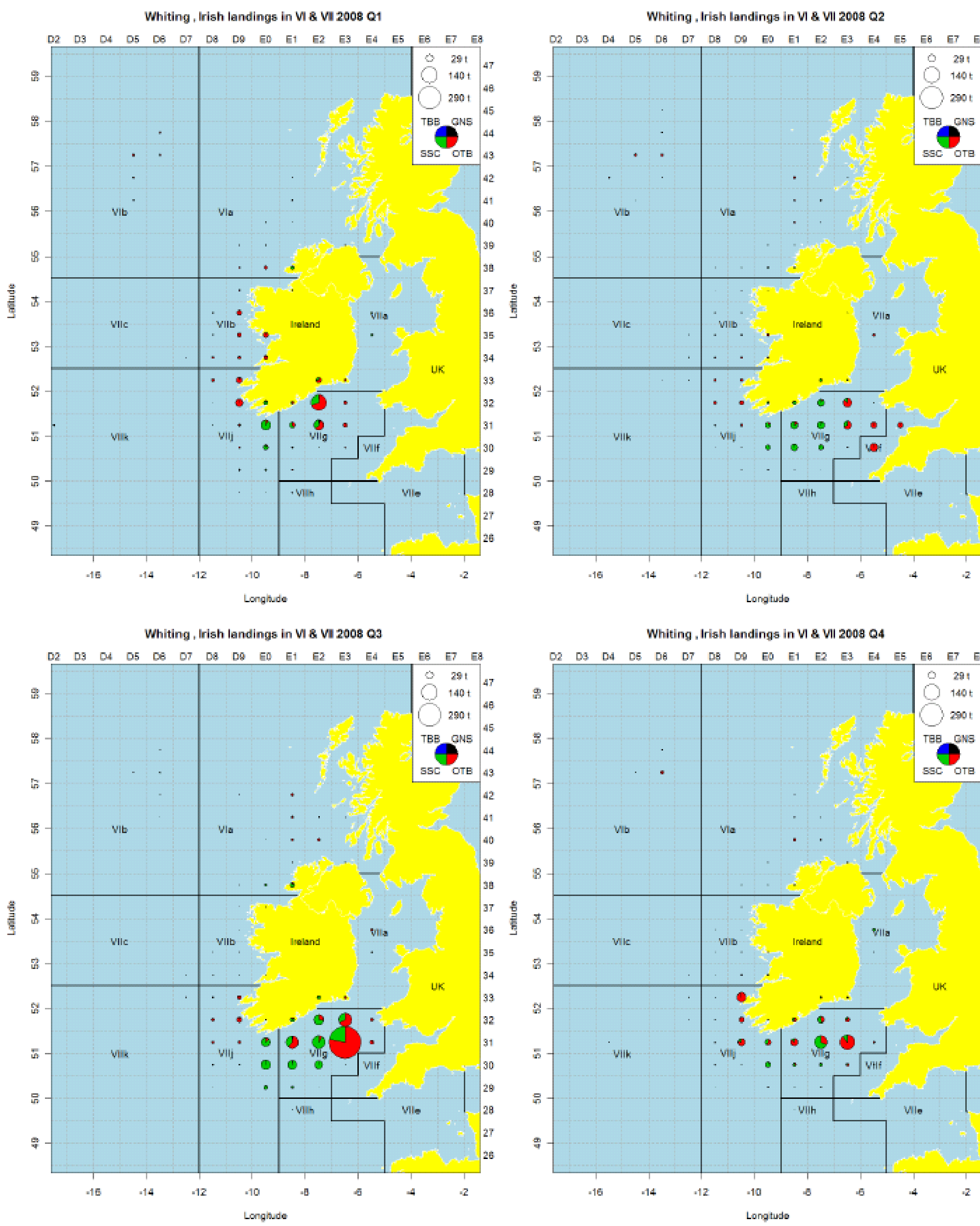
MFYPR version 2a
Run: YPR
Time and date: 08:31 15/05/2009
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	5.5167	2.7383	3.9402	2.6096	3.9402	2.6096
0.1000	0.0906	0.2138	0.1249	4.4531	1.7063	2.8774	1.5781	2.8774	1.5781
0.2000	0.1812	0.3075	0.1653	3.9896	1.2924	2.4148	1.1645	2.4148	1.1645
0.3000	0.2718	0.3614	0.1819	3.7247	1.0752	2.1505	0.9477	2.1505	0.9477
0.4000	0.3624	0.3972	0.1897	3.5499	0.9431	1.9765	0.8158	1.9765	0.8158
0.5000	0.4530	0.4231	0.1935	3.4240	0.8545	1.8512	0.7275	1.8512	0.7275
0.6000	0.5436	0.4430	0.1954	3.3276	0.7907	1.7554	0.6640	1.7554	0.6640
0.7000	0.6342	0.4590	0.1964	3.2505	0.7425	1.6789	0.6160	1.6789	0.6160
0.8000	0.7248	0.4723	0.1967	3.1869	0.7044	1.6159	0.5782	1.6159	0.5782
0.9000	0.8155	0.4836	0.1968	3.1330	0.6734	1.5626	0.5474	1.5626	0.5474
1.0000	0.9061	0.4934	0.1966	3.0866	0.6475	1.5166	0.5217	1.5166	0.5217
1.1000	0.9967	0.5020	0.1963	3.0459	0.6255	1.4764	0.4999	1.4764	0.4999
1.2000	1.0873	0.5096	0.1960	3.0097	0.6064	1.4407	0.4810	1.4407	0.4810
1.3000	1.1779	0.5165	0.1956	2.9773	0.5897	1.4088	0.4645	1.4088	0.4645
1.4000	1.2685	0.5228	0.1952	2.9480	0.5749	1.3799	0.4498	1.3799	0.4498
1.5000	1.3591	0.5285	0.1947	2.9212	0.5616	1.3535	0.4367	1.3535	0.4367
1.6000	1.4497	0.5337	0.1943	2.8967	0.5497	1.3294	0.4249	1.3294	0.4249
1.7000	1.5403	0.5386	0.1939	2.8740	0.5388	1.3071	0.4142	1.3071	0.4142
1.8000	1.6309	0.5431	0.1935	2.8529	0.5289	1.2864	0.4044	1.2864	0.4044
1.9000	1.7215	0.5473	0.1931	2.8333	0.5197	1.2671	0.3954	1.2671	0.3954
2.0000	1.8121	0.5513	0.1927	2.8149	0.5113	1.2491	0.3871	1.2491	0.3871

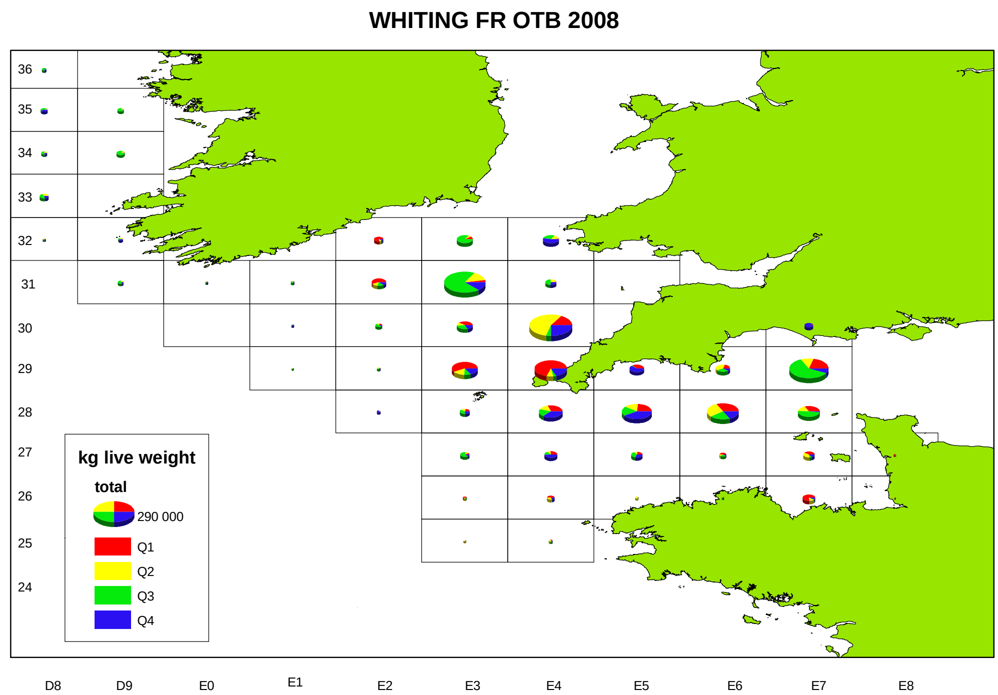
Reference point	F multiplier	Absolute F
Fbar(2-5)	1.0000	0.9061
FMax	0.8641	0.7829
F0.1	0.2067	0.1873
F35%SPR	0.322	0.2918

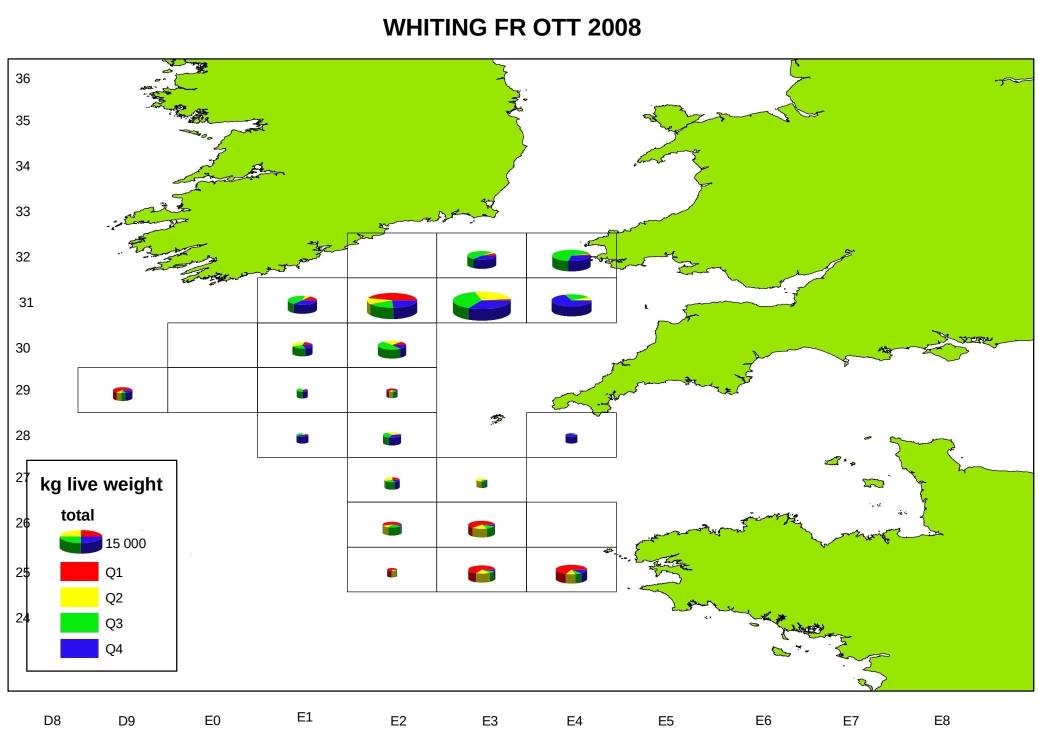
Weights in kilograms

Irish landings for the main gear types by quarter in 2008:



French landings for otter trawlers and twin rigged otter trawlers 2008:





UK (E&W) whiting landings for all gears 2008:

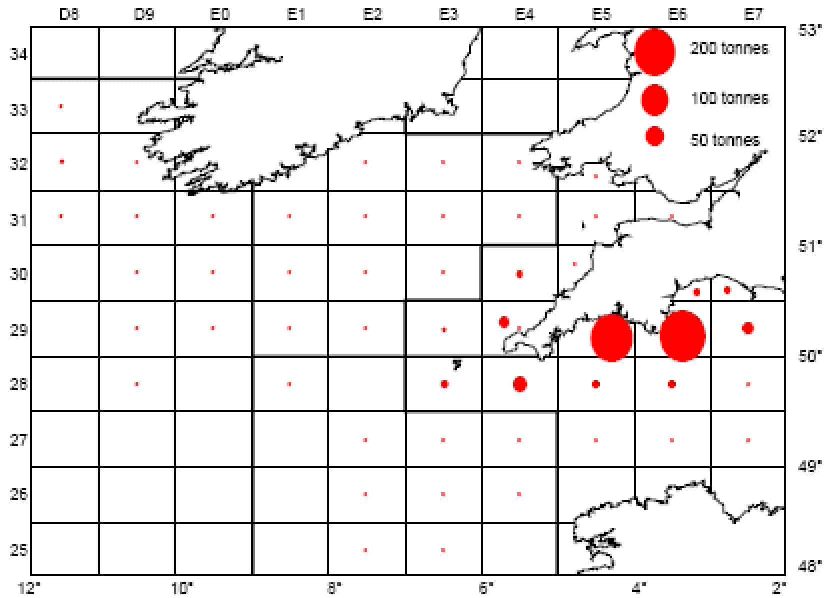


Figure 7.15.1. Whiting in VIIe–k (Celtic Sea). The spatial and temporal distribution of landings data in 2008 available to the WG.

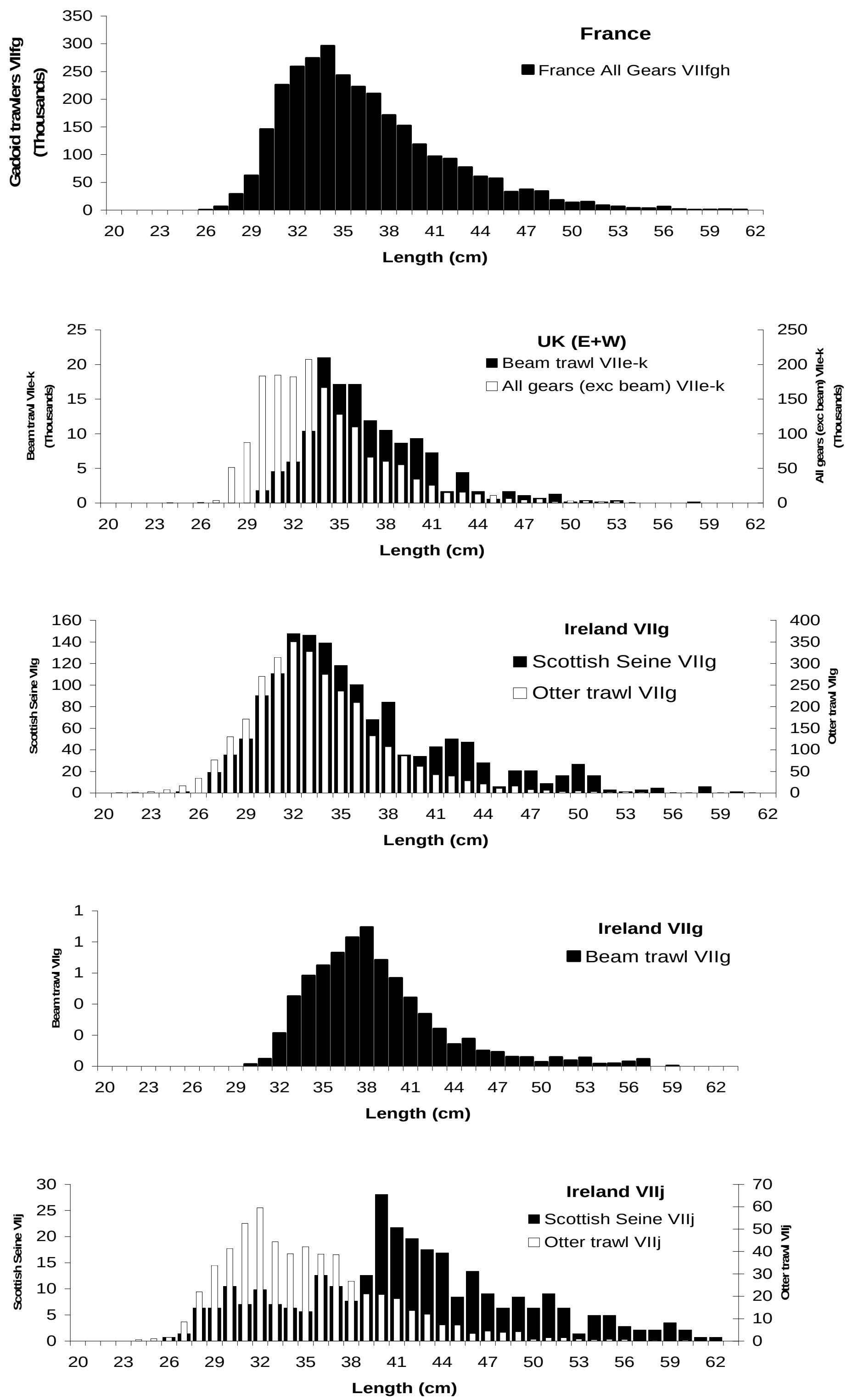
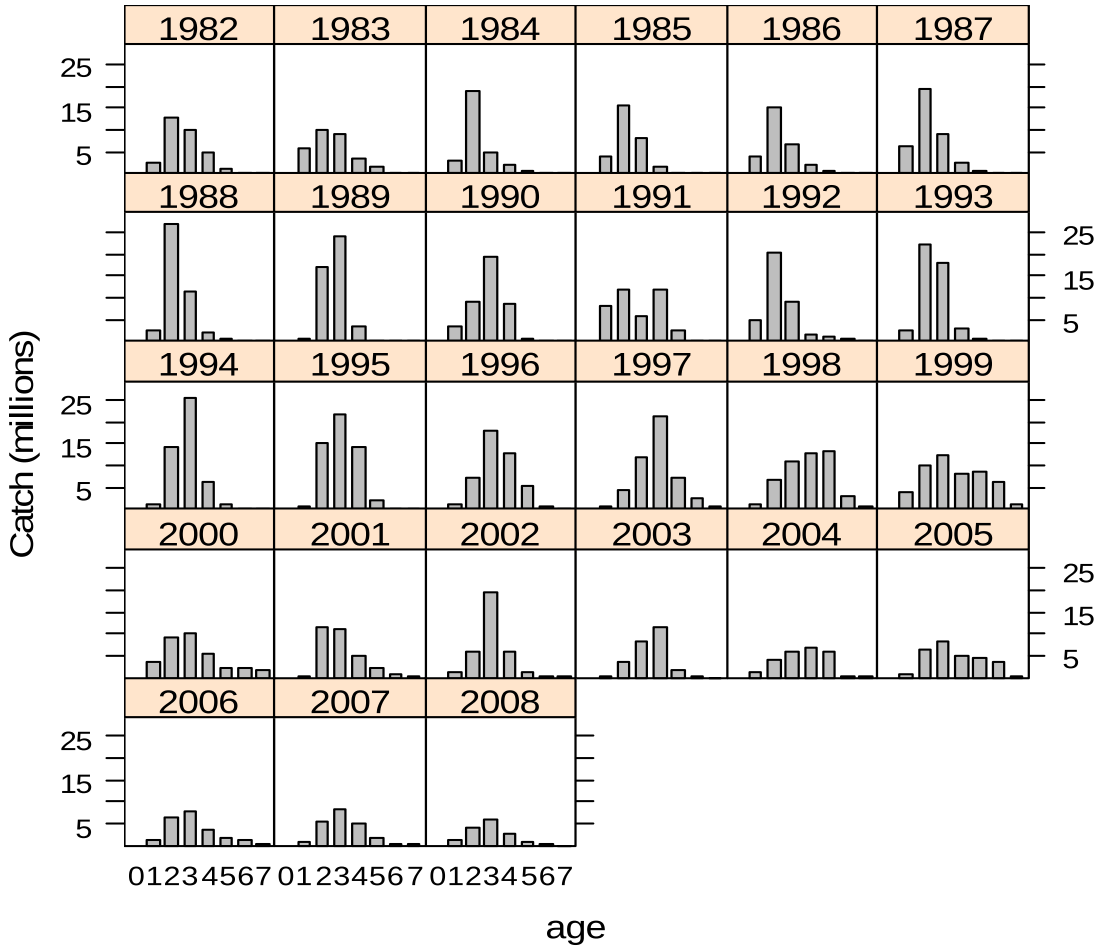


Figure 7.15.2. Whiting in VIIe–k (Celtic Sea). 2008 length compositions (raised numbers) of French, UK and Irish fleets.

(a)


1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
25
15
5
Catch (millions)
01234567
age

(b)

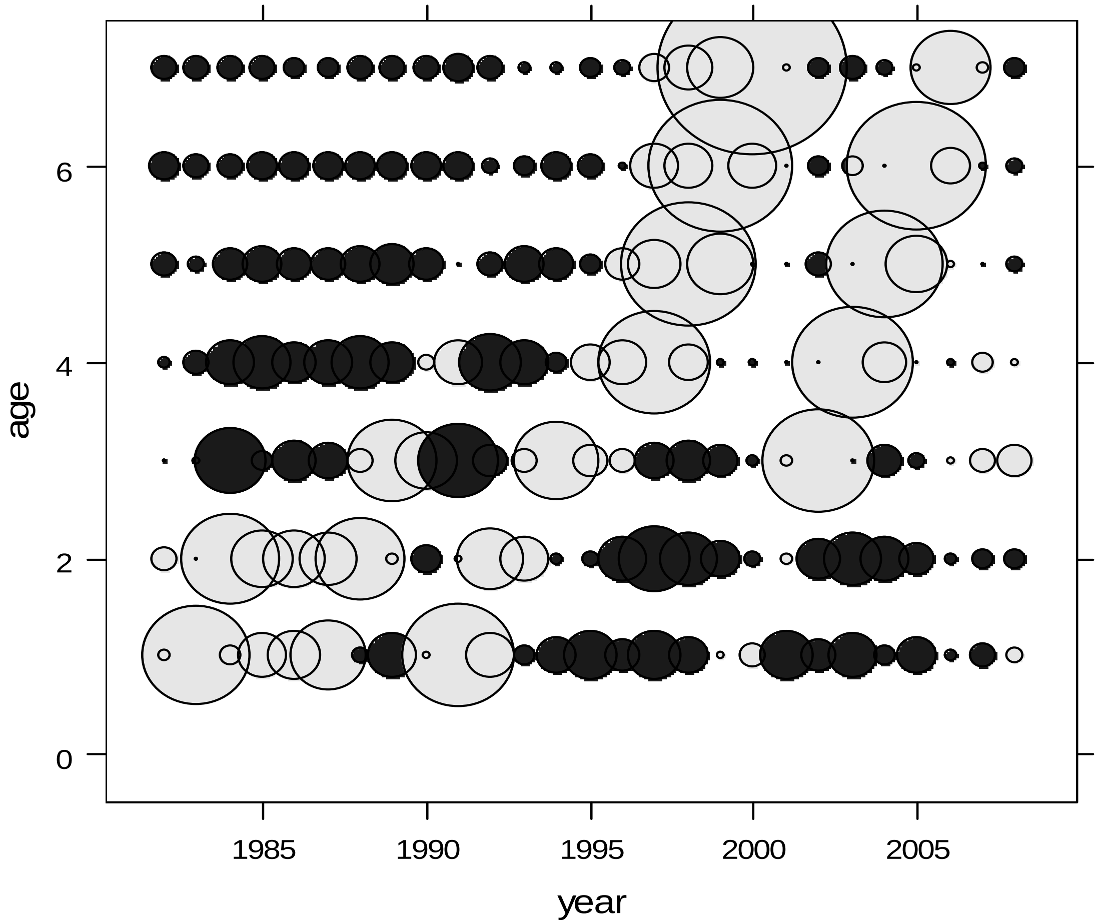


Figure 7.15.3. Whiting in VIIe–k (Celtic Sea). Annual landings age composition (a) and standardized catch proportions-at-age (b).

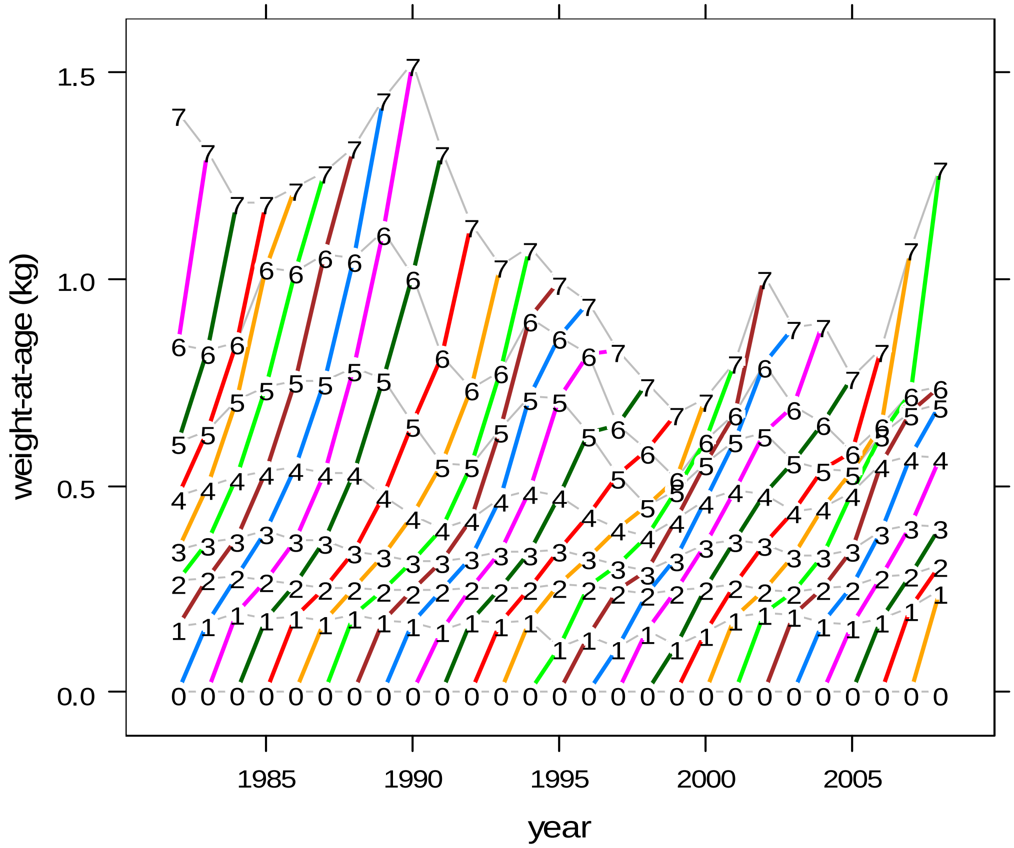


Figure 7.15.4. Whiting in VIIe–k (Celtic Sea). Stock weights-at-age.

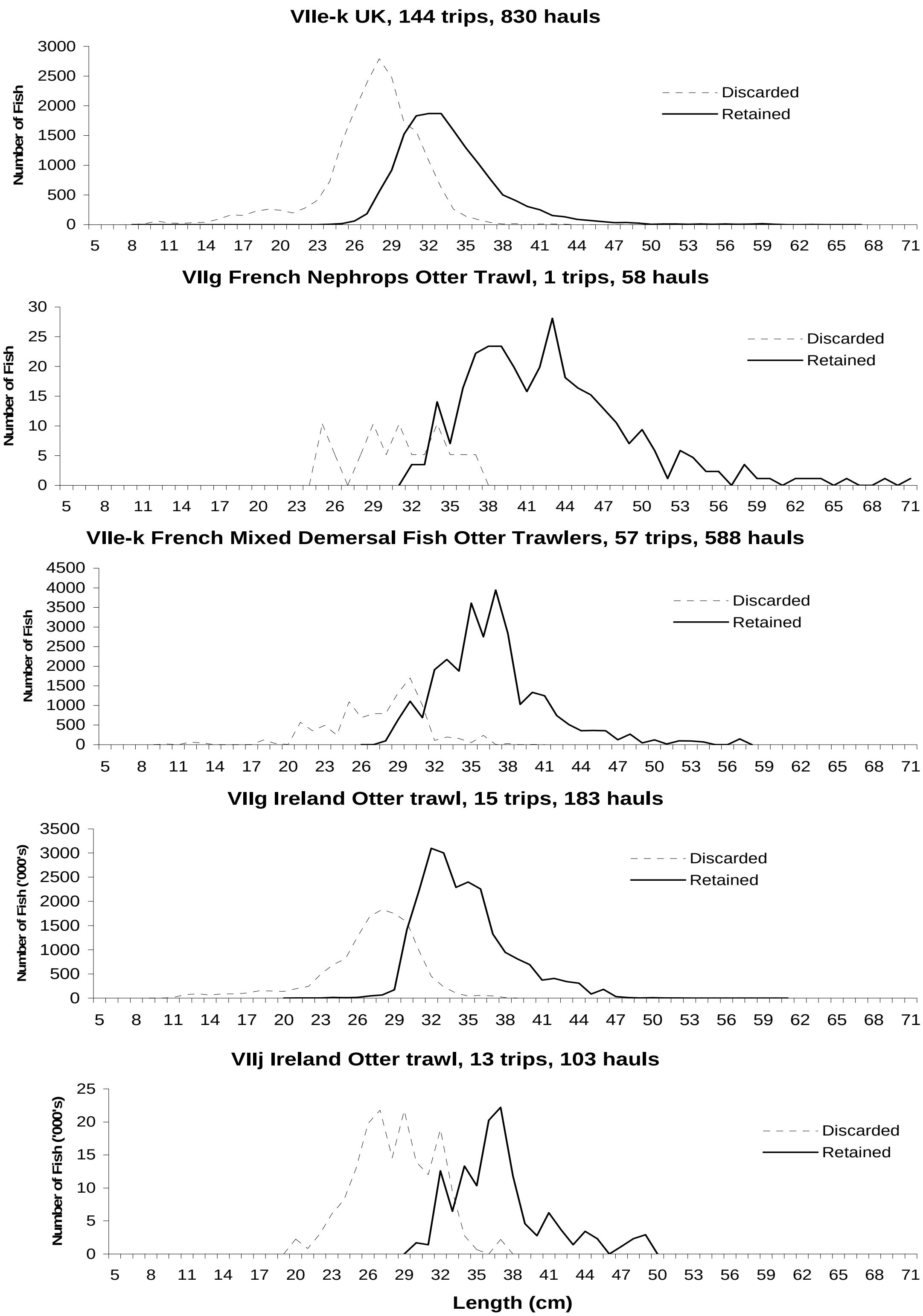


Figure 7.15.5. Whiting in VIIe–k (Celtic Sea). 2008 Annual length compositions of Irish, UK, and French discards. Numbers are raised to the sampled catch for the UK and are raised by trip to the fleet for Ireland, and are unraised sampled lengths for France.

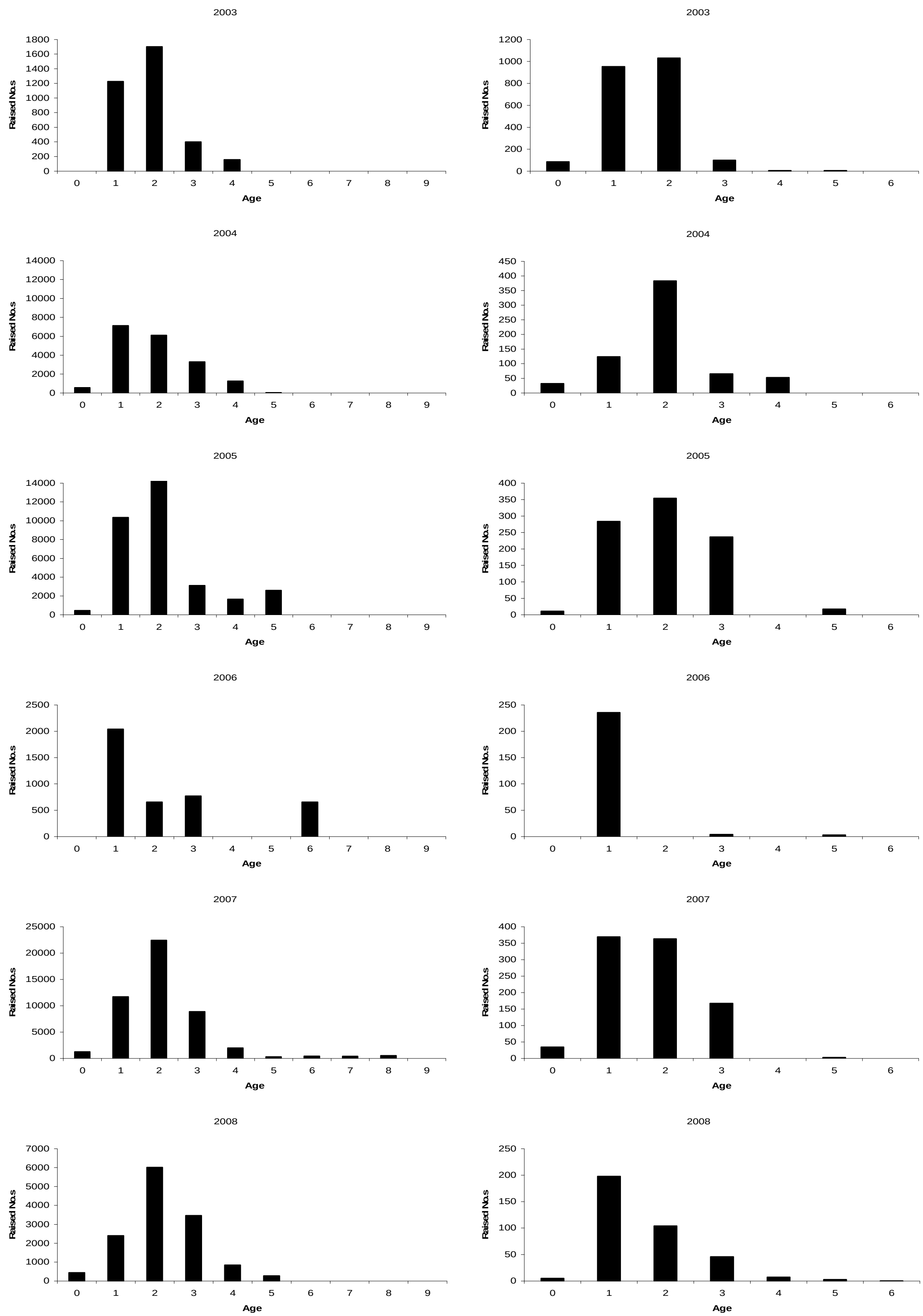
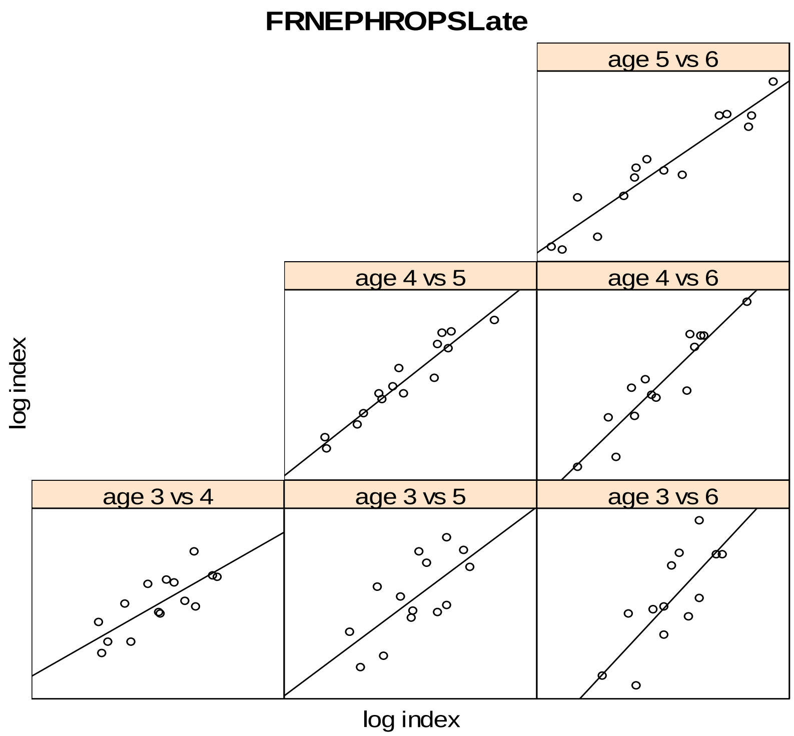
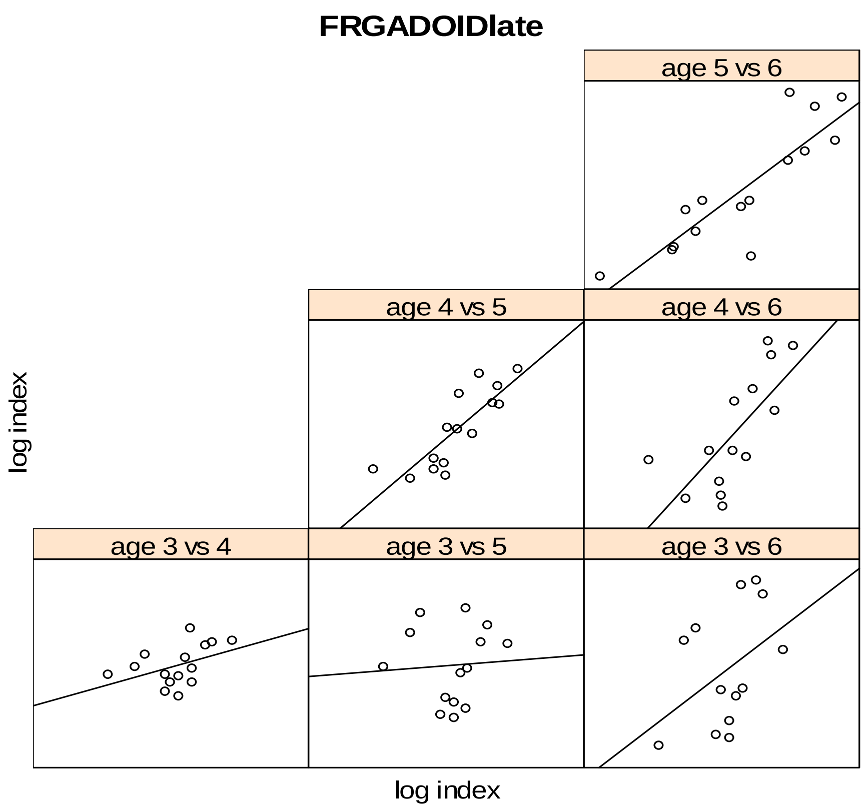
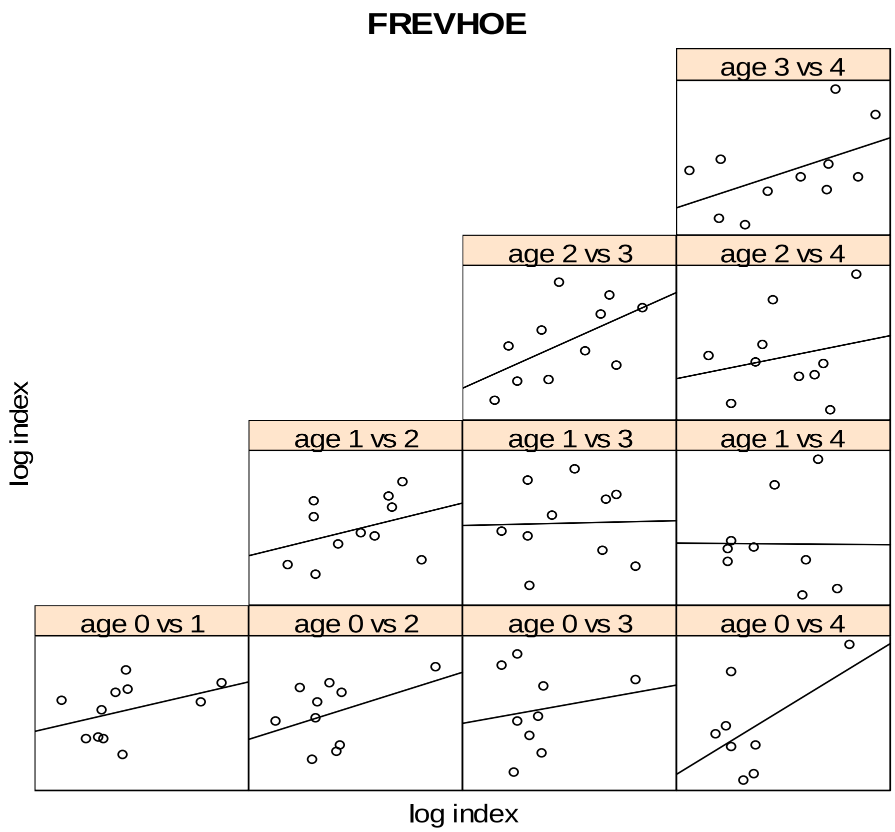
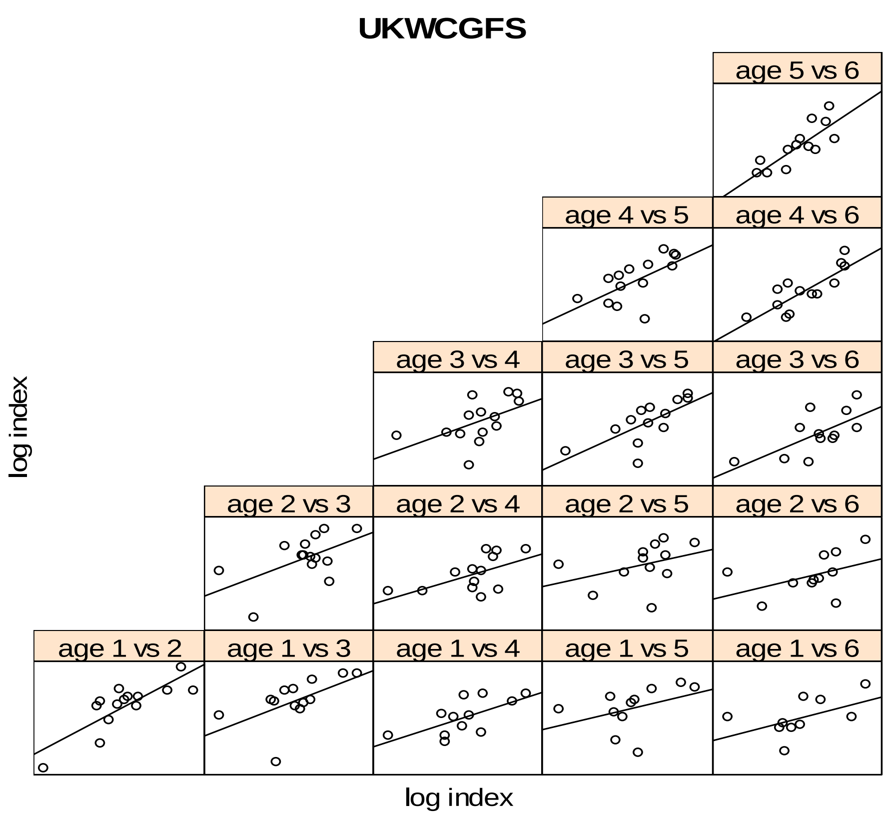


Figure 7.15.6. Whiting in VIIe–k (Celtic Sea). Age Composition of Discards from Irish Otter board trawlers 2003–2008 in VIIg (left) and VIIj (right).


FRNEPHROPSLate
age 5 vs 6
age 4 vs 5
age 4 vs 6
age 3 vs 4
age 3 vs 5
age 3 vs 6
log index
log index


FRGADOIDlate
age 5 vs 6
age 4 vs 5
age 4 vs 6
age 3 vs 4
age 3 vs 5
age 3 vs 6
log index
log index


FREVHOE
age 3 vs 4
age 2 vs 3
age 2 vs 4
age 1 vs 2
age 1 vs 3
age 1 vs 4
age 0 vs 1
age 0 vs 2
age 0 vs 3
age 0 vs 4
log index
log index


UKWCGFS
age 5 vs 6
age 4 vs 5
age 4 vs 6
age 3 vs 4
age 3 vs 5
age 3 vs 6
age 2 vs 3
age 2 vs 4
age 2 vs 5
age 2 vs 6
age 1 vs 2
age 1 vs 3
age 1 vs 4
age 1 vs 5
age 1 vs 6
log index
log index

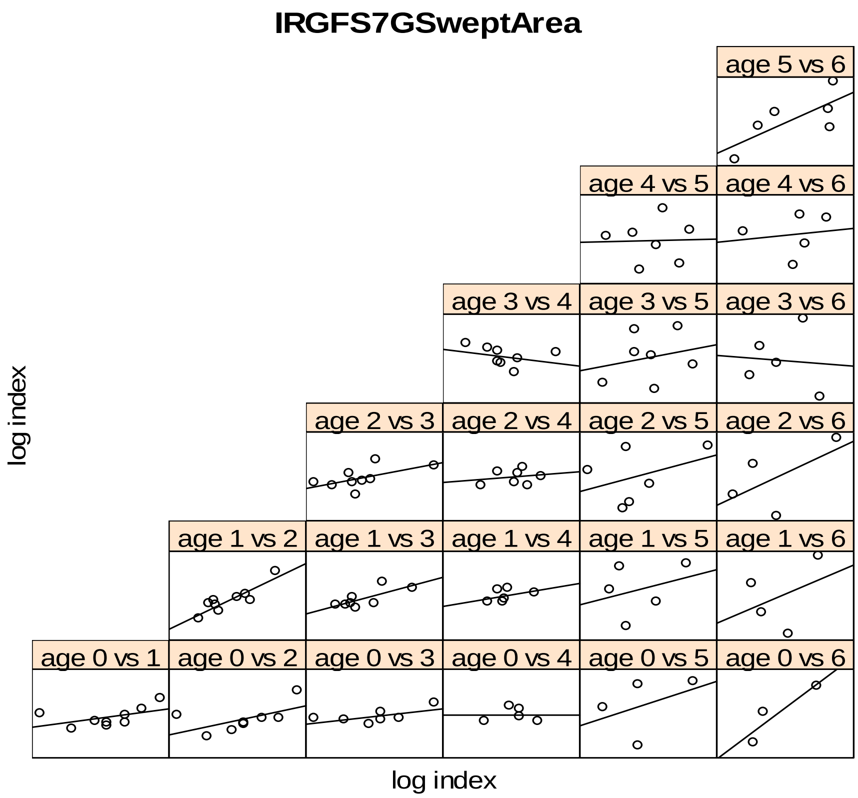


Figure 7.15.7. Whiting in VIIe–k (Celtic Sea). Pair wise scatterplots for the log numbers-at-age for the main tuning fleets to examine internal constancy of the indices.

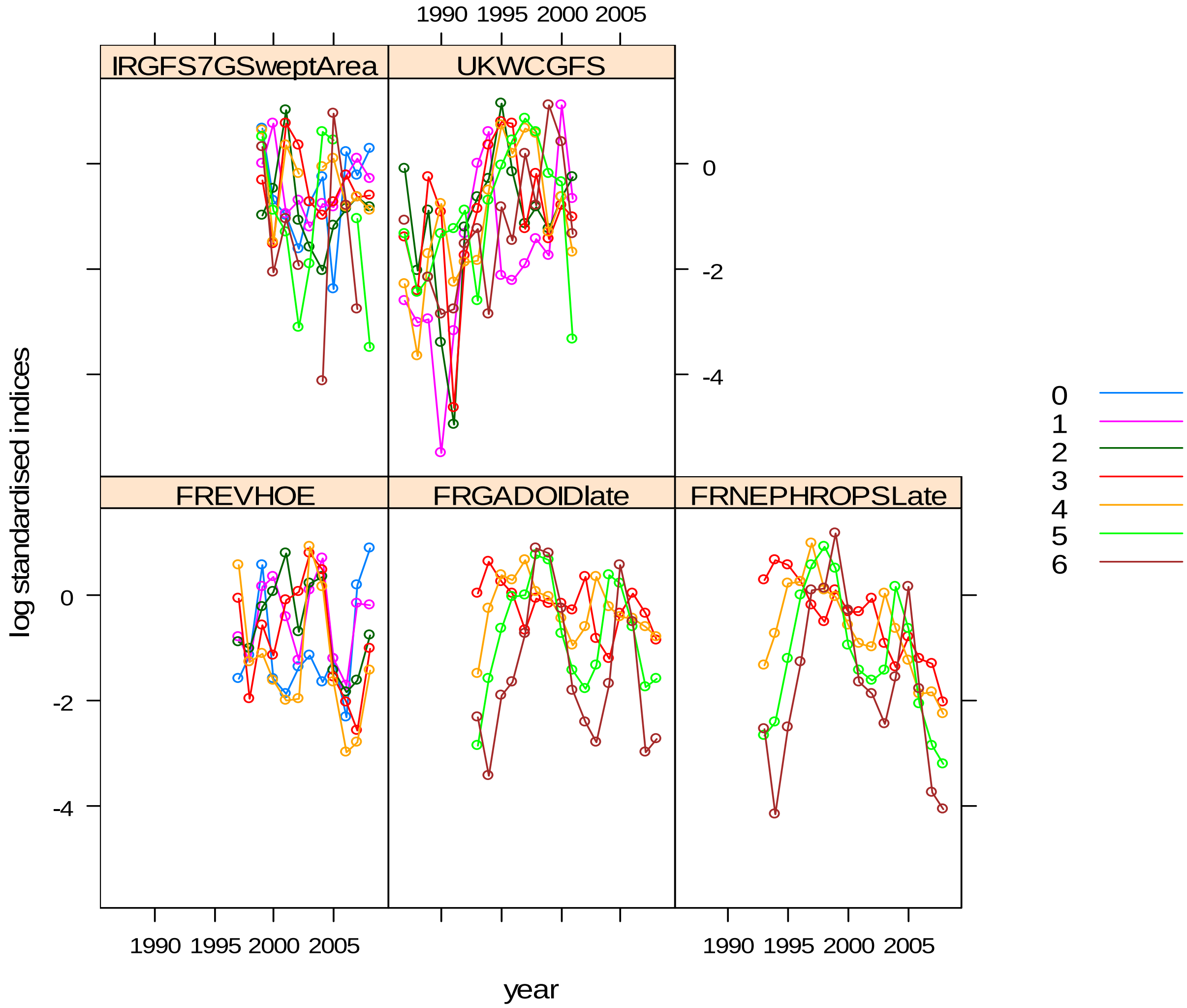


Figure 7.15.8. Whiting in VIIe–k (Celtic Sea). Mean log standardized plots of indices by age and year.

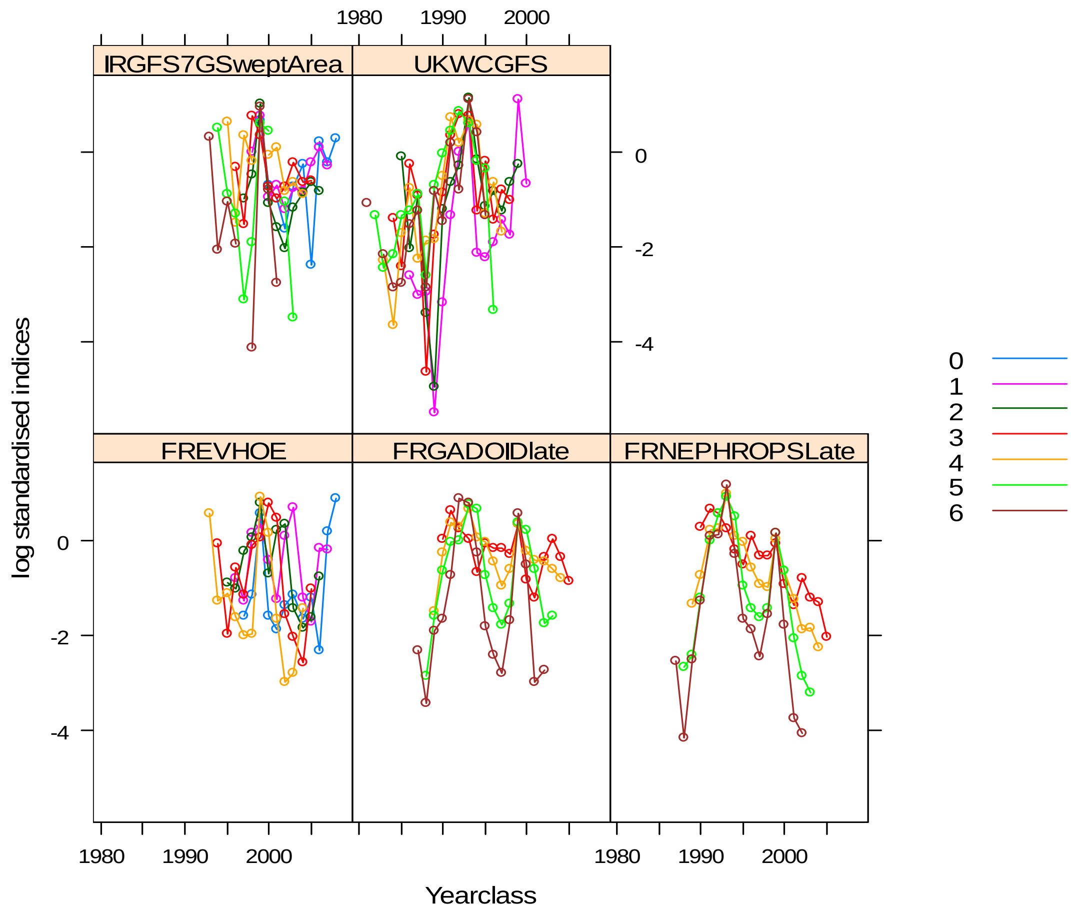


Figure 7.15.9. Whiting in VIIe–k (Celtic Sea). Mean log standardized plots of indices by age and cohort.

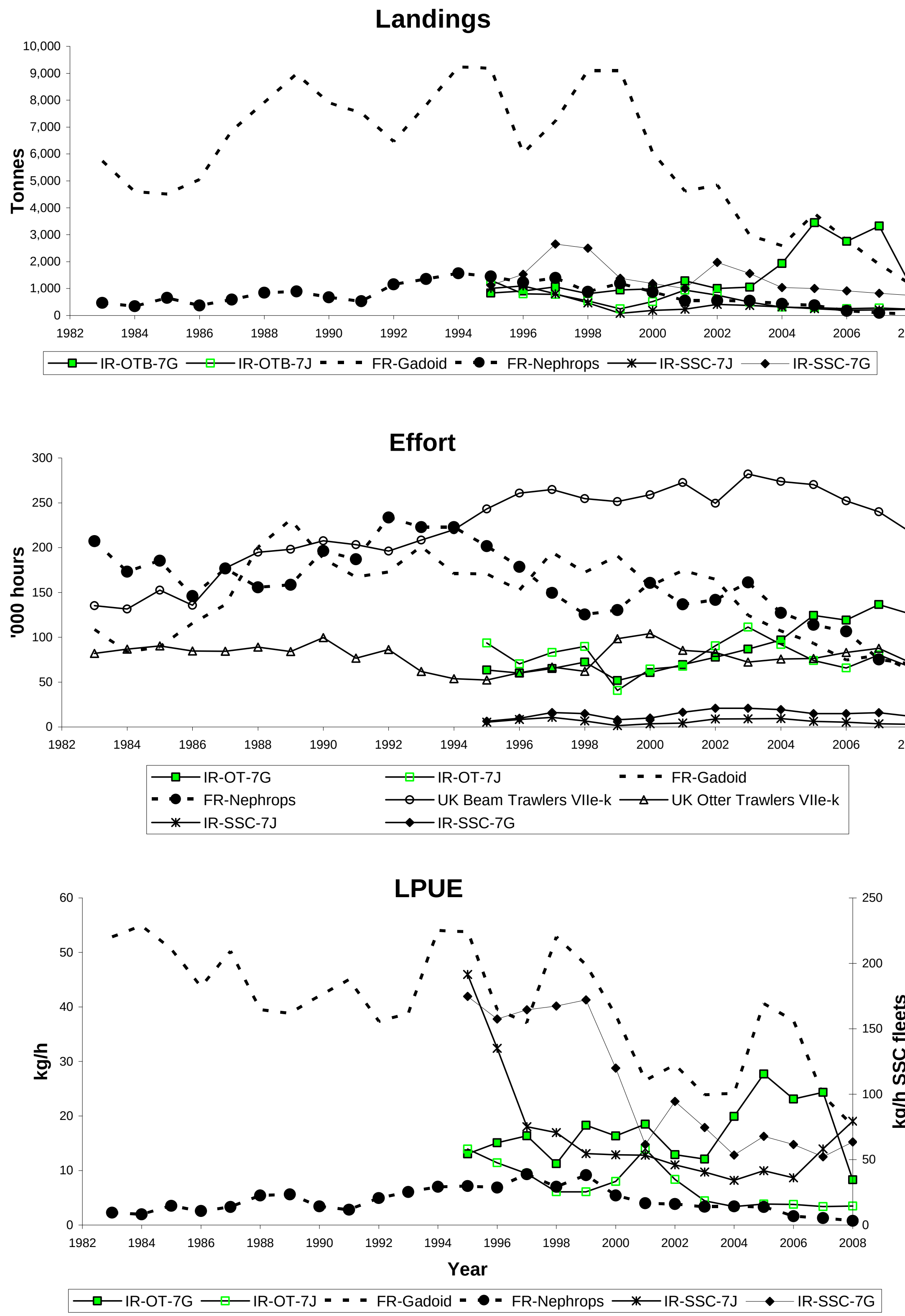


Figure 7.15.10. Whiting in VIIe–k (Celtic Sea). Landings, Effort and Landings per Unit Effort (lpue) for some fleets landing whiting. For the UK fleets Effort is GRT corrected.

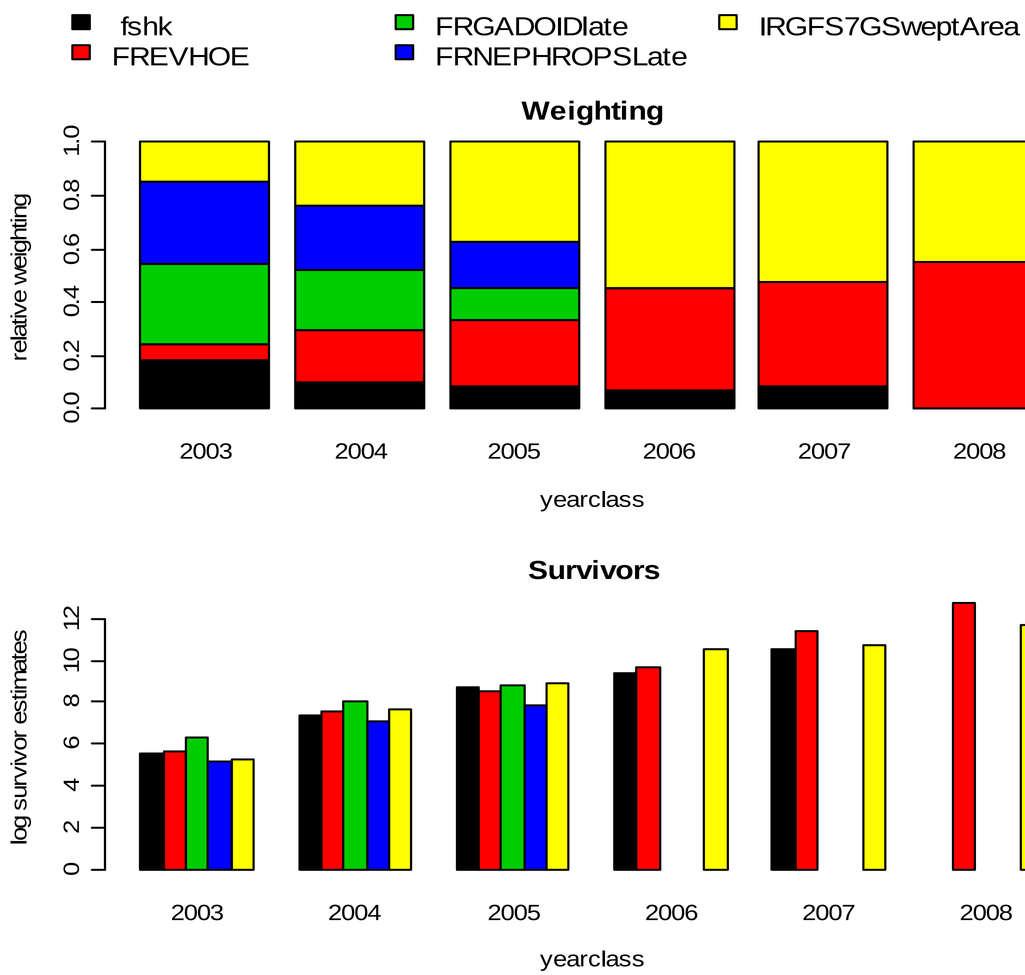
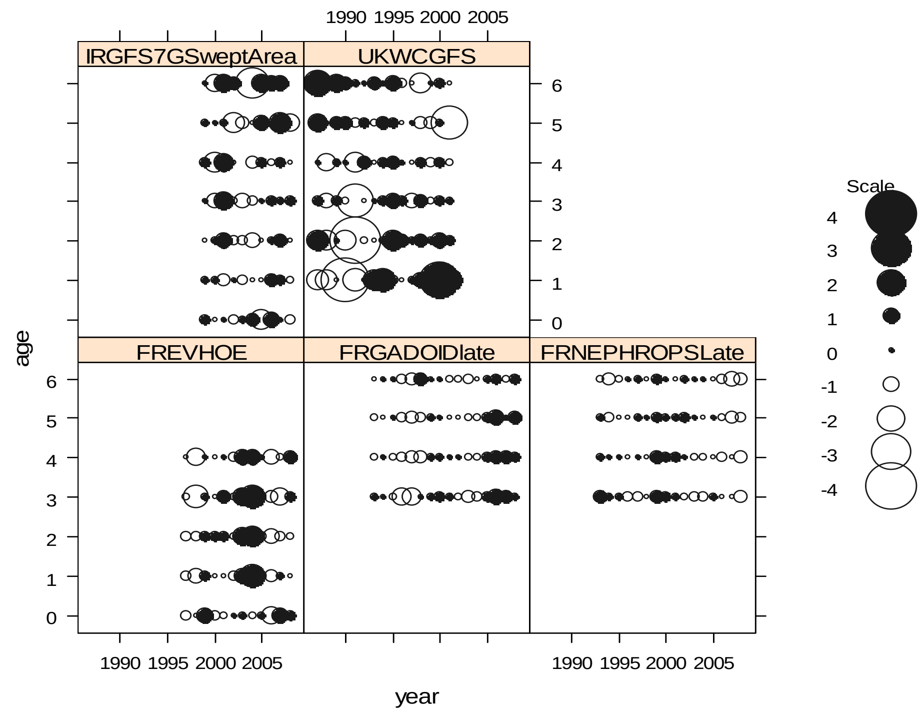


Figure 7.15.11. Whiting in VIIe–k (Celtic Sea). The survivor estimate weightings given by all fleets.

(a)



(b)

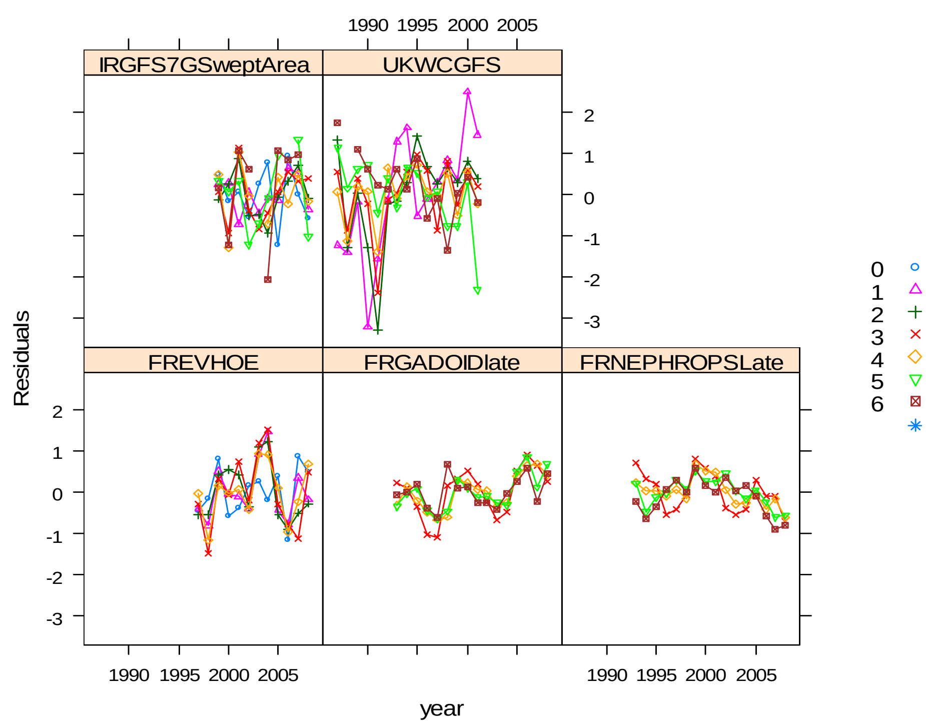


Figure 7.15.12. Whiting in VIIe–k (Celtic Sea). Log fleet catchability residuals bubble (a) and line (b) plots.

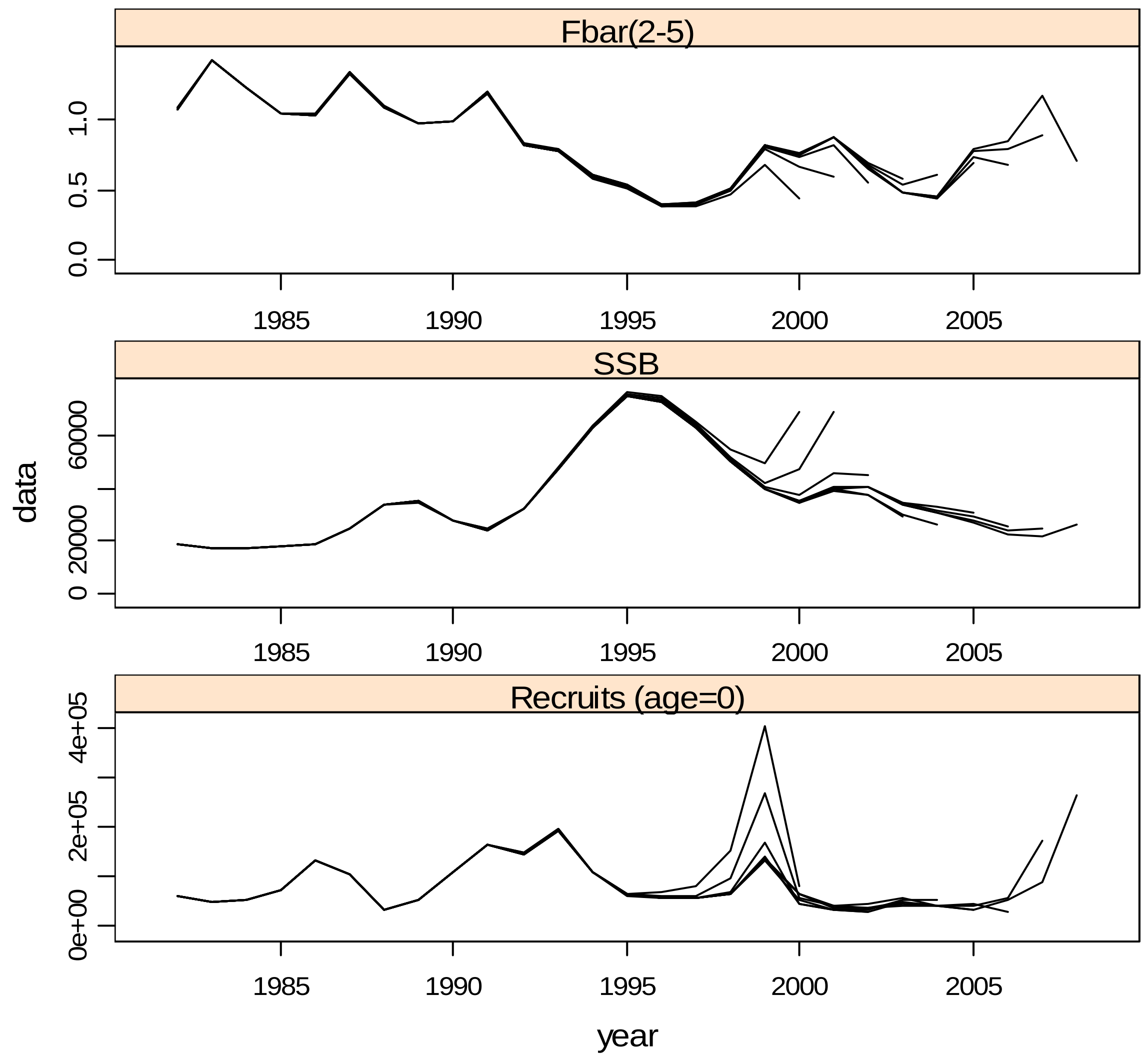


Figure 7.15.13. Whiting in VIIe–k (Celtic Sea). Retrospective analysis.

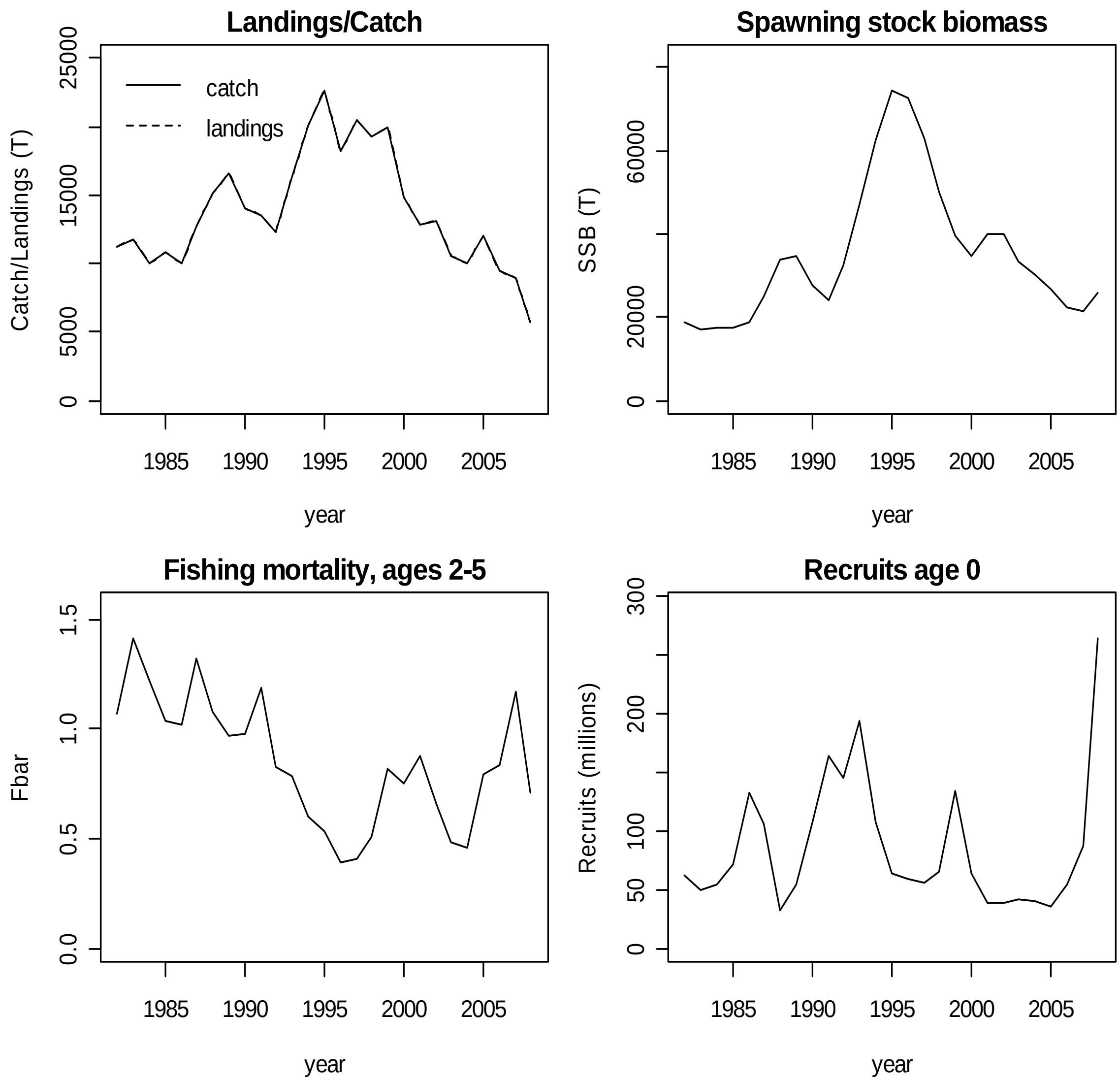


Figure 7.15.14. Whiting in VIIe–k (Celtic Sea). Stock summary.

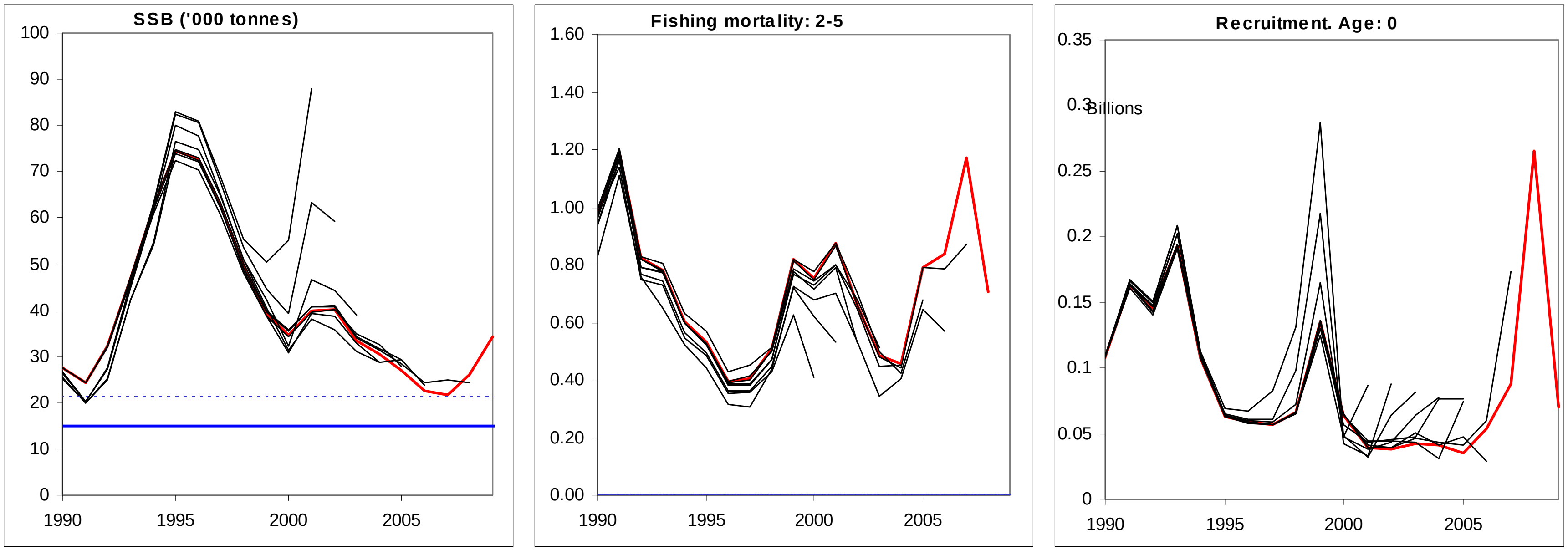


Figure 7.15.15. Whiting in VIIe–k (Celtic Sea). Comparison of the 2009 update assessment with historical assessments.

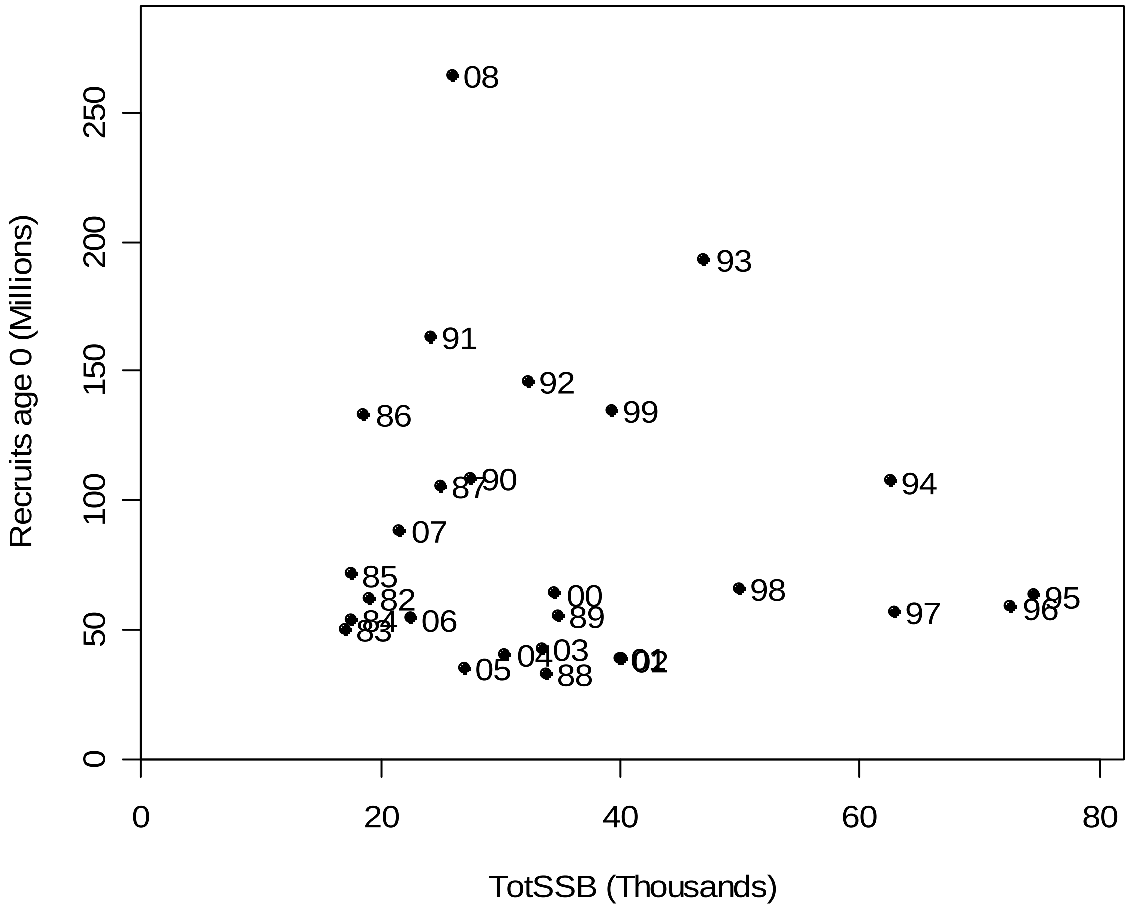
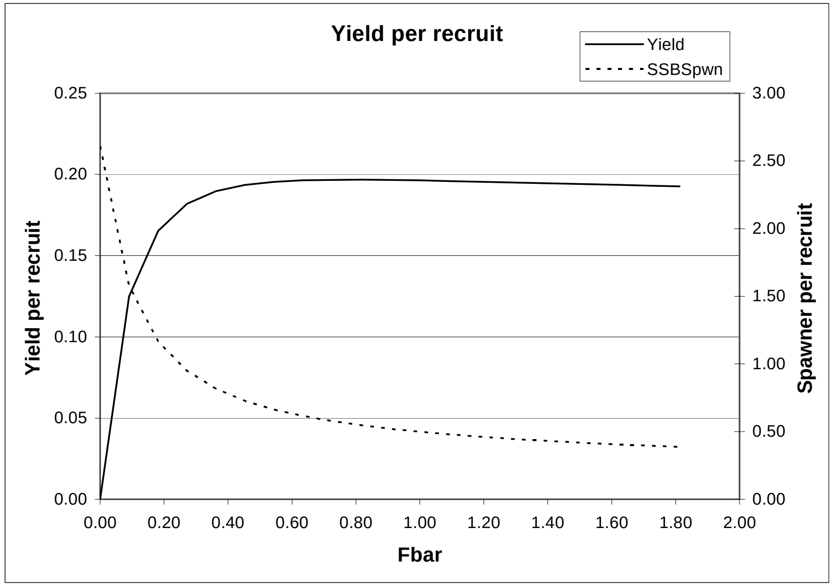
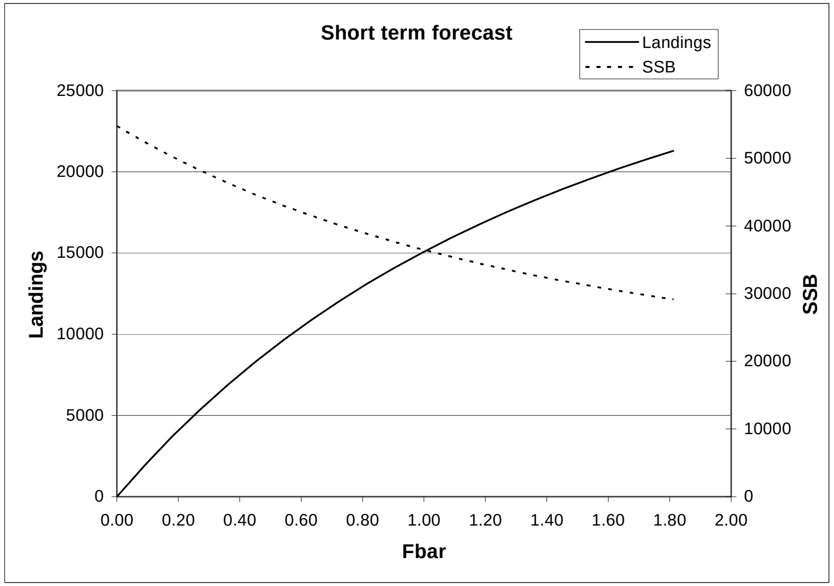


Figure 7.15.16. Whiting in VIIe–k (Celtic Sea). Stock–recruitment relationship.





MFYPR version 2a
Run: YPR
Time and date: 08:31 15/05/2009

Reference point	F multiplier	Absolute F
Fbar(2-5)	1.0000	0.9061
FMax	0.8641	0.7829
F0.1	0.2067	0.1873
F35%SPR	0.3220	0.2918

Weights in kilograms

MFDP version 1a
Run: shorttermforecast
Whiting in the Celtic Sea (VIIe-k), WGCSE 2009, COMBSEX (Updated by SD 27/04/2009)
Time and date: 08:27 15/05/2009
Fbar age range: 2-5

Input units are thousands and kg - output in tonnes

Figure 7.15.17. Whiting in VIIe–k (Celtic Sea). Yield-per-recruit and short-term forecast plots.

7.16 Whiting in Divisions VIIb, c

Type of assessment

No assessment.

The nominal landings are given in Table 7.16.1.

Table 7.16.1. Nominal Landings (t) of Whiting in Division VIIb,c for 1995–2008.

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
France	57	76	65	37*	…1*	109	114	113	92	63	102	62
Ireland	1894	1233	403	323	206	563	357	386	423	135	65	49
Netherlands	-	-	-	-	-	-	2	-	3		2	-
Spain	+	+	-	27	1	4	-	6		31	18	19
UK(E/W/NI)	24	96	75	49	10	6	5	4	5	1	11	5
UK(Scotland)	71	17	4	27	-	19	1	+	-		-	-
Total	2046	1422	547	463	217	701	479	509	523	230	198	135
Unallocated												
Working group estimate												

Country	2007	2008
France	32	1430
Ireland	100	76
Netherlands	-	-
Spain	1	-
UK(E/W/NI)	1	2
UK(Scotland)	-	-
Total	134	1508
Unallocated	-2.404	-1391
Working group estimate	131.6	116.7

[1]See VIIg-k.

8 Western Channel (ICES Division VIIe)

8.1 Area overview

Description of fisheries

The RCM also started the description of the major fishing activities operating in each of the fishing grounds. The statistics used are averages over the years 2005 to 2007, but it is likely that the relative orders of magnitudes remain unchanged in 2008. WGCSE took advantage of this work to progress on the descriptions of the fishing activities operating in the Western Channel.

Table 8.1.1. Métiers level 6 of the DCF, corresponding to 90% of the total fishing effort (Days) by countries operating in the Western Channel (ICES Division VIIe) as given by RCM Atlantic 2008.

MÉTIER	BEL	DNK	FRA	GER	NLD	UK	IRL	TOTAL
FPO_CRU_0_0_0			3433			35 637		39 070
OTB_DEF_70–99_0_0			8351		1	18 831		27 183
TBB_DEF_70–99_0_0	1363 (a)					12 457	13	12 470
GNS_DEF_120–219_0_0			1098			6806		7904
OTB_MOL_70–99_0_0			2551			5232		7783
LHM_FIF_0_0_0			1361			5005		6366
GNS_CRU_>=220_0_0			978			5110		6088
DRB_MOL_0_0_0			5159		54		5	5218
FPO_FIF_0_0_0			4106			405		4511
OTB_DEF_100–119_0_0			2369			359		2728
GNS_DEF_>=220_0_0			62			2428		2490
GNS_DEF_100–119_0_0			43			2431		2474
GTR_DEF_>=220_0_0			1912					1912
LLS_DEF_0_0_0			1543			169		1712
PTM_DEF_70–99_0_0			1685					1685

(a) Métier referenced as beam trawl targeting mixed demersal and cephalopods in the RCM report but virtually the same métier as beam trawl targeting demersal fish.

The Table above clearly demonstrates the prevalence of France and UK for the fishing effort of the area, with Belgium crossing the area en route to the Celtic Sea and Bay of Biscay. The Netherlands, Denmark and Germany appear in the Table only for their midwater trawl activity targeting small pelagics.

Among the métiers listed in the table above, several are targeting species not relevant to the WGCSE. These are pots for crustaceans (FPO_CRU), handlines for sea bass and mackerel (LHM_FIF), set gillnets for crustaceans (GNS_CRU), dredge for scallops (DRB_MOL), pots for whelks and cuttle fish (FPO_FIF) and set longlines for sharks and rays (LLS_DEF). Trawl for targeting squids and cuttlefish (OTB_MOL_70–99) does not target species of interest for WGCSE but may discard sole and plaice. This métier, therefore, needs to be monitored.

Following is a description of the main fishing activities as they appear in the Table above:

1) OTB_DEF_70–99: Trawl targeting mainly gadoids and anglerfish (*Lophius spp.*). Sampling plan indicates that this métier will be monitored for both landings and discards, which is of major importance for the WGCSE. The majority of this activity occurs in the western part of the area.
2) TBB_DEF_70–99: Beam trawl targeting flatfish, operated and monitored by respectively UK and Belgium. The distribution of the activity covers parts of geographical area suitable for beam trawling.
3) GNS_DEF_120–219: Set gillnets mainly targeting anglerfish (*Lophius spp.*). This métier will be monitored for landings and discards by UK and France.
4) OTB_DEF_100–119: This métier is similar to 1 OTB_DEF_70–99_0_0.
5) GNS_DEF_>=220 and GNS_DEF_100–119: These métiers essentially operated by UK will be monitored together with GNS_DEF_119–219_0_0.
6) GTR_DEF_>=220_0_0: This métier uniquely French and targeting anglerfish (*Lophius spp.*) will be monitored for landings together with GTR_DEF_120–219_0_0 not ranked regionally.
7) PTM_DEF_70–99: Pelagic pair trawl targeting sea bass (*Dicentrarchus labrax*) and sea bream (*Spondyliosoma cantharus*) by France and UK.

Regulations and their effects

The other than the TAC and quota limits outlined in the individual stock section main regulation affecting fisheries of interest to WGCSE is: Proposal for a Council Regulation establishing measures for the recovery of the sole stocks in the Western Channel and the Bay of Biscay COM(2003) 819 final. Each year in the TAC and quota regulations days-at-sea limits are established for beam trawler (3a) and gillnetters in VIIe (3b) in VIIe. The Text table below gives the historical days at sea limits since 2005.

Annex	AREA	REG GEAR	SPECON	2003	2004	2005	2006	2007	2008
IIC	7e	3a	none			240	216	192	192
IIC	7e	3b	none			240	216	192	192
IIC	7e	3b deleted	ICC71ab				365		

The main gears in terms of kW days operating in VIIe are not affected by the days-at-sea limits .i.e. otter trawlers and dredgers. Most gears demonstrate a similar pattern of increasing effort up to 2005 thereafter some decreases. The decreases in effort have been 4% for the Beamer and 20% for gillnet fleets since the imposition of days-at-sea in 2005. Whether these declines are directly related to the regulations is not clear.

Impacts of fisheries on the ecosystems

The impact of fishing activities on the benthos and benthic communities is a concern. Large scale discarding of a variety of macrobenthos species occurs in the mixed demersal trawl fisheries, particularly in the beam trawl fishery for sole and plaice. Various technical solutions e.g. benthic drop out panels have been trialled and/or adopted but at present there is no over view available to WGCSE on uptake levels.

Table 8.1.2. Effort in kW Days ('000s) by the main gears operating in VIIe taken from SGRST-08–03 Working Group on Fishing Effort Regime.

Gear	2000	2001	2002	2003	2004	2005	2006	2007
TRAMMEL Total	102	144	105	141	220	361	406	487
POTS Total	1244	1307	1308	1167	1648	1591	1858	1655
PEL_TRAWL Total	1938	1704	2456	2710	2370	2097	2717	2367
PEL_SEINE Total	38	47	52	127	94	94	142	105
OTTER_80-89	9442	11070	15569	12018	14100	17834	14516	13232
OTTER_100-119	2203	2308	2877	2812	1906	1978	2105	2289
OTTER_90-99	739	943	1121	994	1146	1080	522	530
OTTER_other	774	538	943	1112	1264	1082	446	320
none Total	15	6	40	70	70	112	77	39
LONGLINE Total	277	275	287	579	828	949	944	942
GILL Total	603	836	1107	1153	1393	1353	1209	1072
DREDGE Total	2803	2258	2437	2418	2849	3345	3806	4009
DEM_SEINE Total	0	0	22	20	38	77	152	142
BEAM Total	2752	3304	3184	3700	3927	3851	3758	3678

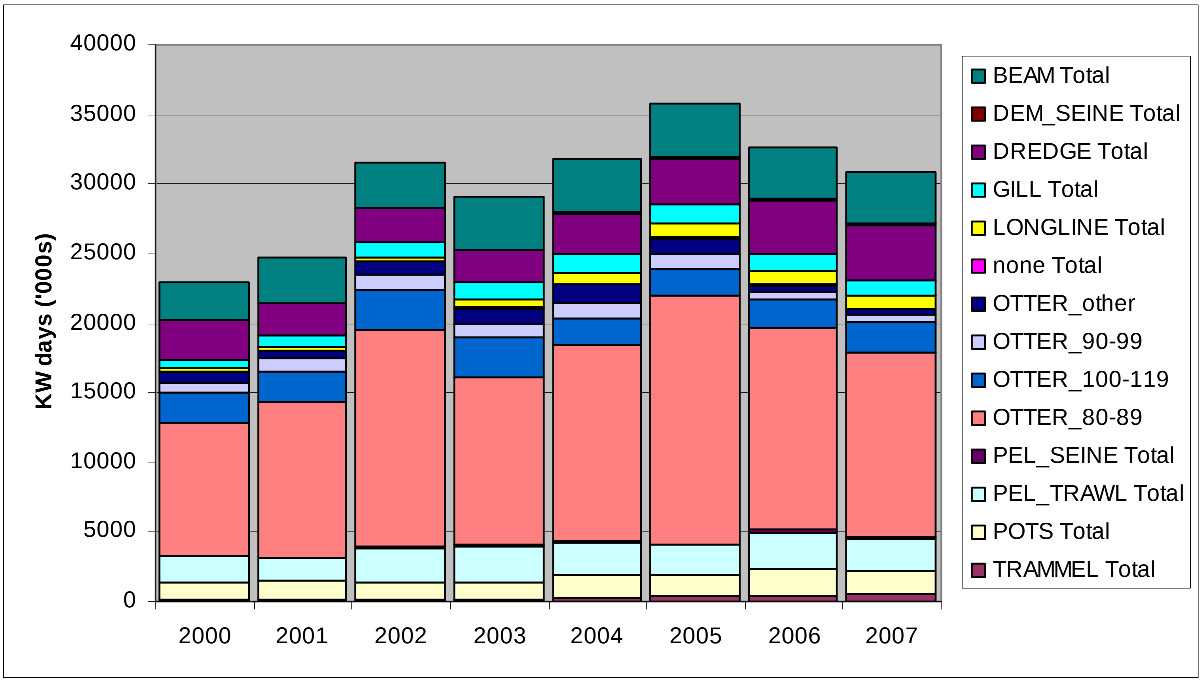


Figure 8.1.1. Effort in kW days (000's) since 2000 by gear for the main gears in VIIe taken from SGRST-08–03 Working Group on Fishing Effort Regime.

8.2 Plaice in the Western Channel (ICES Divisions VIIe)

Type of assessment in 2009

Update, no changes to the assessment settings.

ICES advice applicable to 2008

Exploitation boundaries in relation to precautionary limits: "Given the low stock size, recent poor recruitment, high fishing mortality, the uncertainty in the assessment, and the inability to reliably forecast catch, ICES recommends a substantial reduction in catch until the estimate of SSB is above B_{lim} or other strong evidence of rebuilding is observed."

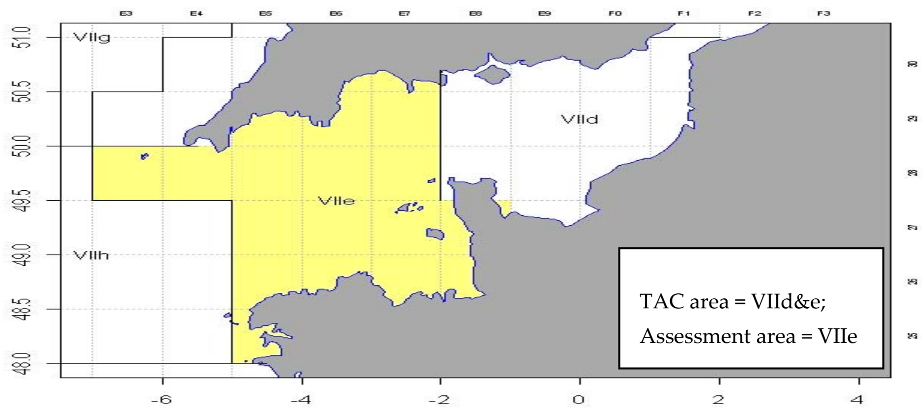
ICES advice applicable to 2009

Exploitation boundaries in relation to precautionary limits: "Given the low stock size, recent poor recruitment, high fishing mortality, the uncertainty in the assessment, and the inability to reliably forecast catch, ICES recommends a substantial reduction in catch until the estimate of SSB is above B_{lim} or other strong evidence of rebuilding is observed."

8.2.1 General

Stock description and management units

The management area for this stock is strictly that for ICES area VIIe called the Western English Channel. The TAC area does not correspond to the stock area as it includes the larger component of VIId (Eastern English Channel). Plaice is not the target species in this area, and it is generally caught as a bycatch by the sole and anglerfish directed fleets.



Management applicable to 2008 and 2009

There are technical measures in operation including a minimum 80 mm mesh size and a MLS (27 cm) for this species.

The TAC and the national quotas by country for 2008.

Species: Plaice *Pleuronectes platessa*		Zone: VIId and VIIe PLE/7DE.
Belgium	826	
France	2 755	
United Kingdom	1 469	
EC	5 050	
TAC	5 050	Precautionary TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 does not apply. Article 5(2) of Regulation (EC) No 847/96 applies.

In addition, Annex IIc, restricts the number of days-at-sea to 192 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional 12 days for the UK beam trawl fleet as a result of a reduction in capacity of the fleet.

The TAC and the national quotas by country for 2009.

Species: Plaice *Pleuronectes platessa*		Zone: VIId and VIIe (PLE/7DE.)
Belgium	760	
France	2 534	
United Kingdom	1 352	
EC	4 646	
TAC	4 646	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

In addition, Annex IIc, restricts the number of days-at-sea to 192 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional 12 days for the UK beam trawl fleet as a result of a reduction in capacity of the fleet.

The fishery in 2008

A full description of the fishery is provided in the Stock Annex, Section A2.

In the western English Channel plaice are taken mainly as a bycatch in beam trawls directed at sole and anglerfish. In 2008, the UK beam trawl fleet took almost 50% of the total landing of this stock with the UK otter trawl fleet taking almost 20%. The remainder of the landings is taken by the French and Belgian fleets.

UK Otter trawl effort in 2008 continues the downward trend but the UK beam trawl effort has stayed at the same high level since 2003.

This stock is the smaller of the two stocks that make up the larger TAC area of VIId,e. The landings from this stock in 2008 and 2007 amounted to around 20% of the TAC.

Landings

National landings data reported to ICES, and estimates of total landings used by the Working Group, are given in Table 8.2.1. Estimated total international landings in 2008 were 974 t. The Working Group estimate of the 2007 landings was revised downwards as a consequence of minor revisions to the landings by France and UK (Guernsey) but these had minimal impact.

Landings increased to levels of 2600 t during the latter half of the 1980s as a consequence of a series of good recruitments in 1986–1988, but subsequently dropped to levels fluctuating around 1200 t. The last two years have seen landings fall to around 1000 t. Unallocated landings in recent years, are generally the additional French landings derived from sales note information.

Discards

Discards estimates, from the UK (E&W) and French discard sampling programme, are available for the period 2002–2008 (Annual Data Files on ICES network) and indicate that discarding appears to be higher in quarters 1 and 2 in this fishery, but is still low compared with other plaice stocks. Quarterly profiles of numbers landed and discarded at length, in 2008, are given in Figure 8.2.2.

Biological

Annual length compositions of the UK (E&W) landings in 2008 are provided for two UK fleets (Table 8.2.3). No length data for the French landings were available. Length distributions of UK (E&W) landings from 1999 to 2008 as used by the WG are illustrated in Figure 8.2.3.

Quarterly age compositions for landings in 2008 were available from UK (E&W) only, which accounted for almost 70% of the total reported international landings. The method for the derivation of the international catch numbers and the calculation of the catch and stock weights-at-age are fully described in the stock annex, Section B1. Catch numbers-at-age landed annually are given in Table 8.2.4 and plotted for 1999 to 2008 in Figure 8.2.4. Catch and stock weights-at-age for 2008 are given in Tables 8.2.5 and 8.2.6.

Catch weights are plotted as mid-year values, stock weights are interpolated back to 1 January, as standard for this stock. The standard settings used for natural mortality and the proportions of F and M before spawning were used. (See Stock Annex).

Surveys

There are currently two surveys that provide abundance estimates to the Working Group. The UK (E&W) commercial beam trawl survey has used the FV Carhelmar for most survey years. For the years 2002–2004, the RV CORYSTES was used, with the survey returning to the FV Carhelmar in 2005. Detailed information on the survey protocols and area coverage can be found in the Stock Annex.

Table 8.2.7 gives abundance indices as numbers caught per 100 km for age groups 1 to 9 as obtained by UK-WECBTS. Strong and weak year classes have been well tracked by this survey in the past. (Figure 8.2.6).

Since 2003 the Fisheries Science Partnership (FSP: Cefas-UK industry cooperative project) has been conducting a survey using commercial vessels with scientific observers and following a standard grid of stations extending from the Scilly Isles to Lyme Bay. The survey covers a substantially larger area than the current survey (UK-

WECBTS) and is thought to be more representative of the stock in UK waters. This dataset was first included in the 2007 assessment, and the exploratory analysis can be seen in that report (ICES, 2007; Section 3.2.5). There have been a number of vessel changes, gear changes and temporal variations in this survey-series, but the survey has performed well in tracking year classes in the past.

Commercial fleet effort and cpue

The UK (E&W) cpue output file reveals the individual fleets that make up the composite of all otter trawl and all beam trawl fleets that are used in the commercial tuning datasets. Trends in lpue and effort are given in Table 8.2.2 and Figure 8.2.1; more detailed information on the distribution of effort by area and trends in the fishery can be found in the Stock Annex. Lpue in the North of VIIe reached a peak in 1988–1990, fell sharply to 1995 and is now at stable but low levels. Survey cpue (Beam trawl survey in the North of VIIe) has demonstrated a similar but slightly earlier trend in the early years but indicates a more pronounced temporary increase in catches during 2000 and 2001 compared with the commercial series. Commercial beam trawl lpue in the South and West of VIIe reveals a general decline from 1990 to 2007, with otter trawlers lpue declining slowly since 1997 in the west, but revealing much more variation throughout the time-series in the south.

Effort (fishing power corrected, using GRT) by UK (E&W) beam trawlers demonstrates an increasing trend from 1992, and in 2008 has remained at the high level seen since 2003. In contrast, effort by otter trawlers continues to decline slowly from the highest values demonstrated at the beginning of the time-series.

8.2.2 Stock assessment

Catch-at-age analysis

See Section 2.1 for the general approach adopted at the WG for this update type of assessment. All relevant tuning and XSA outputs not included in this report are available in the ‘Exploratory runs’ folder. The details of the previous assessment approaches for this stock can be found in the Stock Annex.

Data screening

The age range for the analysis was 1–10+, as standard.

As this was an update assessment, full data screening, tuning data and exploratory XSA trials were not carried out. For catch data screening, a separable VPA was carried out using the standard setting as detailed in the stock annex. The results (Figure 8.2.5 cont.) demonstrate no anomalies in recent years, and high residuals on the youngest age as previously.

Tuning information available consisted of same 5 fleets as last year: three UK commercial series, UK otter historic, UK otter trawl, UK beam trawl; and two UK survey-series: UK-WEC-BTS, and UK (E&W) FSP. These are presented in Table 8.2.8. The figures in bold indicate the data used for the final run.

Details of the derivation of the tuning fleets are presented in the stock Annex.

Tuning indices were examined for inconsistencies using SURBA version 3.0. Log (cpue) plots plotted by year class and by year (Figure 8.2.6). Four of the tuning indices indicate highly consistent year-class estimates, and plots of index by year do not indicate substantial year effects in the tuning data. The UK (E&W) FSP indices demonstrate a large year effect in the 2008 data. Inclusion of these data in the assessment led to the final estimates of each year class for this fleet being cut significantly from the previous year's estimate at all ages. Given that this fleet's estimates receive heavy weighting in the final estimates or survivors, this year's data were excluded from the final assessment. There have been a number of changes to the survey in 2008, but these mostly affected the eastern part of the survey, where as the greatest change in abundance was noted in the western survey. The cause of the year effect is therefore not clear, but needs to be investigated prior to the next benchmark assessment.

In addition, this dataset requires further analysis and standardization across years. Also consideration should be given to using the standard 12 m beams on future surveys in order to ensure consistency in the gear selectivity.

Final update assessment

The settings used for the final run are displayed in the Table. The full assessment history is given in the Stock Annex.

		2008 XSA	2009 XSA
Catch-at-age data		1976–2007, 1–10+	1976–2008, 1–10+
Fleets	UK-WECBTS – Survey	1986–07, 1–8	1986–08, 1–8
	UK WECOT – Commercial	1988–07, 3–9	1988–08, 3–9
	UK WECOT–Commercial historic	1976–87, 2–9	1976–87, 2–9
	UK WECBT – Commercial	1989–07, 3–9	1989–08, 3–9
	UK E&W FSP - Survey	2003–07, 2–9	2003–07, 2–9
Taper		No	No
Taper range		-	-
Ages catch dep. Stock size		None	None
q plateau		7	7
F shrinkage se		2.5	2.5
year range		5	5
age range		4	4
Fleet SE threshold		0.5	0.5
Prior weighting		-	-
Plus group		10	10
F_{Bar} Range		F(3–7)	F(3–7)

The diagnostics for the final XSA run are displayed in Table 8.2.9. and the catchability residuals are plotted in Figure 8.2.5. Some weak trends/patterns can be seen in the commercial beam trawl and otter trawl fleets (UK-WECBT; UK-WECOT) and a year effect can be seen in the survey results (UK-WECBTS) for 2004 probably associated with a change in vessel effect.

Estimates for the youngest ages are almost entirely determined by the UK beam trawl survey. The commercial fleets provide over 50% of the weight of ages 4 and greater. The contribution of F-shrinkage is minor for all ages. Fishing mortalities and population numbers estimated from the final run are given in Tables 8.2.10 and 8.2.11, and summarized in Table 8.2.12. The 2006 above average year class has led to an increase in SSB in 2008. The 2007 year class appears to be very weak.

Retrospective analysis (Figure 8.2.7) was run without the short UK (E&W) FSP tuning-series, and indicates a strong downward revision of the 2001 year-class strength, going from the third strongest year class in history to a value close to long-term GM. Over the last few years there is a sequential downwards revision of F: strongest in the most recent years, but converges mostly within 4 to 5 years. There is a commensurate revision in SSB. The addition of the new FSP survey may reduce this bias, but this could not be examined because of the short time-series and the year effect detected in the most recent year. The bias continues to be a problem for this assessment. The reasons for this are the difference in the estimation of F between the commercial and survey information. Even removing the commercial fleets entirely from the assessment cannot solve this problem and introduces greater potential for poor forecasts as a consequence of increased variability of the assessment.

Comparison with previous assessments

Fishing mortality has decreased in 2008 (0.64) and SSB is estimated to have increased to 1500 t. Last year, fishing mortality and SSB in 2007 were estimated to be 0.79 and 1447 t; this year's estimates for 2007 are 0.72 and 1418 t, a revision of -9% and -2% respectively.

There continues to be bias in the retrospective analysis. Historical stock trends are strongly converged, but recent estimates tend to overestimate F and underestimate SSB. Inaccuracies in the assessment mostly reflect bias and there is little in the way of variability. Figure 8.2.9 shows the historical performance of ICES assessments on this stock.

State of the stock

A summary of the final assessment is given in Table 8.2.12 and Figure 8.2.8. Spawning–stock biomass (SSB) was stable during the period 1981–1987, peaked above 4000 t during 1988–1990 following good recruitments in the mid-1980s, then decreased to 1700 t in 1995–1996. Since then SSB increased following the good 1996 year class but is now estimated to have declined to levels observed in the late 1970s.

Fishing mortality revealed a gradually increasing trend up until the mid 1990s, then a slight decline followed by a sharp increase up to 2007. This assessment demonstrates a marked fall in F in 2008. However, the retrospective analysis indicates a strong tendency to overestimate F, in the most recent years. It is likely that the true F has been variable without trend since the mid 1990s.

Two periods of below average recruitments in the period 1989–1994 and from 1998–2006 have contributed to the decrease in yield and SSB. This assessment estimates that only two year classes have been above the long-term $GM_{76\text{-}06}$ (4489) since 2000.

8.2.3 Short-term projections

The assessment suffers from a persistent strong bias in the estimation of F in the most recent years. Therefore it is not possible to produce accurate short-term forecasts, because the degree of retrospective bias is not predictable. Careful examination of the available data and methodology suggests that the bias originates from the catch-at-age matrix and cannot be corrected, but the WG believes that the assessment is representative of the long-term trends in stock dynamics and recent recruitment, and that it is mainly the recent estimates of F that are affected.

Previously, the Review Group had judged these forecasts as being unhelpful in the management of the stock so last year's WG did not present a short-term forecast.

No short-term forecast has been provided this year.

Estimating year-class abundance

The 2006 year class is now estimated at 6.2 million at-age 1, which is 3 times the estimate from last year's assessment (2.1 million) and now above the long-term mean. The UK-WEC-BTS survey takes 97% of the weight, with the remaining 3% coming from shrinkage. The removal of the 2008 FSP survey estimates from the assessment has led to the increase in the weight given to the UK-WEC-BTS survey.

The 2007 year class is estimated to be 1.4 million with 93% of the weight coming from the UK-WEC-BTS. This is the lowest value in the time-series.

8.2.4 Medium-term projection

Not carried out for this stock.

8.2.5 Biological reference points

F_{lim}	Not defined	
F_{pa}	0.45	(low probability that SSB_{MT}<B_{pa})
B_{lim}	1300 t	(equal to B_{loss})
B_{pa}	2500 t	(equal to MBAL)

WGs since 2004 have considered the biological reference points for this stock as unreliable for the following reasons:

- The stock–recruitment relation demonstrates no evidence of reduced recruitment at low stock levels;
- The basis for $\mathbf{B}_{pa}$ is weak, and heavily dependent on two consecutive points (1985 and 1986);
- $\mathbf{F}_{pa}$ is based on B_{pa}, then this reference point is also rejected.

The stock has been below 2500 t (B_{pa}) since 1993. Increases to SSB have been observed since then and recruitment does not appear to have been limited.

F has been between 0.5 and 0.7 for almost the entire time-series, well above F_{pa}, without apparent stock collapse. Therefore comparisons with the current biological reference points are considered unreliable.

No Yield/recruit analysis was carried out for this stock.

8.2.6 Management plans

There is no management plan in place for this stock.

8.2.7 Uncertainties and bias in assessment and forecast

The tendency for the assessment to overestimate F and underestimate SSB continues to be a problem with this stock. As a result no short-term forecast was possible again this year.

There is a heavy reliance on the age composition data derived from UK (E&W) sample data. Almost 30% of the landings for this stock come from countries that do not provide age based data. Survivor estimates for ages 1 and 2 almost entirely come from the UK beam trawl survey. Consideration should be given to using age 2 information from the commercial tuning fleets.

UK Discard data indicate low discard levels in the second half of the year, and overall that discarding for this stock is variable but relatively low compared with other plaice stocks. As the time-series of data expands, the WG will be able to better determine how to include these data in the assessment appropriately.

Both the UK-WEC_BTS and the UK (E&W) FSP surveys are spatially restricted to the same area as the commercial tuning fleets and little information exists on stock dynamics on the French coast.

The forecast is not presented for this stock in line with previous procedure although it may be no worse than similar forecast for Plaice VIIfg and Plaice VIIa. The retrospective pattern in F is the main problem in the forecast. This should be investigated at the next benchmark.

8.2.8 Recommendation for next Benchmark

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
2009	VIIe Plaice	Investigate migration/stock separation issues including why VIId and VIIe plaice assessments reveal opposite retrospective patterns. Review the tuning datasets available and year and age ranges to remove inconsistencies in vessels and gears and examine the impact on retrospective bias. A detailed review of the derivation and amalgamation of the FSP survey is particularly important following the strong year effect in this years suvey. Consider adding estimates of discarding to the assessment. Even though discards are considered to be lower than for other plaice stocks, its still relatively high in Q1/2. Consider modification of the catch and stock weights-at-age calculation. Examine the impact of changing the method of national data aggregation to using fleet disaggregated data.	2010	Expert group members. Plaice migration experts.

8.2.9 Management considerations

The stock unit (Division VIIe) does not correspond to the management unit (Divisions VIId and VIIe). This hampers effective management of plaice in the Western English Channel.

Plaice are taken as a bycatch in the beam trawl fishery mainly targeting sole, and as part of a mixed demersal fishery by otter trawlers. Therefore the restrictions under the management plan for sole should also benefit the plaice stocks. In addition to the days-at-sea regulations there has been a recent UK decommissioning scheme that has reduced the number of beam trawlers in the southwest fleet. Fishing mortality in 2008 is estimated to have declined slightly which is consistent with the decline in effort.

The assessment is unable to accurately estimate recent trends in F although historical trends are estimated with some certainty. Fishing mortality is estimated to be well above long-term targets with some certainty.

The retrospective trend in the assessment caused by the difference in the mortality signals between commercial and survey information remains unresolved. The most plausible explanation for the difference is incomplete mixing or migration. It is known that plaice undergo spawning and feeding migrations, and one possibility is that the survey fleets are estimating F only in the resident stock, while the commercial fleets operate throughout the year possibly estimating F on an additional migratory component that enters VIIe to spawn.

Table 8.2.1. Plaice in VIIe. Nominal landings (t) in Division VIIe, as used by Working Group.

Year	Belgium	Denmark	France	UK (Engl. & Wales)	Others	Total reported	Unallocated[1]	Total
1976	5	-[3]	323	312	-	640	-	640
1977	3	-[3]	336	363	-	702	-	702
1978	3	-[3]	314	467	-	784	-	784
1979	2	-[3]	458	515	-	975	2	977
1980	23	-[3]	325	609	9	966	113	1079
1981	27	-	537	953	-	1517	-16	1501
1982	81	-	363	1109	-	1553	135	1688
1983	20	-	371	1195	-	1586	-91	1495
1984	24	-	278	1144	-	1446	101	1547
1985	39	-	197	1122	-	1358	83	1441
1986	26	-	276	1389	-[1]	1691	119	1810
1987	68	-	435	1419	-	1922	36	1958
1988	90	-	584	1654	-	2328	130	2458
1989	89	-	448[1]	1708	2	2247	111	2358
1990	82	2	N/A[2]	1885	18	1987	606	2593
1991	57	-	251[1]	1323	16	1647	201	1848
1992	25	-	419	1102	14	1560	64	1624
1993	56	-	284	1080	24	1444	-27	1417
1994	10	-	277	998	3	1288	-132	1156
1995	13	-	288	857	-	1158	-127	1031
1996	4	-	279	855	-	1138	-94	1044
1997	6	-	329	1038	1	1374	-51	1323
1998	22	-	327	892	1	1242	-111	1131
1999	12	-	194[1]	947	-	1153	118	1271
2000	4	-	360	926	+	1290	-9	1281
2001	12	-	303	797	-	1112	-6	1106
2002	27	-	242	978	+	1253	4	1257
2003	39	-	216	985	-	1217	1	1218
2004	46	-	184	912	-	1142	12	1154
2005	48	-	198	887	-	1133	66	1199
2006	52	-	223	966	-	1241	72	1313
2007	84	-	201	677	-	962	41	1003
2008	66	-	105	669	-	840	134	974

[1] **Estimated by the WG.**

[2] **Divisions VIId,e=4739 t.**

[3] **Included in Division VIId.**

Table 8.2.2. Division VIIe Plaice effort and cpue data.

The UK (E&W) data are for vessels > 12 m and are corrected for fishing power (based on GRT). All effort data are in fishing hours, cpue data are in kg/hr for the commercial fleets and in kg/10 km towed for the autumn beam trawl survey.

Year	(CPUE) (kg/hr).						Effort (000 hours)		Landings (tonnes)		(CPUE) (kg/10 km)
	West Sector		North Sector		South Sector						
	Otter	Beam	Otter	Beam	Otter	Beam	Otter	Beam	Otter	Beam	Survey
1972	2.31	-	4.50	-	0.00	-	64.60	-	194.36	-	-
1973	2.25	-	3.85	-	0.00	-	69.54	-	200.45	-	-
1974	1.65	-	3.47	-	2.94	-	50.09	-	121.03	-	-
1975	1.78	-	3.53	-	2.54	-	54.69	-	132.95	-	-
1976	1.89	-	3.62	-	4.14	-	56.13	-	144.56	-	-
1977	1.37	-	3.10	-	4.96	-	55.40	-	117.72	-	-
1978	1.61	5.41	3.63	10.35	4.24	11.84	48.80	22.09	114.02	204.69	-
1979	1.84	4.16	4.58	7.37	1.64	6.58	49.92	39.38	142.52	233.81	-
1980	2.02	3.15	5.82	6.06	0.67	6.45	49.95	62.16	150.69	335.16	-
1981	2.61	4.44	10.98	8.35	7.30	8.33	46.88	65.29	257.28	471.20	-
1982	3.28	4.43	10.77	9.23	0.00	7.69	38.51	81.59	249.60	611.52	-
1983	2.57	2.76	11.03	9.64	8.10	5.71	52.59	103.07	303.04	612.16	-
1984	2.95	4.08	10.92	10.38	2.43	7.80	52.89	87.63	281.94	575.22	-
1985	2.60	3.79	8.81	9.00	0.09	6.38	57.69	92.19	255.86	540.61	15.21
1986	3.25	6.30	10.94	12.21	10.17	6.85	49.52	76.33	315.08	602.07	16.46
1987	3.56	5.37	11.02	9.69	3.63	7.45	45.11	87.05	329.97	672.81	20.59
1988	3.90	3.50	15.38	6.51	5.04	4.85	53.40	103.36	433.20	564.72	25.34
1989	2.69	6.50	10.87	14.25	1.42	6.88	54.71	109.95	315.73	900.19	14.80
1990	2.95	6.52	7.77	15.64	3.55	10.17	53.05	100.95	268.81	990.05	11.60
1991	2.80	6.16	5.08	13.24	0.41	7.47	40.79	83.57	152.93	721.46	8.72
1992	1.92	6.30	3.51	10.61	3.06	9.69	39.91	80.87	105.41	695.70	7.45
1993	1.39	6.14	3.03	11.04	5.46	7.17	39.17	83.92	81.77	655.48	6.16
1994	1.46	4.62	2.48	9.17	2.11	6.47	38.77	100.42	63.67	650.99	5.70
1995	1.61	4.60	1.99	6.29	2.36	5.40	35.45	100.80	60.20	531.06	5.13
1996	2.00	3.09	2.49	6.66	11.62	4.39	30.54	116.45	64.83	482.18	5.97
1997	2.69	3.50	3.08	7.16	1.56	5.58	33.28	108.39	99.05	561.74	9.82
1998	1.65	2.97	4.13	6.10	1.85	3.03	29.80	111.17	73.30	459.22	8.74
1999	1.39	3.49	3.60	8.55	1.11	4.59	27.52	103.56	59.67	576.76	8.42
2000	0.81	2.98	4.00	6.63	1.25	3.72	30.49	118.83	61.82	541.33	11.31
2001	0.89	2.30	3.03	5.45	3.14	3.61	31.90	143.27	48.82	527.38	10.56
2002	0.90	2.90	4.18	6.52	0.56	3.45	28.35	139.83	57.44	651.04	8.05
2003	0.96	3.26	2.10	8.18	0.50	2.89	25.06	159.95	36.88	743.07	7.96
2004	0.88	3.38	2.01	6.16	0.19	2.80	25.58	158.68	37.98	701.17	4.53
2005	0.88	2.62	2.13	8.20	3.48	2.75	21.13	157.81	29.44	691.27	7.02
2006	0.96	2.68	3.41	6.97	1.71	2.50	21.06	161.44	28.57	665.16	7.47
2007	0.68	1.71	1.95	4.55	1.31	2.13	22.35	158.01	27.27	472.27	7.94
2008	0.95	1.83	2.07	4.88	0.71	2.06	19.80	158.17	25.68	462.72	8.18

Table 8.2.3. Plaice in VIIe. Annual length distribution by fleet (2008).

Length (cm)	UK (England & Wales) Beam trawl	All gears (excl. beam)
23		221
24	235	1341
25	4379	9811
26	11545	23092
27	38285	42806
28	72873	55034
29	101484	68583
30	110970	57108
31	104843	54491
32	121793	47385
33	97001	38854
34	82088	29337
35	65675	24425
36	54243	18471
37	42483	14710
38	32918	10683
39	26107	7261
40	21647	6256
41	14813	4420
42	12592	3307
43	10687	2272
44	7993	2998
45	7397	2726
46	6578	1757
47	4847	1496
48	4086	1060
49	3446	912
50	2342	469
51	2189	394
52	2198	660
53	2061	601
54	1352	446
55	799	139
56	1139	157
57	574	127
58	473	115
59	649	94
60	75	39
61	136	0
62	22	54
63	150	
64	3	
65	0	
66	29	
Total	1075199	534112

Table 8.2.4. Plaice in VIIe. Catch numbers-at-age.

Table 1 Catch numbers-at-age Numbers*10**-3

YEAR,	1976,	1977,	1978,
AGE			
1	25	6	46
2	106	621	242
3	620	304	914
4	156	266	103
5	110	84	136
6	58	50	49
7	59	31	29
8	37	46	26
9	14	15	21
+gp	79	59	66
TOTALNUM	1264	1482	1632
TONSLAND	640	702	784
SOPCOF %	100	100	100

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	20	19	41	72	3	77	3	10	74	12
2	519	743	657	273	708	920	573	894	1029	1797
3	697	712	1854	1710	698	1419	1228	2104	1846	4033
4	543	205	381	1131	1184	455	971	642	1103	731
5	70	188	95	198	514	372	122	364	550	369
6	75	56	89	71	84	150	201	67	195	108
7	35	59	16	74	33	71	127	106	50	76
8	23	19	43	11	38	20	19	61	37	28
9	14	13	14	26	2	30	4	27	36	16
+gp	82	130	80	115	92	43	48	59	46	40
TOTALNUM	2078	2144	3270	3681	3356	3557	3296	4334	4966	7210
TONSLAND	977	1079	1501	1688	1495	1547	1441	1810	1958	2458
SOPCOF %	100	100	100	100	100	100	100	100	100	100

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	10	57	41	90	36	84	6	15	7	7
2	254	320	533	674	639	311	304	1030	843	518
3	2520	2875	1020	1159	1256	1283	639	554	1996	1214
4	2186	2233	1547	609	540	605	730	267	192	857
5	617	917	766	553	220	184	191	270	95	114
6	223	202	381	361	231	74	100	84	90	53
7	95	113	80	201	189	91	33	44	38	47
8	80	60	34	53	143	57	62	24	16	15
9	25	42	24	23	31	63	59	34	9	16
+gp	86	55	42	41	74	41	70	81	76	47
TOTALNUM	6096	6874	4468	3764	3359	2793	2194	2403	3362	2888
TONSLAND	2358	2593	1848	1624	1417	1156	1031	1044	1323	1131
SOPCOF %	100	100	100	100	100	100	100	100	100	99

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE										
1	19	46	6	188	23	21	22	18	3	5
2	645	342	448	942	875	458	791	987	388	903
3	1763	960	602	1042	913	1287	824	1285	1012	616
4	691	1288	614	341	477	537	662	442	581	426
5	327	288	782	297	172	316	245	325	214	209
6	80	145	121	391	147	91	131	107	140	85
7	31	29	73	89	195	64	43	54	54	56
8	32	11	17	37	48	87	43	22	26	32
9	14	17	11	10	37	41	48	15	8	14
+gp	40	44	33	35	34	35	40	40	42	27
TOTALNUM	3642	3170	2706	3372	2921	2937	2849	3296	2467	2372
TONSLAND	1299	1281	1106	1257	1277	1212	1203	1313	1003	974
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 8.2.5. Plaice in VIIe. Catch weights-at-age.

Table 2 Catch weights-at-age (kg)

YEAR	1976	1977	1978
AGE			
1	.1860	.1990	.1980
2	.2850	.3050	.3020
3	.3830	.4090	.4060
4	.4790	.5120	.5080
5	.5750	.6150	.6100
6	.6690	.7160	.7100
7	.7630	.8160	.8090
8	.8550	.9150	.9080
9	.9470	1.0140	1.0050
+gp	1.2839	1.3684	1.4027
SOPCOFAC	.9993	1.0001	.9999

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	.1950	.2480	.1540	.1980	.1150	.1520	.1070	.1810	.2570	.1430
2	.2990	.3370	.2870	.2910	.2410	.2670	.2340	.2710	.2940	.2290
3	.4010	.4270	.4170	.3840	.3600	.3840	.3580	.3650	.3440	.3230
4	.5020	.5180	.5430	.4770	.4710	.5000	.4770	.4620	.4110	.4260
5	.6030	.6110	.6660	.5680	.5760	.6160	.5930	.5630	.4900	.5380
6	.7020	.7050	.7850	.6600	.6720	.7320	.7040	.6670	.5840	.6600
7	.8000	.8000	.9000	.7490	.7620	.8480	.8120	.7750	.6930	.7900
8	.8970	.8970	1.0130	.8390	.8450	.9640	.9140	.8870	.8160	.9290
9	.9940	.9950	1.1210	.9270	.9200	1.0800	1.0140	1.0030	.9530	1.0770
+gp	1.3198	1.4026	1.4845	1.2985	1.1188	1.5563	1.3693	1.5072	1.4175	1.4485
SOPCOFAC	1.0002	.9998	1.0004	1.0005	1.0004	.9997	.9998	.9997	1.0002	.9999

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	.1680	.2480	.2060	.2500	.2140	.2180	.2260	.1840	.2090	.1940
2	.2340	.2800	.2610	.2910	.2710	.2800	.2980	.2830	.2880	.2590
3	.3080	.3230	.3260	.3460	.3350	.3490	.3740	.3830	.3710	.3180
4	.3880	.3770	.4010	.4140	.4080	.4230	.4540	.4840	.4580	.4450
5	.4750	.4420	.4850	.4970	.4880	.5030	.5370	.5860	.5490	.5690
6	.5700	.5180	.5800	.5930	.5760	.5880	.6230	.6880	.6450	.6900
7	.6710	.6060	.6840	.7030	.6720	.6800	.7140	.7900	.7440	.8080
8	.7800	.7040	.7980	.8260	.7750	.7770	.8080	.8930	.8480	.9230
9	.8960	.8140	.9210	.9640	.8870	.8800	.9060	.9970	.9560	1.0360
+gp	1.2106	1.1323	1.2986	1.3608	1.2113	1.2102	1.1173	1.2441	1.2347	1.3779
SOPCOFAC	.9999	1.0006	.9982	1.0002	.9998	.9997	.9985	1.0014	.9968	.9943

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE										
1	.1210	.1320	.1730	.2060	.1560	.2630	.2350	.2120	.1920	.2170
2	.2210	.2310	.2390	.2620	.2650	.3030	.2990	.2850	.2670	.2910
3	.3180	.3280	.3160	.3260	.3730	.3540	.3690	.3630	.3450	.3710
4	.4110	.4240	.3980	.3960	.4770	.4140	.4440	.4480	.4250	.4560
5	.5010	.5190	.4850	.4750	.5800	.4840	.5250	.5370	.5090	.5470
6	.5880	.6130	.5780	.5600	.6790	.5640	.6110	.6330	.5950	.6440
7	.6720	.7060	.6770	.6520	.7770	.6540	.7020	.7340	.6840	.7470
8	.7520	.7970	.7810	.7520	.8710	.7530	.7980	.8400	.7760	.8560
9	.8290	.8870	.8920	.8590	.9640	.8620	.9000	.9520	.8710	.9700
+gp	1.0717	1.1644	1.3179	1.2121	1.3039	1.2298	1.1527	1.2014	1.1302	1.3302
SOPCOFAC	.9998	1.0009	.9992	.9996	1.0002	1.0001	1.0007	1.0000	.9993	.9999

Table 8.2.6. Plaice in VIIe. Stock weights-at-age.

Table 3 Stock weights-at-age (kg)

YEAR	1976	1977	1978
AGE			
1	.1090	.1160	.1150
2	.2150	.2300	.2280
3	.3200	.3420	.3390
4	.4220	.4520	.4480
5	.5240	.5600	.5560
6	.6220	.6660	.6600
7	.7190	.7700	.7630
8	.8140	.8720	.8640
9	.9080	.9720	.9630
+gp	1.2411	1.3225	1.3555

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	.1140	.1140	.1260	.1080	.1160	.1110	.1120	.0960	.0680	.1030
2	.2260	.2270	.2500	.2140	.2280	.2220	.2220	.1950	.1450	.1840
3	.3350	.3380	.3730	.3180	.3350	.3340	.3310	.2970	.2320	.2750
4	.4430	.4470	.4920	.4190	.4360	.4460	.4380	.4010	.3260	.3730
5	.5490	.5540	.6090	.5170	.5320	.5600	.5430	.5070	.4290	.4810
6	.6530	.6600	.7250	.6150	.6230	.6730	.6470	.6150	.5390	.5980
7	.7550	.7640	.8380	.7100	.7100	.7880	.7490	.7270	.6590	.7230
8	.8540	.8670	.9490	.8020	.7910	.9030	.8490	.8400	.7880	.8580
9	.9530	.9670	1.0570	.8930	.8670	1.0180	.9480	.9550	.9240	1.0020
+gp	1.2748	1.3511	1.4355	1.2549	1.0940	1.4984	1.3287	1.4415	1.3475	1.3633

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
1	.1380	.2360	.1820	.2350	.1880	.1880	.1910	.1340	.1710	.1690
2	.2000	.2620	.2320	.2690	.2410	.2480	.2620	.2330	.2480	.2250
3	.2700	.3000	.2920	.3170	.3020	.3140	.3360	.3330	.3290	.2540
4	.3470	.3490	.3620	.3780	.3710	.3850	.4130	.4340	.4140	.3820
5	.4310	.4080	.4420	.4540	.4470	.4620	.4950	.5350	.5030	.5070
6	.5220	.4790	.5310	.5430	.5310	.5450	.5800	.6370	.5960	.6290
7	.6200	.5610	.6310	.6460	.6230	.6330	.6680	.7390	.6940	.7490
8	.7250	.6540	.7400	.7630	.7230	.7280	.7600	.8420	.7950	.8660
9	.8370	.7580	.8580	.8930	.8300	.8280	.8560	.9450	.9010	.9800
+gp	1.1432	1.0635	1.2229	1.2742	1.1447	1.1496	1.0643	1.1910	1.1758	1.3262

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE										
1	.0690	.0820	.1390	.1800	.1000	.2460	.2050	.1770	.1560	.1820
2	.1710	.1810	.2040	.2330	.2110	.2820	.2660	.2480	.2290	.2530
3	.2700	.2790	.2770	.2930	.3190	.3270	.3340	.3230	.3050	.3300
4	.3650	.3760	.3560	.3600	.4250	.3830	.4060	.4050	.3850	.4130
5	.4570	.4720	.4410	.4350	.5290	.4480	.4840	.4920	.4670	.5010
6	.5450	.5670	.5310	.5160	.6300	.5230	.5670	.5840	.5510	.5950
7	.6310	.6600	.6270	.6050	.7280	.6080	.6560	.6820	.6390	.6950
8	.7120	.7520	.7290	.7010	.8240	.7020	.7490	.7860	.7300	.8010
9	.7910	.8420	.8360	.8050	.9180	.8070	.8490	.8950	.8230	.9120
+gp	1.0399	1.1216	1.2529	1.1477	1.2631	1.1603	1.0952	1.1392	1.0784	1.2640

Table 8.2.7. UK-WECBTS effort standardized plaice abundance indices.

AGE	0	1	2	3	4	5	6	7	8	9	10+
year											
1985	0.00	82.16	75.37	72.36	113.06	20.35	15.83	8.29	0.75	0.00	2.26
1986	0.00	61.62	86.67	168.60	64.33	23.70	2.71	12.19	1.35	0.00	1.35
1987	0.74	398.98	110.17	104.21	54.34	27.54	21.59	10.42	5.95	5.95	2.98
1988	0.00	108.40	289.33	265.15	75.65	17.16	8.58	7.80	3.12	4.68	3.12
1989	0.00	18.71	42.26	169.63	113.49	13.88	6.64	8.45	4.83	3.62	10.87
1990	0.00	14.23	21.63	125.24	49.53	42.70	1.14	3.42	0.57	3.42	3.98
1991	1.16	12.81	15.73	36.70	46.02	36.11	23.88	5.24	0.00	0.58	1.75
1992	0.00	77.31	22.38	36.62	12.21	20.35	10.17	8.65	1.53	2.54	2.03
1993	0.00	11.10	37.00	31.71	12.69	6.87	13.21	6.87	5.81	1.06	1.06
1994	0.00	16.52	15.54	47.60	14.57	4.86	0.97	4.37	6.31	3.89	0.97
1995	0.00	26.72	24.58	24.04	25.65	6.41	2.14	2.67	3.21	0.53	2.14
1996	0.54	17.90	57.49	16.27	9.22	13.56	2.71	0.54	1.63	3.80	4.34
1997	0.00	28.69	66.04	106.63	12.99	3.25	6.50	3.79	0.54	0.54	3.79
1998	0.00	43.67	67.39	67.39	45.83	4.85	3.23	3.77	2.16	0.00	1.62
1999	0.53	20.22	23.42	96.86	28.21	15.97	1.60	1.06	3.19	2.13	1.06
2000	0.00	26.57	34.79	69.51	99.00	21.13	12.30	0.60	1.11	0.00	2.77
2001	11.52	17.91	35.78	28.65	62.57	54.75	13.79	7.08	0.00	1.69	2.81
2002	0.00	76.78	56.50	48.17	12.91	13.06	22.18	2.97	1.11	0.00	1.11
2003	0.00	15.82	75.35	32.84	27.52	2.47	9.91	14.86	3.96	0.00	1.10
2004	0.00	6.71	19.82	35.67	14.03	6.10	1.83	0.61	6.10	0.00	2.44
2005	0.80	16.31	40.42	48.71	37.42	6.90	1.71	1.43	2.81	1.18	1.47
2006	0.00	29.77	55.43	55.78	16.45	16.89	1.44	2.06	0.00	2.44	1.08
2007	0.00	20.44	50.35	66.58	18.67	14.93	3.31	3.04	0.28	1.38	2.21
2008	0.00	8.54	83.46	38.71	17.67	6.87	4.48	5.44	2.00	0.57	1.72

Table 8.2.8. Plaice in VIIe. Tuning fleet data available (data in bold have been used for tuning).

```
W.CHANNEL PLAICE 2009 WG
105
UK-WEC-BTS
1986 2008
1 1 0.75 0.80
1 8
147.68   91  128   249   95  35   4  18   2   0
134.34  536  148   140   73  37  29  14   8   8
128.23  139  371   340   97  22  11  10   4   6
165.66   31   70   281  188  23  11  14   8   6
175.66   25   38   220   87  75   2   6   1   6
171.68   22   27    63   79  62  41   9   0   1
196.60  152   44    72   24  40  20  17   3   5
189.19   21   70    60   24  13  25  13  11   2
205.87   34   32    98   30  10   2   9  13   8
187.15   50   46    45   48  12   4   5   6   1
184.37   33  106    30   17  25   5   1   3   7
184.74   53  122   197   24   6  12   7   1   1
185.49   81  125   125   85   9   6   7   4   0
187.89   38   44   182   53  30   3   2   6   4
180.37   48   63   125  179  38  22   1   2   0
177.98   32   64    51  111  97  25  13   0   3
179.74  138  102    87   23  23  40   5   2   0
168.07   33  142    80   50   7  17  30   8   2
163.99   11   33    59   23  10   3   1  10   0
186.60   30   75    91   70  13   3   3   5   2
184.74   55  102   103   30  31   3   4   0   5
181.02   37   91   121   34  27   6   6   1   3
169.62   15  146    68   31  12   8  10   4   1
UK WECOT
1988 2008
1 1 0 1
3 9
53.402 754.5 116.9  51.5  15.1 10.0  3.4  1.9
54.707 494.0 359.7  77.0  26.5  7.0  5.9  0.8
53.050 347.1 265.9  85.3  18.4 11.3  6.0  2.8
40.789  89.5 134.9  64.8  30.3  6.3  2.7  1.9
39.909  71.7  46.3  40.1  25.5 12.9  3.9  1.3
39.240  76.1  33.1  12.0  12.2  9.8  7.7  1.7
38.768  86.1  37.1   9.8   3.5  4.4  2.4  2.7
35.453  47.8  48.8  10.8   5.7  1.3  2.7  2.2
30.541  39.8  16.3  14.5   4.0  2.0  1.0  1.2
33.281 180.1  14.6   5.5   4.3  1.6  0.6  0.3
29.802  96.2  61.3   6.4   2.4  1.6  0.4  0.5
27.516  90.1  34.6  14.3   2.8  1.1  0.9  0.3
30.493  49.6  64.4  13.3   6.5  1.3  0.5  0.8
31.900  31.3  29.3  31.5   4.4  2.6  0.5  0.3
28.346  57.1  17.9  12.6  15.6  3.3  1.4  0.5
25.060  33.2  15.8   5.1   3.5  4.3  1.2  0.6
25.584  50.7  18.2  10.5   2.8  1.4  2.1  1.1
21.129  24.1  17.6   5.7   2.6  0.8  0.8  0.8
21.058  32.4   9.9   6.5   1.9  1.0  0.4  0.3
22.347  36.6  18.6   5.3   2.8  1.0  0.3  0.1
19.801  19.2  12.2   5.4   1.9  1.2  0.6  0.3
```

Table 8.2.8. (Cont.) Plaice in VIIe. Tuning fleet data available (data in bold have been used for tuning).

UK WECBT
1989 2008
1 1 0 1
3 9
109.947 922.6 784.7 210.1 96.9 48.9 35.2 7.5
100.947 1053.9 826.9 326.5 77.2 54.4 23.5 13.1
83.574 365.7 641.3 355.6 159.9 35.7 11.3 8.1
80.865 465.5 308.0 293.7 172.0 89.2 25.9 9.7
83.918 543.6 248.2 102.7 114.7 89.6 66.6 14.3
100.415 659.0 312.7 104.4 43.1 53.3 34.7 38.0
100.797 285.7 343.6 101.6 51.4 18.9 34.3 33.5
116.446 221.8 115.0 126.4 41.1 21.5 12.6 19.2
108.388 683.6 76.7 43.9 46.9 20.7 9.6 5.4
111.171 413.3 297.9 48.6 26.1 26.7 8.8 8.8
103.555 747.8 274.5 135.3 40.0 14.4 16.0 8.0
118.833 388.4 529.8 111.8 54.7 11.0 5.4 6.8
143.272 248.7 283.6 393.2 61.0 35.0 7.4 4.0
139.832 497.3 164.6 148.5 197.6 46.8 19.2 4.5
159.894 495.5 260.2 95.0 81.9 116.1 26.8 22.9
158.681 690.0 299.6 168.3 49.9 40.1 51.6 24.9
157.812 464.1 355.3 136.4 71.6 24.9 23.0 27.3
161.440 599.0 202.1 159.3 52.5 27.5 11.2 8.3
158.005 416.7 246.1 100.2 67.6 27.3 13.2 4.3
158.168 260.4 186.1 94.2 41.2 25.4 14.1 6.3
UK WECOT historic
1976 1987
1 1 0 1
2 9
22.771 13.7 80.4 20.2 14.2 7.5 7.7 4.8 1.8
21.194 60.1 29.4 25.8 8.1 4.8 3.0 4.5 1.4
16.823 18.8 71.1 8.0 10.6 3.8 2.3 2.0 1.6
16.981 42.5 57.1 44.5 5.7 6.1 2.9 1.9 1.2
13.647 53.1 50.8 14.7 13.4 4.0 4.2 1.4 1.0
15.172 76.6 216.2 44.4 11.0 10.3 1.8 5.0 1.6
14.422 27.0 169.1 111.9 19.5 7.1 7.3 1.1 2.6
19.117 103.7 102.2 173.4 75.3 12.4 4.8 5.5 0.3
15.800 100.5 155.0 49.7 40.6 16.3 7.7 2.2 3.2
17.545 60.5 129.6 102.4 12.9 21.2 13.4 2.1 0.4
20.758 108.3 254.8 77.8 44.1 8.2 12.9 7.4 3.3
17.995 116.3 208.7 124.7 62.2 22.0 5.6 4.2 4.1
UK (E&W) FSP
2003 2007
1 1 0.75 0.80
2 9
1 0.295 0.320 0.159 0.061 0.047 0.090 0.038 0.025
1 0.287 0.566 0.218 0.129 0.022 0.038 0.047 0.019
1 0.290 0.355 0.231 0.085 0.041 0.010 0.016 0.032
1 0.465 0.357 0.170 0.095 0.035 0.026 0.006 0.008
1 0.131 0.292 0.138 0.067 0.034 0.010 0.006 0.005
1 0.349 0.142 0.074 0.022 0.013 0.009 0.002 0.002

Table 8.2.9 Plaice in VIIe. Diagnostics

```
Lowestoft VPA Version 3.1

   11/05/2009  14:15

 Extended Survivors Analysis

 "W.CHANNEL PLAICE 2009 WG
 Cpue data from file c:\vpa data\ple7etu5_a.dat

 Catch data for  33 years. 1976 to 2008. Ages  1 to  10.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 UK-WEC-BTS         ,   1986, 2008,   1,     8,   .750,   .800
 UK WECOT           ,   1988, 2008,   3,     9,   .000,  1.000
 UK WECBT           ,   1989, 2008,   3,     9,   .000,  1.000
 UK WECOT historic  ,   1976, 2008,   2,     9,   .000,  1.000
 UK (E&W) FSP       ,   2003, 2008,   2,     9,   .750,   .800

 Time series weights :

      Tapered time weighting not applied

 Catchability analysis :

      Catchability independent of stock size for all ages

      Catchability independent of age for ages >=    7

 Terminal population estimation :

      Survivor estimates shrunk towards the mean F
      of the final   5 years or the   4 oldest ages.

      S.E. of the mean to which the estimates  are shrunk =   2.500

      Minimum standard error for population
      estimates derived from each fleet =    .500

      Prior weighting not applied

 Tuning had not converged after   30 iterations

 Total absolute residual between iterations
 29 and  30 =     .00010

 Final year F values
 Age          ,      1,      2,      3,      4,      5,      6,      7,      8,      9
 Iteration 29,  .0036,  .1931,  .5334,  .6698,  .7882,  .6213,  .6098,  .8474,  .9098
 Iteration 30,  .0036,  .1931,  .5334,  .6698,  .7882,  .6213,  .6098,  .8474,  .9098

 Regression weights
       , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

 Fishing mortalities
    Age,  1999,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008

      1,  .008,  .013,  .002,  .040,  .008,  .005,  .006,  .008,  .000,  .004
      2,  .207,  .187,  .156,  .325,  .241,  .198,  .254,  .364,  .208,  .193
      3,  .389,  .486,  .523,  .585,  .545,  .602,  .586,  .754,  .707,  .533
      4,  .607,  .498,  .600,  .577,  .529,  .656,  .652,  .659,  .852,  .670
      5,  .580,  .498,  .582,  .596,  .588,  .733,  .647,  .710,  .713,  .788
      6,  .667,  .499,  .363,  .589,  .606,  .654,  .706,  .596,  .696,  .621
      7,  .588,  .485,  .461,  .456,  .601,  .529,  .679,  .646,  .626,  .610
      8,  .485,  .408,  .541,  .408,  .428,  .532,  .746,  .831,  .676,  .847
      9,  .607,  .482,  .753,  .677,  .846,  .738,  .580,  .583,  .743,  .910
```

Table 8.2.9. Plaice in VIIe. Diagnostics (continued).

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8	9
1999	2.42E+03	3.67E+03	5.80E+03	1.61E+03	7.89E+02	1.75E+02	7.33E+01	8.75E+01	3.36E+01
2000	3.76E+03	2.13E+03	2.65E+03	3.49E+03	7.80E+02	3.91E+02	7.96E+01	3.61E+01	4.78E+01
2001	4.07E+03	3.29E+03	1.57E+03	1.44E+03	1.88E+03	4.20E+02	2.11E+02	4.35E+01	2.13E+01
2002	5.09E+03	3.60E+03	2.50E+03	8.25E+02	7.03E+02	9.32E+02	2.59E+02	1.18E+02	2.24E+01
2003	3.08E+03	4.33E+03	2.31E+03	1.23E+03	4.11E+02	3.43E+02	4.59E+02	1.46E+02	6.96E+01
2004	4.25E+03	2.71E+03	3.02E+03	1.19E+03	6.45E+02	2.02E+02	1.66E+02	2.23E+02	8.42E+01
2005	3.90E+03	3.75E+03	1.97E+03	1.47E+03	5.46E+02	2.75E+02	9.33E+01	8.68E+01	1.16E+02
2006	2.50E+03	3.44E+03	2.58E+03	9.73E+02	6.78E+02	2.53E+02	1.20E+02	4.19E+01	3.65E+01
2007	6.16E+03	2.20E+03	2.12E+03	1.08E+03	4.46E+02	2.96E+02	1.24E+02	5.60E+01	1.62E+01
2008	1.36E+03	5.46E+03	1.58E+03	9.26E+02	4.07E+02	1.94E+02	1.31E+02	5.87E+01	2.52E+01

Estimated population abundance at 1st Jan 2009

0.00E+00	1.20E+03	3.99E+03	8.23E+02	4.20E+02	1.64E+02	9.24E+01	6.30E+01	2.23E+01

Taper weighted geometric mean of the VPA populations:

4.37E+03	3.81E+03	2.73E+03	1.33E+03	6.21E+02	3.11E+02	1.69E+02	9.24E+01	5.02E+01

Standard error of the weighted Log(VPA populations) :

.5234	.5492	.5730	.6315	.6086	.5801	.6136	.6370	.7011

Log catchability residuals.

Fleet : UK-WEC-BTS

Age	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.33	1.67	.70
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.26	-.27	.91
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.57	.15	.28
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.41	.25	.42
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.16	.53	-.10
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.40	.92	.19
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.83	1.18	.05
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.97	.60	.50
9	No data for this fleet at this age									

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-.14	-.51	-.71	.99	-.16	.30	-.43	-.56	-.56	.52
2	-.81	-.50	-.86	-.58	-.20	-.26	.28	-.10	.33	-.24
3	-.04	-.01	-.26	-.22	-.41	-.22	-.01	-.37	.33	.03
4	.18	-.47	-.16	-.48	-.43	-.27	.01	-.17	.01	.31
5	-.34	.04	.08	-.05	-.05	-.54	-.16	.32	-.43	-.25
6	-.08	-1.86	.33	-.23	.49	-1.03	-.35	-.03	.49	.48
7	.44	-.29	-.08	-.44	-.24	-.36	.27	-1.32	.66	.19
8	.15	-1.61	99.99	-.77	-.23	.16	-.09	.45	-.79	.60
9	No data for this fleet at this age									

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	.29	.13	-.35	.90	.02	-1.38	-.42	.64	-.64	.03
2	-.54	.38	-.05	.45	.60	-.40	.01	.50	.73	.35
3	-.35	.18	-.16	-.05	-.02	-.52	.20	.19	.53	.18
4	-.14	.26	.75	-.29	.12	-.50	.27	-.15	.04	.03
5	.11	.34	.47	.02	-.57	-.53	-.30	.41	.72	.12
6	-.34	.75	.72	.56	.78	-.36	-.76	-.75	-.11	.60
7	-.23	-1.05	.54	-.63	.77	-1.65	.01	.03	.41	.92
8	.61	.38	99.99	-.80	.46	.36	.65	99.99	-.55	.99
9	No data for this fleet at this age									

Table 8.2.9. Plaice in VIIe. Diagnostics (continued).

Mean log-catchability and standard error of ages with catchability independent of year-class strength and constant w.r.t. time

Age ,	1,	2,	3,	4,	5,	6,	7,	8
Mean Log q,	-9.5795,	-8.8626,	-7.9533,	-7.9437,	-8.0729,	-8.3492,	-8.0581,	-8.0581,
S.E(Log q),	.6837,	.4948,	.2915,	.3302,	.3605,	.6850,	.7134,	.6971,

Regression statistics :

Ages with q independent of year-class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
1,	.91,	.374,	9.47,	.45,	23,	.63,	-9.58,
2,	1.02,	-.086,	8.87,	.51,	23,	.52,	-8.86,
3,	.91,	.904,	7.96,	.82,	23,	.27,	-7.95,
4,	.88,	1.088,	7.87,	.80,	23,	.29,	-7.94,
5,	.82,	1.676,	7.81,	.81,	23,	.29,	-8.07,
6,	.81,	.952,	7.86,	.53,	23,	.55,	-8.35,
7,	.92,	.325,	7.84,	.46,	23,	.67,	-8.06,
8,	1.39,	-1.117,	9.36,	.31,	20,	.96,	-8.05,

Fleet : UK WECOT

Age ,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988
1 ,	No data for this fleet at this age									
2 ,	No data for this fleet at this age									
3 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.58
4 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.14
5 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.34
6 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.10
7 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.13
8 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	.39
9 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	-.34

Age ,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
1 ,	No data for this fleet at this age									
2 ,	No data for this fleet at this age									
3 ,	.30,	.24,	.14,	-.05,	-.03,	-.07,	.29,	.31,	.53,	.23
4 ,	.52,	.39,	.36,	.30,	.01,	.14,	.23,	.16,	-.12,	.38
5 ,	.60,	.06,	.25,	.21,	.08,	-.19,	.07,	.23,	-.08,	-.04
6 ,	.54,	.21,	.14,	.25,	-.01,	-.15,	.28,	.18,	-.15,	.05
7 ,	.00,	.63,	.17,	.05,	.17,	-.23,	-.26,	.29,	.03,	-.29
8 ,	.09,	.50,	.09,	.24,	.12,	-.66,	-.08,	.25,	-.41,	-.69
9 ,	-.43,	.00,	.21,	-.14,	-.02,	-.33,	-.14,	-.16,	-.40,	.16

Age ,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	2007,	2008
1 ,	No data for this fleet at this age									
2 ,	No data for this fleet at this age									
3 ,	-.45,	-.32,	-.28,	.00,	-.36,	-.20,	-.33,	-.23,	.01,	-.30
4 ,	-.05,	-.35,	-.26,	-.08,	-.51,	-.29,	-.35,	-.50,	.05,	-.18
5 ,	-.02,	-.22,	-.25,	-.05,	-.30,	.01,	-.28,	-.33,	-.18,	.09
6 ,	.11,	-.03,	-.59,	.10,	-.27,	.04,	-.13,	-.41,	-.19,	-.07
7 ,	.20,	.14,	-.20,	-.05,	-.17,	-.33,	-.05,	-.10,	-.19,	.05
8 ,	-.22,	-.06,	-.23,	-.14,	-.38,	-.22,	.05,	.12,	-.58,	.26
9 ,	-.31,	.16,	.06,	.61,	-.15,	.20,	-.32,	-.14,	-.41,	.44

Mean log-catchability and standard error of ages with catchability independent of year-class strength and constant w.r.t. time

Age ,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-6.7878,	-6.7665,	-6.9745,	-7.1962,	-7.3827,	-7.3827,	-7.3827,
S.E(Log q),	.3033,	.3051,	.2386,	.2512,	.2305,	.3442,	.2948,

Table 8.2.9. Plaice in VIIe. Diagnostics (continued).

Regression statistics :

Ages with q independent of year-class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3,	.84,	1.654,	6.98,	.85,	21,	.24,	-6.79,
4,	.83,	1.922,	6.85,	.87,	21,	.24,	-6.77,
5,	.88,	1.603,	6.92,	.90,	21,	.20,	-6.97,
6,	.91,	1.085,	7.07,	.88,	21,	.23,	-7.20,
7,	.98,	.273,	7.33,	.89,	21,	.23,	-7.38,
8,	.95,	.464,	7.31,	.81,	21,	.33,	-7.46,
9,	1.11,	-1.110,	7.83,	.84,	21,	.32,	-7.45,

Fleet : UK WECBT

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-.39,	.09,	.21,	.49,	.56,	.39,	.41,	.06,	.06,	-.25
4	-.15,	.12,	.44,	.73,	.51,	.55,	.38,	.01,	-.40,	-.12
5	-.04,	-.19,	.28,	.55,	.51,	.27,	.31,	.11,	-.14,	-.28
6	.03,	-.11,	-.02,	.34,	.36,	.30,	.33,	.06,	-.05,	.00
7	.00,	.31,	-.06,	.02,	.37,	.06,	.12,	.08,	.16,	-.04
8	-.07,	-.03,	-.45,	.18,	.27,	-.19,	.17,	.20,	-.06,	-.16
9	-.14,	-.35,	-.31,	-.08,	.10,	.12,	.29,	.03,	.06,	.46

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-.28,	-.25,	-.34,	-.06,	-.13,	-.04,	-.01,	.03,	-.14,	-.39
4	-.06,	-.36,	-.25,	-.22,	-.32,	-.07,	-.11,	-.29,	-.08,	-.29
5	-.05,	-.41,	-.18,	-.14,	-.18,	.01,	-.07,	-.12,	-.15,	-.08
6	.34,	-.37,	-.58,	-.07,	-.08,	-.02,	.06,	-.24,	-.07,	-.18
7	.20,	-.34,	-.35,	-.24,	.02,	-.05,	.12,	-.07,	-.09,	-.23
8	.08,	-.29,	-.29,	-.37,	-.37,	-.09,	.14,	.17,	.00,	.09
9	.40,	-.31,	-.10,	-.04,	.39,	.25,	-.05,	-.10,	.14,	.15

Mean log-catchability and standard error of ages with catchability
independent of year-class strength and constant w.r.t. time

Age ,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-6.1642,	-6.0054,	-6.0215,	-6.0841,	-6.1325,	-6.1325,	-6.1325,
S.E(Log q),	.2899,	.3391,	.2581,	.2462,	.1937,	.2252,	.2407,

Regression statistics :

Ages with q independent of year-class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3,	1.12,	-.788,	5.96,	.70,	20,	.33,	-6.16,
4,	.96,	.317,	6.06,	.77,	20,	.33,	-6.01,
5,	.97,	.268,	6.03,	.85,	20,	.26,	-6.02,
6,	1.02,	-.231,	6.09,	.85,	20,	.26,	-6.08,
7,	.96,	.627,	6.09,	.92,	20,	.19,	-6.13,
8,	.97,	.443,	6.14,	.91,	20,	.22,	-6.19,
9,	1.03,	-.324,	6.14,	.90,	20,	.25,	-6.09,

Table 8.2.9. Plaice in VIIe. Diagnostics (continued).

Fleet : UK WECOT historic

Age	1976	1977	1978
1	No data for this fleet at this age		
2	-.17	.10	-.22
3	-.08	-.14	-.31
4	-.31	-.55	-.57
5	.00	-.47	-.54
6	-.04	-.32	-.38
7	-.10	-.44	-.39
8	.29	.06	-.03
9	.00	-.17	-.03

Age	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	No data for this fleet at this age									
2	.20	-.23	.10	.02	.28	.55	-.34	.13	-.41	99.99
3	.15	-.22	.22	.08	.21	.00	-.13	.10	.12	99.99
4	-.10	-.20	.17	.32	.57	.42	.15	-.22	.32	99.99
5	-.20	-.29	.16	.18	.57	.23	-.19	-.02	.59	99.99
6	-.53	.52	-.06	.52	.12	-.02	.24	-.20	.14	99.99
7	-.22	-.30	.33	.04	.48	.31	.15	.14	-.01	99.99
8	-.02	-.18	.31	.60	-.03	.66	-.58	.00	-.29	99.99
9	.16	.24	.44	.32	-.37	.13	-.50	.21	.15	99.99

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age									
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	No data for this fleet at this age									
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Mean log-catchability and standard error of ages with catchability
independent of year-class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-7.0153	-5.7243	-5.7266	-5.8839	-6.0091	-5.9333	-5.9333	-5.9333
S.E(Log q)	.2820	.1735	.3773	.3635	.3320	.2983	.3605	.2822

Regression statistics :

Ages with q independent of year-class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.02	-.159	6.99	.85	12	.30	-7.02
3	.91	1.185	5.91	.95	12	.16	-5.72
4	.72	3.232	6.09	.93	12	.20	-5.73
5	.74	2.331	5.98	.89	12	.23	-5.88
6	1.06	-.286	6.03	.71	12	.37	-6.01
7	1.03	-.206	5.97	.78	12	.32	-5.93
8	1.50	-2.093	6.60	.64	12	.46	-5.87
9	.79	2.566	5.43	.94	12	.18	-5.88

Table 8.2.9. Plaice in VIIe. Diagnostics (continued).

Fleet : UK (E&W) FSP

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	No data for this fleet at this age									
2	99.99	99.99	99.99	99.99	-.23	.17	-.10	.55	-.39	99.99
3	99.99	99.99	99.99	99.99	-.18	.16	.11	-.02	-.06	99.99
4	99.99	99.99	99.99	99.99	-.28	.17	.02	.13	-.03	99.99
5	99.99	99.99	99.99	99.99	-.13	.28	-.04	-.09	-.02	99.99
6	99.99	99.99	99.99	99.99	.03	-.17	.19	.03	-.08	99.99
7	99.99	99.99	99.99	99.99	.24	.33	-.31	.37	-.63	99.99
8	99.99	99.99	99.99	99.99	.39	.25	.29	.10	-.31	99.99
9	99.99	99.99	99.99	99.99	1.03	.48	.56	.33	.80	99.99

Mean log-catchability and standard error of ages with catchability independent of year-class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-9.0806	-8.1839	-8.1736	-8.1365	-8.3603	-8.2143	-8.2143	-8.2143
S.E(Log q)	.3702	.1381	.1774	.1627	.1334	.4461	.3173	.7682

Regression statistics :

Ages with q independent of year-class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.80	.314	8.88	.46	5	.34	-9.08
3	.79	.575	8.10	.72	5	.12	-8.18
4	1.45	-.482	8.67	.28	5	.29	-8.17
5	.74	.926	7.66	.81	5	.12	-8.14
6	.76	.914	7.69	.83	5	.10	-8.36
7	.76	.840	7.47	.81	5	.35	-8.21
8	.80	1.365	7.37	.94	5	.20	-8.07
9	1.04	-.211	7.73	.88	5	.33	-7.57

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 2007

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK-WEC-BTS	1244.	.698	.000	.00	1	.927	.003
UK WECOT	1.	.000	.000	.00	0	.000	.000
UK WECBT	1.	.000	.000	.00	0	.000	.000
UK WECOT historic	1.	.000	.000	.00	0	.000	.000
UK (E&W) FSP	1.	.000	.000	.00	0	.000	.000
F shrinkage mean	781.	2.50				.073	.006

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1203.	.67	.13	2	.187	.004

Table 8.2.9. Plaice in VIIe. Diagnostics (continued).

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2006

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
UK-WEC-BTS	4031.,	.409,	.470,	1.15,	2,	.968,	.191
UK WECOT	1.,	.000,	.000,	.00,	0,	.000,	.000
UK WECBT	1.,	.000,	.000,	.00,	0,	.000,	.000
UK WECOT historic	1.,	.000,	.000,	.00,	0,	.000,	.000
UK (E&W) FSP	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean	2944.,	2.50,,,,				.032,	.254

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
3991.,	.40,	.33,	3,	.816,	.193

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
UK-WEC-BTS	1312.,	.319,	.186,	.58,	3,	.434,	.366
UK WECOT	609.,	.500,	.000,	.00,	1,	.197,	.669
UK WECBT	555.,	.500,	.000,	.00,	1,	.197,	.716
UK WECOT historic	1.,	.000,	.000,	.00,	0,	.000,	.000
UK (E&W) FSP	556.,	.500,	.000,	.00,	1,	.160,	.714
F shrinkage mean	644.,	2.50,,,,				.013,	.642

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
823.,	.21,	.18,	7,	.848,	.533

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2004

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
UK-WEC-BTS	509.,	.297,	.174,	.59,	4,	.339,	.581
UK WECOT	374.,	.373,	.088,	.24,	2,	.253,	.729
UK WECBT	330.,	.373,	.073,	.20,	2,	.253,	.796
UK WECOT historic	1.,	.000,	.000,	.00,	0,	.000,	.000
UK (E&W) FSP	507.,	.359,	.301,	.84,	2,	.142,	.583
F shrinkage mean	418.,	2.50,,,,				.013,	.673

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
420.,	.18,	.09,	11,	.511,	.670

Table 8.2.9. Plaice in VIIe. Diagnostics (continued).

```
Age  5   Catchability constant w.r.t. time and dependent on age

 Year class = 2003

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Esti-
mated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 UK-WEC-BTS         ,       170.,   .302,       .152,    .50,   5,  .311,     .768
 UK WECOT           ,       170.,   .340,       .072,    .21,   3,  .272,     .768
 UK WECBT           ,       153.,   .340,       .026,    .08,   3,  .272,     .828
 UK WECOT historic  ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 UK (E&W) FSP       ,       157.,   .317,       .019,    .06,   3,  .131,     .812

   F shrinkage mean  ,       201.,   2.50,,,,                        .015,     .682

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       164.,       .17,      .05,   15,    .294,   .788
```

```
 Age  6   Catchability constant w.r.t. time and dependent on age

 Year class = 2002

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Esti-
mated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 UK-WEC-BTS         ,       136.,   .295,       .172,    .58,   6,  .244,     .461
 UK WECOT           ,        78.,   .305,       .087,    .28,   4,  .294,     .706
 UK WECBT           ,        78.,   .305,       .036,    .12,   4,  .294,     .705
 UK WECOT historic  ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 UK (E&W) FSP       ,        98.,   .290,       .045,    .16,   4,  .156,     .595

   F shrinkage mean  ,        86.,   2.50,,,,                        .012,     .655

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
        92.,       .16,      .07,   19,    .478,   .621
```

```
 Age  7   Catchability constant w.r.t. time and dependent on age

 Year class = 2001

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Esti-
mated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 UK-WEC-BTS         ,        99.,   .331,       .187,    .57,   7,  .201,     .430
 UK WECOT           ,        57.,   .297,       .079,    .26,   5,  .313,     .655
 UK WECBT           ,        54.,   .297,       .035,    .12,   5,  .313,     .686
 UK WECOT historic  ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 UK (E&W) FSP       ,        59.,   .290,       .040,    .14,   5,  .161,     .638

   F shrinkage mean  ,        62.,   2.50,,,,                        .012,     .619

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
        63.,       .16,      .07,   23,    .438,   .610
```

Table 8.2.9. Plaice in VIIe. Diagnostics (continued).

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 2000

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
UK-WEC-BTS	,	31.,	.343,	.246,	.72,	8,	.184,	.675
UK WECOT	,	22.,	.281,	.123,	.44,	6,	.317,	.860
UK WECBT	,	22.,	.281,	.053,	.19,	6,	.317,	.862
UK WECOT historic	,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK (E&W) FSP	,	17.,	.287,	.164,	.57,	5,	.167,	1.028
F shrinkage mean	,	33.,	2.50,,,,				.014,	.646

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
22.,	.15,	.08,	26,	.525,	.847

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1999

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
UK-WEC-BTS	,	6.,	.355,	.115,	.32,	8,	.102,	1.142
UK WECOT	,	9.,	.287,	.175,	.61,	7,	.353,	.887
UK WECBT	,	10.,	.287,	.041,	.14,	7,	.353,	.873
UK WECOT historic	,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK (E&W) FSP	,	9.,	.295,	.155,	.53,	5,	.175,	.926
F shrinkage mean	,	13.,	2.50,,,,				.017,	.721

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
9.,	.16,	.06,	28,	.398,	.910

Table 8.2.10. Plaice in VIIe. Fishing mortality-at-age.

Run title : "W.CHANNEL PLAICE 2009 WG

At 8/05/2009 13:23

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality-(F) at-age

YEAR,	1976,	1977,	1978,
AGE			
1,	.0070,	.0032,	.0159,
2,	.1341,	.2188,	.1557,
3,	.5314,	.6239,	.5208,
4,	.4208,	.4144,	.4018,
5,	.4928,	.3822,	.3509,
6,	.4193,	.3951,	.3655,
7,	.4201,	.3767,	.3811,
8,	.6288,	.6142,	.5667,
9,	.4733,	.5110,	.5738,
+gp,	.4733,	.5110,	.5738,
FBAR 3- 7,	.4569,	.4385,	.4040,

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.0030,	.0031,	.0165,	.0129,	.0006,	.0120,	.0005,	.0008,	.0066,	.0015,
2,	.2285,	.1365,	.1292,	.1334,	.1550,	.2259,	.1064,	.1749,	.0948,	.1990,
3,	.7923,	.5060,	.5301,	.5185,	.5301,	.4764,	.4804,	.6247,	.5887,	.5785,
4,	.6120,	.5120,	.5065,	.6556,	.7561,	.7212,	.6364,	.4519,	.7193,	.4430,
5,	.4764,	.3998,	.4299,	.4884,	.6437,	.5113,	.3850,	.4717,	.8025,	.5061,
6,	.3030,	.7994,	.3043,	.6024,	.3584,	.3528,	.5219,	.3436,	.4526,	.3182,
7,	.4391,	.3767,	.5015,	.4056,	.5677,	.5290,	.5172,	.5233,	.4231,	.2897,
8,	.5359,	.4117,	.4715,	.7027,	.3419,	.7386,	.2362,	.4570,	.3155,	.4042,
9,	.6216,	.6011,	.5501,	.5288,	.2344,	.4508,	.2830,	.5566,	.4869,	.1995,
+gp,	.6216,	.6011,	.5501,	.5288,	.2344,	.4508,	.2830,	.5566,	.4869,	.1995,
FBAR 3- 7,	.5246,	.5188,	.4544,	.5341,	.5712,	.5181,	.5082,	.4830,	.5972,	.4271,

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	.0031,	.0160,	.0105,	.0208,	.0184,	.0454,	.0010,	.0032,	.0009,	.0018,
2,	.0363,	.1191,	.1861,	.2179,	.1841,	.1996,	.2104,	.2101,	.2275,	.0807,
3,	.4279,	.6371,	.6062,	.6964,	.7166,	.6115,	.7172,	.6561,	.7153,	.5358,
4,	.6515,	.7625,	.7777,	.8235,	.7523,	.8413,	.7786,	.6813,	.4499,	.7048,
5,	.7561,	.5698,	.5840,	.6427,	.7355,	.5639,	.6343,	.6762,	.4971,	.4786,
6,	.5959,	.5397,	.4459,	.5473,	.5528,	.5311,	.6240,	.5783,	.4513,	.5194,
7,	.4646,	.6264,	.3850,	.4068,	.5623,	.3973,	.4344,	.5617,	.5098,	.4093,
8,	.5089,	.5467,	.3501,	.4319,	.5152,	.2965,	.4695,	.5909,	.3697,	.3509,
9,	.6961,	.4987,	.3976,	.3853,	.4405,	.4077,	.5156,	.4628,	.4164,	.7017,
+gp,	.6961,	.4987,	.3976,	.3853,	.4405,	.4077,	.5156,	.4628,	.4164,	.7017,
FBAR 3- 7,	.5792,	.6271,	.5598,	.6233,	.6639,	.5890,	.6377,	.6307,	.5247,	.5296,

YEAR,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	2007,	2008,	FBAR 06-08
AGE											
1,	.0085,	.0132,	.0016,	.0400,	.0080,	.0053,	.0061,	.0079,	.0004,	.0036,	.0040,
2,	.2066,	.1867,	.1562,	.3254,	.2413,	.1979,	.2540,	.3637,	.2080,	.1931,	.2549,
3,	.3893,	.4864,	.5234,	.5854,	.5452,	.6022,	.5864,	.7542,	.7073,	.5334,	.6650,
4,	.6070,	.4977,	.5999,	.5771,	.5286,	.6558,	.6518,	.6593,	.8520,	.6698,	.7270,
5,	.5804,	.4984,	.5821,	.5965,	.5884,	.7332,	.6470,	.7101,	.7134,	.7882,	.7372,
6,	.6673,	.4989,	.3633,	.5889,	.6057,	.6538,	.7057,	.5961,	.6960,	.6213,	.6378,
7,	.5883,	.4849,	.4608,	.4564,	.6012,	.5291,	.6791,	.6456,	.6264,	.6098,	.6273,
8,	.4854,	.4084,	.5408,	.4078,	.4276,	.5316,	.7461,	.8313,	.6762,	.8474,	.7850,
9,	.6069,	.4817,	.7526,	.6771,	.8458,	.7384,	.5804,	.5833,	.7430,	.9098,	.7454,
+gp,	.6069,	.4817,	.7526,	.6771,	.8458,	.7384,	.5804,	.5833,	.7430,	.9098,	
FBAR 3- 7,	.5665,	.4932,	.5059,	.5608,	.5738,	.6348,	.6540,	.6730,	.7190,	.6445,	

Table 8.2.11. Plaice in VIIe. Stock numbers-at-age.

Run title : "W.CHANNEL PLAICE 2009 WG

At 8/05/2009 13:23

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number-at-age (start of year) Numbers*10**-3

YEAR	1976	1977	1978
AGE			
1	3809	2016	3090
2	897	3355	1782
3	1597	695	2391
4	482	833	331
5	300	281	488
6	180	163	170
7	183	105	97
8	84	106	64
9	39	40	51
+gp	221	156	160
TOTAL	7793	7749	8623

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGE										
1	6993	6512	2660	5978	5450	6881	6674	13636	12002	8554
2	2698	6183	5758	2321	5235	4831	6030	5916	12085	10575
3	1353	1904	4785	4488	1801	3976	3418	4809	4405	9749
4	1260	543	1018	2497	2370	940	2190	1875	2283	2169
5	196	606	289	544	1150	987	405	1028	1058	987
6	305	108	360	167	296	536	525	245	569	421
7	105	200	43	236	81	184	334	276	154	321
8	59	60	121	23	139	41	96	177	145	89
9	32	31	35	67	10	88	17	67	99	94
+gp	187	304	200	296	466	125	206	146	126	234
TOTAL	13186	16450	15269	16617	16998	18587	19895	28175	32927	33192

Table 8.2.11. Plaice in VIIe. Stock numbers-at-age (continued).

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	3422,	3818,	4165,	4646,	2096,	2007,	6513,	4976,	8006,	4146,
2,	7575,	3026,	3332,	3655,	4036,	1825,	1701,	5770,	4399,	7094,
3,	7687,	6479,	2382,	2453,	2607,	2978,	1326,	1223,	4148,	3108,
4,	4849,	4444,	3039,	1152,	1084,	1129,	1433,	574,	563,	1799,
5,	1235,	2242,	1839,	1238,	449,	453,	432,	583,	258,	318,
6,	527,	514,	1125,	909,	578,	191,	229,	203,	263,	139,
7,	271,	258,	266,	639,	467,	295,	99,	109,	101,	149,
8,	213,	151,	122,	160,	377,	236,	176,	57,	55,	54,
9,	53,	114,	78,	76,	92,	200,	156,	97,	28,	34,
+gp,	181,	148,	135,	136,	219,	129,	183,	231,	236,	98,
TOTAL,	26013,	21194,	16483,	15066,	12005,	9443,	12247,	13823,	18056,	16938,

YEAR,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	2007,	2008,	2009,	GMST 76-06	AMST 76-06
AGE													
1,	2425,	3761,	4065,	5086,	3079,	4246,	3898,	2495,	6157,	1361,	0,	4489,	5068,
2,	3671,	2132,	3292,	3600,	4335,	2709,	3746,	3436,	2196,	5459,	1203,	3832,	4419,
3,	5804,	2648,	1569,	2498,	2306,	3020,	1971,	2577,	2118,	1582,	3991,	2802,	3295,
4,	1613,	3488,	1444,	825,	1234,	1186,	1467,	973,	1075,	926,	823,	1351,	1648,
5,	789,	780,	1881,	703,	411,	645,	546,	678,	446,	407,	420,	636,	768,
6,	175,	391,	420,	932,	343,	202,	275,	253,	296,	194,	164,	316,	378,
7,	73,	80,	211,	259,	459,	166,	93,	120,	124,	131,	92,	172,	207,
8,	88,	36,	43,	118,	146,	223,	87,	42,	56,	59,	63,	95,	116,
9,	34,	48,	21,	22,	70,	84,	116,	37,	16,	25,	22,	53,	65,
+gp,	92,	120,	65,	75,	63,	70,	96,	96,	84,	48,	26,		
TOTAL,	14762,	13484,	13012,	14118,	12444,	12551,	12294,	10707,	12568,	10191,	6805,		

Table 8.2.12. Plaice in VIIe. Summary.

```
Run title : "W.CHANNEL PLAICE 2009 WG

 At  8/05/2009  13:23

     Table 16    Summary     (without SOP correction)

                Terminal Fs derived using XSA (With F shrinkage)
```

	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 7,
1976,	3809,	2102,	1270,	640,	.5038,	.4569,
1977,	2016,	2303,	1332,	702,	.5272,	.4385,
1978,	3090,	2498,	1433,	784,	.5473,	.4040,
1979,	6993,	3123,	1579,	977,	.6189,	.5246,
1980,	6512,	4083,	1959,	1079,	.5507,	.5188,
1981,	2660,	4972,	2645,	1501,	.5675,	.4544,
1982,	5978,	4616,	2772,	1688,	.6090,	.5341,
1983,	5450,	4945,	2995,	1495,	.4991,	.5712,
1984,	6881,	4955,	2702,	1547,	.5726,	.5181,
1985,	6674,	5358,	2943,	1441,	.4897,	.5082,
1986,	13636,	5938,	2984,	1810,	.6065,	.4830,
1987,	12002,	5573,	2865,	1958,	.6834,	.5972,
1988,	8554,	7765,	4044,	24 8,	.6078,	.4271,
1989,	3422,	7126,	4301,	2358,	.5482,	.5792,
1990,	3818,	6836,	4199,	2593,	.6176,	.6271,
1991,	4165,	5227,	3409,	1848,	.5421,	.5598,
1992,	4646,	5120,	2867,	1624,	.5665,	.6233,
1993,	2096,	3955,	2407,	1417,	.5887,	.6639,
1994,	2007,	3186,	1964,	1156,	.5887,	.5890,
1995,	6513,	3602,	1731,	1031,	.5955,	.6377,
1996,	4976,	3605,	1713,	1044,	.6096,	.6307,
1997,	8006,	4760,	1896,	1323,	.6977,	.5247,
1998,	4146,	4343,	1986,	1131,	.5694,	.5296,
1999,	2425,	3637,	2170,	1299,	.5985,	.5665,
2000,	3761,	3589,	2457,	1281,	.5213,	.4932,
2001,	4065,	3501,	2158,	1106,	.5124,	.5059,
2002,	5086,	3913,	1984,	1257,	.6336,	.5608,
2003,	3079,	3513,	2102,	1277,	.6075,	.5738,
2004,	4246,	4051,	1904,	1212,	.6366,	.6348,
2005,	3898,	3799,	1863,	1203,	.6457,	.6540,
2006,	2495,	3259,	1732,	1313,	.7582,	.6730,
2007,	6157,	3119,	1418,	1003,	.7072,	.7190,
2008,	1361,	3074,	1500,	974,	.6492,	.6445,
Arith. Mean ,	4989,	4286,	2342,	1380,	.5933,	.5584,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Figure 8.2.1 VIIe plaice: UK(E&W) commercial fleet LPUE and effort; and survey CPUE

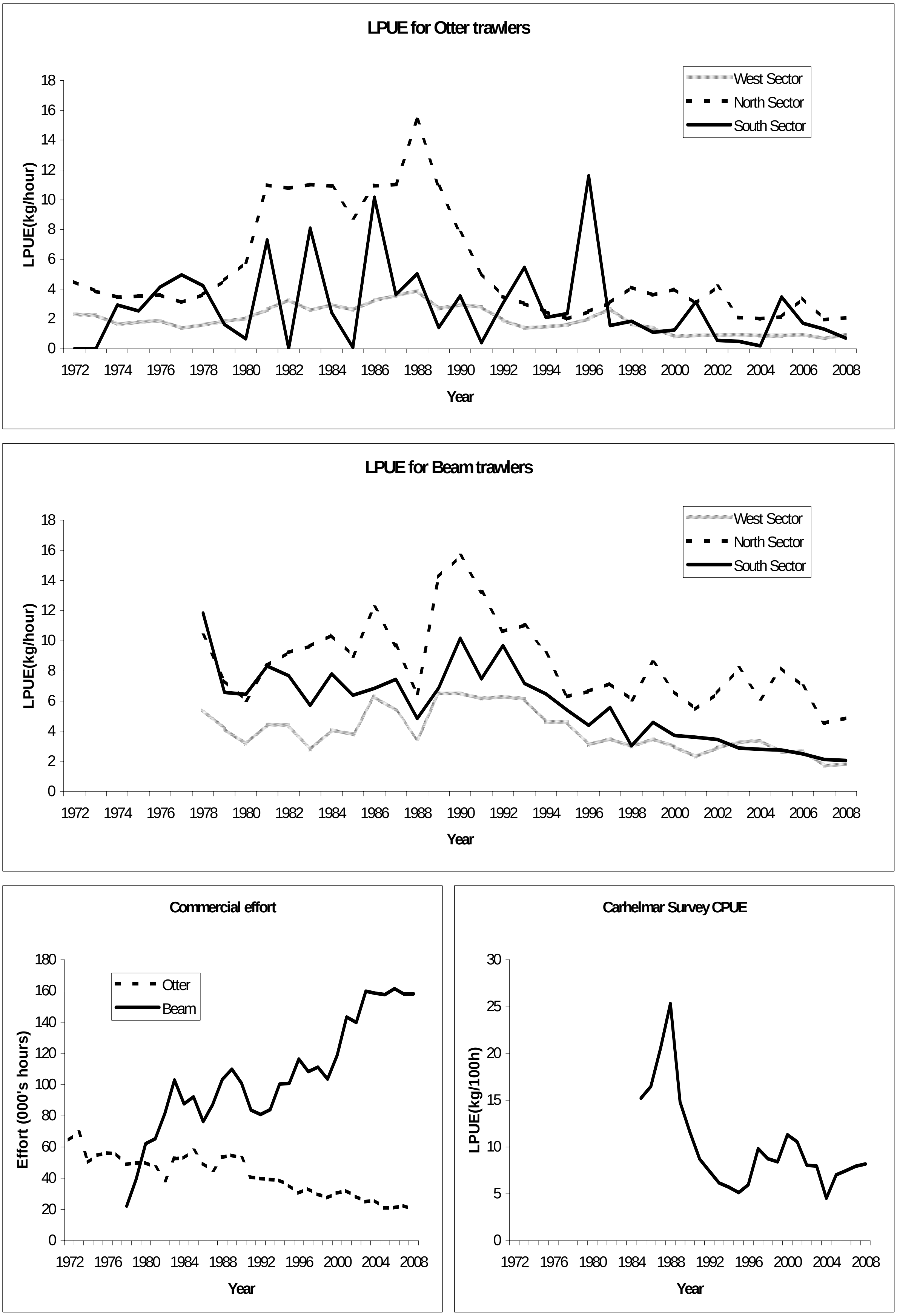


Figure 8.2.2 Plaice VIIe Discards by Quarter and fleet (2008)

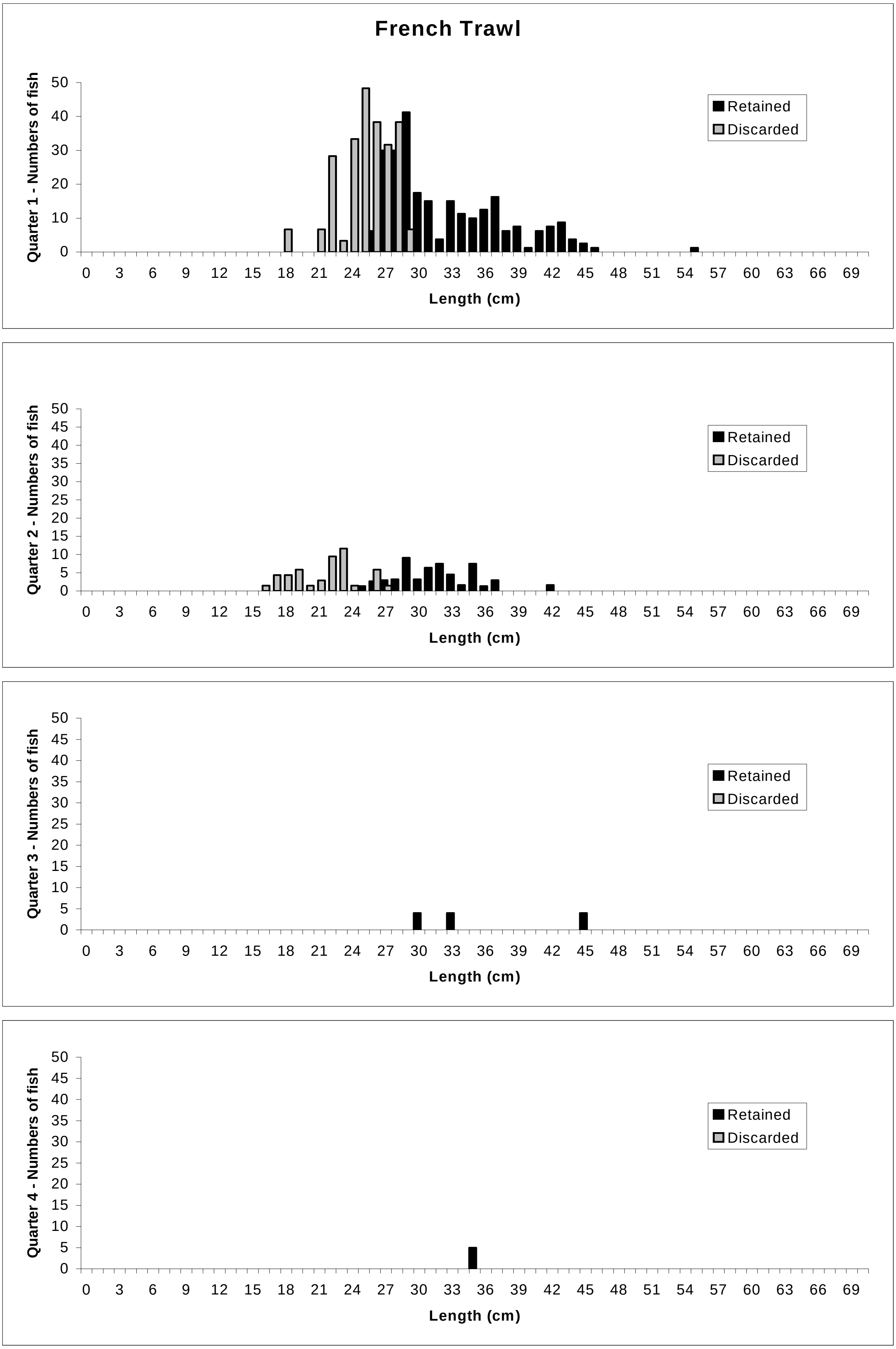


Figure 8.2.2 (cont.) Plaice VIIe Discards by Quarter and fleet (2008)

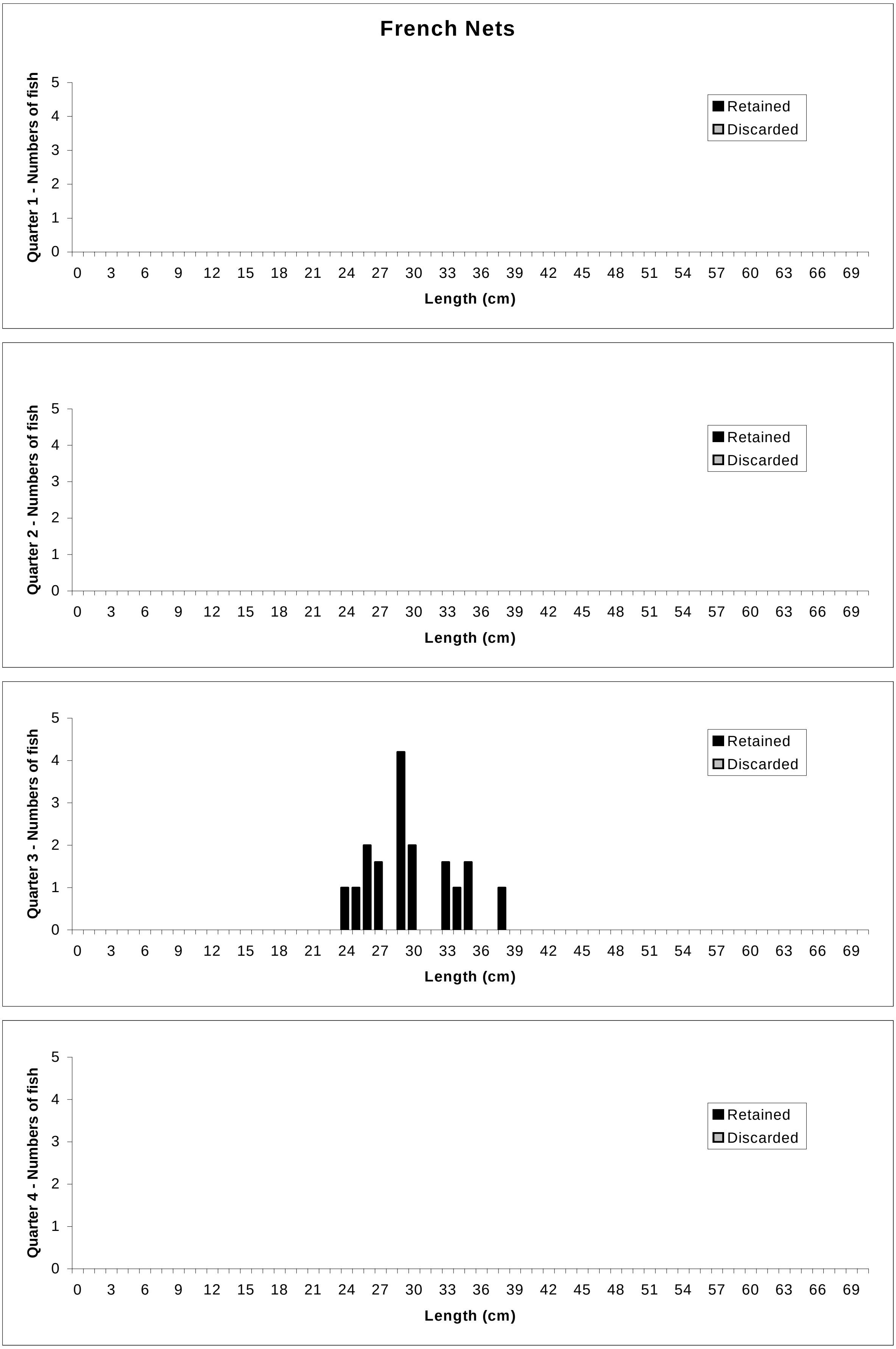
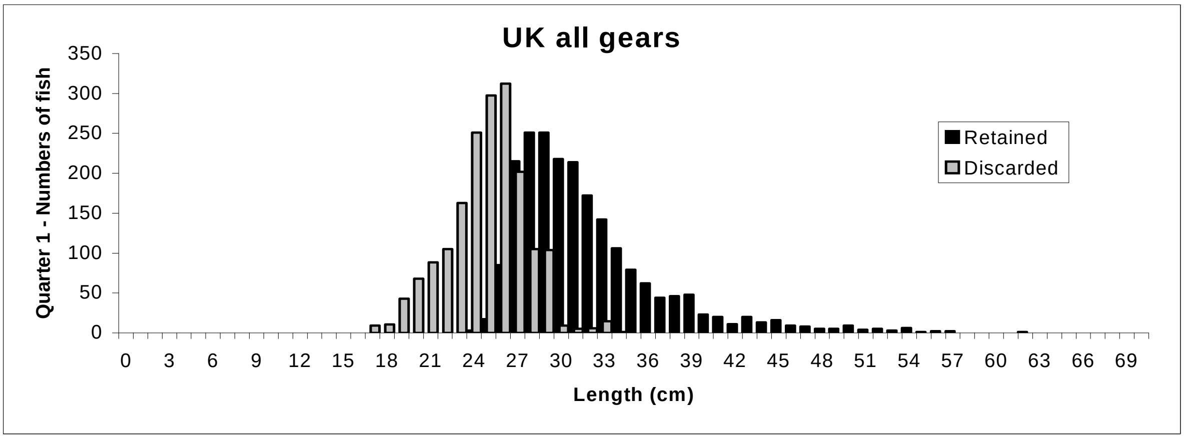
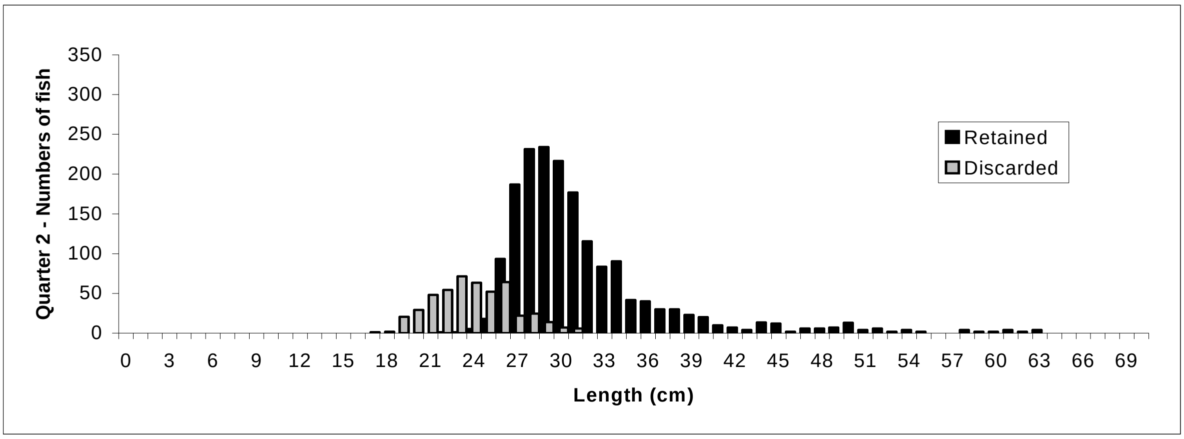
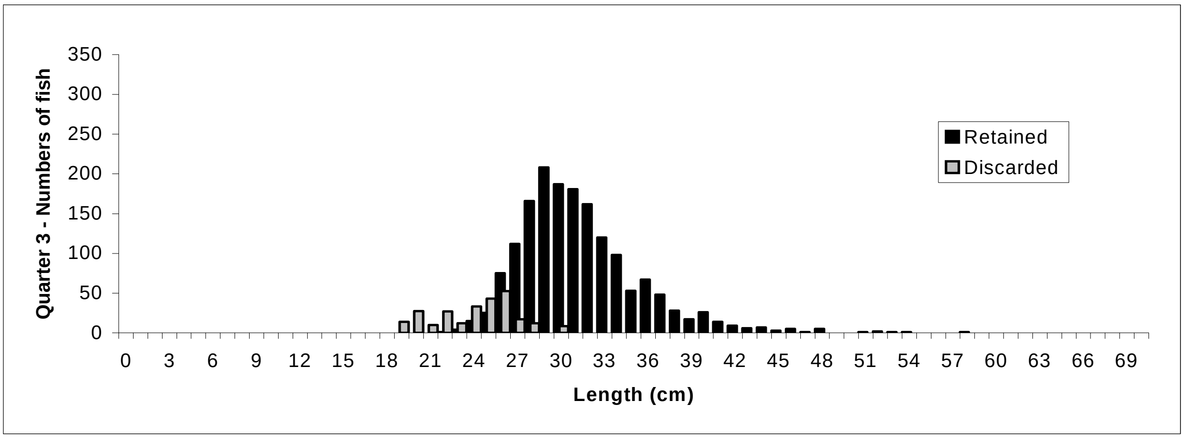


Figure 8.2.2 (cont.) Plaice VIIe Discards by Quarter and fleet (2008)







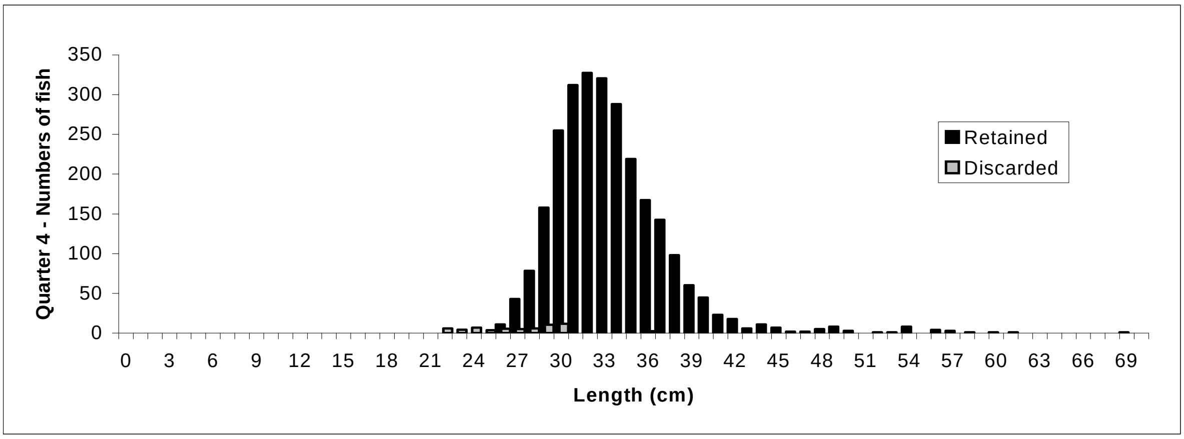


Figure 8.2.3 Plaice in Division VIIe - Length distributions of UK(E+W) landings (1999-2008)

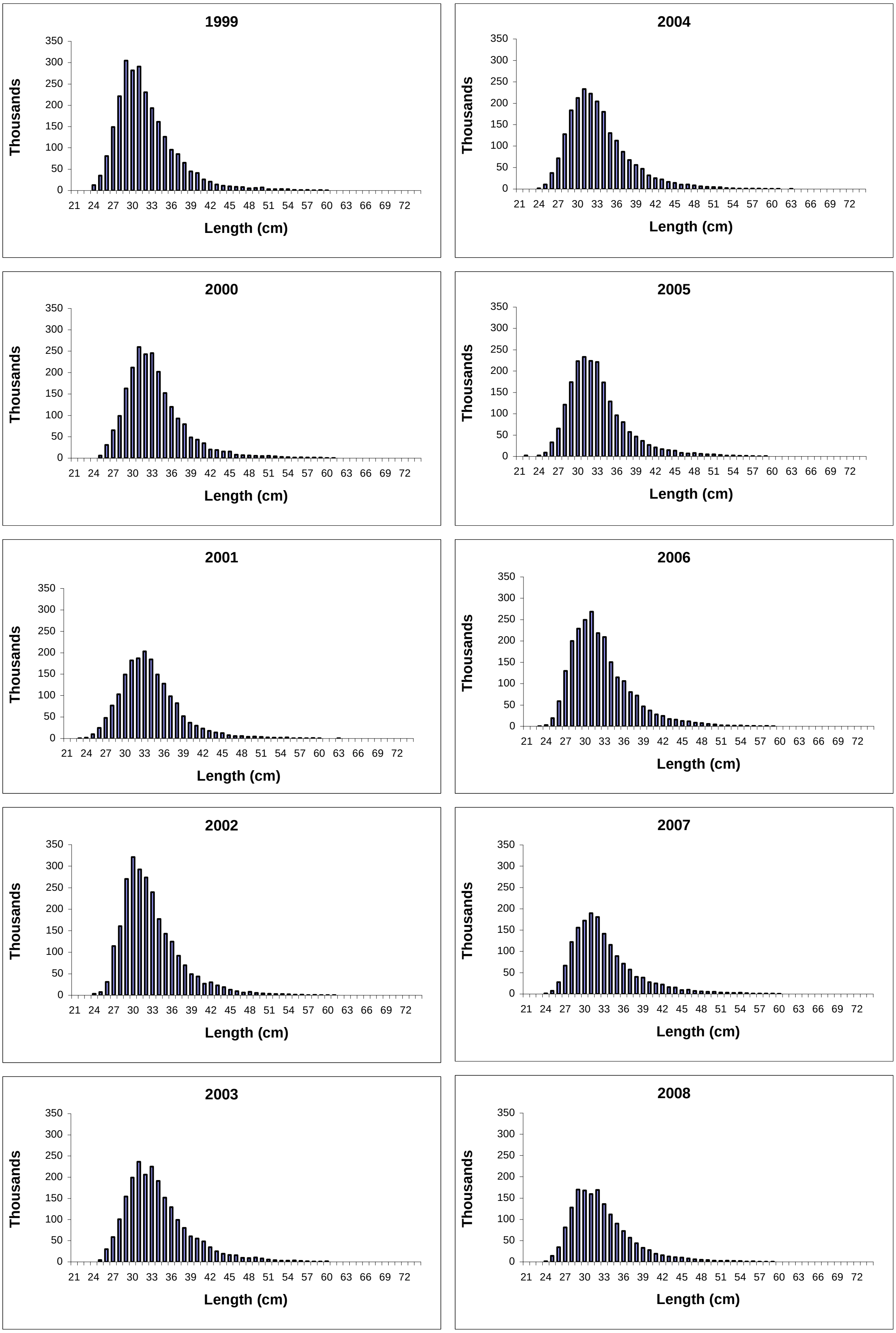


Figure 8.2.4 Plaice in Division VIIe : International age compositions (1999-2008)

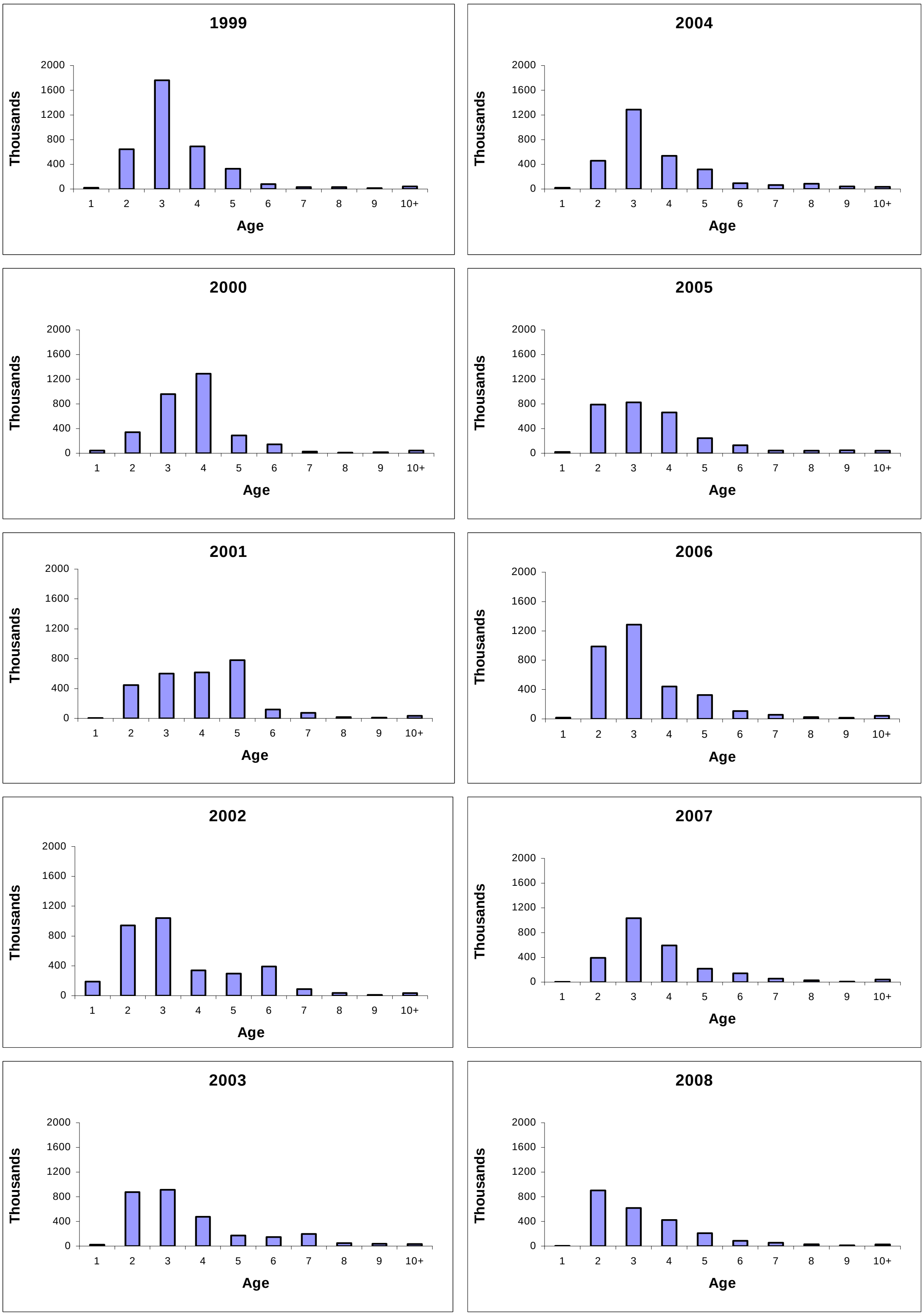


Figure 8.2.5 VIIe Plaice fleet log catchability residuals from the final run

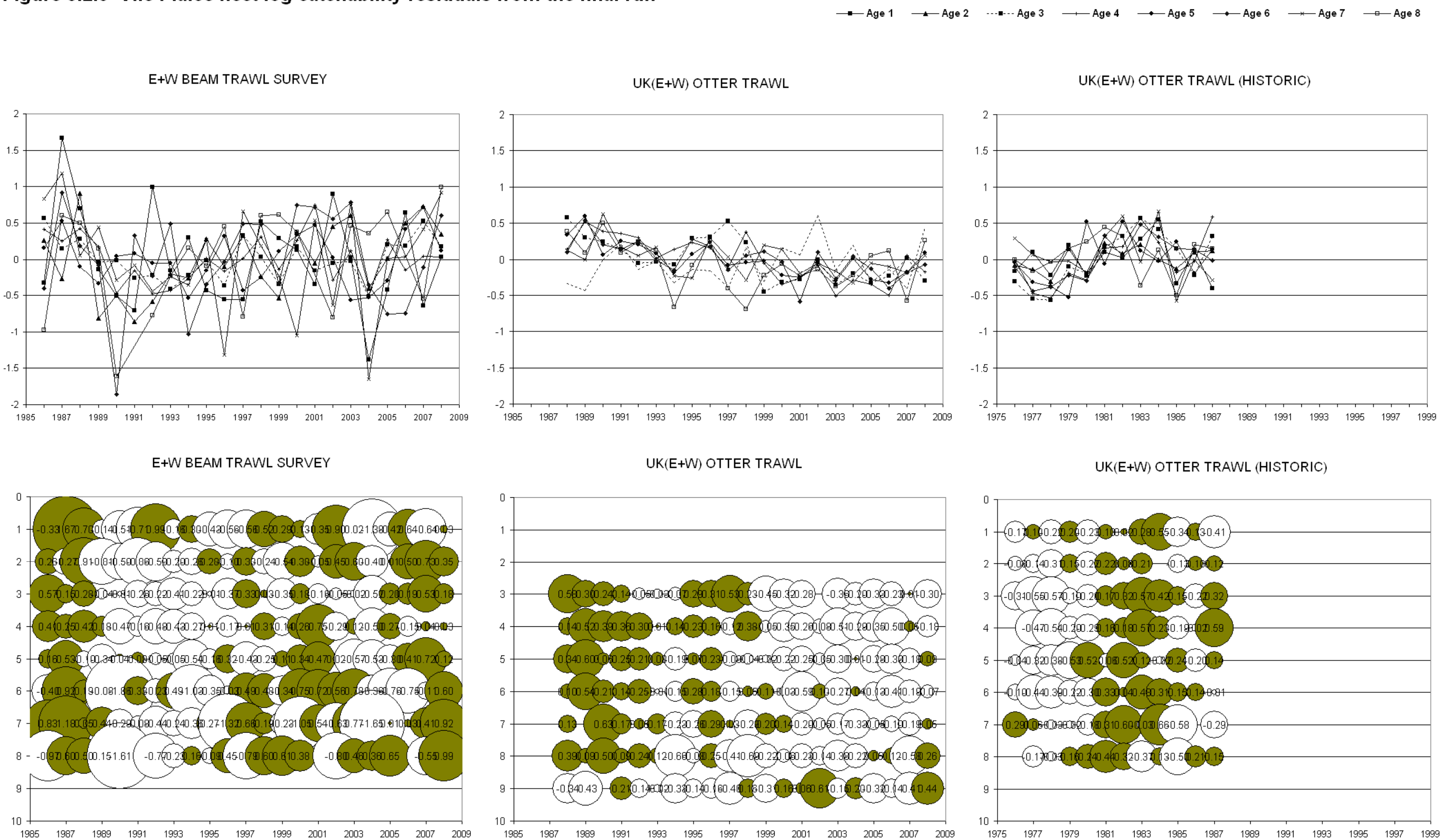
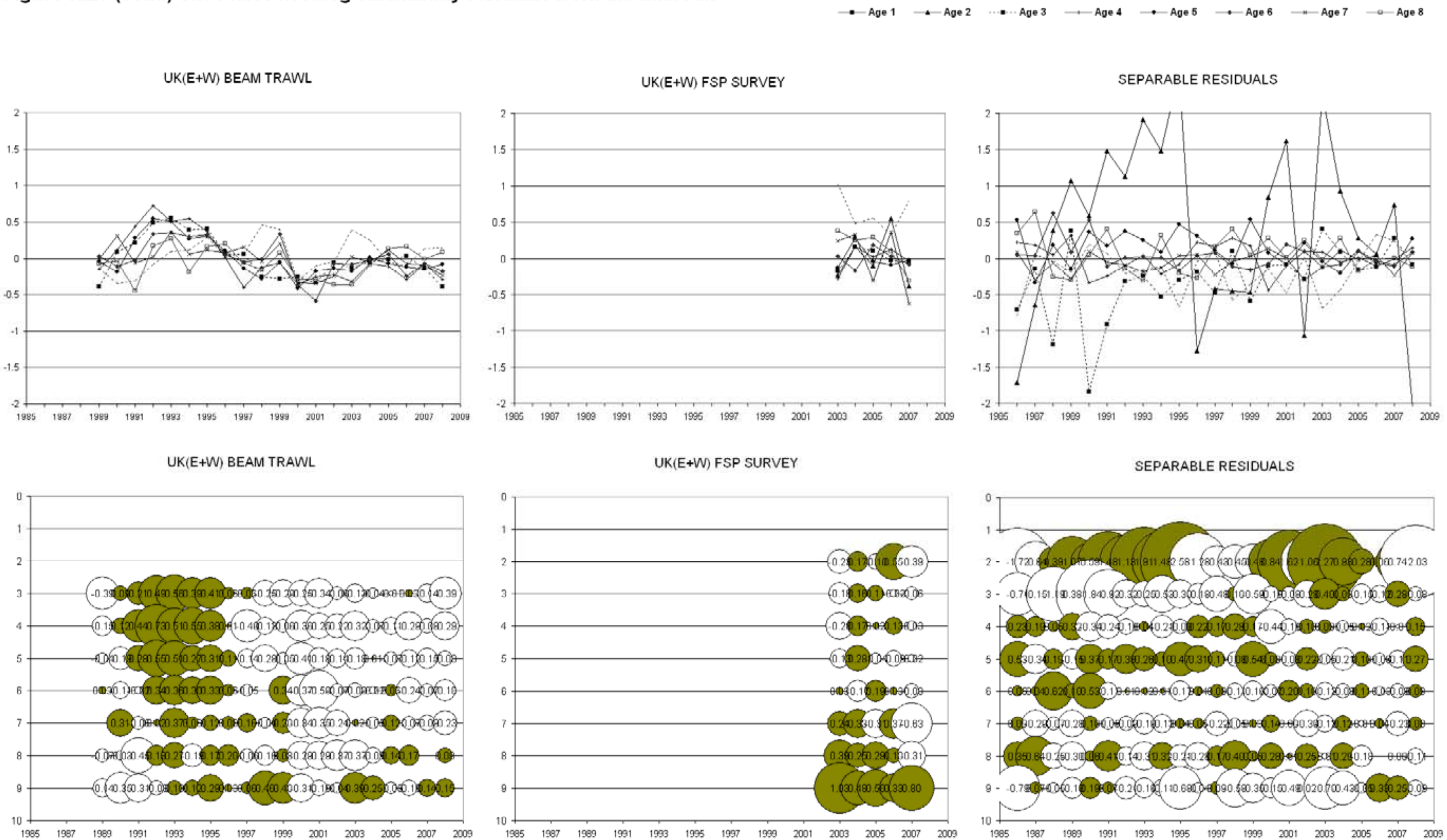
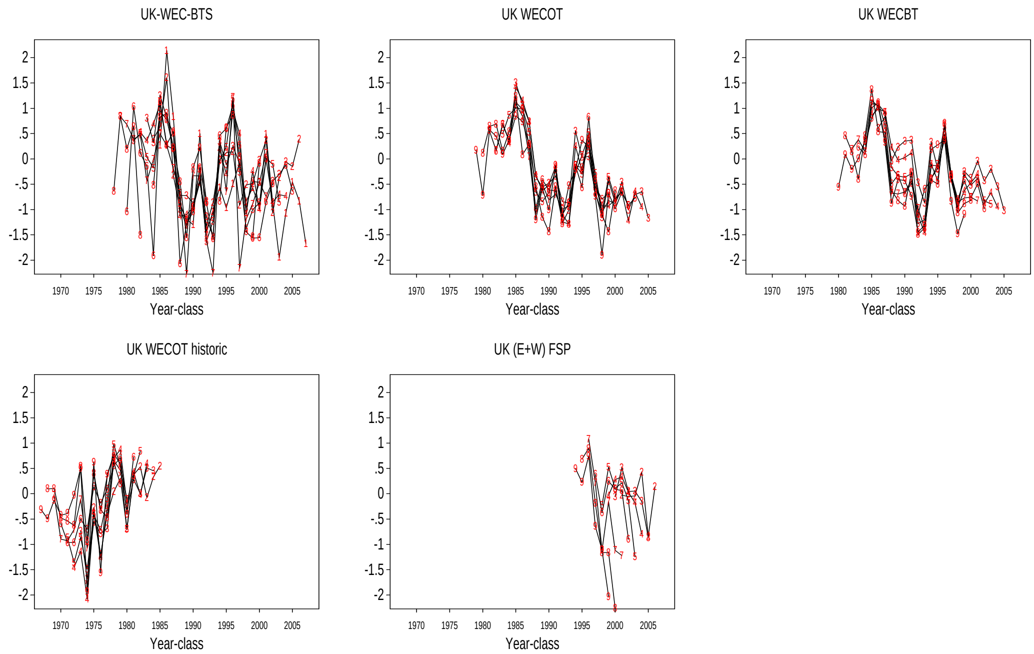


Figure 8.2.5 (cont.) VIIe Plaice fleet log catchability residuals from the final run



Tuning fleets by year-class



Tuning fleets by year

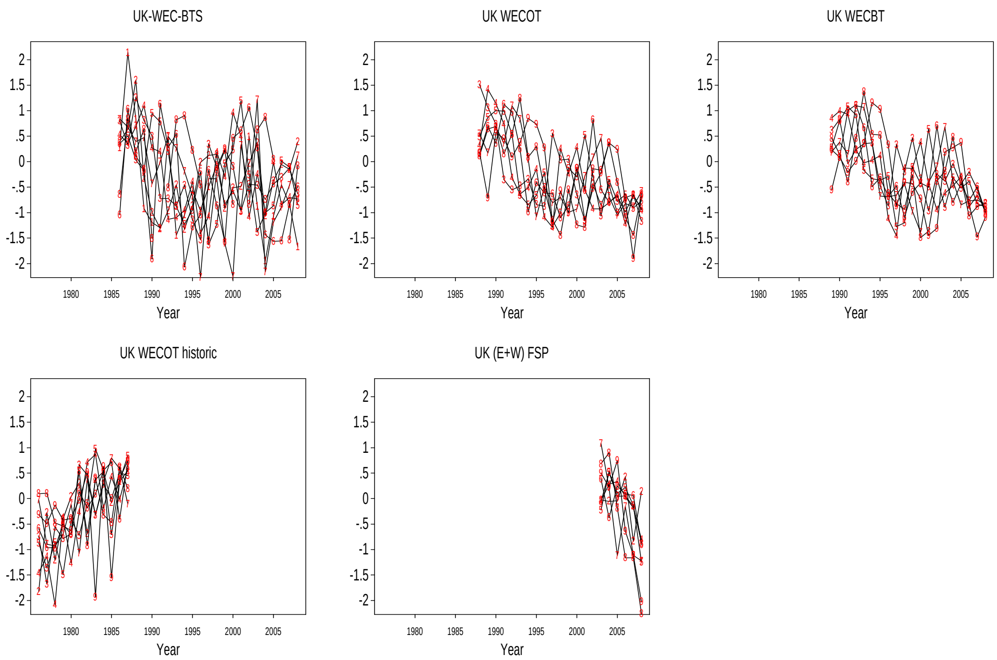
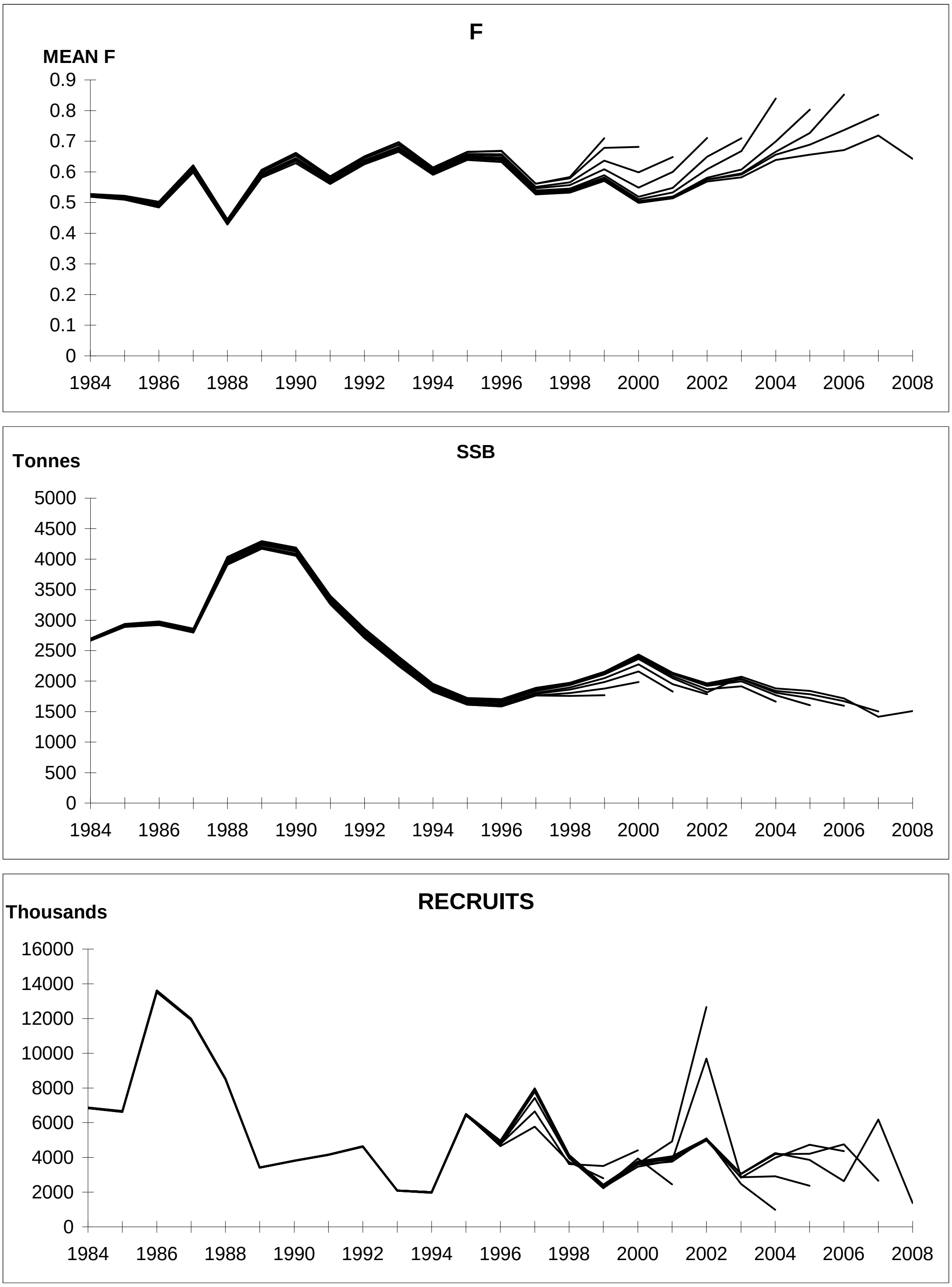


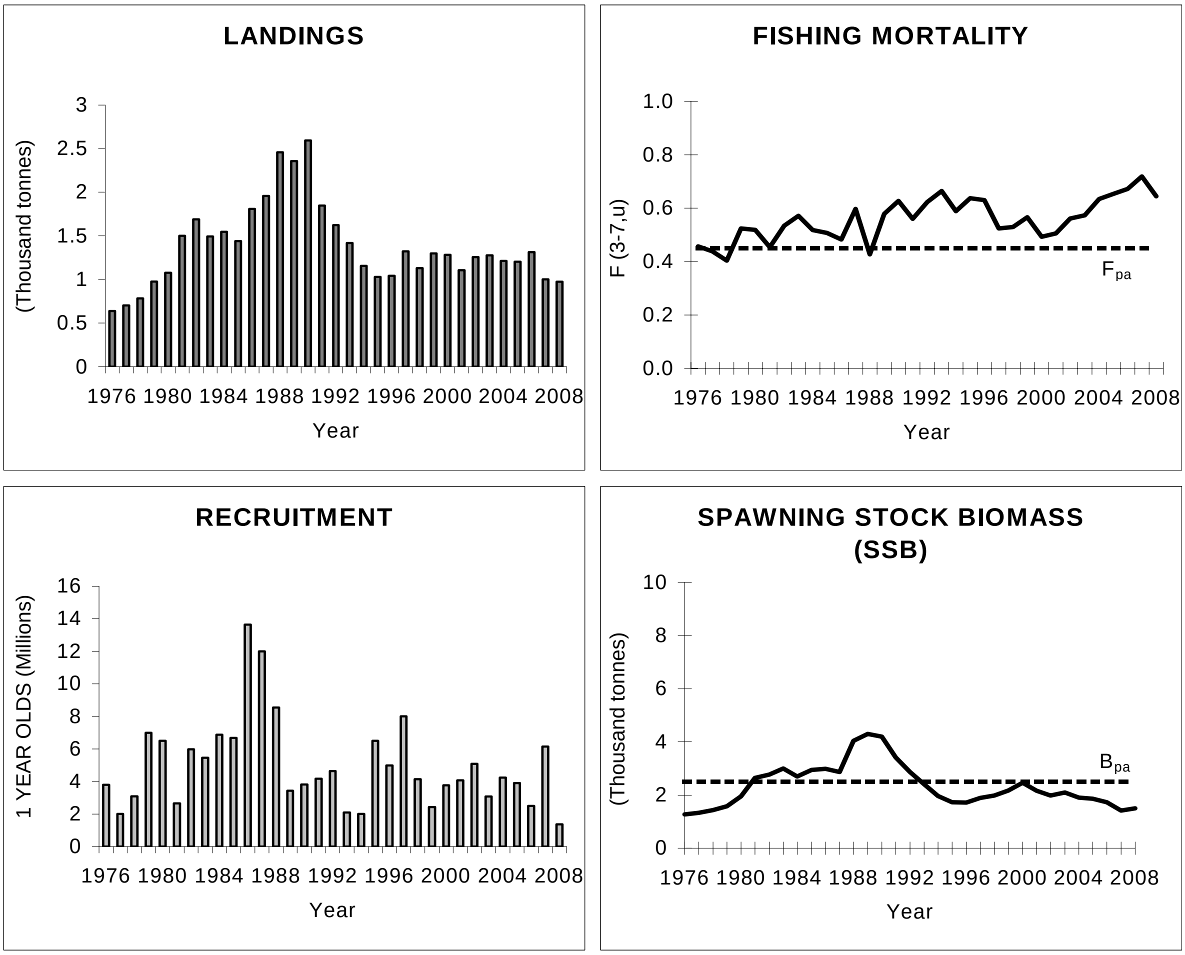
Figure 8.2.6. VIIe Plaice. Surba results.

Figure 8.2.7 **VIIe Plaice: Retrospective XSA results***
(Shrinkage SE=2.5)



* Note the retrospective analysis was run without the short FSP survey

Figure 8.2.8 **Plaice in Division VIIe (Western English Channel)**



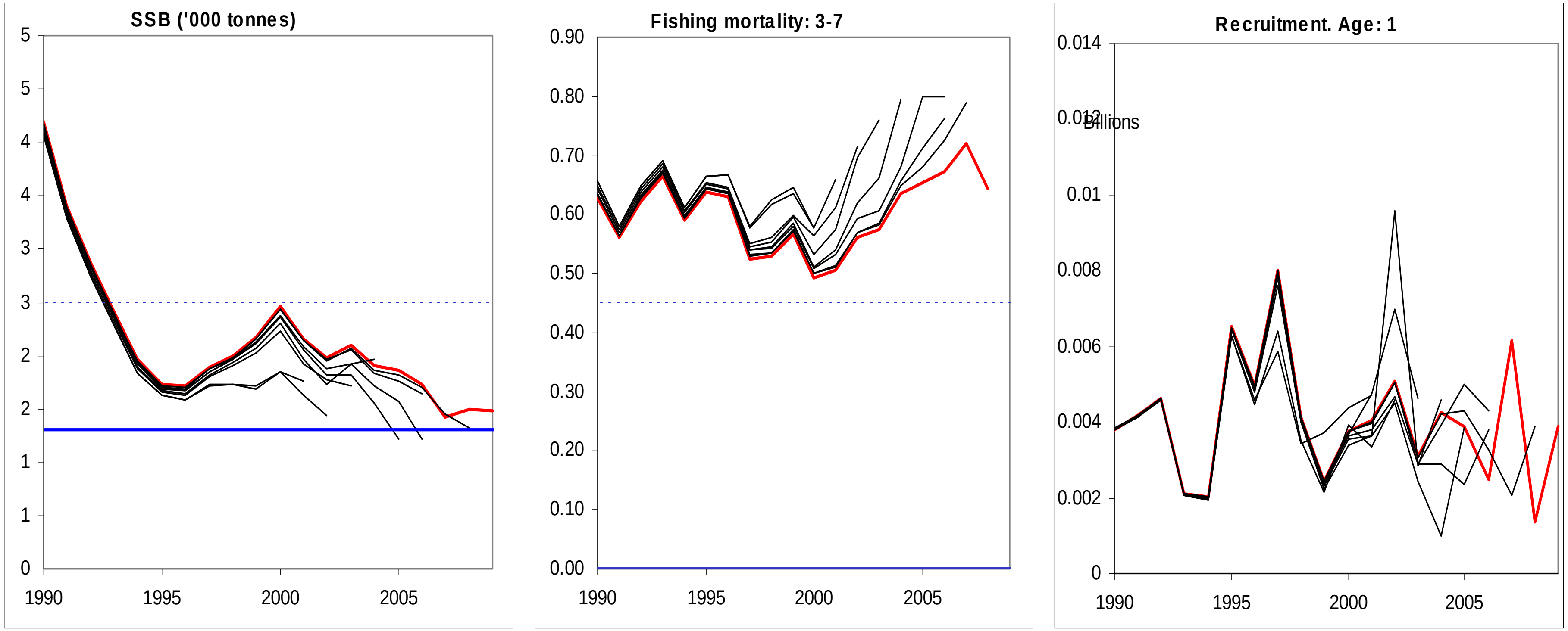


Figure 8.2.9. ICES Quality Control Plots for plaice VIIe.

8.3 Sole in Division VIIe

Type of assessment in 2009

Update data files, no full assessment.

This stock was placed on the observational list in 2004 and has been subject to a full assessment in subsequent years. A management plan for this stock was agreed in May 2007 (Council Regulation (EC) No 509/2007). In 2009 WKFLAT benchmarked this assessment, but failed to develop an update procedure, because it was not possible to address or even elucidate the cause of the substantial and persistent retrospective bias in F and SSB. Consequently the WG only updated data tables, performed an assessment according to previous update setting and commented on useful indicators of stock trends.

ICES advice applicable to 2008

Council Regulation (EC) No. 509/2007 establishes a multi-annual plan for the sustainable exploitation of VIIe sole. Years 2007–2009 are deemed a recovery plan, with subsequent years being deemed a management plan. For 2008 the TAC is required to be at a value that will result in a 20% reduction in F compared with F_{bar} (03–05). If this value exceeds a 15% change in TAC, a 15% change in TAC shall be implemented. The agreed target fishing mortality is 0.27.

ICES has not evaluated the multi-annual plan.

ICES advice applicable to 2009

Exploitation boundaries in relation to existing management plans

The multi-annual plan implies a 20% reduction in F compared with average F(03–05), corresponding to landings of 650 t.

This is a 15% reduction in the TAC compared with 2008.

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

Fishing mortality around F = 0.27 can be considered as a candidate target reference point consistent with taking high long-term yields and achieving a low risk (< 5%) of depleting the productive potential. The present fishing mortality (0.42) is above the candidate reference point.

Exploitation boundaries in relation to precautionary limits

Rebuilding the stock above B_{pa} in just one year would require that fishing mortality is reduced by 70%. This would correspond to landings of around 320 tonnes in 2009.

Conclusion on exploitation boundaries

Considering that the management plan has not been evaluated by ICES, ICES advises on the basis of precautionary limits. This corresponds to a TAC of less than 320 t in 2009.

Technical consideration

Sampling intensity for both age and length are considered to be adequate for this stock. Only little discarding occurs and it is anticipated to include discard to the assessment. There is currently very low level of mis- and underreporting. One survey index used in the assessment provides good stability in the assessment and internally consistent year-class tracking being in agreement with commercial tuning fleets.

Technical comments

- there is a general lack of units indication [g, kg, thousands, etc] in the headings;
- of tables (e.g. Table 3.1.6 Sole VIIE Stock Weights-at-Age; Table 3.1.11;
- Sole VIIE Summary Table neither age-of-recruitment and F_{bar} ages are indicated nor units of TSB, SSB and Landings);
- at the bottom of Table 3.1.10 and Table 3.1.11 XSA is wrongly typed as"XAS";
- there is no reference what shaded boxes in Table 3.1.14 Sole VIIE Management Options Output indicate in Table 3.1.15 Sole VIIE it is not known if year-classes contribution to landings is by weight or by numbers.

Improvements for next year

Include units' indication in tables of next year's report

> Units have been included where requested and spelling of XSA corrected. This year there is no short-term forecast so other comments do not apply to this year's assessments.

consider for the benchmark whether XSA is a suitable assessment model consider the strong trend in F in recent years and the strong retrospective bias in the assessment.

> The WG does not consider there to be a strong trend in F in recent years, this is purely an artifact of the retrospective pattern overestimating F in the recent years. Using less shrinkage or an assessment method that does not rely on some form of F stabilization is likely to worsen not improve the situation.
>
> The WG agrees that XSA is not the perfect method for analysing this stock for reasons other than those described by the technical review group. However the WG feels the problem is in the basic data and the assumptions that it makes about closed populations and complete mixing. Merely trying alternative methods of assessment without specifically addressing these fundamental problems or at least understanding them will merely lead to describing the uncertainty, but not to reductions of bias.

Things that need update before ADG

> None.

Conclusions

> RG agrees with WG on stock.

8.3.1 General

Stock description and management units

A TAC is in place for ICES area VIIe.

Official national landings data as reported to ICES and the landings estimates as used by the Working Group are given in Table 8.3.1.

Official landings in 2008 were 674 t, a 4% overshoot of the TAC (650 t), although taking account of area misreporting the WG used a value of 904 t, representing a 39% overshoot of the TAC. WG landings estimates have been corrected for area misreporting to ICES Division VIId as this occurs in two rectangles in VIId where there are virtually no true landings of sole because of an absence of the species in the area. In general landings have been stable at around 1000 t over the last five years, with the UK taking about 65% of the TAC and France reporting the majority of the remainder.

Management applicable to 2008 and 2009

2009

Species: Common sole *Solea solea*		**Zone:** VIIe (SOL/07E.)
Belgium	23	
France	245	
United Kingdom	382	
EC	650	
TAC	650	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

In addition, Annex IIc, restricts the number of days at sea to 192 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional 12 days for the UK beam trawl fleet because of a reduction in capacity of the fleet.

2008

Species: Common sole *Solea solea*		**Zone:** VIIe SOL/07E.
Belgium	27	
France	288	
United Kingdom	450	
EC	765	
TAC	765	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

In addition, Annex IIc, restricts the number of days at sea to 192 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional 12 days for the UK beam trawl fleet as a result of a reduction in capacity of the fleet.

8.3.2 Data

Landings

Total international catch numbers-at-age (Table 8.3.2, Figure 8.3.1), catch weights and stock weights, -at-age (Table 8.3.3, 8.3.4, Figure 8.3.2) as used in the assessment were derived by the procedure described in the Annex. The differences in the length distributions between the different fleets are displayed in Table 8.3.5.

The UK and France reported landings revisions this year for 2000 (-104 t France), 2006 (-7 t France), 2007 (+0.4 t UK; -1.9 t Guernsey; +34 t France).

Weights-at-age were calculated as in previous years for ages 1–14, but the 15+ group was not included in the within year smoothing, instead the observed weights were used, in accordance with changes with requested by WKFLAT 2009. This new procedure was also applied to years in which there were substantial data revisions (2000, 2006 and 2007), but time did not permit revisions of all years, which is planned for next year's WG.

Discards

Discard data suggests that discarding in 2008 is again minor in this stock (Figure 8.3.3 a–c) for both the UK and French fleets. Discarding is largely restricted to fish under the minimum landing size. Discarding as a result of quota restrictions is rare. For a summary of historical UK discard information see the stock annex.

Biological

Natural mortality and maturity were used as in previous assessments and described in the stock annex.

Survey indices

The abundance for the UK-BTS survey carried out on the chartered beam trawler *FV Carhelmar* is given in Table 8.3.6. and shown in Figures 8.3.4 and 8.3.5, plotted by cohort and by years. The figures show few clear year effects and good year-class tracking for the survey at all ages until about the mid 1990s. Since then, the estimate of year-class strength at-age 1 and at-ages greater than 7 has deteriorated slightly. This may partly be associated with the change of vessel that occurred in 2002 and 2004 (*RV Corystes* used), but it seems likely this is not the only cause and weather may play a part in the catchability. The cpue has substantially increased from the low point of the time-series observed in 2005 to values midrange of those observed since 1989 (Figure 8.3.6). One notable difference between the commercial and survey tuning-series that has been noted this year is the estimate of the strength of the 1998 year class. This is well represented in the commercial data, but much less clearly so in the survey data. This YC was also seen to be very strong in the VIIf&g stock and may represent some overspill of recruitment from that stock in the adjacent western part of VIIe, not covered by the survey.

The UK fisheries science partnership (FSP) again conducted a survey, now in its 7th year, of sole and plaice abundance in the western channel (WD 7). The results indicate that sole continue to be wide spread in the area and that a large number of cohorts contribute to the stock.

Commercial fleets effort and lpue

Derivations of effort and lpue by subarea give an indication of the distribution of stock and fishery throughout the time-series of tuning information (Table 8.3.7, Figure 8.3.6). The areas used are described in the stock annex.

Effort for >24 m beam trawlers has been increasing since 1999 but appears to have peaked in 2006, and is now declining because of a combination of the UK decommissioning scheme and the substantial increases in fuel costs, making these larger boats commercially unviable. The decline of the larger boats has resulted in a resurgence of the use of vessels of less than 24 m (Figure 8.3.6). Given the licence transfer rules currently in force in the UK restructuring of the fleets will lead to a 10% decrease in the kW day capacity of replaced vessels not withstanding any latent capacity not currently used. Otter trawl effort (UK-COT) has been in continual decline since the early

1970s and is currently at a time-series low, at values roughly a third of those seen in the 1970s (Table 8.3.7).

Lpue for the beam trawl fleets has been split into areas (North West and South, see stock annex; not yet) as well as into over 24 m and under 24 m boats in order to observe changes in the distribution of the fishery and the fish. The larger lpue values observed in all beam trawlers for the northern area (primarily Lyme Bay) between 1995 and 2005 appears to have subsided now, having declined in the north and increased in the other two areas. Lpue appears to have been mostly stable since 2005, with all areas producing 2–3 kg/h of sole for the larger beamers and around 4 kg/h for the smaller beamer. In recent years the UK industry has contested the low cpue in part because of the redirection of effort to cuttlefish and other species such as squid and anglerfish. However sole, although not specifically targeted during the cuttlefish season or when targeting anglerfish, do comprise a substantial portion of the value of the catch during the cuttlefish fishery so that the WG felt justified in using the effort and tuning information (lpue has been corrected for area misreporting as described in the landings statistics).

Commercial abundance indices used in the assessment are the commercial beam trawl fleet (UK-CBT) and the otter trawl fleet (UK-COT) are given in Table 8.3.6, and plotted log converted by cohort and year in Figure 8.3.4 and 8.3.5 (historical fleets retained for assessment stability). The UK-CBT demonstrates very good year-class tracking indicated by the consistent estimation of strong and weak year classes at different ages, and demonstrates a decline in the abundance-at-age from 1975 to 1990, after which levels stabilize. There is little indication of year effects in this time-series. The UK-COT fleet also demonstrates good year-class tracking over the middle of the time period and also gives some indication of a decline in lpue in the early 1980s although this is much less clear than in the beam trawl fleet. This is likely in part caused by the strong year effect seen for this fleet in 1991 and to a lesser degree in 2004. The causes of this are not clear from anecdotal evidence, but sampling for the fleet is now at relatively low levels, as a consequence of the small size of the fleet.

See also the stock annex for historical trends.

Information from the fishing industry (for the overview)

The UK fishing industry at WKFLAT 2009 (Jim Portus representing the NWRAC at the meeting) indicated fishing for sole in 2008 had been very good. He also suggested that the beam trawl fleet was increasing mesh sizes to comply with recommendations by the Marine Stewardship Council (MSC) and discarding practices since the introduction of single area licensing by the UK authorities in VIIe to avoid over quota landings. These changes are likely to take effect mainly from 2009 onwards so the situation will require monitoring and redressing in future assessments if necessary.

The Cornish Fish Producers Organisation produced a useful report (WD 9) summarizing the fisheries activities and changes therein by métier, also making some comments regarding VIIe sole mainly in relation to the new enforcement measures and regulations in relation to the management plan for sole VIIe. The CFPO has little quota for this stock and only four boats that would exploit this stock as a target species in the absence of the management plan regulations.

8.3.3 Stock assessment

Model used: experimental XSA assessment

Software used: FLR - FLXSA

Model Options chosen: as in previous years

Input data types and characteristics: catch numbers-at-age without discards, 5 tuning fleets, 1 survey, 2 current commercial cpue series, 2 historical cpue series.

Data screening

Data screening of the catch-at-age, weights, tuning information and ancillary qualitative information was carried out by the procedures set out in the annex.

Single fleet XSA's for the current tuning fleets (see Annex for procedures) were run. Residuals for all single fleet runs were generally small, particularly for the UK-CBT fleet, these were small and indicated no major trends. This consistency with the catch data is to be expected, because the catch-at-age composition is largely derived from the landings of this fleet. A consistent negative year-effect was observed for the otter trawl fleet in 1992 and 2003–2004, with a positive year-effect in 2005 as already seen in the log lpue plots. The cause of this remains unclear, but the residuals, although consistent, were small enough not to warrant removal from the tuning-series particularly as it did not indicate any long-term trends across the time-series. The UK-BTS, although generally noisier than the other tuning fleets, indicated no major trends in the residuals for older ages.

Summary plots of the single fleet runs are shown in Figure 8.3.7 indicate F, SSB and recruitment estimates are consistent between the fleets, although the final estimates vary slightly, with UK-CBT giving the highest F values, followed by the UK-BTS and the UK-COT fleets with the reverse being true of the SSB estimates.

Final update assessment

As a consequence of the lack of a suitable assessment methodology to assess the stock, no final assessment could be presented. An experimental run using the previous assessment settings was run to confirm the findings of WKFLAT 2009 with an additional year's worth of data.

Figures 8.3.8–8.3.10 show the residual plots, the comparison with last year and the retrospective plots for the experimental assessment.

State of the stock

As a consequence of a lack of an assessment it is not possible to determine the status of the stock in absolute terms. However, certain indicators for this stock demonstrate that stock levels are lower than in the past, but stable.

The age structure of this stock is more robust than other sole stocks in European waters, with the plus group (at-age 12) being larger and containing fish to age 38 in recent years.

Although recent estimates of F are too uncertain to use in forecast the range of F seems to have been relatively stable over a period of at least 20 years coincidental with a decline in SSB, which now seems to be approaching new equilibrium conditions.

Recruitment appears to have varied periodically over the period, with a general decrease observed, but the main difference is the reduction in recruitment variability so that from 1989 we have not seen the very large or very small year classes observed in the past.

8.3.4 Short-term projections

No short-term forecast was performed as a result of a lack of an assessment.

8.3.5 Biological reference points

Biological reference points were rejected by WKFLAT 2009 as a consequence of a lack of an appropriate assessment to evaluate their suitability.

8.3.6 Medium-term projections

No medium-term forecast was performed as a consequence of a lack of an assessment.

8.3.7 Management plan

The commission implemented a management plan for the recovery of the stock early in 2007 (Council Regulation (EC) No 509/2007). ICES evaluates the management plan as follows:

The long-term management target (F=0.27) is precautionary in the sense that it ensures that there is a less than 5% chance of SSB declining below previously observed levels, as well as maintaining yield within 10% of MSY (WG 2005, WG 2006).

The methodology of reaching the long-term target in 3-year stepped reductions in F is also acceptable. However, the size of further steps is based on observed fishing mortalities within the period of the management plan. This can only have the desired effect if management measures (TAC) are effective and if estimates of recent levels of F from the assessment are accurate. Neither is the case so that recovery of SSB is likely to be slower and consequently the risk of SSB dropping below previously observed values is higher than the stated 5% risk.

The Commission's management plan adopted to reduce fishing mortality and increase SSB in this stock cannot be evaluated or implemented in the absence a full analytical assessment or biological reference points.

8.3.8 Uncertainties in assessment and forecast

No assessment was accepted for this stock, preliminary evaluation of the data indicated that the following data uncertainties will have to be addressed by future assessment developments.

Sampling

Age and length sampling for this stock is adequate. Age data from the largest two sectors prosecuting this fishery (UK and France, together about 95% of landings) are included in the assessment. The use of commercial tuning data is unavoidable, as there is little information available for older ages from the survey.

Discarding

There is currently little discarding of this stock. It is not anticipated to include discard information in the assessment unless discarding practices change. There is some indication of a change in discard practice in the UK fleet because of the introduction of a single area licensing scheme. If this is found to be significant, it should be possible to include this in the assessment in subsequent years, as it would not require a time-series of discards unlike most other stocks currently assessed without discards.

Surveys

Currently only one survey index is used in the assessment (UK-BTS) which could provide good stability to the assessment in general. Year-class tracking is internally consistent and agrees well with information from commercial tuning fleets. However, in the recent past there is some question regarding the consistency of the tuning-series because of a vessel effect in 2002 and 2004. In addition in recent years it has become apparent that there are some differences in the year-class consistency between the commercial and survey tuning information. Specifically, the 1998 year class known to have been very strong in VII f&g is not represented in the survey that operates solely in the eastern part of the area. This suggests that there may be both an open population as well as an incomplete mixing problem in the data contributing to the inconsistency of the assessment.

Consistency

There is currently no accepted assessment methodology for this stock.

Misreporting

Area misreporting, mainly to area VIId had declined to low levels in recent years, through a combination of enforcement and a substantial increase in the TAC in 2005. There have also been some attempts to prosecute UK fishers for misreporting to area VIIh, although to date none of those prosecutions have been successful for lack of legally acceptable evidence.

Levels of underreporting are thought to have been serious in the early 1980s prior to the shift to area misreporting. Although it is clear that levels of underreporting are also much lower now, no quantitative information is available on the size of the problem.

8.3.9 Recommendation for the next Benchmark

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
2009	VIIe Sole	WKFLAT 2009 could not recommend an appropriate assessment procedure for this stock for the following reasons Closed population and complete mixing assumptions of the assessment are violated. Tuning data indicate differences in trends in F and recruitment resulting in a serious retrospective pattern in the assessment. Survey information only partially covers the stock area. Effort correction parameters / methodologies require updating as the main beam trawl fleet has restructured substantially recently. This effort would be greatly enhanced by an internationally coordinated survey that more appropriately covers the management area and is able to assess recruitment dynamics irrespective of the sources of recruitment and environmental drivers.	2012	Experts with expertise in spatial modelling of stock dynamics, expertise in the analysis of tagging information.

8.3.10 Management considerations

This stock is subject to a management plan based on reductions in F in relation to historical levels of F. Unfortunately both the final F estimate and historical levels of F, those used as the basis for the management plan continue to be revised in the current assessment approach, which is why the assessment was rejected by WKFLAT 2009.

The experimental retrospective analysis indicated a final year estimate of F lower than the penultimate estimate for the first time in 5 years. This suggests that either F is declining or the retrospective trend is reversing. A decline would be consistent with the introduction of a UK decommissioning scheme, but the correlation between F and effort has been poor in part because of the retargeting of the fleet to other species.

The management of the stock by TAC in the past has been ineffective, as the restrictiveness of the TAC is inversely related to the degree of area misreporting. In November 2008 the UK introduced a single area licensing scheme for beam trawlers in VIIe, which will eliminate the possibility of area misreporting from 2009 onwards but will have had little or no effect in 2008.

Effort restrictions have not been sufficiently restrictive to ensure an observable decrease in F in recent years. Restrictions in days-at-sea may not have the desired impact on F, as the most productive fishing grounds are close to the ports. Increases in fuel costs will also tend to force vessels to operate close to home.

No stock–recruit relationship is apparent for this stock (ICES, 2006).

Although sole is the main target species in the beam trawl and trammelnet fisheries, catches of cuttlefish, plaice, monkfish and lemon sole are also important. Management measures applied to sole must take account of management measures applied to the other quota species, particularly VIIe plaice and to a lesser degree VIIe–k cod. The UK beam trawl fleet has recently started to land sizeable quantities of gurnards for human consumption.

8.3.11 Ecosystem considerations

Beam trawling, especially using chain-mat gear, is known to have a significant impact on the benthic communities, although less so on soft substrata and in areas which have been historically exploited by this fishing method. Discard rates of non-commercial species and commercial species of unmarketable size are substantial, but total discards are lower compared with some other gears as a consequence of the relatively small area swept by the gear.

8.3.12 Regulations and their effects

In November of 2008 the UK introduced a single area licensing scheme for beam trawlers, which is thought to be highly effective in eliminating the current practice of area misreporting by this fleet, but will have had little effect on the fishery in 2008.

Management of this stock is mainly by TAC. In 2005 effort restrictions were implemented for beam trawlers and entangling gears targeting sole this fishery to enforce the TAC and improve data quality. To date these restrictions have not been limiting in this fishery, in part as a consequence of the large numbers of days available, but also because in the UK fleet there appears to be a considerable amount of latent effort in the beam trawl fleet.

Mesh restrictions for towed gears are set to 80 mm codends, which correspond well with the minimum landing size of sole at 24 cm. Consequently there is little discarding of sole in this fishery.

8.3.13 Changes in fishing technology and fishing patterns

Recent rises in fuel cost will have affected fishing operations in the main fleets exploiting sole; however no quantitative evaluation of the effect is possible. There is some indication of a stabilization of F in the assessment, which could be interpreted as a decline in F, given the historical retrospective bias in the assessment.

The UK industry has applied for MSC certification in 2009 commensurate with which it has started to adopt larger codend meshes and square mesh panels to limit the impact on benthic ecosystems. However these changes have not been adopted fully in 2008 so the effects are likely to be minimal for this year's assessment, but significant changes may be observed in the 2009 data and the WG will endeavour to monitor the situation.

Also see Section 3.1.10 with regards to the decommissioning scheme operated for beam trawlers by the UK. The effects of this in 2007 would be negligible, and its effect for 2008 is difficult to forecast.

8.3.14 Changes in the environment

WGRED 08 overall indicated that there were no consistent environmental drivers altering the ecosystem in Celtic Sea Area. In contrast to last year WGRED 08 did provide some more detailed description of the environmental changes occurring in the system, including climate change, NAO and changes in plankton productivity and species composition.

The winter NAO experienced a strong negative phase in the 1960s, becoming more positive in the 1980s and early 1990s. It remained mainly negative from 1996 to 2004, but became positive in 2005 (6.7 mbar).

Although the assessment only goes back to 1969, relative year class for sole VIIe from catches indicates some very strong recruitment for example in 1963, following which recruitment appears to have declined coinciding with the strong negative phase of the NAO. Positive NAOs in the 1980s and 1990s coincide with some of the highest recruitments seen in the assessment, which have declined since then along with NAO values. Since 2005 the NAO again reveals more favourable conditions although this has not immediately resulted in returns very large year classes, there is some evidence that recruitment is higher now, but more consistent so that we aren't seeing the extreme recruitments seen earlier in the time-series.

This should be investigated further by at the next benchmark.

Table 8.3.1 Sole VIIE Nominal landings (t) as used by the WG

Year	Belgium	Denmark	France	Netherlands	Ireland	Jersey	Guernsey	UK E W Ni	UK other	Unallocated	Total
1974			323							104	427
1975	3		271				2	215	2		491
1976	4		352				1	259	1		616
1977	3		331					272			606
1978	4		384					453		20	861
1979	1		515				2	663	2		1181
1980	45		447		13		1	763	1		1269
1981	16		415	1			4	784	4	-5	1215
1982	98		321				15	1013	15	-1	1446
1983	47		405	3		2	16	1025	18		1498
1984	48		421			9	14	878	23		1370
1985	58		130			9	8	894	17	310	1409
1986	62		467			3	6	831	9	50	1419
1987	48		432			1	5	626	6	168	1280
1988	67		98			0	4	780	4	495	1444
1989	69		112	6			3	610	3	590	1390
1990	41	0	81			1	3	632	4	556	1315
1991	35		325					477		15	852
1992	41		267				2	457	11	119	895
1993	59		236			1		479	19	111	904
1994	33		257					546	2	-38	800
1995	21		294			1	2	562	3	-24	856
1996	8		297					428	9	91	833
1997	13		348		1	13	13	470	26	91	949
1998	40		343			17	3	369	20	108	880
1999	13					18	3	375	21	548	957
2000	4		241			22	5	386	27	256	914
2001	19		224			20	5	382	25	419	1069
2002	33		198			15	5	289	20	566	1106
2003	1		363		1	15	5	235	20	458	1078
2004	7		302			7	6	172	13	581	1075
2005	26		406			17	5	505	22	80	1039
2006	32		357			4	4	568	8	57	1022
2007	34		383		2	2		525	2	69	1015
2008	28		183		0			463		230	904

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's

Age	1969	1970
1	0	0
2	89	53
3	322	232
4	80	322
5	148	90
6	210	83
7	21	112
8	50	13
9	26	35
10	20	52
11	9	22
+gp	63	113
Total	1037	1127
Landings	353	391

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	0	0	0	0	0	0	0	0	0	0
2	51	146	71	45	82	167	426	250	227	175
3	200	412	396	349	567	419	318	1123	803	559
4	246	167	433	220	170	472	384	347	811	497
5	198	115	89	178	199	161	206	214	250	630
6	65	112	99	71	115	135	102	189	229	126
7	80	14	120	80	28	92	70	103	174	183
8	156	25	17	43	53	46	74	72	103	140
9	10	134	52	32	26	58	10	77	90	65
10	35	38	30	24	22	51	24	38	104	56
11	54	54	4	55	24	14	32	27	28	130
+gp	113	106	136	106	171	213	159	203	290	342
Total	1207	1323	1446	1202	1456	1830	1804	2644	3108	2902
Landings	432	437	459	427	491	616	606	861	1181	1269

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	0	0	0	0	0	0	0	0	0	0
2	245	128	91	333	287	246	487	443	390	341
3	806	1451	753	663	1700	1618	808	1438	871	902
4	651	916	1573	826	756	971	1090	596	1233	581
5	467	553	583	758	469	421	427	728	497	553
6	389	352	351	325	585	321	204	374	509	244
7	179	240	267	204	179	336	224	153	225	264
8	126	136	294	129	97	84	229	162	110	143
9	76	113	119	152	103	75	47	109	107	103
10	58	81	73	54	85	90	50	39	113	75
11	55	61	37	28	29	74	41	50	48	85
+gp	211	294	262	255	125	127	162	171	214	235
Total	3262	4324	4401	3727	4414	4363	3770	4262	4316	3525
Landings	1215	1446	1498	1370	1409	1419	1280	1444	1390	1315

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	0	0	0	0	0	0	0	0	0	0
2	450	316	209	97	95	365	216	265	280	307
3	415	1434	704	657	308	445	831	606	915	599
4	482	417	1107	558	629	364	724	536	500	751
5	289	297	350	558	427	298	325	336	398	367
6	220	115	219	112	411	235	180	209	255	229
7	93	112	151	106	131	257	194	151	114	107
8	111	61	78	49	101	68	173	80	103	53
9	68	74	60	57	61	61	44	127	54	68
10	37	26	56	44	33	49	20	35	107	51
11	31	23	31	50	18	37	40	34	25	88
+gp	145	90	79	99	142	143	88	162	123	91
Total	2341	2964	3045	2388	2356	2321	2835	2543	2874	2710
Landings	852	895	904	800	856	833	949	880	957	914

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	2001	2002	2003	2004	2005	2006	2007	2008	geom mean 06-08	arith mean 06-08
1	0	0	0	0	0	0	0	0	0.00	0.00
2	145	332	598	398	258	500	201	280	304.06	326.95
3	1401	1251	835	1080	468	786	852	749	794.63	795.75
4	531	843	953	448	834	472	755	675	621.89	634.00
5	497	387	645	445	449	606	293	374	404.96	424.39
6	268	322	130	526	366	250	362	162	244.98	258.20
7	178	129	74	164	293	224	179	183	194.26	195.25
8	100	105	50	116	113	185	130	104	135.81	139.69
9	55	94	58	61	80	85	110	71	87.21	88.64
10	43	33	63	54	45	56	55	67	59.17	59.41
11	42	18	14	35	24	31	27	39	31.89	32.30
+gp	159	85	61	85	96	87	99	89	91.42	91.56
Total	3419	3599	3482	3412	3027	3282	3062	2794	3039.56	3046.13
Landings	1069	1106	1078	1075	1039	1023	1015	904	979.12	980.67

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs

Age	1969
1	0.000
2	0.188
3	0.245
4	0.332
5	0.329
6	0.367
7	0.522
8	0.455
9	0.463
10	0.606
11	0.647
+gp	0.660

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	0.000	0.113	0.000	0.000	0.144	0.142	0.139	0.118	0.000	0.000
2	0.187	0.151	0.194	0.203	0.183	0.181	0.170	0.197	0.180	0.187
3	0.223	0.222	0.227	0.224	0.224	0.214	0.217	0.248	0.241	0.237
4	0.294	0.296	0.272	0.262	0.281	0.299	0.286	0.302	0.303	0.327
5	0.314	0.367	0.369	0.310	0.379	0.358	0.323	0.356	0.390	0.423
6	0.354	0.350	0.408	0.381	0.434	0.403	0.390	0.399	0.439	0.460
7	0.434	0.359	0.458	0.414	0.372	0.435	0.454	0.502	0.377	0.468
8	0.498	0.431	0.495	0.459	0.464	0.497	0.413	0.463	0.486	0.477
9	0.442	0.455	0.402	0.466	0.475	0.591	0.475	0.517	0.489	0.565
10	0.512	0.476	0.454	0.537	0.487	0.651	0.478	0.484	0.488	0.522
11	0.528	0.388	0.508	0.654	0.474	0.535	0.583	0.552	0.540	0.569
+gp	0.593	0.653	0.600	0.561	0.731	0.676	0.628	0.681	0.670	0.725

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0.000	0.000	0.120	0.000	0.088	0.000	0.106	0.098	0.091	0.110
2	0.189	0.174	0.213	0.188	0.209	0.162	0.174	0.174	0.170	0.167
3	0.254	0.226	0.208	0.251	0.242	0.225	0.237	0.245	0.244	0.222
4	0.343	0.322	0.276	0.272	0.304	0.296	0.297	0.310	0.312	0.275
5	0.389	0.382	0.345	0.307	0.379	0.358	0.354	0.370	0.375	0.326
6	0.525	0.478	0.424	0.390	0.389	0.389	0.407	0.425	0.432	0.375
7	0.560	0.515	0.495	0.419	0.478	0.469	0.456	0.474	0.484	0.422
8	0.609	0.534	0.507	0.475	0.539	0.520	0.502	0.518	0.531	0.467
9	0.646	0.599	0.520	0.532	0.559	0.531	0.544	0.557	0.572	0.510
10	0.655	0.620	0.523	0.610	0.601	0.519	0.583	0.590	0.608	0.551
11	0.600	0.710	0.561	0.553	0.722	0.584	0.618	0.618	0.639	0.590
+gp	0.783	0.661	0.659	0.667	0.639	0.817	0.703	0.665	0.694	0.692

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.158	0.105	0.088	0.000	0.122	0.133	0.164	0.000	0.000	0.158
2	0.216	0.182	0.166	0.146	0.183	0.192	0.214	0.186	0.191	0.208
3	0.270	0.255	0.238	0.209	0.241	0.248	0.262	0.244	0.247	0.257
4	0.322	0.323	0.305	0.268	0.295	0.301	0.308	0.300	0.300	0.303
5	0.370	0.386	0.366	0.324	0.347	0.351	0.354	0.354	0.350	0.347
6	0.416	0.445	0.423	0.376	0.396	0.397	0.399	0.406	0.397	0.389
7	0.458	0.499	0.474	0.425	0.442	0.441	0.442	0.455	0.441	0.429
8	0.498	0.549	0.520	0.470	0.484	0.481	0.484	0.503	0.482	0.467
9	0.534	0.594	0.561	0.513	0.524	0.518	0.524	0.548	0.520	0.502
10	0.567	0.634	0.597	0.551	0.561	0.552	0.564	0.592	0.555	0.535
11	0.597	0.669	0.627	0.587	0.595	0.583	0.602	0.633	0.586	0.566
+gp	0.664	0.742	0.684	0.672	0.671	0.652	0.695	0.734	0.661	0.636

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	mean 06-08
1	0.141	0.000	0.123	0.101	0.122	0.123	0.106	0.117	0.147	0.123
2	0.201	0.203	0.181	0.173	0.176	0.180	0.168	0.183	0.196	0.182
3	0.257	0.245	0.236	0.241	0.230	0.235	0.226	0.244	0.244	0.238
4	0.309	0.287	0.290	0.306	0.282	0.289	0.280	0.299	0.291	0.290
5	0.357	0.326	0.342	0.367	0.334	0.342	0.331	0.350	0.337	0.339
6	0.400	0.365	0.391	0.425	0.385	0.393	0.378	0.395	0.382	0.385
7	0.440	0.402	0.439	0.479	0.435	0.443	0.421	0.436	0.426	0.428
8	0.475	0.438	0.485	0.530	0.485	0.492	0.461	0.471	0.468	0.467
9	0.507	0.472	0.529	0.577	0.533	0.539	0.497	0.501	0.509	0.502
10	0.534	0.505	0.570	0.620	0.581	0.585	0.529	0.526	0.550	0.535
11	0.557	0.537	0.610	0.660	0.628	0.629	0.558	0.546	0.589	0.564
+gp	0.645	0.615	0.705	0.746	0.756	0.746	0.667	0.616	0.653	0.645

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs

Age	1969
1	0.040
2	0.125
3	0.200
4	0.270
5	0.330
6	0.380
7	0.425
8	0.460
9	0.490
10	0.520
11	0.550
+gp	0.609

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	0.045	0.030	0.055	0.035	0.040	0.071	0.095	0.086	0.090	0.064
2	0.120	0.090	0.130	0.105	0.125	0.144	0.146	0.156	0.156	0.141
3	0.195	0.170	0.200	0.170	0.200	0.221	0.198	0.221	0.217	0.216
4	0.255	0.240	0.265	0.235	0.265	0.267	0.247	0.278	0.276	0.287
5	0.305	0.295	0.325	0.290	0.320	0.327	0.294	0.332	0.330	0.352
6	0.355	0.345	0.380	0.340	0.370	0.385	0.338	0.382	0.380	0.414
7	0.395	0.390	0.420	0.390	0.410	0.435	0.380	0.425	0.425	0.463
8	0.430	0.420	0.460	0.435	0.455	0.479	0.417	0.462	0.463	0.502
9	0.465	0.445	0.490	0.475	0.490	0.516	0.456	0.497	0.498	0.539
10	0.490	0.470	0.520	0.510	0.515	0.545	0.491	0.527	0.526	0.574
11	0.510	0.490	0.540	0.540	0.530	0.569	0.523	0.553	0.555	0.608
+gp	0.541	0.544	0.558	0.585	0.571	0.628	0.595	0.629	0.630	0.719

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0.052	0.038	0.038	0.040	0.032	0.095	0.071	0.058	0.050	0.081
2	0.125	0.119	0.117	0.120	0.108	0.150	0.140	0.137	0.131	0.139
3	0.206	0.197	0.195	0.195	0.192	0.204	0.206	0.210	0.208	0.195
4	0.288	0.276	0.265	0.250	0.268	0.258	0.268	0.278	0.278	0.249
5	0.360	0.358	0.335	0.307	0.339	0.311	0.326	0.341	0.344	0.300
6	0.436	0.427	0.398	0.365	0.400	0.364	0.381	0.398	0.404	0.350
7	0.513	0.490	0.455	0.420	0.453	0.416	0.432	0.450	0.459	0.398
8	0.575	0.543	0.506	0.475	0.501	0.468	0.480	0.497	0.508	0.444
9	0.620	0.582	0.536	0.520	0.545	0.520	0.524	0.538	0.552	0.488
10	0.650	0.616	0.562	0.570	0.577	0.571	0.564	0.574	0.591	0.531
11	0.674	0.645	0.585	0.615	0.607	0.621	0.601	0.605	0.624	0.571
+gp	0.714	0.699	0.632	0.709	0.696	0.790	0.691	0.659	0.687	0.675

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.128	0.065	0.048	0.000	0.091	0.103	0.139	0.000	0.000	0.132
2	0.187	0.144	0.128	0.114	0.153	0.163	0.189	0.156	0.162	0.183
3	0.243	0.219	0.202	0.178	0.212	0.221	0.238	0.215	0.220	0.233
4	0.296	0.290	0.272	0.239	0.268	0.275	0.285	0.272	0.274	0.280
5	0.346	0.355	0.336	0.296	0.322	0.326	0.331	0.327	0.325	0.326
6	0.393	0.416	0.395	0.350	0.372	0.374	0.376	0.380	0.374	0.369
7	0.437	0.473	0.449	0.401	0.419	0.419	0.420	0.431	0.419	0.410
8	0.478	0.524	0.498	0.448	0.463	0.461	0.463	0.480	0.462	0.448
9	0.516	0.572	0.542	0.492	0.505	0.500	0.504	0.526	0.501	0.485
10	0.551	0.614	0.580	0.532	0.543	0.536	0.544	0.570	0.537	0.519
11	0.583	0.652	0.613	0.570	0.578	0.568	0.583	0.612	0.571	0.551
+gp	0.654	0.731	0.677	0.659	0.659	0.641	0.677	0.717	0.650	0.624

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	mean 06-08
1	0.110	0.000	0.094	0.063	0.095	0.094	0.074	0.083	0.122	0.093
2	0.172	0.181	0.152	0.137	0.149	0.152	0.138	0.151	0.172	0.154
3	0.230	0.224	0.209	0.207	0.203	0.208	0.197	0.214	0.220	0.210
4	0.284	0.266	0.263	0.274	0.256	0.263	0.254	0.272	0.268	0.265
5	0.333	0.307	0.316	0.337	0.308	0.316	0.306	0.325	0.315	0.315
6	0.379	0.346	0.367	0.396	0.360	0.368	0.355	0.373	0.360	0.363
7	0.421	0.384	0.415	0.452	0.410	0.419	0.400	0.416	0.404	0.407
8	0.458	0.420	0.462	0.505	0.460	0.468	0.442	0.454	0.447	0.448
9	0.492	0.455	0.507	0.554	0.509	0.516	0.479	0.486	0.489	0.485
10	0.521	0.489	0.550	0.599	0.557	0.562	0.514	0.514	0.530	0.519
11	0.546	0.521	0.591	0.641	0.605	0.607	0.544	0.536	0.569	0.550
+gp	0.643	0.602	0.688	0.732	0.734	0.726	0.661	0.614	0.640	0.639

Table 8.3.5 Sole VIIE Landings Length Frequency Distributions

Length	UK BeamTrawl	UK other	French
21	0	0	0
22	0	6	1619
23	650	730	26233
24	10768	2606	96343
25	33198	5945	110480
26	56931	8864	123415
27	72169	14575	111398
28	83907	15435	82090
29	120313	17101	74970
30	109678	17189	74819
31	97065	16896	76528
32	102318	16579	65056
33	94357	14399	62849
34	78214	12334	48974
35	50395	10884	48279
36	44596	8009	45144
37	36240	6074	34272
38	26603	5332	28750
39	23592	4515	28337
40	15184	3041	20365
41	12008	2587	19712
42	9325	2111	17315
43	6659	1581	12987
44	5990	1131	3934
45	2857	617	7871
46	2510	634	787
47	2127	484	2360
48	1497	365	787
49	460	269	0
50	720	107	0
51	135	55	0
52	47	18	0
53	76	8	0
54	61	0	0
55	0	0	0
56	0	0	0
57	30	0	0
58	0	0	0
59	0	0	0
Total	1100680	190481	1225674

Table 8.3.6 Available tuning data

W CHANNEL SOLE 2008 WG, 1-14, SEXES COMBINED,

105
UK-CBT
1988 2007
1 1 0 1
3 14

107.23	747.49	382.4	497.05	225.59	71.83	70.57	66.73	14.92	24.57	15.09	31.15	7.87
122.09	480.71	603.07	295.68	344.28	124.29	52.66	52.11	48.82	30.47	18.98	21.01	12.79
114.86	478.16	361.27	271.68	174.7	170.9	65.4	49.23	31.81	27.42	14.67	24.04	12.6
92.87	229.74	240.99	186.87	121.76	52.87	67.89	37.54	17.79	12.29	22.67	5.38	9.83
91.43	773.74	216.51	152.49	57.61	60.04	28.95	41.72	10.8	7.61	7.45	7.99	7.08
96.39	382.12	602.61	186.88	114.16	81.18	41.21	31.94	31.52	15.68	4.58	11.85	8.02
108.24	443.52	361.7	347.1	69.39	62.83	30.89	34.86	26.44	29.61	14.09	10.91	5.74
108.1	173.64	357.84	240.49	233.61	71.61	56.73	33.47	18.33	10.07	22.33	9.28	6.44
128.07	239.43	194.61	165.43	133.04	143.67	38.1	34.8	27.59	20.8	22.58	20.66	8.37
122.83	474.85	387.28	181.39	95.01	104.45	92.27	23	10.67	21.69	8.71	10.14	7.52
126.5	352.44	311.69	194.66	115.68	83.44	44.32	66.82	18.37	18.3	15.18	16.05	7.08
115.99	471.41	244.17	181.4	114.13	48.08	45.38	23.67	47.22	10.45	17.65	5.01	5.30
128.65	308.67	374.19	177.98	110.37	53.08	26.86	31.31	23.64	41.62	4.51	6.91	2.95
158.07	832.95	295.63	281.48	143.95	95.75	53.72	28.03	23.25	22.22	25.86	9.65	7.28
153.74	775.07	469.78	172.07	172.99	77.14	54.4	23.91	10.98	12.98	7.28	13.62	6.31
174.26	425.77	550.11	423.34	69.8	59.67	33.48	43.96	21.73	7.15	6.69	10.92	9.19
164.89	494.01	207.46	180.26	253.67	38.28	50.45	25.25	20.16	14.39	7.15	3.98	6.39
159.15	223.71	346.97	141.36	165.05	140.46	29.15	34.66	23.97	15.14	8.83	6.32	5.14
161.74	380.29	188.15	245.65	86.37	109.33	107.95	37.56	20.86	13.81	13.74	6.74	3.01
159.39	488.97	280.33	113.45	110.97	58.13	66.53	55.17	16.44	11.91	11.16	9.05	8.76
159.21	313.73	305.22	134.54	72.43	69.81	45.18	42.19	38.70	15.51	12.59	4.59	6.40

UK-COT
1988 2007
1 1 0 1
3 14

53402	33.38	16.95	20.78	9.30	2.75	2.75	1.98	0.38	0.82	0.43	0.93	0.27
54707	16.22	19.72	9.91	12.63	5.08	2.60	2.54	2.16	1.51	1.20	1.07	0.70
53050	19.09	13.10	9.60	6.35	5.76	2.17	1.91	1.16	0.94	0.65	1.00	0.53
40789	10.04	7.04	4.12	2.46	0.96	1.44	0.42	0.41	0.24	0.27	0.08	0.18
39909	26.15	5.98	3.59	1.19	1.14	0.48	0.65	0.17	0.09	0.07	0.17	0.10
39240	12.22	17.24	5.29	3.38	2.44	1.24	0.98	0.90	0.55	0.13	0.32	0.29
38768	12.67	11.69	12.60	2.55	2.65	1.25	1.38	1.05	1.20	0.63	0.46	0.27
35453	5.26	9.75	6.34	6.18	1.89	1.49	0.91	0.52	0.25	0.59	0.32	0.18
30541	9.46	6.52	4.36	3.14	3.53	0.95	0.75	0.67	0.45	0.44	0.42	0.18
33281	15.05	8.74	4.75	2.81	2.88	2.52	0.62	0.28	0.43	0.31	0.26	0.27
29802	8.50	7.38	4.14	2.42	1.49	0.90	1.43	0.31	0.43	0.37	0.34	0.12
27516	11.35	5.73	4.83	2.84	1.42	1.44	0.72	1.47	0.38	0.56	0.19	0.19
30493	6.40	8.07	3.87	2.53	1.19	0.57	0.77	0.59	0.95	0.09	0.20	0.05
31900	17.90	5.23	4.93	2.67	1.99	1.11	0.70	0.51	0.50	0.65	0.24	0.22
28346	9.77	6.05	2.36	2.64	1.26	0.81	0.33	0.20	0.24	0.17	0.27	0.10
25060	4.49	5.72	4.67	1.01	0.83	0.47	0.52	0.26	0.12	0.15	0.22	0.17
25584	5.98	2.55	2.20	3.21	0.45	0.57	0.29	0.24	0.18	0.13	0.07	0.09
21129	6.34	9.41	3.47	4.07	3.39	0.73	0.89	0.57	0.45	0.25	0.19	0.14
21058	6.85	3.24	4.08	1.34	1.61	1.73	0.59	0.30	0.20	0.19	0.12	0.05
22352	9.17	5.35	2.26	2.28	1.17	1.39	1.11	0.35	0.21	0.23	0.20	0.20
22347	9.16	5.35	2.26	2.28	1.17	1.39	1.11	0.35	0.21	0.23	0.20	0.20
19801	5.56	4.81	2.06	1.14	1.17	0.74	0.74	0.70	0.31	0.23	0.11	0.10

Table 8.3.6 Available tuning data (continued)

```
UK-BTS
1988 2007
1 1 0.75 0.8
1 9
128.2  2  39 129  52 75 22  0 12  3
165.7  5  56 120 107 34 40 17  5  7
175.7 23  52  76  31 24  7 15  3  6
171.7 11 231  79  51 23 21  5 17  4
196.6  5 140 316  44 36 12  7  5 11
189.2  5  54 115 105 14 10  9  3  3
205.9  6  47 106  62 44  5  5  2  3
187.2 14  37  44  42 26 31  4  5  5
184.4 28 112  67  25 32 20 17  3  2
184.7 11 130 126  43 14 16 13 14  5
185.5 11 141 114  76 22 10 14  6  8
187.9 11  97 128  47 23  8  4  4  4
180.4 12 136  70  52 23 16  5  3  5
178.0  9 197 162  52 31 12 12  4  1
180.0  6  37 113  48 27  6  3  2  0
170.7 23 158  57  50 19  4  4  6  1
164.9 16 110 120  24 15 10 16  9  4
186.6  8 110  39  53 12 12  6  2  4
184.7  5 120  95  26 37 10  7  9  0
181.0  7 188 135  50 11 23  3  3  1
174.7 10  85 158  77 40  2 14  3  6


UK-Inshore
1973  1987
1 1 0 1
2 14
15.76  28.3 142.9 145.8  28.7  28.7 33.8  4.9 15.2  8.4  1.0  8.4 12.7 1.2
12.58  17.2 117.7  67.5  51.6  18.0 19.3 11.0  8.2  5.8 12.0  3.1  4.8 2.9
12.84  30.0 163.3  41.9  45.1  21.2  4.8 10.0  4.9  3.7  3.7  7.0  3.8 5.2
12.58  63.6 137.5 139.9  44.9  32.6 21.4 11.4 14.4 11.7  2.9  3.7 16.0 4.6
14.01 169.7 106.7 114.5  57.4  24.3 15.8 18.1  2.5  5.3  6.4  3.5  4.5 8.2
22.31 117.8 449.7 124.4  72.1  54.5 28.5 21.1 22.5 10.4  6.7  5.8  5.9 3.5
31.15 114.2 342.9 310.5  89.6  70.2 51.1 32.4 28.1 30.2  7.3  6.8 17.3 3.6
42.40 131.4 322.7 221.1 257.7  36.9 46.3 37.1 18.1 13.7 32.5  9.2  7.6 8.9
46.36 161.9 478.9 320.6 190.5 123.1 52.6 37.8 22.1 15.7 12.1 11.3  3.4 3.7
51.68  86.0 857.6 442.0 215.7 113.5 70.6 43.0 33.6 22.2 16.7 10.3  8.2 7.6
51.09  76.8 353.4 623.5 210.6  80.1 78.3 94.1 33.8 26.4  5.3  6.5 34.8 5.1
48.21 177.7 280.2 309.0 257.0  88.6 43.9 39.6 38.1  8.5  5.9 13.9 17.5 4.0
54.87  57.7 598.4 320.7 168.7 198.1 37.2 29.9 45.9 32.4 17.7  7.6  4.2 5.6
53.46 103.2 823.1 361.7 111.3  82.9 87.1 23.2  9.3  7.6 17.8  4.2  5.1 9.4
35.61 116.6 183.2 269.3  93.4  17.1 16.7 32.0  5.9  9.0  3.6  7.8  4.5 5.2

UK-Offshore
1973  1987
1 1 0 1
3 14
 5.64  24.6  37.3   8.9  13.0  16.8   2.1  6.6  4.3  0.7  4.3  4.3  0.7
 6.72  30.3  25.7  23.8  12.2  14.4   7.1  5.4  4.5 11.3  2.3  2.4  2.4
13.94  85.2  32.5  42.1  29.2   7.3  13.1  6.4  5.8  6.9 10.8  3.8  8.7
 7.36  38.6  58.4  22.7  24.2  17.3   8.1 10.2  9.8  2.9  3.0  8.8  4.2
 9.88  36.1  57.7  34.9  21.7  15.5  15.3  2.1  5.3  7.9  3.5  3.0  8.8
14.50 140.5  57.7  40.4  44.9  25.8  16.6 17.9  9.7  7.7  5.3  3.6  3.5
20.38 107.9 145.1  50.6  58.2  46.4  25.5 22.4 28.3  8.3  6.3 10.6  3.7
28.18 103.1 104.9 147.7  31.1  42.7  29.7 14.7 13.0 37.9  8.8  4.7  9.0
28.75 142.8 142.1 101.9  96.6  45.3  28.2 16.7 13.9 13.1 10.0  2.0  3.5
39.85 317.9 243.4 143.3 110.7  75.7  39.9 31.6 24.5 22.5 11.3  5.9  9.0
66.45 104.1 433.6 167.6 116.5 100.9 104.4 47.8 27.7 19.8  9.2 18.7 10.2
49.07 152.8 234.7 214.8 133.2  69.9  22.9 54.3 28.5  7.8 29.7  8.2  6.7
47.15 245.2 130.3 110.8 211.1  75.6  26.7 31.6 15.5  7.1  0.0  7.9  6.8
34.66 425.5 215.7 100.2  79.1  70.0  15.2  7.9 30.1 28.6  5.3 13.7  7.6
47.41 158.4 344.2 138.8  53.3  50.7  95.7 22.7 19.0 26.1 13.8 14.2 14.6
```

Table 8.3.7 Sole VIIE effort & CPUE data

Year	BT North u24	BT West u24	BT South u24	BT North o24	BT West o24	BT South o24	Effort BT u24	Effort BT o24	Landings BT u24	Landings BT o24	SurveyCPUE
1985											103.41
1986											130.24
1987											95.70
1988	8.64	5.97	7.75	9.33	5.41	7.62	46.33	60.90	332.79	441.99	74.24
1989	7.44	3.88	5.19	9.04	3.92	5.01	35.29	86.80	200.99	520.43	69.36
1990	8.88	5.46	6.61	8.64	4.34	5.10	36.35	78.51	238.56	474.06	43.72
1991	7.41	4.57	6.37	5.72	3.28	4.10	27.93	64.94	165.12	296.01	72.58
1992	6.95	5.75	6.49	5.38	4.14	5.29	29.47	61.95	169.31	291.50	78.13
1993	7.46	6.53	4.20	5.53	3.40	4.38	31.08	65.31	199.90	281.75	49.63
1994	6.07	5.17	5.73	5.61	3.34	4.76	34.77	73.47	189.29	317.87	40.66
1995	6.34	4.33	5.48	5.27	3.61	4.27	31.30	76.80	158.01	328.93	37.78
1996	6.47	3.35	4.26	6.37	1.70	2.37	33.16	94.91	164.71	300.93	48.72
1997	6.89	4.61	4.88	6.38	2.07	3.01	34.15	88.68	192.26	332.09	63.11
1998	5.28	2.49	3.09	7.12	1.95	2.59	43.41	83.09	186.94	306.70	65.83
1999	5.78	2.48	2.74	6.48	1.60	2.47	42.82	73.17	185.15	271.41	54.50
2000	5.41	3.41	2.57	4.89	1.83	2.34	49.07	79.58	202.29	250.02	51.94
2001	6.96	2.90	2.06	7.07	1.41	1.70	65.65	92.42	302.55	300.74	74.67
2002	6.42	2.46	1.73	6.64	1.19	1.23	61.55	92.19	293.79	298.56	43.18
2003	6.45	1.41	1.53	6.63	1.06	1.35	67.25	107.01	277.64	329.50	50.28
2004	6.13	1.60	1.18	4.74	0.93	0.90	56.25	108.64	206.17	239.23	57.99
2005	3.80	3.84	3.48	3.14	2.08	2.06	51.49	107.66	198.42	255.15	35.67
2006	4.58	3.82	2.71	2.99	2.05	1.92	50.87	110.87	225.31	238.63	49.10
2007	4.32	4.00	2.05	3.09	1.79	2.04	65.06	94.18	237.25	213.72	62.91
2008	3.72	2.61	2.25	2.61	1.77	1.99	75.85	83.37	221.38	170.25	73.55

Figure 8.3.1 Sole VIIE International Landings Age Compositions

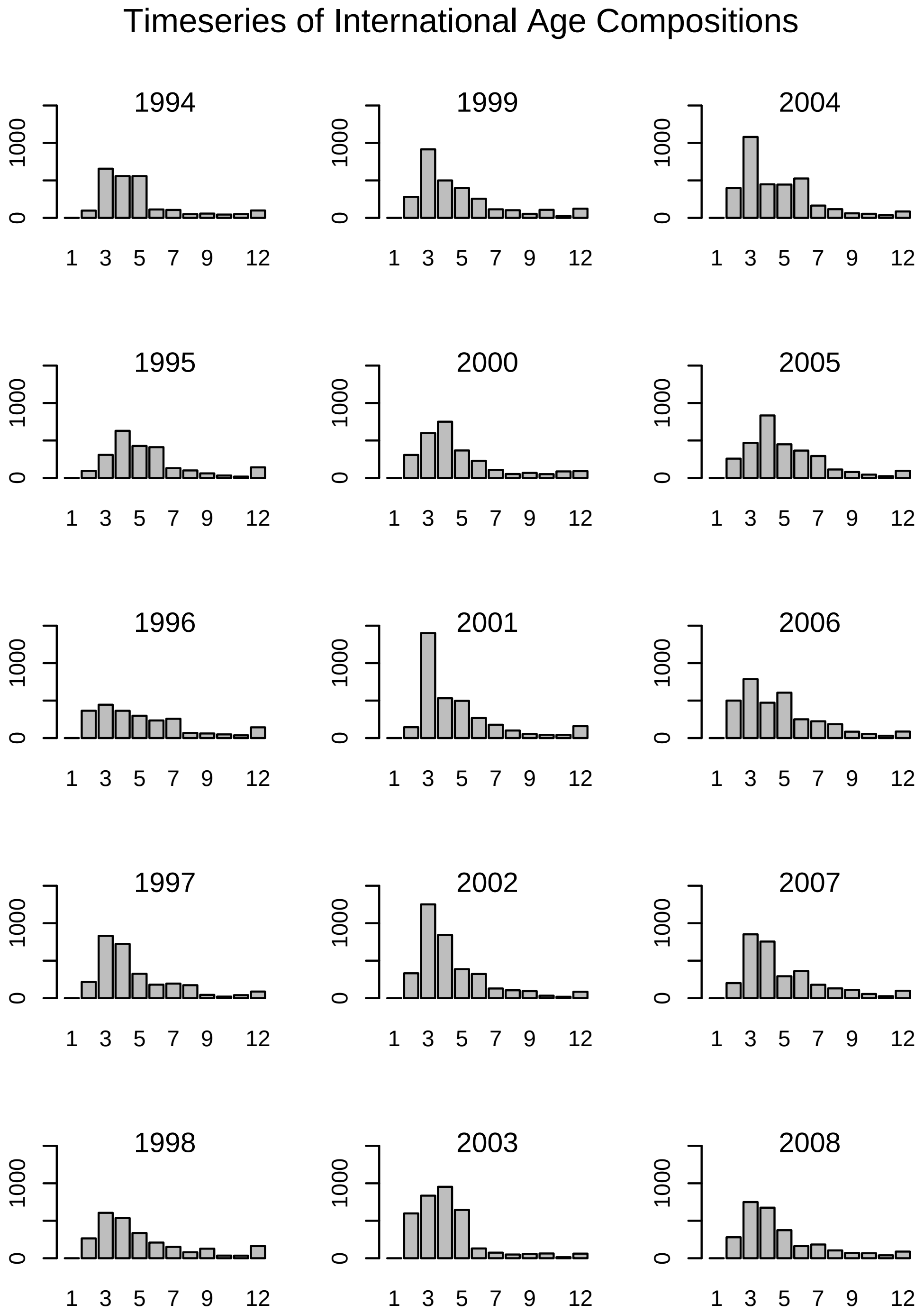
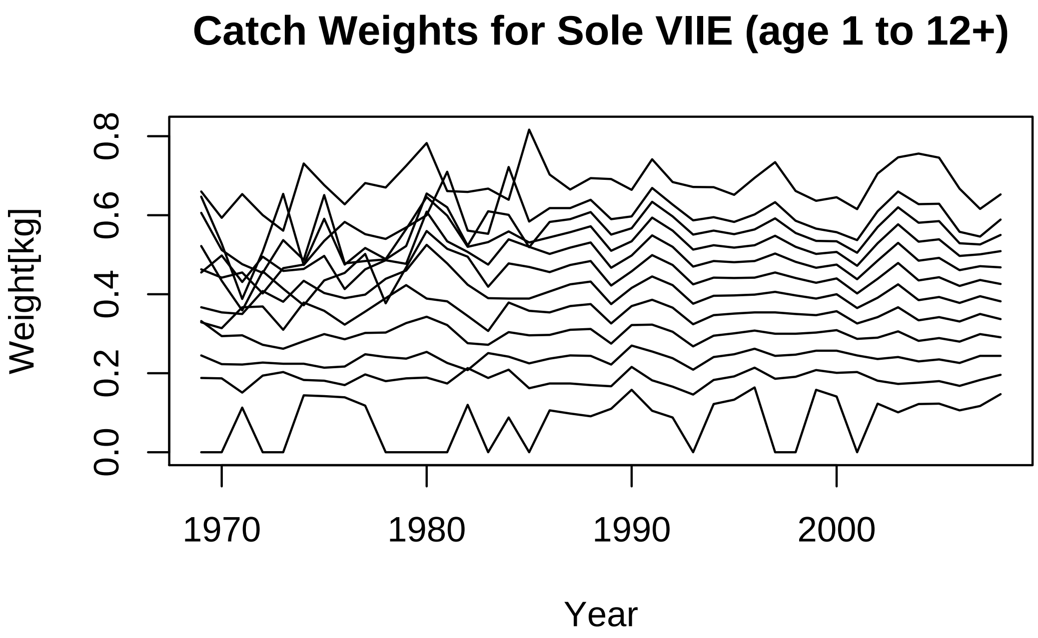


Figure 8.3.2 Sole VIIE Catch and Stock Weights at Age



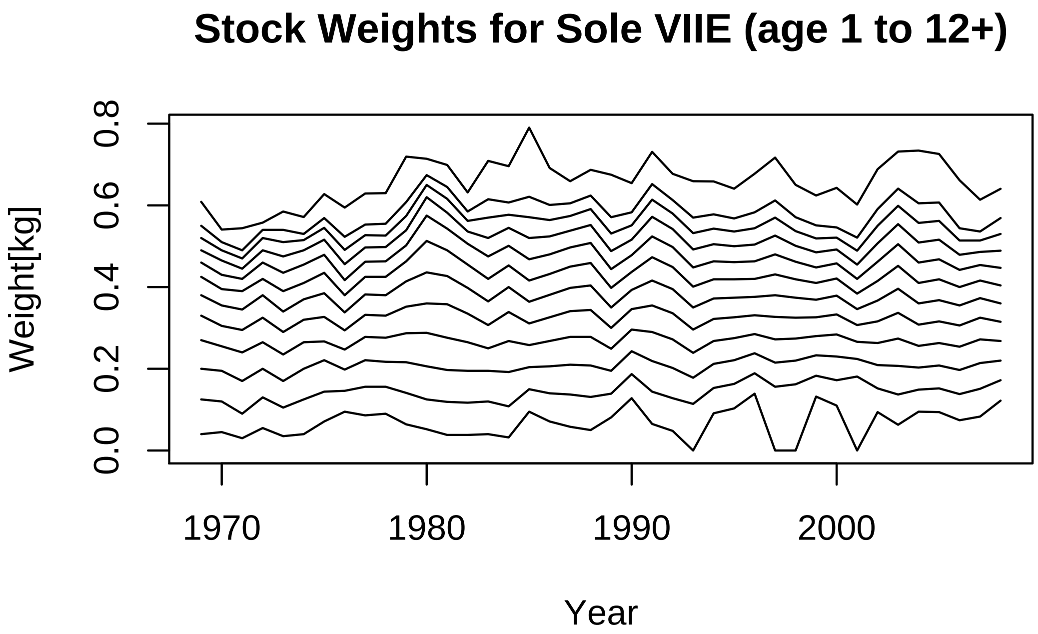


Figure 8.3.3a Sole VIIE Discards by Quarter, Fleet

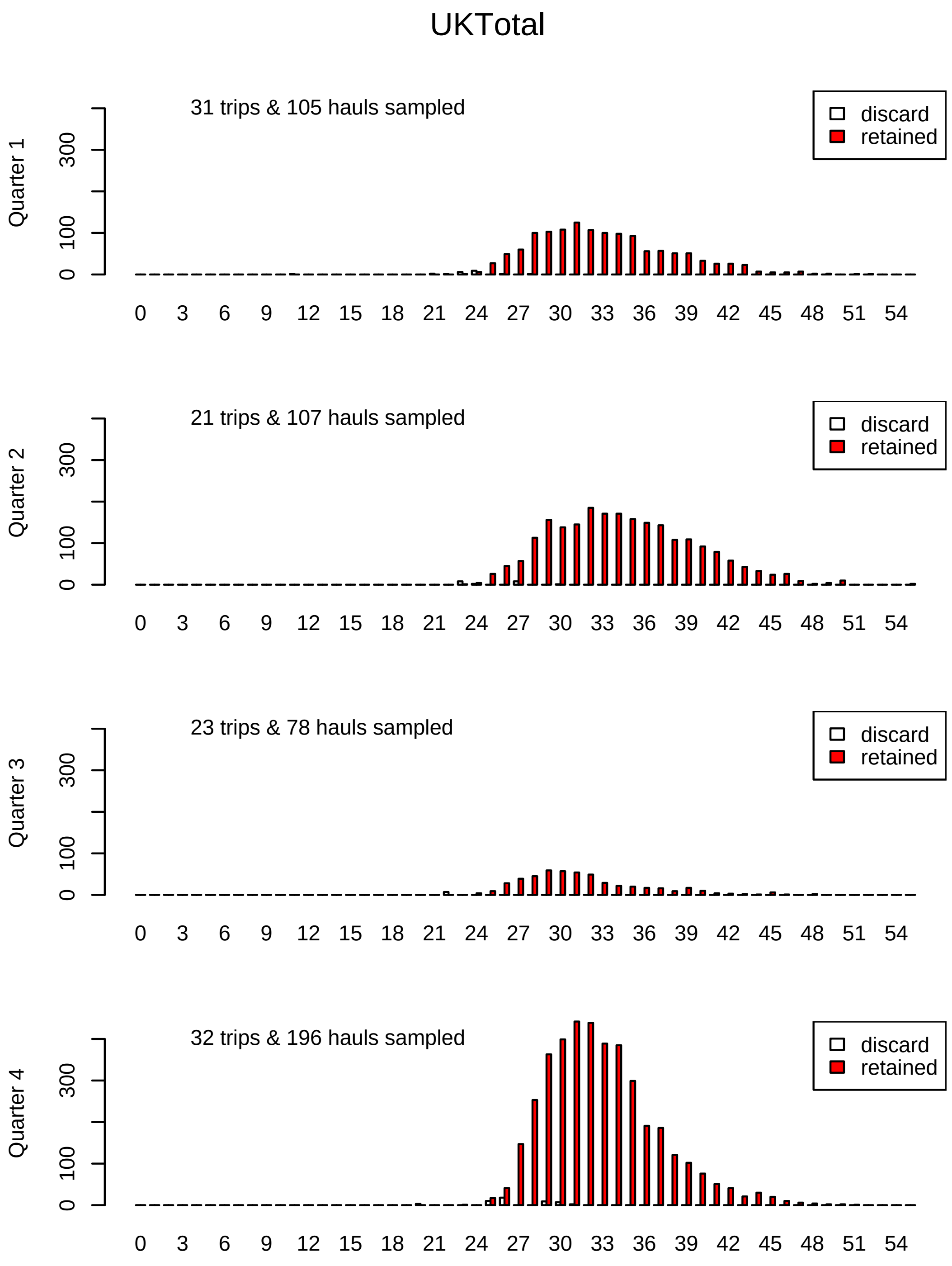


Figure 8.3.3b Sole VIIE Discards by Quarter, Fleet

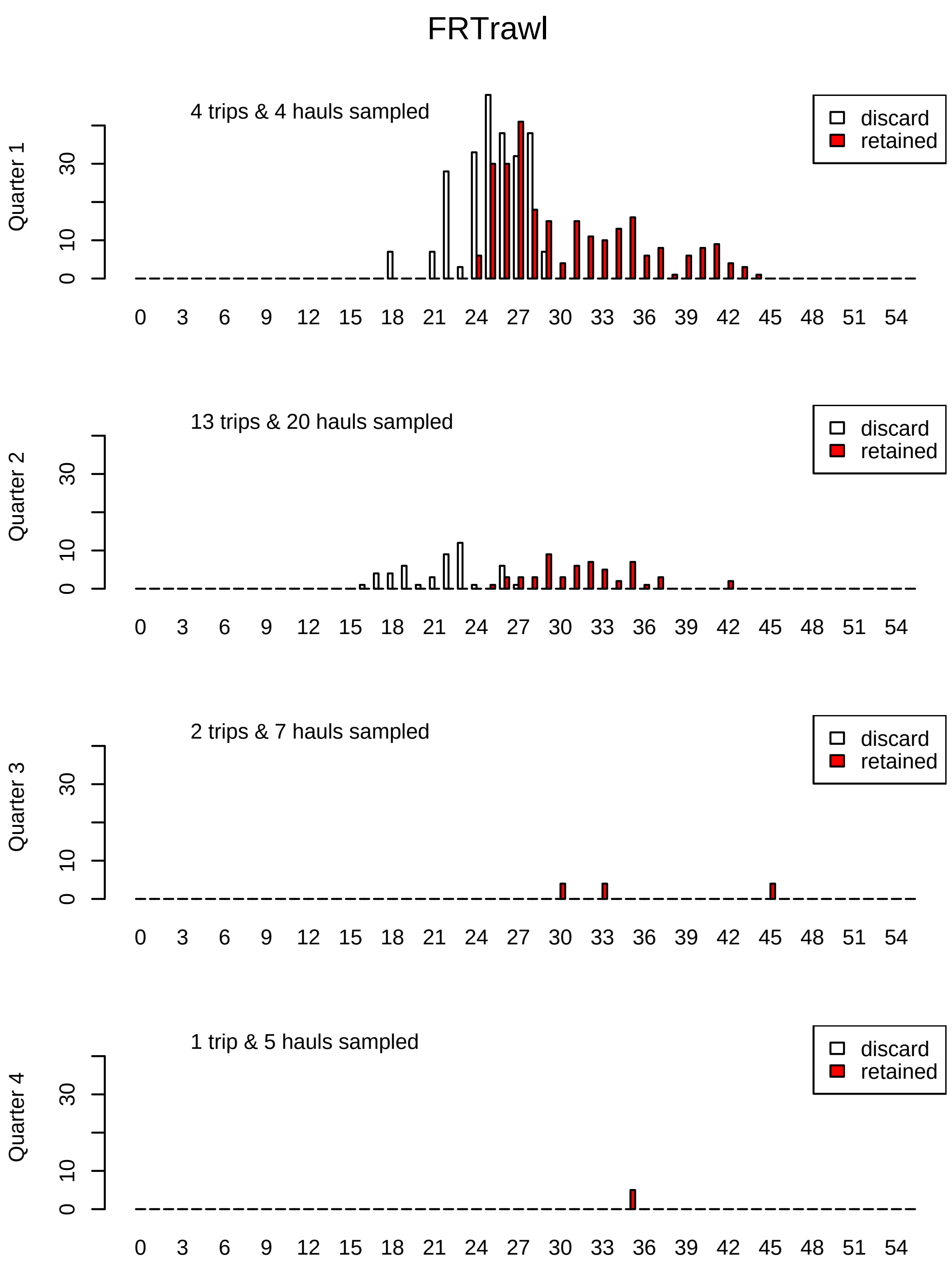


Figure 8.3.3c Sole VIIE Discards by Quarter, Fleet

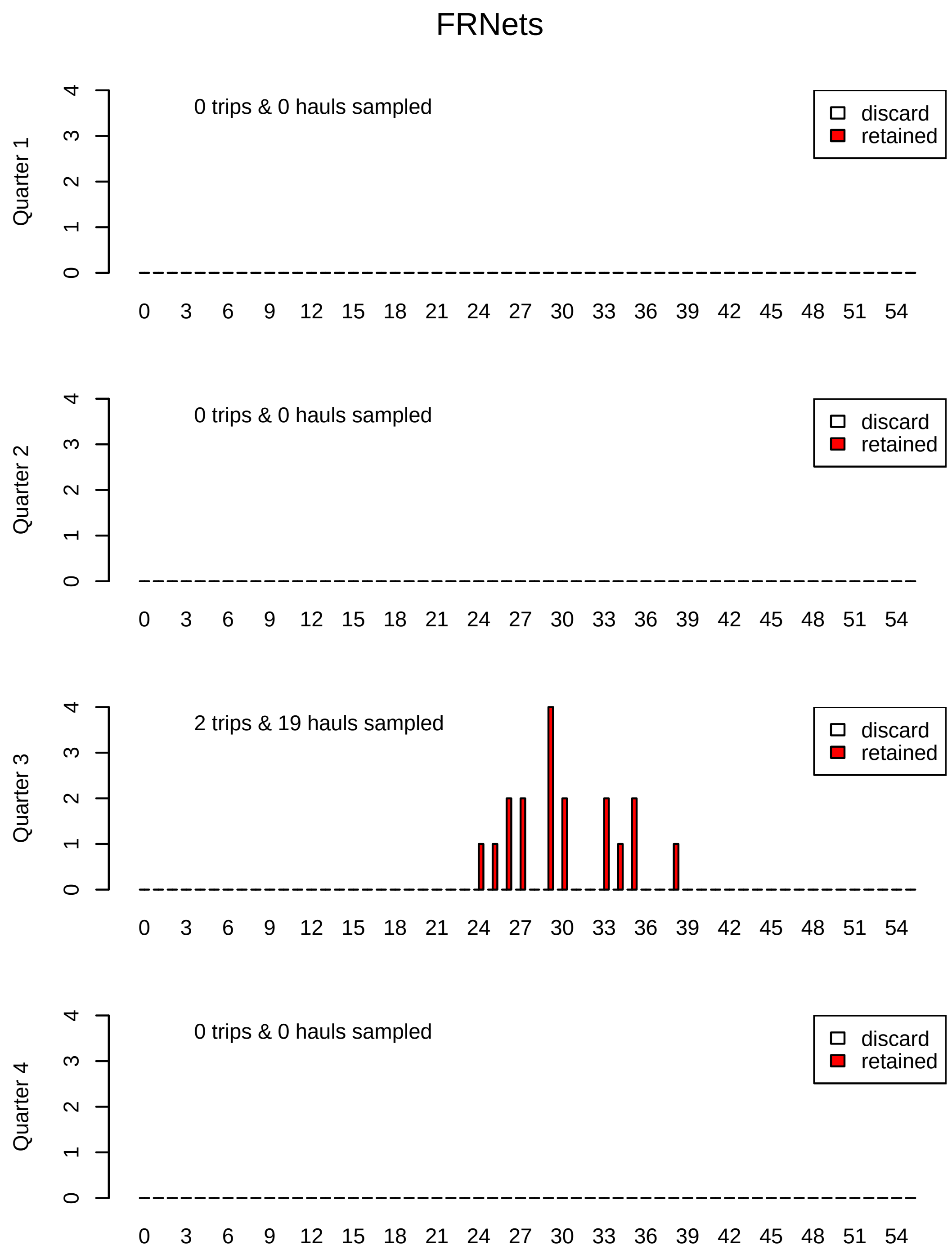


Figure 8.3.4 Sole VIIE Log CPUE by Yearclass

note the cohorts differ on the x-axes due to the differences in the length and age range of the tuning series

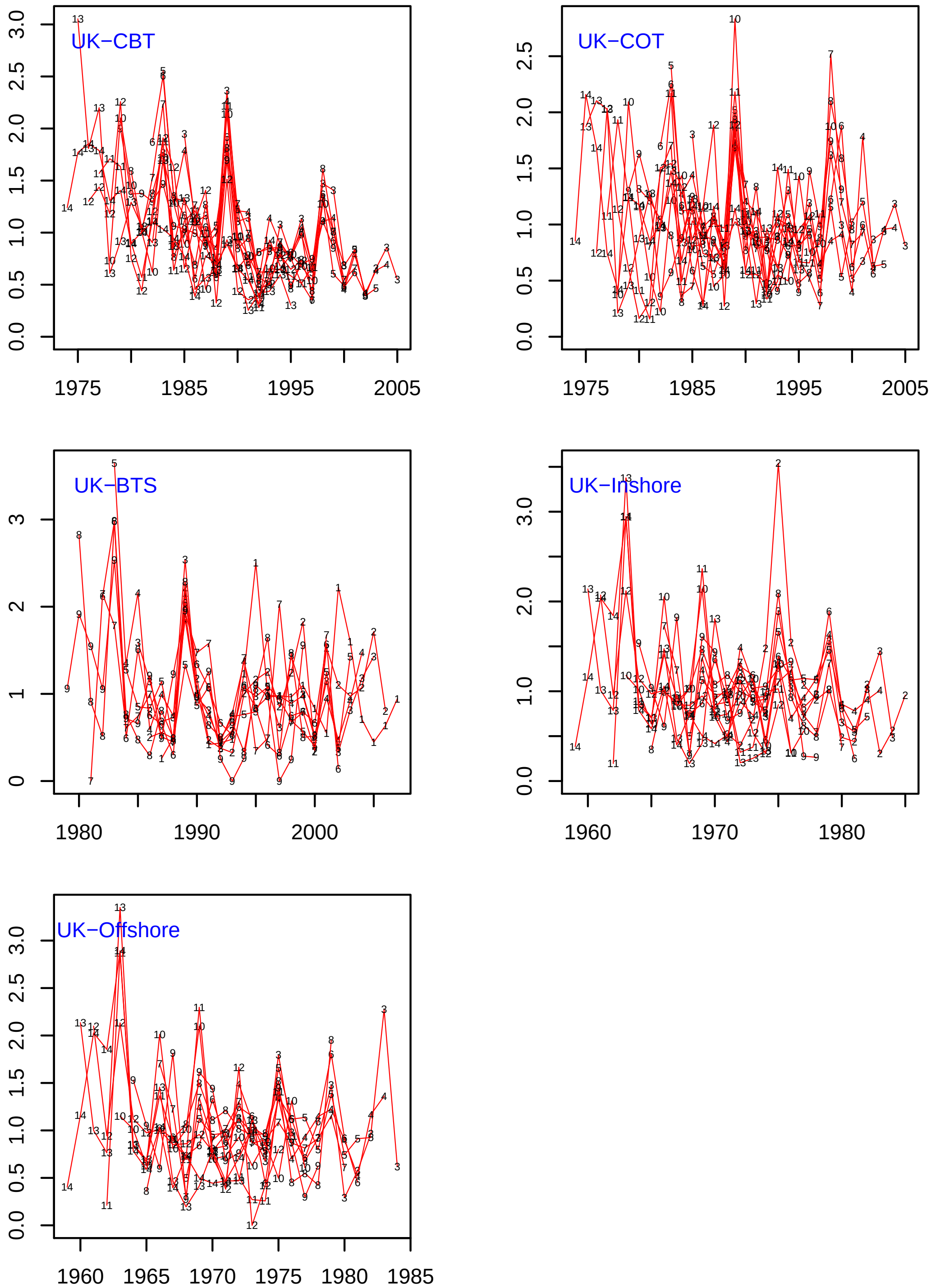


Figure 8.3.5 Sole VIIE Log CPUE by Year

note the cohorts differ on the x-axes due to the differences in the length and age range of the tuning series

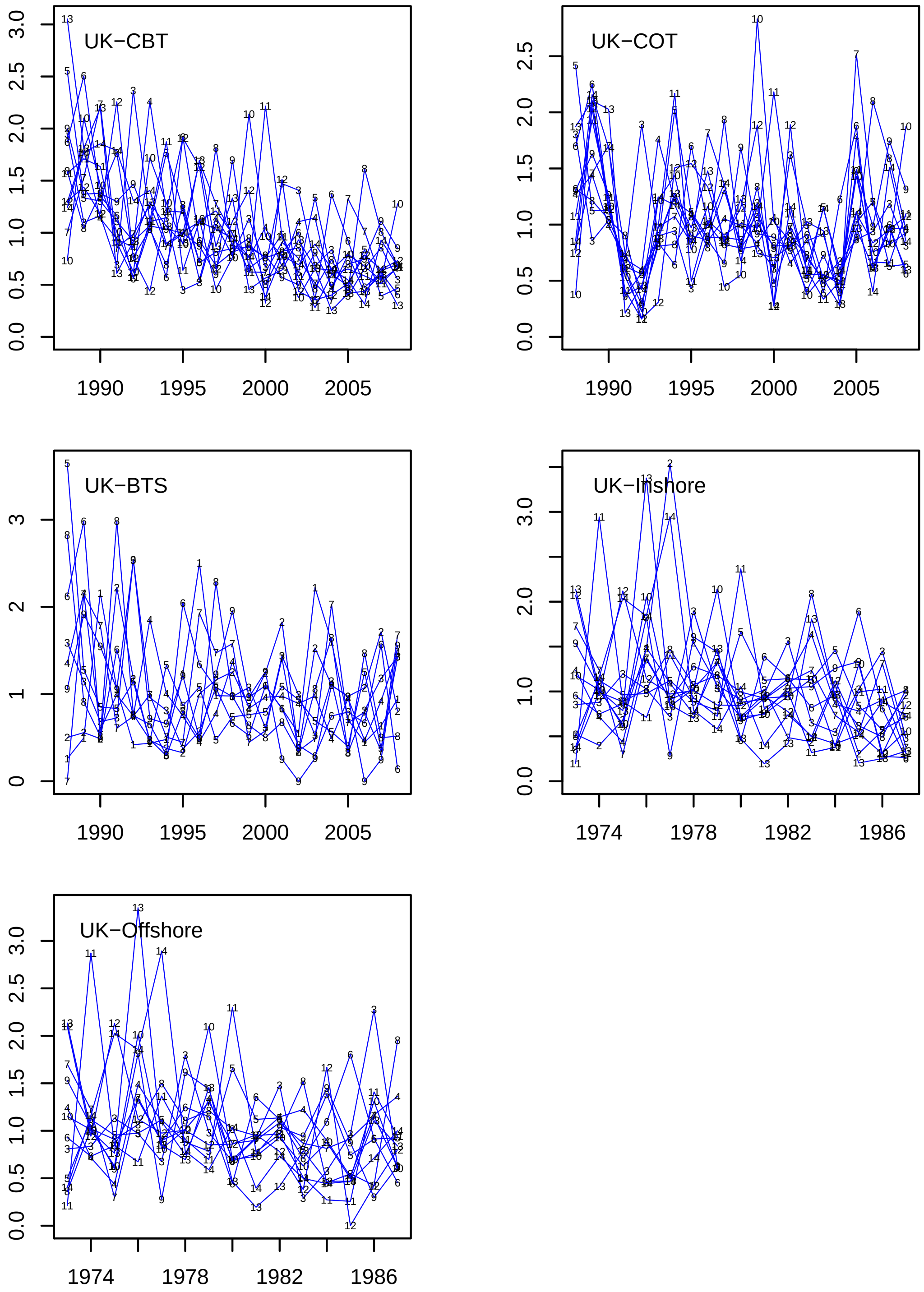


Figure 8.3.6 Sole VIIE LPUE and effort

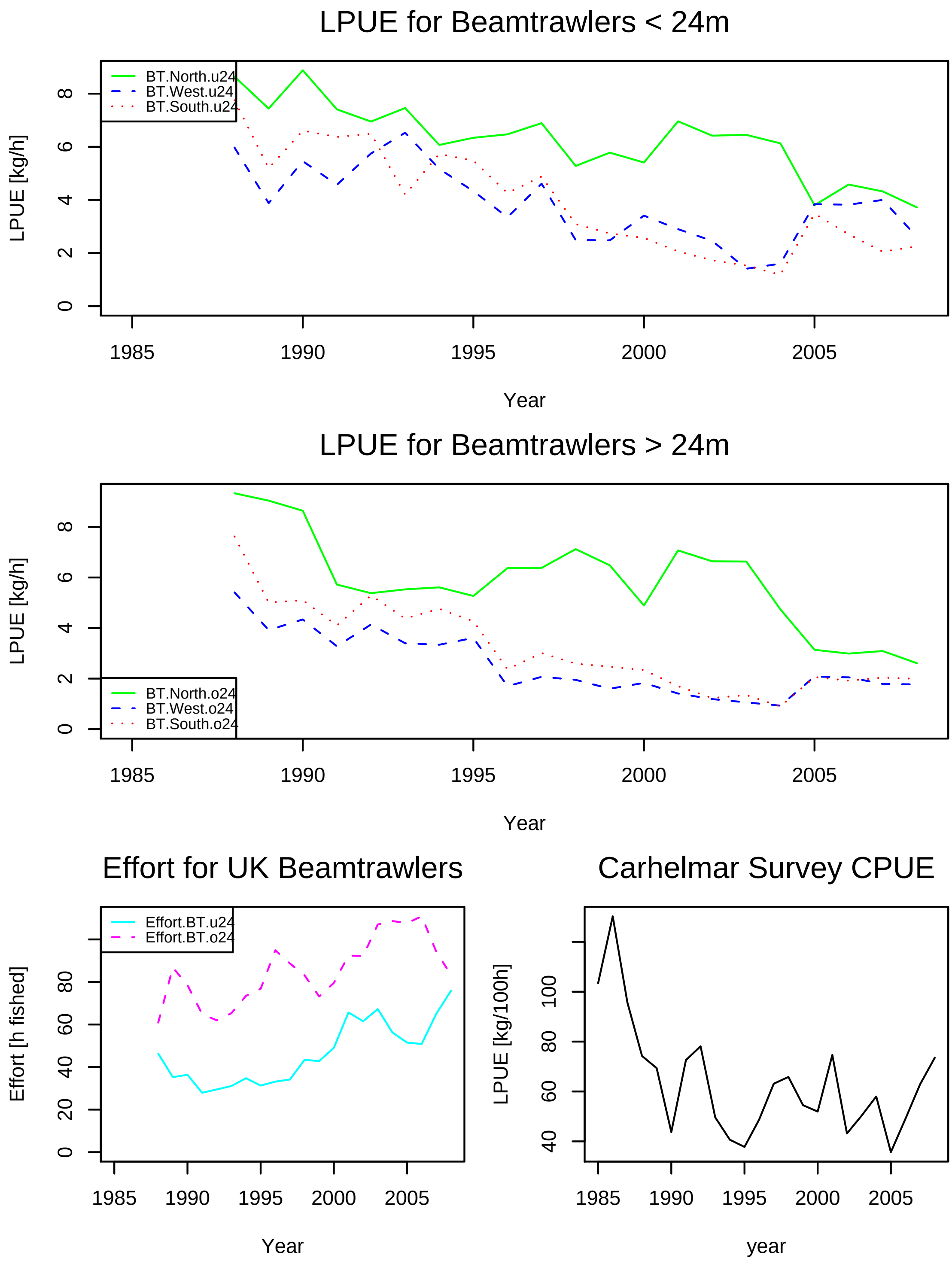


Figure 8.3.7 Sole VIIE Single Fleet Summary

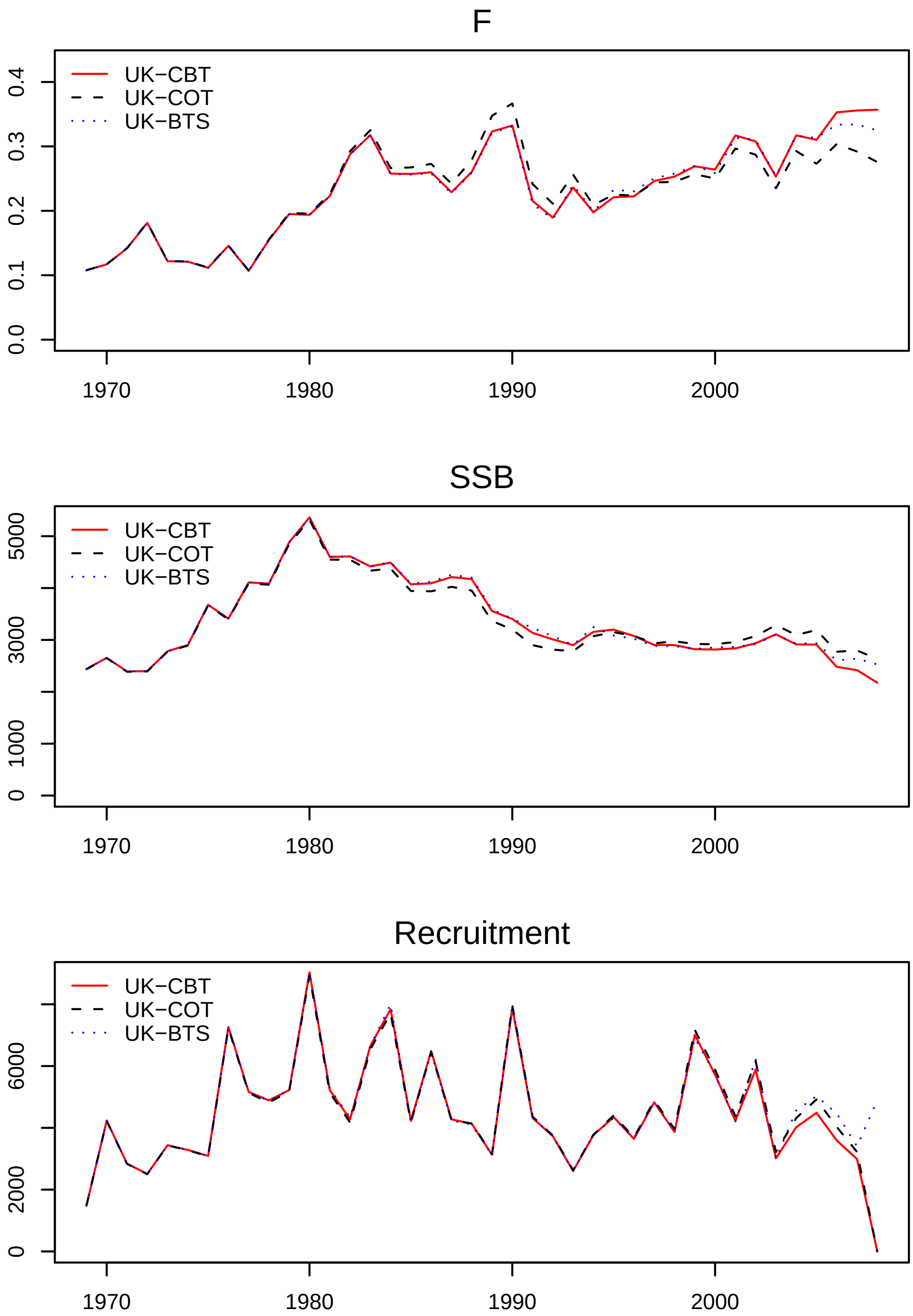


Figure 8.3.8 Sole VIIE Final XSA Residuals

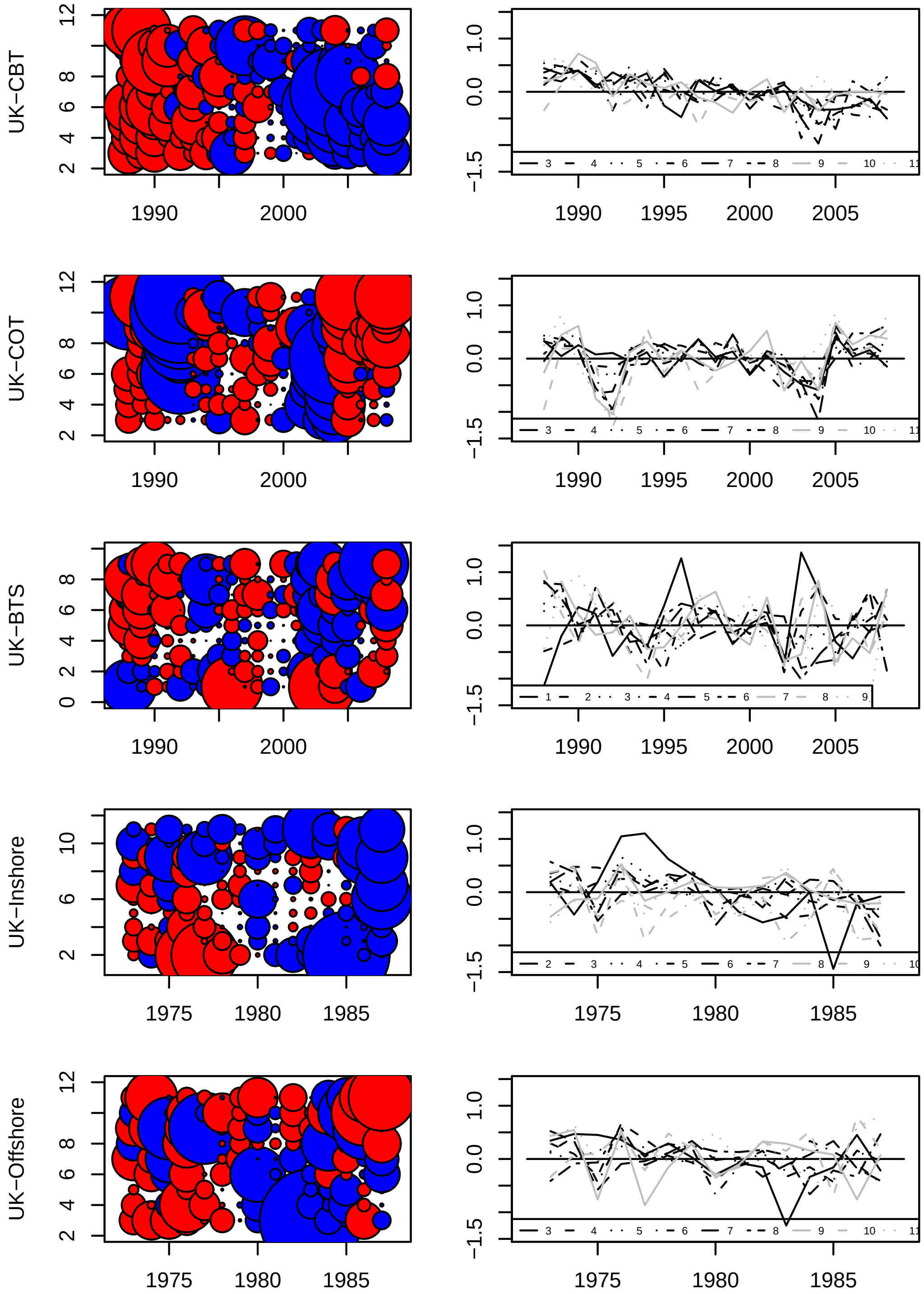


Figure 8.3.9 Sole VIIE Final XSA and previous XSAs

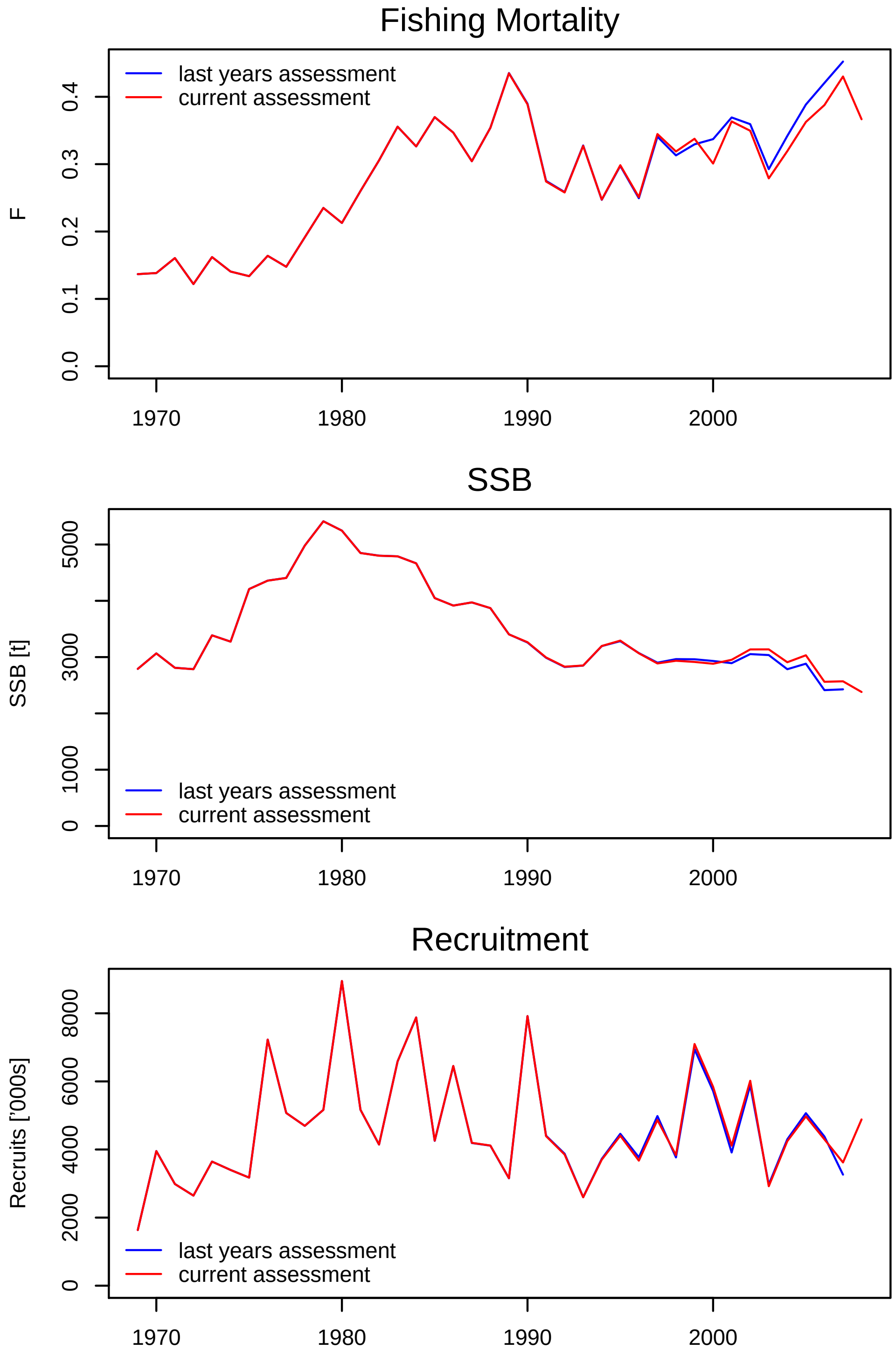
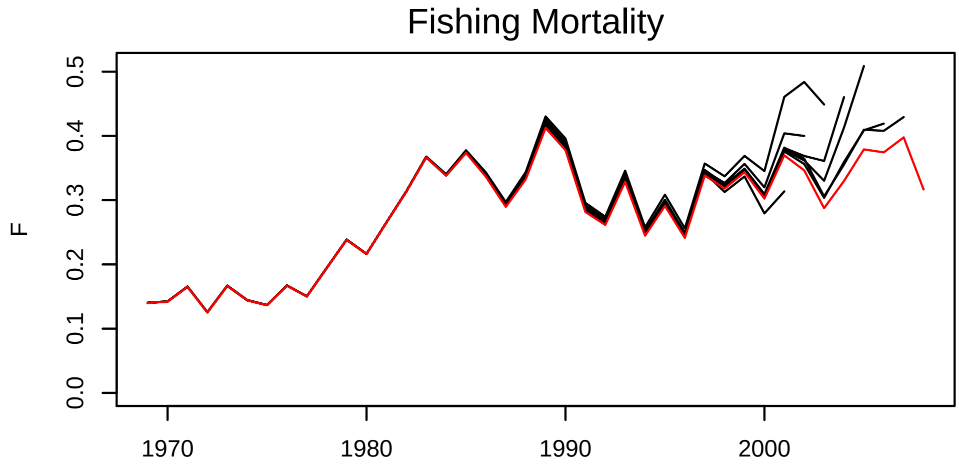
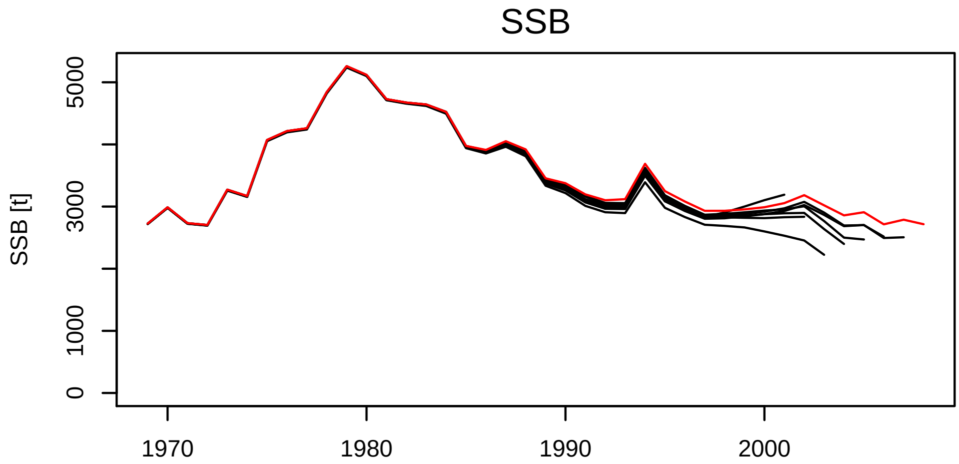
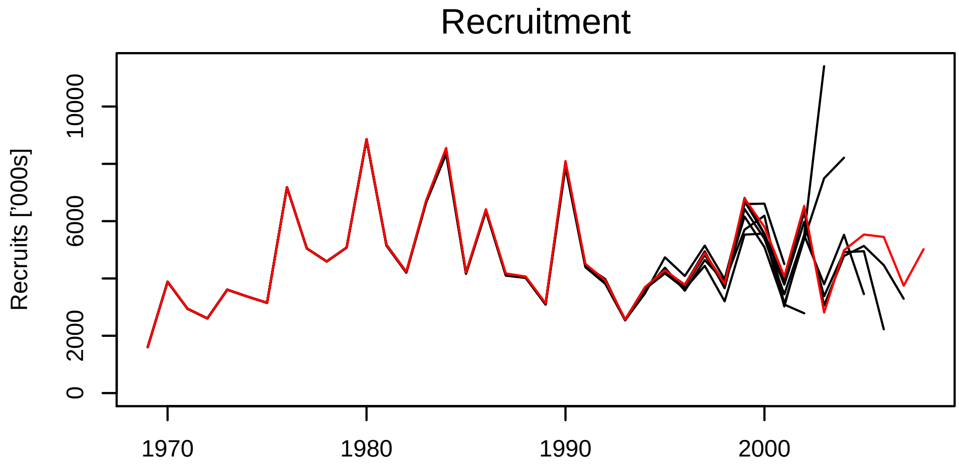


Figure 8.3.10 Sole VIIE XSA Retrospective Plots







9 Cod management plan evaluations

9.1 Background

EC (DG MARE) requested ICES in 2008 to evaluate an EC proposal for cod recovery plans (EC 2008a). The main feature of the proposed management plans was the intended harvest of all stocks covered by the plan (North Sea cod, Kattegat, West of Scotland, Irish Sea, Celtic Sea Cod) at a fishing mortality of 0.4 in the long term, adopting HCRs to achieve a stepwise reduction in fishing mortalities towards 0.4 (Figure 1).

An ICES *Ad hoc* Working Group (AGCREMP) was formed to evaluate objectives foreseen in the long-term management plans and to analyse if a target fishing mortality rate of 0.4 will appear well defined for all cod stocks covered by such a plan (ICES 2008). In particular, the group had to evaluate the consequences of the plans in terms of biological risks (particularly in relation to the ICES interpretation of the precautionary approach; yields (especially in the longer term) and stability of catches.

AGCREMP carried out Management Strategy Evaluation (MSE) for North Sea cod using the simulation tool FLR (Fisheries Library for R, http://www.flr-project.org, Kell *et al.*, 2007). The model included a dynamic feedback between the operating model, the observation-error model and the management procedure. The assessment process was dynamically included in the management procedure. Several sources of uncertainty were included in the modelling (e.g. bias in natural mortality or catch, different recruitment regimes). Therefore, conclusions on the MSE could be given for different assumptions on the operating model and observation-error model. Several different scenarios were considered to address sources of uncertainty in assessments. In addition, the performance of the plans was evaluated for a "standard" recruitment model that reflects the long-term relationship between spawning stock size and recruitment, and for a "low" recruitment model that reduces recruitment by 50%.

An important finding of AGCREMP was that the rule for constraining annual TAC adjustments could lead to very low F if stock recovery outstripped the annual TAC adjustment constraint, or lead to increasing F and stock collapse if the stock was declining at a faster rate than the TAC adjustments.

ICES advice based on AGCREMP (ICES ACOM 2008) was that the proposed Management Plan (including the Norwegian proposal) was likely to recover the North Sea cod stock. However ICES could not advise on the suitability of the Plans in relation to the precautionary approach because generally agreed criteria were lacking for Recovery Plans. ICES recommended that future plans state their objective for the target date for recovery and the acceptable level of risk that recovery does not occur by that date.

In December 2008 the European Commission and Norway agreed on a new cod management plan implementing a new system of effort management and a target fishing mortality of 0.4 ((EC) No. 1342/08). The HCR for setting TACs for cod stocks in the Kattegat the west of Scotland and the Irish Sea are as follows:

Article 7

Procedure for setting TACs for cod stocks in the Kattegat, the west of Scotland and the Irish Sea

1) Each year, the Council shall decide on the TAC for the following year for each of the cod stocks in the Kattegat, the west of Scotland and the Irish Sea. The TAC shall be calculated by deducting the following quantities

from the total removals of cod that are forecast by STECF as corresponding to the fishing mortality rates referred to in paragraphs 2 and 3: (a) a quantity of fish equivalent to the expected discards of cod from the stock concerned; (b) as appropriate a quantity corresponding to other sources of cod mortality caused by fishing to be fixed on the basis of a proposal from the Commission.

2) The TAC shall, based on the advice of STECF, satisfy all of the following conditions: (a) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be below the minimum spawning biomass level established in Article 6, the fishing mortality rate shall be reduced by 25% in the year of application of the TAC as compared with the fishing mortality rate in the previous year; (b) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be below the precautionary spawning biomass level set out in Article 6 and above or equal to the minimum spawning biomass level established in Article 6, the fishing mortality rate shall be reduced by15 % in the year of application of the TAC as compared with the fishing mortality rate in the previous year; and (c) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be above or equal to the precautionary spawning biomass level set out in Article 6, the fishing mortality rate shall be reduced by 10% in the year of application of the TAC as compared with the fishing mortality rate in the previous year.

3) If the application of paragraph 2(b) and (c) would, based on the advice of STECF, result in a fishing mortality rate lower than the fishing mortality rate specified in Article 5(2), the Council shall set the TAC at a level resulting in a fishing mortality rate as specified in that Article.

4) 4. When giving its advice in accordance with paragraphs 2 and 3, STECF shall assume that in the year prior to the year of application of the TAC the stock is fished with an adjustment in fishing mortality equal to the reduction in maximum allowable fishing effort that applies in that year.

5) 5. Notwithstanding paragraph 2(a), (b) and (c) and paragraph 3, the Council shall not set the TAC at a level that is more than 20% below or above the TAC established in the previous year.

Article 9

Procedure for setting TACs in poor data conditions

Where, as a consequence of lack of sufficiently accurate and representative information, STECF is not able to give advice allowing the Council to set the TACs in accordance with Articles 7 or 8, the Council shall decide as follows: (a) where STECF advises that the catches of cod should be reduced to the lowest possible level, the TACs shall be set according to a 25% reduction compared with the TAC in the previous year; (b) in all other cases the TACs shall be set according to a 15% reduction compared with the TAC in the previous year, unless STECF advises that this is not appropriate.

Article 10

Adaptation of measures

1) When the target fishing mortality rate in Article 5(2) has been reached or in the event that STECF advises that this target, or the minimum and precau-

tionary spawning biomass levels in Article 6 or the levels of fishing mortality rates given in Article 7(2) are no longer appropriate in order to maintain a low risk of stock depletion and a maximum sustainable yield, the Council shall decide on new values for these levels.

2) In the event that STECF advises that any of the cod stocks is failing to recover properly, the Council shall take a decision which: (a) sets the TAC for the relevant stock at a level lower than that provided for in Articles 7, 8 and 9; (b) sets the maximum allowable fishing effort at a level lower than that provided for in Article 12; (c) establishes associated conditions as appropriate.

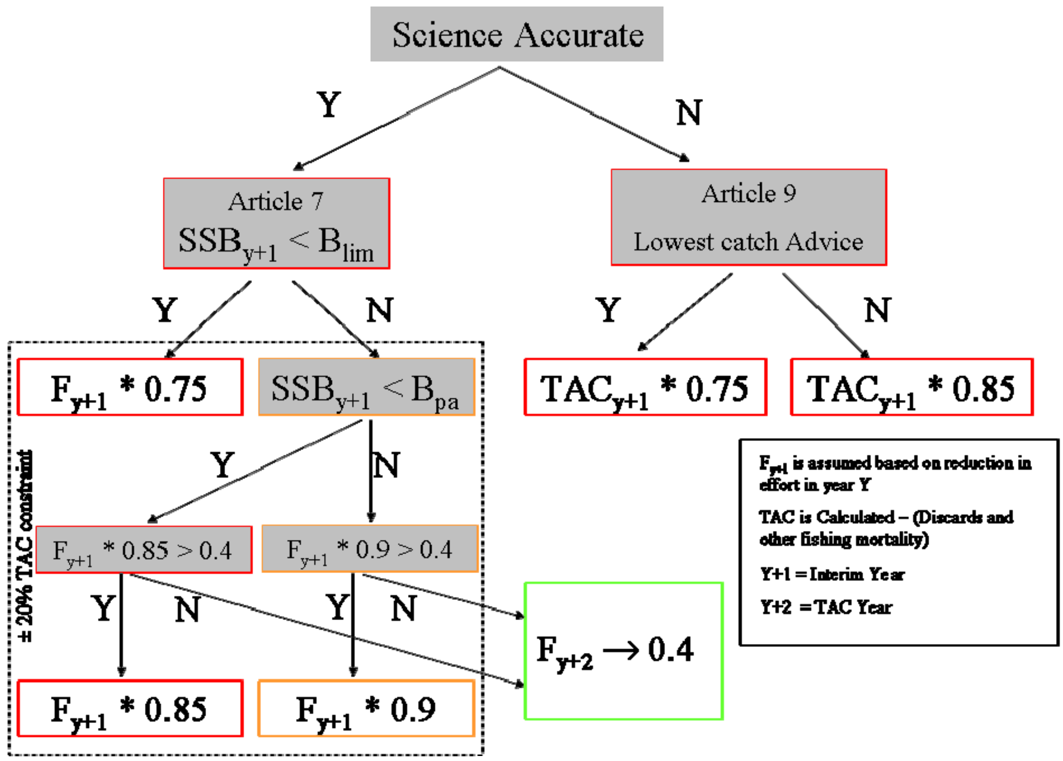


Figure 1. Decision tree for the cod long-term plan harvest control rule (EC) No. 1342/08.

9.2 Review of evaluations of management plans for WGCSE cod stocks

WGCSE 2009 was requested to review the latest evaluations of the final agreed management plan and to evaluate whether the management plan can be considered to be precautionary or not.

The following general conclusions are made:

- The management strategy evaluations carried out by the ACOM Review Group on Cod Management Plans are based on the application of Article 7 which sets TACs based on assessments and associated forecasts. The west of Scotland and Irish Sea cod stocks are however expected to be subject to Article 9(a) (*annual 25% TAC reductions from the 2009 TAC*) and possibly Article 10(2) ((a) *sets the TAC at a level lower than that provided for in Articles 7, 8 and 9; and (b) sets the maximum allowable fishing effort at a level lower than that provided for in Article 12*). These are not simulated in the evaluations of the plan and it is not possible to determine from the evaluations if the implementation of Article 9 is precautionary. The conditions that would trigger application of Article 10(2) (i.e. the STECF criteria for determining "*that any of the cod stocks is failing to recover properly*) are not defined and not incorporated in the MSE. In theory this could make the management plan precautionary but the rules under which this clause might be invoked are not set out in the plan. Delayed or insufficient responses to the failure of stocks to recover would increase the risk to the stock, and the delay could be a function of the accuracy of the assessments.

- WGCSE agrees with the evaluations of the management plan in their conclusion that a limit on annual TAC changes is counter-productive for recovery of depleted cod stocks. Constraints on TAC changes may be more appropriate to stocks that have recovered and are relatively stable, and where it is desirable to avoid unnecessary changes in TAC in response to estimation error in the assessments. However, for recovery plans for severely depleted stocks to be precautionary, there must be elements allowing for sufficient reductions in fishing mortality through appropriate management actions to ensure a high probability of stock recovery by the target date. Limits on TAC changes can have undesirable consequences because of the time-lag between estimating stock status and the resultant catch and effort limits from the plan, and second because of the growth potential of the cod stocks (rapid physical growth and relatively early maturing of cod). The MSE simulations demonstrate how, if the HCR reduces mortality sufficiently in the first year, growth in SSB can outstrip the limited annual TAC changes causing mortality to fall to very low levels. Eventually, the TACs catch up and the opposite problem can occur with SSB declining faster than the TACs can be decreased. The result is large-scale cycles in SSB and TAC (both for biomass and time-scale). The Working Group notes that the same management plan can lead to initial stock recovery or initial stock decline depending on the mean fishing mortality currently experienced by a stock. It is possible the plan, if well enforced, can lead to recovery of the VIa stock, but the VIIa cod MSE indicates that F will tend to increase and SSB decrease if TAC decreases are restricted to 20%.
- Total and fishing mortality rates in the west of Scotland and Irish Sea cod stocks are poorly determined, and as a result it will be very difficult to demonstrate significant changes in mortality in the short term, resulting from relatively small stepwise adjustments in management actions intended to reduce F. This will affect the ability of STECF to determine if the plans are achieving their objectives.
- The plan also includes effort reductions which are commensurate with the F reductions (Figure 2). For the management plan to succeed in recovering the cod stocks in VIa and VIIa, while fishing for other demersal stocks continues, it will be necessary to have well-targeted effort control for fleets with cod bycatches while reducing the bycatches of cod to as close to zero as possible. This could be most reliably achieved through the provisions of Chapter III of (EC) No. 1342/08 linking effort management to cod bycatch level, measures to reduce cod bycatches through avoidance schemes, use of highly selective gears and other effective approaches developed in collaboration with the fishing industry. The effectiveness of these measures would need to be considered in a full evaluation of the plan.

- WGCSE notes that the F 0.4 target is above current estimates of F_{max} for Irish Sea and West of Scotland cod but is also well below any historical observations of fishing mortality.

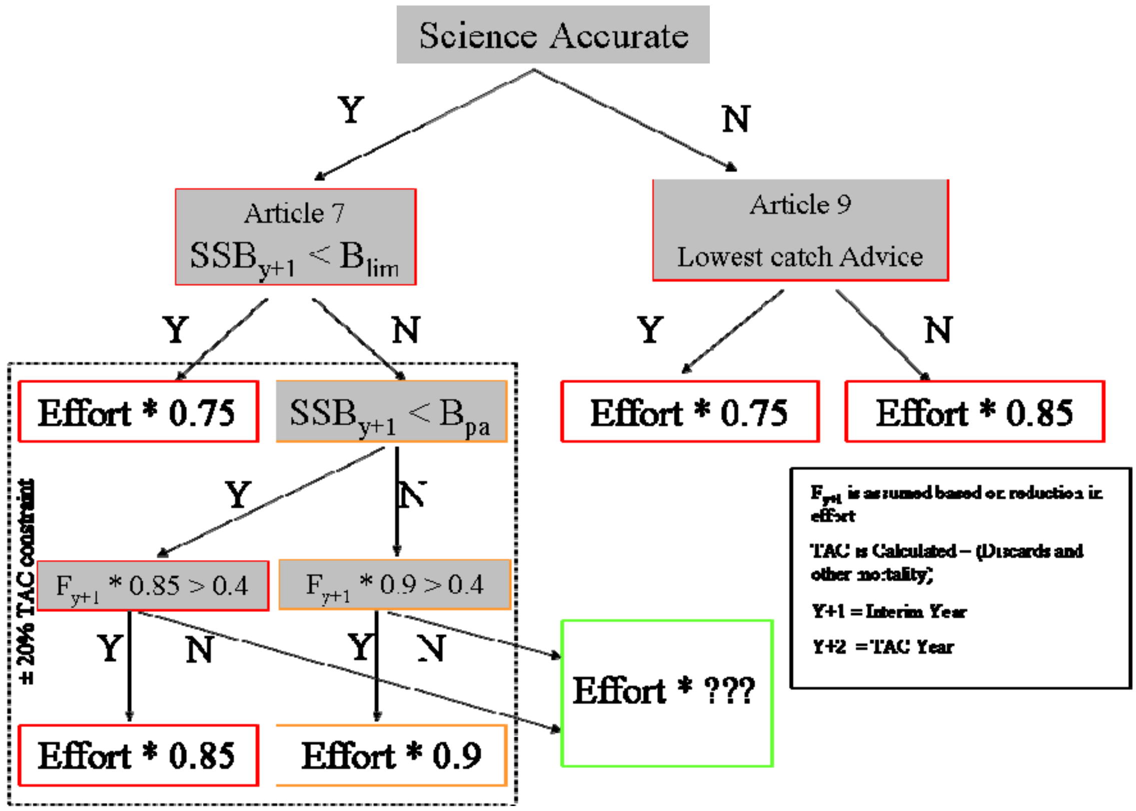


Figure 2. Decision tree for effort control within the cod long-term plan (EC) No. 1342/08.

9.3 West of Scotland cod

The Working Group agrees with the VIa cod MSE and associated review that a limitation of the MSE is the assumption that discard ratios remain constant. In the VIa area it has already been seen how restrictive TACs and a (moderately) strong year class have lead to a considerable increase in discards ratio as well as the size of fish discarded.

Article 7 (paragraph 1) of the management plan requires TACs to be calculate after subtraction of discards and other sources of fishing mortality in excess of landings. The current assessment of VIa cod is considered to estimate a mortality that is a combination of mortality from fishing and natural mortality not accounted for by the standard long-term input value. As such mortality from landings, discards and other causes as a result of fishing cannot be defined.

Article 7 (paragraph 4) requires forecasts assuming a reduction in fishing mortality equal to the reduction in maximum allowable fishing effort in the year prior to the TAC year. The inability to define fishing mortality means this is not possible, i.e. if the rule were applied it is believed it would be assuming a one to one relationship between allowable effort and mortality including that from natural causes.

The application of a constraint on annual TAC adjustments resulted in a very rapid decline in F to values well below even the $F_{0.1}$ reference point for this stock. This differs from the VIIa cod MSE where the opposite occurred. This is clearly a consequence of the starting F as both stocks are severely depleted. The MSE was based on the 2008 WGNSDS assessment indicating an F in 2007 of 0.79 and median F predicted for 2008 was 0.88 under all scenarios tested. The WGCSE 2009 assessment revises F for 2007 up to 0.82 and estimates an F of 0.88 in 2008. The 2008 figure is exactly in line with the MSE median prediction and as such does not invalidate the MSE results for the scenarios explored.

9.4 Irish Sea cod

The only scenario in the MSE for this stock that demonstrated the desired increase in SSB, recruitment and yield was the scenario with no TAC constraint, but this only had a 29% chance of SSB increasing to levels above $\mathbf{B}_{lim}$ by 2015 even assuming a stock recruit curve fitted to all historical data (which is likely to be overoptimistic).

Including a 20% constraint on annual TAC adjustment resulted in a low probability of SSB >B_{lim} by 2015 and a rapidly escalating F. This must be a consequence of the initial high F from the assessment.

The conclusion of the MSE was that the EU Management Plan cannot be considered precautionary. Independent reviews of the management plan evaluation criticized the lack of detail in the evaluation report but did not disagree with the conclusions.

The MSE was based on the 2008 WGNSDS assessment indicating an F in 2007 of 1.56. The WGCSE 2009 assessment revises this down slightly to 1.44 and estimates an F of 1.28 in 2008. This corresponds to an 11% reduction in F in 2008. The differences between the 2008 and 2009 assessment are unlikely to be sufficient to invalidate the MSE results for the scenarios explored.

Similar to VIa cod the mortality from landings, discards and other causes as a result of fishing cannot be defined.

9.5 References

EC 2008a. Proposal for a Council Regulation amending Regulation (EC) No 423/2004 as regards the recovery of cod stocks and amending Regulation (EEC) No 2847/93. {SEC. 2008. 386, SEC(2008) 389} Brussels, 2.4.2008, COM(2008) 162 final, 2008/0063 (CNS).

EC 2008b. Council Regulation establishing a long-term plan for cod stocks and the fisheries exploiting those stocks and repealing Regulation (EC) No. 423/2004. (EC) No. 1342/08.

ICES-AGCREMP 2008. Report of the Ad hoc Group on Cod Recovery Management Plan (AGCREMP). ICES CM 2008/ACOM: 61.

Kell, L.T., Mosqueira, I., Grosjean, P., Fromentin, J-M., Garcia, D., Hillary, R., Jardim, E., Mardle, S., Pastoors, M.A., Poos, J.J., Scott, F. and R.D. Scott. 2007. FLR: an open-source framework for the evaluation and development of management strategies. ICES Journal of Marine Science 64: 640–646.

10 Recommendations

WGCSE 2009 makes the following general recommendations:

RECOMMENDATION	FOR FOLLOW UP BY:
1. WGCSE consider that there needs to be consistency across the ecoregion about the procedure for accepting forecasts as a basis of management advice. In line with the "SPALY" approach short-term forecasts have been provided for several stocks with strong retrospective patterns or other uncertainties. For other stocks other forecasts have been rejected by previous reviews and advice drafting groups for the same reason. In lieu of a full benchmark procedure the WG is best placed to decide on the reliability of a short-term forecast. ACOM and the ADG should reflect on this and provide guidelines to WGCSE.	RGCSE, ADGCSE and ACOM
2. WGCSE recommends the formation of an expert group such as WGSAD to consider the statistical and design aspects of survey data for a number of stocks. The group should include survey practitioners and statisticians to consider the most appropriate way calculate survey indices and uncertainties. Within WGCSE there are several stocks where survey data are critically important and these would form useful case studies e.g. Cod VIIe-k, *Nephrops* UWTV, Anglerfish and Megrim.	SICOM (September ASC)
3. WGCSE is aware of a project currently working on the allocation schemes for attributing the fishing statistics to the DCF matrix, but recommends to convene a workshop on métiers definition in the Celtic Sea Ecoregion, starting from the DCF métier level 6. This workshop should consider the solubility of the historical Fishing Units and other métier based classifications into the new métiers definitions. The ultimate objective is to generate an integrated database for demersal fisheries operating in the Celtic Seas. The COST/Fishframe format might be usefull as a starting platform for integration. Such a database is a prerequsity of mixed fisheries analysis and the production of integrated fisheries based discriptions and advice for the Celtic Seas Ecoregion.	ACOM
4. The is an on going generic problem across ICES demersal assessmet WGs on the integration of more recent, and usually noisey, discard data into analitical assessment with a longer time-series of landings. WGCSE would recommend a dedicated ICES workshop on this issue as a matter of high priority. For many stocks in the WGCSE area new discard data has been collected as part of the DCF but we are still not able to make full use of these data.	SICOM (September ASC), PGCCDBS

WGCSE 2009 makes the following recommendations in regard to benchmarking stocks up to 2012:

Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
VIIe Plaice	The benchmark should adress the following key issues and there is agreement by WGCSE members to undertake the preparatory work necessary. Investigate migration/stock separation issues; including why VIId and VIIe plaice assessments demonstrate opposite retrospective patterns. Review the tuning datasets available and year and age ranges to remove inconsistencies in vessels and gears and examine the impact on retrospective bias. A detailed review of the derivation and amalgamation of the FSP survey is particularly important following the strong year effect in this year's survey. Consider adding estimates of discarding to the assessment. Even though discards are considered to be lower than for other plaice stocks, its still relatively high in Q1/2. Consider modification of the catch and stock weights-at-age calculation. Examine the impact of changing the method of national data aggregation to using fleet disaggregated data.	2010	Expert group members. Plaice migration experts.
Megrim in Division IV and VI	Megrim (Divisions VIIb–k and VIIIabd) has been listed for benchmark in 2011. Many of the data and assessment problems are similar for Megrim in VI and IV i.e. discards, tuning fleets, consistency in the catch-at-age data, poorly known migrations, complicated life histories. It would be very important to benchmark the assessments in both areas at the same time. In advance of a possible benchmark in 2011 it is first necessary to construct international catch numbers/weights-at-length and age for the main fleets engaged in the fishery. For megrim in VI, this requires data from Ireland, UK, France and Spain and for megrim in IV, from the UK. Effort data for the main fleets engaged in both the VI and IV megrim fisheries are required to provide a time-series of trends in commercial lpue in both VI and IV. Progress should be reviewed by WGCSE 2010 at which point the viability of a benchmark process in 2011 should be confirmed.	Early 2011	Expert group members and Megrim biologists.

Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
Western waters cod stocks (Area VI and VII excl. VIId).	The current situation with highly uncertain assessments and no reliable forecasts is unsatisfactory in the context of the long-term management plans for these stocks and an urgent benchmark is required. However, progress towards a benchmark will not be easy and will require a number of years of preparation to address the most important issues. WGCSE propose a benchmark towards the end of 2011 such that the finalized Report in early 2012 will form the basis of future stock assessments. Some generic ideas are discussed below and stock specific issues are mentioned in the the stock sections. Cod stocks in Divisions VI and VII comprise an assemblage of meta-populations with varying degrees of mixing. Fishing effort, predation and other environmental drivers including climate change affect the populations in different ways across the range of the stocks. The stocks have proven difficult to assess because of data deficiencies and an inability to demonstrate responses to changes in fishing effort and other management controls. Improved management advice may benefit more from quantifying the spatial dynamics of cod in relation to spatial variations in fishing and other pressures than by trying to refine the current modelling approaches applied to the current stock definitions and management units. To make progress towards this, an initial Data Workshop is proposed to collate and interpret existing and new data on cod stock structure and mixing, distribution patterns, spatial variations in size/age structure and biological characteristics as well as pressures including predation, fishing and climate. Such analyses will be facilitated by high-resolution spatial data on fishery catches and effort by métier using VMS, rectangle data, employing GIS methods. It will be necessary to develop an international database holding spatially resolved datasets (landings, discards, effort, size/age/biological data, surveys, environmental variables) and data manipulation routines to allow evaluation of the effect on the assessments of altering the stock unit definition. Data on cod movement parameters will be required to allow development of operating models for testing assessment and management procedures and ultimately developing and testing spatially disaggregated assessment models. New datasets e.g. on discarding, biology, predation, surveys and fishing effort/cpue would be evaluated. The Data Workshop would build on and review the outcomes of a major UK collaborative programme on cod stock structure and spatial dynamics, which will be completed in 2011. The ensuing Benchmark Assessment workshop would evaluate the appropriateness of current assessment methods in the light of the Data Workshop outcomes, and explore alternative approaches as candidates for providing management advice. This could include changes to the spatial units for assessment or the development of spatially disaggregated assessment models including mixing coefficients.	Late 2011	Cod biologist and population experts. Data experts.

Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
Cod VIa	The following priority issues would fall within the scope for benchmark of VIa cod: Investigate migration/stock separation issues including linkage of cod to the North of VIa with the North Sea and cod to the south with VIIa or elsewhere. This would require spatially disaggregated data to be examined. An analysis of area misreporting of landings should be examined before next year's WG. The discard estimation procedure should be examined and a new methodology is being developed as part of a PhD project. Results are expected before 2012. Variance and bias in survey index is being examined as Marine Scotland project due for completion in 2010. The inclusion of additional surveys (ScoQ4GFS and IRGFS) in the assessment is also a matter that need to be considered in a benchmark. Uncertainty in natural mortality (level and trend) because of unquantified predation from large and increasing seal population is a key issue in the assessment. Revision of TSA is required to allow inclusion of different fleets, (this in turn allows estimates of age specific consumption of cod by seals to be input as if from an additional fleet). A method for estimating age specific consumption of cod by seals was presented at 2008 ICES ASC. Work to adjust TSA scheduled for 2009.	Late 2011	Expert group members, survey statisticians, TSA experts, seal experts.
Cod VIIa	The following priority issues would fall within the scope for benchmark of VIIa cod: Investigate stock structure/migration of VIIa cod in the context of the other stocks. Assessment model assumptions and formulation need to be investigated thoroughly. Investigate all sources of mortality on the cod stock particularly in the context of no apprent change in mortality rates despite substantial reductions in effort by some fleets and improved control measures. Integration of new datasets particularly the new data from egg production surveys which is expected in mid-2011.	Late 2011	Expert group members
Cod VIIe–k	WKROUND 2009 concluded that more work is required before Celtic Sea cod can be benchmarked successfully. WGCSE 2009 has suggested a response to their recommendation in Section 7.2. The key requirement is to obtaing better discard data and catch data where misreporting may be a problem (the latter is not something the scientific community can solve). Progress towards improved data for this stock will be reviewed by WGCSE in 2010 with a view to conucting another benchmark in late 2011.	Late 2011	Expert group members

Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
Nephrops FU20–22	The FU20–22 *Nephrops* stock is not analytically assessed by the WGCSE. The 2008 total official landings reach the highest level observed in the time-series available. Global indicators suggest the stock is stable or increasing and the has been an expanision of fishing effort in recent years. There is an urgent need to develop a more robust scientific assessment. Several data and methodological aspects should be address and explored in the next benchmark (see Section 7.7.9). A new UWTV survey since 2005 covers some of the stock area but not all. An indicator based framework might also be appropriate given the ongoing data and sampling issues. WGCSE will review progress on these issues in 2010 and confirm that a benchmark in 2011 would be realistic.	Early 2011	Expert group members, UWTV experts and indicator experts.
Sole VIIa	WGCSE considers the following issues should be adressed at the next benchmark: The priority should be to develop a long-term plan to rebuild the stock to sustainable levels. The WGCSE recommends that various HCR might be developed and tested through simulations. The reintroduction of commercial tuning-series into the assessment should be examined. The retrospective application of an international age–length-key and historical precision of catch-at-age data should be investigated. The approach to smoothing catch weight and stock weights should reviewed. Weights in some years look unusual e.g. 2004. Given the current assessment diagnostics the choice of q plateau and f-bar range could also be reviewed. This work can be carried out by 2011. WGCSE will review progress on these issues in 2010.	Early 2011	Expert group members and MSE experts
VIIa Plaice	WGCSE considers the following issues should be adressed at the next benchmark: Discards not available for assessment but are considered significantly larger than landings. Catch weights reveal trends in recent years and it was noticed in 2009 that UK (E&W) and Irish catch weight-at-age data display very different results. It is unsure whether the age based indices used to tune the assessment are representative of the stock. This work can be carried out by 2011. WGCSE will review progress on these issues in 2010.	Early 2011	Expert group members.

Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
VIIf,g Plaice	WGCSE considers the following issues should be adressed at the next benchmark: Biological interactions with adjacent stocks; in particular Irish Sea plaice (Dunn and Pawson, 2002) The lack of discard data in the assessment. The need to review the tuning data included in the assessment as additional survey data are becoming available and the age ranges of all tuning datasets should be reinspected. Need to reconsider the assessment model setting being used as the power model is only indicated by one of the fleets. There is also a retrospective bias in SSB, F and recruitment, which should be examined. Review the new maturity data, which has become available from sampling carried out under the EU DCF. This work can be carried out by 2011.	Early 2011	Expert group members
Other WGCSE plaice stocks	WGCSE considers that it would also be appropriate to review the available data, assessment and advice possibilities for Plaice populations in VIIbc, VIIh–k and VIa at the same time as the stocks in VIIa and VIIfg because there may well be some interconectivity. Significant progress was made in 2009 for a review of data for the VIIbc and VIIh–k stock in particular but a full assessment is unrealistic, however an indicator based framework to support advice provision may be more appropriate.	Early 2011	Expert group members
Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Division IIa, IIIa, Subarea IV and VI	ICES has previously advised a two-stage approach for management of the anglerfish fishery. Stage one was to improve the quality and quantity of data collected (this was expected to take >5 years). Stage two would then be to use these data to examine alternative management approaches and harvest control rules. The data collection stage of this process is currently ongoing (now in year 5). But progress on the second stage is now needed. The following work is needed in advance of a benchmark: The biological data associated with the anglerfish surveys should be evaluated; A workshop on age estimation should take place; The catch-at-age data should then be evaluated for use in any assessment. Survey based assessment model could also be developed to determine the absolute abundance of the total population. Recommendations of WKAGME for the improvement of the anglerfish surveys should be addressed. Additional participation of nations with an interest in this fishery should be encouraged before the next benchmark to extend survey coverage. There is broad agreement at WGCSE to carry out the work above before 2012.	Early 2012	Expert group members, Anglerfish biologists, survey and population modelling experts.

Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
VIIf,g sole	WGCSE considers the following issues should be adressed at the next benchmark: A need to update the Belgian commercial tuning-series. The Belgian beam trawl tuning-series is only used up to 2003, mainly because the estimation of the corresponding lpue series could not be calculated correctly. WKFLAT 2009 proposed a possible way of calculating Belgian beam trawl lpue for Division VIId, using a more realistic horsepower correction method. The proposed method should be investigated, not only for the Belgian beam trawl lpue but also for the UK beam trawl lpue in Division VIIfg, which are the two commercial fleets used in this assessment. A need to investigate the spatial distribution of the major Celtic sea fleets and possible impacts of the Trevose closure. WGCSE will review progress on the above issues in 2010 and 2011 and confirm if a benchmark in 2012 is realistic.	2012	Expert group members
VIIe Sole	WKFLAT 2009 could not recommend an appropriate assessment procedure for this stock for the following reasons: Closed population and complete mixing assumptions of the assessment are violated. Tuning data indicate differences in trends in F and recruitment resulting in a serious retrospective pattern in the assessment. Survey information only partially covers the stock area. Effort correction parameters/methodologies require updating as the main beam trawl fleet has restructured substantially recently. This effort would be greatly enhanced by an internationally coordinated survey that more appropriately covers the management area and is able to assess recruitment dynamics irrespective of the sources of recruitment and environmental drivers. WGCSE will review progress on the above issues in 2010 and 2011 and confirm if a benchmark in 2012 is realistic.	2012	Experts with expertise in spatial modelling of stock dynamics, expertise in the analysis of tagging information.

WGCSE make the above recommendations with due consideration of resources required before and during the benchmark. Although several stocks are recommended for benchmark in 2011 this is considered achievable given that different persons will be involved in the benchmarks for different stocks.

Annex 1: List of participants

Name	Address	Phone/Fax	Email
Mike Armstrong	Centre for Environment, Fisheries and Aquaculture Science Lowestoft Laboratory Pakefield Road NR33 0HT Lowestoft Suffolk UK	Phone +44 1502 524362 Fax +44 1502 524511	mike.armstrong@cefas.co.uk
Robert Bellail	IFREMER Lorient Station 8 rue François Toullec F-56100 Lorient France	Phone +33 2 97 87 3819 Fax +33 2 97 87 3836	robert.bellail@ifremer.fr
Otte Bjelland	Institute of Marine Research PO Box 1870 N-5817 Bergen Norway	Phone +47 55 23 86 03 Fax +47 55 238 531	otte.bjelland@imr.no
Richard Briggs	Agri-food and Biosciences Institute 18a Newforge Lane BT9 5PX Belfast UK	Phone +44(0)28 90255503 Fax +44(0)28 90255004	richard.briggs@afbini.gov.uk
Sarah Clarke	Fisheries Research Services FRS Marine Laboratory PO Box 101 AB11 9DB Aberdeen Torry UK	Phone +44 1224 295 427	Clarkes@marlab.ac.uk
Sarah Davie	Marine Institute Rinville Oranmore Co. Galway Ireland		sarah.davie@marine.ie
Helen Dobby	Fisheries Research Services FRS Marine Laboratory PO Box 101 AB11 9DB Aberdeen Torry UK	Phone +44 1224 876544 Fax +44 1224 295511	h.dobby@marlab.ac.uk

Name	Address	Phone/Fax	Email
Jennifer Doyle By correspondence	Marine Institute Rinville Oranmore Co. Galway Ireland	Phone 353 91 387200 Fax 353 91387201	jennifer.doyle@marine.ie
Jon Elson By correspondence	Centre for Environment, Fisheries and Aquaculture Science Lowestoft Laboratory Pakefield Road NR33 0HT Lowestoft Suffolk UK	Phone +44 1 502 524 243 Fax +44 1 502 562 244	jon.elson@cefas.co.uk
Paul Fernandes	Fisheries Research Services FRS Marine Laboratory PO Box 101 AB11 9DB Aberdeen Torry UK	Phone +44 1224 295 403 Fax +44 1224 295511	fernandespg@marlab.ac.uk
Spyros Fifas	IFREMER Centre de Brest PO Box 70 F-29280 Plouzané France	Phone +33 0298224378 Fax +33 0229008547	spyros.fifas@ifremer.fr
Ross Fitzgerald By correspondence	Marine Institute Rinville Oranmore Co. Galway Ireland	Phone +353 Fax +353	ross.fitzgerald@marine.ie
Steve Flatman	Centre for Environment, Fisheries and Aquaculture Science Lowestoft Laboratory Pakefield Road NR33 0HT Lowestoft Suffolk UK	Phone +44 1502 524245 Fax +44 1502 513865	steve.flatman@cefas.co.uk
Hans Gerritsen	Marine Institute Rinville Oranmore Co. Galway Ireland	Phone +353 91 387297 Fax +353 91 387201	hans.gerritsen@marine.ie

Name	Address	Phone/Fax	Email
Norman Graham	Marine Institute Rinville Oranmore Co. Galway Ireland	Phone +353 91 387 307	norman.graham@marine.ie
Deirdre Hoare By correspondence	Marine Institute Rinville Oranmore Co. Galway Ireland	Phone +353 Fax +353	deirdre.hoare@marine.ie
Ian Holmes	Centre for Environment, Fisheries and Aquaculture Science Lowestoft Laboratory Pakefield Road NR33 0HT Lowestoft Suffolk UK	Phone +44 1502 562244 Fax +44 1502 513865	ian.holmes@cefas.co.uk
Steven Holmes	Fisheries Research Services FRS Marine Laboratory PO Box 101 AB11 9DB Aberdeen Torry UK	Phone +44(0) 1224 29 5507 Fax +44(0) 1224 29 5511	s.holmes@marlab.ac.uk
Andrzej Jaworski	Fisheries Research Services FRS Marine Laboratory PO Box 101 AB11 9DB Aberdeen Torry UK		a.jaworski@marlab.ac.uk
Vladimir Khlivnoy	Knipovich Polar Research Institute of Marine Fisheries and Oceanography 6 Knipovitch Street RU-183763 Murmansk Russian Federation	Fax +47 7891 0518	khlivn@pinro.ru
Sven Kupschus	Centre for Environment, Fisheries and Aquaculture Science Lowestoft Laboratory Pakefield Road NR33 0HT Lowestoft Suffolk UK	Phone +44 1502 562244 Fax +44 1502 513865	Sven.Kupschus@cefas.co.uk

Name	Address	Phone/Fax	Email
Colm Lordan Chair	Marine Institute Rinville Oranmore Co. Galway Ireland	Phone +353 91 387200 Fax +353 91 387201	colm.lordan@marine.ie
Chris Lynam	Centre for Environment, Fisheries and Aquaculture Science Pakefield Road NR33 0HT Lowestoft Suffolk UK		chris.lynam@cefas.co.uk
Charlotte Main	Fisheries Research Services FRS Marine Laboratory PO Box 101 AB11 9DB Aberdeen Torry UK	Phone +44 1224 295 427	c.main@marlab.ac.uk
Sara-Jane Moore By correspondence	Marine Institute Rinville Oranmore Co. Galway Ireland	Phone +353(0)91387200 Fax +353(0)91387201	sara-jane.moore@marine.ie
Kelle Moreau	Institute for Agricultural and Fisheries Research Ankerstraat 1 B-8400 Oostende Belgium	Phone +32 59 569830 Fax +32 59 330629	kelle.moreau@ilvo.vlaanderen.be
Cristina Morgado	International Council for the Exploration of the Sea H. C. Andersens Boulevard 44–46 DK-1553 Copenhagen V Denmark	Phone +45 33 38 67 21 Fax +45 33 63 42 15	cristina@ices.dk
Sten Munch-Petersen	National Institute of Aquatic Resources Section for Fisheries Advice Charlottenlund Slot Jægersborg Alle 1 DK-2920 Charlottenlund Denmark	Phone 45 33963390 Fax 45 33 96 33 33	smp@aqua.dtu.dk

NAME	ADDRESS	PHONE/FAX	EMAIL
Matthew Parker-Humphreys	Centre for Environment, Fisheries and Aquaculture Science Lowestoft Laboratory Pakefield Road NR33 0HT Lowestoft Suffolk UK	Phone +44 (0)1502 524219 Fax +44 (0)1502 513865	matthew.parker-humphreys@cefas.co.uk
Pieter-Jan Schön Chair	Agri-food and Biosciences Institute 18a Newforge Lane BT9 5PX Belfast UK	Phone +44 28 90255015 Fax +44 28 90255004	pieter-jan.schon@afbini.gov.uk
Willy Vanhee	Institute for Agricultural and Fisheries Research Ankerstraat 1 B-8400 Oostende Belgium	Phone +32 5 956 9829 Fax +32 5 933 0629	willy.vanhee@ilvo.vlaanderen.be
Joël Vigneau	IFREMER Port-en-Bessin Station PO Box 32 F-14520 Port-en-Bessin France	Phone +33 231 515 600 Fax +33 231 515 601	joel.vigneau@ifremer.fr

Annex 10: Technical Minutes of the Celtic Sea Review Group 2009

- RGCS
- 26 May–4 June 2009, Fairhaven Massachusetts, USA
- Participants: Steve Cadrin (Chair), Adam Barkley, Greg DeCelles, Dan Goethel, Nikki Jacobson, Lisa Kerr, Dave Martins, Cate O'Keefe, Sally Roman, Tony Wood. Barbara Schoute (ICES Secretariat).
    - Working Group: Working Group on Celtic Seas Ecoregion (WGCSE, Chairs: Colm Lordan and Pieter-Jan Schön)
    - Herring Assessment Working Group (HAWG, Maurice Clarke chair)
    - Working Group on the Assessment of Hake Monk and Megrim (WGHMM, Carmen Fernandez, chair

Process - The ICES advisory service quality assurance programme requested that a team of graduate and post-doctoral students and their professor serve as a review group. The Group initially met on 26 May to review the ICES advisory process, RG guidelines and to assign several WG report sections to each reviewer. A second meeting was held on 27 May to review standard ICES assessment models (XSA, ICA, SURBA, TSA and BADAPT). Members reviewed WG report sections independently, then presented their summaries and reviews to the group in a series of meetings during 1–3 June to discuss reviewers' proposals and form RG conclusions.

General - Stock assessment reports for 32 stocks were reviewed (Table1). The WG Reports were generally informative, and WG decisions about data, model choice and specification and interpretations were clearly explained and justified. The RG concludes that the Reports are technically correct, and the RG agrees with WG recommendations, with few exceptions. In nearly all cases, the assessments appropriately applied the procedures specified in the stock annexes. Some general issues were raised for many stocks related to discards, definition of assessment and management units and standardized methods. These general observations should be considered for the next benchmark reviews of these stocks.

Table 1. Stocks reviewed ordered by working group (WG), terms of reference (ToR), type of assessment and assessment method.

WG	Stock	Name	ToR	type	method
wgcse	cod-7e-k	Cod in Divisions VIIe-k (Celtic Sea Cod)	Update	no method	Benchmarked
wgcse	cod-iris	Cod in Division VIIa (Irish Sea)	Update	assess	BADAPT
wgcse	cod-rock	Cod in Division VIb (Rockall)	No assessment	no advice	
wgcse	cod-scow	Cod in Division VIa (West of Scotland)	Update	assess trends	TSA
wgcse	had-7b-k	Haddock in Divisions VIIb-k	Update	assess trends	XSA
wgcse	had-iris	Haddock in Division VIIa (Irish Sea)	Update	assess trends	SURBA
wgcse	had-rock	Haddock in Division VIb (Rockall)	Update	assess	XSA
wgcse	had-scow	Haddock in Division VIa (West of Scotland)	Update	assess	TSA
wgcse	whg-7e-k	Whiting in Divisions VIIe-k	Same Advice	assess trends	XSA
wgcse	whg-iris	Whiting in Division VIIa (Irish Sea)	Same Advice	assess trends	SURBA
wgcse	whg-scow	Whiting in Division VIa (West of Scotland)	Update	assess	SURBA
wgcse	ple-7h-k	Plaice in Divisions VIIh-k (Southwest of Ireland)	Same Advice	catch trends	-
wgcse	ple-celt	Plaice in Divisions VIIf,g (Celtic Sea)	Update	assess	XSA
wgcse	ple-echw	Plaice in Division VIIe (Western Channel)	Update	catch trends	XSA
wgcse	ple-iris	Plaice in Division VIIa (Irish Sea)	Update	assess	ICA
wgcse	sol-celt	Sole in Divisions VIIf, g (Celtic Sea)	Update	assess	XSA
wgcse	sol-echw	Sole in Division VIIe (Western Channel)	Update	survey trends	Benchmarked
wgcse	sol-iris	Sole in Division VIIa (Irish Sea)	Update	assess	XSA
wgcse	nep-11	Nephrops in Division VIa (North Minch, FU 11)	Update	assess trends	Benchmarked
wgcse	nep-12	Nephrops in Division VIa (South Minch, FU 12)	Update	assess trends	Benchmarked
wgcse	nep-13	Nephrops in Division VIa (Firth of Clyde, FU 13)	Update	assess trends	Benchmarked
wgcse	nep-14	Nephrops in Division VIIa (Irish Sea East, FU 14)	No assessment	assess trends	
wgcse	nep-15	Nephrops in Division VIIa (Irish Sea West, FU 15)	Update	assess trends	Benchmarked
wgcse	nep-17	Nephrops in Division VIIb (Aran Grounds, FU 17)	Update	assess trends	Benchmarked
wgcse	nep-19	Nephrops in Division VIIa,g,j (South East & West of IRL, FU 19)	No assessment	assess trends	
wgcse	nep-2022	Nephrops in Division VIIf,g,h (Celtic Sea, FU 20-22)	No assessment	assess trends	
wgcse	nep-7bcj	Nephrops in Division VIIb,c,j,k (Porcupine Bank, FU 16)	No assessment	assess	Status changed
wgcse	ang-ivvi	Anglerfish in Division IIa, IIIa, Subarea IV and VI	Update	assess trends	-
wgcse	meg-scrk	Megrim in Subarea VI (West of Scotland and Rockall)	Update	catch trends	-
wghmm	ang-78ab	Anglerfish in Divisions VIIb-k and VIIIa,b,d	Update	assess trends	-
wghmm	mgw-78	Megrim in Divisions VIIb-k and VIIIa,b,d	Update	survey & cpue trends	-
hawg	her-irls	Herring in Division VIIa South VIIg,h,j,k (Celtic Sea & S. Ireland)	Benchmark	assess trends	ICA
hawg	her-irlw	Herring in Divisions VIa (South) and VIIb,c	Same Advice	assess trends	ICA
hawg	her-nirs	Herring in Division VIIa North of 52° 30' N (Irish Sea)	Same Advice	assess trends	-
hawg	her-vian	Herring in Division VIa (North)	Update	assess	ICA

Most of the stocks that were reviewed are caught in mixed-stock fisheries. Many assessments include mixed-stock considerations, estimate discards, and include them in the stock assessment. However, the treatment of discards varies widely among assessments. The RG recommends that all information on discarded catch should be reported, the magnitude of discards should be estimated or approximated for all fleets, and if the proportion of discards is substantial, discards should be included as a component of catch for the entire assessment series for exploratory analyses and possibly as the basis for fishery management advice. The RG recognizes that estimates of discards for some fleets and in historical periods will be highly uncertain. However, many of the stocks in this group have substantial discards, and retrospective patterns suggest underreported catch. The RG concludes that including discard approximations may improve the accuracy and consistency of assessments.

The definition of assessment units and management units do not correspond for many stocks in this group. Many management areas include multiple assessment units, such that catch of each assessment unit is not directly managed, because TACs can be taken from any component stock. Assessment and management unit definitions should be re-evaluated to improve the effectiveness of management. Furthermore, stock units should reflect biological stocks within the practical constraints of fishery monitoring and resource surveys for stocks that overlap. Many of the data-poor assessments in this group may benefit from aggregation of management units.

Stock: Cod in Division VIIe–k (Celtic Sea)

Assessment type: Update assessment, Benchmarked in 2009.

Assessment: Trends analysis. Discontinued use of XSA. The benchmark workshop WKROUND 2009 concluded that more work is required on improving input data before Celtic Sea Cod can be benchmarked again.

Forecast: No short-term prediction, no accepted forecast methodology. No medium- or long-term forecast provided for this stock.

Assessment model: No accepted model. No new datasets available and awaiting revision of existing datasets. The WKROUND recommended that an analytical assessment not be carried out for this stock.

Consistency: The XSA performed last year was discontinued this year.

Stock status: Stock size is low and recent recruitment is poor. Maps of historical landings distribution (Figure 7.2.4) indicate the geographical area of the stock has shrunk over the years.

Management Plan: None. A long-term management plan is currently under discussion for this stock. The 2004 reference points remain in place.

General comments:

- The WG report explains that the quality of the landings and catch-at-age input data for this stock has deteriorated to a point where an XSA-VPA assessment is no longer possible. The causes for the decrease in data quality are highgrading and unreported landings since 2003 when restrictive quotas were put in place for this stock area. Highgrading has occurred in the French fishery representing ~70% of cod landings mainly in area VIIfgh in response to quota restrictions. The description on page 5 of misreporting, its causes and magnitude was helpful and well written. The confirmation of misreporting by representatives of Fishermen Organizations at the WKROUND 2009 was particularly meaningful. Historical datasets are in the process of being housed in a central dataset called Intercatch and correct raising techniques are under development.
- WKROUND 2009 evaluated XSA with catch levels adjusted for missing landings (unreported and highgrading) against B-ADAPT and the SAM space state model. All models exhibited different patterns in the recent years, each with a high degree of uncertainty. Treating catch numbers as unbiased was no longer appropriate. The group concluded that no model could be recommended as a basis for providing advice about recent stock trends and that further investigations would be required or additional datasets made available to resolve the problems.
- There are three surveys for this fishery, one historical and two active. They are UK-WCGFS survey (1986–2004) discontinued, FR-EVHOE survey (1997–2008) and IrGFS survey (2003–2008). The absolute numbers of cod caught in surveys are extremely low.
- The RG agrees with the WG that adding a survey in quarter 1 would improve data on the concentration of fish, (index of abundance) as well as maturity during the spawning period.

Technical comments:

- Pages should be numbered in the final Report.
- Final Report, page 3, Section 7.2.1 Stock description and management units. The figure is too small to show all the management unit designations.
- Section 7.2.2. Page 6. Data. The first sentence references Table 2.1. There is no Table 2.1. Should it be 7.2.1?
- Table 7.2.2. What are the units of length; cm or mm?
- The catch-at-age data for the time-series in Table 7.2.3 should also be plotted as a figure.
- Commercial cpue. Page 7. Provide a figure that shows which rectangles are closed to fishing.
- Table 7.2.7. There are no column headings so not sure what the data in each column actually are.

Conclusions:

- The RG concurs with the WG that fishing mortality should be reduced to sustainable levels that increase yields, and close monitoring of catches should get top priority at the highest levels of fisheries management.
- Shortcomings of the data and reconstruction of datasets should be completed in order to continue using an aged based assessment in future.
- A long-term rebuilding strategy is needed for this fishery.
- The RG concurs with the conclusion drawn by the Benchmark that cooperative projects with industry on self sampling, and reference fleets, etc should be developed to obtain better estimates of discards. Datasets obtained through fishers science partnerships should be used to complement those discard data collected by fishery observers.

Stock: Cod in Division VIIa (Irish Sea)

Assessment Type: Update

Assessment: Analytical

Forecast: A short-term (1 year) prediction was provided. Two medium-term (6 year) projections were also provided. The results indicated that with an F=0, the stock had a high probability of rebuilding above B_{lim} as well as rebuilding above B_{pa} by 2015. The second scenario (25% reduction in F) indicated that the stock had a low probability of rebuilding above B_{lim} and a 0% probability of rebuilding above B_{pa} by 2015.

Assessment method: B-ADAPT, tuning with five surveys, three of the surveys using recruitment (0-group) information (NI-GFS October Groundfish survey, ENG BTS-Sept survey, and NIMIKNET pelagic 0-gp index May–June), and two surveys including 1–4-group information(Scottish spring groundfish survey of the Irish Sea, NI-GFS March Groundfish survey).

Consistency: The retrospective analysis demonstrates that there is little retrospective difference and that the current assessment is consistent with the previous assessment.

Stock Status: The SSB has been suffering reduced reproductive capacity (SSB< B_{lim}) for many years, and the stock has been harvested unsustainably (F> F_{lim}=1.28) for over 20 years.

Management Plan: The current management plan has a long-term target of F=0.4, and there has been strict management of the stock since 2002. These measures include reduced TACs, DAS limits, area closures and technical measures.

General Comments:

- General ecosystem information has not been provided, but the WG indicated that there may be some ecosystem effects on recruitment.
- Mixed fisheries information was not provided.
- Discard data were provided, but not used in the assessment (discards were estimated in the model).
- There is mention of an IBTS series that started in 2004, but was not included in the assessment. This may be a valuable survey in the near future because it is will cover many of the years at which the stock was very low.
- The medium-term projections indicate two possible scenarios that would both follow the management plan. These projections also point out the severity of the status of this stock indicating that unless there is an F=0, there is very little probability that this stock will recover.
- The stock recruit relationship indicates that the most recent seven years falls below the segmented regression trend. This was taken into account in the medium-term projections, by using only the recruitment data from 2002–2008.
- The mixed-stock aspect of this fishery was not considered in the Report.

Technical Comments:

- The stock annex describes how discards can be used in this stock assessment using different discard raising methods. The Table of discards by each fleet was included in the text, but those values were not included in the assessment. The discard data are also only on the younger fish (Ages-0–2), which may be having an effect on the poor recruitment.

- The model used for this assessment (BADAPT), estimates the catch from the landings, but this method was not well defined in the text or the stock annex.
- The use of the term 'catch' is used very loosely thought out and should be replaced with landings because discards are not taken into account.

Conclusions:

- The RG agrees with the WG on the assessment and agrees with the ICES advice of zero catch in 2009. Continuing with 25% yearly reductions in the TAC will result in a much slower rebuilding according to the medium-term projections and should be reconsidered. The recent poor recruitment indicates that there may be some ecosystem effects on recruitment and should be studied further.
- The seasonal migrations of Irish Sea cod may be a source of the unaccounted removals, the tagging data described by the WG warrants further investigation into the amount of Irish Sea cod caught in other stock areas, mainly Division VIa.
- The WG stated that the research surveys that are used to tune this assessment do not cover the deep waters of the North Channel, which have historically large catches of cod. This should also be investigated.
- The proportion mature-at-age used in this assessment was estimated from the NI-GFS March Groundfish survey from 1992–1996. During that period of time the SSB was above B_{lim}. The stock in 2009 has a much lower SSB which may have affected the proportion mature-at-age.

Stock: Cod in VIb (Rockall)

Assessment Type: No advice

Assessment: Not presented

Forecast: Not presented

Assessment method: None

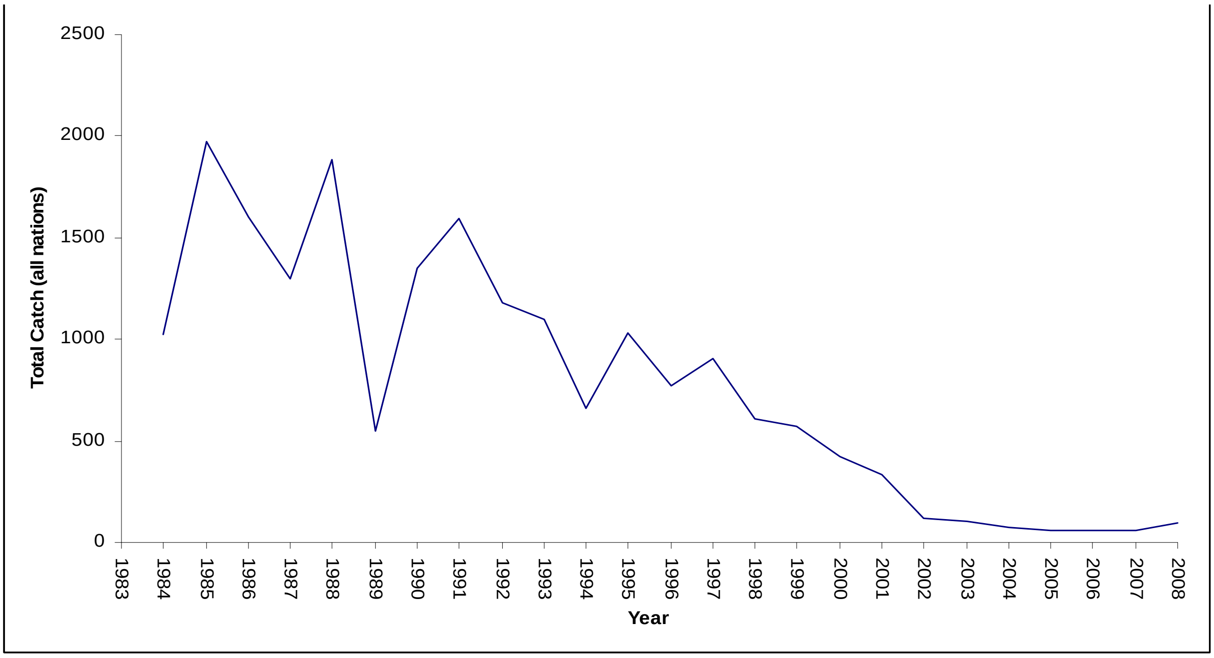
Consistency: No assessment was carried out in 2008, or any prior year for this stock and the same is true for 2009. It appears to be a very data limited stock with minimal catch statistics from ~9 different nations.

Stock Status: A plot of total catch demonstrates a decline in total catch from 1984 to 2008.

Management Plan: There is no management plan in place for this stock.

General Comments:

With only one table of official catch statistics available for this stock it was very difficult to conclude or recommend anything. A simple plot of the landings would provide some information on fishery development.



Conclusions:

A standardized cpue or some information on the fishing effort from each nation targeting this stock would be a good next step.

Stock: Cod in Division VIa (West of Scotland)

Assessment Type: Update.

Assessment: Trends

Forecast: A short-term projection is presented. The Working Group indicated that the forecast should not be used to determine future TAC. Medium-term projections are not presented.

Assessment method: The update assessment is run using time-series analysis (TSA).

Consistency: The assessment method was the same as last year. Retrospective bias in the estimate of SSB and recruitment is small. SSB estimated for 2008 by the update assessment is slightly less than the estimate of SSB from the short-term forecast. The estimate of SSB in 2007 has been revised down (6276 to 5836 t), recruitment revised up (2.4 to 2.7 million), and F revised up (0.79 to 0.82). There is considerable uncertainty in mortality estimates.

Stock Status: Estimated SSB in 2008 was 6500 t, the projected SSB for 2009 and 2010 is 5500 and 4900 t respectively. Both the estimate and projections are less than B_{lim} (14 000 t). Nominal calculation of F that does not account for increased natural mortality (F~Z-0.2) was 0.88 for 2008, the projected ~F for 2009 and 2010 is 0.86 and 0.84 respectively. Both the estimate and projections are greater than F_{lim} (0.8).

Management Plan: In 2001, a cod recovery plan was introduced that applied to cod in Division VIa, consisting of area closures and effort limitations, gear restrictions, and stricter tracking of fish processed and sold through the supply chain. Further description of regulation of the stock under the cod long-term management plan is described in the annex. ICES advised zero catch of cod in 2009. Simulations run in 2006 indicated that closure of the fishery for three years would rebuild SSB to > B_{lim}. This approach is consistent with the precautionary approach to management of this stock. Although the assessment unit is Division VIa, the TAC is set for VIa and Vb.

General Comments:

Cod in Division VIa is no longer targeted in a directed fishery, but caught as bycatch in a mixed demersal fishery. Based on the reported catch by country, it appears that the TAC has been exceeded in recent years. Additionally, area misreporting of cod catch is thought to be high for this stock because of restrictions on catch. The Report did not quantify the scale of misreporting in this fishery. Furthermore, legislation enacted in 2006 to track fish through the supply chain is thought to have increased discards. In recent years, the weight of discards has been equal to or exceeding the weight of landings. The Working Group indicated that in order to reduce catch of cod, the harvest of other targeted species (haddock, whiting, and anglerfish) would have to be reduced in this area.

Overall the results of the assessment indicate that the current SSB is low (<B_{lim}), total mortality is high (>F_{lim}), and recruitment is low. The precautionary approach plot was particularly useful, clearly demonstrating the timeline of SSB reduction of this stock due to years of high exploitation in this fishery. Unfortunately, current mortality rates remain high on a stock that is experiencing reduced reproductive capacity.

Predation by seals is thought to contribute to higher natural mortality than currently accounted for with an assumed M = 0.2. Therefore, the Working Group considered a nominal fishing mortality calculation as F~ Z-0.2. However, it appears as though the TSA model assumes M=0.2 in its process equations, so the F~Z-0.2 approach has no advantage over a stock assessment and F estimates that assume M=0.2. Any alternative calculation of F (e.g. F~Z-0.3) would be internally inconsistent with the process equations in the assessment model.

In recent years (1995–2008), only survey data (Scottish first-quarter west coast groundfish survey) contribute to the TSA solution due to uncertainty associated with commercial catch data. There are issues with the estimation of mortality in the assessment from this survey. The Scottish groundfish survey does not appear to track the youngest age classes in the most recent years. Log catch curve gradients from the survey across years indicate an increase in mortality through 2001, followed by a subsequent decline in mortality from 2002–2004, however trends vary based on the year classes included in catch curves. Therefore, estimates of abundance and mortality in the recent period are highly uncertain.

The Working Group identified problems which may introduce uncertainty and bias into the assessment and forecast, including: 1) incorrect reporting of landings (species, quantity), 2) commercial effort data for Scottish fleet is uncertain and not included in the assessment, 3) discards are only reported for age-1 and -2 (since 2006 there has been increased discarding of older age classes), 4) a new method of estimating discards is currently under review, but was not available at the time of this update, 5) survey design has changed over time and use of a correction factor introduces additional variance to estimates, 5) the spatial aggregation of the survey has a strong influence on index values 6) natural mortality may be underestimated, 7) short-term forecasts are sensitive to estimate of mean fishing mortality, which is considered to be poorly estimated. The Working Group compiled their recommendations for addressing current problems in the next benchmark for this stock.

Short-term forecasts were presented, but due to uncertainty are not thought to be informative in determining management advice. Yield per recruit analysis was conducted in 2006 (F0.1 = 0.17), it was not considered necessary to update this analysis.

The fact that this stock is caught in a mixed fishery presents problems as it is difficult to regulate catch of a bycatch species. There is a current effort in EU Management to provide incentives to vessels in the mixed fishery (of particular concern is *Nephrops* trawling) that use gear that take a small percentage of cod.

Technical Comments:

This technical review was based on the report downloaded 2 June 2009. Many revisions to the Report were still underway, but they do not appear to affect the overall view of stock status in this update. Overall, the Working Group did a good job of presenting data clearly and making sure that figures and tables were easily interpretable. Figure 3.2.18 is referenced in the text, but was not presented in the Report.

Conclusions:

This update assessment and short-term forecast have been performed as indicated in the annex and the Review Group agrees with the Working Group’s assessment. The Working Group has clearly outlined the problems and the next steps necessary in improving the assessment of this stock. Given the uncertainties in the assessment, particularly in the recent period (when catch data are not included in the solution and survey data do not track cohorts), the RG concludes that there is reason to deviate from the standard procedure for this stock, and forecasts should not be included in ICES advice, not even for illustrative purposes. The zero-catch advice is well supported without the forecasts.

Despite uncertainties and data limitations, the current assessment presents a clear picture of a stock that is at critically low levels, resulting in reduced reproductive capacity. Based on the sources of uncertainty in the assessment (i.e. catch reporting, discard estimation) the assessment may be an overly optimistic view of current stock status. The current results of the assessment, however, are congruent with the ICES advice that this fishery should closed. As the short-term forecasts are presented with the caveat that they are not considered a reliable basis for determining advice, removal of the forecast may be appropriate.

Although the fishery is highly regulated, the current allowable catch, high discard rate, and misreporting of catch result in continued exploitation of a stock that is below critical biomass levels. ICES has recommended closure of the fishery since 2003. EU management has continued to allow catch of this stock, but has reduced TAC continuously over this period.

The RG agrees with ICES recommendation of zero catch in this fishery. The WG 'Recommendations for next benchmark' presents a road map for improving the assessment of this stock. We agree with the WG conclusion that to significantly reduce exploitation of this cod stock harvest of other targeted species (haddock, whiting, and anglerfish) would have to be reduced in this area.

Stock: Haddock in Divisions VIIb–k

Assessment Type: Update

Assessment: Analytical

Forecast: A short-term forecast was provided, but no medium-term projections were attempted.

Assessment method: Extended survivor analysis (XSA) was used for this assessment. The model was calibrated with two out of an available six surveys and both of the available commercial indices.

Consistency: XSA settings have not changed since previous assessments, data were updated but with no significant changes, and the perception of the stock remains relatively unchanged. Retrospective analysis indicates a consistent underestimation of SSB and overestimation of F, but bias has been small in recent years.

Stock Status: Precautionary reference points have not been calculated due to the short time-series of data available. F (.61) is three times higher than F_{max} (.19) and almost five times greater than $F_{.01}$ (.13), but uncertainties in the assessment have led to reservations regarding these reference point estimates.

Management Plan: No management plan has been developed. General guidance is to retain current fishing levels until uncertainty in assessment can be better understood and the time-series of the various data sources is long enough to provide more accurate results.

General Comments:

- Overall, the assessment is well done considering the short time-series of the various data sources (e.g. catch, surveys, etc.) and the relatively high levels of uncertainty in the landings data, especially the discard estimates.
- The RG agrees with the WG that assessment results and associated reference points should be carefully analysed when better estimates of discards can be calculated. Currently, discard estimates are taken from the Irish Sea OTB fleet and raised to international levels by using the ratio of effort. Considering the high levels of discards (almost half of all catch weight in some years) and the differences in discard practices between fleets and countries, it is necessary to collect more accurate discard information if reliable results are to be calculated. This issue is currently being addressed as other countries are beginning to gather these statistics (e.g. France and the UK), which should help to improve future assessments.
- As a mixed-stock fishery, it seems that the potential for species interactions are high, yet no information is given on ecosystem aspects.

Technical Comments:

- Although some surveys were dropped because sampling was discontinued, no information was given as to why only two of a possible six surveys were used to calibrate the model. More details should be given either in the stock annex or the assessment document regarding this aspect of the model development. In addition, the annex was relatively brief. More information should have been included on model development and modelling assumptions so it can be better understood why decisions such as this were made and how it affects the results.

- Many of the plots are not well labelled or described. In addition, many are too small and difficult to read and interpret. This is particularly true of the diagnostic and retrospective plots. It is also suggested that an increased variety of diagnostic plots are provided to help determine how well the model is fitting the data.
- Many of the tables look overly crowded and use too many abbreviations, which make them hard to understand and interpret.

Conclusions:

- The RG agrees with the WG that the current XSA assessment is an acceptable model for haddock in areas VIIb–k and that fishing levels should remain at or below the *status quo* until better data can be gathered to reduce uncertainty in model outputs. It appears that SSB has been generally increasing in recent years, whereas F has been decreasing, but catch increased sharply in the last year causing a reversal in this trend. In order to avoid continued increases in F and possible declines in biomass it is suggested that catch should be decreased to 2006–2007 levels.
- The RG also agrees that the main source of uncertainty in the model is estimates of discards, especially because discard rates have been historically high resulting in almost 50% of landings weight in some years. As more data on discards is collected in future and the time-series of data becomes longer, assessment results should be greatly improved.
- It is also agreed that switching to a model that allows for catch by multiple fleets should be developed to account for differences between countries and gear types. The RG suggests that in order to account for numerous fleets a forward projection, statistical catch-at-age model should be considered in the next benchmark assessment, because it may be a more appropriate method than the XSA model due to its increased flexibility. In addition, such a model will allow for error in catch-at-age, which is important for a fishery with such high and uncertain levels of discards. It might also be possible under such a framework to more readily and easily include all the surveys, even those for which sampling has been discontinued. Finally, it is suggested that when the model has been updated that the associated reference points are also updated.

Stock: Haddock in Division VIIa (Irish Sea)

Assessment type: Update

Assessment: Trends

Forecast: A short-term projection was based on 2009 survey information, knife-edge maturity-at-age two, the average of the last three years total mortality from the SURBA model, three year average of stock weights and 10 year geometric mean recruitment.

Assessment model: SURBA model used based on the UK (NI) groundfish age-structured survey with additional age-structured abundance indices for auxiliary information.

Consistency: Last year's assessment was accepted, and the procedure was the same as used last year, as described in the Stock Annex.

Stock status: There is not enough information to evaluate spawning stock or fishing mortality relative to precautionary reference points. There is an increasing trend in SSB from 2005–2008 with a decrease in 2009. Total mortality remains stable. Recruitment was below average in 2007 and 2008.

Management plan: There is no management plan for haddock in the Irish Sea. Management measures are linked to those implemented under the cod recovery plan due to bycatch of cod in haddock fishery. Management measures include TAC and effort restrictions as well as technical measures. TAC for 2009 was increased despite 25% decrease in the cod TAC. The minimum landing size for haddock in the Irish Sea is 30 cm. ICES recommended fishing effort should not be allowed to increase.

General comments:

- Issues with the lack of data were made clear and assessment seems the most appropriate with current information available.
- Discard quantities are estimated but not included in the assessment due to inadequate data.
- No real description of why TAC for 2009 was increased despite 25% decrease in the cod TAC if haddock management is linked to the cod recovery plan.
- No ecosystem information was provided or discussed.

Technical comments:

- This Section seemed to be in draft form at the time of review. However, the information seemed to be sound.
- Title of Report states "2008".
- Some table numbers are not provided and Table 6.3.5 is difficult to read due to small print size. Tables are not presented in a consistent format.
- The following sentences under Section 6.3.4 need to be reviewed; they appear to be a copy of what was written last year. "No short-term forecast has been performed in 2008 for this stock. This year the WG projected the SSB for 2010 using the 2009 survey information."

Conclusion: The assessment has been performed correctly though better data are needed for a more accurate assessment of this stock, as stated in section.

Stock: Haddock in Division VIb (Rockall)

Assessment Type: Update

Assessment: Analytical

Forecast: A short-term forecast was provided, assuming *status quo* fishing mortality, indicating low probability of SSB in 2011 being below B_{pa} and F_{sq}. Medium-term projections were conducted, indicating that there is less than 5% probability of SSB falling below B_{pa} in the long term.

Assessment method: XSA, based on catch-at-age and one survey index (Scottish Groundfish Survey). This method allows modelling of the total catch which includes discards of the Irish, Scottish and Russian fleets.

Consistency: XSA was conducted with the same basic assumptions and setup as last year's assessment. Perceptions of the stock have not changed. The estimates of SSB, recruitment-at-age 1 and mean F (2–5) from this year's assessment are reasonably consistent with the assessments carried out in previous years.

Stock Status: The stock can be considered as having full reproductive capacity and that it is harvested sustainably. Spawning biomass has generally increased in recent years as a result of the 2001 and 2005 year classes. $SSB>B_{pa}$ since 2003. $F<F_{pa}$ since 2005.

Management Plan: Currently there is no internationally agreed management plan. The Working Group mentions that development of a plan would require a management strategy evaluation to identify an appropriate FMSY target, and measures in the haddock fishery could be a combined application of TAC, fishing effort limits and effective control and enforcement measures.

General Comments:

- Although it is stated the exploitation boundaries are determined considering ecosystem effects, no ecosystem information was provided.
- Further investigation should be made into why weak year classes are often observed when biomass is high.
- More accurate discard data are required for better estimates of F and stock size.

Technical Comments: Consistent data among fleets would greatly improve assessment estimates.

Conclusions: The RG agrees with the WG on the assessment and TAC advice for this stock. However, more data from participating fleets would greatly reduce uncertainty.

Stock: Haddock in Division VIa (West of Scotland)

Assessment Type: Update

Assessment: Analytical

Forecast: Short-term projections were completed with two recruitment assumptions (based on survey or stock–recruit estimates).

Assessment method: TSA with tuning from two Scottish groundfish surveys. The assessment is completely survey based from 1995.

Consistency: There is consistency between the 2008 and 2009 assessments with the same model type and tuning data being used. Stock status changed between 2008 and 2009. There were no retrospective patterns for SSB, R or F for the most recent years.

Stock Status: SSB in 2008 (30 436 t) was greater than B_{pa} (30 000 t), but SSB in 2009 (20 271 t) is less than B_{lim} (22 000 t); F in 2008 (0.46) is slightly less than F_{pa} (0.5). Projections indicate that the stock cannot be rebuilt to B_{pa} even in the absence of fishing.

Management Plan: There is no management plan, but one is in the process of being developed.

General Comments:

- The WG states that lack of reliable catch data makes it difficult to use the assessment for management purposes including setting a TAC for the stock. Catch data are not used because of misreporting or underreporting of catch along with some unaccounted discards.
- Discards are included in the model and are based on estimates from the Scottish and Irish observer programmes.
- The Annex states that the WG is unclear about the statistical properties associated with the short-term projections of F and are not confident in using the projection results. Therefore, the inclusion of projection results in the assessment seems to be contradictory to the Annex.
- Other issues with using a TSA model were raised in the Annex including the assumptions and parameter settings for the model. When TSA model runs were compared with other models there were conflicting results. The Annex states that the WG is unclear as to what model to use. The RG is concerned that the TSA model was chosen over more user-friendly models although it is difficult to replicate and run.
- The assessment includes information on mixed fisheries and ecosystem information.
- The linear growth model used to estimate weight-at-age should be revisited as stated by the WG because of the fluctuations that can be observed in haddock with changes in recruitment.
- If none of the countries have caught the allocated TAC (Ireland has the highest percentage of TAC caught for 2008 with 88%, but the remaining countries are all below 40% of the TAC), then lowering the TAC would not seem to have an impact on the fishery. Although, lowering the TAC may not reduce effort in the stock area because of other fisheries operating in the same area so F would remain high.
- Other technical recommendations made by the WG are productive and would add valuable information about the stock.

Technical Comments:

- The Report that was reviewed was a draft version downloaded from the SharePoint website on 27 May 2009.
- Neither Figure 3.3.16, Figure 3.3.17 nor Figure 3.3.18 is discussed in the Report.

Conclusions:

- The RG agrees with the WG that the assessment cannot be used to set catch quotas, and that the assessment indicates declines in SSB and recruitment.
- The RG recommends that the TSA model may not be the best model to use because of the lack of understanding of the model. It would be interesting to see the results of the other models discussed in the Annex.

Whiting in Divisions VIIe–k

Assessment Type: Same as last year

Assessment: Assess trends

Forecast: Short-term projections assuming *status quo* F and geometric mean recruitment indicate that SSB is expected to increase and remain above B_{pa}. Long-term projections indicate that fishing at F_{max} (0.78) long-term yield and SSB are 13 703 t and 36 364 t respectively. No medium-term projections were carried out.

Assessment Model: FLXSA 1.4–2- tuned with 2 commercial indices (FR-Gadoid late and FR-*Nephrops*) and 3 survey indices (FR-EVHOE, UK-WCGFS and IR-IGFS area swept). The assessment is used as an indicator of trends only.

Consistency: The methods are the same as last year with the addition of 1 year of data. Recruitment has been revised downwards by 49% from last year's assessment, whereas F has been revised upwards by 35%. SSB was revised downward by 13% from last year. The retrospective problems associated with this assessment may be due to the fact that discards are not included in the assessment.

Stock Status: SSB is greater than B_{pa}. F has been increasing in recent years, although it was perceived to decrease in 2008. F2–5 is believed to be roughly 0.91. Recruitment has been below average since 1995, with the exception of the 2007 and 2008 year classes. The 2008 year class is perceived as being extremely large.

Management Plan: No management plan has been agreed or proposed. Technical measures, including a minimum landing size (27 cm), minimum mesh size, and a TAC are used in the management of this stock.

General Comments:

- The Report is well written and well organized, making it easy to comprehend and follow.
- General ecosystem information has not been provided or considered in the Report.
- The background information on misreporting of catches is thorough and easy to follow.
- The WG Report suggests that management measures be put in to place to reduce discarding of what is thought to be a strong 2008 year class. However, no specifics are provided to explain the measures that should be taken to protect this year class. This information appears to be very important, as available data suggests that discard rates in the various fisheries are exceptionally high (Table 7.15.6).
- The RG agrees with the WG for the need to improve the estimation of discarding for this stock. Based on the large proportion of whiting that are discarded, this is a major obstacle for the assessment of this stock.

Technical Comments: The WG should provide potential management actions that can be taken to protect the 2008 year class from excessive discarding.

Conclusions:

- The RG agrees with the analysis carried out by the WG. However, it is unlikely that the lower TAC will lead to any noticeable decrease in F, as only 24.7% of last year's TAC (19 940 t) was landed by the fishery.

- The RG agrees with the WG on the need to protect the larger than average 2007 and 2008 year classes against excessive discarding. Discarding rates appear to be excessive in the fisheries for this stock. Improved monitoring and directed regulations should be a management focus to attempt and reduce discards.
- Effort to collect more data would be beneficial to understanding the status and dynamics of this stock.

Whiting in Division VIIa (Irish Sea)

Assessment type: Same as last year

Assessment: Trends.

Forecast: None.

Assessment model: SURBA.

Consistency: Last year's assessment was accepted.

Stock status: Unknown.

Management Plan: None. ICES advice was lowest catch possible. The minimum landing size (MLS) for whiting is 27 cm.

General comments: There was no mention of ecosystem considerations and minimal mention of mixed fisheries (cod fishery interaction only).

Technical comments: Some tables were not numbered.

Conclusions:

- The assessment has been performed as best as possible with available data and the RG agrees with the WG on the assessment.
- Effort to collect more data would be beneficial to understanding the status and dynamics of this stock.

Stock: Whiting in Subarea VIa (West of Scotland)

Assessment type: Same as last year.

Assessment: Trends

Forecast: None.

Assessment model: SURBA

Consistency: Last year's assessment accepted.

Stock status: Present stock size is low.

Management Plan: None, but same advice since 2006; given that SSB is estimated at the lowest observed level and total mortality at the highest level over the time period, catches should be reduced to the lowest possible level.

General comments

- This was a well ordered section, it was easy to follow.
- There was no mention of ecosystem considerations or mixed fisheries.
- There seems to be enough information to attempt some sort catch-at-age of assessment (discard information, survey information, some catch information) especially because present stock size seems low according to catch and survey information.

Technical comments

- This Section seemed to be in draft form at the time of this review.
- The final section on uncertainties and bias do not mention any uncertainties or bias but more a summation of the Report section.

Conclusions: The RG agrees with the WG on the assessment.

Plaice in Divisions VIIh–k (Southwest of Ireland)

Assessment Type: Same as last year

Assessment: Assess trends

Forecast: None provided.

Assessment Model: catch curves using Irish otter trawl catch data from 1993–2008.

Consistency: Same as last year with the addition of 1 year of data

Stock Status: Recent estimates of F (0.48–1.08) are greater than $F_{0.1}$ (0.14) and F_{max} (0.24)

Management Plan: No management plan is presented.

General Comments:

- General ecosystem information was not provided or evaluated in the Report.
- Mixed fisheries data are not described in the Report. Based on the Report, it is unclear if plaice in this area are targeted by the fishery, or if they are caught primarily as a bycatch species in fisheries targeting other species.
- No information on discarding is provided in the Report nor is there a statement that discard data are not available. If discard data are available, the sizes and proportions of fish that are discarded in the fishery should be included.
- Specific actions and recommendations are needed to improve data collection for this stock. For example, it would be helpful to estimate a maturity-at-age ogive for plaice in this stock area. Currently, the maturity-at-age ogive for plaice in VIIfg is being used to estimate SSB for plaice in VIIh–k. If the maturity schedules in the two areas are different, it will lead to inaccurate estimates of SSB and F reference points.
- It is unclear why Irish data for areas VIIgjk is the sole data source used in the YPR assessment. Table 7.11.1 demonstrates that from 1993–1998 Irish landings were less than or almost equal to Belgian landings. In addition, UK landings were significant in certain years (1993–1999). If no data are available for the other fleets (Belgian and UK) this should be stated in the Report.
- There are a substantial amount of unallocated catches from 1993–1998; however, an explanation of why these catches are unallocated is not included in the Report. It would be helpful to include information about these catches in the document.

Technical Comments: In Figure 7.11.3 the caption states that there were too few samples in 2006 to estimate 95% confidence limits for this year. However, the 2006 data in the Figure was provided with the 95% confidence intervals demonstrated.

Conclusions:

The use of catch curves and a YPR assessment is acceptable based on the lack of data for this stock. However, the Report does not provide any advice relating to this stock. Based on the results of the YPR assessment, recent estimates of F appear to be far greater than long-term yield targets. However, the Report does not include information regarding management measures (i.e. TAC limits) for this stock. The WG should suggest management measures.

Stock: Plaice in Divisions VIIfg (Celtic Sea)

Assessment Type: Update

Assessment: Analytical

Forecast: A short-term projection assuming *status quo* F indicated that the SSB would increase from 1388 t in 2009 to 1492 t in 2010 followed by an increase to 1540 t in 2011. Medium- and long-term projections were not provided.

Assessment method: XSA –tuning with three survey abundance indices (UK beam trawl survey, ISCSGFS, and Celtic Explorer-IBTS Q4), and two commercial indices (UK beam trawl, UK otter trawl).

Consistency: The current assessment method is consistent with the previous assessment, but the assessment has retrospective patterns.

Stock Status: The SSB for this stock is at increased risk (B_{pa}>SSB> B_{lim}), but due to the retrospective pattern this may change with next year's assessment. The fishing mortality rate in relation to precautionary limits is not defined, because the reference points F_{lim} and F_{pa} are not defined.

Management Plan: There is currently no management plan for this stock.

General Comments:

- General ecosystem information has not been provided, but the WG indicated that incorporation of temperature data will probably not have a major impact on recruitment in short-term projections.
- Mixed fisheries data were not provided.
- Discards are considered to be substantial but are only sampled in some fisheries in recent years and are not included in the assessment.

Technical Comments:

- The WG explains the use of landings data and explains why discards were not including in the assessment.
- The use of the term 'catch' is used very loosely throughout and should be replaced with landings because discards are not taken into account.

Conclusions:

- The RG agrees with the WG on the assessment and agrees with the ICES advice of *status quo* fishing mortality rate. The projection indicates that SSB will increase each year and will be above B_{lim} in 2009.
- If the assessment model is not estimating discards or unaccounted removals, then this assessment is missing an important component of the catch. The WG states that discards may make up a large portion of the total catch. The perceived large amount of discards should be studied to see if the discards are due to the minimum size regulation or other reasons.
- The maturity ogive used in this assessment was derived in 1997. During that period of time the SSB was above B_{pa}. The stock in 2009 has a much lower SSB which may have affected the age-at-maturity.

Stock: Plaice in Division VIIe (Western Channel)

Assessment type: Update, no changes to assessment settings

Assessment: Analytical

Forecast: No short-term projection provided since 2006 due to strong retrospective bias in F (consistent overestimate of F). No medium-term projection carried out for this stock.

Assessment model: XSA, tuning by 3 commercial fisheries and 2 surveys

Consistency: same as last year with addition of data for 1 extra year

Stock status: SSB is greater than B_{lim} but below B_{pa}, F is above F_{pa}, F_{lim} not defined. SSB (1500 t) has declined to lowest levels observed since the 1970s. Recruitment has been near or below average since 1998, and the 2007 year class is the lowest in the time-series. Fishing mortality decreased from 0.79 in 2007 to 0.64 in 2008, and has been well above F_{pa} (.45) for almost the entire time-series.

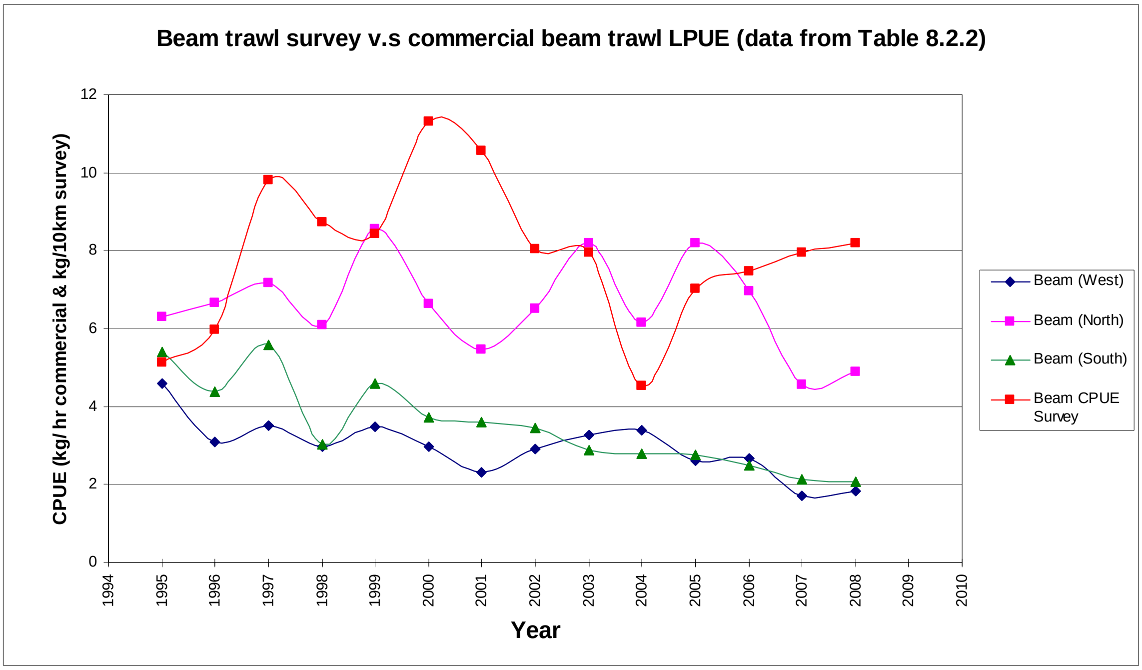
Management Plan: There is no rebuilding strategy in place for this stock. Since 1984 the fishery is controlled by a TAC that is shared with area VIId. Minimum mesh size for both beam and otter trawlers is 80 mm or 3 1/8 inches. Minimum landing size (MLS) is 27 cm or 10 3/8 inches. The number of days at sea is restricted to 192 for beam trawlers. The TAC for 2009, 4646 tons, represents a reduction of 404 tons from the 2008 TAC of 5050 tons.

General comments:

- This was an update assessment, so full data screening, tuning data and exploratory XSA trials were not carried out. Some catch data screening was carried out using a separable VPA using the following standard settings reference age of 4, F set to .7 and S set to .8. The next benchmark assessment is scheduled for 2010.
- Given the low stock size, recent poor recruitment, high fishing mortality, the uncertainty in the assessment, and the inability to reliably forecast catch, ICES recommends a substantial reduction in catch until the estimate of SSB is above B_{lim} or other strong evidence of rebuilding is observed.
- Unallocated landings in 2008 (134 mt) were the highest in the last 16 years (Table 8.2.1) and were much greater than the individual landings estimated for France (105 mt) and Belgium (66 mt). Unallocated landings are said to be generally additional French landings derived from sales note information.
- Data on age composition of the catch are only available from the UK (England and Wales) fishery representing 70% of the total catch, but are missing for the French and Belgian fleets representing the remaining 30%. It would be ideal to obtain actual age composition data of the entire international catch to better inform the model.
- Figure 8.2.4 shows that older age-3 fish dominated the catch from 1999 to 2007, except for 2000 when age-4 dominated the catch. In 2008 a shift occurs and for the first time, younger age-2 fish dominate the catch. The tendency to remove increasingly smaller younger fish from the population may lead to recruitment overfishing and potential for stock collapse be-

cause only 25% of age-2 fish have reached sexual maturity. No age 1 fish are sexually mature.

- The Fisheries Science Partnership Survey (FSP survey) complements the standard beam trawl survey and has performed well in tracking year classes in the past. The FSP survey should be continued and further developed into a standardized and consistent survey. The data obtained should be utilized to its full potential to improve the stock assessment.
- The RG agrees with the WG that the pronounced temporary increase in beam trawl survey cpue catches in 2000 and 2001 does not correspond to a general decline in cpue for commercial catches from 1990 to 2007. There appears to be a temporary gear effect perhaps caused by the beam trawl used in the survey that should be further investigated. The higher cpue in the survey over two year time period may be one of many factors contributing to the retrospective pattern in F, (see Figure below). Otherwise the beam trawl survey cpue tracks the commercial trends well.
- Tuning information consisted of the same five fleets used in the previous year, historic UK otter trawl using ages-2–9, current UK otter trawl and beam trawl UK beam trawl using ages 2–9, and two UK surveys UK_WEC_BTS and UK (E&W) FSP. Four of the tuning indices indicate highly consistent year-class estimates. The UK FSP demonstrates a large year effect in the 2008 data and was not included in the assessment due to many modifications to the 2008 FSP survey such as a change in the gear used. The RG agrees with the WG that the 2008 FSP survey should be excluded from consideration.
- The RG agrees with the WG that the consistent bias in F (overestimation of F) seen in the retrospective pattern is a problem in this assessment and its causes require investigation. Obtaining age based data from the French and Belgian fleets to obtain better estimates of survivors and investigating causes for the high cpue in the beam trawl survey during 2000 and 2001 may help alleviate the pattern.
- Ecosystem effects on stock dynamics is currently blank, (Annex, Section A.3) and indicates information to be added in future.
- Discards are currently not included in the assessment and are described in the final Report as low compared with other plaice stocks. The RG agrees with the WG that adding discards should be considered at the next benchmark in 2010.



Technical comments:

- The total international age composition is obtained by raising the UK age compositions to include the landings of France and Belgium and summing to give an annual total. The raising technique should be explained in greater detail.
- A better explanation of the reasons for the increase in beam trawl effort to record high levels over time is needed particularly considering that otter trawl effort has decreased during the same time period in Figure 8.2.1. For example, what changes to the beam trawl vessel fishing power may have led to the continuous increase in beam trawl effort? Table 8.2.2 suggests it's due to an increase in the hours fished by beam trawlers over time. If so, why not state it clearly in Section B.4 of the Annex. Also, the X-axis label in Figure 8.2.1 for commercial effort is incorrect. It says lpue when it should say hours fished in correspondence with the data in Table 8.2.2.
- Fishery discards are not described anywhere in the Annex.
- Figure 8.2.2 If there are no discards to demonstrate in the French nets fleet, the graphs demonstrating no catch in quarters 1, 2 and 4 and only retained catch in quarter 2 should be omitted from the Report. The vertical Y-axis and the horizontal X-axis should be labelled. Is X length? Is Y biomass in tons?
- Figure 8.2.5 The residuals would be easier to understand and interpret if they were plotted using bars rather than trend lines.
- Table 8.2.11 The heading for this table is incorrect. It should read, Population numbers and not Terminal F's. The terminal F's were presented in the previous Table, 8.2.10.
- Table 8.2.11. Introduce and or explain what the abbreviations GMST and AMST mean.

- Table 3.2.12 (the final Table) should be Table 8.2.12. The heading is again incorrect. It should read Summary. The heading "Terminal F's derived using XSA (with F shrinkage)" should be deleted.

Conclusions

The RG agrees with the WG that efforts to reduce F should continue because SSB is less than B_{pa} and F is higher than F_{pa}. The RG agrees with the WG on all of its considerations and recommendations including the following measures that may improve future assessments.

- Obtain the actual age composition of the catch data for the French and Belgian fisheries in order to better inform the VPA.
- Investigate the temporarily high cpue in the beam trawl survey compared with decreasing cpue in the commercial beam trawl fishery during the same time period.
- Standardize and improve the FSP survey and utilize the data in future assessments.
- Consideration should be given to updating migration and movement patterns of plaice in VIIe with a more current tagging programme.
- Investigate reasons for the retrospective pattern in F which may be caused by the factors above.
- Comparison of beam trawl survey cpue (red trend line) and commercial beam trawl cpue from 1995 to 2008. The data are from Table 8.2.2. Note the high cpue in the beam trawl survey in 2000 and 2001 which does not correspond to decreasing cpue in the commercial fleet. Otherwise, the survey cpue tracks the commercial cpue fairly well in other years.

Stock: Plaice in Division VIIa (Irish Sea)

Assessment Type: Update

Assessment: Analytical

Forecast: A short-term forecast assuming *status quo* F indicates that SSB will increase, but was deemed unreliable because of consistent retrospective biases.

Assessment method: ICA, tuning by survey data and 2 biomass indices.

Consistency: an update assessment with the same settings as 2008. Stock status has not changed, current F remains well below F_{pa}, and current SSB is above B_{pa}. The assessment has consistently biased retrospective patterns for SSB, recruitment and F. Advice has remained consistent from 2008: There would be little gain to the long-term yield by increasing fishing mortalities above the current levels.

Stock Status: F rose to high levels in the mid 1970s but has declined over the past 4 decades. Since the early 1990s F has continuously declined and has been below F_{pa} (0.45) since 1998. F was at the lowest estimate of the time-series in 2008 (0.06). SSB has been steadily rising since 2000 and is above B_{pa} (3100 t) but is still below historical levels. Estimated recruitment has been variable over the time-series but the trend demonstrates a marked decline since 1988, with only minor variations until 2008.

Management Plan: Management is by TAC and technical measures. TAC limits for 2009 (1430 t) are well below forecasted catch at F_{pa} for 2009 (3960 t) and biomass should remain above B_{pa} (3100 t).

General Comments:

- The stock definition for this stock seems to be poorly understood. The degree of separation between Irish Sea and Celtic Sea stocks is still unclear. The uncertain view of mixing and movement patterns between stocks coupled with the lack of ecosystem information for this species should be addressed.
- The Irish Sea plaice stock is targeted within a mixed fishery for cod, haddock, whiting and plaice. The stock is also taken as bycatch in fisheries for *Nephrops* and sole. Multiple fisheries catch plaice below the legal size and discards are greater than retained catch levels in all fisheries (see Figures below). The fact that there is such a high level of discards in multiple fisheries yet these data are not included in the assessment is troublesome. The strong retrospective pattern (Figure below) may result from the discards not being accounted for.

Technical Comments:

- First page of the assessment, under the 2008 advice and 2009 advice, it appears the F estimated have been truncated instead of rounding. $F_{0.1}$ was estimated at 0.1385, under the 2008 advice "$F_{0.1}$ (0.13)" should read $F_{0.1}$ (0.14).
- The advice for 2009 states: "The current fishing mortality (2007) is estimated to be 0.09…" F2007 was estimated at 0.0985, should this read "The current fishing mortality (2007) is estimated to be 0.10…" Why not use the F2008 as the current estimate of fishing mortality? Should this sentence read, "The current fishing mortality (2008) is estimated to be 0.07…?" F2008 was estimated to be 0.06571, rounding up, not truncating gives 0.07.

- Are the final F values being used F_{bar} values from ages 3–6 (Table 6.7.3.4) and not the fit values from Table 6.7.3.1? If this is the case it needs to be clearer in the assessment document why only ages 3–6 were used to generated mean estimates of F.

Conclusions:

- The RG agrees with the advice that there would be little gain to the long-term yield by increasing fishing mortalities above the current levels. Fishing mortality seems well below F_{pa} and SSB seems well above B_{pa} however, there is still much uncertainty and bias in this assessment and advising changes to F based on uncertain estimates could be problematic.
- The WG recognized all of the problems associated with assessing this stock and that "aspects of this assessment seem to be deteriorating." The problems with retrospective patterns in F, SSB and recruitment and the inability to incorporate very high levels of discards (levels considered to be larger than the retained catch) might be too much for this assessment to overcome. It would be wise to forgo drawing conclusions from this assessment until the issues stated above can be addressed at the scheduled flatfish benchmark meeting in 2011.
- The RG agrees with the WG that the forecasts are not reliable, and the RG concludes that forecasts should not be included in the assessment or ICES advice.

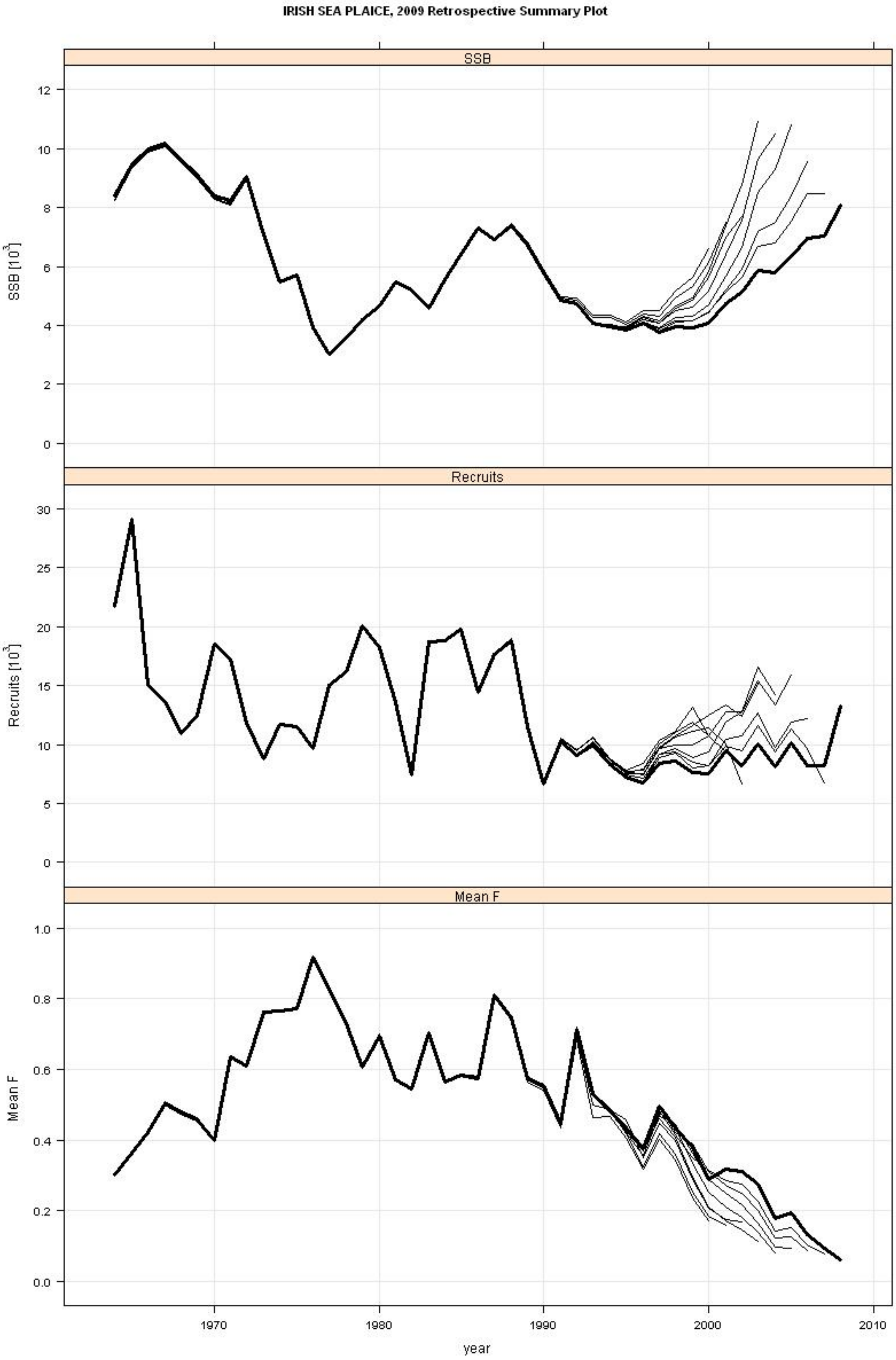


Figure 6.7.3.2. Retrospective pattern for update ICA.

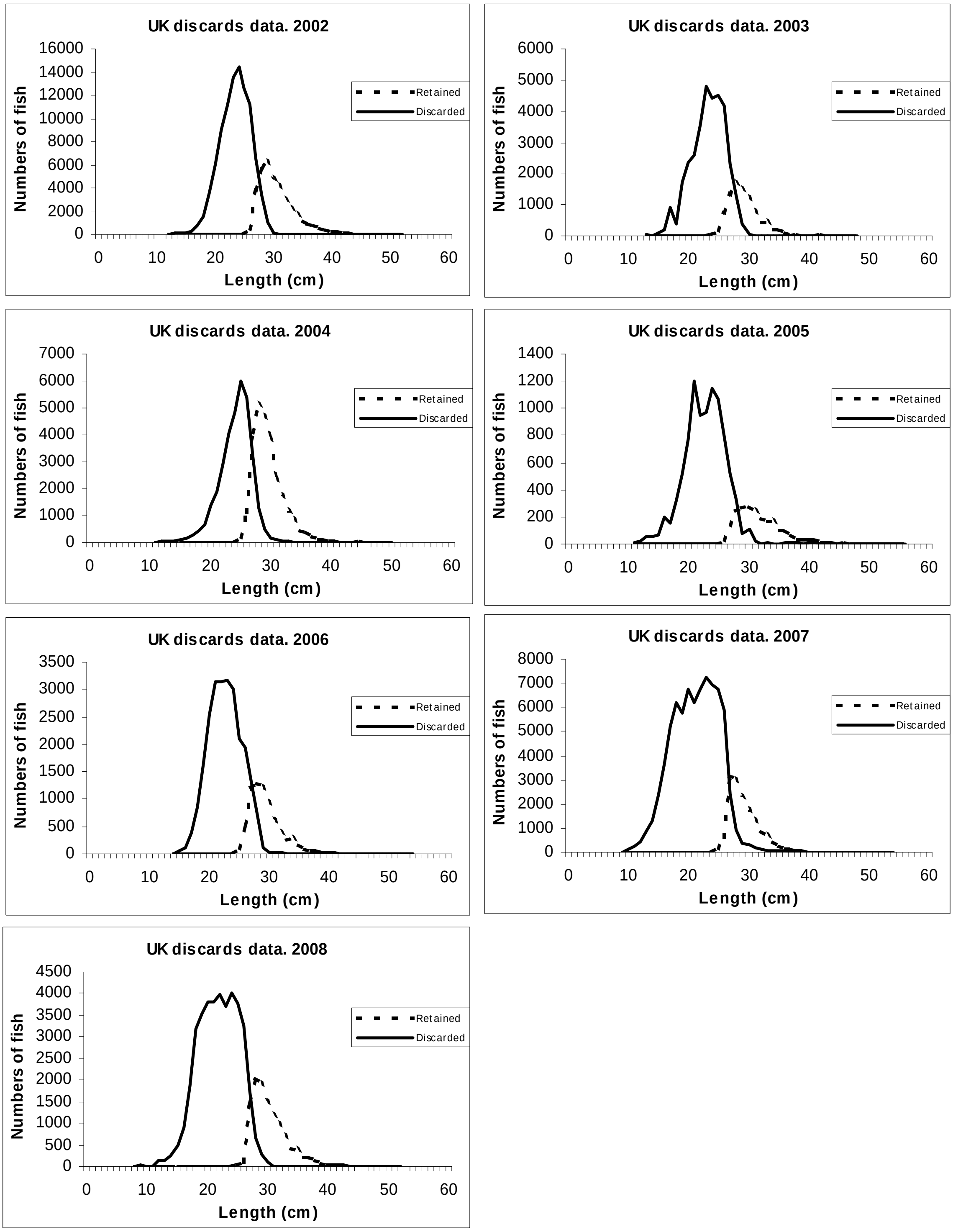


Figure 6.7.2.3. Length distributions of discarded and retained catches from UK (E&W).

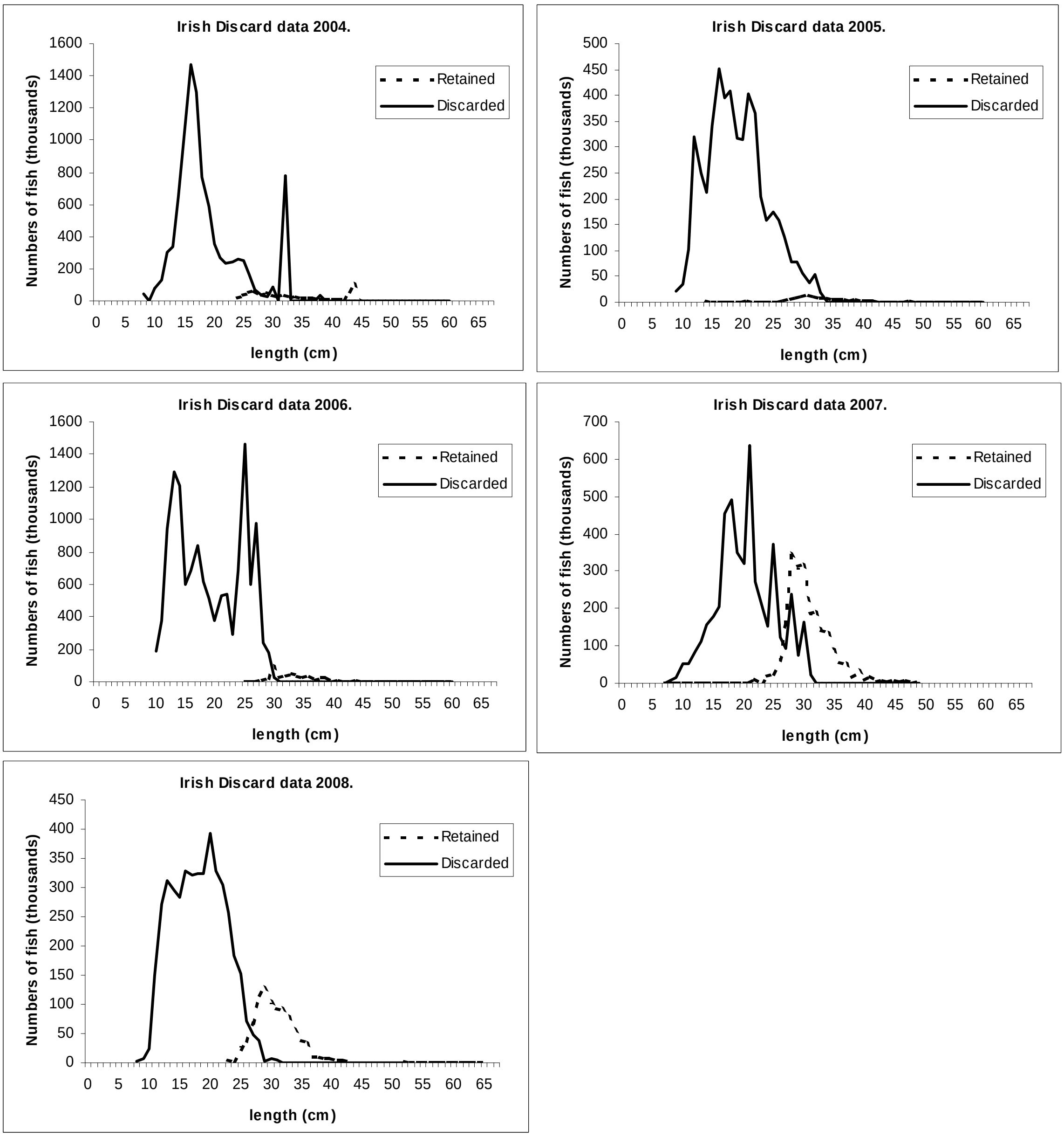


Figure 6.7.2.4. Length distributions of discarded and retained catches from Ireland.

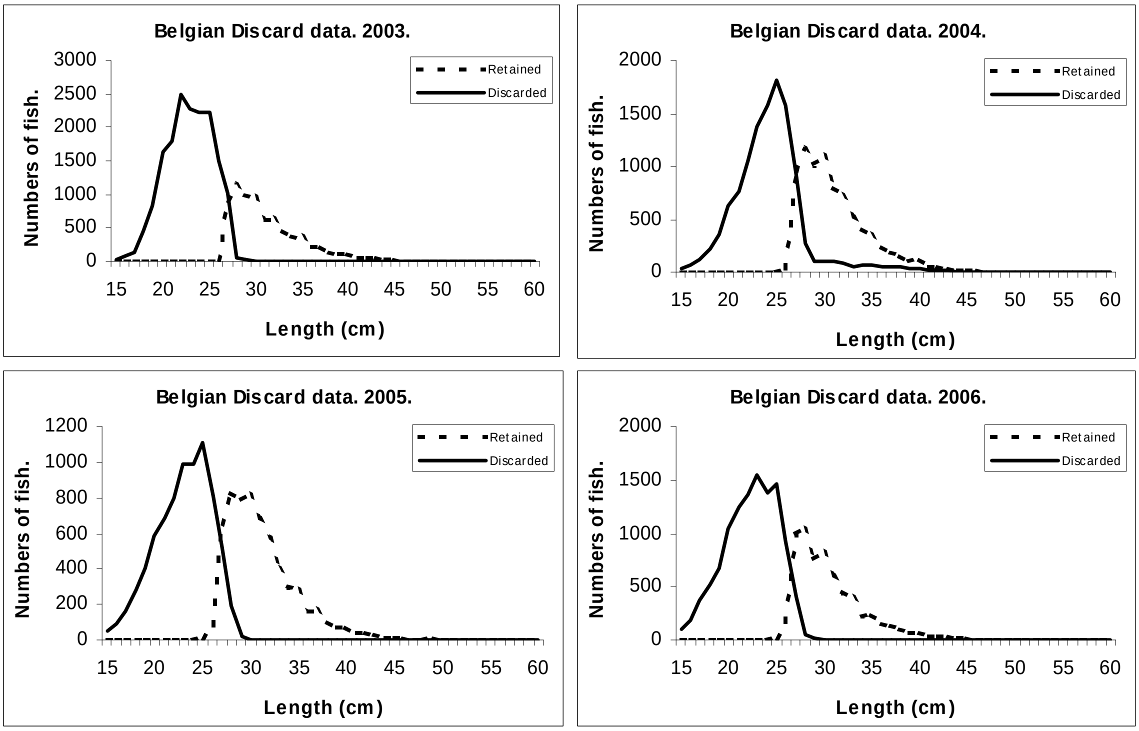


Figure 6.7.2.5. Length distributions of discarded and retained catches from Belgium.

Stock: Sole in Divisions VIIfg (Celtic Sea)

Assessment Type: Update

Assessment: Analytical

Forecast: A short-term forecast assuming *status quo* F indicates that SSB will increase to 3090 tonnes in 2010 and 3250 tonnes in 2011. No medium-term projections were completed. A long-term projection assuming geometric mean recruitment estimates the long-term yield and SSB to be 885 t and 3120 t respectively at *status quo* F. F_{max} is estimated to be 0.25, which is less than the 2008 estimate of F (0.27).

Assessment method: XSA, tuned by one survey (UK Beam Trawl survey) and two commercial indices (UK and Belgian Beam Trawl).

Consistency: Last years' assessment was accepted. As in 2009, the 2008 assessment stated that the stock had full reproductive capacity and was being harvested sustainably. The XSA exhibits a retrospective bias, where the 2007 estimates of F were revised downwards by 7%, SSB was revised upwards by 5% and recruitment in 2007 was revised downwards by 40%.

Stock Status: In 2009, the spawning biomass was ($B>B_{pa}$ since 2001) and the fishing mortality was sustainable ($F<F_{pa}$ since 2004).

Management Plan: Currently there is no explicit management plan for Celtic Sea sole. Management measures include technical measures and a TAC for this stock. The working groups recommended that F should be kept below F_{pa}, in order to keep B above B_{pa}.

General Comments:

- General ecosystem information has not been provided or considered in the current assessment.
- More information is needed on mixed fisheries associated with this stock.
- Reference points should be agreed upon for this stock. There is a large discrepancy between F_{pa} (0.37) and $F_{0.1}$ (0.11), although both represent precautionary management options.
- The conflicting signals between the UK beam trawl fleet and UK beam trawl survey in 2007 and 2008 need to be addressed. This is especially important as the UK beam trawl survey is the only estimate available to predict recruitment for this stock since 2007. The spatial and temporal extent of the two datasets may need to be compared to evaluate why different trends in catchability were noted.
- The WG states that in certain years the recruitment of sole in VIIfg has been scaled downwards, by as much as 40%. This has been assumed to be due to a retrospective bias in the XSA model. However, the stock annex for VIIe sole reports that juveniles from VIIfg may immigrate to Area VIIe, particularly when year classes are above average. Therefore, the downward revisions in recruitment may not be an artefact of the model, but rather a result of the movement of the stock. This possibility should be considered by the WG during upcoming assessments. It may be necessary to conduct additional tagging work to quantify the movement of juveniles from VIIfg to VIIe.

Technical Comments:

- The format of the tables and figures was very difficult to interpret and follow. Ideally, these tables and figures would have been provided as a document file. The small size of both the tables and figures made interpretation difficult. In addition, several figures are provided without adequate axes labels.
- The landings data indicate that the length compositions of the Belgian and UK beam trawl fisheries are substantially different (Figure 17.3.1), and that the Belgian fleet typically lands smaller fish than the UK fleet. However, the discard estimates are taken only from observed trips of the UK fleet, as no data are available for the Belgian fleet after 2005. If available, discard estimates for the Belgian fleet since 2005 should be reexamined, and should be included in the XSA assessment if they are found to be significant.

Conclusions:

RG agrees with the WG on the assessment methods and TAC measures for this stock. The recommendation to limit the TAC in order to reduce F below F_{pa} is justified. However, reference points should be revisited for this stock. In addition, general ecosystem considerations should be taken into account, especially with regard to the stock–recruit relationship for this stock

Stock: Sole in Division VIIe (Western Channel)

Assessment Type: Update

Assessment: Survey trends

Forecast: No projections were carried out in this report due to the lack of an assessment.

Assessment Model: No final assessment was presented. WKFLAT 2009 rejected all biological reference points for this stock. However, last year's results were updated using the most recent data. An exploratory XSA model was used, which included catch numbers-at-age, 5 tuning fleets, 1 survey (UK-BTS), 2 commercial cpue series (UK-CBT and UK-COT), as well as 2 historical cpue series.

Consistency: The XSA consistently produces a persistent retrospective bias in estimating F and SSB.

Stock Status: Uncertain due to a lack of assessment methodology. SSB has been low over the last 20 years. Recruitment appears to be less than historical levels, and recruitment variability has decreased.

Management Plan: A multi-annual plan was established in 2007 (Council Regulation (EC) No. 509/2007) to implement a 20% reduction in F for VIIe sole. The proposed target for F was established as 0.27. However, ICES could not evaluate or apply this plan for management advice due to the absence of an assessment model.

General Comments:

- The Report was well ordered and easy to follow and interpret.
- An overview of the potential mixed fishery interactions between sole and other species has been provided in the Report.
- Ecosystem information was also provided in the Report. It is stated that no conclusive links have been found between sole and specific environmental drivers. However, a correlation between above average recruitment and positive NAO indices may be present.
- The sections about misreporting of landings were helpful and concise.
- The recommendations for the next benchmark provided by the WG are well directed and appropriate to this stock.
- A tagging study demonstrated that some interchange of juvenile sole occurs between areas VIIfg and VIIe. An additional tagging study may be an appropriate method to assess the population structure of sole in area VIIe and adjacent areas, and estimate the amount of interchange between adjacent stock areas. This tagging study could also estimate whether the Hurd Deep presents a barrier that prevents mixing between sole on either side of the Hurd Deep in area VIIe. Expansion of the UK-BTS survey to cover the entire VIIe stock area may be worthwhile, as it will provide an improved index of sole abundance in the VIIe area. It may also be worthwhile to consider assessing the VIIe and VIId stocks as a single unit, as it appears that there is no physical barrier restricting movement between the two adjacent units.

Technical Comments:

- It would be useful to include some data regarding mixed species impacts in the next Report. This may be especially relevant if a precautionary TAC is used in 2009, as discarding of sole in fisheries targeting other species may increase.
- Based on the available figures (8.3.3 a–c) it appears that sampling is adequate for the combined UK fleet (486 sampled hauls), but sparse in the French trawl fleet (37 sampled hauls). Based on the available data, it appears that discarding may be more prevalent in the French trawl fleet, especially in the first and second quarter. The assessment may become better informed if sampling intensity is increased in the French fleet.

Conclusions:

As a formal assessment was not possible, the precautionary TAC proposed by the WG seems appropriate. Lpue indices for the beam trawl fleets have declined consistently over the available time-series. In addition, the trends in F and SSB estimated in the XSA suggest that the production of the stock is declining. Therefore, a precautionary approach seems most appropriate until a suitable assessment can be conducted.

Stock: Sole in Division VIIa (Irish Sea)

Assessment Type: Update

Assessment: Analytical

Forecast: A short-term projection is presented.

Assessment method: This assessment uses an XSA tuned with September and March UK beam trawl surveys.

Consistency: The settings for the XSA remain unchanged except for updates of landings and survey data. Results are similar to the stock demonstrating a much reduced reproductive capacity and continued declines in SSB.

Stock Status: Currently the stock is in poor condition. SSB remains less than B_{lim} (2200 t) and has been declining since 2001. F remains relatively high (0.38) and is just below F_{lim} (0.4), but well above F_{pa} (0.3) and $F_{0.1}$ (0.15).

Management Plan: No management plan is given. The fishery appears to be at a level much greater than is sustainable and it is suggested that the fishery is closed for the near future.

General Comments:

- The RG agrees that the XSA model presented is appropriate to the assessment of Irish Sea Sole in area VIIa. Considering the benchmark review of possible tuning indices, it seems appropriate to only use the March and September UK beam trawl surveys. The model appears to provide fairly reliable results with no substantial patterns in residuals. In addition, bias appears to be relatively low although retrospective plots do indicate overestimation of SSB and underestimation of F in recent years. This indicates that stock status is likely worse off than is presented in current assessments, but this bias is low.
- Considering the extremely low levels of stock abundance, it is worrisome that discards are ignored in the assessment. Even though data suggests that discard rates in the various fisheries are generally less than 8%, when dealing with a stock in such a depleted state this can be an important mortality component. It is suggested that in future work discards are included within the assessment. In addition, attempts should be made to obtain better discard estimates from the various fisheries.
- Ecosystem aspects are generally ignored in this assessment. The only mention is that Sole is caught in a mixed species fishery and also as bycatch in the *Nephrops* fishery.
- No mention is given as to why M of .1 was chosen. It is assumed that this is based on maximum ages seen, but this should be better explained in the annex.

Technical Comments:

The document was well done, although the fact that tables and figures were still in Excel format made it difficult to review. Also, it would be helpful to include more diagnostic plots especially for the catch data. A variety of diagnostic plots are a necessity for assessing model fit and so it would be very useful to have more than a single bubble plot for each of the surveys.

Conclusions:

- The RG agrees with the WG that the XSA assessment tuned to the two UK beam trawl surveys is an acceptable way to determine stock health for Irish Sea (VIIa) Sole. The model appears well done and no residual trends are apparent, although it is suggested that in future work more diagnostic plots are presented especially for fits to the catch data. In addition, retrospective plots demonstrate relatively little bias or significant patterns.
- Due to the extremely low and declining SSB and recruitment, it appears that the reproductive potential for the stock has been reduced and that the Irish Sea Sole stock is in danger of collapse. This is supported by the fact that SSB has declined well below B_{lim} and has been in this state for many years. It is agreed that the sole fishery should be closed until the stock can be rebuilt to sustainable levels.
- Finally, the RG suggests that a forward projecting statistical catch-at-age model maybe appropriate to this stock. Such a model would allow for modelling each of the fleets separately allowing separate selectivity for each. In addition, it relaxes the assumption that catch data are known exactly. This appeared to be a concern for the WG, which stated that the model bias was believed to be due to the fact that the catch-at-age data were much less precise than survey data. It is possible that a SCAA formulation could improve model results.

Stock: *Nephrops* in Division VIa (FU11, North Minch)

Assessment type: Update assessment, with an adjustment to abundance in time-series following Benchmark assessment held March 2009. The adjustment results in a slightly higher abundance for the time-series.

Assessment: Assess trends. Benchmarked in March 2009

Forecast: Short-term prediction of landings for 2010 at various harvest ratios using catch option table developed during the Benchmark. No medium or long-term projection presented.

Assessment model: UWTV survey index of total abundance over the survey area, not possible to structure by age or length.

Consistency: Survey methods and results same as last year, but incorporates a bias correction factor of 1.33 to obtain absolute abundance from relative abundance. Following benchmark, survey data are a measure of absolute abundance.

Stock status: Long-term harvest reference points, $F_{0.1}$ and F_{max} were estimated at the Benchmark assessment. Precautionary approach biological reference points have not been determined. Landings in FU11 have been stable over the course of the time-series (1981–2008). The length–frequency distribution, mean size and mean weight of *Nephrops* have all been stable for the time-series. The current fishery is sustainable.

Management Plan: There is no management plan. DAS limits apply to trawlers (maximum of 25 DAS per month). The DAS available in 2009 are the same as in 2008. Square mesh panels are required in trawls to reduce finfish bycatch in particular cod, haddock and whiting. *Nephrops* catches are generally above the minimum landing size (MLS).

General comments:

- No information on ecosystem dynamics of *Nephrops* was included in the final Report but should be considered in future assessments for this stock.
- The RG agrees with the WG that a uniform approach to deal with unsurveyed smaller isolated pockets of mud that coincide with the creel fishery in sea lochs around N and S Minch should be developed. The RG suggests that a standardized Fishermen Science Partnership creel survey (FSP creel survey) could be developed to address *Nephrops* abundance from these smaller areas.
- Likewise, the RG agrees with the WG that further examination of the extent of the *Nephrops* stock area is warranted and the UWTV survey may be underrepresentative of the *Nephrops* stock area because VMS data reveal *Nephrops* fishing activity outside the current survey area.
- The RG concurs with the WG that management of this stock should be applied at a local FU level rather then at the ICES Division level.

Technical comments:

- The citation for the Howard *et al*. in the Annex is incomplete.
- More details on the difference in burrow emergence patterns for males and females would be helpful. For example, do females emerge less often from burrows when they are bearing eggs?

- Figure 3.5.6. Label the X and Y-axis of the graph. The figure legend should be under the figure and not on the following page. Eliminate the black background.
- Table 3.5.8. Column heading "Station #" is actually the number of valid stations per survey.
- Figure 13.5.8. Should be Figure 3.5.8.
- Section 3.5.4. Final assessment. Provide a figure to go along with the statement that "…2008 abundance declined slightly although confidence limits overlap for the past two years."

Conclusions:

- The RG agrees with the recent advice not to allow harvest rates to increase relative to the landings in 2006 and 2007 because those two years likely represent the more accurate landings of the time-series following implementation of mandatory Seller Buyer reporting.
- The RG agrees that the Underwater Television Survey (UWTV) is the best scientific information available for this stock because trawl surveys are highly variable due to *Nephrops* burrowing behaviour and their variable emergence rates.
- The RG agrees with the WG that measures should be adopted that control creel numbers to prevent unforeseen, uncontrolled increases in fishing effort.
- The RG supports the WG's decision to use larger meshed square panels in *Nephrops* trawls to avoid unwanted finfish bycatch while maintaining catches of *Nephrops*, in accordance with the Scottish Conservation Credits Scheme and Cod Long Term Plan.

Stock: *Nephrops* in Division VIa (FU12, South Minch)

Assessment Type: Update

Assessment: Assess trends

Forecast: 2010 landings were forecasted using a range of harvest rates, ranging from 0–20%. The 2010 landings limit of 5000 t proposed by ICES corresponds to a harvest rate of roughly 17%. These landings are slightly above the F_{max} harvest rate of 16%, which corresponds to landings of 4715 t. No medium or long-term projections were presented.

Assessment Model: UWTV survey index of total abundance.

Consistency: Survey trends indicate that the stock abundance is relatively stable. A bias correction factor of 1.32 was applied to the UWTV survey index.

Stock Status: Survey data indicate that the current abundance of this stock is close to the historical average from 1999–2008. There are no precautionary reference points available for this stock. Recent survey indices and landings of *Nephrops* <35 mm indicate that recent recruitment classes may be above average.

Management Plan: *Nephrops* catches are currently allocated using a TAC management system. There is a minimum landing size of 20 mm in place. *Nephrops* trawl fisheries are governed by the North Sea and West coast of Scotland cod recovery plan (EC 2056/2001), which provided additional measures to EC850/98. This limits vessels targeting *Nephrops* with mesh sizes between 70 and 99 mm to 25 days at sea per month. Scottish legislation (SSI No 2000/226) also applies gear restrictions to twin trawlers operating north of 56°N.

General Comments:

- The Report was well ordered and easy to follow and interpret.
- The description of the fishery in 2007 and 2008 was well written and helpful to the RG.
- Mixed fishery interactions were provided in both the WG report and the stock annex.
- Ecosystem information was not provided in the Report.
- To improve the abundance estimates for this stock, it may be beneficial to increase the spatial coverage of the UWTV survey. Currently, this survey does not cover the sea loch areas adjacent to the South Minch grounds. The WG acknowledges that the lack of survey data in this region likely leads to an underestimation of *Nephrops* abundance in the South Minch area.

Technical Comments:

- It would have been helpful to include a map demonstrating the size of the South Minch Area (FU12) relative to the entire stock Area VIa. This would be useful because the WG Report states that the landings correspond to the entire VIa Area.
- The WG Report was still in a draft form when it was submitted to the RG.

Conclusions:

Although the data suggests that the fishery appears to be sustainable, there is some uncertainty associated with the survey estimates of abundance. Therefore, a precautionary (and reduced) TAC seems appropriate to avoid harvesting the stock unsustainably.

Stock: *Nephrops* in Division VIa (FU13, Firth of Clyde)

Assessment Type: Update

Assessment: Trend Assessment

Forecast: A short-term (1 year) predictions of landings in 2010 were included using various harvest rates.

Medium and long-term projections were not provided

Assessment method: UWTV survey Abundance index-based on burrow counts

Consistency: There is no retrospective analysis, although the confidence intervals on the abundance estimates are wide, especially in recent years.

Stock Status: Status of the stock cannot be evaluated because reference points have not been determined for this stock, although the stock is perceived to be stable.

Management Plan: There is currently no management plan for this stock.

General Comments:

- General ecosystem information has not been provided. The WG mentioned the sediment types used in the UWTV surveys. The surveys only covered mud and sand bottoms, presumably this is due to the burrowing of *Nephrops*, but wasn't clearly explained.
- Mixed fisheries information was not provided.
- Discard data were provided and included in the adjusted abundance estimate.
- The abundance index of *Nephrops* in 2007 was considerably lower than 2006 but rebounded in 2008. Other than this change the abundance index has been increasing since 1999 and appears to be stable even at harvest rates in the last two years above F_{max}.

Technical Comments:

- The value for the 2008 total nominal landings in Table 3.7.1 is incorrect according to the values given in the Table. The total should be 5321+182+416=5919.
- The value for the 2008 adjusted survey in Table 3.7.5 is incorrect and should be 1768 according to the rest of the text. Rounding in Excel may be the cause of those of these errors.

Conclusions:

- RG agrees with the WG on the assessment and feels it follows the protocol described in the stock annex. The short-term projection gives various harvest rates and this should be used to assign the TAC. The idea of fishing at a level above F_{max} is unsettling and should be avoided especially for a stock that utilizes such a basic assessment.
- Why is there such a dramatic increase in harvest rate between 2006 and 2007? Table 3.7.5 states that 'harvest rates prior to 2006 are unreliable', should this read 'harvest rates prior to 2007 are unreliable', or was there really an increase in harvest rate of more than 200%?

Stock: *Nephrops* in Division VIIa (FU14, Irish Sea East)

Assessment Type: No assessment (update to available data)

Assessment: Not presented

Forecast: None

Assessment Model: None

Consistency: Same as last year with update to available data. Advice was that landings and effort should no increase above that recorded for 2007.

Stock Status: Unknown (higher landings in 2 most recent years)

Management Plan: None

General Comments:

- Presentation was clear with updated data.
- As stated by the WG, the introduction of the new buyers and sellers legislation in 2006 by the UK has resulted in increased reporting of landings. As noted, this precludes direct comparison with previous years reported landings due to a potential break in the time-series of landings.
- There has been an observed decrease in mean size of landed animals. The WG stated that this could be an indication of good recruitment in 2007 and 2008. However, no other potential reasons were given (growth overfishing, new reporting methods).
- The WG also noted a declining discard rate over the last six years from 29% to 22% of total catch-by-weight. As noted, this could be an indication of a change in landings preference to tails only; however the WG does not consider the change in landings reporting.
- Integration of the UMTV survey in the next assessment may enable the determination of stock biological reference points, or at least an estimate of absolute abundance.
- Further investigation into the change of reporting methods in 2006 and potential impacts to landings data time-series should be considered.

Technical Comments:

Figure 6.4.2 is labeled "Landings, effort and plus…", however the charts demonstrate only lpue. Figure 6.4.3 shows the same data as 6.4.2 for a longer time-series. Figure 6.4.2 needs to be changed to reflect the correct charts.

Conclusions:

- RG agrees with recent catch advice from 2008 that states that landings and effort should not increase above that recorded for 2007. However, it should be noted that 2007 landings are the highest on record and may be a result of a change in reporting methods as opposed to any change in the stock. Landings decreased slightly in 2008. If there continues to be a decline in 2009, the advice should be revisited for 2010.
- RG also agrees with WG that TAC allocations should be made on a finer scale, instead of a single TAC for the entire Area VII in order to prevent localized overfishing.

Stock: *Nephrops* in Division VIIa (FU15, Irish Sea West)

Assessment Type: Update

Assessment: Trends

Forecast: Only a short-term projection is presented.

Assessment method: The assessment method determines the health of the stock by looking at trends in: raised burrow density estimates from underwater TV surveys; catch rates, size composition, and biological data from spring and summer *Nephrops* trawl surveys; and total landings, lpue, size composition, and biological data from the commercial fisheries.

Consistency: The technique for assessing trends in surveys and commercial data have remained relatively unchanged. UWTV trends indicate a general decrease in burrow density, whereas trawl survey data indicates no change in size composition, and commercial data indicates increasing landings and lpue.

Stock Status: No target reference points are given. $F_{0.1}$ represents a harvest rate of 12.2% and F_{max} corresponds to a harvest rate of 20.4%. These estimates are used in the short-term projections, but no estimate of current harvest rate is given. Overall, stock status appears to be good as the stock has withstood current harvest levels for many years and have not demonstrated signs of collapse.

Management Plan: No management plan is given. The fishery is presented as being sustainable and it was suggested that effort should not increase above 2003–2005 levels.

General Comments:

- *Nephrops* are a difficult species to assess for many reasons and attempting to determine stock status is made more difficult by the uncertainty in landings data. Considering the amount and quality of data available the current assessment appears to be appropriate to this stock.
- One area that is unclear is how UWTV survey burrow density is raised to total burrow abundance. More details should be provided on how this procedure is undertaken. Also, no mention is given of whether account is taken of sediment type when raising to total burrow abundance. The main issue being that if sediment type changes from the areas that are surveyed to those that are not, then the number of burrows will likely differ causing the raised abundance to be greatly different from the actual abundance. It appears that many of the biases that occur in the UWTV survey are considered and taken into account as best as is currently possible using the bias correction factor.
- The RG agrees with the WG that the 16 month delay between the survey and the start of the year for which the assessment is used to set management measures is very troublesome. Work should be done to attempt to reduce this delay.
- Some attempt to estimate harvest rate should be made so that a rough estimate of stock status can be made. For instance, converting density abundance to actual *Nephrops* abundance, then comparing the ratio of landings to abundance to get an estimate of harvest rate. Although this will be a very crude estimate it would be helpful to compare with $F_{0.1}$ or F_{max} and a

time-series of harvest rate can be made to assess the general trend in the stock.

- Ecosystem aspects are generally ignored in this assessment. There is some discussion of early life history of *Nephrops* in relation to general ocean circulation in the area and how it can affect distribution and mixing between stocks, but species interactions and bycatch are largely ignored.
- The discard rate is assumed to be 22.8% by number and is a combination of discard rates from both the UK and Irish fleets.

Technical Comments:

Overall, the document is well presented. Graphs and tables are well formatted and informative.

Conclusions:

The RG agrees with the WG that the assessment of trends in survey and commercial *Nephrops* data are an acceptable way to determine stock health for the Irish Sea West (FU15). It is noted that *Nephrops* have proven a difficult species to model throughout their range and uncertainty in landings data has increased modelling problems. Assessing trends in UWTV burrow density, size composition, biological data, and catch rates from trawl surveys and the commercial fishery appears to be one of the only ways to determine stock status. However, the RG has concerns that current fishing levels may not be sustainable as the WG suggests. Although size composition has remained relatively constant and lpue has increased, both surveys indicate abundance has been slightly declining. It is possible that increases in lpue have increased due to technological advances. The general decline in burrow density from the UWTV survey is particularly troublesome.

The RG suggests that if these trends continue, future TACs should be reduced from current levels to avoid a possible stock collapse. Although current harvest levels appear sustainable, it is possible that *Nephrops* are concentrating in preferential habitat areas as the population declines. The result of this would be that lpue could remain high due to this schooling-like effect, but total burrow density would decrease. Finally, it is suggested that some type of analytical model is attempted. One possibility is to use a catch survey analysis (CSA) that tracks recruits and post recruits each year.

Stock: *Nephrops* in Division VIIb (FU17, Aran Grounds)

Assessment Type: Update

Assessment: Assess Trends

Forecast: A short-term projection was completed using a catch option table for different management options for 2010. Projections were done for different harvest rates at $F_{0.1}$ and F_{max}.

Assessment method: UWTV based assessment. A bias correction of 1.35 is used in the assessment to compensate for an "edge effect".

Consistency: The stock was not reviewed in 2008, but advice for the 2009 TAC is consistent with the TAC set for 2008.

Stock Status: The stock was benchmarked in 2009, but there insufficient data to estimate reference points. Both $F_{0.1}$ and F_{max} used for the short-term projections are from other *Nephrops* stocks. The current F is approximately F_{max} (F_{max}=17%), and the survey estimate of abundance of burrows is the lowest in the time-series.

Management Plan: None

General Comments:

- The decisions made in the benchmark assessment in 2009 are appropriate. It appears that the stock is in need of more data before further work can be done in regards to determining reference points.
- The document states that there is no information on discard survival, but the Annex includes a paragraph on discard survival giving an estimate of 10% for a survival estimate. The WG does include the 10% discard survival in the short-term projections so should amendment the Report to include this information.
- The use of the UWTV survey to determine absolute abundance estimates of *Nephrops* burrows is valid, but more work may need to be done to try to quantify the bias in the survey that depends on expert opinion. This opinion is noted by the WG.
- It is difficult to review the methods of the assessment used because the document refers to the Annex which refers to another section, Section 9.2, which is not included.
- Discard data are included in the short-term projections, but only for the most recent year (2008). There is no discard information for either 2006 or 2007 because of a lack of industry cooperation.
- There are no discussions of ecosystem or mixed fisheries effects.

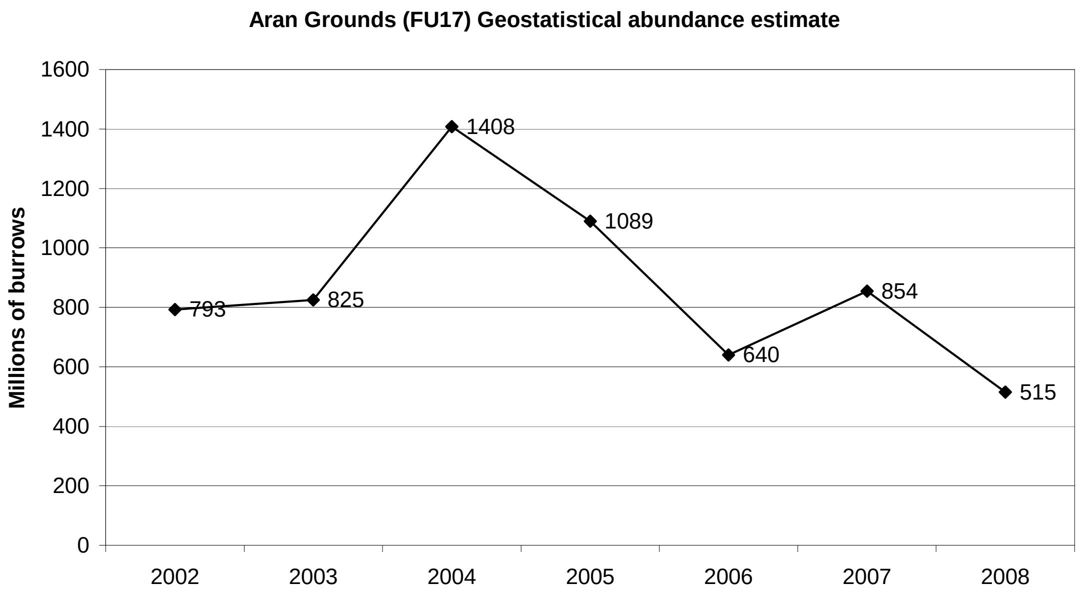
Technical Comments:

- The Report that was reviewed was a draft version downloaded from the SharePoint website on 27 May 2009.
- The Figure on page 2 showing the different stock areas included in the TAC is cut off.
- There is no Figure 7.5.6b, but if the comment "a seasonal trend is observed" is pertaining to Figure 7.5.6, it is difficult to see a seasonal trend when the data are presented as millions of burrows per year.

- In Section 7.5.2, the sampling levels are in Section B of the Annex, not Section 2 and there is no Table 2.3. There is a table of sampling levels, but it is not labelled.
- In Section 7.5.3, the sentence "In line with the WKNEPH 2009 results of these are not presented as the model fit is good." seems contradictory to other statements made at the in the rest of the paragraph that indicate the model did not perform well. Should the sentence have read "model fit was not good" instead?
- In Section 7.5.5, 7.3.3 should be 7.5.3.

Conclusions:

The RG agrees with the WG on the assessment used and considers the data the best available. With that said, the RG disagrees with ICES and the WG advice that the fishery is sustainable at current levels of effort. The 2008 survey estimates of burrows is the lowest in the time-series at ~60% of the time-series average with a high current F and has the highest harvest rate in the short time-series. Effort has increased and is at the highest level in the time-series, but lpue (kg/hr) decreased slightly from 2007 to 2008. The slight decrease in lpue coupled with the lowest abundance estimate in the time-series could be an indicator that the TAC could be set lower to decrease F and effort. This may be difficult given the changes in the fishery (i.e. increases in effort being displaced from other areas and misreporting of landing statistical area). Unless there is an observed increased in burrows in the next survey, a precautionary approach should be taken.



Stock: *Nephrops* in Divisions VIIjg (FU19 South, East and West of Ireland)

Assessment Type: No Assessment

Assessment: None

Forecast: No forecasting was provided for this stock

Assessment method: No Analytical Assessment

Consistency: Same methodology as last year

Stock Status: Unknown

Management Plan: There is currently no management plan for this stock, but there are minimum landing size and mesh size regulations.

General Comments:

- General ecosystem information has not been provided.
- Mixed fisheries information was not provided.
- Discards are not used in this assessment, and discard levels are unknown.

Technical Comments:

- The text was still in draft form, which made it more difficult to read. Some of the sections seemed somewhat inappropriately labelled (i.e. Ecosystem aspects section discussing spatial locations of effort).
- The tables and figures included FU18 and FU19, but the text did not refer to FU18 at all.

Conclusions:

- The RG agrees with the WG advice of constraining effort and landings to recent levels.
- The RG also agrees that increased data quality and a longer time-series of data are needed to perform an analytical assessment.
- Figure 7.8.1 shows the spatial distribution of the fishery and it indicates there is an area of high effort. This may be a good area to try using the UWTV.
- This text only included updates to the available data and fishery information. No analyses were carried out.

Stock: *Nephrops* in Divisions VIIf,g,h (FU20–22, Celtic Sea)

Assessment Type: Update

Assessment: Trends

Forecast: No projections are presented.

Assessment method: The assessment method determines the health of the stock by looking at trends in: raised burrow density estimates from underwater TV surveys; size composition, and biological data from French (EVHOE) and Irish groundfish trawl surveys; and total landings, lpue, size composition, and biological data from the commercial fisheries.

Consistency: The technique for assessing trends in surveys and commercial data have remained relatively unchanged. Lpue has increased substantially in recent years and EVHOE indicators suggest that the stock is improving in recent years. Size composition from the various sources indicates a slight decline in mean size, but it is believed that this is from increased recruitment in recent years although the possibility of overfishing cannot be ruled out.

Stock Status: There has been no change in the perception of the state of the stock. Overall, stock status appears to be good as the stock has withstood current harvest levels for many years and have not demonstrated signs of collapse.

Management Plan: No management plan is given. The fishery is presented as being sustainable and it was suggested that effort should not increase above 2007 levels.

General Comments:

- *Nephrops* are a difficult species to assess for many reasons and attempting to determine stock status is made more difficult by the uncertainty in discard estimates and lack of commercial sampling. Considering the lack of data available the current assessment appears to be appropriate to this stock.
- One area that is unclear is how UWTV survey burrow density is raised to total burrow abundance. More details should be provided on how this procedure is undertaken. Also, no mention is given of whether account is taken of sediment type when raising to total burrow abundance. The main issue being that if sediment type changes from the areas that are surveyed to those that are not, then the number of burrows will likely differ causing the raised abundance to be greatly different from the actual abundance. Ecosystem aspects are generally ignored in this assessment. There is some discussion of early life history of *Nephrops* in relation to general ocean circulation in the area and how it can affect distribution and mixing between stocks, but species interactions and bycatch are largely ignored. The RG understands the lack of information on ecosystem considerations as more focus has and should be given to improving data and developing an analytical model before work can be directed to other areas.
- Discard rates are high due to large numbers of small *Nephrops* being thrown back and the increase in landings of tailed *Nephrops*. In addition, little sampling has taken place on discards due to lack of observer coverage on longer French trips (12–15 days). Although considerable work has been put into attempting to derive and back calculate discard rates with moderate success, effort should be put into increasing observer coverage to

get better estimates of discards and sizes of landed *Nephrops* (the latter being especially important for tailed *Nephrops* that are difficult to port sample).

- The RG agrees with the WG that effort should be put forward to attempt to standardized commercial catch rates between fleets and to attempt to account for technological creep so that a consistent time-series of cpue and/or lpue can be developed.
- It is suggested that effort is made to identify where preferential habitat is in this functional unit so that UWTV surveys can be directed to the important distributional areas in the region. In future, thought should be given to expanding the survey so that a majority of these habitats are surveyed as the WG claims that currently the UWTV survey misses a large portion of *Nephrops* habitat. Overall, the UWTV survey appears to provide one of the best sources of abundance trends and effort should be made immediately to optimize the results from it by identifying and correcting possible biases and making sure that the most important habitats are surveyed.

Technical Comments:

The document reviewed appeared to still be in an editing phase. All tables and figures were in separate files with many still in Excel format. The lack of coherence in the document made it very difficult to review. Data from the EVHOE survey were constantly cited, but only graphs of number of individuals at length could be found. More information from surveys should be provided (time-series plots of number caught by year, etc.). Overall, the document did not appear ready for review and should be better formatted before being sent to the RG.

Conclusions:

- The RG agrees with the WG that the assessment of trends in survey and commercial *Nephrops* data are an acceptable way to determine stock health for the Celtic Sea (FU20–22) stocks. It is noted that *Nephrops* have proven a difficult species to model throughout their range and uncertainty in discard data and lack of time-series of reliable surveys has increased modelling problems. Assessing trends in UWTV burrow density, along with trawl survey and commercial fishery size composition, biological data, and catch rates appears to be one of the only ways to determine stock status.
- The RG agrees with the WG that the stock appears to be harvested sustainably and that *status quo* TAC levels should be retained. Lpue has been increasing and the EVHOE survey suggests that the stock is generally increasing. However, it is noted that the UWTV survey demonstrates a general decline, although the time-series is very short. It is suggested that in future as the reliability of the UWTV survey increases and the time-series is lengthened, that this is the best source of abundance trends for *Nephrops*. Lpue data can be affected by technological creep in the fishery and the grouping of *Nephrops* into preferential habitat as the species declines in abundance. This can cause lpue to increase as the population decreases, assuming that fishers know where the preferred habitat is located. Also, the EVHOE survey is not designed for *Nephrops*, thus results are not as reliable. If the current trend in declining burrow density continues in the UWTV survey, declines in TACs should be greatly considered. Finally, it is suggested that some type of analytical model is attempted.

- The RG agrees with the WG that one possibility is to use a catch survey analysis (CSA) that tracks recruits and post recruits each year. Although difficulties remain in determining recruitment levels using the UWTV survey, there are alternative ways to deal with recruitment and options should be explored so that some type of general abundance and harvesting rate estimate can be made.

Stock: *Nephrops* in DivisionVIIb,c,j,k (FU16, Porcupine Bank)

Assessment Type: No Assessment

Assessment: Trend Assessment

Forecast: No forecasting was provided for this stock

Assessment method: No Analytical Assessment

Consistency: Consistent with last assessment

Stock Status: Status of the stock cannot be evaluated because reference points have not been determined for this stock, although the stock is perceived to be deteriorating.

Management Plan: There is currently no management plan for this stock, but there are MLS and mesh size regulations.

General Comments:

- General ecosystem information has not been provided.
- Mixed fisheries information was not provided.
- Discards are not used in this assessment, and discard levels are unknown.

Technical Comments:

- The text was still in draft form and the figures were still in Excel, which made it more difficult to read.
- The use of the term 'catch' is used very loosely thought out and should be replaced with landings because discards are not taken into account.

Conclusions:

- RG agrees with the recent advice of restricting catches to no more than 1000 t. The WG states that this will reduce the catch levels to what they were before the fleet expanded in the early 2000s.
- The RG agrees with the length–frequency based trend assessments, but it should be stated with caution. The size distribution of the landings indicate a large increase in mean size of both male and female *Nephrops*, the size distribution of the survey data demonstrates an increase, but it is much lower than the commercial fleet.
- The WG mentions that there is discarding of small and maturing female *Nephrops* in this stock which may be a cause of the perceived low recruitment.
- The length–frequency trends also indicate a large increase in the size distribution of both males and females since the fleet expanded. Without a good feel for the discarding practices and the magnitude of the discards these trends may be largely due to highgrading. The WG states that the fleet is 'reluctant to allow sampling of the landings due to the high value of the larger *Nephrops* and the risk of damage during sampling.' It would be interesting to look at the market prices of large *Nephrops* over this same time period to see if the increase the size distribution of landings is concurrent with an increase in market price for large *Nephrops*. Another way to identify this is to gain better estimates of the discards. The RG feels that

without quantifying the discards much of the length based trends should be viewed with caution.

- The lpue series need to be standardized. With some countries giving effort in hours and others giving effort in day*BHP/100 (relative horsepower??), there is no way to compare the effort.

Stock: Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Divisions IIa, IIIa and Subareas IV, VI

Assessment Type: No assessment

Assessment: Not present

Forecast: There were no short or medium term projections for this stock.

Assessment method: None

Consistency: The newly collected data for this stock did not provide enough information to change the 2008 advice for this stock. The advice remains consistent: catch should not be allowed to increase and that mandatory programmes must be implemented to collect both catch and effort data from the fishery.

Stock Status: Biological reference points for this stock are for the most part undefined. F_{pa} was set at 0.30 in 1998 and has remained unchanged since that time. A length based assessment in 2004 estimated a total stock size of 35 000 t in 2003.

Management Plan: There is no direct management plan for this stock. ICES has advised a two-stage approach in order to facilitate future management of this fishery. This approach was a direct result of quality and quantity issues with the available data. The first stage was a data collection stage, designed to improve the data collected by the fishery without increasing exploitation of the stock. The second stage will then use these data to pursue a management plan. The data collection phase is still underway.

General Comments:

- The basis for F_{pa} = 0.30 is unclear. It seems like this value has been set arbitrarily and should be left undefined like the rest of the BRP's. Is there any documentation or analysis to demonstrate that F35%SPR = 0.30 and that it is in fact a good approximation of F_{msy}?
- The effort to improve the catch-at-length data from the commercial fishery should continue.
- The results from the two tagging studies (ribbon tags and data storage tags) should provide good quality additional data for this stock. These two tagging studies will return valuable information about the biology and the stock structure of anglerfish in this region.
- Age validation is very important and needs to be addressed.
- Convincing more countries to participate in the surveys and help cover the entire area of interest should be a priority. Using the IBTS to fill in gaps for abundance estimates is a good idea but could lead to standardization issues.

Conclusions:

The RG aggress with the current drive for improvement in the quality and quantity of data for this stock. The ongoing two-stage approach seems well thought out and the current focus on data collection and quality control is an important first step. A few more years of good data should provide the necessary information for a future assessment of this stock.

Stock: Megrim in Subarea VI (West of Scotland and Rockall)

Assessment Type: Update

Assessment: Catch trends

Forecast: None provided.

Assessment Model: There is no accepted analytical assessment method for this stock.

Consistency: Same as last year with the addition of 1 year of data. The perception of the stock is the same as last year.

Stock Status: The state of the stock is unknown. Data from the anglerfish survey suggests an increase in biomass in both Area IV and Area VI.

Management Plan: No management plan is presented. The Report suggests that the TAC should be based on the average of landings from 2004–2006 (1400 t).

General Comments:

- The Report is well written and well ordered and generally easy to follow.
- General ecosystem information was not provided or evaluated in the report.
- Information on mixed fisheries interactions is given and explained well. The shift in effort in Area VIa due to management measures was very helpful.
- The WG has provided a concise explanation of the data that needs to be collected prior to the benchmark assessment.
- Prior to the benchmark assessment, it would be useful to conduct some research into the stock structure of megrim in Subareas VIa and VIb. It is likely that this information could be collected during the anglerfish survey. If these stocks are revealed to have significantly different life-history traits (i.e. growth rate, L50, A50, age composition, etc.) it may be more prudent to allocate a separate TAC to each subarea.

Technical Comments:

The WG recommends that effort data and catch numbers/weights-at-age need to be collected from the main fleets in the fishery prior to the benchmark assessment. The RG also thinks that discard data should also be improved (where possible), as the current discard estimate of 9% is based solely on data from the Irish otter trawl fishery. It is possible that discard rates may be higher in other fisheries that utilize different gear types. Currently, there is no data available on discarding in Area IV, where the majority of the landings occur. It would be helpful to obtain some quantitative estimates of discarding in this area, where catches are generally higher and the fishery is persecuted almost entirely by the Scottish fleet.

Conclusions:

Based on the lack of available data, the RG feels that this report gives a valid basis for advice regarding the TAC for this stock. Survey indices of megrim have increased in recent years under an identical TAC quota, and there is no data to suggest that the allocated TAC level will lead to depletion of this stock.

Annex 11: Reopening of the advice for *Nephrops* FU15 and FU17

In 2007 the timing of the advisory process was changed at the request of ICES clients. This means that the fisheries advice is delivered in the first half of the year instead of in October. To evaluate whether new information that becomes available after the advice is released would form a basis to update the advice, ICES has developed a generic approach (AGCREFA, ICES 2008). The approach is based on a statistical evaluation of the importance of that information (e.g. new survey information available in August/September). For *Nephrops* stocks different datasets are collected and reviewed in a similar way.

For two stocks of *Nephrops* in Subarea VII, FU15 and FU17, the thresholds for reopening the advice were met and the advice was reopened. The following Annex describes the changes (two Working Documents) in the input and output data and the review of the work.

Sources of information

ICES. 2008. Report of the *Ad hoc* Group on Criteria for Reopening Fisheries Advice (AGCREFA), 20–22 August 2008, Copenhagen, Denmark. ICES CM 2008/ACOM:60.

Working document FU15 2009 Survey update 16/09/09

Update on the 2009 UWTV Survey of the Western Irish Sea *Nephrops* Grounds (FU 15)

Colm Lordan[1], Jennifer Doyle[1] and Richard Briggs[2].

[1]**The Marine Institute, Rinville, Oranmore, Galway, Ireland.**

[2]**Fisheries and Aquatic Ecosystems Branch, Agri-Food & Biosciences Institute, Newforge Lane, BELFAST BT9 5PX, Northern Ireland.**

Introduction

Since 2003 a joint UWTV survey has been carried out by the Marine Institute (Ireland) and AFBI (Northern Ireland). In 2009 this survey was used to develop catch options for the stock using a bias corrected survey estimate as an absolute measure of stock size and recent discard rates and mean weight to forecast catch (ICES, 2009a). This Report details the results of the 2009 survey for the western Irish Sea *Nephrops* stock. We also update the catch option table using the most recent survey estimate.

Material and methods

For the western Irish Sea prior information was available on the distribution of sediments was available and the boundaries of the fishing grounds were obtained from VMS data from the Republic of Ireland. The survey design is a randomized fixed grid where a point is picked at random and stations are carried out at a fixed distance northsouth and eastwest. The distance between stations is currently 3.5 nautical miles. An adaptive approach is taken where by stations are continued past the known perimeter of the ground until the burrow densities are close to zero.

Survey timing was generally standardized to August each year. In 2009, 142 stations were surveyed. Of these 79 were carried out on RV Croystes and 63 were carried out on RV Celtic Voyager. The protocols used were those reviewed by WKNEPHTV 2007 (ICES, 2007).

At each station the UWTV sledge was deployed and once stable on the seabed a 10 minute tow was recorded onto DVD. Vessel position (DGPS) and position of sledge (using a USBL transponder) were recorded every 1 second. The navigational data were quality controlled using an "r" script developed by the Marine Institute (ICES, 2009b). In addition depth was logged for the duration of the tow.

In line with SGNEPS recommendations all scientist were trained/re-familiarised using training material, validated and reference footage prior to recounting at sea (ICES, 2009). All recounts were conducted by two trained "burrow identifying" scientists independent of each other on board the research vessel during the survey. During this review process the visibility, ground type and speed of the sledge during one-minute intervals were subjectively classified using the classification. In addition the numbers of *Nephrops* burrows complexes (multiple burrows in close proximity which appear to be part of a single complex are only counted once), *Nephrops* in and *Nephrops* out of burrows counted by each scientist for each one-minute interval was recorded. Notes were also recorded on the occurrence of trawl marks, fish species and other species during the one-minute interval. Finally, if any there was any time during the one-minute where counting was not possible this was also estimated so that the time window could be removed from the distance over ground calculations. The "r" quality control tool allowed for individual station data to be analysed in terms of data quality for navigation, overall tow factors such as speed and visual clarity and consistency in counts (Figure 1). Consistency and bias between individual counters was examined using Figure 2. Figures 3 and 4 show the variability of density between minutes and operators (counters) for each station.

The main change in protocol this year relates to the amount of time recounted. Following the recommendation of SGNEPS the time for verified recounts was reduced from 10 to 7 minutes (ICES, 2009b). The survey data for years prior to 2009 has not been updated although work is underway to recount footage in 2003 and 2004 as discussed at SGNEPS (ICES, 2009b).

The recount data were screened for one minute intervals with an unusually large deviation between recounts. Means of the burrow and *Nephrops* recounts were standardized by dividing by the survey area observed. Either the USBL or estimated sledge lay-back were used to calculate distance over ground of the sledge. The field of view of the camera at the bottom of the screen was estimated at 75 cm assuming that the sledge was flat on the seabed (i.e. no sinking). This field of view was confirmed for the majority of tows using lasers during the 2009 survey. Occasionally the lasers were not visible at the bottom of the screen because of sinking in very soft mud (the impact of this is a minor underestimate of densities at stations where this occurred).

To account for the spatial covariance and other spatial structuring a geo-statistical analysis was carried out using SURFER Version 8.02. The spatial structure of the density data was studied through variograms. Initially the midpoints of each UWTV transect were converted to UTMs. In addition to the survey stations various boundary positions were included in the analysis. The assumption at these boundary positions was that the *Nephrops* abundance was zero. These stations were outside the known distribution of *Nephrops* or suitable sediment and were approximately equidistant to the spacing within the main grid each year. An unweighted and unsmoothed omnidirectional variogram was constructed with a lag width of approximately 1417m and maximum lag distance of between 53–55 km. A model variogram $\gamma(h)$, was produced with an exponential component (Equation 8). Model fitting was via the SURFER algorithm using the variogram estimation option. Various other experimental variograms and model setting were examined before the final model choice was made.

Equation 8: Exponential Variogram Model

$$\gamma(h) = C\left[1 - e^{-h}\right]$$

Where C is the scale for the structural component of the variogram and h is the aniostrophically.

The resulting annual variograms were used to create krigged grid files and the resulting cross-validation data were plotted. If the results looked reasonable then surface plots of the grids were made using a standardized scale. The final part of the process was to limit the calculation to the known extent of the ground using a boundary blanking file. The resulting blanked grid was used to estimate the mean domain area and total burrow abundance estimate.

Although SURFER was used to estimate the burrow abundance this does not provide the kriged estimation variance or CV. This was carried out using the EVA: Estimation VAriance software (Petitgas and Lafont, 1997). The EVA burrow abundance estimates were all extremely close to the Surfer estimate (+- 0.1 billion burrows).

Results

A histogram of the observed burrow densities for 2003 to 2009 on the western Irish Sea is presented in Figure 5. These indicate significant changes in the densities observed particularly in 2003 and 2004. However, since 2005 the density estimates observed are very similar to modal density of around 1/m^2.

The geo-statistical structural analysis is shown in the form of variograms in Figure 6. There are a few outliers apparent but they appear have little leverage on the variogram models observed. A comparison of the observer and expected density estimates for each year is given in Figure 7. There is good concordance between the observation and model estimates.

The blanked kriged contour plot and posted point density data are shown in Figure 8. The kriged contours correspond very well to the observed data. The results indicate the densities increased from 2003–2004 when very high densities were apparent throughout the ground. Densities subsequently decreased to the lowest levels observed in 2008. The 2009 result demonstrates an increase in densities mainly in the western side. These densities plots demonstrate a relatively dynamic situation although some parts of the ground have consistently higher or lower densities there is a fair bit of interannual variability.

The summary statistics from this geo-statistical analysis are given in Table 1. The burrow abundance estimate is an 8% increase on the 2008. The CV for 2009 was 2.9% indicating a very precise survey estimate as observed in previous years. The time-series of survey estimates together with CVs are shown in Figure 9. The mean densities and overall abundance is estimated to have decreased significantly between 2004 and 2005. The abundance estimates were between 7 to 8.4 billion in 2003 and 2004 and since then the estimate have been similar for most years ~5–6 billion.

Discussion

This is a relatively well studied *Nephrops* stock with size information on catches extending back to the 1970s, a trawl survey series since 1994 and larval production surveys in a few years. Despite the above the concerns about the accuracy of recent catch data and unknown and variable growth rates have hampered the development of analytical assessments.

The UWTV survey was developed in 2003 and has become the main source of fishery-independent information on this stock. The methods employed during the Irish Sea UWTV surveys have recently been discussed and well documented by WKNEPHTV, WKNEPHBID and SGNEPS (ICES, 2007, 2008 and 2009b). The uncertainty estimates in the survey were examined initially using EVA during WKNEPH 2009 and updated for all years here. This analysis indicates that the survey method (randomized grid and geostatistical estimation of abundance) does estimate the abundance very precisely compared with other approaches.

The development of the UWTV survey abundance estimates correlates very well with the summer trawl survey. Both series indicate high abundance in 2003 and 2004 and a decline in abundance thereafter (Figures 9 and 10). The longer time-series of the trawl survey demonstrates that catch rates in the last few years (2005–2009) are close to the mean of the series when UWTV burrow abundances were in the range of 5–6 billion burrows.

The WKNEPH reported developed a methodology for developing catch options based directly on the surveys (ICES, 2009a). In addition, WKNEPH developed a methodology for estimating long-term fishing mortality reference points. The methodology was used by WGCSE to develop a catch option table according to the stock annex (ICES, 2009c). Table 2 is an updated catch option table for FU15 using the 2009 survey estimate. All the other inputs to the catch option table are based on those used at WGCSE 2009 (ICES, 2009c).

In conclusion, the survey estimates themselves are precisely estimated given the relatively homogeneous distribution of burrow density and the modelling of spatial structuring. The 2009 survey is a statistically significant 8% increase compared with 2008. Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates. In the provision of catch options based on the bias corrected absolute survey estimates additional uncertainties related to the bias correction factor, mean weight in the landings and the discard rates also arise.

References

ICES 2007. Report of the Workshop on the use of UWTV surveys for determining abundance in *Nephrops* stocks throughout European waters (WKNEPHTV). ICES CM: 2007/ACFM: 14.

ICES 2008. Report of the Workshop and training course on *Nephrops* burrow identification (WKNEPHBID). ICES CM 2008/LRC:03.

ICES, 2009a. Report of the Benchmark Workshop on *Nephrops* assessment (WKNEPH). ICES CM 2009/ACOM:33.

ICES 2009b. Report of the Study Group on *Nephrops* Surveys (SGNEPS). ICES CM 2009/LRC: 15, pp 52.

ICES 2009c. Report of the Working Group on the Celtic Seas Region (WGCSE)ICES CM 2009/ACOM:09.

Petitgas and Lafont, 1997. EVA (Estimation VAriance). A geostatistical software on IBM-PC for structure characterization and variance computation. Version 2.

Table1. Summary geostatistics for the Nephrops UWTV surveys of the western Irish Sea from 2003–2009.

Ground	Year	Number of stations	Mean Density (No./m2)	Estimation Standard Deviation	Domain Area (km2)	Geostatistical abundance estimate (billion burrows)	CV on Burrow estimate
Western Irish Sea	2003	160	1.25	0.02	5292	7.0	1%
	2004	147	1.52	0.02	5302	8.5	2%
	2005	140	1.08	0.04	5288	6.0	3%
	2006	138	1.07	0.05	5429	5.9	4%
	2007	148	1.00	0.03	5452	5.6	3%
	2008	141	0.88	0.03	5287	4.9	3%
	2009	142	0.95	0.03	5267	5.3	3%

Table2. Updated management option table for FU15 with 2009 survey estimate included.

			Implied fishery	
	Harvest rate	Survey Index (Millions)	Retained number (Millions)	Landings (tonnes)
	0%	4,623	0	0
	2%	"	73	966
	4%	"	146	1932
	6%	"	219	2898
	8%	"	292	3863
	10%	"	365	4829
	12%	"	438	5795
F0.1	12.2%	"	446	5892
	14%	"	512	6761
	16%	"	585	7727
	18%	"	658	8693
	20%	"	731	9659
Fmax	20.4%	"	745	9852
	22.0%		804	10 624
F2008	23.5%	"	858	11 335
	24%	"	877	11 590

		Basis
Landings Mean Weight (KG)	0.0132	Sampling 2008
Survey Overestimate Bias	1.14	WKNEPH 2009
Survey Numbers (Millions)	5271	UWTV Survey 2009
Prop of removals retained by the Fishery	0.79	Sampling 2008

*** note all other inputs are identical with those used by WGCES 2009.**

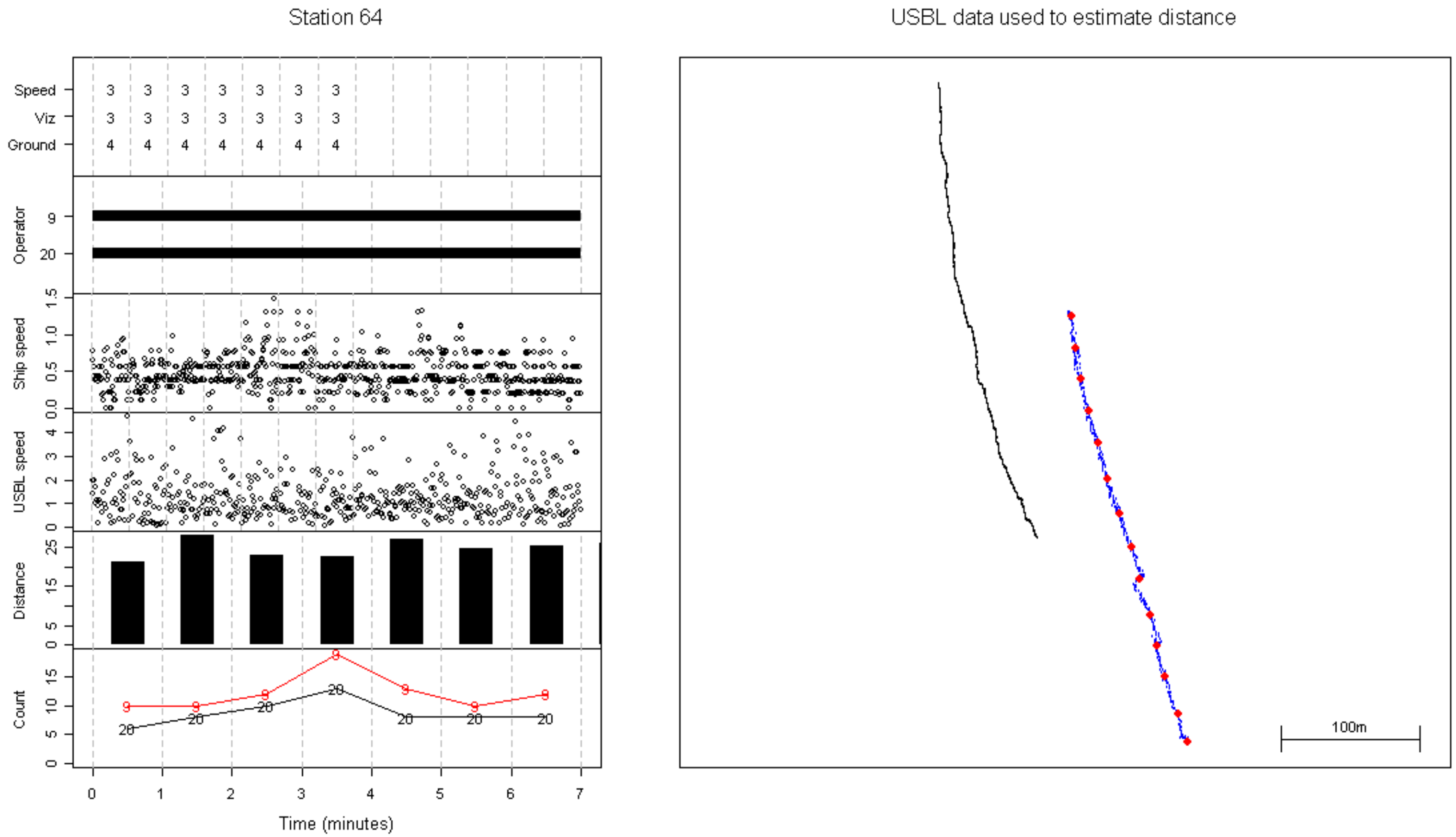


Figure 1. R tool quality control plot of station 64 UWTV Survey of the Irish Sea Grounds FU15 2009.

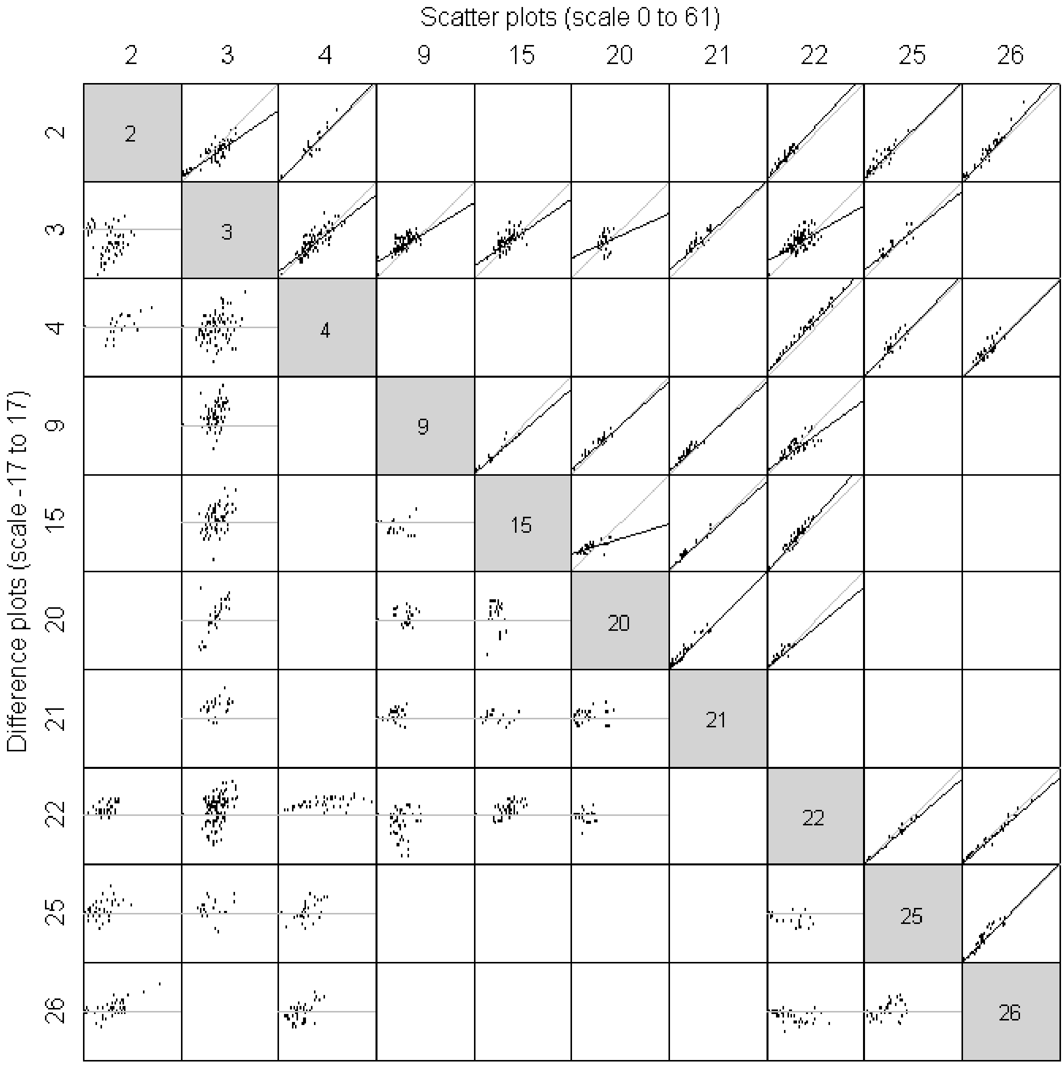


Figure 2. Scatterplot analysis of counter trends during UWTV Survey of the Irish Sea Grounds FU15 2009.

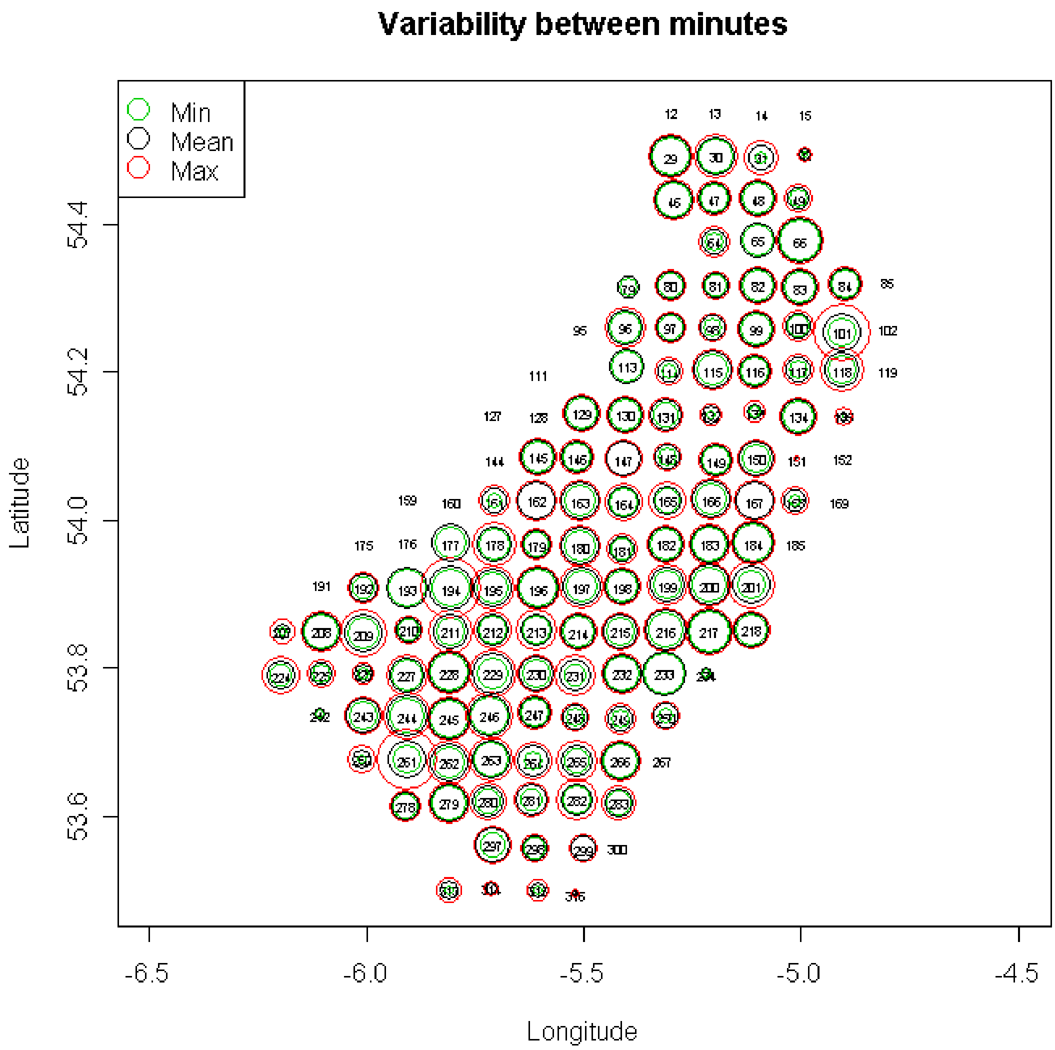


Figure 3. Plot of the variability of density between minutes for each station in the 2009 survey.

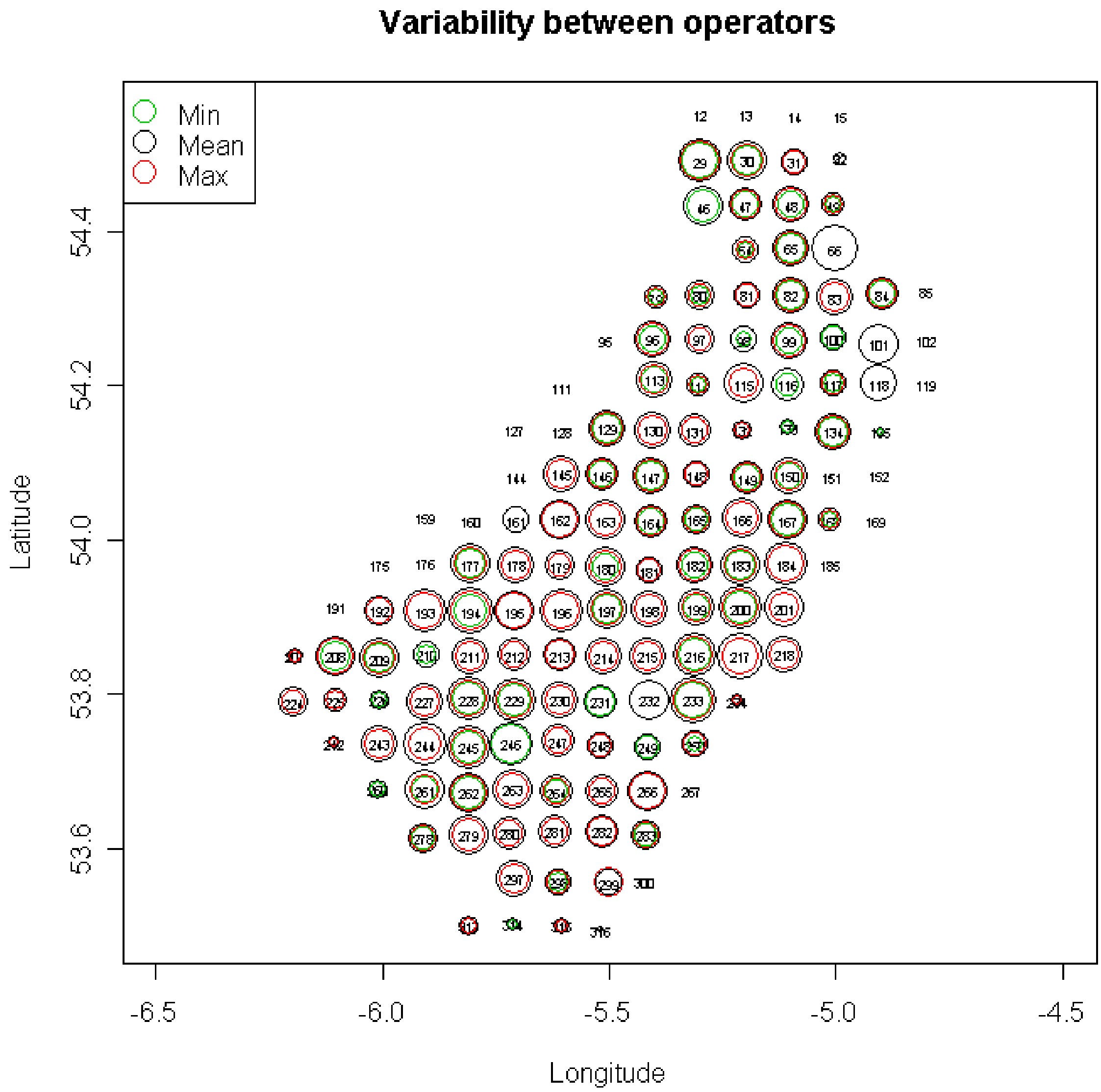


Figure 4. Plot of the variability of density between operators (counters) for each station in the 2009 survey.

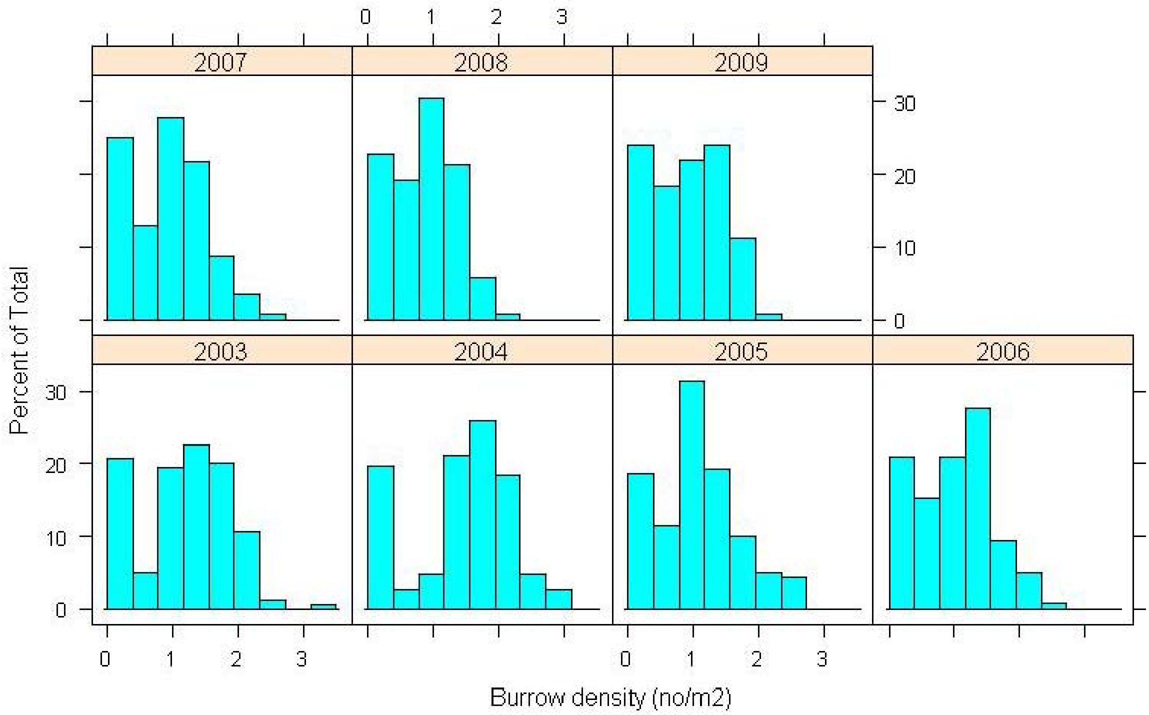


Figure 5. Burrow density distributions for the western Irish Sea by year from 2003–2009.

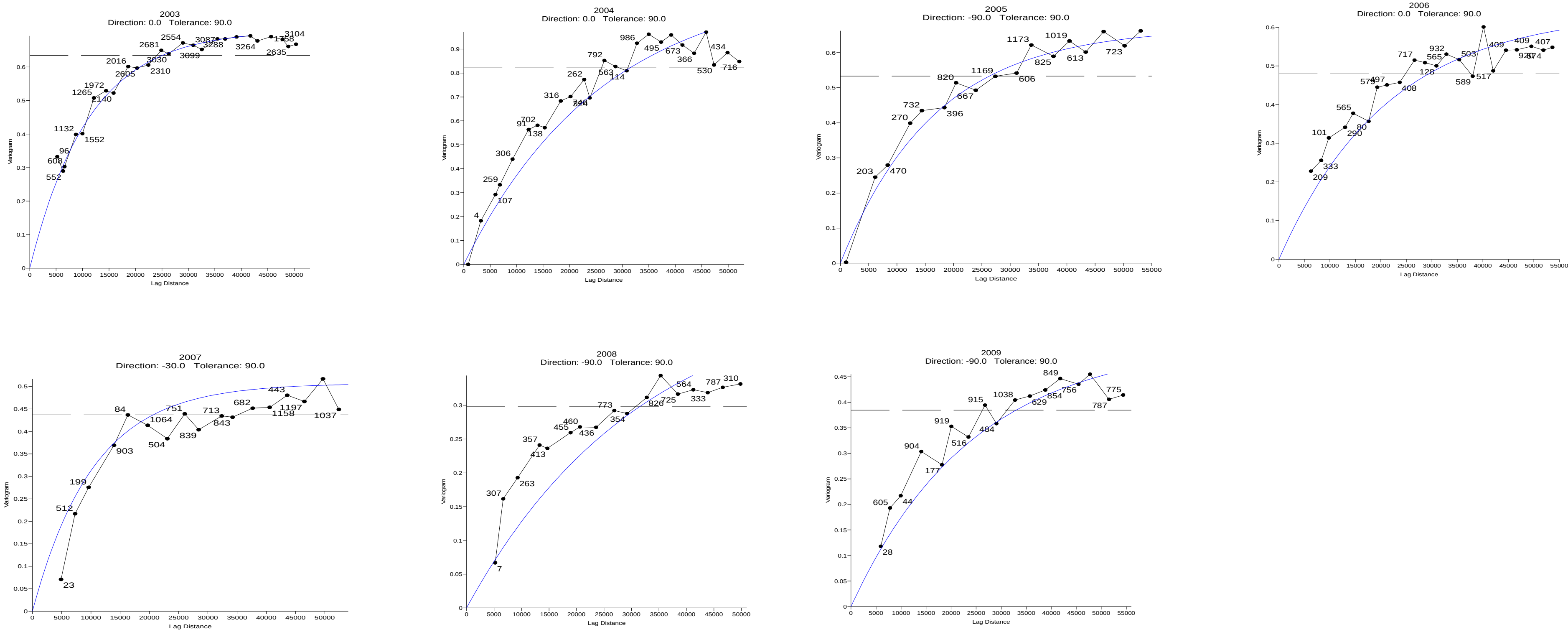


Figure 6. Omnidirectional mean variograms for the western Irish Sea by year from 2003–2009.

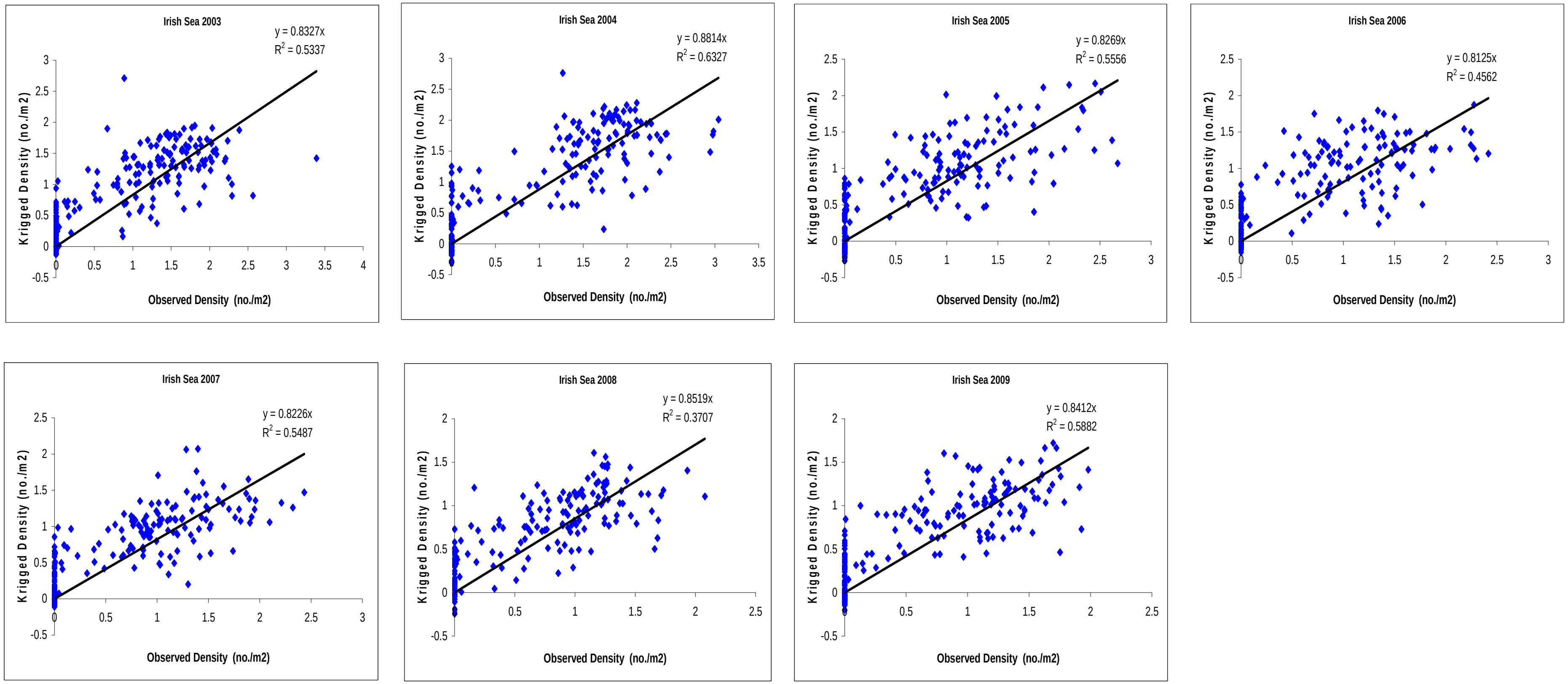


Figure 7. Cross validation plots for the western Irish Sea by year from 2003–2009.

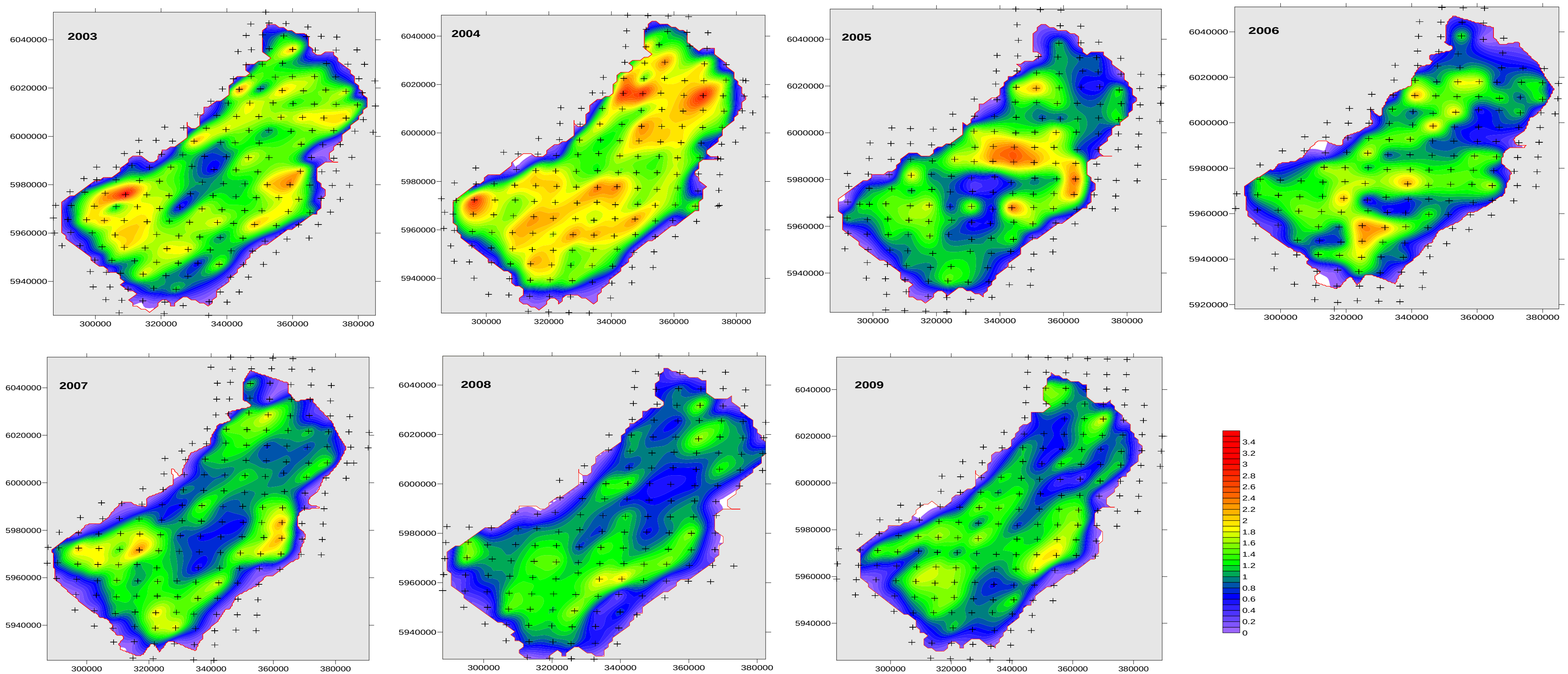


Figure 8. Contour plots of the krigged density estimates for the western Irish Sea from 2003–2009.

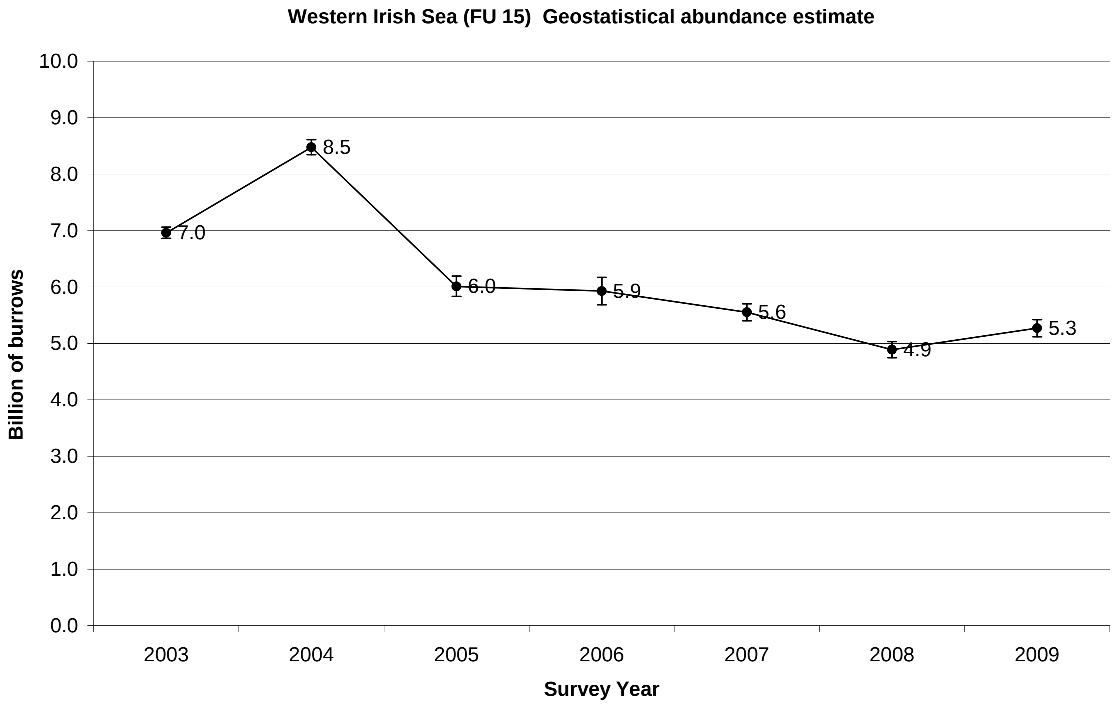


Figure 9. Raised abundance estimates for the western Irish Sea from 2003–2009.

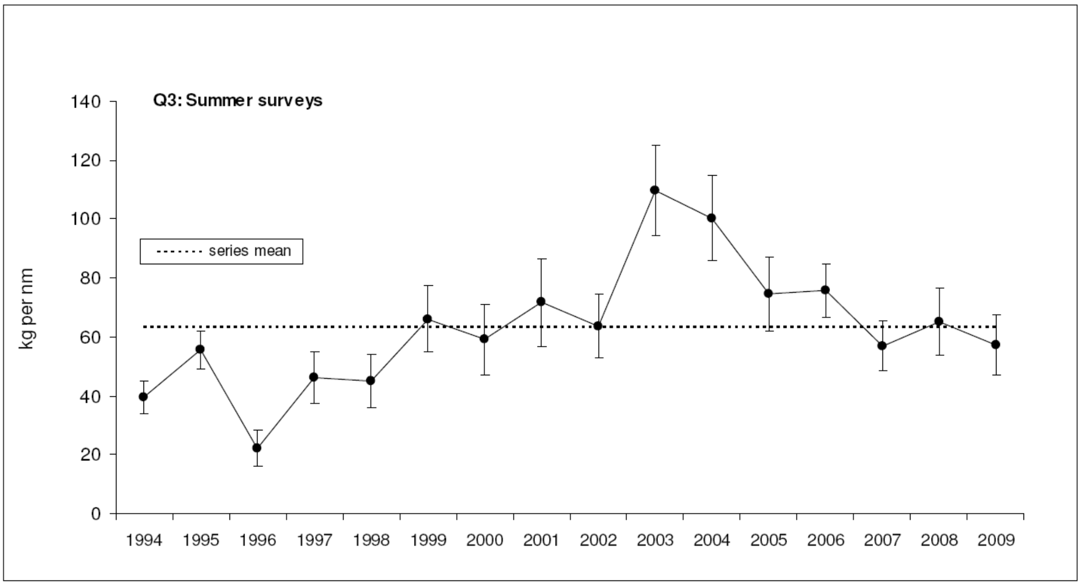


Figure 10. Mean *Nephrops* catch (Kg nm-1) 1994–2009 (error bars = SE).

Working document FU17 2009 Survey update 17/09/09

Update on the 2009 UWTV Survey of the Aran, Galway Bay and Slyne Head *Nephrops* Grounds

Colm Lordan and Jennifer Doyle

The Marine Institute, Rinville,

Oranmore, Galway, Ireland.

Introduction

The prawn (*Nephrops norvegicus*) are common around the Irish coast occurring in geographically distinct sandy/muddy areas were the sediment is suitable for them to construct their burrows. The Irish *Nephrops* fishery is extremely valuable with landings in recent years worth around €30 m at first sale supporting an important indigenous processing industry. The *Nephrops* fishery 'at the back of the Aran Islands' can be considered the mainstay of the Ros a Mhíl fleet. Without this *Nephrops* fishery the majority of vessels in the fleet would cease being economically viable (Meredith, 1999). Given these socio-economic realities good scientific information on stock status to allow sustainable management of the resources are urgently required.

This is the eight data point in a time-series of UWTV surveys on the 'Aran grounds'. The survey covers three distinct mud patches; the Aran Ground, Galway Bay and Slyne Head. These have approximate areas of 940, 41 and 26 km^2 respectively. In 2009 this survey was used to develop catch options for the stock using a bias corrected survey estimate as an absolute measure of stock size and recent discard rates and mean weight to forecast catch (ICES, 2009a). This Report details the results of the 2009 survey and updates the catch option table using the most recent survey estimate.

Material and methods

Stations in Galway Bay and Slyne Head were either randomly picked or selected based on previously completed tows. A randomized fixed grid design is used for the Aran grounds where a point is picked at random and stations are carried out at a fixed distance northsouth and eastwest. The distance between stations varied somewhat but is currently 2.25 nautical miles. An adaptive approach is taken where by stations are continued past the known perimeter of the ground until the burrow densities are close to zero. The boundary use to delineate the edge of the ground was based on information from the fishing industry and has not been changed since 2002.

Survey timing was generally standardized to June each year. In 2004, bad weather prevented the completion of the survey in June so approximately 50% of the stations were carried out one month later in July. In 2003, poor weather and technical problems meant that coverage was poor compared with the other years. In 2009 all three *Nephrops* grounds were surveyed successfully in June.

At each station the UWTV sledge was deployed and once stable on the seabed a 10 minute tow was recorded onto DVD. Vessel position (DGPS) and position of sledge (using a USBL transponder) were recorded every 1 second. The navigational data were quality controlled using an "r" script developed by the Marine Institute (ICES, 2009b). In addition depth was logged for the duration of the tow.

In line with SGNEPS recommendations all scientist were trained/re-familiarised using training material, validated and reference footage prior to recounting at sea (ICES, 2009). All recounts were conducted by two trained "burrow identifying" scientists independent of each other on board the research vessel during the survey. During this review process the visibility, ground type and speed of the sledge during one-minute intervals were subjectively classified using the classification. In addition the numbers of *Nephrops* burrows complexes (multiple burrows in close proximity which appear to be part of a single complex are only counted once), *Nephrops* in and *Nephrops* out of burrows counted by each scientist for each one-minute interval was recorded. Notes were also recorded on the occurrence of trawl marks, fish species and other species during the one-minute interval. Finally, if any there was any time during the one-minute where counting was not possible this was also estimated so that the time window could be removed from the distance over ground calculations. The "r" quality control tool allowed for individual station data to be analysed in terms of data quality for navigation, overall tow factors such as speed and visual clarity and consistency in counts (Figure 1). There was a problem with the navigational information for the ship in 2009 but this does not affect the distance over ground calculations which were based on USBL navigational information. Consistency and bias between individual counters was examined using Figure 2. Figures 3 and 4 show the variability of density between minutes and operators (counters) for each station.

The main change in protocol this year relates to the amount of time recounted. Following the recommendation of SGNEPS the time for verified recounts was reduced from 10 to 7 minutes (ICES, 2009b). The survey data for years prior to 2009 has not been updated although work is underway to recount footage.

The resultant recount data were screened for one minute intervals with an unusually large deviation between recounts. Means of the burrow and *Nephrops* recounts were standardized by dividing by the survey area observed. The USBL data were used to calculate distance over ground of the sledge. The field of view of the camera at the bottom of the screen was estimated assuming that the sledge was flat on the seabed (i.e. no sinking). This field of view was confirmed for all of tows using lasers during the 2009 survey.

To account for the spatial covariance and other spatial structuring a geo-statistical analysis of the data was also carried out using SURFER Version 8.02 for stations within the main fishing area the Aran Grounds for all years. The spatial structure of the density data was studied through variograms. Initially the midpoints of each UWTV transect were converted to UTMs. In addition to the survey stations various boundary positions were included in the analysis. The assumption at these boundary positions was that the *Nephrops* abundance was zero. These stations were outside the known distribution of *Nephrops* or suitable sediment and were approximately equidistant to the spacing within the main grid each year. An unweighted and unsmoothed omnidirectional variogram was constructed with a lag width of between 1–1.4 and maximum lag distance of between 19–20 km. A model variogram $\gamma(h)$, was produced with a nugget component and a exponential component (Equation 8). Model fitting was via the SURFER algorithm using the variogram estimation option. Various other experimental variograms and model setting were examined before the final model choice was made.

Equation 8: Exponential Variogram Model

$$\gamma(h) = C\left[1 - e^{-h}\right]$$

Where C is the scale for the structural component of the variogram and h is the aniostrophically.

The resulting annual variograms were used to create krigged grid files and the resulting cross-validation data were plotted. If the results looked reasonable then surface plots of the grids were made using a standardized scale. The final part of the process was to limit the calculation to the known extent of the ground using a boundary blanking file. The resulting blanked grid was used to estimate the mean, domain area and total burrow abundance estimate.

Although SURFER was used to estimate the burrow abundance this does not provide the kriged estimation variance or CV. This was carried out using the EVA: Estimation VAriance software (Petitgas and Lafont, 1997). The EVA burrow abundance estimates were all extremely close to the Surfer estimate (+- 30 million burrows) with the exception of 2004 when the spatial coverage was poor.

Results

Landings, effort and lpue trends for FU17 are given in Figure 5. These indicate that landings increased throughout the 1990s with some fluctuations peaking in 1999 at >1400 t since then there has been a general decline in landings with an increase in 2008 on 2007 figure by 14% to 1050 t. This is fourth time in the series that landings have been in excess of 1000 t from this FU. Effort in the "*Nephrops* directed fleet" demonstrates a declining trend since 1998 and lpue has remained fairly stable over the time-series and both have increased in 2008.

A histogram of the observed burrow densities for 2009 and previous years on the Aran Grounds is presented in Figure 6. This shows large interannual variation in modal burrow densities.

The geostatistical structural analysis is shown in the form of variograms in Figure 7. There are a few outliers apparent but they appear have little leverage on the variogram models observed. With the exception of 2006 a nugget is apparent in most years. There is weak evidence of a sill at around 12 km in some years but it is not clear and the logarithmic model used does not have a sill. A comparison of the obsever and expected density estimates confirms that there is good concordance between the observation and model estimates.

The blanked kriged contour plot and posted point density data are shown in Figure 8. The kriged contours correspond very well to the observed data. The results indicate the densities have fluctuated considerably over the time-series and throughout the ground. The fluctuations are not limited to a single station but instead occur fairly homogeneously across the ground. In general the densities are higher towards the western side of the ground rather and there is a notable trend towards lower densities towards the east. On the southwestern boundary there are indications of high densities close to the boundary. In this area there is a sharp transition from mud to rocky substratum and work is underway to define this boundary more accurately.

The summary statistics from this geostatistical analysis are given in Table 1 and plotted in Figure 9. The 2009 estimate of 718 million burrows is a 39% increase on the lowest to date in 2008. The estimates have fluctuated widely since the survey commenced. The estimation variance of the survey as calculated by EVA is relatively low (CVs in the order <5%). The 2009 estimate is below the mean of the series but given the fluctuations observed to date it is difficult to conclude how significant that is.

The survey abundance is compared with landings and lpue data for the *Nephrops* directed fleet in Figure 10. This indicates a slightly negative relationship between survey abundance and landings. However, this may not be statistically significant. A more detailed investigation was then carried out to examine the relationship between burrow abundance and monthly landings and lpue. The fishery can be characterized by two main periods; the autumn fishery and the fishery in the subsequent spring. There is a weak relationship between survey abundance and lpues (Figure 11). The results also suggest that there is a negative relationship between survey abundance in June and lpue in autumn and a positive relationship with the fishery in the subsequent spring. The results are based on few data points and the landings are based on logbook data which may not reflect true levels of catch because discards and misreporting have not be taken into account (ICES, 2006).

Discussion

The UWTV survey series for the Aran Grounds was first developed in 2002 and has become the main source of fishery-independent information on this stock. Sampling of the fishery has been sporadic although normal sampling resumed in 2008 and fishery dependent data a subject to some quality concerns (ICES, 2009c). The methods employed during the Aran UWTV surveys have recently been discussed and well documented by WKNEPHTV, WKNEPHBID and SGNEPS (ICES, 2007, 2008 and 2009b). The uncertainty estimates in the survey were examined initially using EVA during WKNEPH 2009 and updated for all years here. This analysis indicates that the survey method (randomized grid and geostatistical estimation of abundance) does estimate the abundance very precisely compared with other approaches.

For this particular survey occupancy and edge effects become critical when using the survey as an absolute abundance estimate. WKNEPH 2009 estimated the cumulative overestimation bias to be in the order of 1.3. Occupancy is assumed to be one *Nephrops* per burrow. The fishing intensity on the Aran Grounds is high with trawls sweeping several times the area of the ground annually. Given the high intensity of trawling it is likely that unoccupied burrows are filled in quickly. The edge effect bias is more difficult to quantify. This has been estimated by WKNEPH 2009 by double counting footage, once counting all complexes then counting only those that remain within the field of view when passing off the bottom of the screen. The difference between these counts are the edge burrows and half of these are together with those that remain on the screen are used to estimate the bias.

It is worth noting that there is no positive correlation between survey abundance estimates and landings or lpue (if anything there is a negative one Figure 10). In previous WDs to WGCSE this has been explored by looking at survey abundance and lagged lpues.

The WKNEPH reported developing a methodology for developing catch options based directly on the surveys (ICES, 2009a). In addition, WKNEPH developed a methodology for estimating long-term fishing mortality reference points. The lack of sampling data meant that stock specific reference points could not be developed for FU17. The methodology was used by WGCSE to develop a catch option table according to the stock annex (ICES, 2009c). Table 3 is an updated catch option table for FU17 using the 2009 survey estimate. All the other inputs to the catch option table are based on those used at WGCSE 2009.

In conclusion, the survey estimates themselves are precisely estimated given the relatively homogeneous distribution of burrow density and the modelling of spatial structuring. Large fluctuations in burrow abundance have been observed in this short time-series but landings and lpue trends are not well correlated with these. The 2009 survey is a statistically significant 39% increase compared with 2008. Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates. In the provision of catch options based on the bias corrected absolute survey estimates additional uncertainties related to the bias correction factor, mean weight in the landings and the discard rates also arise.

References

ICES 2007. Report of the Workshop on the use of UWTV surveys for determining abundance in *Nephrops* stocks throughout European waters (WKNEPHTV). ICES CM: 2007/ACFM: 14.

ICES 2008. Report of the Workshop and training course on *Nephrops* burrow identification (WKNEPHBID). ICES CM 2008/LRC:03.

ICES, 2009a. Report of the Benchmark Workshop on *Nephrops* assessment (WKNEPH). ICES CM 2009/ACOM:33.

ICES 2009b. Report of the Study Group on *Nephrops* Surveys (SGNEPS). ICES CM 2009/LRC: 15, pp 52.

ICES 2009c. Report of the Working Group on the Celtic Seas Region (WGCSE)ICES CM 2009/ACOM:09.

Petitgas and Lafont. 1997. EVA (Estimation VAriance). A geostatistical software on IBM-PC for structure characterization and variance computation. Version 2.

Table 1. Summary geostatistics for the *Nephrops* UWTV surveys of the Aran Grounds from 2002–2009.

Ground	Year	Number of stations	Mean Density (No./m2)	Estimation Standard Deviation	Domain Area (m2)	Geostatistical abundance estimate (million burrows)	CV on Burrow estimate
Aran	2002	49	0.81	0.02	943	793	2%
	2003	42	0.85	0.06	943	825	5%
	2004	64	1.44	0.04	937	1408	3%
	2005	70	1.11	0.04	931	1089	3%
	2006	67	0.66	0.02	932	640	3%
	2007	71	0.88	0.02	942	854	3%
	2008	62	0.57	0.02	842	515	3%
	2009	79	0.73	0.02	940	718	2%

Table 2. Summary statistics for the *Nephrops* UWTV surveys of the Galway Bay and Slyne Head grounds from 2002–2009.

Ground	Year	Number of stations	Area Surveyed (m2)	Burrow count	Mean Density (No./m2)	Var	Standard Deviation	Standard Error	t-value	95%CI	CVIID (Relative SE)
Galway Bay	2002	7	1,299	2,017	1.58	0.14	0.37	0.14	2.45	0.34	8.8%
	2003	3	591	941	1.60	0.09	0.29	0.17	4.30	0.73	10.6%
	2004	9	2,312	1,625	0.73	0.18	0.42	0.14	2.31	0.32	19.4%
	2005	4	661	1,107	1.67	0.04	0.20	0.10	3.18	0.32	6.0%
	2006	3	522	522	1.01	0.06	0.25	0.15	4.30	0.63	14.5%
	2007	5	890	992	1.14	0.06	0.24	0.11	2.78	0.29	9.3%
	2008	10	1,907	859	0.42	0.10	0.31	0.10	2.26	0.22	23.4%
	2009	8	1,207	1,116	0.93	0.03	0.16	0.06	2.36	0.14	6.2%
Slyne Grounds	2002	5	1,216	1,027	0.85	0.04	0.19	0.08	2.78	0.23	9.9%
	2003	-	-	-	-	-	-	-	-	-	-
	2004	3	827	531	0.68	0.07	0.27	0.15	4.30	0.66	22.7%
	2005	3	531	294	0.55	0.00	0.05	0.03	4.30	0.13	5.6%
	2006	3	526	210	0.41	0.04	0.20	0.11	4.30	0.49	28.1%
	2007	4	841	547	0.63	0.10	0.31	0.15	3.18	0.49	24.6%
	2008	-	-	-	-	-	-	-	-	-	-
	2009	6	531	144	0.40	0.05	0.22	0.09	2.57	0.23	22.5%

Table 3. Updated management option table for FU17 with 2009 survey estimate included.

			Implied fishery	
	Harvest rate	Survey Index (millions)	Retained number (millions)	Landings (tonnes)
	0%	552	0	0
	2%	"	8	176
	4%	"	16	352
	6%	"	23	528
F0.1for other Nephrops stocks is in this range	8%	"	31	704
	10%	"	39	880
	12%	"	47	1050
Fmax for other Nephrops stocks is in this range	12%	"	47	1055
	13%	"	51	1143
	14%	"	55	1231
	15%	"	58	1319
	16%	"	62	1407
F2008	16.7%	"	65	1464

		Basis
Landings Mean Weight (KG)	0.0226	Sampling 2008
Survey Overestimate Bias	1.30	WKNEPH 2009
Survey Numbers (Millions)	718	UWTV Survey 2009
Prop. Retained by the Fishery	0.71	Sampling 2008

*** note all other inputs are identical with those used by WGCES 2009.**

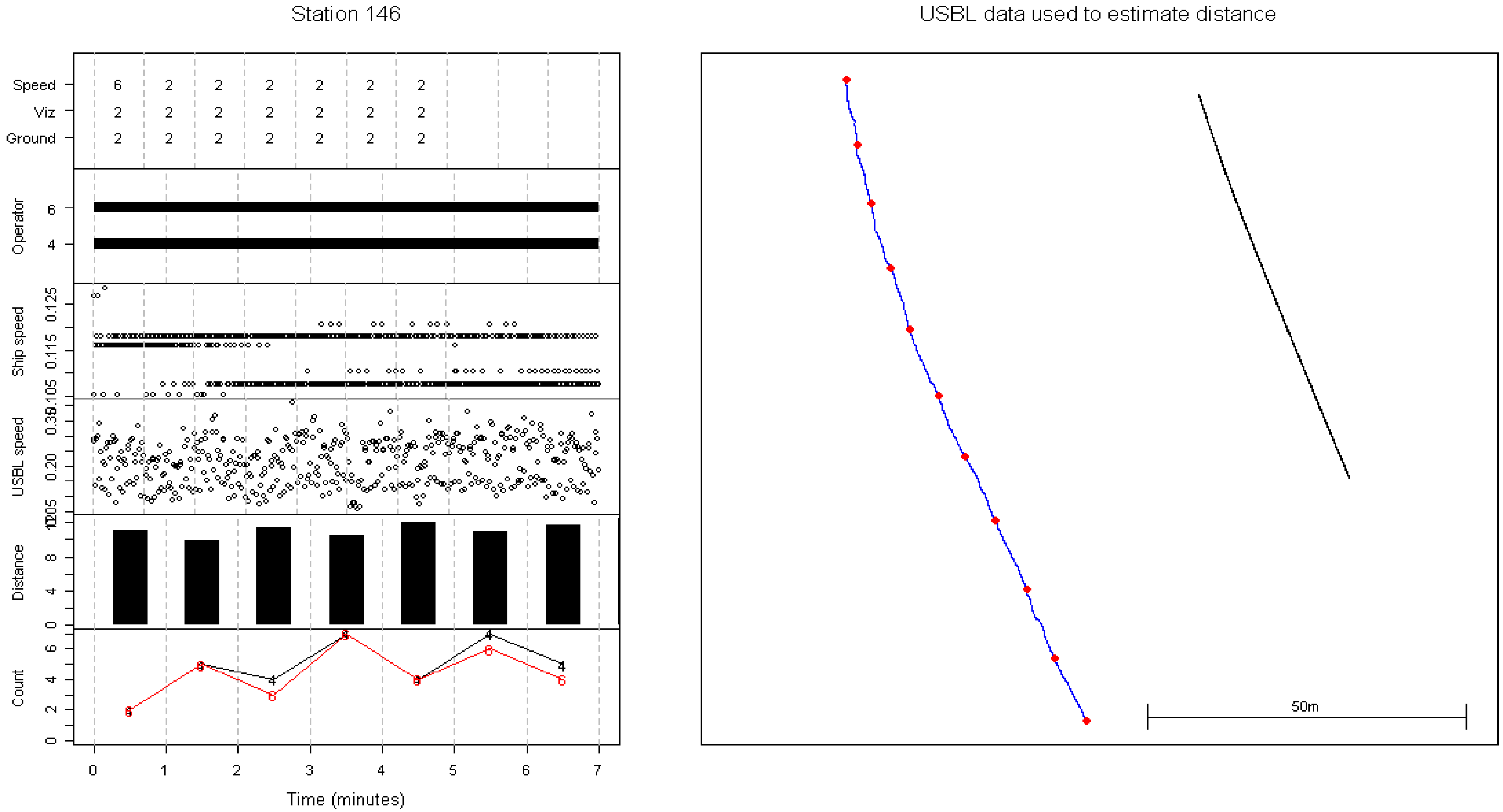


Figure 1. R tool quality control plot of station 146 UWTV Survey Aran Grounds FU17 2009.

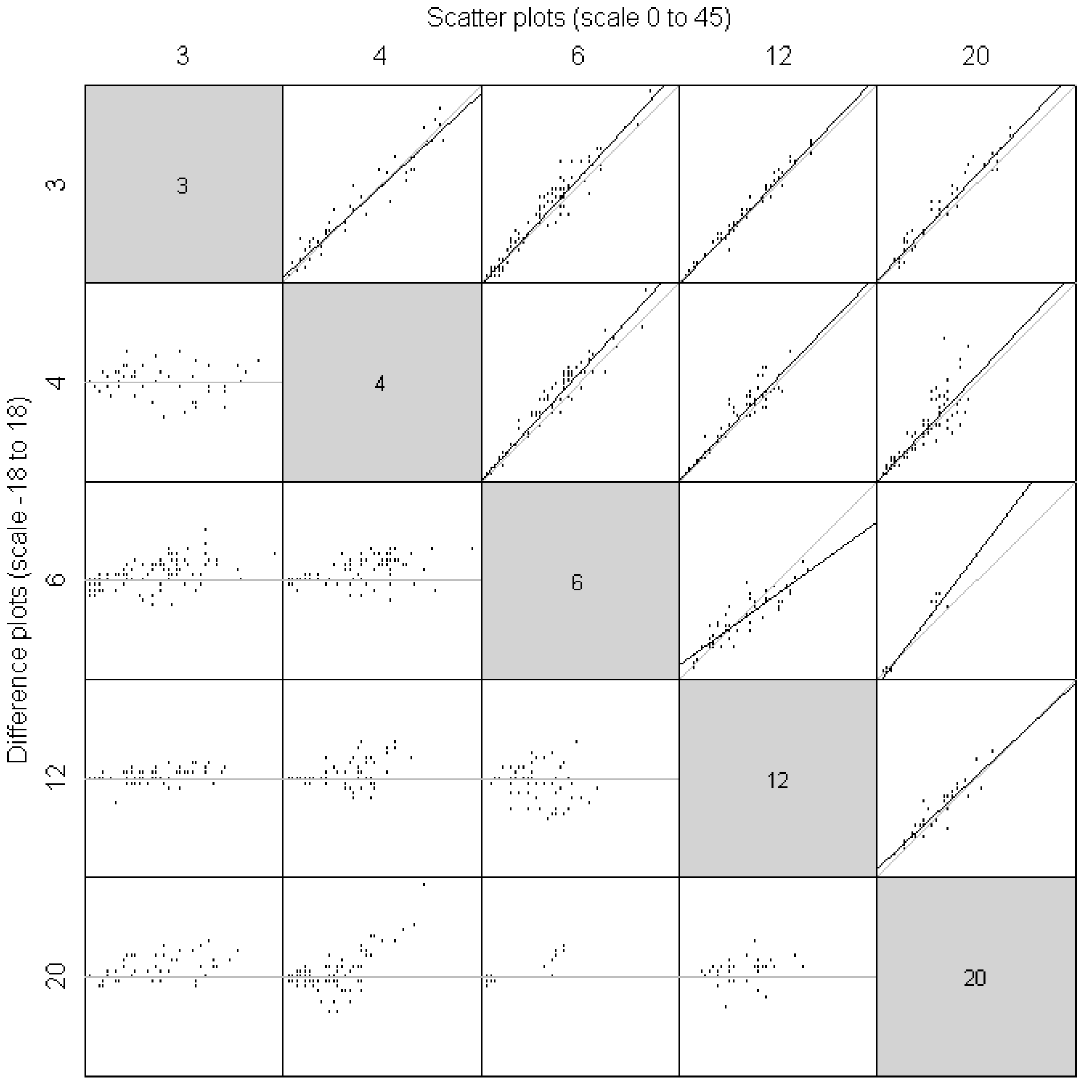


Figure 2. Scatterplot analysis of counter trends during 2009 survey of the Aran Grounds.

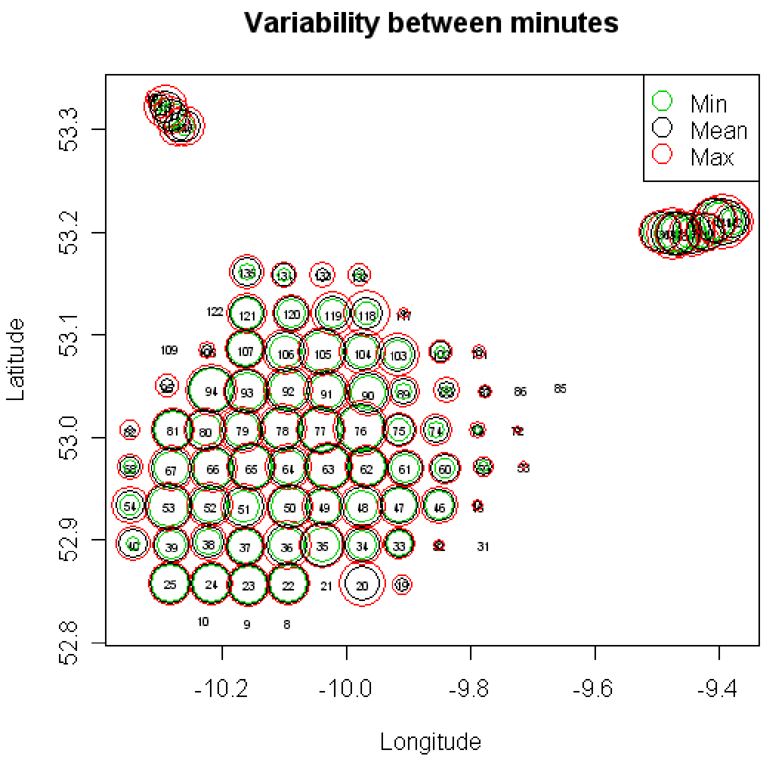


Figure 3. Plot of the variability of density between minutes. Aran Ground UWTV 2009 survey.

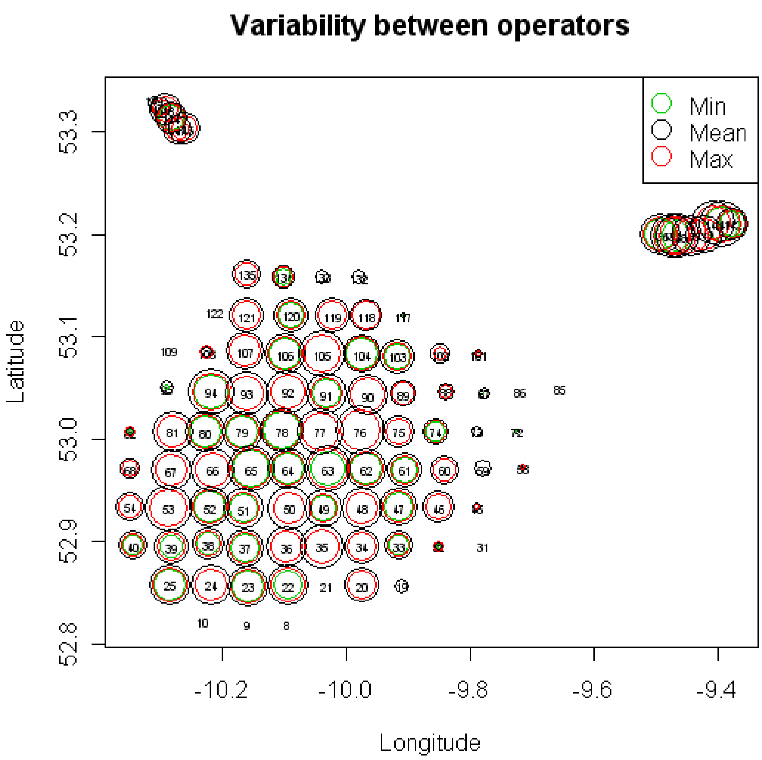


Figure 4. Plot of the variability of density between operators for each station. Aran Ground UWTV 2009 survey.

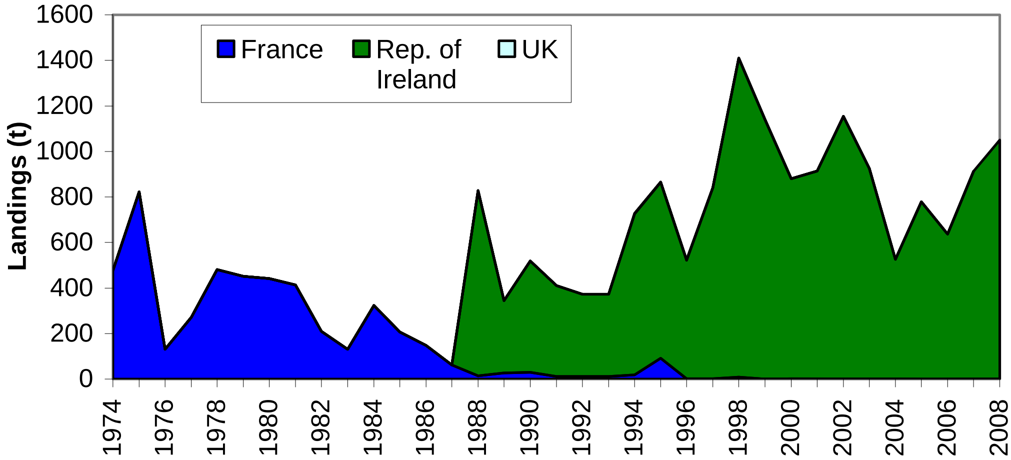


Figure 5. Landings, effort and lpue trends for the Aran Grounds (FU17). Note effort and lpue is for the "*Nephrops* directed fleet" only.

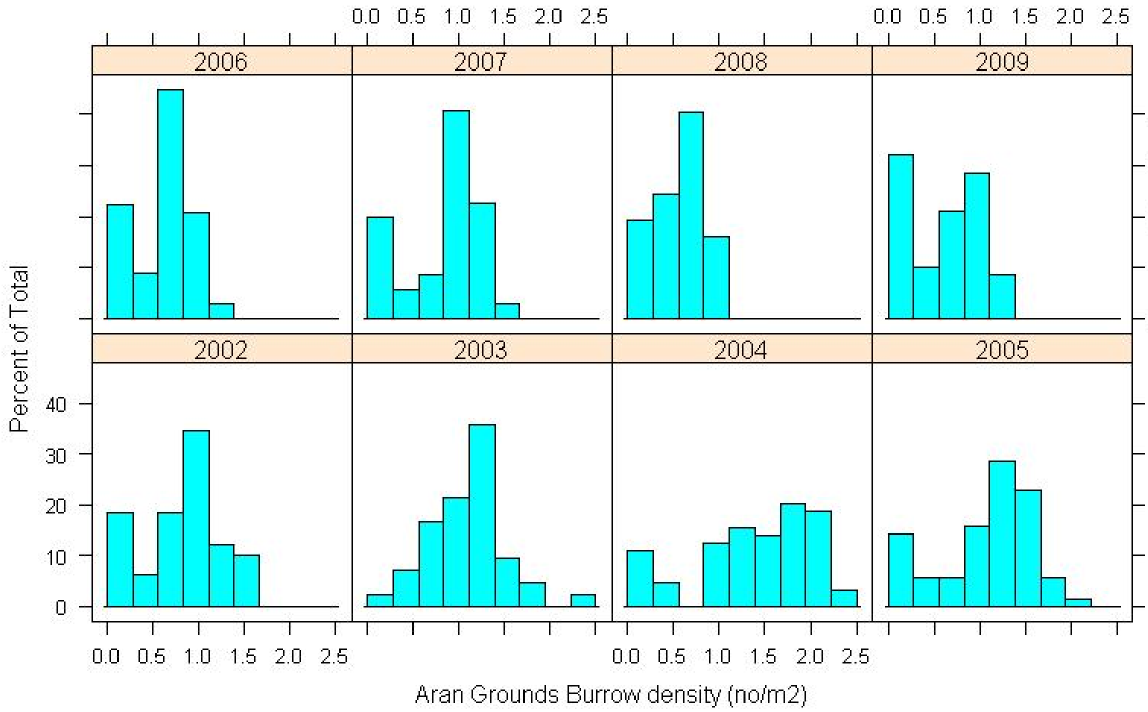


Figure 6. Burrow density distributions for the Aran Grounds by year from 2002–2009.

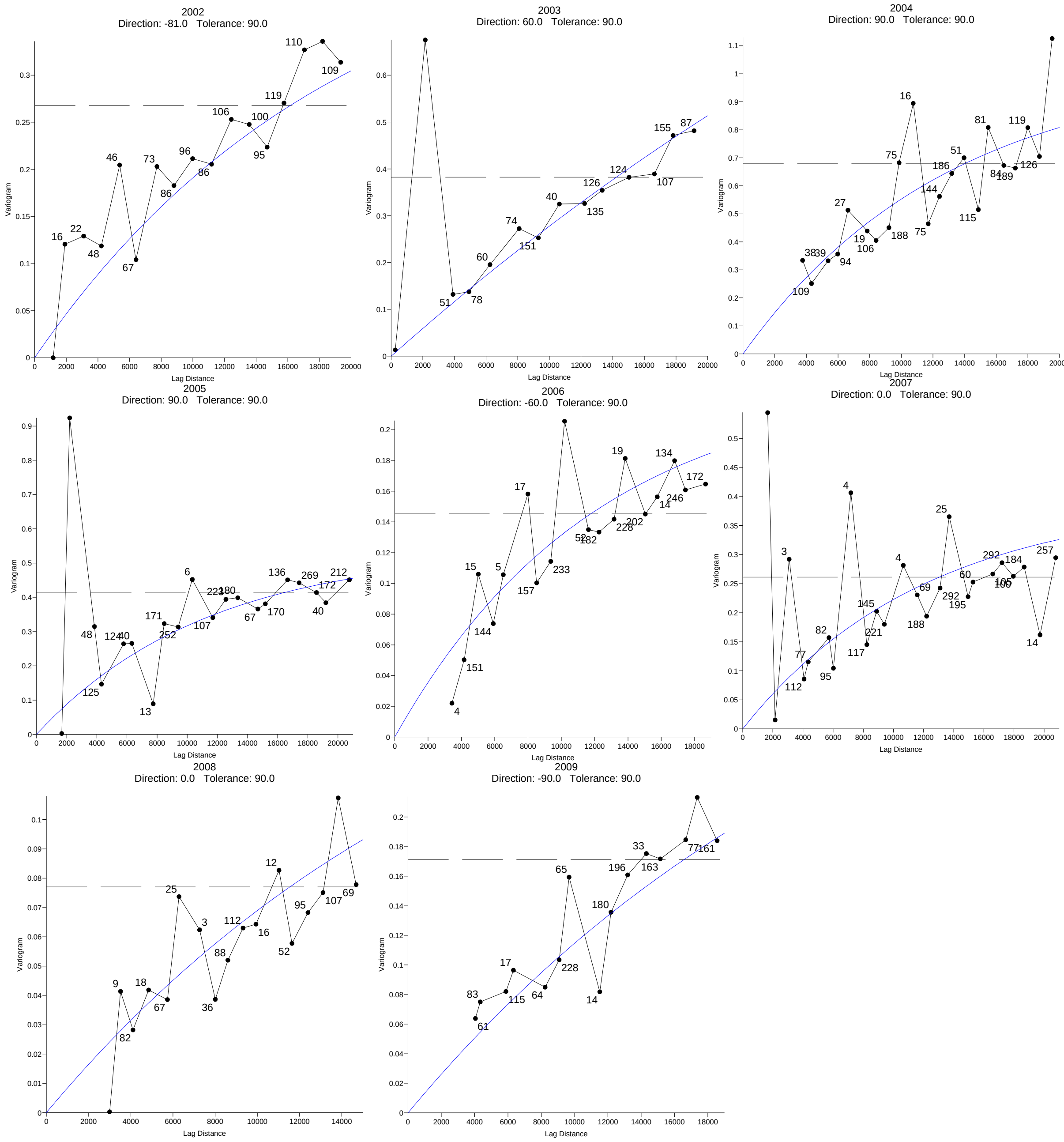


Figure 7. Omnidirectional variogram models used for kriging for the Aran Grounds from 2002–2009.

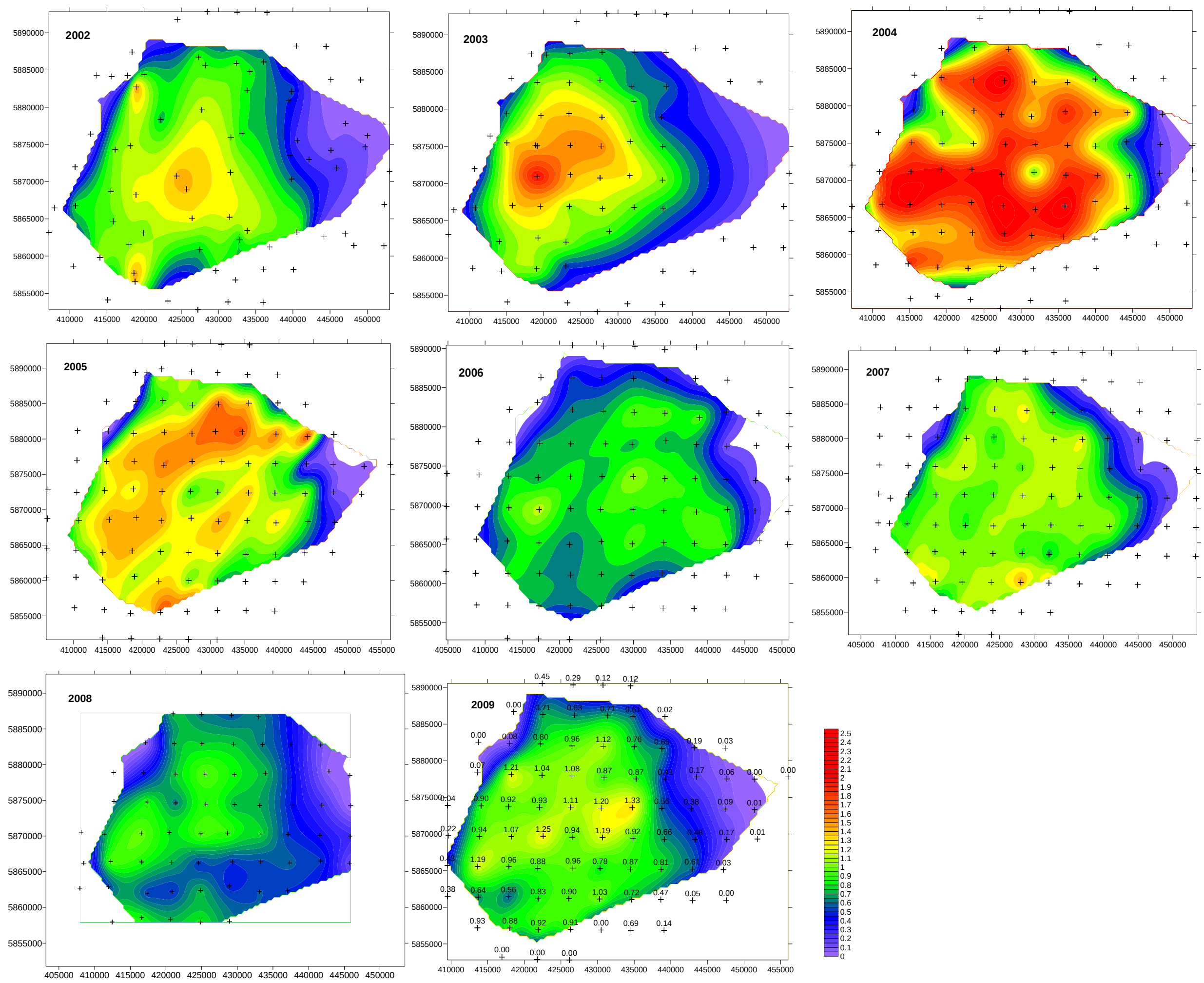


Figure 8. Contour plots of the krigged density estimates for the Aran Grounds from 2002–2009.

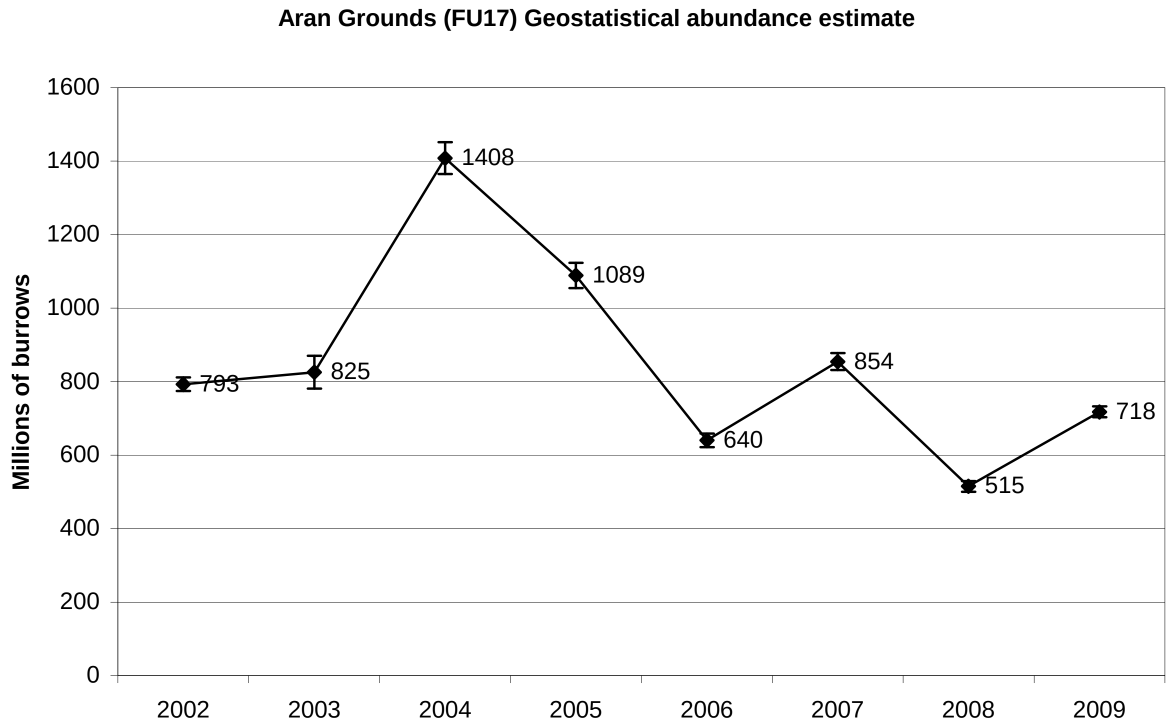


Figure 9. Time-series of geostatistical abundance estimates (in millions of burrows) for the Aran Grounds from 2002–2009.

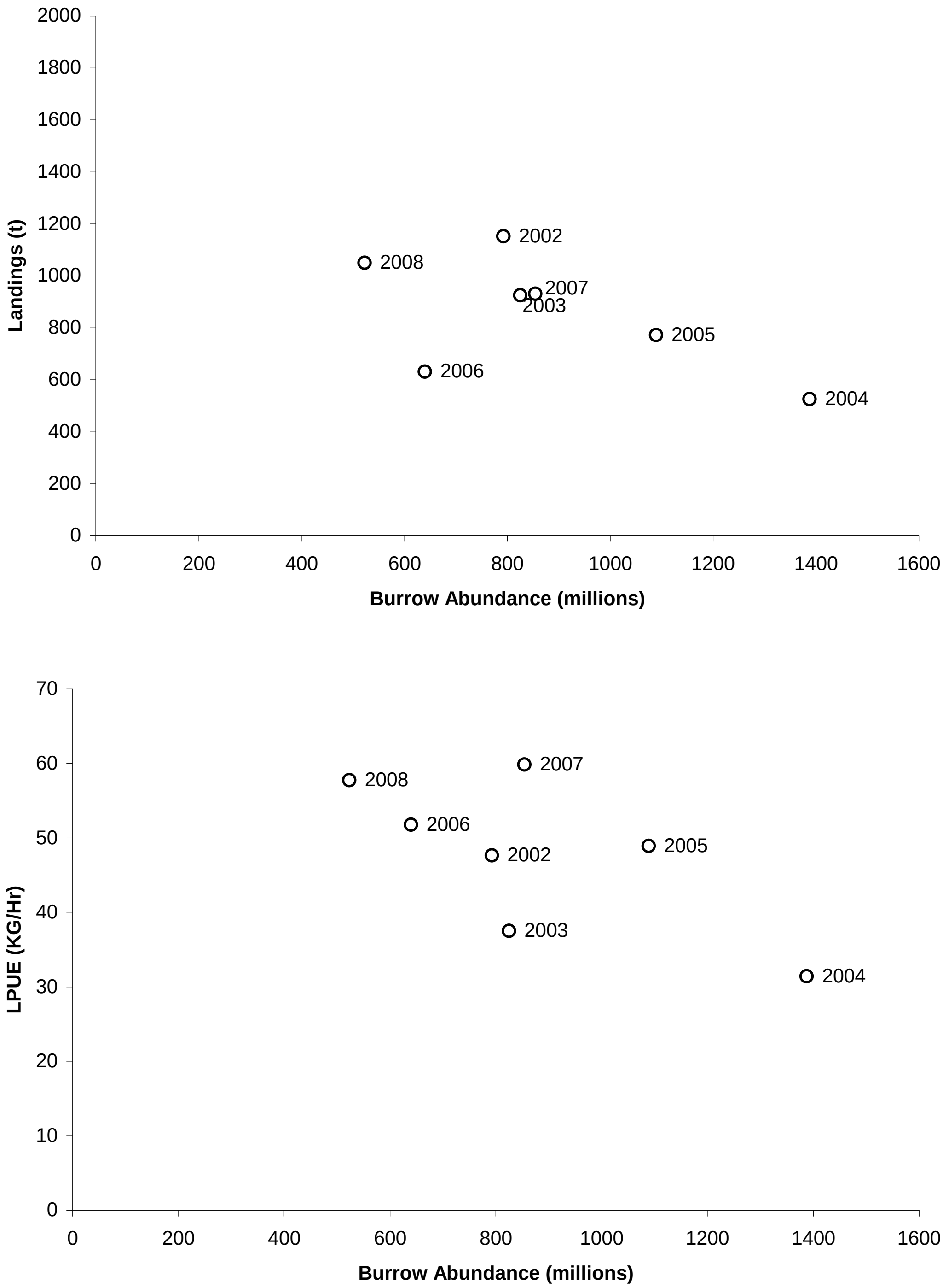


Figure 10. The relationship between landings and lpue and the abundance estimates from the UWTV surveys on the Aran Grounds.

Review

The new input for *Nephrops* in FU15 and 17 was reviewed by Hans Lassen in October 2009.

The WG produced two WD's that were reviewed for errors, and in relation to consistency with the assessment and forecast produced in June. Some remarks can be made.

1) The calculations are reasonably well documented in the WG Report and in the working documents from which it is possible to reconstruct the projection.

2) The calculations done in October were found to be correct and in accordance with the methodology described in the Stock Annex, albeit difficult to find the exact basis for the forecast table from the stock annex itself.

Concluding, the results presented in the Working Documents are suitable as a basis for advice.