ICES Resource Management Committee
ICES CM 2004/D:05

Report of the International Bottom Trawl Survey Working Group (IBTSWG)

23–26 March 2004
Lisbon, Portugal

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 TERMS OF REFERENCE AND PARTICIPATION

The **International Bottom Trawl Survey Working Group** [IBTSWG] (Chair: J.-C. Mahé, France) will meet in Lisbon, Portugal, from 23–26 March 2004 to:

a) coordinate and plan North Sea and North Eastern Atlantic surveys for the next twelve months;
b) review the work completed by the Study Group on "Survey Trawl Gear for the IBTS Western and Southern Areas";
c) review the outcome of the SURVEYTRAWL project;
d) comment on the outputs from the DATRAS data base;
e) agree on the intersessional revisions to the new IBTS manual;
f) further develop protocols and criteria to ensure standardization of all sampling tools and survey gears and review institutional checking lists;
g) review the outcome of the Workshop on "Sampling and Calculation Methodology for Fisheries Data";
h) make a detailed check of the age/length/sex/maturity data for the last 3 years from the ICES database;
i) consider and agree on depth stratification in the eastern Atlantic and Skagerrak;
j) consider the integration of fish and oceanographic data with particular emphasis on the production of the North Sea Pilot Project (NORSEPP) status report in 2004;
k) propose procedures for QC of historical data in the DATRAS database.

IBTSWG will report by 15 April 2004 for the attention of the Resource Management Committee.

The meeting was attended by:

Helle Andersen	Denmark	
Finlay Burns	UK (Scotland)	(*Non-member)*
Fatima Cardador	Portugal	
Corina Chaves	Portugal	
Ken Coull	UK (Scotland)	
Jorgen Dalskov	Denmark	
Siegfried Ehrich	Germany	
Jim Ellis	UK (England)	
Brian Harley	UK (England)	
Henk Heessen	Netherlands	
Joakim Hjelm	Sweden	
Remment ter Hofstede	Netherlands	
Lena Larsen	ICES Secretariat	
Jean-Claude Mahé (Chair)	France	
Gerjan Piet	Netherlands	
Odd Smedstad	Norway	
David Stokes	Ireland	
Francisco Velasco	Spain	
Yves Verin	France	

2 INTRODUCTION

The International Bottom Trawl Working Group (IBTSWG) has its origin in the North Sea, the Skagerrak and the Kattegat where co-ordinated surveys have occurred since 1965. Initially these surveys only took place during the first quarter of the year, but between 1991 and 1996 co-ordinated surveys took place in all four quarters of the year. Pressure on ship time caused the number of surveys to be reduced and currently co-ordinated surveys in the North Sea are only undertaken in the first and third quarters.

The IBTSWG assumed responsibility for co-ordinating western and southern division surveys in 1994. Initially progress in co-ordination was slow but in the last few years there has been a marked improvement and whilst data exchange etc. is not at the level of that enjoyed in the North Sea, there is excellent co-operation between the participating institutes.

The particular problem of data exchange has been addressed through the EU funded project DATRAS (Database TRAwl Surveys Project) – see Section 6.

However, the Working Group was informed that in 2003 and 2004, major changes were made by a member country in the GOV trawl used in the North Sea and in the GOV trawl recommended by the Group for the Eastern Atlantic. In view of those changes, the Working group decided that the data from those surveys could not be integrated in the IBTS database.

Furthermore the WG feels that if such practices are continued in the future, it will undermine coordinated surveys, and may lead to a weakening, or collapse, of internationally coordinated surveys like the IBTS.

At the 2003 meeting of the Working Group in Lorient (March 2003) it was decided that a full day would be dedicated to the north-eastern Atlantic surveys. However some of the terms of reference devoted to these surveys included aspect of importance to all the IBTS surveys. Therefore, all the TORs were addressed in plenary. The work and comments are to be found under the relevant sections.

3 REVIEW OF IBTSWG 2003 RECOMMENDATIONS

In order to reinforce the coordination task of the Working Group, it was decided that a review of the WG previous recommendations should be carried at each meeting and that recommendations not implemented should be reiterated.

Surveys planning and coordination

That all countries participating in the Quarter 1 survey in the North Sea, the Skagerrak and the Kattegat to use a MIK as specified in the IBTS Manual and to use a well balanced and calibrated flow-meter. The flow-meter should be attached to the MIK-frame correctly.

Most of the countries have complied with this recommendation but since there are still some lack of standardisation for some countries the WG reiterates this recommendation.

Given that the GOV is the gear used in most of the surveys in Celtic and Irish sea, it is recommended that this gear is adopted for the English survey series starting this year by R|V CEFAS Endeavour and for the Celtic Explorer for the continental margin.

Refer to Section 4.1.2 of the report.

Outputs from EU projects

EVARES

Work on the standardisation of trawl surveys and the ways indices of abundance are calculated should be encouraged.

This is an ongoing process in the IBTSWG.

DATRAS Database

It was recommended that a 'health warning' be attached to any data extracted from the IBTS database in the future. This would be in the form of a text file sent out with any data extraction, explaining the history of the surveys, the nature of the data and the possible limitations for its use. Following on from this an analysis of data from beam trawl and GOV hauls carried out at the same time in the same areas is suggested, allowing a comparison of the different catchabilities of the various gears. This would provide a better understanding on the actual abundance of various commercial species, as well as the overall composition of the fish community in the areas covered.

This has been implemented; see Section 6 of the present report.

Biological Data

Until guidelines have been provided and sampling schemes and protocols for this biological activity have been developed, institutes should continue sampling according to their national sampling schemes, whether these schemes are in accordance with the EU Data Directive or the sampling is carried out as part of national interest. As part of this strategy IBTSWG will seek guidance from SGGROMAT. IBTSWG recognises the Commission's desire to have a combined analysis and the willingness of the Commission to fund a dedicated Workshop but this procedure will have to await a response from the SGGROMAT before being developed further. Such an eventuality could occur in 2004 but recommend that it should be undertaken in conjunction with the ICES Planning Group on Commercial Catch, Discards and Biological Sampling (PGCCDBSC).

No more information have been provided to the WG from SGGROMAT

Species identification

Institutes should apply for funding under Data Collection Regulation 1639/2001 in order that a Workshop can be held in Ijmuiden in 2004 to finalise the format of a photographic collection to aid identification of species and maturity stages.

This Workshop will be held in IJmuiden from the 1–2 June 2004.

4 NORTH SEA AND EASTERN ATLANTIC SURVEYS (TOR A)

4.1 Q1 North Sea

Seven vessels participated in the quarter 1 survey in 2004: "Argos" (Sweden), "Dana" (Denmark), "Håkon Mosby" (Norway), "Scotia" (Scotland), "Thalassa" (France) and "Tridens" (Netherlands). In all, 372 GOV hauls were made and 501 MIK hauls. Most rectangles were covered by two GOV hauls, and also the coverage of the MIK sampling was good. In addition to these seven vessels, CEFAS Endeavour fished a number of stations off the northeast coast of England. Since modifications were made to the standard GOV trawl (see elsewhere in this report), the IBTS WG decided not to include these data in the IBTS dataset for 2004.

The preliminary indices for the 2004 quarter 1 survey are shown in Figure 4.1.1.

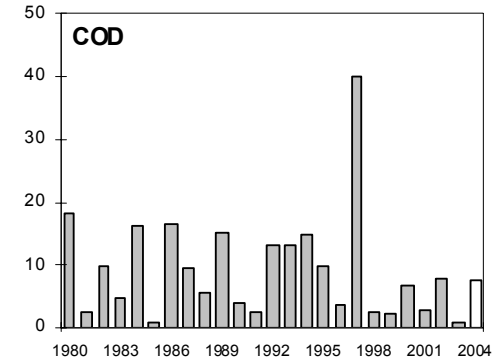
From 1999 to 2003 young herring was caught in great numbers. This year the catch was much lower than the long-term average. This confirmed the low numbers of herring larvae caught during the 2003 quarter 1 IBTS.

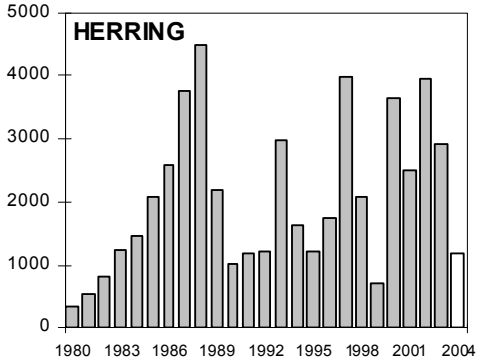
According to the preliminary results, sprat produced a good year class in 2003, better than the average for the year classes born since 1980.

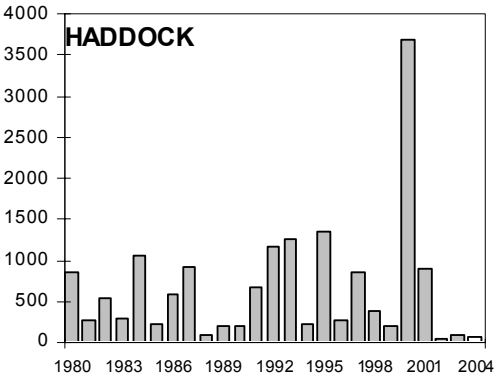
The index for 1-group cod was just below the average since 1980 and much better than last year when hardly any 1-year-old cod was caught. The distribution map (Figure 4.1.2) shows that in the German Bight, as during last years, hardly any young cod was caught. Greatest abundance of young cod was observed in the Skagerrak-Kattegat area.

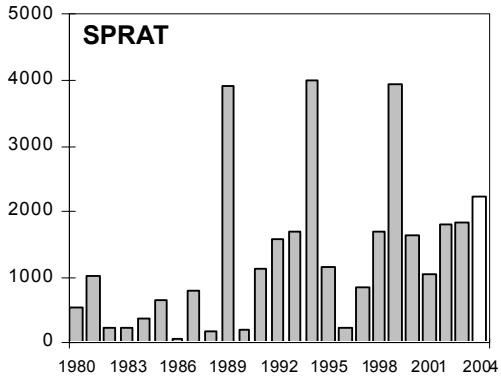
In 2003 and 2004 the abundance of 1-group whiting was much lower than in the 20 preceding years. Haddock produced an extremely strong year class in 1999 (as in 1967). Since 2000 year classes have been very week. Norway pout has a similar pattern: a very strong year class in 1999, but low catches during the last 4 years.

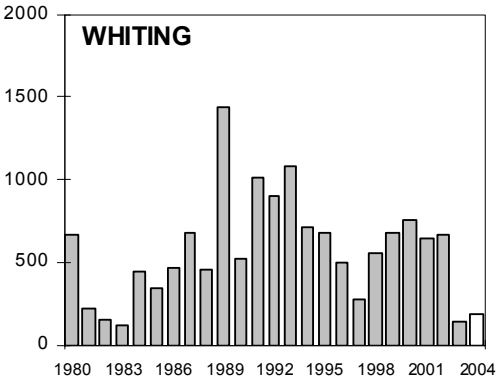
MIK sampling showed a low abundance of herring larvae (see also Section 4.1.2).

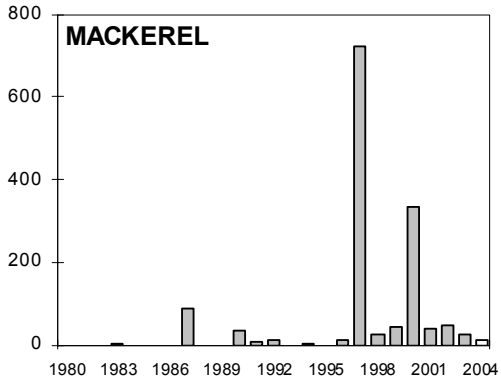


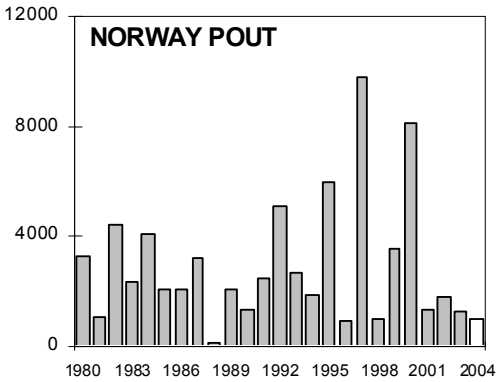












	final 2003	preliminary 2004	MEAN av 80-03
cod	0.6	**7.6**	9
haddock	90	**71**	685
whiting	146	**187**	590
Norway pout	1243	**1001**	2997
herring	2926	**1196**	2091
sprat	1823	**2204**	1283
mackerel	24.8	**10**	59

Figure 4.1.1. Time series of indices for 1-group (1-ring) fish caught during the quarter 1 IBTS survey in the North Sea. Indices for the last year are preliminary, and based on a length split of the catches.

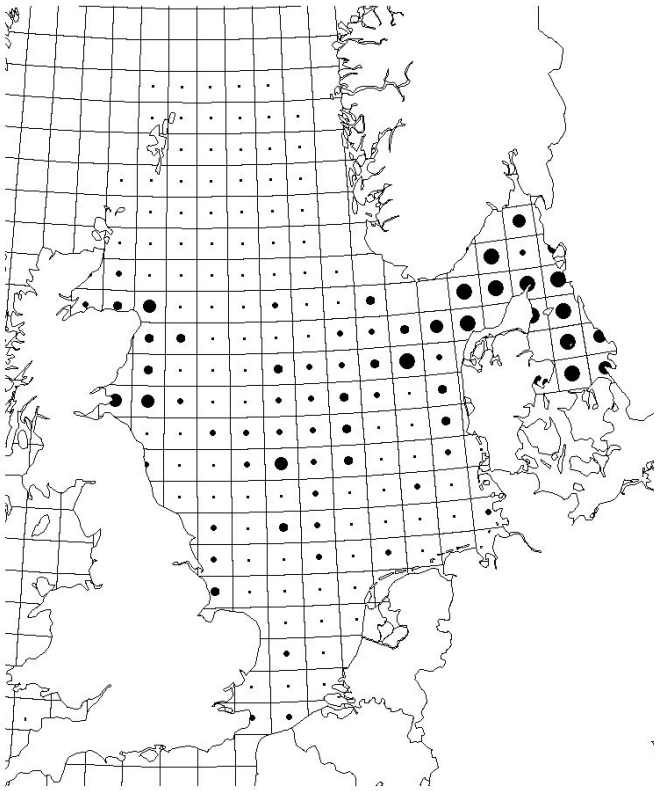


Figure 4.1.2. Distribution of cod year class 2003 as 1-year-olds in the 2004 quarter 1 IBTS.

4.1.1 GOV modification for UK 2004 survey

The survey gear routinely used by England in the North Sea is the GOV trawl that is rigged to the specifications listed in the IBTS manual. Commercial fishermen from the UK have criticised the gears performance particularly in relation to its efficiency for cod (see Fishing News, 27 February 2004). The comments have focussed on the gaps between the groundgear and the fishing line, which the industry felt might allow cod to escape. The gaps result from the spacing (1m apart) and the length (0.3 m) of the toggle chains used to connect the groundgear to the fishing line. Following discussions between CEFAS survey managers and industry representatives, in January 2004, it was agreed to make modifications to that part of the rigging of the GOV. The modification would take the form of shortening the toggle chain connections as much as was practicable between the groundgear and the fishing line.

From observations of a one tenth scale model GOV trawl deployed in the SFIA flume tank, Hull, the shortened toggle chains did not appear to distort the net. Since the difference in length of the groundgear (46 m) and fishing line (47 m) is only 1m, the gap between them, over the length of the groundgear, may not have been of major concern.

The CEFAS contribution to the IBTS quarter 1 coordinated North Sea survey in 2004 was undertaken using a GOV trawl modified in this way but otherwise the rigging was standard.

CEFAS has also proposed that this modification will be used on the English grid of the third quarter IBTS in the North Sea in August 2004.

The WG understands that the pressure from the fishing industry is an increasing problem that fisheries institutes are facing, and is likely to increase in the future. However the scientific community has the responsibility to develop and implement programmes to gather the best information on marine living resources, including monitoring the status of ecosystems and the relative abundance of populations. This can only be achieved by ensuring that the sampling tools

and strategies are maintained at the same level of consistent gear performance. Invariably, this means that the relative efficiency of scientific gears, in comparison to commercial gears and fishing techniques, has decreased over time. Commercial gears have constantly improved their efficiency over time to meet considerations that are not consistent with the characteristics of the tools needed for obtaining consistent time series of scientific data.

The main purpose of this WG is to recommend proposed protocols and strategies, and monitor that these protocols and strategies are implemented by all member countries. The North Sea IBTS has achieved one of the highest levels of standardisation to date, although some problems are still identified and this is the task of this WG to ensure that such problems are identified and solutions proposed.

The changes to the gear presented to the WG and described above are against all recommendations and was considered by the group to likely have changes in the catchability and the Working Group strongly recommends that they are abandoned.

Furthermore the WG feels that if such practices are continued in the future, it will undermine coordinated surveys, and may lead to a weakening, or collapse, of internationally coordinated surveys like the IBTS.

4.1.2 NS Herring Assessment - MIK sampling

For the ICES Herring Assessment Working Group for the area South of 62°N (HAWG) the IBTS survey provides recruitment indices for herring and sprat. Examinations of the catch data from the 1st quarter IBTS have shown that catch during the surveys also indicates abundances of the adult stages of herring. As sampling at night with fine-meshed nets (MIK) was implemented from 1977 the catch of large herring larvae has been used for estimation of 0-ringer abundance in the survey area.

Indices of 2–5+ ringer herring abundances

Fishing gear and survey practices were standardised from 1985, and herring abundance estimates of 2–5+ ringers from 1983 onwards have shown the most consistent results in assessments of these age groups. This time series is used in North Sea herring assessment.

Due to uncertainties about standardisation of the English trawl catches in 1st Quarter 2004, the HAWG decided that these catches should not be included in the calculations of 1–5+ ringer herring indices for 1st Quarter 2004. The HAWG recommends that the IBTS WG evaluates the inclusion of the English 2004 catches in future calculations of IBTS indices.

The IBTSWG was informed that England in the forthcoming years will not participate in the 1st quarter IBTS survey.

Index of herring 1-ringer recruitment

The 1-ringer index of recruitment is based on trawl catches in the entire survey area. This year's estimate of the 2002 year class strength indicates a very low recruitment, among the lowest on record.

Figure 4.1.2.1 illustrates the spatial distribution of 1-ringers as estimated by the trawling in February during 2002, 2003 and 2004.

Index of 0-ringer recruitment (MIK-index)

The February 2004 sampling is shown in Figure 4.1.2.2. This sampling has in 2004 been satisfactorily evenly spread on the survey area. The estimate of the 2003 year class indicates a very low recruitment, of the same size as last years recruitment estimate. The 0-ringers were concentrated in north-western areas of the North Sea, with highest concentrations off the Scottish coast into the north/central part of the North Sea (Figure 4.1.2.3). This distribution pattern differs from the distribution of the preceding two year classes of 0-ringers, also shown in Figure 4.1.2.3.

The standard sampling gear in the sampling programme for 0-ringers is a fine-meshed ring net. However, the Scottish sampling is carried out using a modified frame version of a larger opening. In the calculation of 0-ringer indices, the differences in gear size is taken into account, but in order to avoid potential catch-ability differences, the HAWG recommends a full standardisation of the sampling programme, hence, that Scotland changes gear to the 2-metre ring version with standard netting (see Recommendations).

Index of sprat

Unfortunately, data on sprat from the IBTS survey during the third quarter were not available prior to the 2004 HAWG meeting. The HAWG has decided that at its 2005 meeting that comparison between the February and the third quarter IBTS indices should be performed with the aim of obtaining an index of abundance of age 1 sprat. Further examination on maturity at length and at age, available from the IBTS conducted in the 3rd quarter and commercial catches could provide important insight into the maturity dynamics during the autumn resulting in a better understanding of the spawning and recruitment processes. Therefore, the HAWG recommends that countries involved in IBTS analyze data on maturity at age of sprat and make available the results prior to the 2005 HAWG meeting.

In order to avoid bias due to catch-ability differences between gears used in the IBTS-MIK sampling, the HAWG recommends a full standardization of the sampling programme, hence, that Scotland changes gear to the 2-metre ring version with standard netting (as described in the IBTS Manual).

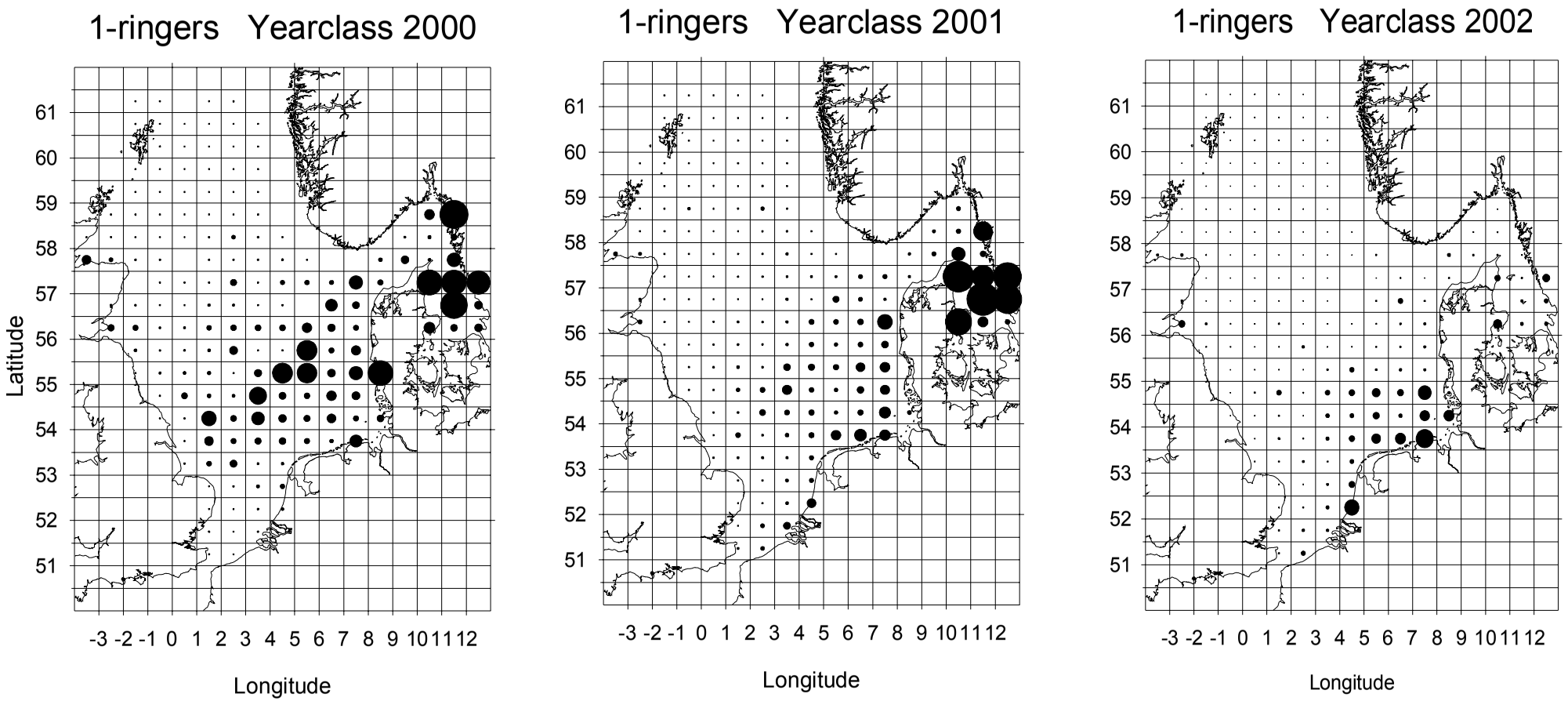


Figure 4.1.2.1. North Sea herring. Distribution of 1-ringer herring, year classes 2000–2002. Abundance estimates of 1-ringers within each statistical rectangle are based on GOV catches during IBTS in February 2002–2004. Areas of filled circles illustrate numbers per hour, the area of a circle extending to the border of a rectangle represents 45000 h^{-1}.

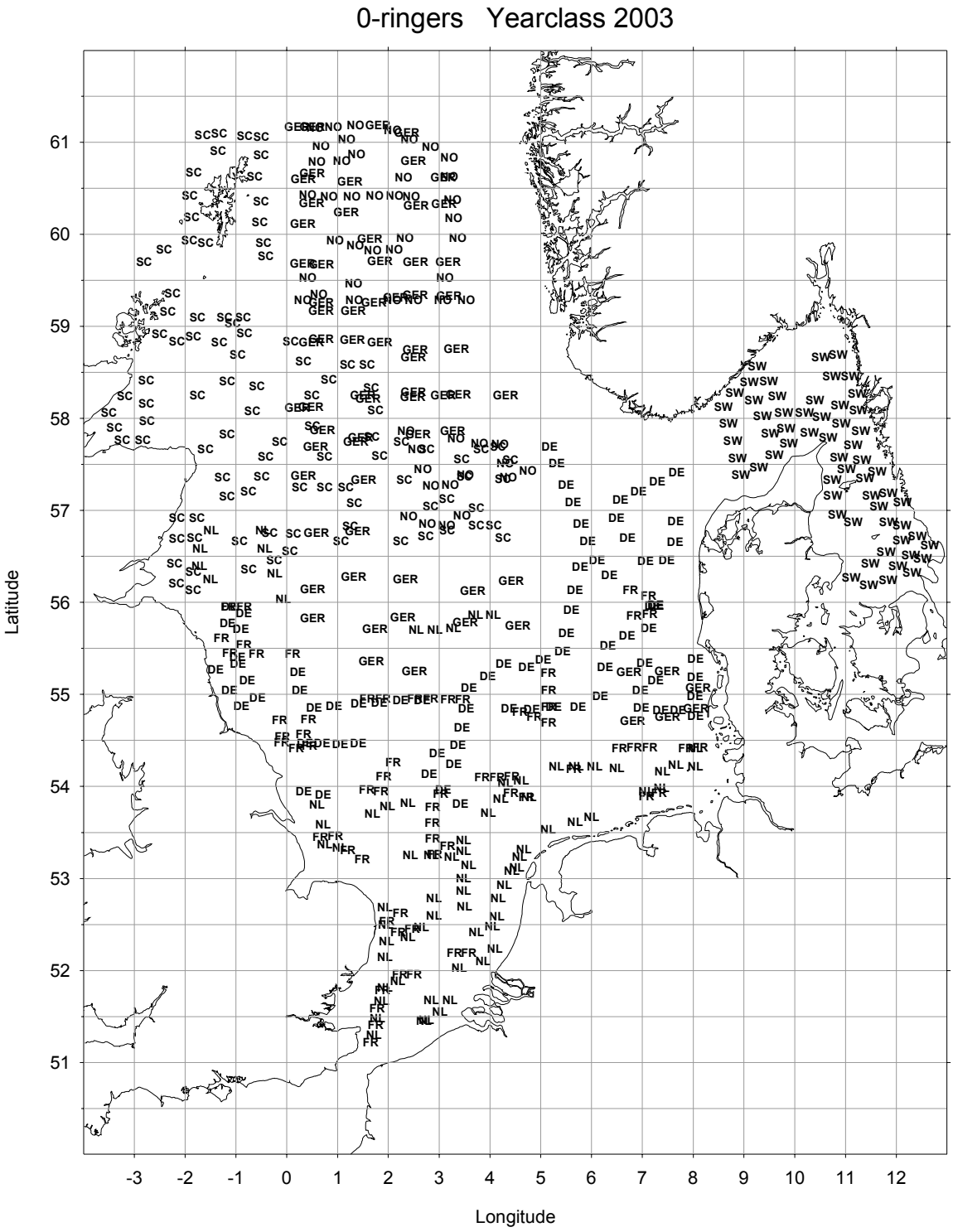


Figure 4.1.2.2. Distribution of the MIK hauls made at the February 2004 IBTS survey.

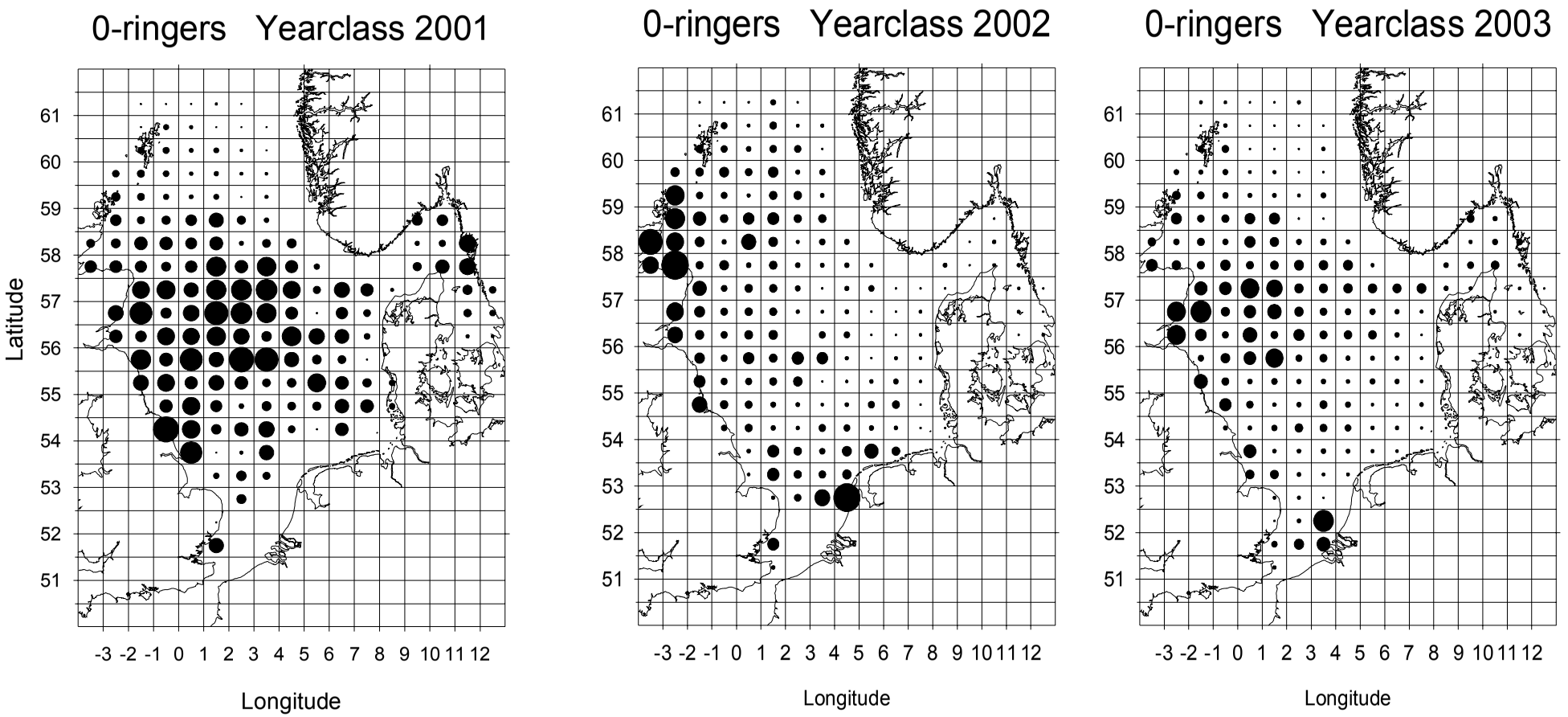


Figure 4.12.3. North Sea herring. Distribution of 0-ringer herring, year classes 2001–2003. Abundance estimates of 0-ringers within each statistical rectangle are based on MIK catches during IBTS in February 2002–2004. Areas of filled circles illustrate densities in no m^{-2}, the area of a circle extending to the border of a rectangle represents 1 m^{-2}.

4.1.3 Sampling efficiency: vulnerability of bottom fish species to the standard GOV

During the last years several comparison fishing experiments have been carried out to illustrate to which degree qualitative and quantitative descriptors of fish assemblages in an area depend on the gear used. First results are provided here together with information on the vulnerability of fish species to the GOV. Vulnerability, the proportion of fish in the gear's area of influence which is retained, can vary between 0 (no specimen of a certain species which stays within the path of the gear is retained) and 1 (all specimens are caught).

Three experiments were carried out by Germany. Data on these are listed below (Table 4.1.3.1). The experiments took place in Boxes A and N, areas of 10 to 10 nm each in the German Bight.

Table. 4.1.3.1. Data on fishing experiments.

vessel	gear	date	Box	no. of hauls	towing time (min)	mean effective swept area (m^3)
Solea	7m-beam trawl	12.-18.Dec.01	A	27	30	22766
Solea	Cod trawl	12.-18.Dec.01	A	27	30	71141
W. Herwig III	GOV	04.-07.Jan.02	A	19	30	79238
W. Herwig III	2m-beam trawl	04.-07.Jan.02	A	9	5	616
W. Herwig III	GOV	14.-16.Aug.03	A	20	30	88701
Solea	7m-beam trawl	16.-17.Aug.03	A	22	15	13014
W. Herwig III	2m-beam trawl	06.-10.Jan.04	A	13	5	460
W. Herwig III	triple beam trawl	07.Jan.04	A	3	5	636
W. Herwig III	2m-beam trawl	11.-12.Jan.04	N	8	5	459
W. Herwig III	triple beam trawl	10.Jan.04	N	3	5	612

GOV: The standard GOV as used in the experiments was equipped with the standard ground rope and fully described in the manual of the IBTS.

Cod Trawl: In average the Standard Cod Trawl as used aboard "Solea" has a headline height of 1m less and a vertical opening of 3m more compared to the GOV. The net is provided with a rubber disc roller gear whose discs have a diameter of 20 cm.

7 m-beam trawl: The beam trawl is used in the International Beam Trawl Survey (BTS) and is characterised by a 7 m beam, 5 tickler chains and an overall net length of ca. 21 m.

The codend of all three gears were fitted with a 20mm mesh liner.

2 m-beam trawl: The 2m-beam trawl is normally used to fish epibenthic species. It is fitted with a 20mm mesh and a liner of 4mm knotless mesh inside the codend. A chainmat was attached to protect the gear and to prevent the catch of heavy stones.

Triple beam trawl: Three standard 2 m-beam trawls as described above were tied one behind the other by steel ropes of 6 m in length on both sides (Figure 4.1.3.1).

To compare the catch rates of the gears the swept area of each haul was calculated and the catch data were than standardised to an area of one nautical square mile. Only in the experiment with the triple 2 m-beamtrawl the catch data were standardised to 500 m^2.

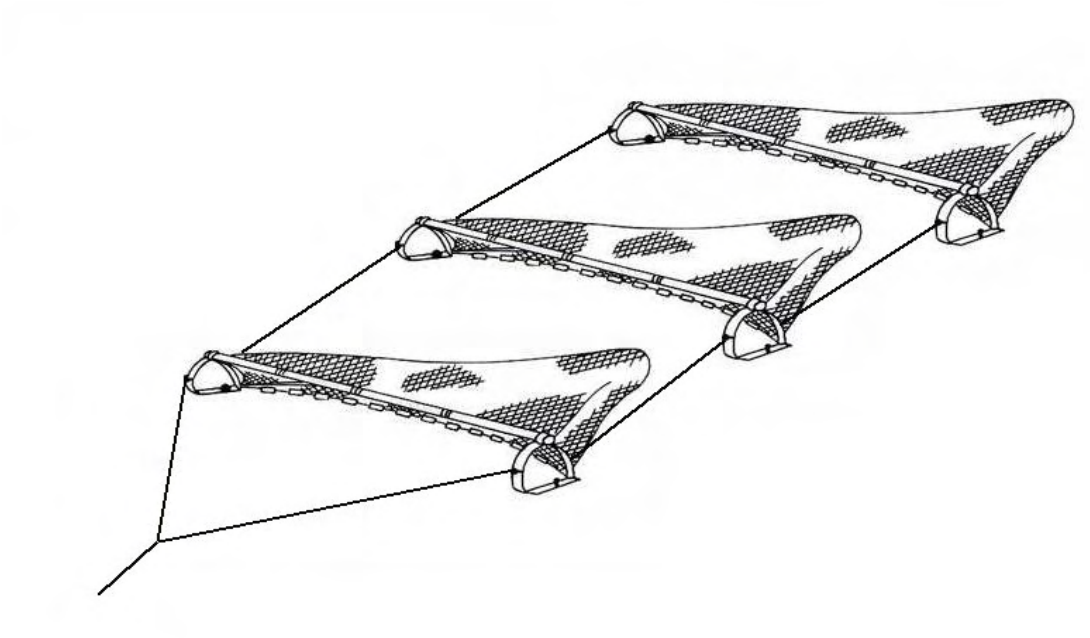


Figure 4.1.3.1. Triple 2 m-beam trawl.

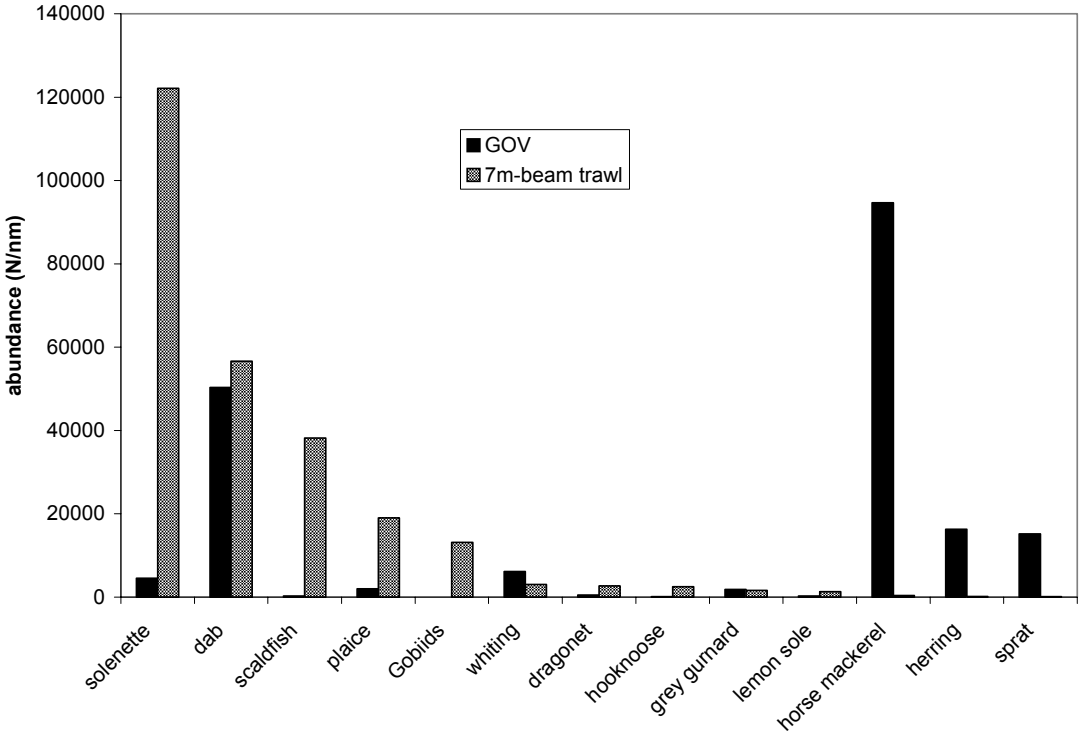


Figure 4.1.3.2. Differences in abundance estimates of fish species in Box A (German Bight) in summer based on catches of the GOV and the 7 m-beam trawl.

As supposed and shown in Figure 4.1.3.2 the pelagic species like herring, sprat and horse mackerel are highly represented in the GOV whereas the bottom living species like flatfishes, gobiids and dragonets are caught in high numbers by the 7 m-beam trawl.

It might be expected that catches of the triple 2 m-beam trawl would decrease from the first to the third net. But the distribution of the total catch in the 3 nets for various species changes by species. As shown in Figure 4.1.3.3, Solenette (*Buglossidium luteum*) a small flatfish of 4–13 cm in length lives buried in muddy sand. It seems that the first gear disturbs and digs out the specimens and they are then more vulnerable to the second and third nets. On average, only 26% of the total catch (by number) of solenette was caught by the first gear. The higher agility of species like sand goby (*Pomatoschistus minutes*) could explain the higher proportion of catch in the first gear (52%).

Taking all the factors between the gears of the 3 experiments into account the vulnerability of fish species to the standard GOV was calculated (Table 4.1.3.2). Factors <1 means that the GOV is not so efficient in relation to the other gear. There are more specimens of this species in the path of the gear and the GOV only catch a part of them. The last row of Table 4.1.3.2 gives the vulnerability of the species to the standard GOV.

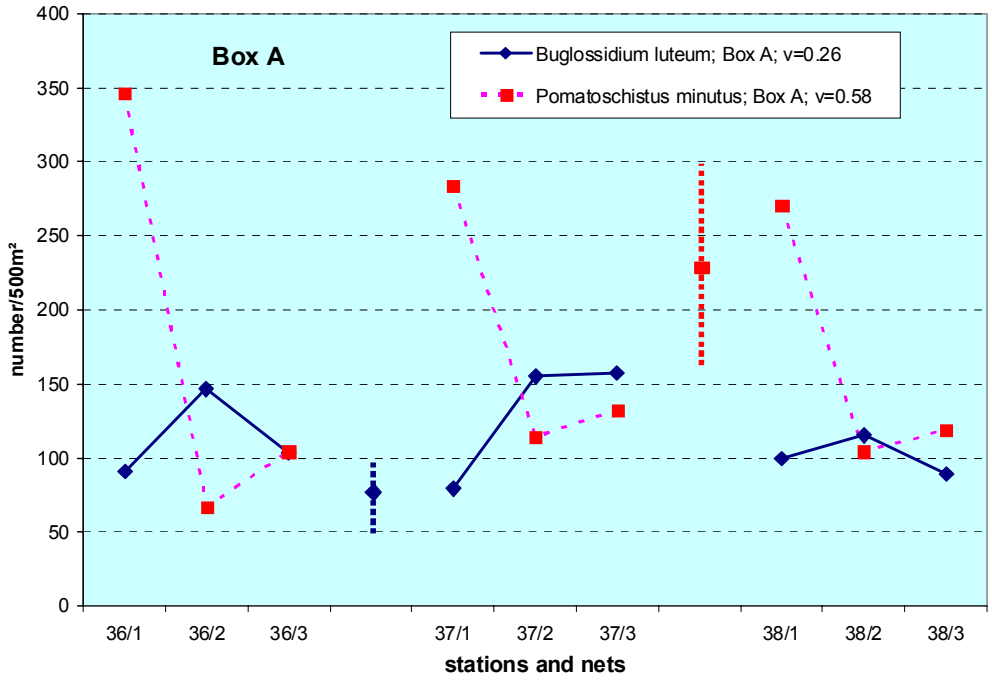


Figure 4.1.3.3. Catch of solenette (*B. luteum*) and sand goby (*P. minutes*) in the triple 2 m-beam trawl on 3 stations in Box A. v= vulnerability to the first gear. The vertical line represents the mean catch and the confidence interval of the single 2m-beam trawl in the Box.

Table 4.1.3.2. Factors between the gears (1st and 2nd experiment) and of the first gear of the triple 2m-beam trawl (3rd experiment); limited to species with confidence intervals of the mean <100%. Vulnerability of the species to the standard GOV.

species	**experiment 1** GOV/KJN	**experiment 1** GOV/ BT7m	**experiment 2** GOV/ BT7m	**experiment 1** GOV/BT2m	**experiment 3** 1st gear/triple trawl	**vulnerability GOV**
TRISOPTERUS MINUTUS; poor cod	0.78120	-	-	-	-	0.78120
MERLANGIUS MERLANGUS; whiting	0.97757	4.05404	2.00885	3.47933	-	0.97757
CLUPEA HARENGUS; herring	79.85051	-	-	-	-	1.00000
MYOXOCEPHALUS SCORPIUS; bullrout	2.26146	0.15709	0.17551	-	-	0.15709
SPRATTUS SPRATTUS; sprat	348.07765	-	179.89678	-	-	1.00000
PSETTA MAXIMA; turbot	-	-	0.11637	-	-	0.11637
MICROSTOMUS KITT; lemon sole	-	-	0.21049	-	-	0.21049
EUTRIGLA GURNARDUS; grey gurnard	-	-	1.14816	-	-	1.00000
RHINONEMUS CIMBRIUS; four-bearded rockling	-	-	0.19632	-	-	0.19632
TRIGLA LUCERNA; tub gurnard	-	-	0.26249	-	-	0.26249
SCOPHTHALMUS RHOMBUS; brill	-	-	0.18619	-	-	0.18619
SOLEA VULGARIS; sole	-	-	0.01294	-	-	0.01294
TRACHURUS TRACHURUS; horse mackerel	-	-	249.56559	-	-	1.00000
PLEURONECTES PLATESSA; plaice	0.60557	0.01325	0.10480	0.03611	0.24289	0.00877
ARNOGLOSSUS LATERNA; scaldfish	-	0.00745	0.00713	0.00110	0.30843	0.00034
POMATOSCHISTUS MINUTUS; sand goby	-	-	-	0.00009	0.52000	0.00005
LIMANDA LIMANDA; dab	1.84512	0.42811	0.88870	0.33242	0.34289	0.11398
BUGLOSSIDIUM LUTEUM; solenette	-	0.01013	0.03728	0.00052	0.26047	0.00014
AGONUS CATAPHRACTUS; hooknoose	8.03056	0.02757	0.04139	0.00630	0.18353	0.00116
CALLIONYMUS LYRA; dragonet	5.27144	0.02246	0.17684	0.00391	0.37427	0.00146

Conclusions

1) The qualitative and quantitative species composition and the length composition in the catch from an area are gear specific and might not be representative of the fish fauna living in that area. Therefore, when describing a fish assemblage by using data from a single gear, the caveat that the description is gear-dependent should be highlighted.
2) The factors between the gears and the vulnerability indices given in this paper should not be used as conversion factors between the gears. The vulnerability of a species not only depends on gear parameters which can be kept constant, but is also dependent on environmental parameters like sediment structure and on the characteristics of the species like length composition, physiological condition and differences in the behaviour of age or length groups during fishing. All these parameters will change with the density of the species in front of the gear and perhaps with the time of the year.
3) The results of the comparison experiments emphasize the importance of gear standardization and the validity of the basic rule: "Never change the survey gear" without having very serious reasons to do so.

4.1.4 Participation in 2005

Only some countries have at this moment decided on their programmes for 2005. As yet, there are no signals that effort will decrease in 2005.

4.2 Q3 - North Sea

Six vessels participated in the quarter three survey in 2003: "Dana" (Denmark), "Walter Herwig III" (Germany), "G.O. Sars" (old) (Norway), "Argos" (Sweden), "CEFAS Endeavour" (England) and "Scotia" (Scotland). In all, 345 valid GOV hauls were made, allowing full coverage of the survey area. The North Sea, Skagerrak and Kattegat quarter 3 survey has now completed 13 years in its coordinated form. Table 4.2.1 shows the effort ascribed to this survey over the time series. Good coverage of the area had continued until 2000 when, unfortunately Sweden withdrew their vessel at very short notice. As a consequence the Skagerrak and Kattegat were not surveyed that year. Up to present only data from the separate Scottish and English elements of this survey have been used each year in the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK). This is because of their longer time series. Now there are 13 years of the more extensive combined data, it is hoped that ICES will be able to provide indices from the combined data set for use by the NSDWG when they meet in 2004. Towards satisfying a recommendation from the last report of this working group, a spreadsheet has been made available containing preliminary data for the target species for the years 1998 to 2003.

Table 4.2.1. Number of valid hauls and days at sea per country for quarter 3 surveys 1991–2003 and number of days proposed for 2004.

Year		Denmark	France	Germany	Netherlands	Norway	Sweden	UK England	UK Scotland	Total
1991	Days				19		15	27	20	81
	Hauls				73		52	87	90	302
1992	Days		17	12	11		15	31	20	106
	Hauls		61	48	32		52	72	87	353
1993	Days		19		17		15	27	20	98
	Hauls		70		65		53	71	87	346
1994	Days		19		10		15	23	20	87
	Hauls		55		42		53	73	89	312
1995	Days				9		15	30	20	74
	Hauls				34		53	74	89	250
1996	Days		32	8	5		15	27	20	107
	Hauls		56	32	17		53	79	85	323
1997	Days			8	8		15	26	20	77
	Hauls			32	18		46	74	88	258
1998	Days	14		8			15	28	18	83
	Hauls	51		28			48	74	77	278
1999	Days	15		9		26	15	28	21	114
	Hauls	53		32		75	47	74	83	364

Year		Denmark	France	Germany	Netherlands	Norway	Sweden	UK England	UK Scotland	Total
2000	Days	15		7		21		28	18	89
	Hauls	60		26		69		75	87	317
2001	Days	16		8		20	15	28	22	109
	Hauls	56		29		49	46	74	87	341
2002	Days	18		13		28	15	32	23	129
	Hauls	47		32		57	46	75	85	342
2003	Days	18		10		26	23	32	26	134
	Hauls	46		29		61	48	75	86	345
*2004**	*Days*	*18*		*11*		*30*	*15*	*29*	*27*	*130*

*Preliminary

4.2.1 Participation in 2004

All the participants of the third quarter 2003 survey have advised that they will be participating fully in the programme in 2004. The timing of the surveys will be broadly in line with recent years.

4.3 Q4 - Eastern Atlantic

In 2003 a total of 11 IBTS groundfish surveys were carried out in the ICES Western and Southern Area of the Eastern Atlantic (Figure 4.3.1; Table 4.3.1). The UK introduced a new survey covering the Irish Sea and northern Celtic Seas and the Irish Marine Institute replaced its West Coast and Irish Sea Celtic Sea Surveys with the Irish Groundfish Survey (IGFS).

Coordination for this year will focus on establishing a number of agreed haul positions in overlapping survey areas that can be used for ongoing survey standardisation on an annual basis. The preliminary schedule of Western and Southern Area surveys in 2004 is given in Table 4.3.2.

4.3.1 Intercalibration

During the mid-cruise break of the Spanish Porcupine Survey a baca trawl modified by the Marine Institute was transferred to the RV "Visconde de Eza" for intercalibration against the standard Porcupine baca trawl, during the second half of the survey (see Section 5.1).

In November 2003, a number of tows for the purposes of intercalibration were attempted between CEFAS and IFREMER during the 4th quarter surveys in the Celtic Sea, but significant gear damage restricted the amount of useful hauls that could be achieved in the affordable time and further work had to be abandoned.

Clear tow positions were exchanged between the Marine Institute and CEFAS, but a combination of survey timing and weather conspired to prevent further intercalibration work between these surveys. However, additional work on gear configuration and or selectivity is reported by IBTS members in the SGSTG report and elsewhere in this document.

The IBTSWG **recommended** that some overlap be established between the Portuguese Groundfish Survey and either the Spanish North Coast Survey or the Spanish Gulf of Cadiz Survey (or both) as to generate a dataset for ongoing or future calibration work.

The regional coordinator for the Western and Southern Area will undertake to archive the data resulting from any intercalibration work in a centralised access database. The data forwarded should include the exact shoot and haul positions, date and time, net geometry readings, species abundance and length frequencies, as well as a description of the gear and contact for further details. A copy of the Marine Institute's Survey database model will be circulated as a starting point for discussion of an appropriate data warehouse.

4.3.2 Survey design

As mentioned above two Q4 surveys were introduced into the Western Area this year. The CEFAS survey essentially followed a 2 station per ICES rectangle survey design (see below).

In addition, Ireland reviewed historical survey data from earlier IBTS surveys using cluster analysis and moved towards a depth stratification for the new IGFS Survey, as agreed at the 2003 IBTS meeting in Lorient.

Following up on a working document presented to IBTS in 2003 a detailed bathymetry data set was acquired for the Porcupine Bank region from the Geological Survey of Ireland and the IEO re-stratified this years Porcupine Survey (discussed below).

4.3.3 Combined indices

The desirability of combined indices was highlighted at last years meeting and it was agreed to move towards an EVHOE type depth stratification and endeavour to intercalibrate the new surveys, in particular where there is overlap of three surveys in the Celtic Sea, in pursuit of this.

At present not enough information on conversion factors between surveys is available to undertake the estimation of combined indices. Identified surveys that need to intercalibrate with second gears are those performed by CEFAS with the new RV "CEFAS Endeavour", and the Porcupine survey carried out by IEO. Some data are available for Irish surveys carried out on board the RV "Celtic Voyager", comparing gear performance with RV "Thalassa", but additional intercalibration is still needed to obtain comprehensive comparisons.. Indications from the earlier IPROSTS project are that statistical inferences could be made about differences in gear/survey selectivity with a dataset of a minimum of 15–20 comparative tows for each given species of interest over all the relevant length classes, using the techniques described therein. It should be possible therefore, with one or two days parallel fishing annually, to produce a dataset for intercalibration of these new surveys within 3–5 years, at which point these surveys will start to become important as time series in their own right.

Table 4.3.1. Western and Southern Area IBTS surveys completed in 2003.

Survey	Code	Starting	Ending	No. valid hauls	Intercal*
UK-Scotland Rockall	-	30th Aug	12th Sep	60	-
UK-Scotland Western Survey - (autumn)	SCOGFS03	12th Nov	4th Dec	80	-
UK-Scotland Western Survey – (spring)	-	28th Feb	24th Mar	74	-
UK-Northern Ireland	NIRGFS03	NA	NA	-	-
Ireland – Groundfish Survey	IGFS03	20th Oct	2nd Dec	159	-
UK-England and Wales	CEFAS03	3rd Nov	4th Dec	61	FR
France – EVHOE	EVHOE03	18th Oct	1st Dec		UK
France – Western Channel	CGFS03	1st Oct	1st Nov	98	-
Spain – Porcupine	PO3	4th Sep	4th Oct	80	ES
Spain north coast	SPGFS03	24th Sep	27th Oct	120	-
Spain Gulf of Cadiz (autumn)	SPGFP	2nd Nov	14th Nov	41	-
Spain Gulf of Cadiz (spring)	SPGFP	-	-	-	-
Portugal	PGFS03	6th Oct	9th Nov	80	NA

Table 4.3.2. Schedule of Western and Southern Area surveys for 2004.

Survey	Code	Starting	Ending	No. valid hauls	Intercal*
UK-Scotland Rockall	-	25th Aug	7th Sep		
UK-Scotland Western Survey	SCOGFS04	11th Nov	3rd Dec		IRL
UK-Scotland Western Survey – (spring)	-	28th Feb	24th Mar	74	-
UK-Northern Ireland	NIRGFS04	NA	NA	-	-
Ireland – Groundfish Survey	IGFS04	7th Oct	19th Nov	170	SCO
UK-England and Wales	CEFAS04	9th Nov	9th Dec	70	FR, IR, SCO
France	EVHOE04	28th Oct	11th Dec		
France – Western Channel	CGFS04	Oct	Nov	98	-
Spain – Porcupine	PO4	1st Sep	2nd Oct	80	-
Spain north coast	SPGFS04	15th Sep	20th Oct	120	-
Spain Gulf of Cadiz (autumn)	SPGFP04	28th Oct	11th Nov	41	-
Spain Gulf of Cadiz (spring)	SPGFP	4th Mar	14th Mar		-
Portugal	PGFS04	1st Oct	31st Oct	97	-

* 'Intercal' here denotes the intention to carry out parallel or same tow position fishing for intercalibration purposes.

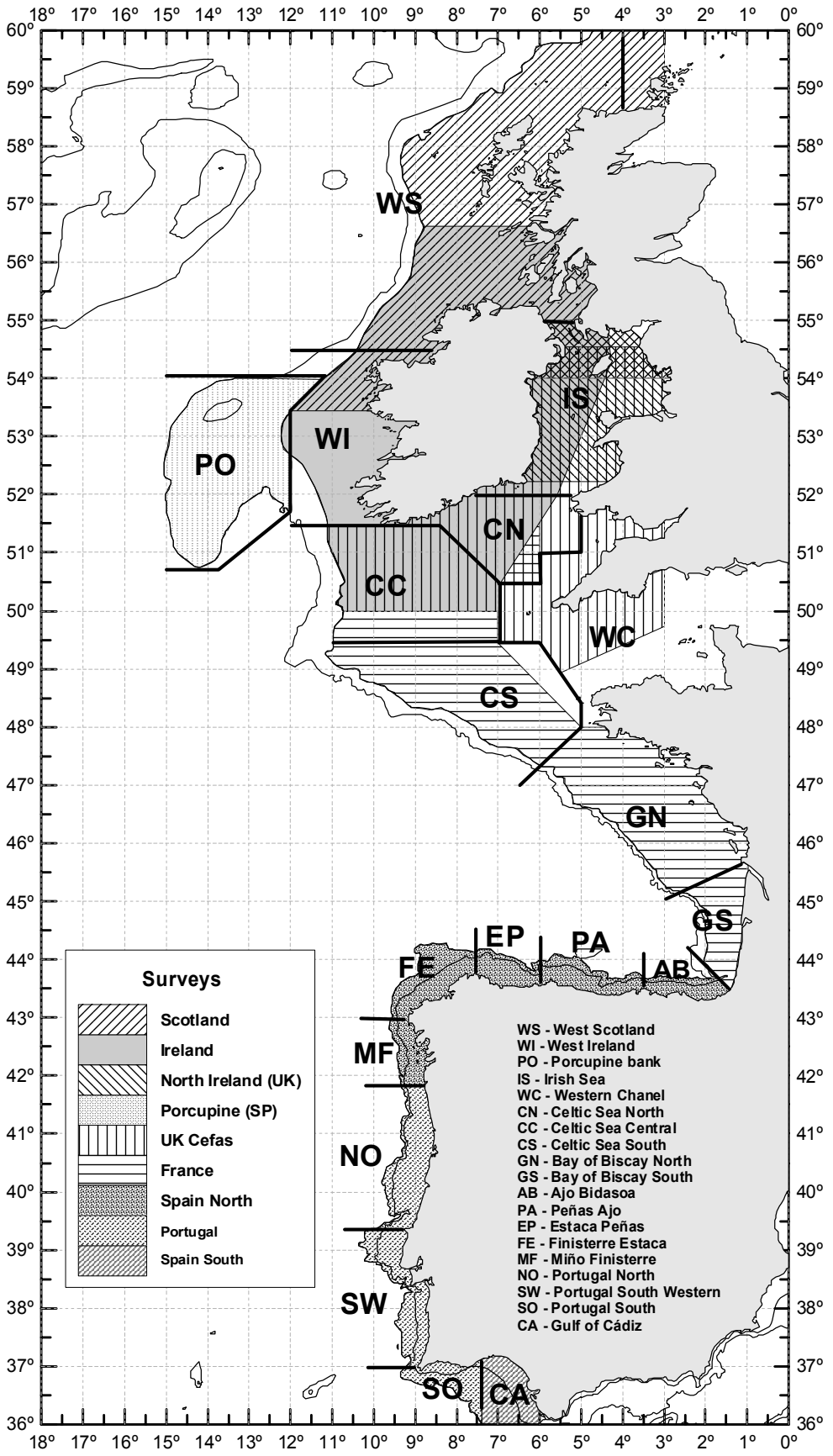


Figure 4.3.1. Map of Western and Southern Area Autumn Surveys undertaken in 2003.

4.3.4 ½ hr vs. 1hr tow in Portuguese surveys

The Portuguese groundfish survey in the 4th quarter (October/November) had a 60 minute tow duration from 1990 to 2001. Along these years, the ship time available for this survey has been progressively reduced, which caused a reduction in the number of tows carried out in each cruise. In 1990 a total of 35 fishing days were available providing 123 valid hauls, while in 2001 only 14 fishing days could be used due to bad weather and consequently only 58 valid hauls were performed.

Given the need for an adequate spatial cover of the Portuguese continental shelf and slope, it was decided that a reduction of towing time from 60 to 30 minutes would help to increase the number of tows carried out in the limited time attributed to the survey. A previous study (Cardador, 1983) indicate that a reduction of tow duration from 60 to 30 minutes would result in an increase from 4 to 6 hauls per day. The tow reduction could cause changes both in the catch-per-unit-effort (CPUE) as in the length distributions of the catches. This latter possibility seemed important to take into account, since this survey is used to provide age-structured CPUEs for the assessment of several species, particularly hake and horse mackerel.

Therefore, an experimental survey was conducted in the south and southwest Portuguese coasts in July 2002. In this experiment, two parallel tows were carried out at each of 18 stations, one of 30 minutes duration and another of 60 minutes. The CPUE in number/hour and the length distributions of blue whiting, hake and horse mackerel were analysed statistically.

The results obtained show that there are no significant differences in CPUE between different duration tows for hake and horse mackerel, but for blue whiting significant differences were found, hence an appropriate conversion factor would be needed. Both the mean length and the length distribution analyses showed significant effects for blue whiting and horse mackerel due to different tow durations. These effects could be associated with the schooling behaviour of those species (Figure 4.3.4.1).

From this work it was concluded that a change in tow duration may lead to an interruption of the current CPUE series for blue whiting, horse mackerel, and probably also for other species with similar behaviour. The number or calibration hauls may be insufficient to assess the effect of tow duration on the relative length composition of the catches. Therefore the Working Group **recommends** carrying additional parallel tows of 1 hour versus ½ hour duration during the Portugese Groundfish Survey, noting that this will require additional ship time.

An experiment was carried out in 1996 (Ehrich 1997 WD) and the statistical comparison of the catch data series based on hauls of 30 and 60 minutes, using the nonparametric U-Test, does not result in significant differences between both haul series.

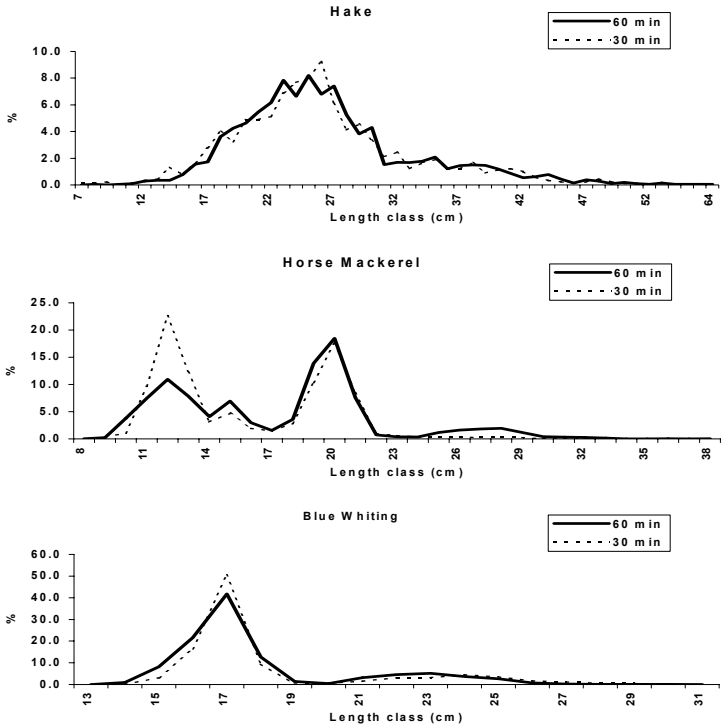


Figure 4.3.4.1. Length distributions for hake, horse mackerel and blue whiting in ½ and 1 hour tow in Portuguese Summer 2002 experiment.

Figure 4.3.4.1 shows that for horse mackerel the 60 minutes tow caught higher proportion of larger fish. The main objective of the autumn surveys is to estimate the recruitment indices and horse mackerel at age range 0–5 correspond to more than 90% of the catch of those surveys. Therefore, since 2002, for the autumn surveys it was decided to adopt the 30 minutes tow.

4.3.5 Survey overviews

UK - Scotland

West of Scotland and Irish Sea
28 February - 24 March 2003
Ken Coull and Craig Davis (Cruise Leaders)
Total of 74 survey stations (including 11 additional stations) completed. A further 30 stations for biological sampling and tagging of cod were carried out in several locations.
CTD used at each station to collect temperature and salinity profiles.

Western Division Survey
12 Nov - 4 Dec 2003
A P Robb (Cruise Leader)
Total of 80 valid hauls within the survey area completed successfully.
CTD deployed at each station to obtain temperature and salinity profiles.
At 21 trawl stations, sampling for Benthic studies were also carried out. At each station, the sampling consisted of;
1 * 2m Beam Trawl tow
5 * 0.1m2 van Veen grab
Acoustic data was logged continuously throughout cruise.

Rockall Survey
Q3 2003
Rockall Bank
30 August - 12 September 2003
K Peach (Cruise Leader)
Total of 60 hauls completed covering 42 standard trawl stations. Of the 18 repeated stations, 6 were within the International Conservation Area and the remaining 12 were randomly chosen from the rest of the survey area.

France

EVHOE Survey
The EVHOE survey was conducted from the 18th of October to the 1st of December 2003 in the Bay of Biscay and the Celtic Sea.
148 valid hauls were completed on randomly chosen stations from a databank of valid tows.

French Groundfish Survey in the Eastern Channel (CGFS)
In 2003, the CGFS survey was conducted between the 1st of October and the 1st of November. A total of 98 hauls (96 valid hauls) were done during this period.

Since 1988, the Channel Ground Fish Survey (CGFS) has been carried out every year in October on the Research Vessel GWEN DREZ. The objective of this survey is to estimate the recruitment and the abundance per age group of the main commercial fish species.

The Eastern Channel and the southern part of the North Sea (divisions VIId and IVc4) were divided in rectangles of 15' of latitude and 15' of longitude. In each rectangle, the same hauls (2 in coastal waters and 1 offshore) are fished each year. The haul duration is 30 minutes, and fishing methods are standardized (towing speed, warp length). The fishing gear used is a GOV 19,70 / 25,90 m with a double codend of 20 mm mesh size (stretched). At each station, all fish species are sorted, weighed, measured and otoliths or scales of the main commercial species are collected (whiting, cod, pout, red gurnard, plaice, black bream).

Spain

Spain carried out three surveys during 2003, one in the western area covering the Porcupine bank; and two along the Spanish coast covering Galicia, the Cantabrian Sea and the Gulf of Cádiz areas. The standard baca 36/40 was used in Spanish waters while the Porcupine baca (40/52) was used in the Porcupine area. No detailed pre-survey checklist for preparation of the gears is used at the moment for Spanish surveys due to the limited time availability although a general revision of gear condition is done before the survey. The implementation of these checklists is deemed desirable, but how to obtain the required time and personnel to perform the revision and fill up the checklists still has to be considered. Scanmar monitoring of the gear was used only in Porcupine survey, but not for the North of Spain survey due to the lack of available sensors. The monitoring of the gear is meant to be included as a standard procedure in the Gulf of Cádiz survey from this year.

Porcupine survey stratification was changed according to the results of the analyses presented to the IBTSWG in 2003, final stratification adopted includes the same number of strata as the previous one, but geographical stratification was latitudinal with a Northern and a Southern strata. Depth stratification changed to areas shallower than 300 m, 301–450 m and 451–800 m. All abundance indices from the first two surveys have been re-estimated with the new stratification presenting small differences regarding abundance. One of the main advantages of the new design is that it fits better the distribution of the trawl fish assemblages and at the same time increases the area of the shallower strata which in the previous stratification was a small area with only two hauls.

A total of 241 valid hauls were performed, 80 in Porcupine bank, 120 in the North of Spain, 8 of them covering the shallow and deep waters not included in the standard sampling area (less than 70 m and deeper than 500 m); and 41 in the Gulf of Cadiz area. Hauls in Porcupine and North of Spain area lasted 30 minutes, and Gulf of Cadiz ones lasted 1 hour. CTD casts were carried out in all the surveys (121 in the North of Spain, 78 in Porcupine and 23 in the Gulf of Cádiz).

As in previous surveys abundance and biomass indices have been estimated for the main commercial species in each area. These indices are estimated per age group for hake in all the surveys, for megrim and monkfish (black and white) in Porcupine and Northern Spain, and also for four-spotted megrim, horse mackerel, mackerel and blue whiting in the latter one.

During the Northern Spanish Survey in the Galician area an additional sampling with a beam trawl (3.45/6 m) was performed to assess the impact of the Prestige oil spill on the benthic species and estimate the amount of oil deposited on the soft grounds on the Galician shelf. The sampling design for this gear was based on 5 transects distributed along the coast. The information collected will be compared with other surveys carried out due to the oil spill in December, January and March. This beam trawl sampling scheme will continue in this survey for 2004 and depending on the results also for 2005.

Portugal

Portugal presented a working document (Chaves and Cardador, 2004 in Appendix IV) about Portuguese groundfish surveys in 1999–2003. This work has been presented due to the change from 60 minutes to 30 minutes in tow duration in 2002. Abundance (number per hour) and biomass indices (kg per hour) were presented for the main commercial species. The high abundance indices in the lowest coverage survey (2001) raised the need to re-compute the indices for the whole series based on 2001 stations coverage to find if the tendency is not masked by the change in tow duration. The new computations were performed and it was concluded that the trend is real once the indices kept the same tendency. The mean length analysis for these species showed no particular pattern for blue whiting and hake but a slight decreasing trend for horse mackerel.

In 2003 only the autumn groundfish survey was carried out, covering Division IXa in Portuguese continental waters. The RV "Capricornio" with a bottom trawl gear type FGAV019 with no roller on the groundrope was used. The area sampled extends from 41º 50' N to 36º 41' N and from 20 to 750 meters depth. The sampling strategy is unchanged from previous years except for the tow duration that was of 30 minutes. Fishing operations were carried out during daylight. A total of 80 valid fishing stations with 136 CTD sampling stations were performed during 21 fishing days. The SCANMAR equipment was used in some fishing stations with headline, wings and speed sensors. The mean vertical opening of the net obtained was 2.2 m, the mean horizontal openings between wings was 25.3 m and the mean towing speed was 3.5 knots.

Once the catch was onboard it was sorted by species, counted and weighed. All fish, commercial cephalopods and crustacean species were measured. Biological parameters (length, weight, status of maturity among others) and hard structures (otoliths and illicia) are collected. The catch was composed of 112 different fish species, 40 crustacean species and 18 cephalopod species. The most abundant species was blue whiting (*Micromessistus poutassou*), followed by snipefish (*Macroramphosus* spp.) which distributes over the whole sampled area.

Abundance and biomass indices are decreasing for almost all commercial species except anglerfish and megrims due to the change in the gear which is better for catching benthic species and also horse mackerel and Norway lobster.

Ireland

On 20 October 2003, a revised Irish Groundfish Survey (IGFS) commenced aboard the recently commissioned RV "Celtic Explorer". The new survey supersedes those carried out previously on an annual basis in the Irish Sea and Celtic Sea aboard the RV "Celtic Voyager" since 1997, as well as those undertaken on commercial vessels around the west and south-west coasts since 1990.

The new vessel is 65 m in length and has a total capacity of approximately 4,000Kw of propulsion. Stratification of the survey has moved from a fixed, approximately 2 stations per statistical rectangle design, to a quasi-random depth stratified design which was agreed on at the 2003 IBTS meeting. Extent of the survey is from 50°N to 56.5 °N, and includes VIIa and VIIg in the east out to the 200 m contour in the west.

Sampling gear is the standard GOV 36/47 demersal trawl and protocols are per the IBTS manual, although the Exocet kite is omitted. The survey grid comprises approximately 170 stations in any given year carried out over a six-week period. Ground gear is IBTS standard Type - A rubber disks with the exception of ICES Division VIa where the majority of stations are carried out using Type - C rockhopper gear.

Cluster analysis was carried out on the historical groundfish survey data sets (WCGFS and ISCGS) for the years 1997–2002 to evaluate appropriate depth stratification of the new survey. An agglomerative hierarchical analysis was performed using Manhattan distances. The results indicated that there was a clustering in catches above and below the 70m contour. The final strata decided upon were between 15 m – 70m and 71 m – 200 m. This was further divided east and west Irish Sea and finally also by ICES division.

Multibeam data was gathered during the IGFS03 to add new clean tow areas (22 in total) as well as investigate the potential for mapping herring spawning beds and other fisheries habitats during non fishing hours. These two activities will be continued during IGFS04.

UK - England and Wales

RV "CEFAS Endeavour" undertook the Quarter 4 survey in the south-west from 3 November to 4 December 2003, using a modified GOV trawl. A total of 61 valid tows were made, and 12 additional tows also made (two with the modified GOV and 10 with a Portuguese High Headline Trawl (PHHT).

For the 2003 survey, following flume tank trials (see Section 5.1), the GOV was modified substantially. These modifications were described in ICES (2004) and followed suggestions made by SGSTG (2003). **It was considered that the modifications made were major and, therefore, that the data were not directly comparable with those data collected by the surveys using other GOV gears.** Field trials to examine the modified gear are required, and comparative fishing to compare and/or intercalibrate the modified GOV and the standard GOV is of high priority. In the absence of intercalibration studies, the data collected with this gear cannot be integrated with those data collected by other nations using GOV trawls, therefore restricting standardised data collection in this internationally-coordinated survey. Issues regarding standardisation for gears in the western and southern areas are further discussed in Section 5.

4.4 Exchange of trawl positions

On board most vessels a list of clear tow positions is used when fishing positions are decided. Although the exchange of this information was not given a high priority during recent years, participants are strongly encouraged to send this information to Trevor Boon (CEFAS) who will then make the overview available to all participants.

5 REVIEW OF THE SGSTG REPORT AND THE OUTPUT OF THE SURVEYTRAWL PROJECT (TOR B AND C)

5.1 Revision of modifications of candidate gears

In 2004 the Study Group on Survey Trawl Gear for the IBTS Western and Southern Areas made a review of the tests performed during this year on the proposed modifications to the candidate standard gears identified in 2003, namely the GOV and the Porcupine baca.

Regarding the GOV, the FRS performed at sea trials with and without the Exocet kite, replacing it with several configurations of additional floatation, the conclusions of these trials is that the Exocet kite is very effective at providing hydrodynamic lift to the headline and wings of the GOV without compromising net efficiency. Its replacement with extra flotation can cause ground gear contact to reduce and therefore affect catchability. FRS also carried out some different trials to compare the performance of short and long sweeps, but even if it was clear that this factor may influence the herding effect of the sweeps given the changes in the angle of the bridles, not enough information on catch data was gathered to draw any definitive conclusion regarding selection.

CEFAS also tested in the Hull flume tank with a scale model of the GOV some modifications with a view to establishing a robust GOV that could be fished on coarse grounds. The main modifications tested were:

a) the middle bridle was removed to avoid slacks in the forward-lower panels;
b) the bosom section of the GOV used was reduced from 5 m to 3 m with a similar purpose;
c) the ground gear was replaced with a rock-hopper set composed of nine sections with different combinations of rock hoppers and spacers;
d) the fishing line was tightened to the ground gear;
e) the headline floatation was spread evenly over the headline and extra floats used instead of the kite; and
f) tearing strips were added to selected parts of the net. Such modifications were used in the Q4 westerly survey in 2003, but direct observations of net geometry and fishing performance in the field are still required.

IEO compared the performance of the standard Porcupine baca with a modified gear from the Marine Institute, the main modifications as agreed last year were a progressive reduction of the mesh size (90 mm in anterior panels and 70 mm in posterior ones) and the replacement of the double-coat ground gear with 8.5 cm rubber discs. The results based on 9 comparison hauls performed during Porcupine Survey shown that the species composition of the haul catches did not

show important differences after the exclusion of blue whiting due to its schooling behaviour. The modified gear presented a slightly higher capture of small individuals; nevertheless these differences did not have an important effect in the overall length distribution of the species considered in these trials (several flatfishes and both large and small ground fishes). Total catches per haul were larger for the modified net in 7 of the 9 paired hauls performed, although only in 3 of them did this difference persist once the catches of most abundant schooling species. Due to the availability of only one modified net and the reduced time to perform the trials robustness in coarse grounds could not be tested.

Another problem identified was the limited towing capacity of the Portuguese vessel that would not be able to trawl either the GOV or the Porcupine baca, therefore a scaled-down model of a potential standard gear will have to be considered as the most appropriated option to solve this problem.

5.2 Proposal of commercial net manufacturers and new options (Survey trawl project)

The group also reviewed the proposals from commercial net manufacturers approached by Marlab, the conclusion was that the knowledge and technology to develop a gear matching all the needs of the IBTS North Eastern Atlantic Area surveys exists, and this task can be achieved within a relatively short period. But, since the gears are usually designed and built for fishing vessels with specific requirements, to develop this gear it would be necessary to have a collaborative study involving gear experts from the WGFTFB, cruise representatives from the IBTSWG, and commercial net manufacturers

The "Surveytrawl" accompanying measure (for 2003) was intended to provide the strategic basis and initial design for a new survey trawl, which would represent a good compromise in terms of being non-herding and non-selective, and with stable and consistent operation. The final objective was to design a new trawl with the characteristics of a beam trawl (no herding effect, stability), but with no beam. To avoid the herding effect, different rigging concepts were studied. The netting parts of the different trawls are very similar for each concept, but the riggings are very different. The designs have been tested by means of numerical simulation, using DynamiT software, to verify whether the designs represent hydrodynamically viable options. Some of the most feasible designs were also tested in flume tanks and at the sea. These results were presented both to the SGSTG and to the IBTSWG.

The results of the Surveytrawl accompanying measure led to a new Norwegian (IMR) project to deliver a new survey trawl for the Barents Sea Groundfish survey to be implemented by 2008. The gear design will be based on recent developments in the trawl manufacturing industry, but with focus on the special requirements of the survey situation (predictable, minimal or no herding; solid bottom contact/minimal escapement under the trawl; sampling a wide variety of species and size groups on a wide variety of bottom types). The design will be in compliance with requirements identified by SGSTG/IBTS and will have potential for optional configurations regarding critical elements like vertical opening and ground gear.

An international resource group consisting of gear and survey experts will aid the project team. Additionally and in order to ascertain two-way communication and a mutually favourable outcome SGSTG/IBTSWG should set up a liaison to facilitate communication with the Surveytrawl project group.

There was general agreement among the SGSTG and IBTSWG participants that the work being undertaken by the Norwegian Surveytrawl Project would make a valuable contribution to the trawl gear problems identified by the group. In recognition of this it was decided to that two members of the group (Francisco Velasco and Odd Smedstad) will liase between the Norwegian Surveytrawl Project and IBTSWG.

In addition, it was requested that given the innovative nature of the Surveytrawl Project it was important that some applied aspects should be investigated in parallel to ensure any final design would be applicable across the range of grounds and target species identified in the SGSTG report 2003. In particular the reliance of the Surveytrawl, in part, on the ground gear to spread the net might limit possible modifications to this gear to target flatfish or benthic species, or possibly work in particularly rough or soft muddy areas. Current groundgears in the western area that a new gear will have to replace range from 23 inch disks on the Type-C GOV down a simple steel cable with a double wrap of polypropelene resulting in an approximately 4 inch diameter for the baca trawls.

Many of the other questions driving discussion over various net designs and configuration revolve around the merits of herding versus non herding gears. To what degree is herding desirable to ensure sample size, as well as predictable for a given station from year to year and at what point does it become unpredictable, as in shallow water where annual weather conditions can heavily influence herding and catchability between consecutive surveys.

Another important question is, given an agreed design of trawl, what would be the lowest number of ground gear configurations required to ensure adequate sampling of the target species over all survey ranges identified by the group during it's first meeting (ICES 2003).

The available information and experience of fish behaviour scientists, research and commercial gear technologists and survey managers should be combined to address the questions posed above by the SGSTG project, and discussion at this years IBTSWG. The IBTSWG in collaboration with the WGFTFB should seek funding for appropriate applied study of these issues across the designated IBTS western and southern area so that survey managers have a number of questions answered and options available to them in the near future should any aspect of a proposed new survey trawl prove problematic.

5.3 Options to standardize the IBTS North Eastern Atlantic division gear

After considering all the previous information the Group concluded that, at the moment, there is no gear that addresses all of the criteria laid down by the group for a standard gear, but there are options of having a new survey trawl within a 3–5 year period, through the Survey trawl project and/or a parallel project to develop some additional aspects in collaboration with gear technologist and commercial manufacturers. Adopting two interim standard gears, the only feasible option in the short term, is not considered a good option by the group since it would imply breaks in time series and extensive and expensive inter-calibration experiments that should be repeated when the definitive standard gear is available.

Conversion factors between the different gears for the most important commercial species, available from SESITS (Sánchez, 1999) and IPROST (Mahé, 2001) projects, can be used to produce combined information, mainly through distribution maps for these species, until a standard gear is adopted and implemented; and more precise indices of abundance, biodiversity and regional stock indicators can be obtained. The only gear used in the IBTS North Eastern Atlantic area that has not been inter-calibrated with a second gear is the Porcupine Baca, an inter-calibration experiment with the Irish survey in Western Ireland is thus recommended.

On the other hand some standardising within the GOV trawls in rougher areas was viewed as the most appropriate option since there are problems with the performance of this gear in hard grounds, and it will also made more straightforward future inter-calibrations towards the standard gear. Two potential designs for this ground gear D were tabled at the SGSTG, future development and final decisions will be agreed and accomplished by the institutes with surveys in hard grounds areas (FRS, CEFAS, MI).

Suggestions for survey design for Multi-Vessel/Gears

Although standardisation to a single gear type was not considered appropriate at the current time, progress towards standardising survey design was viewed more favourably. Its proposed that a revision of "The IBTS Survey Manual for the North-Eastern Atlantic Area" should convert it into a manual for the work on board, covering aspects as quality control (including detailed checklists for gears at the beginning of the survey, sampling protocols on board, gear monitoring procedures). Other issues that should also be improved or implemented are common methodology for defining survey stratification, overlap areas between adjacent surveys to allow continuous inter-calibration and staff exchange between surveys.

5.4 Funding of development and implementation of the standard gear

Funding of the implementation of a new standard gear, covering both the achievement of an agreed design and the required inter-calibrations to maintain continuity in time-series, was considered a major problem. At the same time extra funding will have to be sought to finance some aspects of the standardization, as the implementation of overlap areas between surveys or quality control of gears, that will imply extra time at sea. These issues will require important expenses, however, most of the IBTS data constitute national contributions to the requirements of the EU Council Regulation 1543/2000 "Regulation for Data Collection", and standardization is considered an important issue for the quality and comparability of the data collected. DG Fisheries should therefore be motivated to finance such exercises through funding available for research related to this Council Regulation.

5.5 Recommendations from the SGSTG group

1) Development of a Standard Gear using all the previously described SGSTG criteria should be decided by the IBTSWG in consultation with WGFTFB.

2) To set up a liaison between IBTS/SGSTG and Norwegian Surveytrawl project group to exchange and update the necessary information regarding the requirements of the IBTS North Eastern Atlantic standard gear.
3) Develop a working manual for Southern and Western areas, which will include gear diagrams and descriptions covering all survey gears. All aspects of survey work should be covered including sampling protocols. This should be considered as a working manual and updated as the surveys develop.
4) Standardise the GOV sweep, kite and ground-gear usage (FRS, CEFAS, and MI).
5) Inter-calibrate the new rock-hopper ground-gear D with previously used ground-gears. Paired hauls or dedicated twin rig survey to compare net geometry and catch data would be required.
6) Carry out an inter-calibration between Western Irish Survey and Porcupine survey to complete the inter-calibrations between all the gears currently used in the area.
7) Identify current areas of survey overlap and design inter-calibration exercises to assess vessel and fishing gear variability. Possible overlap areas should also be considered for adjacent surveys without overlap at present.
8) Inter-calibration in relation to maintaining time series data will be revisited when the new candidate gear has been designed.
9) Surveys that currently are not depth and geographical stratified should investigate this issue through an analysis of the distribution of target species and the ecological communities in their area.

5.6 IBTS Working Group Conclusion

No major transformation should be undertaken on the existing gears before the conclusions of the Norwegian Surveytrawl project or any appropriate ongoing work. The development of a new survey sampling gear should be undertaken in cooperation with IBTS and WGFTFB as well take into consideration inputs from commercial gear designers. If the conclusions of the study is that major improvement in stability, robustness, efficiency in sampling the targeted species are achieved by the proposed gear, then following comprehensive field trials, this new gear will have to be adopted for all surveys coordinated by the IBTSWG. We must be aware however that if such a decision is made in the future this will induce high costs in time and funding to undertake intercalibration studies. Meanwhile the group has designated Francisco Velasco and Odd Smedstad as contact persons to follow the development of the Surveytrawl II or any other appropriate ongoing project.

6 DATABASE TRAWL SURVEY (DATRAS)(TOR D)

6.1 Database development

The aim of this project is to create one comprehensive database with the major international bottom trawl surveys in ICES waters. The database will contain data from four surveys covering the Baltic Sea, Skagerrak, Kattegat, North Sea, Channel, Celtic Sea, Irish Sea, Bay of Biscay and the eastern Atlantic from the Shetlands to Gibraltar over a period of up to 35 years. The project started on December 1st 2001 and finished April 1st 2004 and was funded by the European Community Fifth Framework Programme (QLRT-2001–00025).

The project involves a review and description of the surveys and allows submission of bottom trawl survey data and access to these data through the web (http://www.ices.dk/datacentre/datras/datras.asp).

6.2 ICES Policy on Access to DATRAS

The protocol on access to the DATRAS database that was presented in last year's report was discussed and some minor alterations were suggested.

To structure data access, three IBTS survey/area combinations were distinguished, the countries participating in these combinations and whether data were submitted to the database (table).

Country	North Sea	Western[1]	Southern	Data in database
Denmark	X			X
England	X	X		X
France	X	X	X	X
Germany	X			X
Ireland		X		
Netherlands	X			X

Country	North Sea	Western[1]	Southern	Data in database
Norway	X			X
Portugal			X	
Scotland	X	X		X
Spain		X	X	
Sweden	X			X

Notes:

[1]This does not include the porcupine survey due to the Spanish data regulation.

Within each of these survey/area combinations there was agreement on the data access policy. This is exemplified in the table below, which distinguishes three user categories:

1) Public and other parties that request data, typically for research purposes.
2) ICES working groups
3) Institutes that have supplied data to the database.

and three data types:

1) Standard maps and graphs: Per survey/area combination for all relevant ages of species for which assessments are conducted. Maps will show bubble plots indicating abundance per ICES rectangle or per haul. Time series of the indices and a graph showing the proportion of the age-groups will be generated.
2) Aggregated data. A query of the database using pivot tables. Based on these tables, plots and graphs can be made on an interactive basis. The minimum level of aggregation differs between survey/area combinations.
   - ICES rectangle: IBTS in the North Sea, Skagerrak, Kattegat and the BTS in the North Sea, Channel and Irish Sea
   - Stratum: IBTS western and southern divisions
   - Sub-division and stratum: BITS Baltic Sea
3) Un-aggregated (raw) data. These are catch (numbers at length and/or numbers at age) data on a haul-by-haul basis and SMALK (Sex, Maturity, Age-Length-Keys) data per individual.

Data access per "User category" and per "Data type" can be organized according to the following matrix. F is the abbreviation for "free access", P for "password protected access" and R for "access to extracted data after granted request".

Data type	User categories		
	ICES WG[1]	Data supplier[2]	Public and other parties
Standard maps and graphs	F	F	F
Aggregated data	P	P	P/R[3]
Non-aggregated (raw) data	R	P	R[4]

Notes:

[1]ICES WGs will have access to data from only those survey/area combinations that are relevant for their recommendations and as such should be specified in those recommendations.

[2]Data suppliers will only have access to data of those survey/area combinations to which the institute has provided data.

[3]Per survey/area combination the members can decide whether individuals will have free access to aggregated data or only after request. If a request is granted, an extraction of the data will be made available.

[4]Access can be requested and if granted, an extraction of the data will be made available.

All data (aggregated or non-aggregated) are protected by passwords. Each institute delivering data to the database can suggest a username and password to ICES which will give them access to the data in those survey/area combinations they are (for a sufficiently long period) part of. ICES Working Groups will have a password that allows them access to aggregated data, raw data will be issued to the Chair of the WG after request. Other parties can request access to the (both aggregated or non-aggregated) data through the ICES website. A standard form must be filled in to inform the institutes involved in the survey(s) on:

- Who is requesting data, including partners in the research project
- The purpose of the data request
- Which data (at what aggregation level) are requested
- Confirmation that the ICES rules for acknowledging the data source will be observed

Completing the form will result in a request to the relevant survey contact person of each institute involved with that survey/area combination and this person will be requested to reply to ICES within 14 days. If a contact person does not reply within this time limit, it will be taken as acceptance of the request for data access. When after 14 days no relevant data supplier has objected, ICES will extract the requested data from the database and make them available.

As only France has submitted data for the southern division the above agreement has no consequences yet for this division. If more countries in this survey/area combination submit data a comparable agreement on data access may be drafted.

6.3 Health Warning attached to data extracted from the database

Following the recommendation of the IBTSWG in 2003 a "health warning" will be attached to data extracted from the data base. The text is given below:

'Health' Warning

Whilst the data have been extensively checked by both the supplying institutes and ICES there are inherent flaws in gathering the information. For example:

- The surveys are structured by quarter and the data can only be analysed on a quarterly basis.
- In the early years of the surveys participants may not have gathered information on all species caught. Thus an incomplete picture may be provided for the abundance and spatial location for non-commercial species over a long time series. Members of IBTS recommend that analysis of trends in abundance etc. should only commence for the time series starting in 1980 for countries that have reported "all species caught" (former species recording code 11).
- There is no guarantee that the gears deployed adequately sample all species e.g., currently there are concerns over the accurate sampling of flatfish and juvenile cod by the GOV trawl.

Thus users are urged to treat the data with caution. If the user has any queries on the validity of the data or the conclusions to be drawn they should contact either the ICES Secretariat or the Chairs of the relevant Working Group (IBTS, BITS or BEAM)"

6.4 Special requests for data access

ICES was contacted by FishBase with a request to get access to length frequency data from the IBTS survey. After consulting the WGIBTS Chair ICES informed them that this would be against the IBTS data regulation rules and they would have to put their request forward to delegates if they want to overrule these regulations.

The request was then presented to the Working Group by the Chair and ICES and it was decided that FishBase only can have access to data in the public domain by a link from FishBase to the DATRAS public domain. This should inform the FishBase users about the existence of and information content of the survey data and the procedure to request data through the official channels.

The following points were made to support the decision:

- If the DATRAS database is opened for FishBase there is a risk that it will interfere with the willingness of parties to submit data to the ICES database which is against the interest of the WG members. At present there is enough difficulty to agree on data access even within WG members.
- The IBTS data are sensitive and data therefore need to be treated correctly and not misinterpreted. This can not be guaranteed in the format FishBase currently uses. FishBase is developed for point data and used for biodiversity studies while the surveys are designed for calculating abundances by quarter and are based on statistical

rectangles. This means that data have to be treated differently than other data in FishBase and this is not supported by FishBase.

7 REVISION OF THE IBTS NORTHSEA MANUAL (TOR E)

It was suggested at the 2003 IBTS meeting in Lorient that the North Sea IBTS survey manual needed some updating. New IBTS delegates from various countries had found that the manual was missing some key information, without which they had experienced minor problems whilst carrying out surveys in their particular area. The revised manual will be completed during the next few months, after consultation with all representatives, and the revised version will be implemented for the 2004 quarter 3 survey.

The following changes were agreed:

It was decided that there should be a concise history of the IBTS survey included, summarising Heessen (1997). As the current gear and survey design and protocol for the IBTS has gradually evolved over many years, text on the reasons for changes will also be included.

Also within this Section, the current primary objectives are clearly stated

As haul duration was reduced from one hour to 30 minutes, a brief description for the reasons for this will be included.

In recent years the quality control of various aspects of the surveys has come into question, ranging from questions regarding species identification (Daan, 2001) to criticism from the fishing industry regarding gear and survey design. In order to satisfy some of these fears quality control checks are carried out on the survey gears. The recommended check sheets have now been included in the manual to facilitate this checking procedure.

Some institutes use a ground gear other than ground gear 'A', although the current manual does not include description for ground gear B. The new manual will have detailed descriptive diagrams for both groundgears.

As all institutes use instrumentation to record gear geometry, a summary of these has also been added.

As it is recommended that trawling only occurs in daylight hours a more explicit description of this will be added to the manual, including details of an algorithm that is currently used to provide times of sunrise and sunset.

The earlier section on catch sampling was very brief and this section has now been expanded to describe sub-sampling and catch categorisation. The ICES Working Group on Elasmobranch Fishes recently requested that all surveys record elasmobranch fishes by sex (ICES, 2003), so this recommendation will be in the revised manual. More details about how fish and shellfish are measured will be added.

The section on the MIK sampling will be sent to Peter Munk, and he will be requested to add any necessary clarifications. The Netherlands and France reported that it was not possible for them to undertake the more extensive sampling requested in the Southern Bight area, and the text has been edited to allow for this.

The section dealing with the ICES exchange of data format will be completely revised, as the DATRAS project has provided ICES with a new database for holding and manipulating IBTS data.

Many of the appendices will be removed, as they pertained to now obsolete protocols, however new ones have been included: the new GOV survey gear quality control check sheets and new maps showing distribution of survey stations and the allocation of these to the various countries involved, for the first and third quarters. Historical maps that are not archived elsewhere and are required for the interpretation of archived data will be retained.

8 REVIEW OF PROTOCOLS AND STANDARDISATION OF SAMPLING TOOLS AND SURVEY GEARS (TOR F)

8.1 North Sea GOV specifications

A summary of the current detailed specifications of all the different GOV gears actually in use by the different countries for the North Sea surveys was presented (Appendix II). It appeared that there have been changes made from the specifications found in the manual by almost all countries ranging from type and strength of twine to ground gear

modifications. Although it cannot be concluded that most of the changes are minor (e.g., slight increase in twine diameter) and would not affect the overall performance and catchability of the gear, the WG **recommends** that this should be investigated. A first step could be that these changes be investigated by mean of numerical simulation. It was also **recommended** to conduct a review the GOV specifications with respect to the actual material available for construction.

8.2 Comparison of GOV Ground Gears

As part of the MAFCON project, FRS, Aberdeen carried out a limited pilot study during the quarter 3 IBTS survey of 2003 to compare the catch of the GOV using ground gear A and ground gear B. During this survey it is traditional to fish with ground gear B for stations north of 57 30'N and with ground gear A for stations south of 57 30'N. Due to the limited survey time available for this study it was agreed that 10 stations in the region of the boundary where the ground gear was routinely changed should be sampled. The initial results from analysing the data are presented in a working document (Appendix IV). It is intended that further work will be carried out over the next two years in the hope that sufficient data can be gathered to produce a meaningful report. An update of the progress made in this area will be presented at IBTS meeting in 2005 for consideration.

8.3 Review of Institutional Checking Lists

Denmark

The IBTS surveys in Denmark are carried out according to the present IBTS Manual. No gear check or other standard protocols has yet been implemented. The gear parameters is at least checked once a year.

France

A well established protocol has not been implemented yet for checking the gear specifications in details before the start of a survey. A quality control procedure will be developed in IFREMER and will cover all gear for all surveys on an annual basis. The gear parameters are continuously monitored during the IBTS North Sea and EVHOE surveys by mean of Scanmar equipment.

Germany

In general on board of our research vessels the gear officer is responsible for the correctness of the nets and the ground gears. During the shooting process of the first haul of an IBTS survey the characteristics of the GOV rigging are measured by the cruise leader and the gear officer following page 1 (overall rigging) of the protocol given in the report of 2003. The overall net dimensions (length, number and size of the meshes) and the lengths and weights of the ground gear are only checked once by the officer when the net or the ground gear are delivered by the net factory.

The GOV net and its rigging recently in use was measured very carefully and described in detail by a gear technologist in 2003. So it can be directly compared to the GOV standards to find out possible deviations.

Ireland

There is currently no ongoing standard procedure for checking the trawls prior to commencement of the survey. The GOV nets for the earlier ISCGS survey were measured in detail in 2002 and checked in relation to the IBTS manual. The nets for the new IGFS survey were constructed last year and the net manufacturer was instructed to fill in the exact measurements for each net into the checklists given in last years report (ICES CM 2003/D:05, Appendix IV). Due to difficulties in manufacture the nets will have to be rebuilt this year and will be thoroughly checked again by our own gear technologist. Tags have been commissioned for the nets and a record will now be kept for each net. A protocol is being drawn up for this new survey so that a log of damage and major work can be maintained on a net specific basis. The nets will be checked for damage and wear and major measurement such as bridle and sweep lengths will, and have recently been, checked and recorded prior to each survey, but staffing is unlikely to permit a complete review of all measurements on an annual basis.

On a haul by haul basis any damage is reviewed by the chief scientist and gear technologist in relation to its impact on the validity of the haul. From this year any significant damage or wear requiring the replacement of part or whole sections of panel, ropes, bridles etc. will be recorded for each net. A summary deck sheet will also be implemented this year similar to that proposed in the SGSTG report (ICES CM 2004/B:01 ref G), which records general gear damage and behaviour on a haul by haul basis.

Net geometry is monitored by Scanmar sensors and consists of headline height, ground contact, door spread and wing spread. Currently we are using a Trawleye positioned over the footrope to give ground contact and a trawlsounder on the headline to give headline height. The data is logged using the Pescawin software developed by Francisco Sanchez of the IEO, previously presented to the IBTSWG.

Netherlands

In the Netherlands, the GOV-trawl is checked using the checklist as published in last years WG report, before the start of he survey, to find out if the gear is in agreement with the manual. As yet, there is no formal procedure in which the outcome of the checking procedure is documented.

Norway

In Norway, the GOV-trawl is checked using the checklist as published in last years WG report, before the start of the survey, to find out if the gear is in agreement with the manual.

Portugal

There is no detailed checklist of the gears used in the Portuguese surveys. Scanmar monitoring system has been used in 2003 and is planned to be used regularly in the following years. During the surveys a protocol for catch processing and sampling is used as defined in the SESITS project.

Spain

As stated in Section 4.3.4, no detailed checklist of the gears is used at the moment for Spanish surveys due to the limited time availability although a general revision of gear condition is done before the survey. The implementation of these checklists is deemed desirable, but how to obtain the required time and personnel to perform the revision and fill up the checklists still has to be considered. Scanmar monitoring system has been used regularly in North Spain survey between 1995 and 2001, in the last two years this monitoring was not performed due to the unavailability of sensors, problem solved at the end of 2003. In Porcupine survey gear monitoring was used in 2001 (Simrad ITI) and 2003 (Scanmar), while in 2002 survey it was impossible to obtain any data due to problems in the ITI equipment. In the Gulf of Cadiz surveys gear monitoring has not been implemented up to now; but is meant to be implemented as a standard protocol in next surveys.

Sweden

Since 2003 IMR-SE, has implemented a procedure to ensure that the quality of work carried out during IBTS surveys. Before the Q1 survey it is checked over fully by experienced net menders to ensure that the net meet the specifications as presented in the IBTS manual. Sweeps, backstrops and groundgear are checked on a regular basis to ensure that they are in good working condition and also meet the specifications outlined in the IBTS manual (including amendments. The gear parameters are continuously monitored during the IBTS North Sea and EVHOE surveys by the use of Scanmar equipment.

UK (England)

UK (England) has had quality control of the GOV gear in place for many years. This consists of the check sheets that will be available in the revised North Sea IBTS manual. This documentation is held at the CEFAS laboratory in Lowestoft by the cruise series leader and can be made available on request.

UK (Scotland)

At FRS, Marine Laboratory a series of protocols (Appendix V) have been established to ensure that the quality of work carried out in relation to IBTS surveys is maintained at a high level. When a net is returned from a fishing survey, it is checked over fully by experienced net menders who arrange for any repairs or replacements to be carried out and ensure that this is done to meet the specifications as presented in the IBTS manual. GOV nets are identified by a unique number and details relating to each net, such as alterations, replacement of sections and checks of measurements are kept on computer records. Sweeps, backstrops and groundgear are checked on a regular basis to ensure that they are in good working condition and also meet the specifications outlined in the IBTS manual (including amendments). During the fishing survey the procedures ensuring the hauls are completed and worked up according to accepted practices are achieved by following the FRS research vessel sampling protocols which include sections on;

- Protocols for deployment of GOV on IBTS surveys
- Flow chart - GOV preparation
- Flow chart - Use of scanmar
- Protocols for catch processing
- Flow chart - catch processing
- Protocols for completion of Deck Summary Report

9 REVIEW OF THE OUTPUTS FROM THE WORKSHOP ON SAMPLING METHODOLOGY (TOR G)

This Workshop dealt only with landings and discards data. A dedicated workshop on survey sampling strategy will be held in Aberdeen in June 2004 and members of the IBTSWG will be attending this meeting. The output of this workshop will be reviewed in the next IBTSWG meeting in 2005.

10 REVIEW OF AGE/LENGTH/SEX/MATURITY DATA IN THE ICES DATABASE FROM THE LAST THREE YEARS (TOR H)

A check has been performed on the age/length/sex/maturity data from the ICES database for the years 2001, 2002 and 2003. The year 2004 has not been examined, since the dataset was still incomplete. In total, 14 records were recognized as outliers (see Table 10.1). It is suggested to remove these records from the ICES database, in consultation with the concerning countries.

For many fish, the age and/or maturity stage appeared to be unrecorded (see Table 10.2). It is known that Scotland hasn't carried out age and maturity analysis on sprat and mackerel throughout the concerning years, but the incompleteness in the data of the other species remains unexplained.

It is therefore **recommended** that an investigation into the origin of all the missing values will be performed, in order to find out whether the data about age and maturity stage really hasn't been collected, or whether a problem has occurred, for instance in the transfer of the data from the institutes to ICES.

Finally, it is **recommended** to additionally check the age/length/sex/maturity data from the ICES database by round fish area.

Table 10.1. Outliers found in the ALK, Sex, Maturity database for the years 2001, 2003. Checks performed on the data years 2001, 2002 and 2003.

year	species	number	length	age	maturity
2001	cod	2	56	30	
	cod	1	5		3
	haddock	1	42	1	
	Norway pout	1	12	4	
	saithe	1	61	3	
	sprat	1	6.5	3	
	sprat	1	10	23	
	mackerel	1	20	2	
2003	haddock	1	10		3
	herring	1	8.5	6	
	herring	1	16	4	
	herring	1	11.5		3
	whiting	1	13		3

Table 10.2. Inventory of missing data in the ALK, Sex, Maturity database for the years 2001, 2002 and 2003.

year		cod	haddock	herring	n pout	plaice	saithe	sprat	whiting	mackerel
2001	# ALK	2121	4716	5839	871	1563	374	2327	5413	332
	% no age	*0.0*	*10.8*	*0.5*	*0*	*1.0*	*0*	*0.6*	*0.0*	*21.4*
	# maturity	2121	4716	5839	871	1563	374	2327	5413	332
	% no maturity	*0.2*	*3.5*	*2.5*	*9.0*	*25.0*	*0*	*79.2*	*3.3*	*78.6*
2002	# ALK	2187	3323	6587	1015	637	677	2554	4332	363
	% no age	*0*	*0.2*	*0.2*	*0*	*4.7*	*0*	*0.4*	*0.0*	*0*
	# maturity	2187	3323	6587	1015	637	677	2554	4332	363
	% no maturity	*0.4*	*0.5*	*0.3*	*21.9*	*0.2*	*0*	*43.5*	*4.3*	*27.0*
2003	# ALK	1422	3580	5209	1004	1006	493	2261	4611	248
	% no age	*0*	*8.9*	*0.1*	*8.0*	*2.3*	*0*	*2.8*	*12.3*	*0*
	# maturity	1422	3580	5209	1004	1006	493	2261	4611	248
	% no maturity	*8.1*	*10.5*	*12.5*	*37.4*	*2.1*	*0.4*	*43.9*	*14.1*	*25.4*

11 DEPTH STRATIFICATION IN THE EASTERN ATLANTIC AND SKAGERRAK (TOR I)

11.1 Eastern Atlantic

11.1.1 Introduction

Data collected during annual autumn surveys were used to analyse the spatial organisation of species assemblages on the continental shelf and upper-slope of the Celtic sea in the period 1997–2003. The study of the multispecies spatial structures over time requires the combined analysis of different tables of species density sampled at different stations. This was done using multitable factorial analysis.

Data used for this analysis was collected during seven surveys from 1997 to 2003 and from 458 hauls carried out in the Celtic sea. A total of 107 fish species were caught but only 52 species which the mean relative frequency of occurrence was at least 5% were included in the analysis.

Automatic classification techniques were used to establish a cluster distribution of the sampling sites. Hierarchical ascending classification was applied to the factorial co-ordinates of sites in the space defined by the multitable analysis.

11.1.2 Results

The spatial distribution and species composition of the 5 different groups identified are described as follows and shown on Figure 11.2.1.

Southern Celtic shelf assemblage (cluster1)

The average depth of the 105 hauls included in this group is 155 m (minimum 120 and maximum 269 m). All of the seven typical species of this assemblage are eurytopic species, i.e., typical of groups identified at a higher level of the hierarchy.

Western Celtic shelf assemblage (cluster 2)

The average depth of the 71 hauls included in this group is 195 m (minimum 130 and maximum 334 m). From the 10 typical species of this group 4 are characteristic species, their Indval value being maximum. The other 6 are all eurytopic species.

Intermediate zone (cluster 3)

The average depth of the 129 hauls included in this group is 155 m (minimum 46 and maximum 276 m). None species characterises this group.

Northeast Celtic shelf assemblage (cluster 4)

The average depth of the 101 hauls included in this group is 118 m (minimum 86 and maximum 157 m). From the 15 typical species of this group 6 ones are characteristic species). Three species (*Chelidonichthys gurnardus, Trisopterus esmarkii, Gadus morhua*) are eurytopic while the last three ones are rather ubiquitous species, i.e., abundant over all the study area.

Central Celtic shelf assemblage (cluster 5)

The average depth of the 52 hauls included in this group is 83 m (minimum 57 and maximum 120 m). From the 6 typical species of this group only one (*Enchelyopus cimbrius*) is a characteristic species. Although *Merluccius merluccius* is an ubiquitous species, its presence as a typical species in this group is due to the existence of a nursery in the area.

11.1.3 Species assemblages and Evhoe stratification sampling scheme

Table 11.2.1 crosses the number of hauls per species assemblage and per stratum used for the Evhoe sampling scheme. It shows that southern (cluster 1), Northeast (cluster 4) and central (cluster 5) Celtic shelf assemblages fit individually with a limited number of strata. On contrary, western assemblage encompasses a large depth range (120–400 m) along the shelf edge. The transition zone is more represented between 120–160 m and slightly more in the north of the study area (Cc4).

In all of the strata, more than 50% of the hauls belongs to one cluster. For 6 out of 9 strata, more than 68% of the hauls belongs to one cluster. This provides some evidence that the current definition of the strata is relevant.

Table 11.2.1. Number of hauls per fish species assemblage and Evhoe stratum.

Stratum	Depth range (m)	Cluster					
		1	2	3	4	5	Total
Cc3	80–120			10	4	51	65
Cc4	120–160		15	57		33	105
Cc5	160–200		11	5			16
Cc6	200–400		14	1			15
Cn2	30–80				28		28
Cn3	80–120			1	20	15	36
Cs4	120–160	63	12	43		2	120
Cs5	160–200	39	8	10			57
Cs6	200–400	3	11	2			16
Total		105	71	129	52	101	458

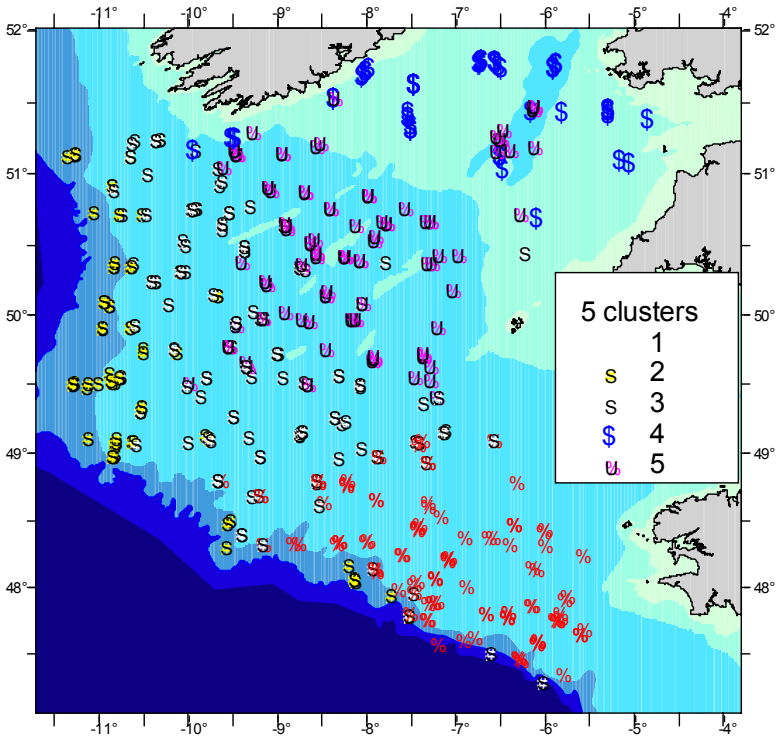


Figure 11.2.1. Distribution of the fish species assemblages in the Celtic sea based on 458 hauls sampled during autumn surveys from 1997 to 2003. Space partitions in 5 clusters were obtained by ascending hierarchical classification of the factorial scores of the hauls on the first three axes.

11.1.4 Working Group comments and recommendations

The results from this study confirms the adequacy of the current stratification used for the EVHOE survey. The actual contour of the strata are still to be put into GIS format and data from surveys covering the most northern part have to be analysed. Therefore the WG will revisit this TOR at the next meeting before agreeing on a stratification for the Celtic Sea and adjacent areas to be used for all surveys.

11.2 Skagerrak

11.2.1 Introduction

Compared to the rest of the North Sea IBTS area, the Skagerrak is much deeper and its typography is much more divers. Additionally, the spatial coverage by Sweden has not covered all the different rectangles in the area and at the same time over sampled other rectangles. The habitat characteristics and the physical environment influence the spatial distribution of demersal species and depth is often considered to be the main factor driving the fish fauna gradient changes occur. This study is a first attempt to analyse the effect of changing the sampling design. The objective of this study was first to explore how representative the present sampling design is compared to the area of different depth. Secondly, to explore what effect a depth stratified sampling design would have on the index of gadoids, and thirdly, to consider a spatially more disaggregated sampling design compared to the sampling design presently used.

11.2.2 Method

The analysis was based on the hauls made the first quarter with the standard GOV trawl between the years 1993 and 2003. To make the analysis conservative, it was focused on only gadoids which where decreasing in abundance during this period. By taking into consideration the abundance of gadoids at different depth strata and recalculating a gadoid index, I could calculate the difference between the presently used design and a new depth stratified design. The depth strata that Argos has not previously sampled (151–200 m), the biomass of gadoids were calculated as a mean biomass between 100–150 and 201–350 m. A second analysis was made with only one haul per rectangle, which of course

reduces the number of hauls dramatically (Figure 11.2.1). The area of the different depth were based on the analysis of ordinary charts and hence, only preliminary. However the analysis of area of the different will be modified and reanalysed with the new and complete depth charts.

11.2.3 Results

The preliminary analysis suggests that Argos is under-sampling depth strata 20–40 m and 151–200 m, but over-sampling depth strata 61–80 m and 101–150 m (Figure 11.2.2). By using hauls, which were according to the area of the depth strata, on average the biomass was lower compared to the index presently used (Figure 11.2.3). The variance is similar to the presently used if the number of hauls is considered.

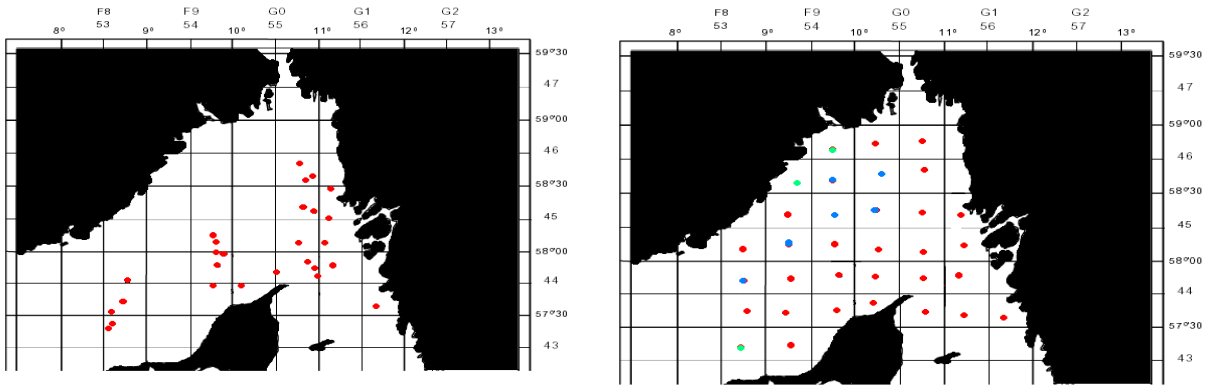


Figure 11.2.1. The average depth strata that Argos has sampled 1993–2003 (black bars) and the proportion of depth in the Skagerrak area (gray bars).

By using only one haul per rectangle the index was less consistent but generally lower at least at the end of the time series (Figure 11.2.3).

However, the variance was much higher than the variance in the presently used biomass index even if the number of hauls is considered.

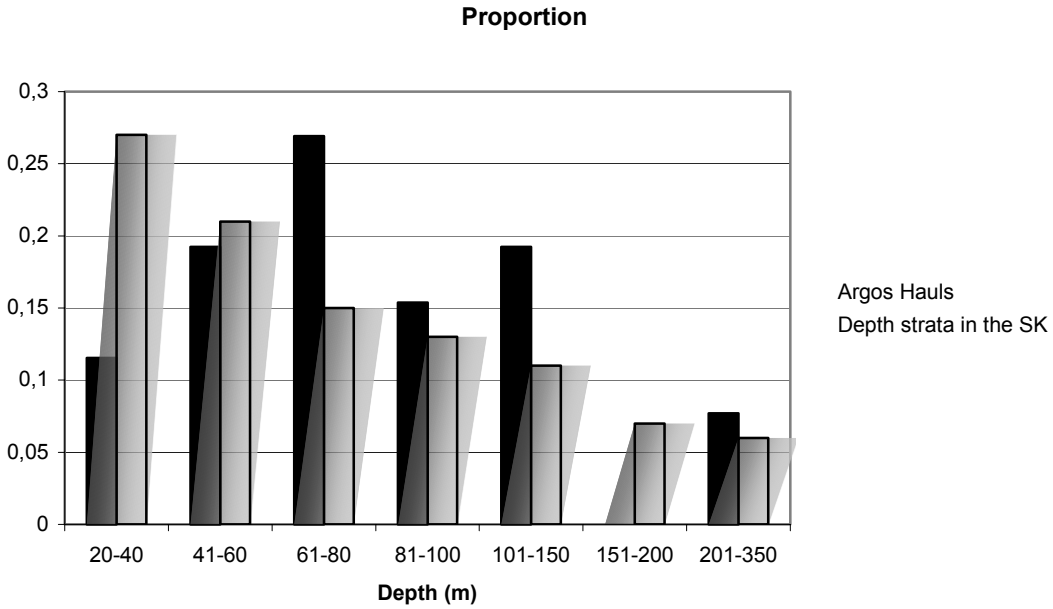


Figure 11.2.2. The average depth strata that Argos has sampled 1993–2003 (black bars) and the proportion of depth in the Skagerrak area (grey bars).

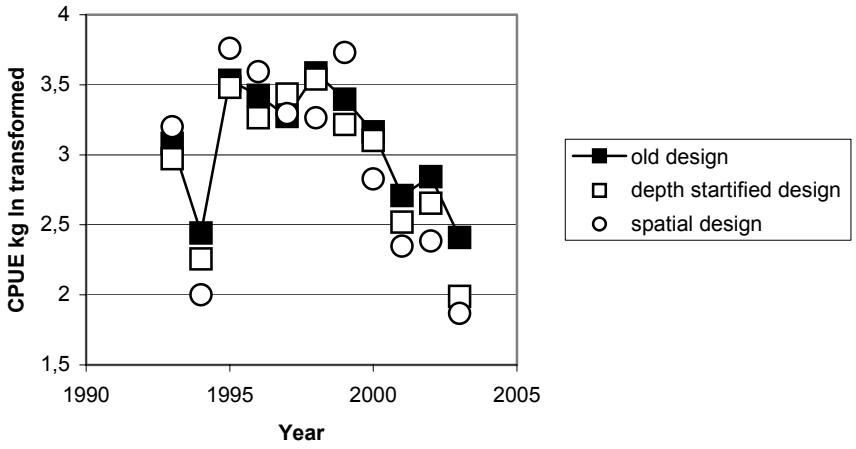


Figure 11.2.3. The CPUE indices with the old design and recalculating the index accordingly to a depth stratified sampling and a spatial design.

11.2.4 Discussion

The results suggest that changing the sampling design will affect the time series. The reason for why the index is slightly lower with a depth stratified sampling design is related to that the depth stratified sampling design include fewer hauls where we have caught more cod in the past. Just make the design depth stratified will only affect it qualitatively but changing it towards a more spatially will have a serious effect on the index and the variance.

11.2.5 Recommendations

The Working Group **recommends** Sweden to change their sampling design in the Skagerrak because Sweden is not covering the entire area. However, the WG recognises the problem with breaking a long time series and suggest that Sweden keeps as many hauls as possible from previous years but at the same time try to cover all rectangles with at least 1 haul where ever possible. It was also suggested that a sensitivity analysis should be made prior the change of sampling design. The WG has also noticed that Sweden has in some rectangles up to six hauls that could be allocated elsewhere.

12 INTEGRATION OF IBTS DATA FOR THE NORSEPP PROJECT (TOR J)

A description of the NORSEPP project and some information on its current situation is given in Appendix III.

In advance of the meeting the Chair of the IBTS WG received a letter by A. Kenny (Chair of the Regional Ecosystem Study Group for the North Sea), B. Turrell (Co-Chair Steering Group on GOOS) and H.R. Skjoldal (outgoing Chair of the Advisory Committee on Ecosystems) to introduce the above term of reference.

Although it was mentioned in this letter that one of the authors would participate in the IBTS WG to explain precisely what sort of output is expected of the WG, none of them attended the meeting. Unfortunately, it was not clear from the available background information what exactly was expected of the WG. The WG expects that what will soon be produced as a standard output of the DATRAS database, should suit the request for information from NORSEPP.

The WG is aware that the project has goals that are highly valuable. However, apart from the data available in the DATRAS database and in absence of any particular request from the main actors in the project, the WG was unable to address more precisely this term of reference.

13 QUALITY CONTROL IN ICES DATABASE (TOR K)

13.1 Standardisation of fish identification and quality assurance

It has been highlighted that the IBTS has some potential problems associated with data entry errors and more fundamental problems associated with the mis-identification of selected taxa, primarily non-commercial fish species (Daan, 2001). Additionally, there are several taxa that some member states report at either a species, generic or family level. Although these problems will have no impact on the assessment of commercial fish stocks, it does have implications on the utility of the IBTS dataset for studies on fish communities, and diversity studies etc. Taxa that appear to cause some confusion, either in surveys in the North Sea or adjacent waters, include:

- Smoothhounds (*Mustelus* spp.)
- Shads (*Alosa* spp.)
- Argentines (*Argentina* spp.)
- Clingfishes (*Gobiesocidae*)
- Sticklebacks (*Gasterosteidae*)
- Pipefish (*Syngnathidae*)
- Redfish (*Sebastes* spp.)
- Sea scorpions (*Cottidae*)
- Skates and rays (*Rajidae*)
- Sand eels (*Ammodytidae*)
- Dragonets (*Callionymus* spp.)
- Wrasse (*Labridae*)
- Eelpouts (*Zoarcidae*)
- Snake blennies (*Stichaeidae*)
- Mullets (*Mugilidae*)
- Gobies (*Gobidae*)

Rays (*Rajidae*) have very occasional problems with misidentifications, and these normally only with respect to recently hatched or aberrant specimens. Improved identification material is available following on from the DELASS project.

Protocols that could be established to improve data quality include:

- Promote more accurate species identification of those taxa that are commonly caught during surveys through the development of user-friendly keys (including photographic keys), training courses and staff exchange.
- Verification of certain species, whereby certain rare species that are difficult to identify are either preserved in formaldehyde or frozen for subsequent identification/confirmation by experts.
- Include flags in electronic data capture software and laboratory databases so that species that are "oversized" (i.e., the length record is greater than the reported maximum length in the scientific literature), "undersized", are outside their normal depth, latitudinal or geographic range are highlighted so that confirmation is required.
- Ring-tests, whereby staff involved in fish identification at sea are periodically tested.

It is **recommended** that the ICES Working Group on Fish Ecology (WGFE) is asked to comment on this issue.

13.2 Quality Control in Datras database

13.2.1 Incoming data

A series of data checking routines are implemented when submitting data to ICES Datras Database. These were evoked in the 2003 IBTSWG report and details are available on the Datras website (http://www.ices.dk/datacentre/datras/datras.asp).

13.2.2 Historical data

All historical data actually in the database will be resubmitted through the Datras checking programme. National institutes have also started their own checking and will resubmit corrected data if necessary.

14 NEW PROJECTS

Update of the ICES Atlas of North Sea fishes

In 1993 the 'Atlas of North Sea Fishes' was published by ICES (Knijn *et al.* 1993) as an ICES Cooperative Research Report. This Atlas was based on data from all species that were caught during a number of bottom trawl surveys in summer and winter of the years 1985 to 1987. The preparation of the Atlas was partly funded under the EU FAR programme and the publication by the EU FAIR programme.

The main aim of the Atlas was to give an overview of the data available from trawl surveys and at the same time to fill an important gap in our knowledge of the spatial distribution of North Sea fish species. Prior to the publication of the Atlas, information on the spatial distribution of non-commercial species was virtually non-existent, and information on commercial species could only be found in technical reports, which were not readily accessible to non-specialists. The additional biological information presented in the Atlas was more detailed than that given in most of the standard popular books on North Sea fishes.

The 1993 Atlas gave a snapshot of the distribution of North Sea fish in the years 1985–1987, i.e., it describes the situation that prevailed more than 15 years ago. Since that time, a significant amount of new data has become available. In particular, standardised quarterly IBTS Surveys of the North Sea took place during the years 1991–1996. The data from these surveys make it possible to describe and compare seasonal distributions throughout the entire year and to determine whether there have been significant changes in the distribution and abundance of species. At the same time, a complete set of data of the February IBTS since 1965 has become available (partly through the EU funded project "Input of historic IBTS data", which will allow for the analysis of catch trends during winter over a period of more than 30 years. All these data are stored in the ICES IBTS Database. At the same time, there have been major changes in stock levels of some of the most important commercial species, with the cod and the plaice stocks showing severe declines, whereas the herring stock has enormously increased in recent years. Fishing activity has also been linked to declines in various fish species, such as common skate, and environmental changes have also had impacts on North Sea fishes.

Objectives

In January 2004 a proposal was submitted to the EU (by RIVO Netherlands, CEFAS United Kingdom and ICES) to update the 1993 atlas. Due to the very limited budget that was proposed to be made available for this project, it was decided to set up the project in two parts. The 2004 proposal represents the first phase and has the following objective:

i. revise and update the existing Atlas of North Sea Fishes focusing on a small number of fish species as a pilot project, and
ii. publish the revised Atlas online.

Phase 2 will only be possible when further funding is secured. It will be a larger project including more partners and its objectives will be to:

i. widen the species coverage of the interactive North Sea Fish Atlas to include all species caught in North Sea surveys;
ii. widen the area coverage of the interactive North Sea Fish Atlas to cover the NE Atlantic; and
iii. produce a colour report "NE Atlantic Fish Atlas"

Phase 1

Similar to the first edition in 1993, the online atlas will provide general information on the North Sea ecosystem, information on research vessel surveys, and specific information for a small number of species. Species-specific information will include maps showing (seasonal) distributions, changes in abundance over the past decades, length compositions, information on growth, age, life history, population and exploitation, etc. and provide appropriate reference material. Species included in the first phase will cover examples of ecologically different groups, and also represent examples of data-rich and data-poor species.[PDE1]

The main source of data will be the International Bottom Trawl Survey which has been conducted annually since 1965. Seasonal changes in distribution will be described on the basis of quarterly IBTS surveys from the years 1991–1996. Additional information will be derived from other sources available in ICES, such as a number of ICES coordinated surveys targeting flatfish. Historic datasets from surveys conducted in the first decade of the twentieth century by the United Kingdom and the Netherlands will be used to assess whether any of the first phase species have shifted their geographic distribution. [PDE2]

CEFAS has the expertise and technological infrastructure to develop and host an internet mapping server due to the recent implementation of an online atlas for CEFAS data. The updated Atlas of North Sea Fishes will therefore be hosted by CEFAS and accessed via a link on the ICES website.

Phase 2

When further funding is secured for a second phase, all fish species encountered in the surveys will be included. Also the area covered will be expanded to include the whole NE Atlantic from the southern Iberian Peninsula to Iceland and Norway, this covering the majority of the OSPAR area, and extending where possible into the Baltic and Mediterranean Seas. In addition, the Atlas will be transferred to a server at ICES HQ in Copenhagen with a direct link to the DATRAS database, and a colour report "NE Atlantic Fish Atlas" will be published. In this second phase it would be important that other countries also cooperated in the project.

15 REGIONAL CO-ORDINATORS

There are three regional co-ordinators with the IBTS WG – one for the quarter 1surveys in the North Sea (Henk Heessen, RIVO), one for the quarter 3 surveys in the North Sea (Trevor Boon, CEFAS) and one for the eastern Atlantic (David Stokes, MI-Ireland) assisted by Francisco Velasco (IEO). Both the North Sea co-ordinators tended their resignation due to other commitments. The WG appointed, Remment ter Hofstede from the RIVO, Netherlands as the new quarter 1 survey in the North Sea co-ordinator and Brian Harley from CEFAS Lowestoft as the new quarter 3 survey in the North Sea coordinator.

16 RECOMMENDATIONS

16.1 Recommendations reiterated from the 2003 IBTSWG report Surveys planning and coordination

That all countries participating in the Quarter 1 survey in the North Sea, the Skagerrak and the Kattegat to use a MIK as specified in the IBTS Manual and to use a well balanced and calibrated flow-meter. The flow-meter should be attached to the MIK-frame correctly.

16.2 IBTSWG 2004 recommendations

Section 4.1.1 - GOV modification for UK 2004 survey

The changes to the gear presented to the WG and described above are against all recommendations and was considered by the group to likely have changes in the catchability and strongly recommends that they are abandoned.

Section 4.3.1 - Intercalibration in Eastern Atlantic

The IBTSWG **recommended** that some overlap in the Portuguese Groundfish Survey with the Spanish North Coast Survey and or the Spanish Gulf of Cadiz Survey be established in order to maintain a dataset for ongoing or future calibration work.

The only gear used in the IBTS North Eastern Atlantic area that has not been inter-calibrated with a second gear is the Porcupine Baca, an inter-calibration experiment with the Irish survey in Western Ireland is thus **recommended**.

Section 4.3.4 - ½ hr vs. 1hr tow in Portuguese surveys

From this work it was concluded that a change in tow duration may lead to an interruption of the current CPUE series for blue whiting, horse mackerel, and probably also for other species with similar behaviour. The number or calibration hauls may be insufficient to assess the effect of tow duration on the relative length composition of the catches. Therefore the Working Group **recommends** carrying additional parallel tows of 1 hour versus ½ hour duration during the Portuguese Groundfish Survey, noting that this will require additional ship time.

Section 8.1 – North Sea GOV specifications

Although it cannot be concluded that most of the changes are minor (e.g., slight increase in twine diameter) and would not affect the overall performance and catchability of the gear, the WG **recommends** that this should be investigated. A first step could be that these changes be investigated by mean of numerical simulation. It was also **recommended** to conduct a review the GOV specifications with respect to the actual material available for construction.

Section 10 – Review of Age/length/sex/maturity data

It is therefore **recommended** that an investigation into the origin of all the missing values will be performed, in order to find out whether the data about age and maturity stage really hasn't been collected, or whether a problem has occurred, for instance in the transfer of the data from the institutes to ICES.

Finally, it is **recommended** to additionally check the age/length/sex/maturity data from the ICES database by round fish area.

Section 11 - Depth stratification

The working group **recommends** Sweden to change their sampling design in the Skagerrak because Sweden is not covering the entire area. However, the WG recognises the problem with breaking a long time series and suggest that Sweden keeps as many hauls as possible from previous years but at the same time try to cover all rectangles with at least 1 haul where ever possible. It was also suggested that a sensitivity analysis should be made prior the change of sampling design. The WG has also noticed that Sweden has in some rectangles up to six hauls that could be allocated elsewhere.

Section 13.1 - Quality control – species identification

It is **recommended** that the ICES Working Group on Fish Ecology (WGFE) is asked to comment on this issue.

17 SUGGESTED TERMS OF REFERENCE FOR 2005

The **International Bottom Trawl Survey Working Group** [IBTSWG] (Chair: J.-C. Mahé, France) will meet in Hamburg, Germany from the 29 March to the 1 April 2005 to:

a) coordinate and plan North Sea and North Eastern Atlantic surveys for the next twelve months;
b) further develop protocols and criteria to ensure standardization of all sampling tools and survey gears and review institutional checking lists;
c) investigate the adequacy of some fishing protocol defined in the IBTS manual from ancient studies with respect to the most recent data available from modern monitoring of gear performances;
d) review the GOV specifications with respect to the actual material available for construction;
e) review the outcome of the Survey design and data analysis Workshop (WKSAD) in be held in Aberdeen, June 2005;
f) review the progress made in the Surveytrawl II (check for the right name) project;
g) review and comment on the new Datras database;
h) make a detailed check of the age/length/sex/maturity data for the last 3 years from the ICES database per roundfish area;
i) review the progress made in defining a stratification scheme for the Eastern Atlantic and the Skaggerak.

18 REFERENCES

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Dufrêne, M., and Legendre, P. 1997. Species assemblages and indicator species: the need for a flexible asymmetrical approach. Ecol. Monogr. 67, 345–366.

Ehrich, S. 1997. Mixture of haul duration of 30 and 60 minutes in the IBTS. Are there significant differences in the catch data standardised to one hour? W.D. presented to 1997 IBTS WG, Santander, Spain, 3–7 March 1997.

ICES, (2004). Report of the Study Group on Survey Trawl Gear for the IBTS Western and Southern Areas. Santander, Spain (11–13 February 2004). ICES CM 2004/B:01

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Knijn, R.J., Boon, T., Heessen, H.J.L., and Hislop, J.R.G. 1993. Atlas of North Sea fishes. ICES Cooperative Research Report 194, 268 pp.

Mahé J.C. (Ed.) 2001. International program of standardised trawl surveys (IPROSTS). Study EC-DGXIV N° 98–057. Ifremer - Marine Institute - Marine laboratory: 122 pp.

Sánchez F. (Ed.) 1999. Evaluation of demersal resources of southwestern Europe from standardised groundfish surveys (SESITS). Study EC-DGXIV N° 96–029. IEO - Ifremer - Ipimar: 195 pp.

18.1 Working Documents presented (Appendix IV)

Chaves, C. and Cardador, F. 2004. Portuguese Autumn Surveys in 1999–2003. WD for IBTSWG, Lisbon 2004, 3 p.

Ehrich S., Reiss, H., Damm, U., and Kröncke, I. 2004. Vulnerability of bottom fish species to the standard GOV. WD for IBTSWG, Lisbon 2004.

Fraser H. 2004. Comparative Fishing Study to assess Catchability of Groundgear A and B during the Quarter 3 North Sea Survey 2003 (Working Document of preliminary analysis of data from year 1 of ongoing data collection) WD for IBTSWG, Lisbon 2004.

Poulard J.-C. and Mahé, J.-C. 2004. Structure and spatial distribution of fish assemblages in the Celtic sea. WD for IBTSWG, Lisbon 2004, 14p.

Boon T. 2004. Modification to GOV used in the English Q1 NSGFS, 1p.

APPENDIX 1: NORTH SEA GOV SPECIFICATIONS

Appendix I North Sea GOV Specifications

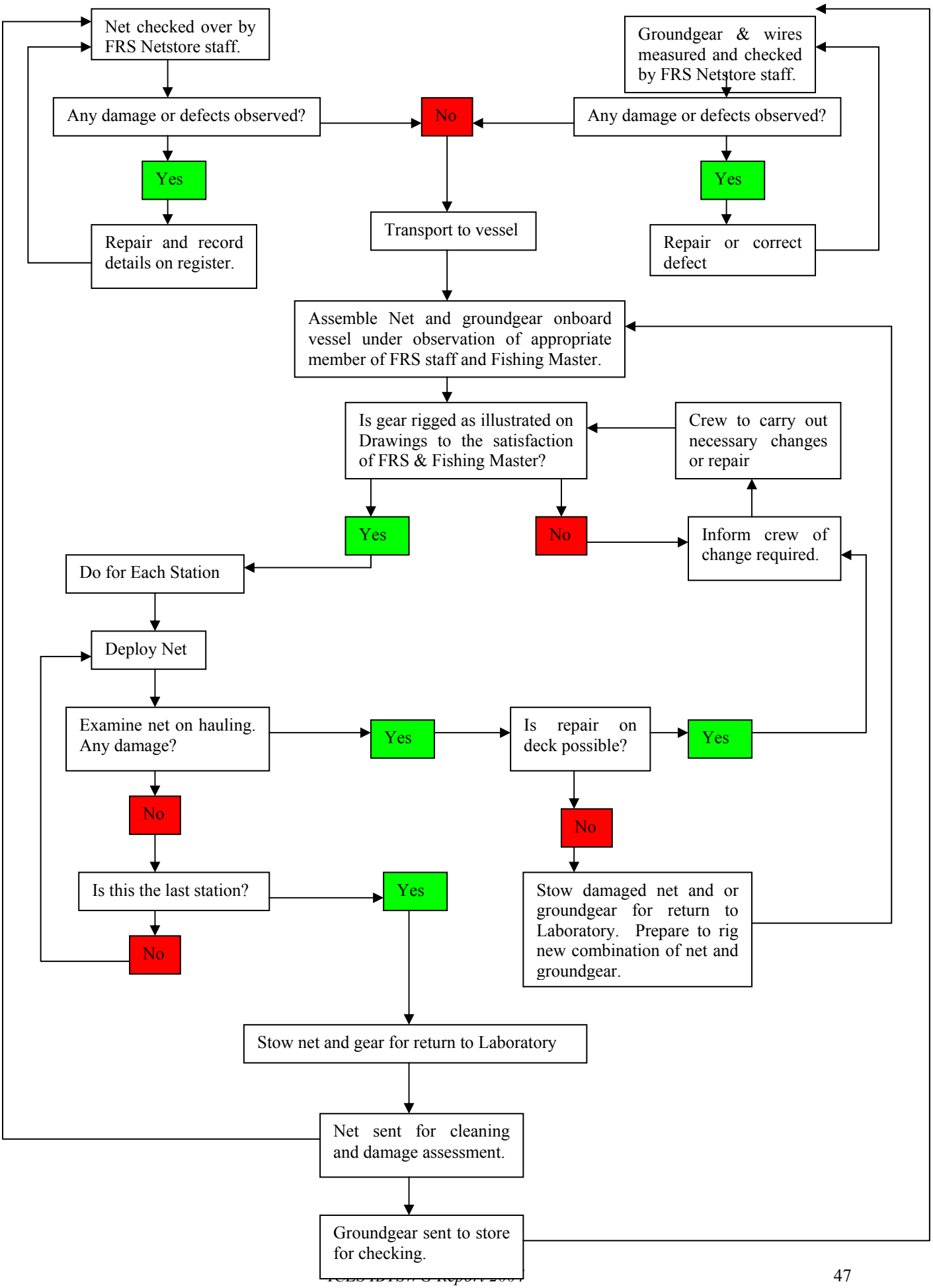
	UK(England)	France	Sweden	Danmark	Germany	UK(Scotland)	Netherlands	Norway	
Boat Power (HP)		2000	900	2300	3886	1575	2000	1496	1496
distance between winches			11.7	8.8	7.3	10.12	14	6,40m	6,30
Boat length		74						H.MOSBY	SARS
		le drézen							
Headline/Fishingline length	36/47,20	36/47,20m	36/47,20					36m/14mm	47,20/22mm
Material upper	pa	pa	pa	pa	?	pe poche en pa	pa		
Material lower	pa	pa	pa	pa	?	pe	pa		
Superior wing mesh size/strenght	100mm/270mkg*2	100mm/280mkg *2	100mm/270mkg*2	100mm/170mkg*2	100mm/mkg*2	100mm/290mkg*2	100mm/270mkg*2	100mm	
lower wing mesh size/strenght	100mm/180mkg*2	100mm/140mkg *2	100mm/180mkg*2	100mm/250mkg*2	100mm/mkg*2	100mm/200mkg*2	100mm/270mkg*2	100mm	
Square mesh size/strenght	80mm/270mkg	80mm/280mkg	80mm/270mkg	100mm/120mkg/100mm170mkg	100mm/mkg/100mm/mkg	100mm/290mkg/100mm/290mkg	80mm/270mkg	80mm	
Belly mesh size/strenght	80mm/270mkg	100mm/180mkg	80mm/270mkg	100mm/120mkg/100mm250mkg	100mm/mkg/100mm/mkg	100mm/200mkg/100mm/200mkg	80mm/180mkg	80mm	
Top belly mesh size/strenght	60mm/360mkg	60mm/280mkg	60mm/360mkg	80mm/250mkg,60/312mkg,40mm/250mkg	80mm/mkg,60/mkg,40mm/mkg	80mm/290mkg,60/290mkg,40mm/mkg	60mm/250mkg	60mm	
Belly mesh size/strenght	60mm/360mkg	60mm/180mkg	60mm/360mkg	80mm/250mkg,60/312mkg,40mm/250mkg	80mm/mkg,60/mkg,40mm/mkg	80mm/125mkg,60/125mkg,40mm/125mkg	60mm/250mkg	60mm	
Upper extension piece mesh size/strenght	40mm/360mkg	40mm/280mkg	40mm/360mkg	25mm/312mkg	25mm/mkg	25mm/450mkg	40mm/360mkg	40mm	
Upper extension piece mesh size/strenght	25mm/400mkg	25mm/280mkg	25mm/400mkg	25mm/312mkg	25mm/mkg	25mm/450mkg	25mm/360mkg	25mm	
Lower extension piece mesh size/strenght	25mm/400mkg,25mmdbl400mkg	25mm/280,180mkg/2	25mm/400mkg,25mmdbl400mkg	25mm/312mkg	25mm/mkg	25mm/450mkg	25mm/360mkg	25mmdbl	
Upper codend mesh size/strenght	25mmdbl/400mkg	25mm/180mkg/1	25mmdbl/400mkg	25mm/312mkg/1	25mm/mkg/1	25mm/385mkg double nylon	25mm/400mkg	25mmdbl	
Lower codend mesh size/strenght	25mmdbl/400mkg	25mm/180mkg/1	25mmdbl/400mkg	25mm/312mkg/1	25mm/mkg/1	25mm/385mkg/ double nylon	25mml/400mkg	25mmdbl	
Selvedge rope length (m)/diam (mm)									
Headline (a)	5/14mm	5/14mm	5/14mm	5/22mm	5/18mm	5/22mm	5/14mm	5/14mm	
Headline (b)	15,5/14mm	15,5/14mm	15,5/14mm	15.5/22mm	15.5/18mm	15.5/22mm	15,5/14mm	15,5/14mm	
Fishingline ©	5/22mm	5/18mm	5/22mm	5/22mm	5/22mm	5/22mm	5/22mm	5/22mm	
Fishingline (d)	21,10/22mm	21,1/18mm	21,10/22mm	21,10/22mm	21,10/22mm	21/22mm	21,10/22mm	21,10/22mm	
Floats									
Nb	60	60	60?	60?	60	60	50	50	
type (volume or diam.)	4l	4l	4l	??	plastik TYP1 D=200mm	200mm	200mm (4l)		
Buoyancy		3.1	3.1			2.77		2,7kgf	
positioning									
Total Buoyancy	172	186		??	??	145		135kgf	
Exocet type	exocet 0,85*0,85	exocet 0,85*0,85			exocet 0,85*0,85				
Exocet Buoyancy	14	14	14		14	exocet0,85cm*0,85cm flot 5*200mm 14kgf	wooden multiplex (80/100cm) 1 float?	balmoral kite float 4 (13,2kgf)	
Ground gear and chain				PB CF PLAN? 2 types					
Bodom length and diameter	5/18mm,	5/18mm,5/24mm,	5/18mm,	5/	5/20mm	??	5/18mm,	??	
Disc diameter	200mm	200mm	200mm	360mm	200mm	??	200mm	??	
Chain weight	70kg	70kg	140kg	??	280kg	??	70kg	??	
Total weight in air	175kg	175kg	175kg	??	??	??	175kg	??	
Number of sections for the sides	8	8	8	8	8	??	8	??	
Wire length + diameter	5/18mm,5/18mm	5/18mm,5/18mm	5/18mm,5/18mm	5/13mm,5/18mm	5/20mm	??	5/18mm,5/18mm	??	
Disc diameter	200mm/100mm	200mm/100mm	200mm/100mm	360mm	200mm/100mm/75mm	??	200mm/100mm	??	
Chain weights	35kg/0/0/35kg						35kg/30kg /35kg	??	
Total weight in air	140/30/30/65Kg	140kg/140kg/140kg	65kg/60kg /65kg		14kg/140kg/140kg	??		??	
	45,90m	45,90m	45,90m	47,8m	47,40m	??	45,90m	??	
	705Kg	1015	835kg	??	1120kg	880kg	705Kg		
Rigging									
nb legs	3	3	3	3	3	3			
superior leg (length, diam)	2*20m/14mm	20m/12mm	20m/14mm	??	20m/14mm	20m/14mm			
middle leg (length, diam)	1*20m/14mm,1*7,1/14mm	20m,7,12mm/18mm	20m/14mm,7,1/14mm	??	20m/14mm6,50m/14mm	20m/14mm7,10m/14mm			
lower leg (length, diam)	1*38m/20mm	1*38m/22mm	1*38m/20mm	??	38/22m	38/20m			
briddle diameter	22mm	24	22mm	??	50m/22	47m/26mm			
Door									
Type	ovale	ovale	ovale	??	ovale (A9 polyvalent)	oval (polyvalent)	oval (polyvalent)	polyvalent	
length		3.4	??	??	??	3.02	3.1		
height		2.1	??	??	??	1.88	1.8		
Surface	4.5	5.7	5.85	??	4.4	5.68	4.5	5.58	
weight	1000kg?	1300kg	1050	??	1500	1107kg 1109kg 1077kg 1077kg 1102kg	1200kg	1075	
Warp									
diameter		24	21	??	30mm	28mm	28mm	22mm	24mm
depth/warp	25/150,50/275,100/450	25/160,50/220,100/350	25/150,50/275,100/450	??	??	??	??		

APPENDIX II: DRAFT PROTOCOLS FOR DEPLOYMENT OF GOV ON IBTS SURVEYS (UK SCOTLAND)

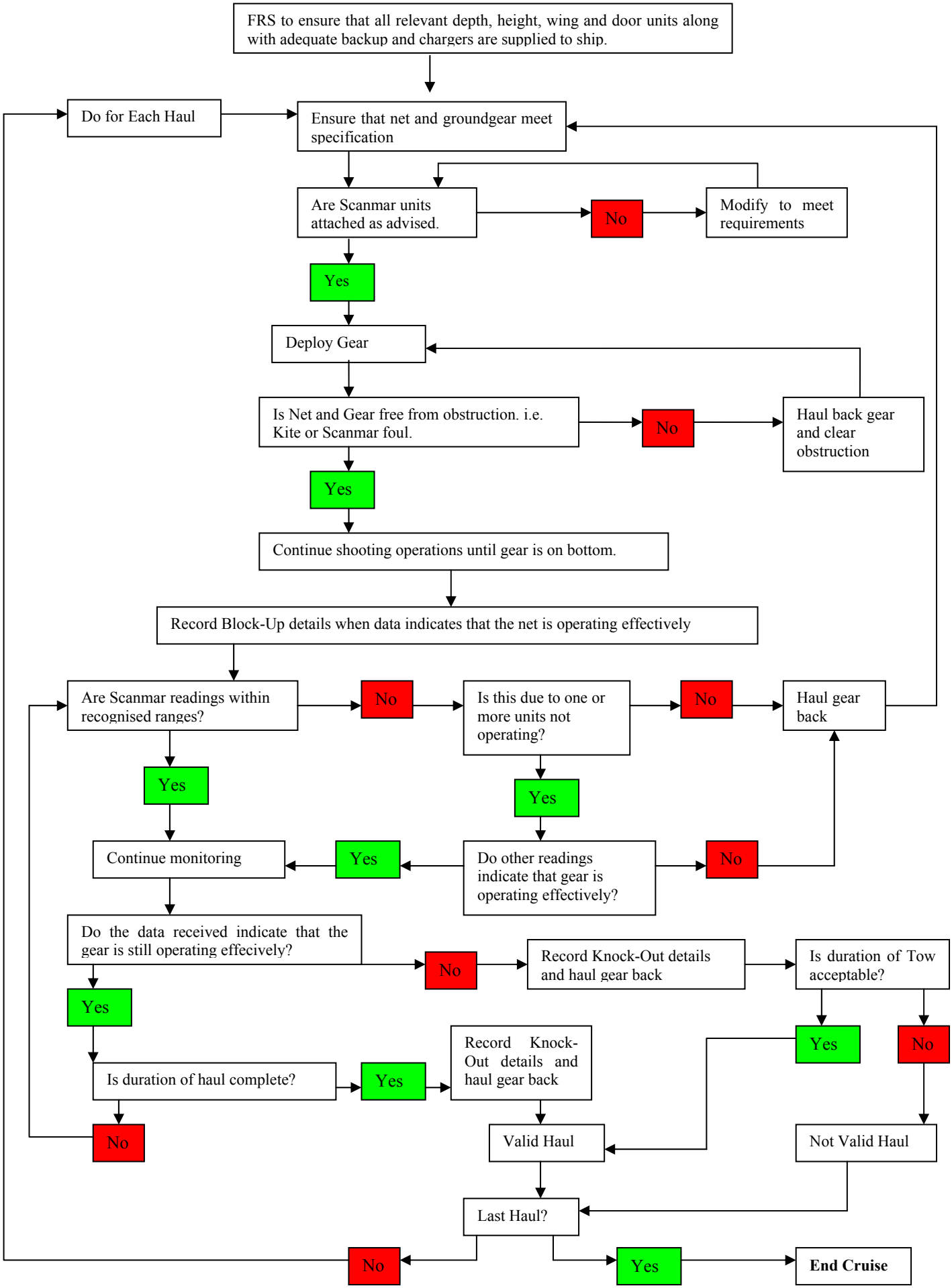
1) Ensure GOV and Groundgear are prepared onshore according to "IBTS–Manual (taking into account any national variation as previously advised to IBTS).
2) Senior (or appropriate) member of scientific staff to oversee / observe the gear being assembled onboard.
3) Appropriate member of scientific staff to monitor installation of Kite as described in IBTS manual and Scanmar units as illustrated in local instructions.
4) Ensure liner is free from holes and cod-lines are sealed in an acceptable way.
5) Experienced member of scientific staff to observe deployment of gear, ensuring that gear is free from any defects or obstructions.
6) Start Scanmar monitoring programme on PC.
7) Once gear has settled on seabed, record Block-Up on PC monitor system and inform Fishing Master of Block-Up time and position.
8) Monitor Scanmar display throughout haul, ensuring "IBTS-Scotland-Use of Scanmar" procedures are followed.
9) After 30 minutes towing, press Knock-Out on PC monitor system and advise Fishing Master of Knock-Out time and position.
10) Experienced member of scientific staff to observe retrieval of gear.
11) Examine GOV and Groundgear as it arrives back onboard to ensure that gear is still clear from obstruction.
12) Experienced member of scientific staff to examine catch in cod-end ensuring that no damage to small mesh liner has occurred and that the cod-end is sealed properly.
13) Transfer the catch to hopper.
14) Catch to be worked up according to "IBTS-Scotland-Catch Processing" procedures and relevant Research Vessel Standing Instructions.

K A Coull
26-March-2003

IBTS – Scotland – GOV Preparation



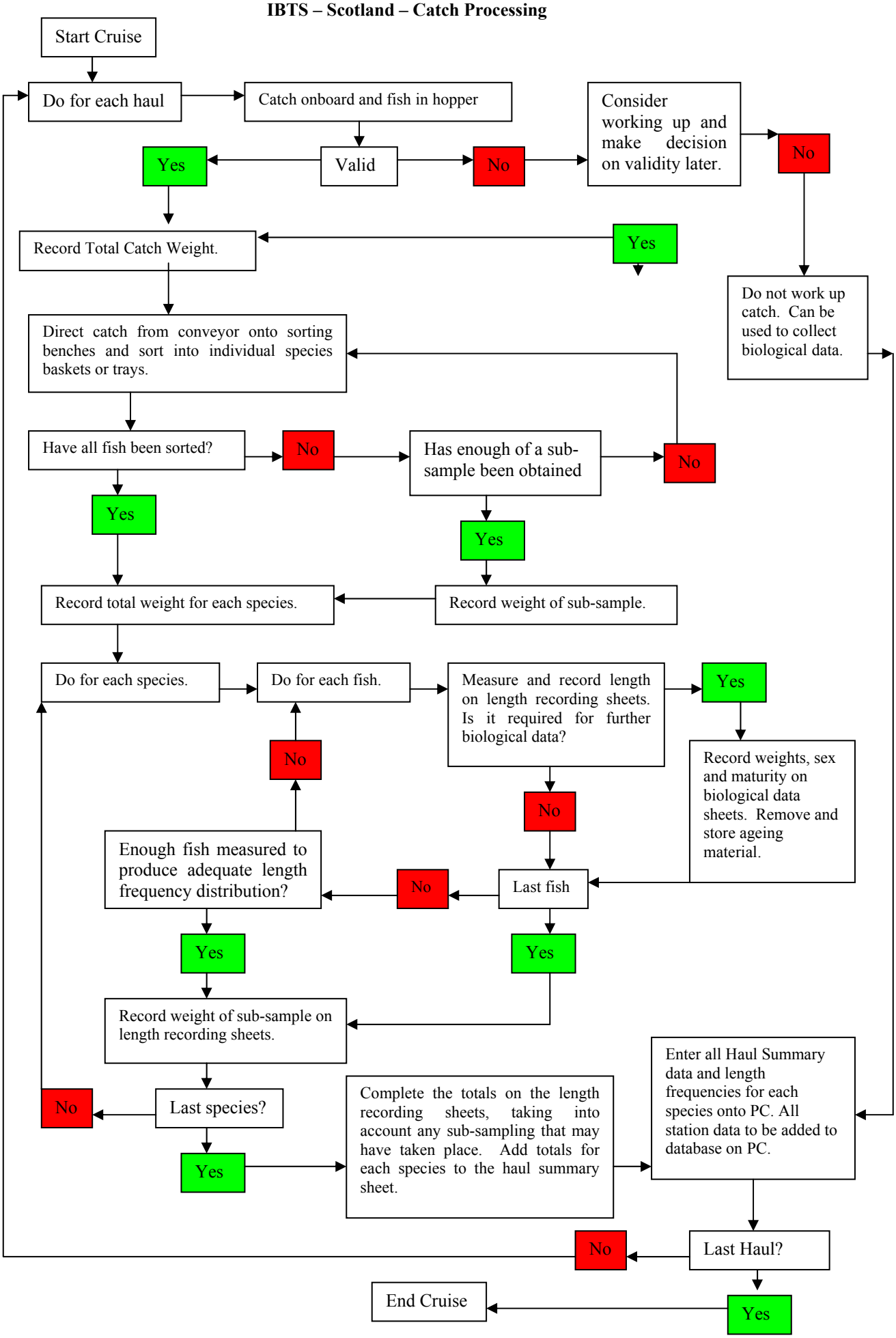
IBTS – Scotland – Use of Scanmar



IBTS – Scotland – catch processing

1) Catch emptied into hopper and cod-end shaken clean.
2) Haul valid / invalid – but may be worked up so that a decision on validity can be reviewed once the Scanmar data and other factors are taken into consideration.
3) Total weight for catch noted.
4) Fishhouse manager to determine sampling strategy and relay this to all staff involved. Normally all fish are sorted, but sub-sampling may be required if:
   i) Catch is too large.
   ii) Catch composition is mainly small fish.
5) Fish for sorting is directed from conveyor to sorting benches where all fish are selected into individual species baskets or trays. No selection by size to take place.
6) Sorting continues until completion or adequate sub-sample is obtained. In some cases it may be necessary to draw the sub-sample from different stages of transfer from the hopper in order to ensure a representative sample is obtained. Sub-sample weights should be noted.
7) All baskets or trays of fish are weighed (and noted on fish weight sheets) in order to obtain a total weight for each species. If sub-sampling is envisaged, the weights should be noted on each individual basket.
8) For all species, the total catch or sub-sample are measured to the cm below (except for herring and sprat, which are measured to the 0.5cm below) and recorded on species length recording sheets. Where the number of fish for a species is more than normally required to provide an adequate length distribution, a sub-sample (typically, 200 – 250 fish per length range or 150 for small range such as Norway pout) may be selected. A detailed description of sampling procedures and variations is provided in the Marine Laboratory Sea-Going Manual.
9) All sub-samples weights are noted on the species length recording sheets to assist with raising to haul level.
10) For certain species additional biological data are required. Targets are described in IBTS Manual and, as a minimum we collect these targets. In addition we will collect data for species prescribed under EU Data Collection Regulations. The additional biological data are – fish weight (total), fish weight (gutted), sex, maturity stage and ageing material (otoliths). These should be noted on Biological Data Sheets.
11) When all measuring and biological sampling has been completed, the species length recording sheets are totalled to provide a length frequency (taking into account any raising that may be required when sub-sampling took place). Total numbers for each species are recorded on the Haul Summary sheet.
12) All Haul Summary information and length frequencies for each species are entered and checked on a PC system, using the Finfish programs.
13) All station detail data according to IBTS Exchange File Format record type HH are collected and stored on database on PC system.
14) Additional biological data are entered on Excel spreadsheet on a daily basis.

IBTS – Scotland – Catch Processing



GOV DECK SUMMARY SHEET

Haul No_____________		Date________________		Net No____________		Adjuster Chain Length_________	
Valid Haul		Foul Haul		Clear Haul		Fast Haul	
Items to comment on are: Polished Doors & Bunt, Twisted Bridles, Twisted wings, Damaged Wings, Damaged Net, Groundgear Attachment, Codend damage, Floatation intact, Scanmar sensor attachment.							
Comments: Signed							

Haul No_____________		Date________________		Net No____________		Adjuster Chain Length_________	
Valid Haul		Foul Haul		Clear Haul		Fast Haul	
Items to comment on are: Polished Doors & Bunt, Twisted Bridles, Twisted wings, Damaged Wings, Damaged Net, Groundgear Attachment, Codend damage, Floatation intact, Scanmar sensor attachment.							
Comments: Signed							

Haul No_____________		Date________________		Net No____________		Adjuster Chain Length_________	
Valid Haul		Foul Haul		Clear Haul		Fast Haul	
Items to comment on are: Polished Doors & Bunt, Twisted Bridles, Twisted wings, Damaged Wings, Damaged Net, Groundgear Attachment, Codend damage, Floatation intact, Scanmar sensor attachment.							
Comments: Signed							

Haul No_____________		Date________________		Net No____________		Adjuster Chain Length_________	
Valid Haul		Foul Haul		Clear Haul		Fast Haul	
Items to comment on are: Polished Doors & Bunt, Twisted Bridles, Twisted wings, Damaged Wings, Damaged Net, Groundgear Attachment, Codend damage, Floatation intact, Scanmar sensor attachment.							
Comments: Signed							

GOV DECK SUMMARY SHEET

The purpose of this sheet is to record significant information about the fishing gear for every haul to strengthen the Quality Assurance of GOV deployment. The designated 'Net Figure Scanmar' person should observe the net being shot and retrieved EVERY HAUL noting any damage or problems with the gear, examples of which are listed below.

1) There must be an entry every time the net is deployed and a haul number is assigned to the trawling operation. Please complete the forms clearly and legibly, if there is insufficient room within the box continue in the next one on the sheet.
2) The Haul Number, Date and Net Number must be entered.
3) Mark if haul is Valid or Foul (delete as appropriate).
4) If the haul is designated 'Foul' briefly outline the reasons.
5) Indicate if the gear has come fast during the tow as this may have implications of stretch on the headline, Footrope, Groundgear, Sweeps and Bridles.
6) Look for polish on the 'Bunt Bobbins'.
7) Pay attention to the Wingends for damage.
8) Observe the Groundgear to Footrope attachment points (CRINGLES) making sure all settings are complete to the Wingends.
9) Observe the body of the net, top and bottom sheets noting any damage.
10) Pay particular attention to the Codend and small mesh cover looking for holes, any large fish on the outside of the small mesh would indicate a hole in the cover.
11) Observe the orientation and attachment of all scanmar sensors and adjust if necessary prior to shooting the next haul. Scanmar data is vital in assessing the gear geometry and net performance during the trawling operation.
12) A successful haul with no damage should be marked 'Clear Haul'.
13) A legible signature must be entered for every haul.

All damage large or small must be rectified prior to the next haul, consult the SIC if in doubt. Do not be pressurised by the deck crew into thinking the damage is too insignificant to repair.

All hauls should be carried out using the same standard gear any damage must be repaired between hauls.

Every 20 -25 hauls the 'Adjuster Chains' at the 'Bunt Bobbins' must be checked and measured, ideally this job should be done before the first haul in the morning as measurements can only be taken once the net is off the net drum. An earlier start every fourth or fifth morning would allow measurements to be made without interrupting the fishing operations. Indicate in the appropriate haul record that these measurements have been taken noting any necessary changes made.

APPENDIX III NORSEPP (NORTH SEA ECOSYSTEM PILOT PROJECT)

1. Introduction

At the Intermediate Ministerial Meeting (IMM) on fisheries in Bergen in 1997, the Ministers of the North Sea countries agreed as one of the guiding principles:

Further integration of fisheries and environmental protection, conservation and management measures, drawing upon the development and application of an ecosystem approach which, as far as the best available scientific understanding and information permit, is based on in particular:

- *the identification of processes in, and influences on, the ecosystems which are critical for maintaining their characteristic structure and functioning, productivity and biological diversity;*
- *taking into account the interaction among the different components in the food-webs of the ecosystems (multi-species approach) and other important ecosystem interactions; and*
- *providing for a chemical, physical and biological environment in these ecosystems consistent with a high level of protection of those critical ecosystem processes.*

As a follow-up activity, a Workshop on the Ecosystem Approach to the Management and Protection of the North Sea was held in Oslo in June 1998. This workshop identified monitoring as a key component of an ecosystem approach in relation to ecological objectives, to assessments, and to scientific advice to management.

The 5th North Sea Ministerial Conference met in Bergen, Norway, 20–21 March 2002 with the aim of agreeing to implement an ecosystem approach, based on a conceptual framework developed at the 1998 workshop.

In 1997 an ICES Steering Group on GOOS (SGGOOS) was formed in order to prepare an action plan as to how ICES should take an active and leading role in the further development and implementation of GOOS at a North Atlantic regional level, with special emphasis on operational fisheries oceanography. At a workshop convened in Bergen in 1999 a draft design and implementation plan was conceived. This had three essential components:

- To promote global / regional linkages in a GOOS context.
- To promote the ICES Annual Ocean Climate Status Summary as a contribution to GOOS.
- **To design and implement a North Sea ecosystem component of GOOS in collaboration with EuroGOOS**.

In order to develop these suggestions further the SGGOOS was re-nominated in 1999 as a joint ICES/IOC Steering Group on GOOS with the terms of reference to further develop an Implementation Plan. The SGGOOS initiated a workshop co-sponsored by IOC, ICES, OSPAR, the North Sea Conferences and EuroGOOS in September 2001 to agree on a strategy for a pilot North Sea Ecosystem GOOS project.

In order to meet the challenges identified at the meeting, the workshop agreed to increase the efficiency and effectiveness of the use of data products from current relevant national and international monitoring, and therefore invited the national agencies responsible for monitoring of the North Sea to:

- establish a co-ordinated mechanism that could add value to existing activities by integrating data from various sources (physical, chemical, biological) to aid development of an ecosystem approach,
- collaborate by means of a pilot project sponsored by ICES and EuroGOOS to demonstrate the usefulness of this approach by integrating data on oceanography and fisheries.

Further efforts will be required in consultation with appropriate bodies to develop a strategy for establishing and implementing the co-ordinated mechanism.

Although considerable progress has been made recently by a variety of national agencies and through EuroGOOS on monitoring, modelling, and forecasting physical parameters, until now no attempt has been made to establish an

integrated information system for the North Sea which include ecosystem parameters. Such an approach would have the synergistic effect of integrating many current national activities.

The present monitoring of the North Sea is insufficient to discriminate between human impacts and natural variation on the ecosystem. There is a need for improved, integrated monitoring through co-ordination and harmonisation of existing national and international monitoring activities, as well as through implementation of new methods and technology.

For marine ecosystems, meteorological and climatic variability are primary driving forces for ecosystem variability. Improved knowledge of the relationship between climate and changes in ecosystems would greatly benefit the difficult task of distinguishing between anthropogenic impacts and natural variability in environmental assessments. A particular and new challenge in the future will be the use of environmental data within the annual assessment cycle for fish stocks by the fisheries research and management community. Such an approach will involve the bringing together of very diverse data sets and the application of new approaches to fishery assessment modelling.

The North Sea, because of the intensive work that has already been carried out in this area, is an obvious candidate for a pilot project. Developing an ecosystem approach for the management of the North Sea will need an integrated monitoring and information system and a continuous updating of information, which could be seen as a North Sea ecosystem component of GOOS.

2. North Sea Ecosystem Pilot Project (NORSEPP)

The project will engage fishery scientists and oceanographers from all North Sea countries. A particular and new challenge will be the use of environmental data within the annual assessment cycle for fish stocks by the fisheries research and management community. Such an approach will involve the bringing together of very large data sets and the application of new approaches to fishery assessment modelling. There is thus a need to develop a harmonised system to monitor, assess and forecast the environment and ocean climate of North Sea, taking into account existing operational collaborative mechanisms within meteorology, oceanography, fisheries, modelling and remote sensing.

2.1 Overall Objective

To initiate operational fisheries oceanography by integrating existing physical, geochemical, and biological monitoring programmes and models to improve advice to fisheries managers.

2.2 Specific Objectives

There are seven specific objectives, each of them related to a specific work package:

Co-ordinate and harmonise relevant physical, geochemical and biological monitoring programmes and networks.

Combine models and data to generate operational products relevant to fish stock assessment

Further develop and demonstrate applications of operational products to fish stock assessment using test cases

Streamline the flow and exchange of data and information

Evaluate the outputs of the operational systems in order to assess their usefulness and accuracy, and suggest improvements where necessary

Establish efficient communication in order to disseminate operational products to users

Evaluate existing North Sea monitoring technologies and strategies regarding their usefulness for operational fisheries oceanography and initiate improvement

The focus on living resources is intended to limit the scope of the project to something achievable within the time frame. If the project succeeds its remit could be expanded to determine the usefulness of this approach as a tool for comprehensive environmental analysis in support of improved environmental assessments.

To achieve the objectives, the following project structure has been suggested.

NORSEPP – Project Structure:

Work Package	Content	Potential Partners
1 Data compilation	Compilation of existing observations. Information about relevant datasets. Identification of gaps	NOOS agencies, ICES agencies (CEFAS, RIVO, MARLAB, IMR, BFA, DIFRES), IBTS, WGOH, SAHFOS
2 Product Development	Combine data with models to produce basic products. Apply existing coupled physical-ecosystem models in now-cast mode. Testing and validation.	METO, BSH, IMR, SGPBI, POL, MUMM, RIKZ, SAHFOS, NERSC, Met.no, etc.
3 Retrospective Analysis and Research	Relating hindcast models and time series to historical population dynamics, in order to identify suitable test cases. See how environmental models can be used in support of stock assessment and prediction. Identify gaps and needs.	WP1 plus GKSS, NIOZ, POL, SOC, IfM (Hamburg), Universities, SGPRISM/WGRP, ICES-GLOBEC, IBTS, SAHFOS
4 Data Management and Exchange	Streamline the flow and exchange of relevant data and information. Actively stimulate the use of data standards, quality assurance procedures, inter-laboratory comparison and data exchange among the data providers in close co-operation with relevant Working Groups.	WP1 plus relevant data management centres e.g., BODC, ICES, DOD etc
5 Evaluation	Assess the performance of stock forecasts, using methods developed by the Pilot Project, including demonstration projects as appropriate. This will include an expert assessment of environmental conditions.	WP1 plus WGRP, WGOH, IBTS, ICES-GLOBEC
6 Innovative Technologies	Review existing technology and initiate innovative technologies suitable for operational fisheries oceanography	EuroGOOS, SMEs, SeaNet, EDIOS
7 Communication	Encourage further interaction between fishery and environmental scientists by demonstrating the value of the products developed by the Pilot Project. Develop interface between environment and fish communities via web products etc. A possible 'front end' approach could be that developed by Canada http://seaserver.nos.noaa.gov/projects/ecnasap/ecnasap.html. (See SGGOOS report CM2000/C01, page 17)	SGGOOS, EuroGOOS, ICES-GLOBEC
8 Project Management		Leaders of WPs, project managers

WP 8 reports to SGGOOS and the latter, in turn, will report to the relevant ICES science and advisory Committees, EuroGOOS and IOC.

2.3 Relation to assessment process

This is a 5 year project (2003–2007) and it is intended that project outputs should be reported after each annual milestone to WGIBTS and the key ICES North Sea assessment groups for discussion and feedback viz.

- Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK)
- Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine, and Anchovy (WGMHSA)
- Herring Assessment Working Group for the area south of 62ºN

2.4 NORSEPP products

Products for improved environmental input to fisheries management can be based on either observations or model output or a combination of the two. But most benefit will be gained from a combined approach. Observations are also required for the testing and validation of models. Physical models of the North Sea may be further developed by nesting to provide higher resolution where needed, and may be coupled to an ecosystem model to provide a full 3D calculation of ecologically relevant variables, providing suitable inputs for new data products.

Development of these products could take place in two phases. In the first instance, available data could be assembled into a readily useable format and provided to the users, perhaps through a web based browser interface. In a second phase, additional new diagnostics can be prepared, for example based on output from a coupled physical-ecosystem model.

Throughout the development and application of the products, clear mechanisms for feedback from users to developers will need to be established.

It is likely that there will be value in providing environmental data at different levels in the chain of fisheries management. Firstly as input to research, secondly in preparation for the assessment working groups, thirdly as input to the ACFM, and finally in a suitably refined form, to the policy managers, the public and the fishing industry and other interested parties.

Through setting up the new diagnostics, gaps in existing knowledge may be identified. This will lead to new requirements for monitoring, such as monitoring of zooplankton, or of secondary production, or of nutrients as needed for model boundary forcing. As models increase in complexity and resolution, improved data on river flow rates and loading will be required. The identification of these additional requirements may be considered a deliverable of the project.

Models and observation systems produce huge amounts of output, which require advanced visualisation and presentation tools to provide an interface to user groups.

2.5 Oceanographic Products

Several products are expected from the project. Maps or time series at specific locations of daily – weekly – monthly or seasonal averages of physical parameters as sea surface temperature, near-bed temperature, thermocline depth, currents at different depth levels, transport through specific sections, temperature or current profiles, outflow from the Baltic, oceanic inflow to the North Sea and forecasts of the position of fronts. Nutrient at different depth and areas will be presented in the same way. Relevant biological information on primary and secondary production and some fish population parameters need also to be presented.

The diagnostics and environmental products should turn the complex datasets into readily useable information and be based on “smart” volume or time integrated parameters (e.g., transports), presented as maps, as well as data. The products should be timely for input to ICES Assessment Working Groups

2.6 Some concrete products/ analysis in NORSEPP:

- Visualisation and analysis of historic and present fish distribution (spawning, feeding and fishing areas) in relation to water mass distribution and characteristics (including oxygen conditions). To demonstrate to what degree the fish distribution is explained by the environmental conditions.
- Visualisation and analysis of historic and present larval drift and distribution in relation to water mass distribution and characteristics. To demonstrate to what degree can the highly variable larval drift and its surrounding environment explain recruitment variability
- Produce new historic environmental time series from data and/or models for statistical analysis towards fisheries state variables (abundance, recruitment, growth….) and for possible input to multi species models of population dynamics. Examples of such new time series could be: Transports through selected sections, area coverage (or volume) of water masses or characteristics, turbulence (of relevance to larval feeding), oxygen conditions, the presence or loss of larvae in critical areas, algae abundance (including timing of blooming), primary production, zooplankton abundance and extreme events.
- From the above, demonstrate improved fish stock predictability.

- Use the models to analyse the "optimum" needs and use of observations, and the possible operational services from models and remote sensing to ship surveys.

Observations include:

- IBTS and other ICES and national surveys / moored buoys
- Remote sensing – satellite SST, ocean colour
- CPR and ships of opportunity
- Catch statistics and distribution

The products will be of benefit to everyone contributing. These will be attractive and must be relevant to both the public and the policy makers. Products will be timely, understandable, of relevance to a wide audience as well as addressing policy issues. The latest technologies will be used in the distribution of information e.g., the Internet, XML and GIS. The project will disseminate and publicise new developments to policy makers, environmental managers and the public.

2.7 Data management

The Pilot Project will use data standards that will facilitate co-operation between different agencies and institutes. Operational fisheries oceanography will benefit from a widely accepted data standard (e.g., marine-XML, IODE initiatives).

Groups within the North Sea Pilot Project must reach agreement on a data policy that enables open access for data, to the extent possible. There should be clear conditions for use and appropriate recognition for the data collecting agencies and/or funding organisations (example: EuroGOOS data policy).

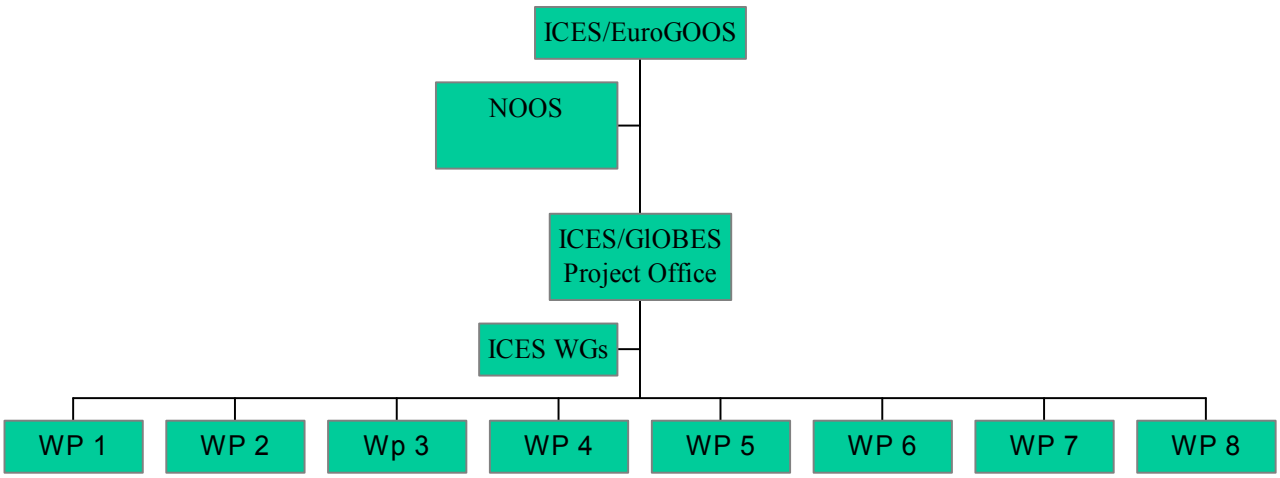
It is necessary to identify and disseminate best practice in management of the rapid increase in data volumes generated by multi-disciplinary automated instrumentation (in-situ, models and remote sensing). Quality control and near real time distribution of large data volumes has an impact on the use of, and developments in, existing infrastructure to fulfil user needs for quick access to data.

The Pilot Project will use an annual web-based reporting system with a standardised format that could be updated as new national information becomes available.

2.8 Organisation

It is a recommended that there should be two co-leaders (one from GOOS and one from ICES) for the Pilot Project.

NORSEPP organisation



3. Current Situation

A Workshop on NORSEPP will be held in Southampton, UK on 25–26 March 2004. The original intention was to provide some integrated fisheries and environmental data in advance of the workshop. To facility this approach permission was sought, and obtained, to use the IBTS database in order to provide spatial and temporal coverage of a variety of species in the North Sea. At the same time North Sea environmental data was to be sourced from a variety of organisations including ICES. However, progress has been slow and the latest efforts revolve around the preliminary catches of cod, herring, haddock, whiting and Norway pout by statistical rectangle for the Quarter 1 survey in 2003. At the time of writing (9 March 2004) the environmental data has still to be obtained. However, it is still hoped to provide the Southampton workshop with demonstration maps of integrated environmental and fisheries data as a first step in the NORSEPP project.

APPENDIX IV: WORKING DOCUCENTS PRESENTED TO THE 2004 IBTSWG MEETING IN LISBON

NB: The documents presented in this Appendix are not to be quoted without prior consultation with the authors. The views presented in those documents are the responsibilities of the authors and do not necessarily represent the views of the IBTS Working Group.

Comparative Fishing Study to assess Catchability of Groundgear A and B During the Quarter 3 North Sea Survey 2003

(Working Document of preliminary analysis of data from year 1 of ongoing data collection)

Helen Fraser
FRS, Marine Laboratory Aberdeen, Scotland, UK
March 2004

In August 2003, a comparative fishing trial was undertaken in the North Sea to compare the catchabilities of 2 different ground-gears on the FRV Scotia using the GOV Trawl BT137. During North Sea trawl surveys it is traditional to change the ground gear depending on the type of substrate being fished on. In Figure 1 the red line shows the line where the ground-gear is traditionally changed. To the north the substrate is generally hard and sandy and ground-gear B is used, to the south the substrate is soft and muddy and ground-gear A used. This study aims to look at the difference in catchability of different fish species by fishing on stations either side of the line using both gears.

Figure 1 shows the location of the fishing stations, 5 stations were fished on either side of the line, each station was fished once with each ground-gear.

In all 32 species were caught in the 20 tows. The 10 most abundant species were Herring, Norway pout, Haddock, Whiting, Common dab, Long rough dab, Grey gurnard, Lemon sole, Sprat and Poor cod. The differences in the total abundance of each species caught using each ground-gear at each station are shown in Annex 1. No obvious differences in the catchability of each ground-gear were observed. A cluster analysis was performed on the data (Figure 2). It can been seen that the data separated out in to 3 spatially separated clusters. In cluster 1 in the east of the North Sea (Figure 3) the fish assemblage was very different to that of the two clusters to the west. The two clusters in the west were similar, but they can be split in to two clusters, cluster 2 in the centre of the North Sea and cluster 1 on the Scottish east coast. Within each cluster there was no separation out of gear type.

The fish caught in the 5 most abundant species (Herring, Norway Pout, Haddock, Whiting and Common dab) were split in to size classes; Small, Medium and Large. The average number of fish caught in each size class was calculated to establish whether the two gears had different catchabilities of fish in each size class. The size classes chosen for each species are shown in Table 1.

Table 1. Length of fish allocated to each size class for each species.

Species	Size Class	Size (cm)
Herring	Small	<17
	Medium	17.5–29.5
	Large	>30
Norway pout	Small	<9
	Medium	10–17
	Large	>18
Haddock	Small	<14
	Medium	15–27
	Large	>28
Whiting	Small	<14
	Medium	15–27
	Large	>28
Common dab	Small	<18
	Medium	19–24
	Large	>25

The results in Figure 4 show that gear B caught the most Herring, Norway pout, Haddock and Whiting in the small and medium size classes. Gear A caught the most Common dab in the small and medium size classes. This result suggests that gear A has a greater catchability of flatfish than gear B and that gear B has a greater catchability of roundfish than gear A. There were too few fish caught in the large size class to make any conclusions about the catchability of larger fish.

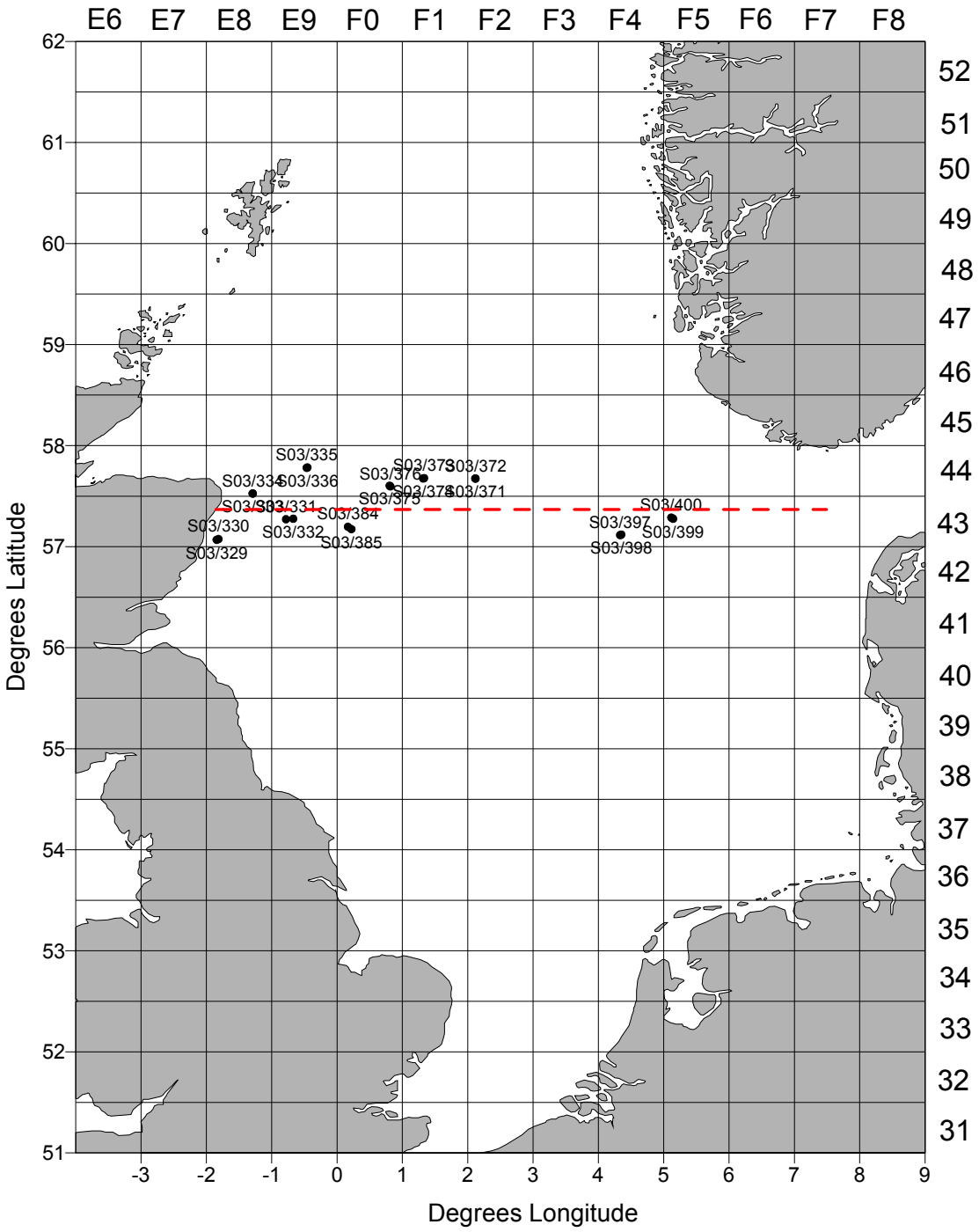


Figure 1. Locations of the fishing stations.

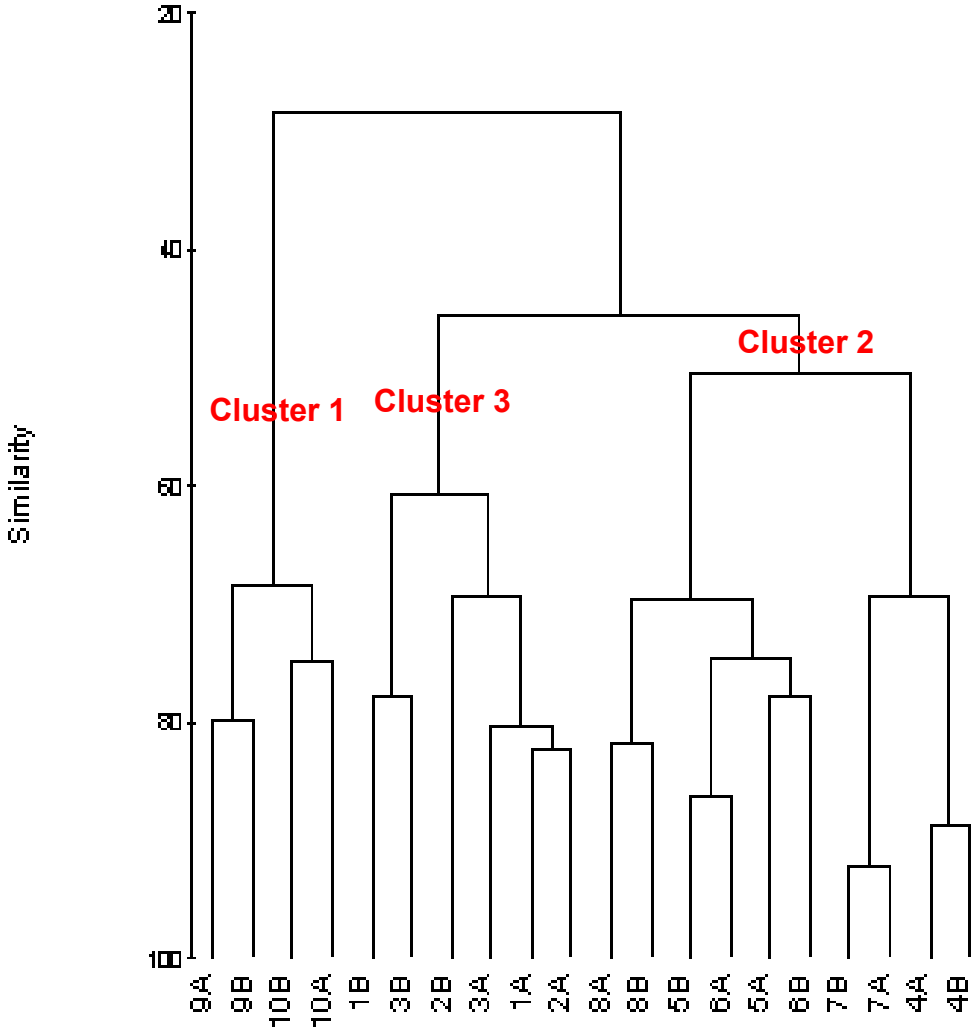


Figure 2. Results of the cluster analysis. Replicates 9 and 10 are separated out as one distinct cluster. The other replicates are more similar but they can be separated out in to 2 clusters.

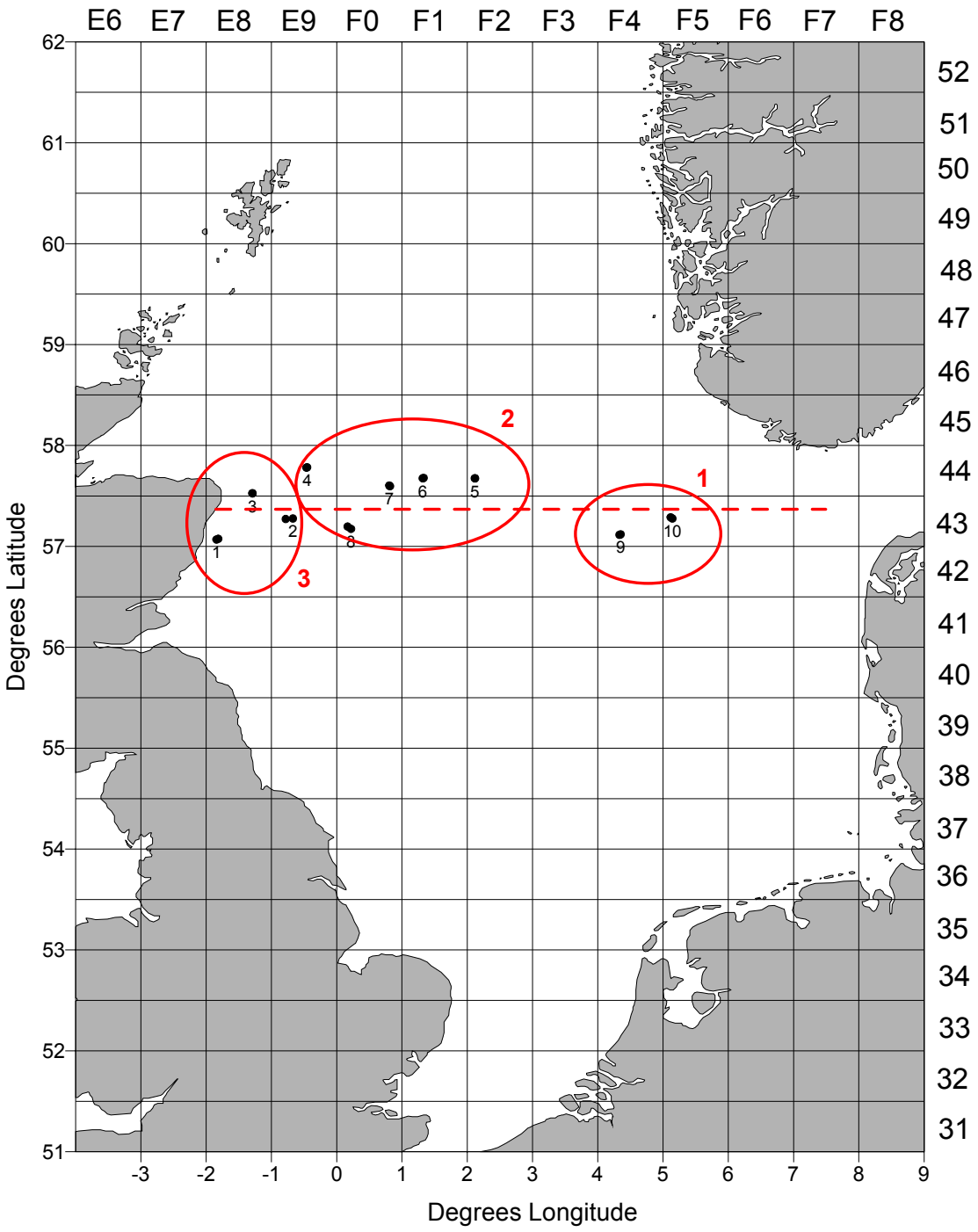


Figure 3. The 3 spatially separated clusters.

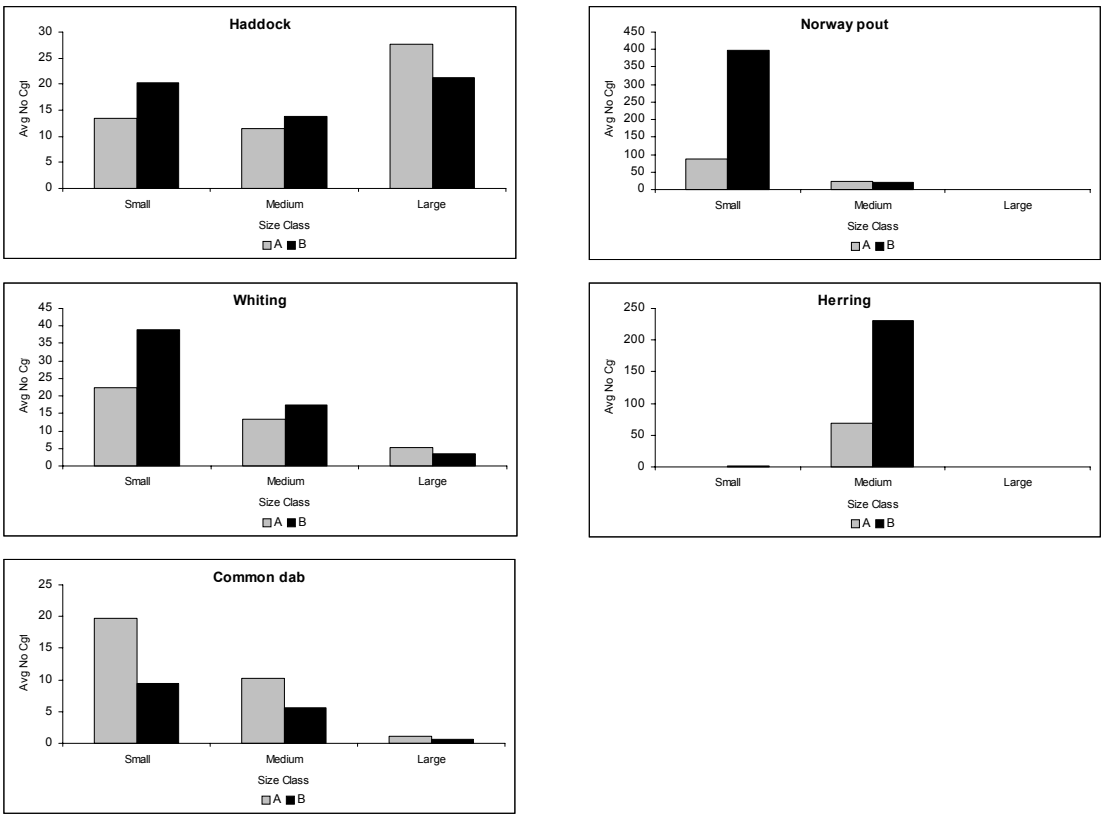


Figure 4. The average catchability of each size class of each species by both gears.

In May 2003 a twin trawling fishing trial was under taken by FRS aboard the FRV “Scotia”. The purpose of the trial was to compare the catchabilities of 2 different ground-gears A and B, using the GOV trawl BT137. The trial was undertaken at one station in the Moray Firth.

Annex 1

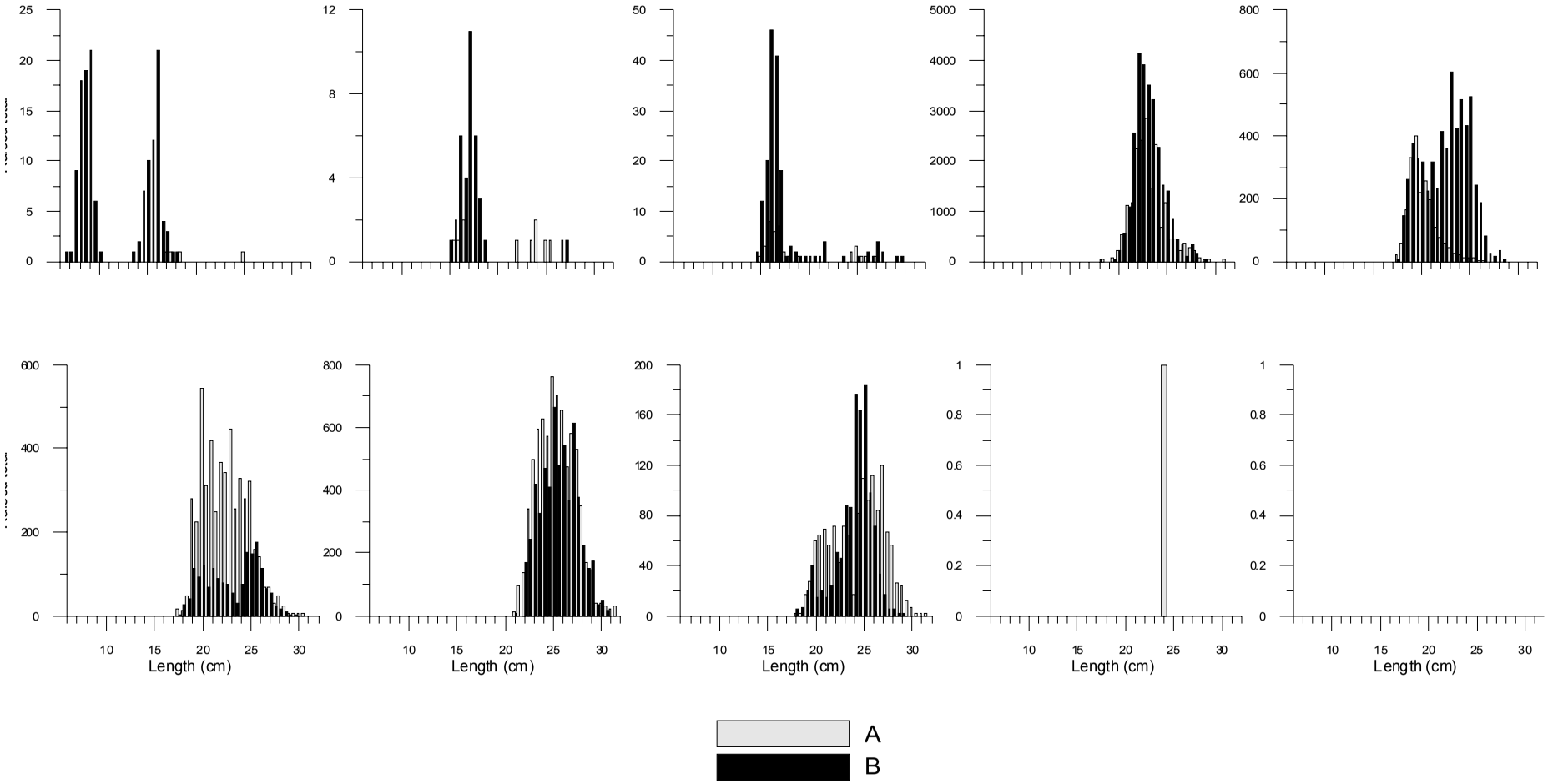


Figure 1. Herring.

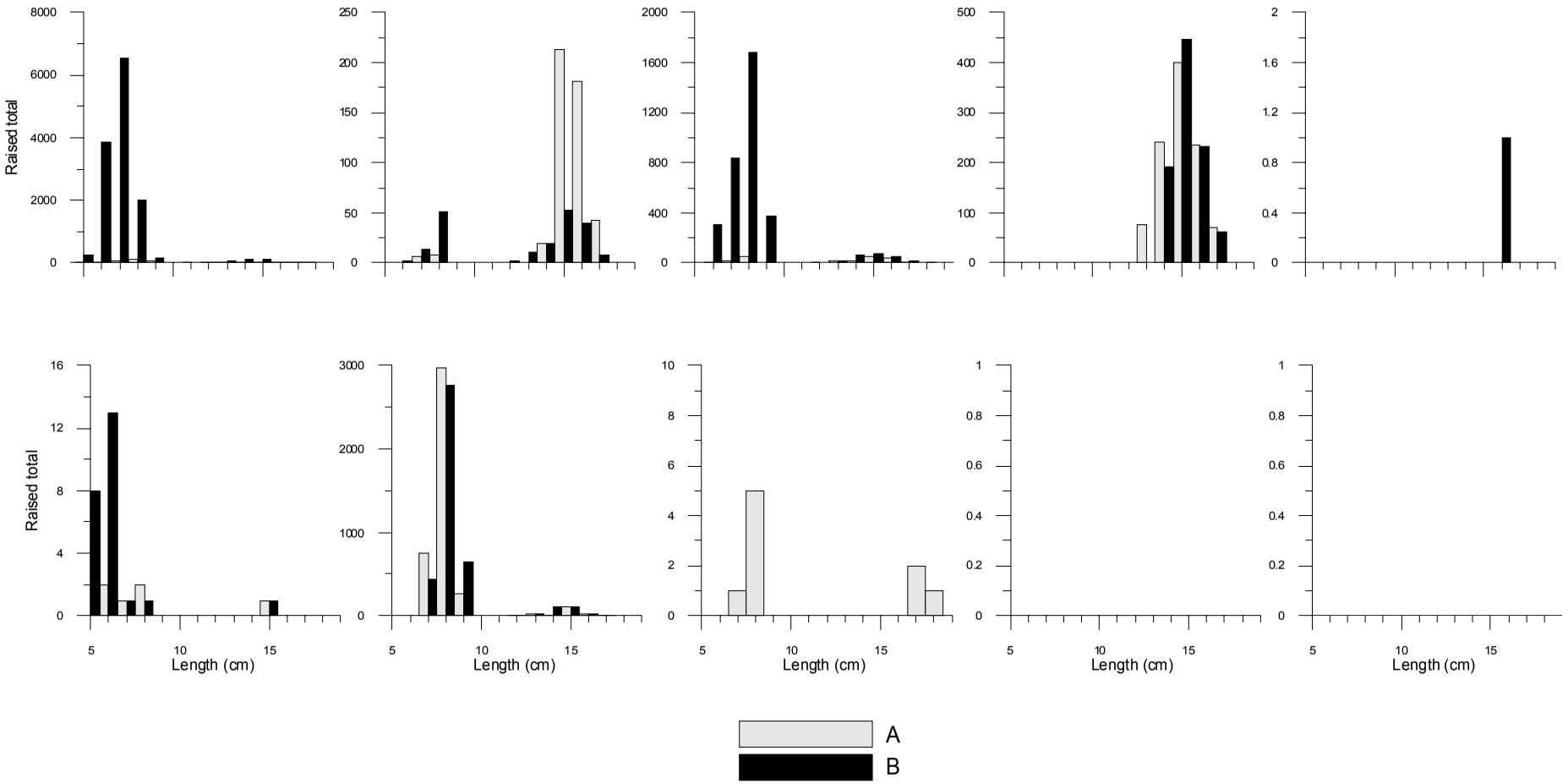


Figure 2. Norway pout.

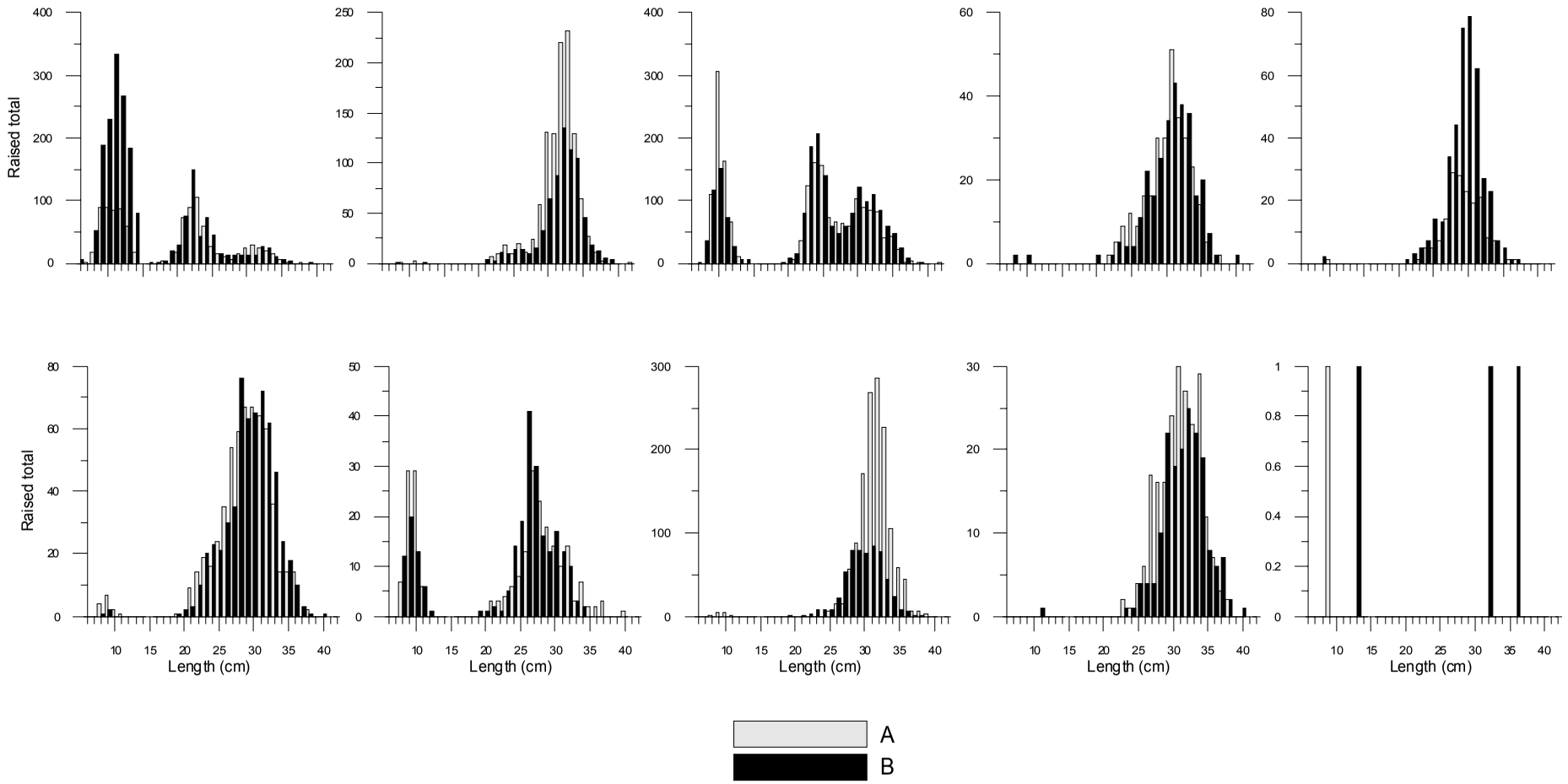


Figure 3 Haddock

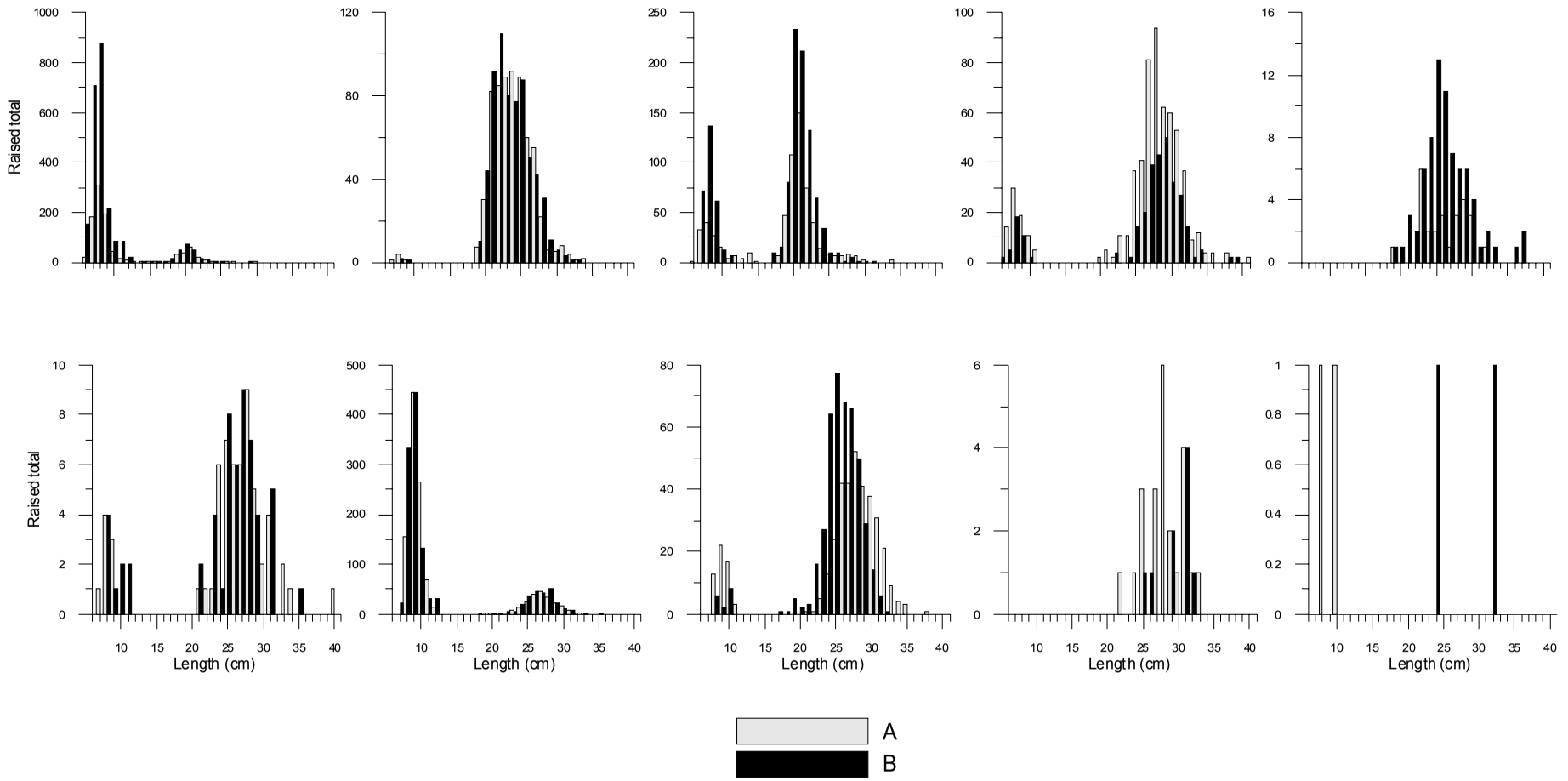


Figure 4. Whiting.

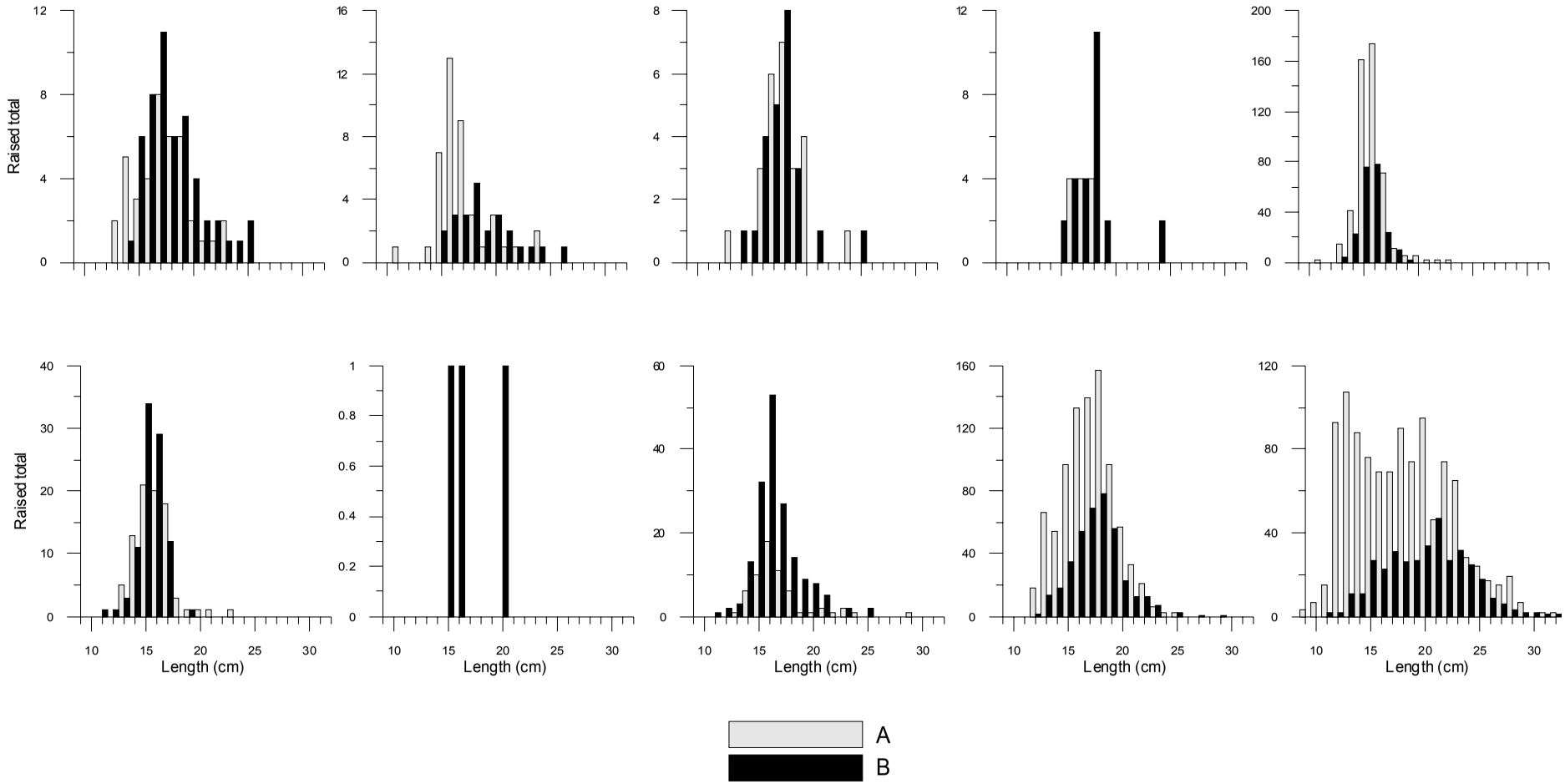


Figure 5. Common dab.

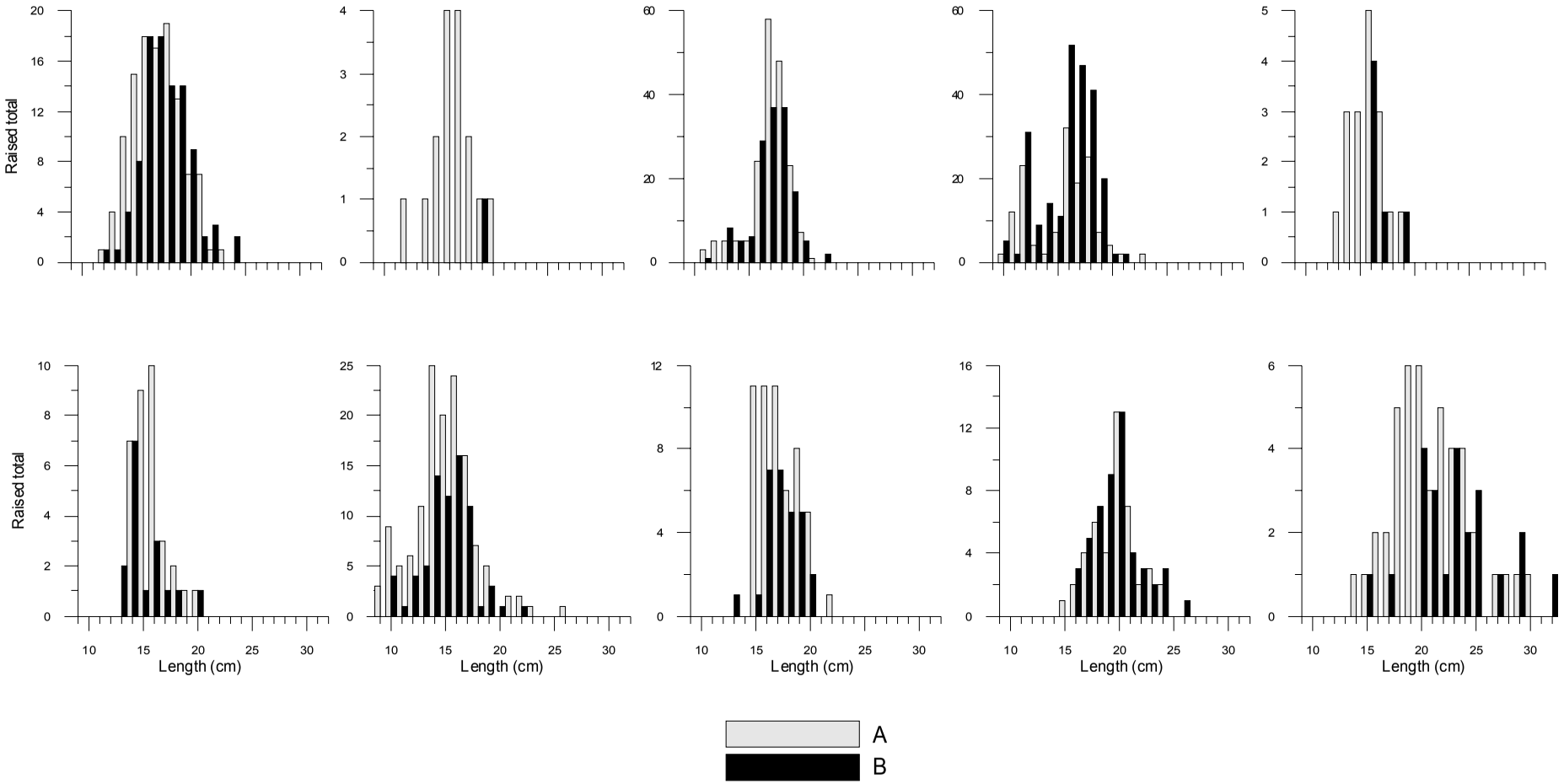


Figure 6. Long rough dab.

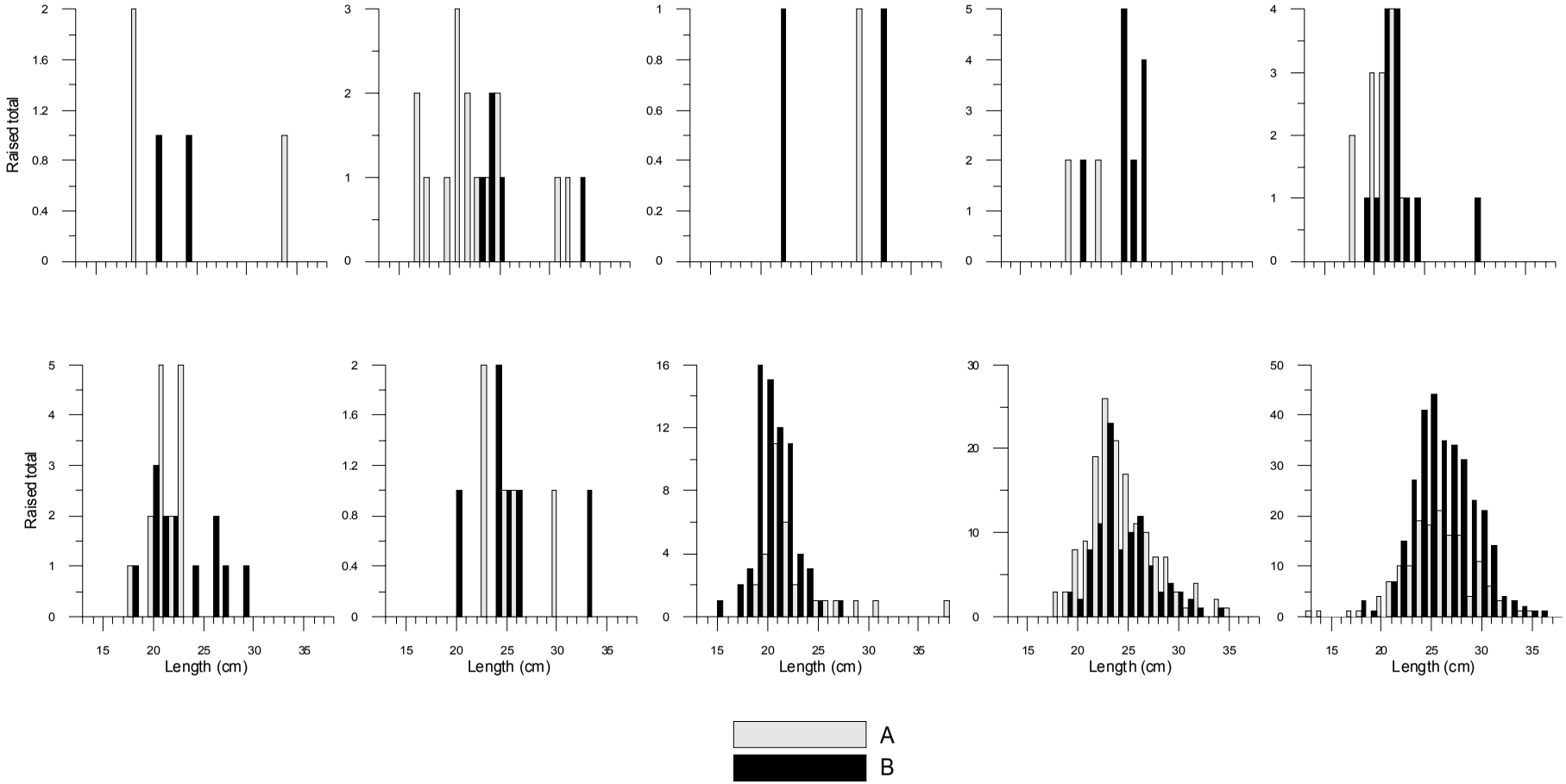


Figure 7. Grey gurnard.

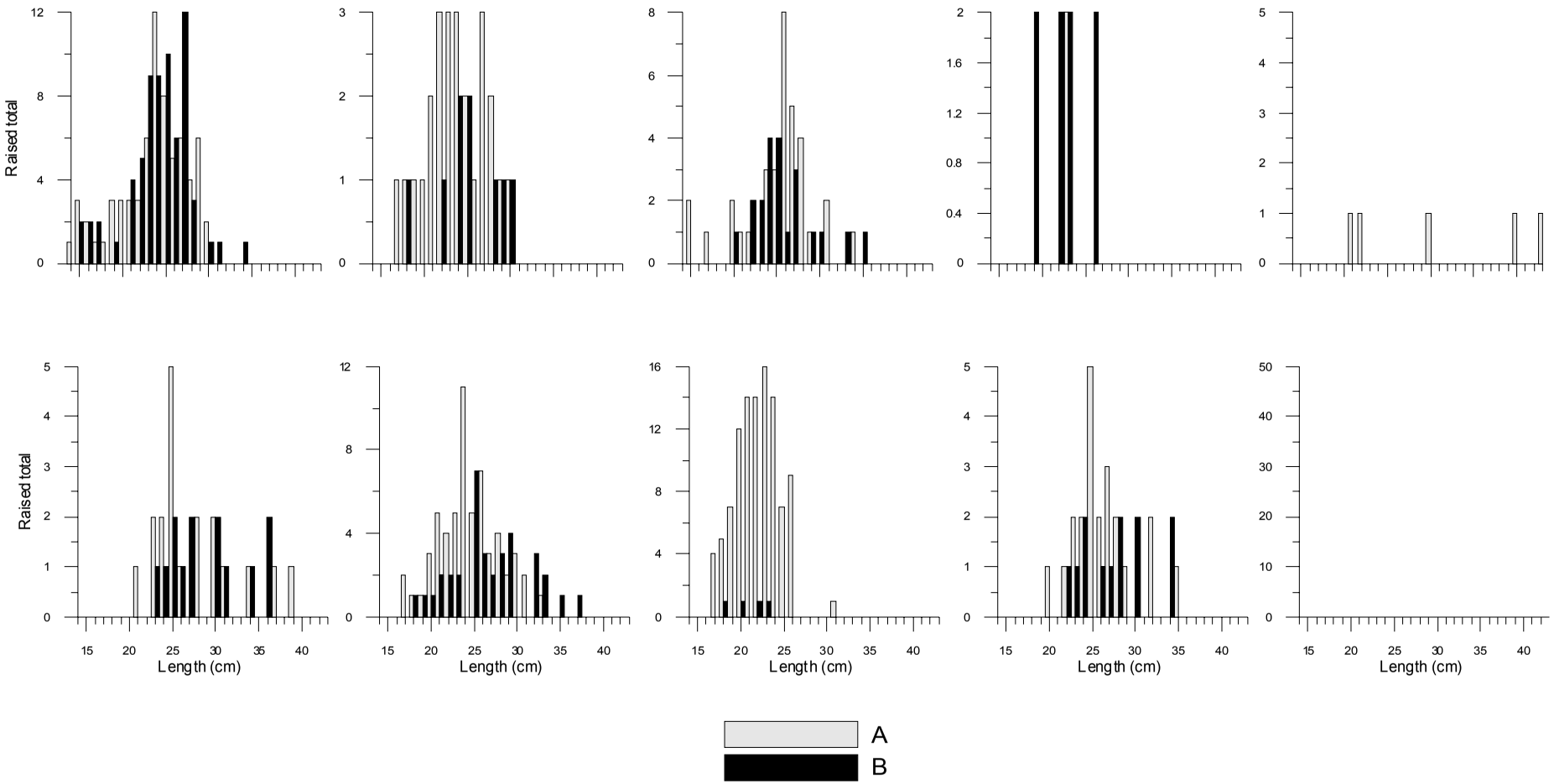


Figure 8. Lemon sole.

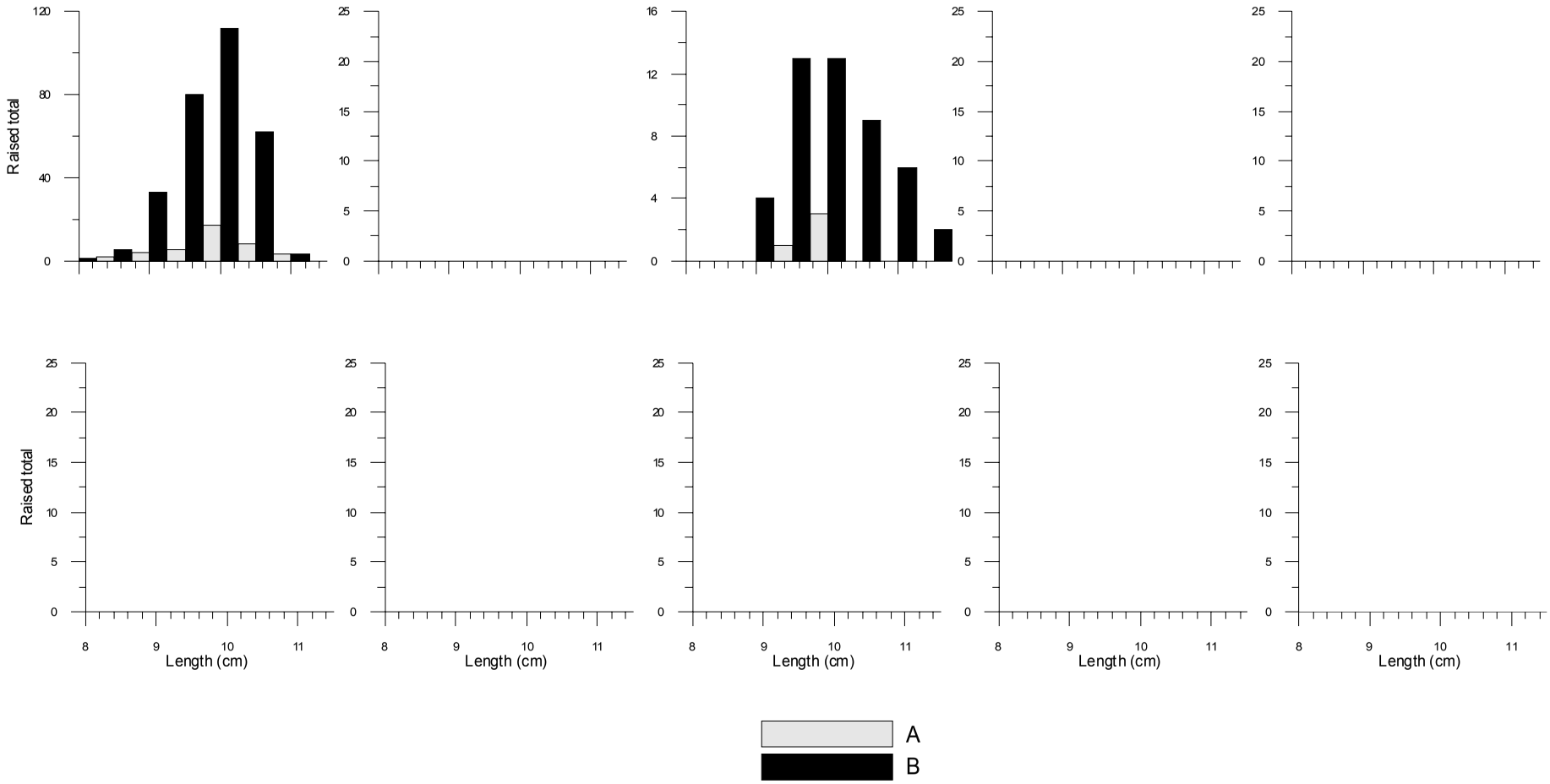


Figure 9. Sprat.

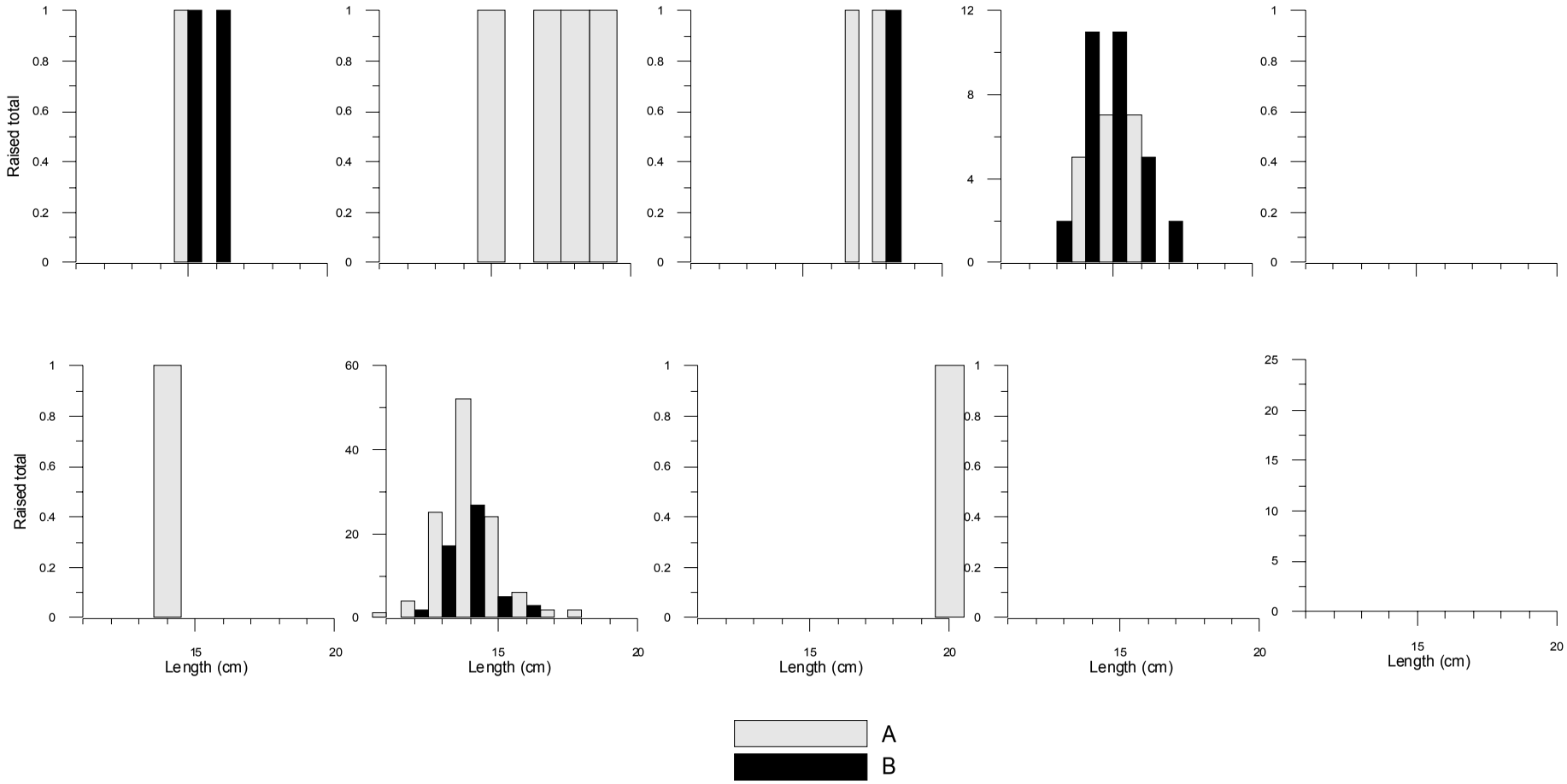


Figure 10. Poor cod.

Vulnerability of bottom fish species to the standard GOV

by

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1. Introduction

Traditionally, catch data from the IBTS have been used in stock assessments calculating indices of the recruiting as well as exploited year-classes of the eight target species. In light of the growing overfishing problems and the integration of the environment into the fishery policy during the last decade, the demands on surveys have generally increased. Now long-term data series like the IBTS are necessary to answer questions related to changes in bottom fish assemblages due to fishing or other human activities and to climate change. Appropriate time series are very scarce, as the gear or parts of the gear which affect the catch efficiency have changed during the period. This paper provides preliminary data that illustrates the degree to which qualitative and quantitative descriptors of fish assemblages in an area depend on the gear used, and provides information on the relative catchability (vulnerability) of bottom fish species between different gears.

The difference between the terms catchability and vulnerability is explained by King (1998). He points out "*the distinction between vulnerability, the proportion of fish in the gear's area of influence which is retained, and catchability, the proportion of fish in the stock which is caught by one unit of effort"*. To avoid misunderstanding we use the term vulnerability, which can vary between 0 (no specimen of a certain species which stays within the path of the gear is retained) and 1 (all specimens are caught).

The areas in which the comparison fishing trials took place are two of the 12 standard areas of the German Small-scale Bottom Trawl survey (GSBTS) which are distributed over the whole North Sea. When ever possible the German research vessels visit these areas and especially Box A, which is situated in the inner German Bight (Figure 1). In December 2001 and January 2002 comparative fishing trials were organized between the research cutter "Solea", using a 7m-beam trawl and an otter trawl (Cod trawl) and the "W. Herwig III", using a GOV and a 2m-beam trawl. In August 2003 there was an opportunity that both vessels stayed for 3 and 2 days in that area, overlapping by one day. In January 2004 the "W. Herwig III" visited Box A and Box N to monitor seasonal changes in the bottom fish and epibenthic assemblages. Additionally to the standard monitoring programmes, the vulnerability of epibenthic and small bottom fish species was investigated by using a triple 2m-beam trawl instead of a single 2m-beam trawl as usual (Figure 2). This experiment was carried out within the scope of the EU-project "MAFCONS"; the abbreviation for "Managing Fisheries to Conserve Groundfish and Benthic Invertebrate Species Diversity".

2. Material and Methods

First experiment:

Within 7 days in December 2001, 54 hauls were conducted aboard "Solea"; 27 by each net, an otter-trawl (Standard Cod Trawl) and a 7m-beam trawl. The position of hauls and the towing directions were randomly distributed within Box A, an area of 10 to 10 nm in the German Bight around 25nm north-west of Helgoland. Each day the gear has changed to avoid the effect of changing environmental conditions during the period. The towing time and speed for these gears were 30 min and 3.5 knots respectively.

Two weeks later (4.–7.1.2002) the FRV "Walther Herwig III" also visited Box A to investigate the species distribution of fish and epibenthos using the GOV standard gear (19 hauls) and 2m-beam trawl (9 hauls). The GOV trawl was towed for 30 min at 4 knots, and the 2m-beam trawl for 5 min at one knot (Table 1).

During the period from mid December to the beginning of January the winter was mild and the hydrographic conditions changed very little (bottom temperature in December and in January between 6.5 and 7°C). Only small fishing activities were observed during that time of the year between Christmas and New Year. Therefore one can expect that the abundance of the bottom species (not pelagic species) were comparable.

Second experiment:

In August 2003 during the third quarter IBTS and the International Beam Trawl Survey (BTS) there was a chance to compare the GOV and the 7m-beam trawl simultaneously for both vessels ("W. Herwig III" and "Solea") fished in Box A for 3 days and 2 days respectively with a one day overlapping (Table 1). Also the stations and towing directions were randomly distributed over the area of 100nm² like in experiment 1.

Third experiment:

In January 2004 during the standard GSBTS into the German Bight 6 hauls were carried out with a triple 2m-beam trawl in addition to the standard single trawl to monitor the epibenthos. Three standard 2m-beam trawls were tied one after the other by steel ropes of 6m length (Figure 2). On the head line of the first one a net sonde was fixed to determine the exact point in time when the gear touched and left the bottom.

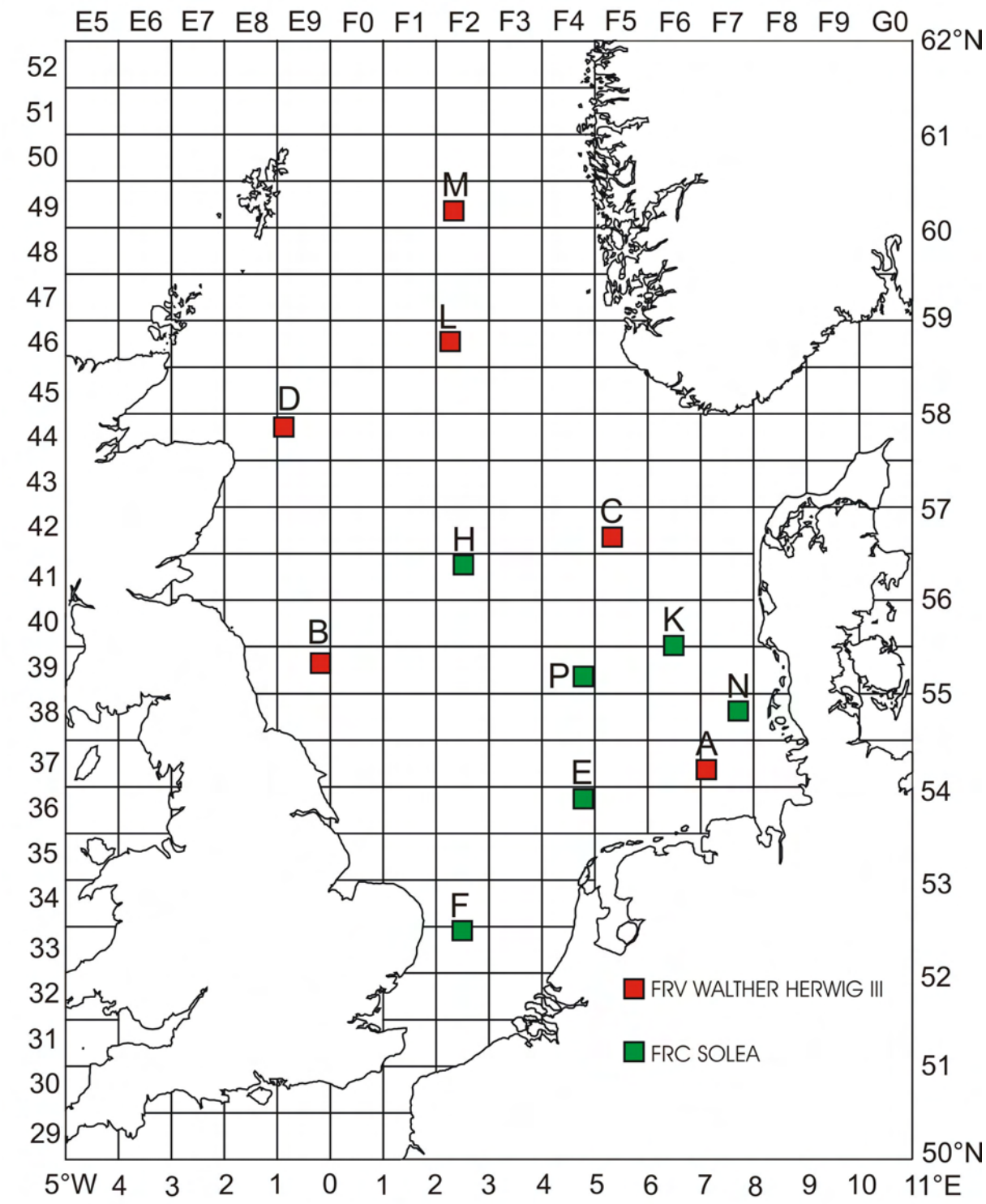


Figure 1. Position of the Boxes of the GSBTS.

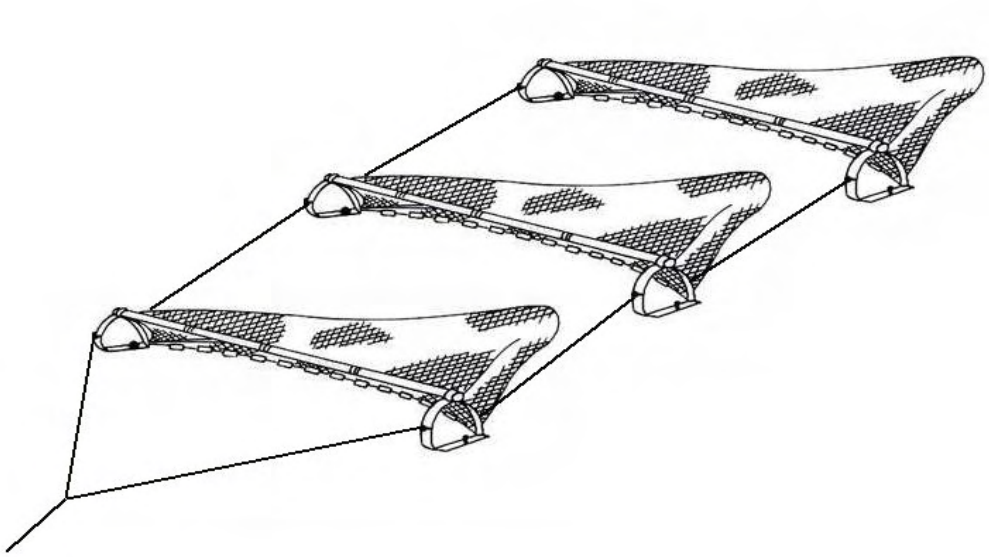


Figure 2. Triple 2m-beam trawl.

Gear description

GOV: The standard GOV equipped with the standard ground rope is exactly and fully described in the manual of the IBTS (Anon. 1999). Therefore only a short description is presented: At the given depths of around 40m in Box A the vertical and horizontal openings of the net were 4.5m and 19m respectively. The standard footrope comprised 20cm rubber discs in the square and 10cm rubber discs in the wings. For better bottom contact iron discs are fixed between the rubber discs to give extra weight. The codend is equipped with a fine mesh liner (20mm).

Cod Trawl: The Standard Cod Trawl, used in the commercial fisheries in the early seventies and as a standard trawl aboard "Solea", has a headline length of 48.68 m and a circumference of 528 meshes at the bosom. At a depth of 40 m the opening height of the net is 3.5 m and the horizontal wing spread 23m. The net is provided with a rubber disc roller gear whose discs have a diameter of 20 cm. The trawl is fitted out with 22kg wing tip weights. The codend was as used in the GOV (Dahm *et al,* 1996).

7m-beam trawl: The larger beam trawl is used in the International Beam Trawl Survey (IBS). It is characterised by a 7m beam, 5 tickler chains and an overall net length of ca 21m. The normal 80mm codend is fitted with a 20 mm mesh liner.

2m-beam trawl: The 2m-beam trawl was developed within the scope of an EU-project to monitor the epibenthos during the Quarter 3 IBTS-survey in the North Sea. It is constructed from galvanised steel. It was fitted with a 20mm mesh and a liner of 4mm knotless mesh was fitted inside the codend. A chainmat was attached to protect the gear and to prevent the catch of heavy stones. It is fully described by Jennings *et al.*. (1999). On the beam a net sonde was fixed to measure the distance over ground and to determine the exact point in time when the gear touched and left the bottom.

Triple beam trawl: Three standard 2m-beam trawls as described above were tied one behind the other by steel ropes of 6m in length on both sides (Figure 2).A net sonde was fixed on the beam of the first net.

To compare the catch rates of the gears the swept area of each haul was calculated by multiplying the towed distance over ground (satellite positions) by the effective width of the gear. The distance between the tips of the wings of both otter trawls were taken as the effective width of the trawls and for the beam trawls the distance between the beam trawl shoes. The catch data of each haul were than standardised to an area of one nautical square mile. Only in the third experiment were catch data standardised to 500m².

Table 1. Data on fishing experiments.

vessel	gear	date	Box	no. of hauls	towing time (min)	mean effective swept area (m³)
Solea	7m-beam trawl	12.-18.Dec.01	A	27	30	22766
Solea	Cod trawl	12.-18.Dec.01	A	27	30	71141
W. Herwig III	GOV	04.-07.Jan.02	A	19	30	79238
W. Herwig III	2m-beam trawl	04.-07.Jan.02	A	9	5	616
W. Herwig III	GOV	14.-16.Aug.03	A	20	30	88701
Solea	7m-beam trawl	16.-17.Aug.03	A	22	15	13014
W. Herwig III	2m-beam trawl	06.-10.Jan.04	A	13	5	460
W. Herwig III	triple beam trawl	07.Jan.04	A	3	5	636
W. Herwig III	2m-beam trawl	11.-12.Jan.04	N	8	5	459
W. Herwig III	triple beam trawl	10.Jan.04	N	3	5	612

3. Results

3.1. First experiment

In Table 2 the mean catch rate standardised to 1nm² and its 95% confidence interval are listed for the 4 gears and all species caught. Mean catch rates with confidence limits >100% should be neglected, for these species were only caught in one or two hauls in very low numbers.

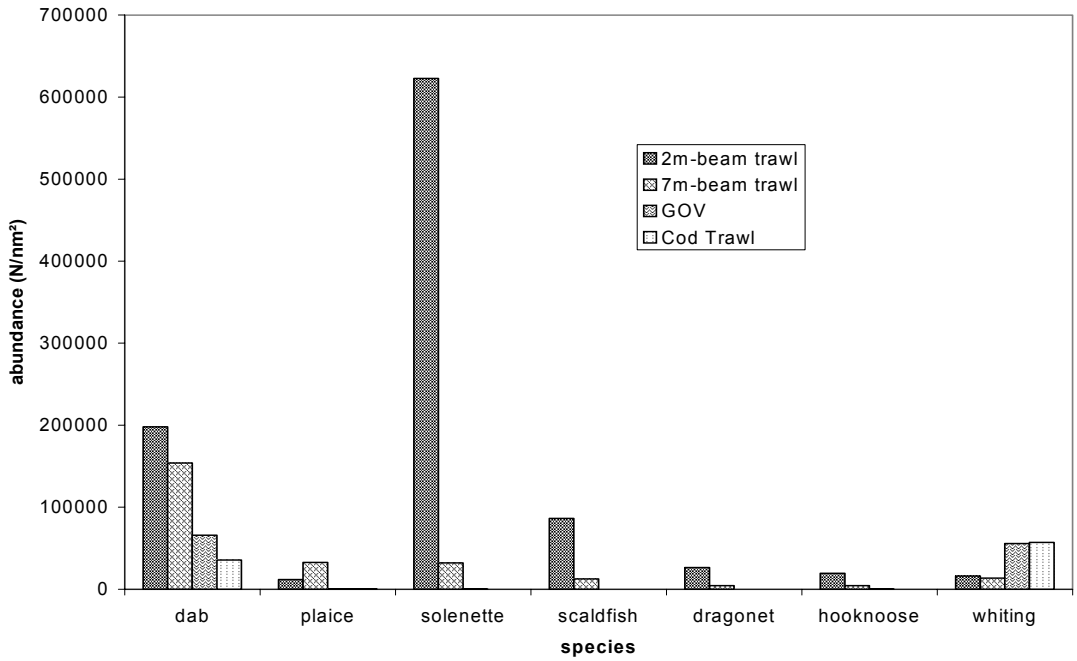


Figure 3. Differences in abundance estimates for several fish species in Box A (German Bight) based on catches of 4 different gears.

The highest abundance for most of the near or in the bottom living species of small size are calculated using the 2m-beam trawl. For solenette the abundance is nearly 20 times higher compared to the 7m-beam trawl. The GOV only catches solenette randomly and in this small flatfish was not recorded in the cod trawl. The same ranking also exists for scaldfish, dragonet, hooknose and dab, whereas the 7m-beam trawl was the most effective gear for larger-bodied demersal species, such as larger plaice. As supposed for whiting the ranking was in the reverse order. The abundance based on the Cod trawl and GOV was 3 to 4 times higher than that of the beam trawls.

3.2. Second experiment

In summer 2003 the GOV was directly compared with the 7m-beam trawl in Box A. As shown in Figure 4 the proportions of bottom and pelagic species in both nets are naturally very similar compared to the results in the first experiment. The standardised mean catch and the 95% confidence interval are listed in Table 3.

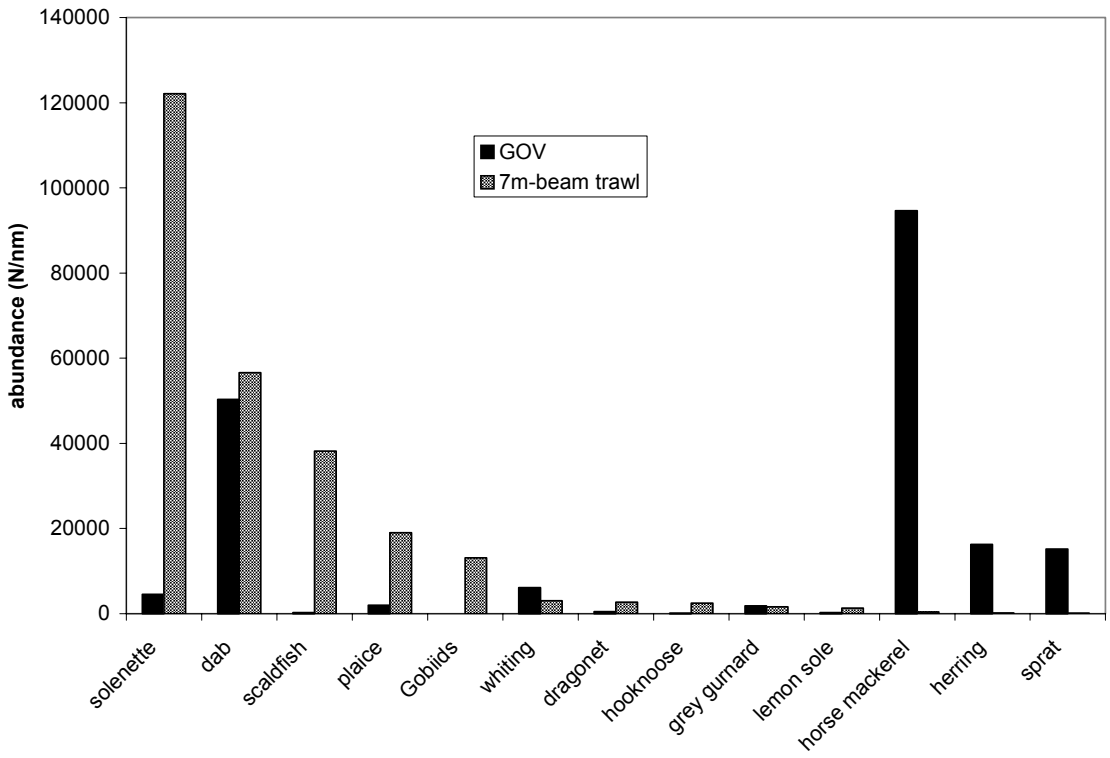


Figure 4. Differences in abundance estimates of fish species in Box A (German Bight) in summer based on catches of the GOV and the 7m-beam trawl.

Table 2: Box A. Winter 2002. Comparison between 4 gears. Catch data are standardised to 1nm²

species	GOV			KJN			7m-beam trawl			2m-beam trawl		
	hauls	standardised mean catch	confidence interval (%)	hauls	standardised mean catch	confidence interval (%)	hauls	standardised mean catch	confidence interval (%)	hauls	standardised mean catch	confidence interval (%)
BUGLOSSIDIUM LUTEUM	19	327	27.2	27			27	32234	14.0	9	622885	38.3
AGONUS CATAPHRACTUS	19	123	44.1	27	15	81.6	27	4451	19.6	9	19481	61.1
CALLIONYMUS LYRA	19	103	53.7	27	20	59.7	27	4591	23.8	9	26381	79.6
CALLIONYMUS MACULATUS	19			27			27			9	1717	196.0
CLUPEA HARENGUS	19	397008	64.9	27	4972	31.8	27			9	526	196.0
ALOSA FALLAX	19	5	134.7	27	5	142.1	27			9		
ECHIICHTHYS VIPERA	19			27	2	196.0	27			9		
ENGRAULIS ENCRASICOLUS	19	9	89.8	27	2	196.0	27			9		
EUTRIGLA GURNARDUS	19	12	77.6	27	61	42.0	27	989	26.3	9		
GADUS MORHUA	19	82	41.2	27	855	21.0	27	710	27.1	9	744	196.0
GOBIIDAE	19			27	5	109.0	27	610	32.3	9		
AMMODYTES MARINUS	19	6	196.0	27			27			9		
HYPEROPLUS LANCEOLATUS	19	7	106.8	27			27			9		
HIPPOGLOSSOIDES PLATESSOIDES	19			27	5	147.2	27			9		
LIMANDA LIMANDA	19	65869	35.9	27	35699	37.9	27	153858	21.9	9	198147	67.7
LIPARIS LIPARIS	19			27			27	5	196.0	9		
MERLANGIUS MERLANGUS	19	55816	35.1	27	57096	20.3	27	13768	25.4	9	16042	90.4
MICROSTOMUS KITT	19	5	196.0	27	12	75.1	27	44	70.2	9		
MULLUS SURMULETUS	19			27	3	135.9	27	27	80.9	9		
MYOXOCEPHALUS SCORPIUS	19	42	49.2	27	19	86.9	27	269	31.4	9		
PETROMYZON MARINUS	19	2	196.0	27			27			9		
PLATICHTHYS FLESUS	19	61	55.0	27	27	47.6	27	12	136.2	9		
PLEURONECTES PLATESSA	19	432	20.5	27	713	44.7	27	32587	15.6	9	11954	63.7
POLLACHIUS POLLACHIUS	19	2	196.0	27			27			9		
POMATOSCHISTUS MINUTUS	19	12	97.6	27			27			9	132696	42.7
PSETTA MAXIMA	19	7	106.9	27	13	78.8	27	24	92.3	9		
RHINONEMUS CIMBRIUS	19	10	89.5	27	5	108.8	27	36	116.8	9	538	196.0
SCOMBER SCOMBRUS	19	4	134.7	27	39	72.0	27			9		
ARNOGLOSSUS LATERNA	19	95	34.7	27			27	12700	10.9	9	86307	26.4
SCOPHTHALMUS RHOMBUS	19			27	2	196.0	27			9		
SCYLIORHINUS CANICULA	19			27	2	196.0	27			9		
SOLEA VULGARIS	19			27	2	196.0	27	46	59.5	9	468	196.0
SPRATTUS SPRATTUS	19	456747	55.4	27	1312	35.6	27	39	105.5	9	722	196.0
SYNGNATHUS ROSTELLATUS	19	5	134.7	27			27	69	67.6	9		
TRACHURUS TRACHURUS	19	75	37.1	27	438	32.6	27	5	196.0	9	538	196.0
TRIGLA LUCERNA	19			27	5	196.0	27			9		
TRISOPTERUS LUSCUS	19			27	16	78.5	27	37	85.2	9		
TRISOPTERUS MINUTUS	19	12	77.5	27	15	70.4	27	12	137.0	9		

Table 3. Box A. Summer 2003. Comparison between GOV and 7m-beam trawl. Catch data are standardised to 1nm².

species	GOV			7m-beam trawl			factor
	hauls	standardised mean catch	confidence interval (%)	hauls	standardised mean catch	confidence interval (%)	GOV/7m BT
BUGLOSSIDIUM LUTEUM	20	4554	45.0	22	122134	9.9	0.037
AGONUS CATAPHRACTUS	20	103	52.0	22	2483	19.8	0.041
CALLIONYMUS LYRA	20	480	20.7	22	2714	13.6	0.177
CLUPEA HARENGUS	20	16253	72.7	22	174	113.7	93.673
ALOSA FALLAX	20	16	55.4	22			-
ECHIICHTHYS VIPERA	20	2	196.0	22			-
EUTRIGLA GURNARDUS	20	1848	41.8	22	1610	24.9	1.148
GOBIIDAE	20			22	13125	29.6	-
GADUS MORHUA	20	2	196.0	22			-
LAMPETRA FLUVIATILIS	20	17	98.3	22			-
LIMANDA LIMANDA	20	50339	15.9	22	56643	9.5	0.889
MELANOGRAMMUS AEGLEFINUS	20	2	196.0	22			-
MERLANGIUS MERLANGUS	20	6152	41.7	22	3063	42.0	2.009
MICROSTOMUS KITT	20	270	25.5	22	1281	21.1	0.210
MULLUS SURMULETUS	20	2	196.0	22			-
MYOXOCEPHALUS SCORPIUS	20	35	55.2	22	200	40.6	0.176
PHRYNORHOMBUS NORVEGICUS	20	2	196.0	22	23	135.4	0.086
PLATICHTHYS FLESUS	20			22	11	196.0	-
PLEURONECTES PLATESSA	20	1993	38.8	22	19018	9.5	0.105
POMATOSCHISTUS MINUTUS	20	316	72.5	22	12	196.0	26.618
PSETTA MAXIMA	20	21	59.6	22	181	51.3	0.116
RHINONEMUS CIMBRIUS	20	75	53.4	22	382	35.9	0.196
ARNOGLOSSUS LATERNA	20	272	31.0	22	38196	10.1	0.007
SCOMBER SCOMBRUS	20	421	58.7	22			-
SCOPHTHALMUS RHOMBUS	20	22	47.2	22	120	54.7	0.186
SOLEA VULGARIS	20	8	90.0	22	616	29.7	0.013
SPRATTUS SPRATTUS	20	15162	62.3	22	84	75.7	179.897
SYNGNATHUS ROSTELLATUS	20	2	196.0	22	12	196.0	0.168
TAURULUS BUBALIS	20			22	12	196.0	-
TRACHURUS TRACHURUS	20	94687	43.9	22	379	56.3	249.566
TRIGLA LUCERNA	20	85	30.8	22	324	34.9	0.262
TRISOPTERUS LUSCUS	20			22	48	196.0	-
TRISOPTERUS MINUTUS	20	6	143.6	22			-

3.3. Third experiment

The third experiment was carried out aboard "W. Herwig III" in January 2004 in the Boxes A and N within the German Bight. It might be expected that catches would decrease from the first to the third net, and the distribution of the total catch in the 3 nets for various species are shown in Figs. 5 to 8. Solenette (*Buglossidium luteum*), a small flatfish of 4–13cm in length lives buried in muddy sand. It seems that the first gear disturbs and digs out the specimens and they are then more vulnerable to the second and third nets. On average, only 26% of the total catch (by number) of solenette was caught by the first gear (Figure 5 and Table 4). The scaldfish (*Arnoglossus laterna*), another small flatfish, showed a similar pattern (31%; Figure 6). The higher agility of species like sand goby (*Pomatoschistus minutes*) and dragonets (*Callionymus* spp.) could explain the higher proportion of catch in the first gear (52% and 37%; Figures 6 and 7 and Table 4).

The mean catch of the single 2m-beam trawl hauls within the standard programme and the confidence interval were included in the figures (vertical lines). It shows that the catch of the single gear is of the same order than the catch of the first gear of the triple beam trawl. That means the two gears behind the first one do not affect the catch efficiency or catching characteristics of the first one (e.g., penetration depth of the chainmat). Therefore the results of the first net of the triple gear can be transferred to the single gear.

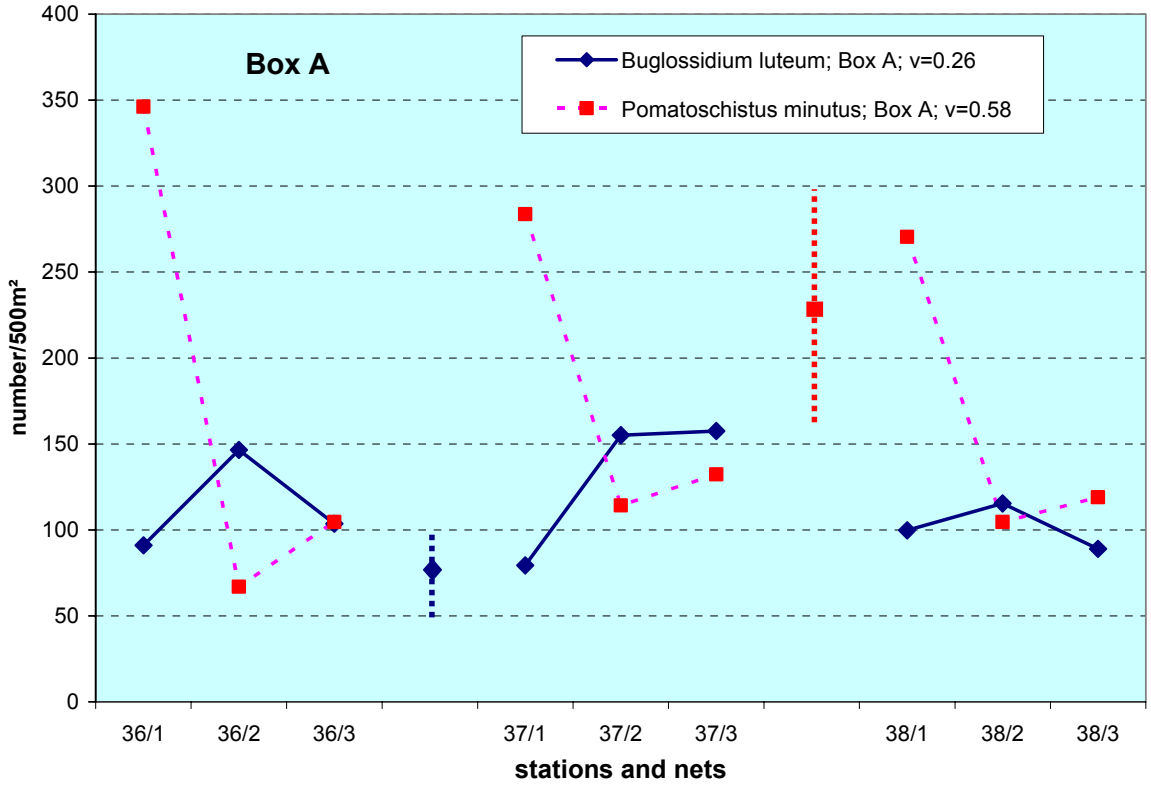
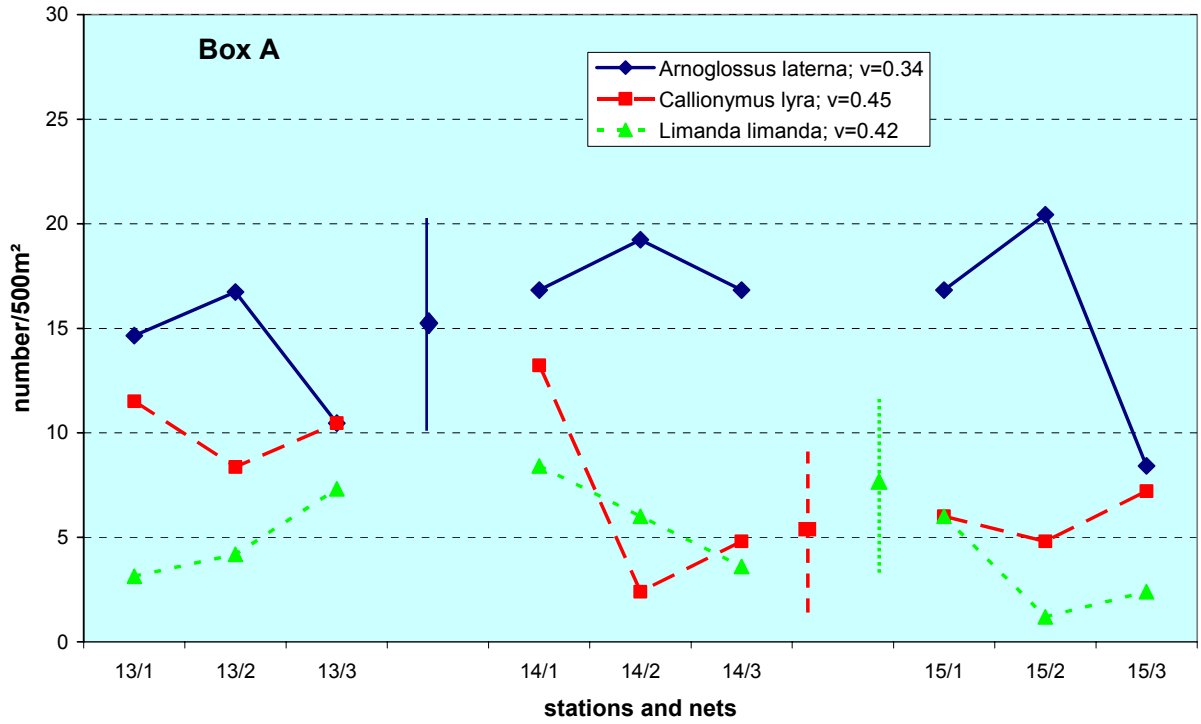


Figure 5. Catch of solenette (B. *luteum*) and sand goby (P. minutes) in the triple 2m-beam trawl on 3 stations in Box A. v= vulnerability to the first gear. The vertical line represents the mean catch and the confidence interval of the single 2m-beam trawl in the Box.



Figuer 6. Catch of scaldfish (A. laterna), dragonet (*C.lyra*) and dab (*L. limanda*) in the triple 2m-beam trawl on 3 stations in Box A. v= vulnerability to the first gear. The vertical line represents the mean catch and the confidence interval of the single 2m-beam trawl in the Box.

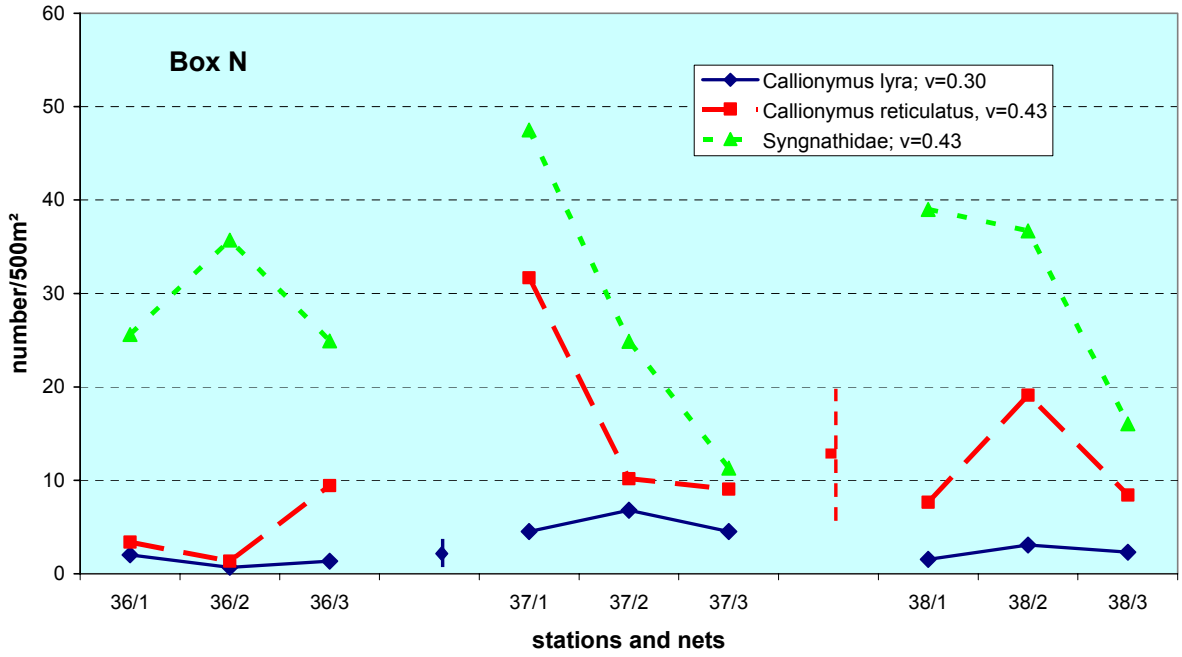


Figure 7. Catch of two dragonet species (*C. lyra* and *C. reticulates*) and pipefish (*Syngnathidae*) in the triple 2 m-beam trawl on 3 stations in Box N. v= vulnerability to the first gear. The vertical line represents the mean catch and the confidence interval of the single 2 m-beam trawl in the Box.

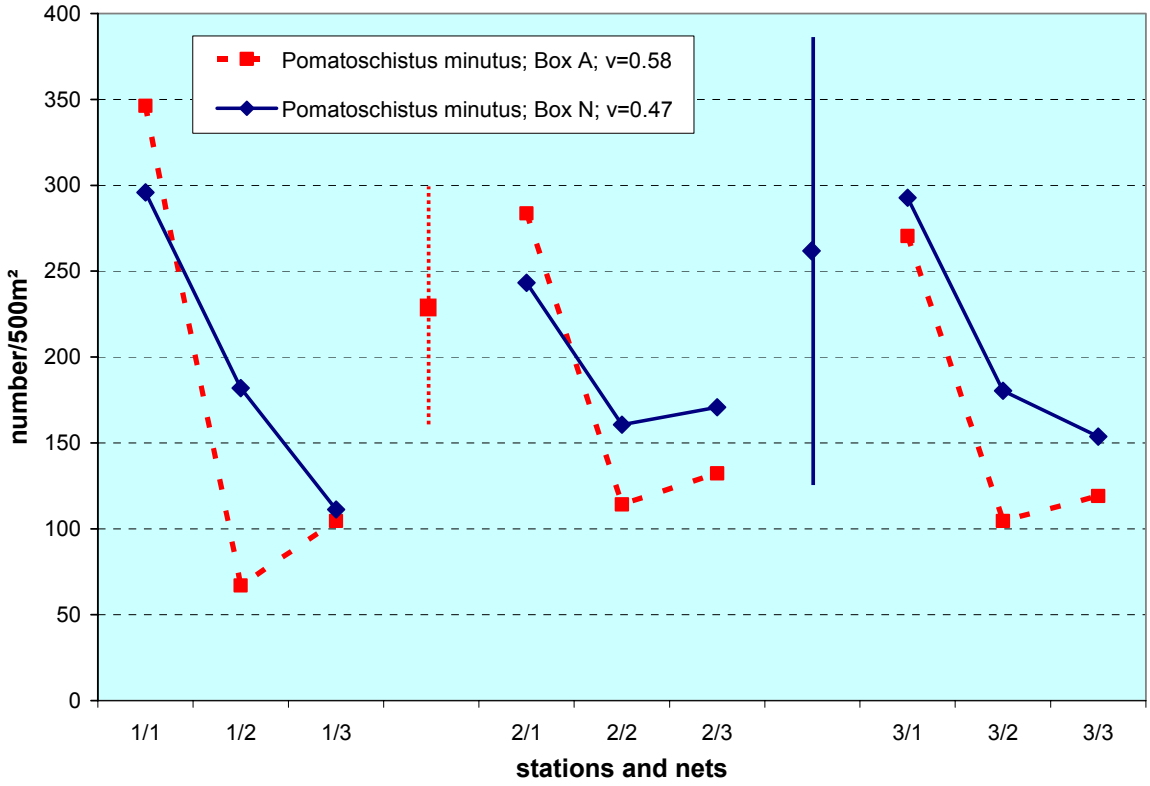


Figure 8. Comparison of the catch of sand goby in the triple 2 m-beam trawl on 3 stations in Boxes A and N respectively. v= vulnerability to the first gear. The vertical line represents the mean catch and the confidence interval of the single 2 m-beam trawl in the Boxes.

3.4. Vulnerability of fish species to the standard GOV

In Table. 4 the factors between the gears (first and second experiment) and of the first gear of the triple 2 m-beam trawl (third experiment) are listed. It is limited to species with confidence intervals of the mean <100%. Factors <1 means that the GOV is not so efficient in relation to the other gear. There are more specimens of this species in the path of the gear and the GOV only catch a part of them. Therefore the vulnerability of this species related to the GOV is smaller than 1.

The last row of Table. 4 gives the vulnerability of the species to the standard GOV. Factors between the GOV and another gear of >1 result in a vulnerability of 1 according to the definition. From the first and second experiments the lowest value per species was taken. If more than one value per gear combination was available the mean was calculated. If the lowest factor was found in the quotient GOV/2m-beam trawl then this value was multiplied with the factor derived from the third experiment, assuming that the triple beam trawl catches the fish completely.

If a species like sole was only caught randomly by the single or triple 2m-beam trawl a correction factor from the third experiment could not calculated. For it was possible for plaice the vulnerability index given in Tab 4 for both species is of the same order of magnitude. Looking at the results of the second experiment the factor for sole is only one tenth of the factor for plaice and this relationship seems realistic from the experience. Taking this into account the vulnerability index for sole should be estimated at a value of 0.001 or lower.

In Figure 9 the differences in the vulnerability between the species are illustrated.

Table 4. Factors between the gears (1st and 2nd experiment) and of the first gear of the triple 2m-beam trawl (3rd experiment); limited to species with confidence intervals of the mean <100%. Vulnerability of the species to the standard GOV.

species	experiment 1 GOV/KJN	experiment 1 GOV/ BT7m	experiment 2 GOV/ BT7m	experiment 1 GOV/BT2m	experiment 3 1st gear/triple trawl	vulnerability GOV
TRISOPTERUS MINUTUS; poor cod	0.78120	-	-	-	-	0.78120
MERLANGIUS MERLANGUS; whiting	0.97757	4.05404	2.00885	3.47933	-	0.97757
CLUPEA HARENGUS; herring	79.85051	-	-	-	-	1.00000
MYOXOCEPHALUS SCORPIUS; bullrout	2.26146	0.15709	0.17551	-	-	0.15709
SPRATTUS SPRATTUS; sprat	348.07765	-	179.89678	-	-	1.00000
PSETTA MAXIMA; turbot	-	-	0.11637	-	-	0.11637
MICROSTOMUS KITT; lemon sole	-	-	0.21049	-	-	0.21049
EUTRIGLA GURNARDUS; grey gurnard	-	-	1.14816	-	-	1.00000
RHINONEMUS CIMBRIUS; four-bearded rockling	-	-	0.19632	-	-	0.19632
TRIGLA LUCERNA; tub gurnard	-	-	0.26249	-	-	0.26249
SCOPHTHALMUS RHOMBUS; brill	-	-	0.18619	-	-	0.18619
SOLEA VULGARIS; sole	-	-	0.01294	-	-	0.01294
TRACHURUS TRACHURUS; horse mackerel	-	-	249.56559	-	-	1.00000
PLEURONECTES PLATESSA; plaice	0.60557	0.01325	0.10480	0.03611	0.24289	0.00877
ARNOGLOSSUS LATERNA; scaldfish	-	0.00745	0.00713	0.00110	0.30843	0.00034
POMATOSCHISTUS MINUTUS; sand goby	-	-	-	0.00009	0.52000	0.00005
LIMANDA LIMANDA; dab	1.84512	0.42811	0.88870	0.33242	0.34289	0.11398
BUGLOSSIDIUM LUTEUM; solenette	-	0.01013	0.03728	0.00052	0.26047	0.00014
AGONUS CATAPHRACTUS; hooknoose	8.03056	0.02757	0.04139	0.00630	0.18353	0.00116
CALLIONYMUS LYRA; dragonet	5.27144	0.02246	0.17684	0.00391	0.37427	0.00146

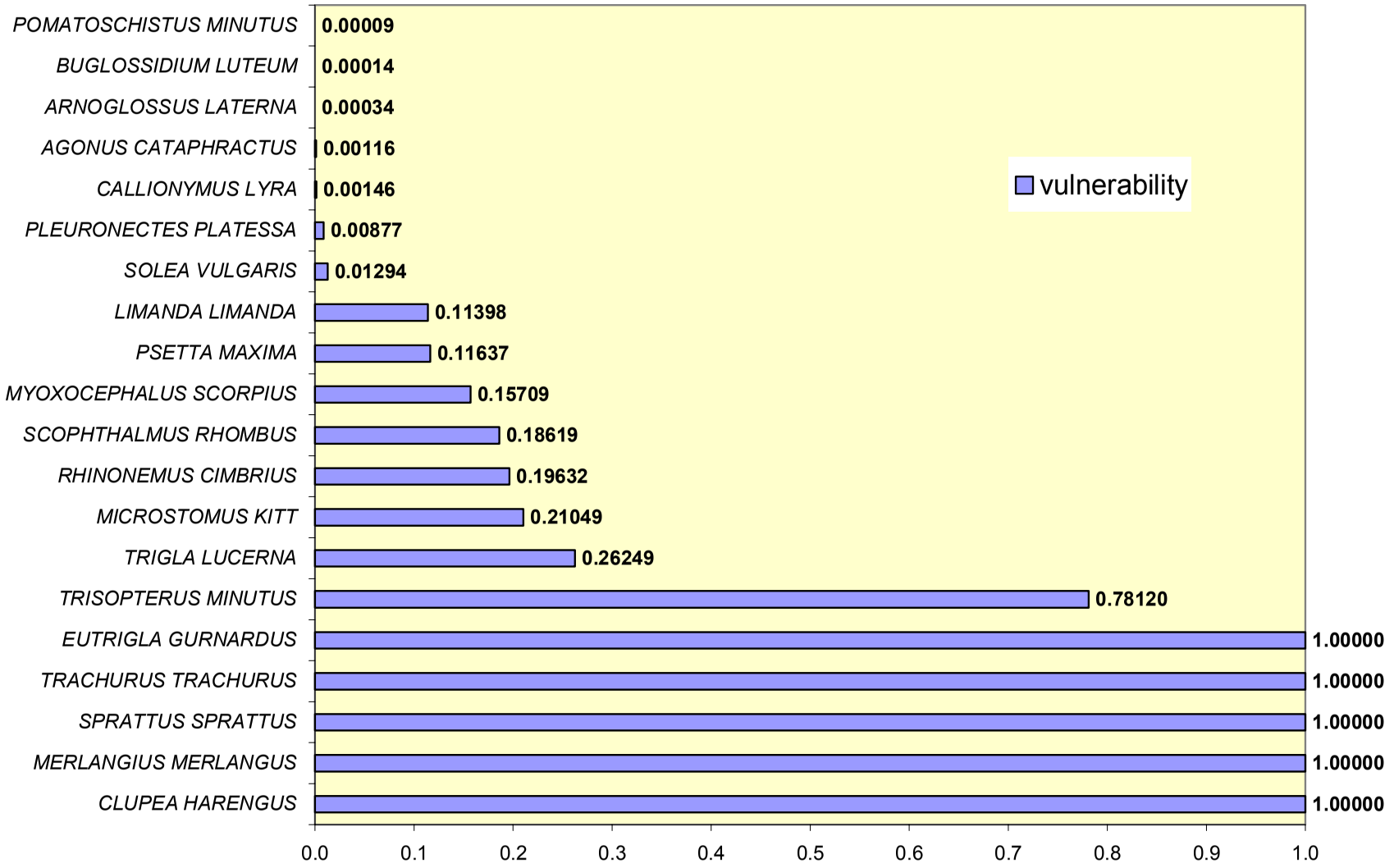


Figure 9. Vulnerability index of fish species related to the standard GOV.

4. Discussion

The catches of a bottom trawl like the GOV contain a large variety of species; from small flatfishes like sole buried in the sediments to pelagic species living normally in the upper layer of the water column. On one hand, the contact of rubber disk ground ropes of the gear with the bottom is weak and individuals living in or very close to the bottom like solenette (*Buglossidium luteum*), hooknose (*Agonus cataphractus*) and dragonets (*Callionymidae*) are underrepresented in the catches. On the other hand bottom trawls catch pelagic fish that are occasionally within the path of the net. Another characteristic of the GOV is the small-meshed liner of 20 mm mesh opening in the cod-end to prevent escapement of small fish through the meshes. Thus, the qualitative and quantitative species composition and the length composition in the catch from an area are gear specific and might not be representative of the fish fauna living in that area. Therefore, when describing a fish assemblage by using data from a single gear, the caveat that the description is gear-dependent should be highlighted.

The factors between the gears and the vulnerability indices given in this paper should not be used as conversion factors between the gears. The vulnerability of a species not only depends on gear parameters which can be kept constant, but is also dependent on environmental parameters like sediment structure and on the characteristics of the species like length composition, physiological condition and differences in the behaviour of age or length groups during fishing. All these parameters will change with the density of the species in front of the gear and perhaps with the time of the year.

A comparison of fish abundance data or only a list of them from different time periods not taken by the same gear can create lots of misunderstandings. After the collapse of the cod stocks on the Labrador Shelf the Canadian colleagues changed the survey gear from a gear targeting cod to a gear targeting shrimps. It was impossible for them to find realistic conversion factors from the old to the new survey gear to avoid a break in the time series (Rätz, pers. comm.). Rijnsdorp *et al.* (1996) compared catch rates of demersal trawl surveys carried out in the period 1990–1995 and 1906 - 1909. For solenette (*Buglossidium luteum*) the standardised catch rate was 457.6 in the beginning and 0.5 at the end of the last century, caught by a not precisely described otter trawl (OT20) and the GOV respectively. In a preliminary version of the actual North Sea Quality Status Report these two figures were compared by other authors and it was stated that not only the target species but also the by-catch species have decreased; for example solenette by a factor of 900.. Taking the vulnerability index for solenette of 0.00014 into account a value of 0.5 means that at least 3500 individuals in the path of the gear were not caught by the GOV. This example may show how difficult, and in some cases impossible it is to compare abundance indices derived from different gears. On the other hand this example and the results of the comparison experiments emphasize the importance of gear standardization and the validity of the basic rule: “Never change the survey gear” without having very serious reasons for that.

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Structure and spatial distribution of fish assemblages in the Celtic sea

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Introduction

The spatial pattern of groundfish distribution is influenced by the physical environmental and habitat characteristics. In the case of shelf and upper-slope demersal assemblages, depth is often reported to be the main gradient along which faunal changes occur.

Data collected during annual autumn surveys are used to analyse the spatial organisation of species assemblages on the continental shelf and upper-slope of the Celtic sea in the period 1997–2003. The study of the multispecies spatial structures over time requires the combined analysis of different tables of species density sampled at different stations. This is done using multitable factorial analysis.

Data

Ifremer carries annually and in autumn a programme of groundfish surveys on the Bay of Biscay and Celtic Sea shelves and upper slopes (figure 1). The survey area lies between 51°20' N and 43°30' N and is stratified according to latitude and depth. A 36/47 GOV bottom trawl is used with a 20 mm mesh codend liner. Haul duration is 30 minutes at a towing speed of 4 knots. Fishing is mainly restricted to daylight hours (ICES, 1997).

Catch weight and catch numbers are recorded for all species. All fish species and only selected shellfish ones are measured.

Data used for this analysis was collected during seven surveys from 1997 to 2003 and from 458 hauls carried out in the Celtic sea. A total of 107 fish species were caught but only 52 species which the mean relative frequency of occurrence was at least 5% (Table 1) were included in the analysis. The numbers per tow were log-transformed before conducting the analysis to down-weight high catches.

Methods

To identify the stable part of the spatial structuring of the assemblages requires the combined analysis of the seven survey data. Although they are still little used in fishery sciences and marine ecology (Gaertner *et al.,* 1998; Gaertner *et al.,* 1999; Poulard *et al.,* 2003; Poulard and Léauté, 2002; Sánchez and Serrano, 2003), multitable factorial analyses (Escofier and Pagès, 1994; Lavit *et al.,* 1994) offer a suited theoretical frame work to investigate the reproducibility of multivariate structures.

The analysis methods used are described in Gaertner *et al.* (1998). The table of the total number of individuals per survey and per species (matrix with seven surveys and 52 species) was used as input in a between-class correspondence analysis (CoA) to test a survey effect in the overall species composition. The significance of between survey differences was checked by means of a permutation test.

The Correspondence Analysis (CoA) is a good ordination technique to extract from the species data the dominant pattern of variations in community compositions in relation to one or more environmental gradients (Ter Braak, 1986).

The CoA version (Gaertner *et al.,* 1998) of the STATIS multitable method (Lavit *et al.,* 1994) was used to provide a simultaneous representation of the seven surveys studied. The first stage of the STATIS method consists of calculating a scalar product matrix between species for each survey. This allows comparison between surveys by calculation of a scalar product matrix between surveys. The seven elements of the first eigenvector of the diagonalized between survey scalar product matrix are then used to weight the seven species scalar product matrices to construct a mean table of

maximum inertia (compromise table). The analysis (Correspondence Analysis) of the compromise table defines axes and components which express the stable part of the spatial structures studied. In addition, the projection of the separated analyses of the seven survey matrices into the compromise space allows to plot the species trajectories that represent the temporal variations of each species with respect to the common structure and to locate sampling stations in this space.

Automatic classification techniques were used to establish a cluster distribution of the sampling sites. Hierarchical ascending classification (Legendre and Legendre, 1998) was applied to the factorial co-ordinates of sites in the space defined by STATIS. Ward's criterion was used to aggregate two elements by minimising intra-cluster inertia. The groups identified by truncating the tree diagram are consolidated by aggregation around mobile centres (Banfield and Raftery, 1992).

The calculations were performed with the ADE4 software which is freely available at the following address: http://pbil.univ-lyon1.fr/ADE-4/ADE-4F.html

The indicator value index proposed by (Dufrêne and Legendre, 1997) (1997) was used to identify the species that characterise each habitat. The specificity and fidelity of each species *s* in each cluster *g* are measured by the values A_{sg} and B_{sg} respectively:

$A_{sg} = Nindividuals_{sg} / Nindividuals_{g+}$

$B_{sg} = Nhauls_{sg} / Nhauls_{+g}$

where $Nindividuals_{sg}$ is the mean abundance of species *s* across hauls of cluster *g* while $Nindividuals_{g+}$ is the sum of the mean abundances of species *s* over all clusters. At the same time $Nhauls_{sg}$ is the number of hauls in cluster *g* where the species *s* is present and $Nhauls_{+g}$ is the total number of hauls in that cluster.

The specificity value (A_{sg}) is maximum when species *s* is present in cluster *g* only, whereas the fidelity value (B_{sg}) is maximum when species *s* is present in all hauls of cluster *g*. The specificity and fidelity represent information independent from each other, their product multiplied by 100 produces a percentage of the indicator value $IndVal_{sg}$:

$IndVal_{sg} = A_{sg} * B_{sg} * 100$

This index is maximum when all individuals of a species are found in a single cluster of hauls and when the species occurs in all hauls of that cluster. For this study, only species having an indicator value greater than 25%, being the threshold level used by Dufrêne and Legendre (1997), were retained in the assemblages. The species that have an indicator value greater than or equal to 25% are symmetrical indicators. The other species must be considered accidental or anecdotal. Furthermore, the indicator value indices were computed for each level of the hierarchical classification. The analysis of the variation of indicator value as the number of clusters increases points out the characteristic species for each hierarchical level.

The calculations were performed with the software freely available at the following address: http://mrw.wallonie.be/dgrne/sibw/outils/indval/home.html

Results

The inter-survey CoA demonstrates the occurrence of weak but significant annual variations ($p<0.05$) in overall species composition between the seven surveys at the scale of the study area.

A good fit of most surveys to the common structure

The STATIS results (Table 2) show that the contribution (weight) of the seven surveys to the construction of the compromise table is balanced. The fit (Cos^2) of each survey to the compromise table is relatively constant and does not exhibit temporal trend. The lowest values observed for 2001 indicate that the structure of this survey is less taken into account in the compromise table. The projections of the first two axes of the separate CoAs of 1997 to 1999, 2002 and 2003 confirm the very good fit of these surveys with the compromise (figure 2). The fit is less good for 2001 survey and to a lesser extent for 2000 survey. Despite some annual variations, the spatial organisation of the assemblages shows a good degree of reproducibility over the whole study period.

Main spatial structuring directions

The first three axes of the correspondence analysis of the compromise table explain more than one-third of the inertia of the stable part of the spatial structuring of the assemblages (inertia being the multivariate measure of the amount of variation in the data set). They represent the main spatial organisational directions of the species assemblages. The analysis will be limited to these three components.

Figure 3A shows the axis 1 direction is perpendicular to the general isobath orientation. Thus, the depth gradient is the main structuring factor over the survey area. The second axis (figure 3B) contributes mainly to divide the Celtic shelf in two parts on both sides of 49°30'N latitude. Along this axis, a small group of hauls come apart in the shallower north-eastern part of the study area. The third axis (figure 3C) contributes mainly to separate the northern part of the shelf (north to 49°30'N) in two parts on both sides of 9°30'W longitude. Again, a small group of hauls is identified in the shallower part of the study area.

Space partitioning and species assemblages

The analysis of the hierarchical tree obtained (figure 4) suggests that a partition in four clusters (figure 5A) will give us a robust picture of the fish species assemblages. Two other possibilities have been considered: partitions in five and six clusters. A five group partition (figure 5B) simultaneously maximises the two criterions:

- between-clusters inertia with four clusters having a relative contribution ranging from 21 to 30% and one a low contribution (2%)
- number of species with Indval maximum indicator values (11 species for 5 clusters against 7 for 4 and 2 for 6).

To allow a better understanding of the spatial organisation both 4 and 5 groups partitioning are mapped (Figure 5). Each of the species assemblage identified was found every year. The spatial distribution and species composition of the 5 different groups identified are described as follows.

Southern Celtic shelf assemblage (cluster 1, figure 5B)

The average depth of the 105 hauls included in this group is 155 m (minimum 120 and maximum 269 m). All of the seven typical species of this assemblage (Table 3) are eurytopic species, *i.e.,* typical of groups identified at a higher level of the hierarchy. This is shown by the fact that for all those species, the max Indval values are found for a partitioning in less number of cluster. The decrease of the species indicator value, as the number of groups increases, indicates that the hauls where the species is abundant are spread among different groups.

Western Celtic shelf assemblage (cluster 2, figure 5B)

The average depth of the 71 hauls included in this group is 195 m (minimum 130 and maximum 334 m). From the 10 typical species of this group 4 are characteristic species (Table 3), their Indval value being maximum. The other 6 are all eurytopic species.

Intermediate zone (cluster 3, figure 5B)

The average depth of the 129 hauls included in this group is 155 m (minimum 46 and maximum 276 m). None species characterises this group.

Northeast Celtic shelf assemblage (cluster 4, figure 5B)

The average depth of the 101 hauls included in this group is 118 m (minimum 86 and maximum 157 m). From the 15 typical species of this group 6 ones are characteristic species (Table 3). The Indval values for *Merlangius merlangus, Limanda limanda, Pleuronectes platessa* are close to their maximum values (respectively 89, 82 and 68) obtained with a partition in 4 clusters. Three species (*Chelidonichthys gurnardus, Trisopterus esmarkii, Gadus morhua*) are eurytopic while the last three ones are rather ubiquitous species, *i.e.,* abundant over all the study area.

Central Celtic shelf assemblage (cluster 5, figure 5B)

The average depth of the 52 hauls included in this group is 83 m (minimum 57 and maximum 120 m). From the 6 typical species of this group only one *(Enchelyopus cimbrius)* is a characteristic species (Table 3). However, *Glyptocephalus cynoglossus* maximum Indval value is obtained for a 6 group partition, which separates this cluster in two (Figure 3). Thus the 6 cluster partitioning isolates the hauls where this species is most abundant. Although *Merluccius merluccius* is a ubiquitous species, its presence as a typical species in this group is due to the existence of a nursery in the area.

Discussion

Depth appears as the most structuring factor but other environmental variables, like bottom temperature, may be spatially organised in a similar way. Bottom type contribute also to the structuring process (Poulard *et al.*, 2003).

Celtic Sea species assemblages and bottom types

Distribution of bottom types on the Celtic shelf (Pinot, 1972) is mapped in figure 6. In the northern part of the area, the following successive types are found from east to west: prelittoral sands and pebbles, sparse mud, mixed sand and mud, hard grey fine sand. This succession fits well with the arrangement of the clusters 4, 5, 3 and 2.

Most of the typical species (Table 3) of the central assemblage (cluster 5) are known to be found on soft sandy and muddy bottoms.

The North/South separation around 49°30'N defined by the second axis corresponds to a shift North to South from a heterogeneous to a more homogeneous substrate, dominated by fine sand (figure 6).

The intermediate zone (cluster 3) remains uncharacterised. One possible reason could be related to the spatial scale used and this zone may show some structure at a smaller spatial scale. Also, in fringe areas, more than one assemblage can sometimes be sampled by the gear during the tow.

Species assemblages and Evhoe stratification sampling scheme

Table 4 crosses the number of hauls per species assemblage and per stratum used for the Evhoe sampling scheme. It shows that southern (cluster 1), Northeast (cluster 4) and central (cluster 5) Celtic shelf assemblages fit individually with a limited number of strata. On contrary, western assemblage encompasses a large depth range (120–400 m) along the shelf edge. The transition zone is more represented between 120–160 m and slightly more in the north of the study area (Cc4).

In all of the strata, more than 50% of the hauls belongs to one cluster. For 6 out of 9 strata, more than 68% of the hauls belongs to one cluster. This provides some evidence that the current definition of the strata is relevant.

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Table 1. List of the 52 fish species present on average in a least 5% of the hauls carried out in autumn from 1997 to 2003.

Species	Occurrence (%)	Mean density (number/km2)	Mean weight (kg/km2)
Scyliorhinus canicula (Linnaeus, 1758)	84	276	79.8
Galeorhinus galeus (Linnaeus, 1758)	7	1	9.8
Mustelus asterias Cloquet, 1821	5	2	4.8
Squalus acanthias Linnaeus, 1758	24	15	23.7
Raja clavata Linnaeus, 1758	7	3	7.5
Raja montagui Fowler, 1910	6	8	7.3
Leucoraja fullonica (Linnaeus, 1758)	15	3	3.5
Leucoraja naevus (Müller Figure Henle, 1841)	50	36	28.7
Dipturus batis (Linnaeus, 1758)	12	4	9.1
Conger conger (Linnaeus, 1758)	33	10	16.4
Clupea harengus Linnaeus, 1758	8	1607	246.5
Sardina pilchardus (Walbaum, 1792)	15	382	40.5
Sprattus sprattus (Linnaeus, 1758)	16	553	5.6
Argentina sphyraena Linnaeus, 1758	87	1601	65.6
Argentina silus (Ascanius, 1775)	21	238	27.2
Gadus morhua Linnaeus, 1758	31	15	46.3
Gadiculus argenteus argenteus Guichenot, 1850	42	313	2.2
Melanogrammus aeglefinus (Linnaeus, 1758)	63	2095	200.7
Merlangius merlangus (Linnaeus, 1758)	40	2343	313.8
Micromesistius poutassou (Risso, 1827)	86	29456	932.9
Trisopterus minutus (Linnaeus, 1758)	83	5363	216.1
Trisopterus esmarkii (Nilsson, 1855)	35	9201	201.9
Molva molva (Linnaeus, 1758)	20	7	16.3
Molva dypterygia (Pennant, 1784)	6	3	0.1
Enchelyopus cimbrius (Linnaeus, 1766)	10	7	0.2
Gaidropsarus vulgaris (Cloquet, 1824)	14	3	0.4
Phycis blennoides (Brünnich, 1768)	33	21	2.0
Merluccius merluccius (Linnaeus, 1758)	94	656	56.4
Lophius piscatorius Linnaeus, 1758	67	32	31.8
Lophius budegassa Spinola, 1807	49	19	12.2
Zeus faber Linnaeus, 1758	53	29	20.3
Capros aper (Linnaeus, 1758)	77	20820	689.5
Helicolenus dactylopterus dactylopterus (Delaroche, 1809)	23	29	2.6
Chelidonichthys gurnardus (Linnaeus, 1758)	50	271	17.2
Chelidonichthys lucerna (Linnaeus, 1758)	5	1	0.5
Chelidonichthys cuculus (Linnaeus, 1758)	70	431	38.3
Trachurus trachurus (Linnaeus, 1758)	85	20042	1255.7
Mullus surmuletus Linnaeus, 1758	6	2	0.4
Callionymus lyra Linnaeus, 1758	73	185	7.6
Callionymus maculatus Rafinesque, 1810	62	151	1.6
Scomber scombrus Linnaeus, 1758	38	2744	253.3
Lepidorhombus whiffiagonis (Walbaum, 1792)	91	312	40.9
Lepidorhombus boscii (Risso, 1810)	21	29	2.9
Arnoglossus laterna (Walbaum, 1792)	16	21	0.3
Arnoglossus imperialis (Rafinesque, 1810)	58	220	4.4
Pleuronectes platessa Linnaeus, 1758	14	24	8.4
Glyptocephalus cynoglossus (Linnaeus, 1758)	19	25	4.8
Hippoglossoides platessoides (Fabricius, 1780)	42	552	17.7
Limanda limanda (Linnaeus, 1758)	15	119	7.3
Microstomus kitt (Walbaum, 1792)	39	56	9.6
Solea solea (Linnaeus, 1758)	9	5	1.3
Microchirus variegatus (Donovan, 1808)	66	171	6.0

Table 2. STATIS analysis: contribution of each survey to the construction of the compromise table (weight) and fit of each survey to the common space (Cos^2).

Survey	No. of sampled stations	Weight	Cos^2
1997	52	0.38	0.56
1998	59	0.38	0.51
1999	59	0.39	0.59
2000	54	0.36	0.46
2001	78	0.33	0.35
2002	78	0.39	0.59
2003	78	0.40	0.63

Table 3. List of the 38 typical species having a significant Indval index value ($p<0.05$) greater than or equal to 25%. Maximum value refers to species Indval values obtained through the first 6 successive hierarchical clustering levels.

Celtic shelf species assemblage	Cluster	Species	Indval	Maximum value
Southern	1	*Chelidonichthys cuculus*	68	
		Trachurus trachurus	67	
		Capros aper	61	
		Arnoglossus imperialis	48	
		Leucoraja naevus	47	
		Trisopterus minutus	40	
		Sardina pilchardus	38	
Western	2	*Lepidorhombus boscii*	85	yes
		Gadiculus argenteus argenteus	76	
		Micromesistius poutassou	59	
		Helicolenus dactylopterus dactylopterus	53	yes
		Lepidorhombus whiffiagonis	53	
		Microchirus variegatus	48	
		Lophius budegassa	47	
		Argentina silus	42	yes
		Callionymus maculatus	41	
		Arnoglossus laterna	32	yes
Intermediate zone	3	*None*		
Northeast	4	*Merlangius merlangus*	86	
		Limanda limanda	81	
		Pleuronectes platessa	66	
		Microstomus kitt	64	yes
		Sprattus sprattus	63	yes
		Chelidonichthys gurnardus	61	
		Trisopterus esmarkii	58	
		Clupea harengus	46	yes
		Raja montagui	45	yes
		Melanogrammus aeglefinus	45	
		Callionymus lyra	44	
		Solea solea	42	yes
		Scyliorhinus canicula	38	
		Gadus morhua	33	
		Raja clavata	25	yes
Central	5	*Hippoglossoides platessoides*	59	
		Glyptocephalus cynoglossus	58	
		Phycis blennoides	55	
		Merluccius merluccius	42	
		Enchelyopus cimbrius	37	yes
		Squalus acanthias	29	

Table 4. Number of hauls per fish species assemblage and Evhoe stratum.

Stratum	Depth range (m)	Cluster					Total
		1	2	3	4	5	
Cc3	80–120			10	4	51	65
Cc4	120–160		15	57		33	105
Cc5	160–200		11	5			16
Cc6	200–400		14	1			15
Cn2	30–80				28		28
Cn3	80–120			1	20	15	36
Cs4	120–160	63	12	43		2	120
Cs5	160–200	39	8	10			57
Cs6	200–400	3	11	2			16
Total		105	71	129	52	101	458

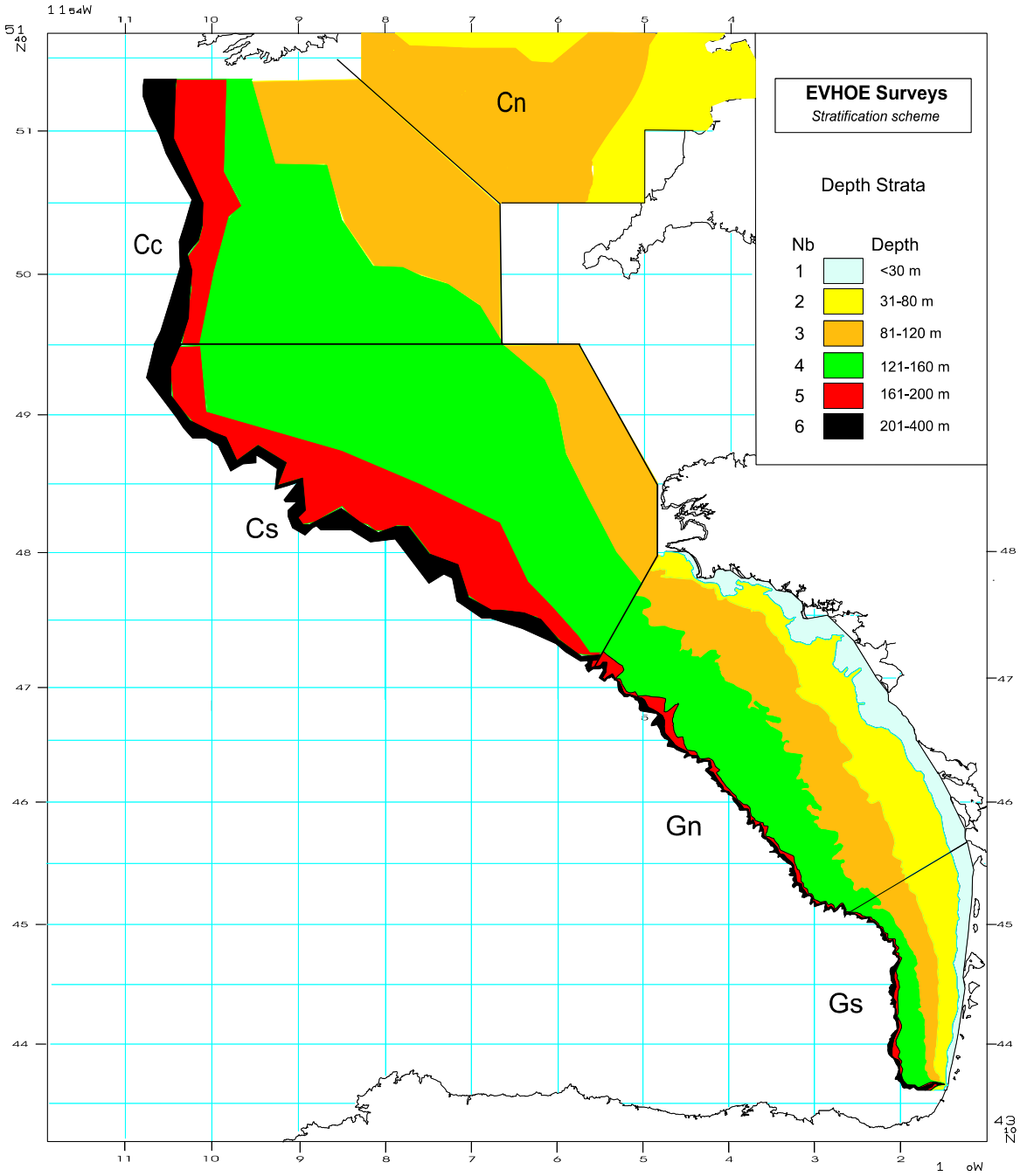


Figure 1. Evhoe survey: study area and stratification scheme.

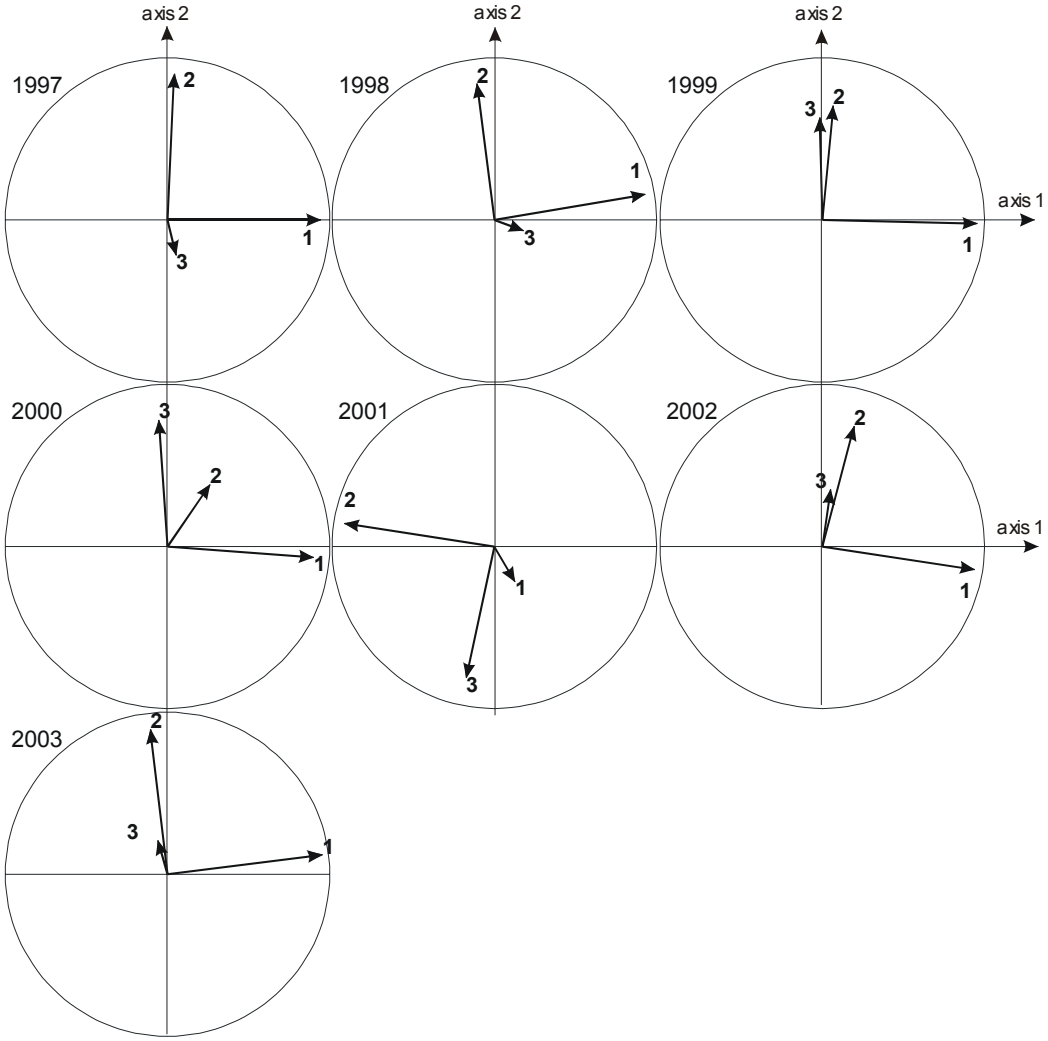


Figure 2. Projection of the first three factorial axes of the seven separate correspondence analysis of each survey (arrows) on the first two factorial axes of the STATIS compromise.

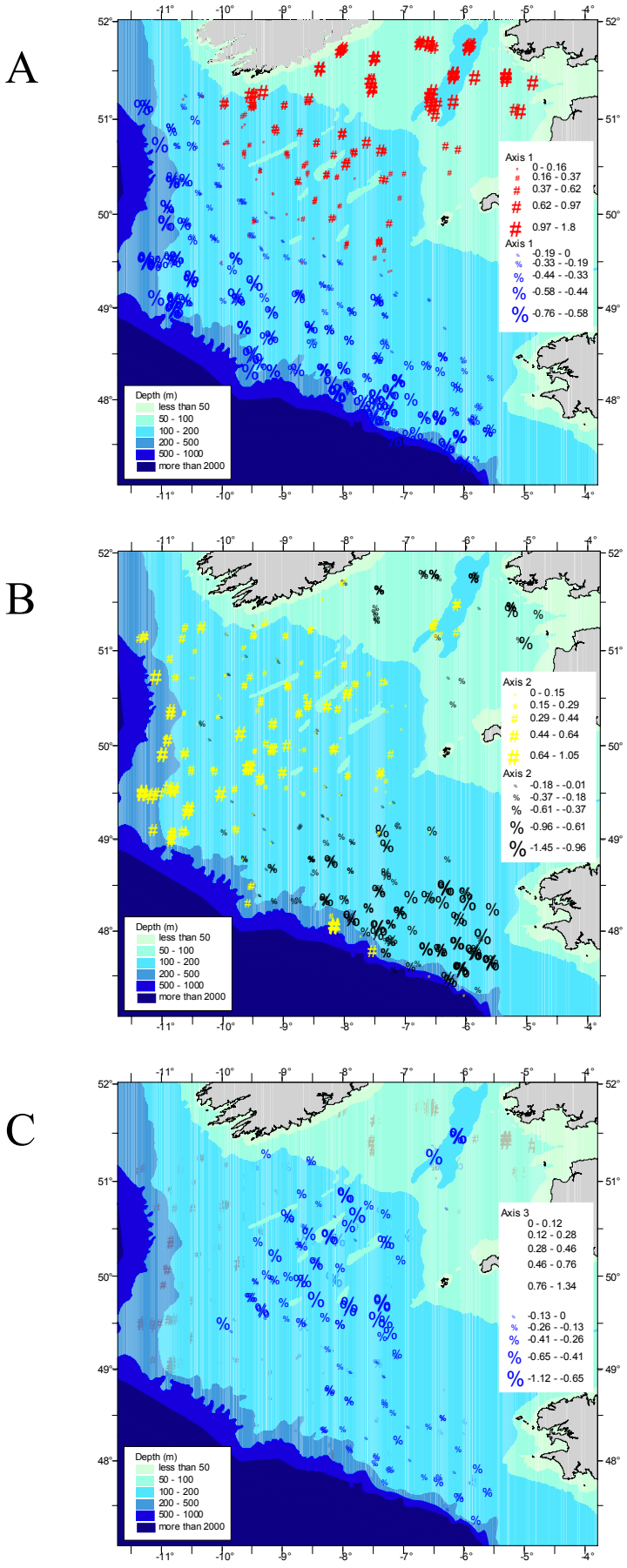


Figure 3. Maps of the factorial scores of the sampling stations on the first three axes (A to C) of the correspondence analysis of the STATIS compromise table. Circle symbol is used for positive values of the axis and square for negative ones.

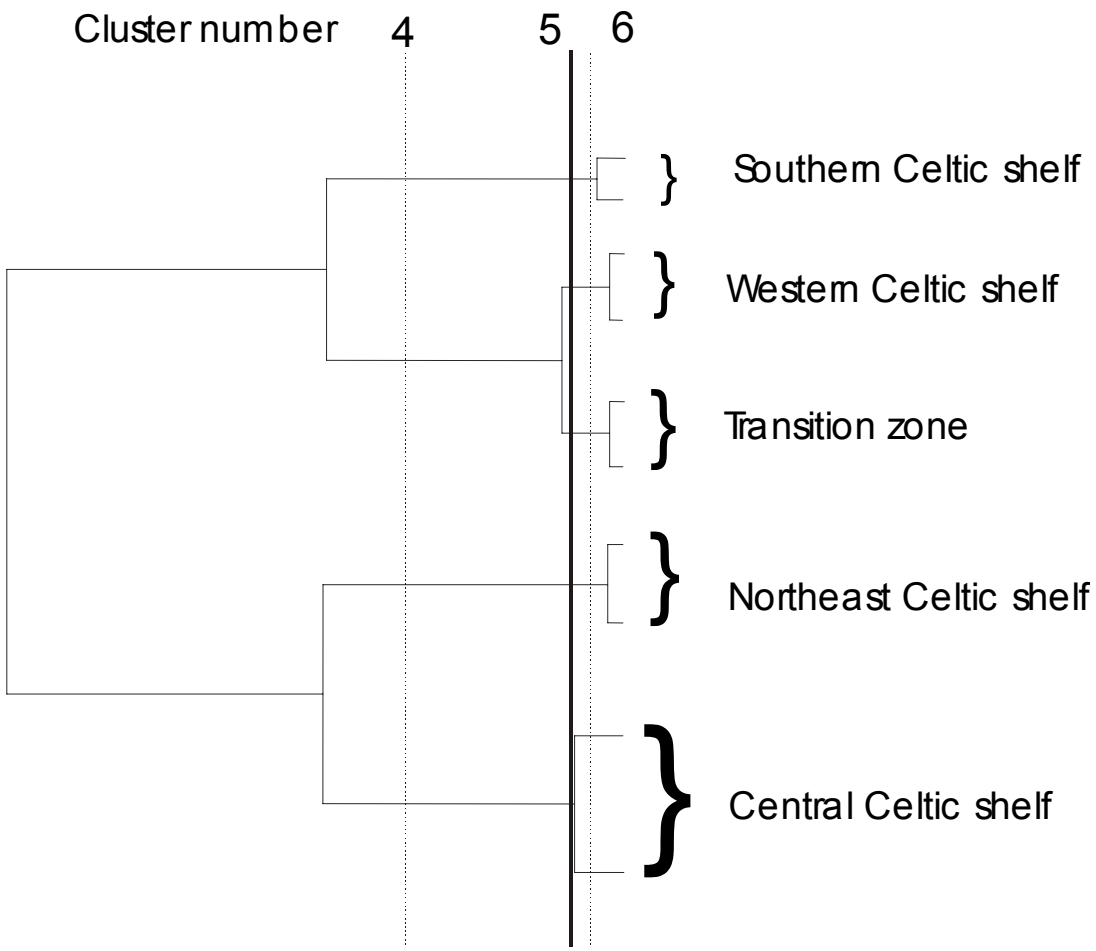
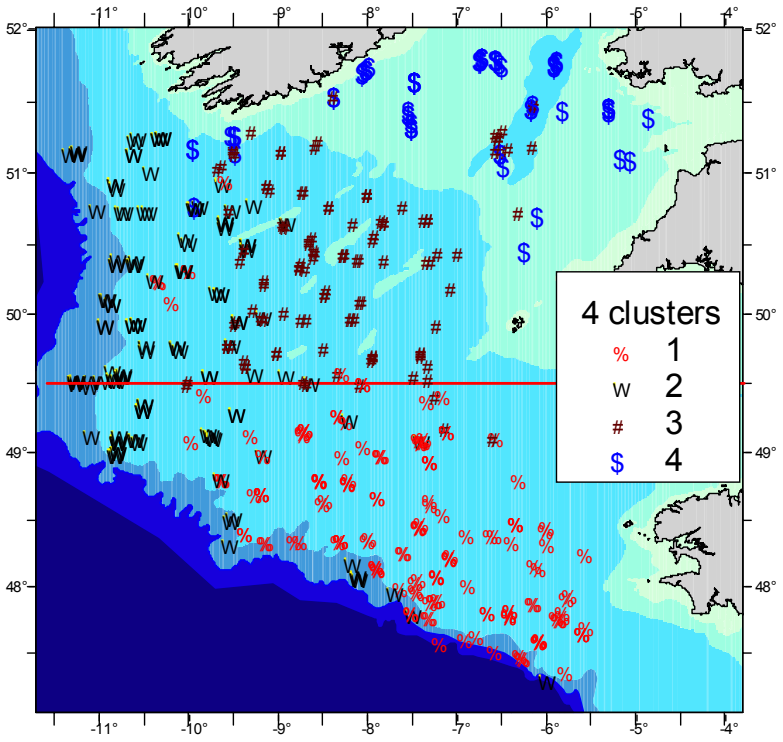


Figure 4. Hierarchical dendrogram derived from the ascending hierarchical classification of the factorial scores of the 458 hauls on the first three STATIS axes.

A



B

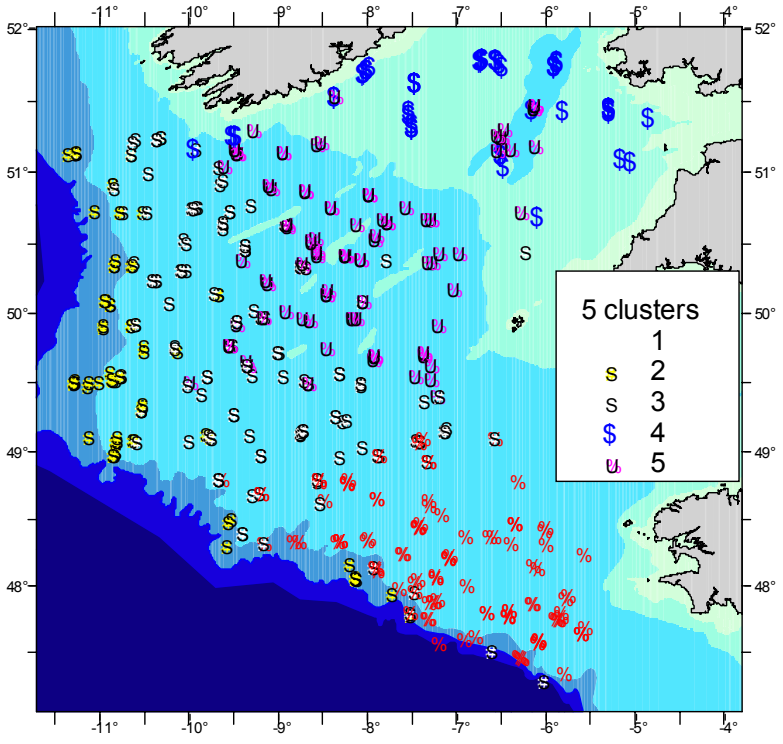


Figure 5. Distribution of the fish species assemblages in the Celtic sea based on 458 hauls sampled during autumn surveys from 1997 to 2003. Space partitions in 4 clusters (A) and 5 clusters (B) were obtained by ascending hierarchical classification of the factorial scores of the hauls on the first three STATIS axes.

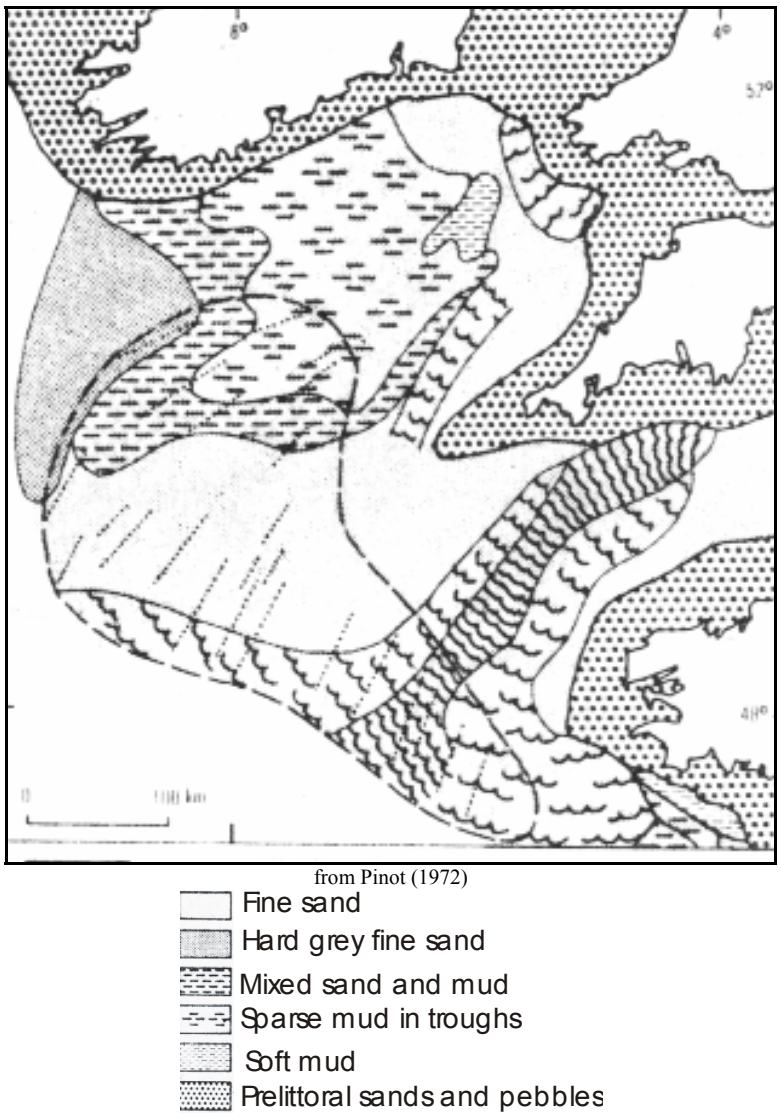


Figure 6. Map of the bottom sediments in Celtic sea from Pinot (1972).

PORTUGUESE AUTUMN GROUNDFISH SURVEYS IN 1999 - 2003

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SURVEY METHODOLOGY AND FISHING OPERATIONS IN 1999-2003

The Portuguese Autumn Groundfish Survey are carried out during the 4th quarter in Portuguese waters (Division IXa). The area surveyed extends from 41° 50' N to 36° 41' N and from 20 to 750 meters depth. The sampling strategy is a fixed station sampling scheme with 97 fixed stations, spread over 12 sectors. Each sector is subdivided into 4 depth ranges: 20-100, 101-200, 201-500 and 501-750 m with a total of 48 strata. The duration of each tow was 60 minutes but changed in Autumn 2002 to 30 minutes in order to increase the number of hauls. Fishing operations are carried out during daylight at a towing mean speed of 3.5 knots (Borges *et al*, 1999).

The surveys are performed with the R/V *Noruega* and the fishing gear used is a bottom trawl (type Norwegian Campell Trawl 1800/96 NCT) with a 20 mm codend mesh size and rollers in the groundrope. The mean vertical opening is 4.6 m and the mean horizontal openings between wings and doors are 15.1 m and 45.7 m (Borges *et al*, 1999).

In 1999 and 2003 those surveys were performed with the R/V *Capricórnio* because the main vessel was in repairing. The bottom trawl gear used (type FGAV019) had 25 mm codend mesh size and no rollers in the groundrope. In 2003 the SCANMAR equipment was used in some fishing stations and the mean vertical opening of the net obtained was 2.2 m and the mean horizontal openings between wings was 25.3 m (Leotte, 2003).

CTD sampling stations were conducted during the end of each fishing operations and also distributed all over the study area avoiding leaving large extensions uncovered, according to a scheme with 95 planned stations. CTD casts sampled at stations over the shelf area covered the whole water column, from surface to a maximum of 400 m.

During 2003 survey a total of 80 valid hauls with 136 CTDs sampling stations (Figure 1) were conducted.

The total number of valid hauls by depth (Table 1; Figure 1) varied over the years due to bad weather conditions and/or to damages in the fishing gear/vessel.

Table 1 - Total number of valid hauls by depth by survey.

Survey	20-100 m	101-200 m	201-500 m	500-750 m	Total
Autumn 1999	20	33	17	9	79
Autumn 2000	19	29	17	13	78
Autumn 2001	20	24	14	0	58
Autumn 2002	21	28	17	0	66
Autumn 2003	23	30	17	10	80

Once the catch is onboard it is sorted by species, counted and weighted. In the case of a huge catch of one dominant species, only a fraction of the catch is sorted. All fish and commercial cephalopods and crustaceans species are measured. Biological parameters (length, weight, status of maturity among others) and hard structures (otoliths and *illicia*) are collected.

RESULTS

ABUNDANCE AND BIOMASS INDICES IN 1999-2003

Abundance (number per hour), biomass indices (kg per hour) and their standard deviations were computed for the whole area (excluding strata 501-750 m due to poor sampling coverage). This indices are presented for the main commercial species: hake, horse mackerel, blue whiting, mackerel and Spanish mackerel, megrims, anglerfish, rose (*Parapenaeus longirostris*) and red (*Aristeus antennatus*) shrimps and Norway lobster. The results for the Autumn 2003 are shown in Table 2.

Table 2 - Standardised indices of abundance in Autumn 2003 survey. Indices for rose shrimp were converted using coefficients obtained by the SESITS project (x 3,12).

Species	kg/hour	CV	N/hour	CV
Hake	9.84	0.10	97.7	0.08
Four-spot megrim	1.61	0.21	22.7	0.20
Megrim	0.01	0.42	0.06	0.23
Black anglerfish	0.25	0.30	0.26	0.29
White anglerfish	0.35	0.47	0.18	0.40
Blue whiting	84.37	0.11	2992.5	0.12
Horse mackerel	5.72	0.27	145.3	0.44
Mackerel	1.50	0.26	10.6	0.24
Spanish mackerel	0.33	0.08	4.4	0.07
Norway lobster	0.05	0.40	1.0	0.29
Rose shrimp	0.77	0.21	79.5	0.22
Red shrimp	0.00		0.0	

The evolution of the abundance and biomass indices (Figure 2a and 2b) shows that some species (hake, horse mackerel, mackerel and blue whiting) have a maximum in Autumn 2001. Hake, blue whiting and mackerel have decreasing trends had achieved their low indices in 2003 with 10 kg/h (98 ind./h) for hake, 84 kg/h (2993 ind./h) for blue whiting and 1,5 kg/h (11 ind./h) for mackerel.

The high values for four-spot megrim and anglerfishes in 2003 may be due to the CAR fishing gear which catch better benthic species. Four-spot megrim had an average of 0,09 kg/h (1 ind./h) in 1999-2002 and in 2003 achieved 1,6 kg/h (23 ind./h) and anglerfish had an average of 0,03 kg/h (0,04 ind./h) in 1999-2002 and achieved 0,3 kg/h (0,22 ind./h) in 2003.

Horse mackerel and Norway lobster are the only species with a slight increase in 2003 both in number and weight.

Rose shrimp catches have decreased from 0,8 kg/h (92 ind./h) in 1999 to 0,3 kg/h (25 ind./h) in 2003, below the average of 0,4 kg/h (47 ind./h) of the series. In 2002 and 2003 there are no catches of red shrimp despite the maximum observed in 2000.

The abundance indices was also computed by length class for each species and survey. Figure 3 shows these results for hake, horse mackerel, blue whiting, mackerel and rose shrimp. The mean lengths with its standard deviation are presented in Figure 4 for all species.

Despite the fluctuations in the length distribution of hake from 1999 to 2003 with mean length between 21,0 and 24,7 cm, the main modal point maintains at length where age is

0. Considering the length split into juveniles and adults (Geographical distribution - Table 3) the catch of hake is comprised of 94% of juveniles (below 36 cm, younger than age 3).

For horse mackerel, the modal length varies between 9 and 13 cm with an average mean length between 14,4 cm and 21,0 cm with a general decreasing trend. In 2000 the catches were 70 % composed by juveniles, and for the others years the catches of juveniles represented more than 90 %.

Blue whiting is the more stable species with low variations in mean length (17,2-19,3 corresponding to age 0-1) with a modal length between 16 and 19 cm. The catch of juveniles varies between 41% (Autumn 2001) and 73-94%. The mean length has been decreasing in the last years.

Mackerel juveniles corresponds to more than 90% of the catches with an increasing trend in mean length (between 21,5 and 26,6 cm) and modal lengths of 20-21 cm. Spanish mackerel mean length has been decreasing since 1999 from 25,8 cm to 21,4 cm with more than 90% of juveniles in the catches.

Four-spot megrim mean length has been decreasing from 23,4 cm to 19,3 cm, being the catches of adults superior to juveniles.

The lowest mean length for rose shrimp (24 mm in 2002) is due to the highest catches of individuals below 14 mm for this species, the mean length has been stable during the whole series.

Red Shrimp has an increase in mean length until 2001. Since 2002 no catch occurred till 500 m depth.

GEOGRAPHICAL DISTRIBUTION IN 1999-2003

The geographical distribution is presented in number per 30 minutes tow for juveniles and adults. The length split is based on the L50% calculated from the maturity ogives used in the assessment of those species (Table 3). The maps for hake, horse mackerel, blue whiting, mackerel, anglerfish and megrims are presented in figures 5-11.

Hake juveniles (Figure 5, upper panel) distribute preferentially in South and Southwest of Portugal, since the catches of juveniles are above 94%, the adults distribution (Figure 5, lower panel) are almost non-existent with some spots in Southwest of Portugal. The geographical distribution has no variation during the 1999-2003 period.

Horse mackerel juveniles (Figure 6, upper panel) distribute mostly in the North and adults (Figure 6, lower panel) are present mostly in Southwest.

Blue whiting, megrim and four-spot megrim (Figure 7, 8 and 9) distributes mostly in grounds deeper than 200 m. These species juveniles and adults are mostly catches in Southwest and South of Portugal, but in 2003 four-spot megrim, both juveniles and adults, were catch in the whole area.

Mackerel juveniles (Figure 10, upper panel) distribute in the North in coastal water (till 200 m).

Hake recruits (Figure 12) distribute in the whole area but preferentially in the Southwest of Portugal, where a nursery ground is located.

REFERENCES

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Leotte, F. 2003. Parâmetros de funcionamento da rede de arrasto utilizada no Cruzeiro Demersal de Outubro 2003. Relatório interno do IPIMAR, 9 pp.

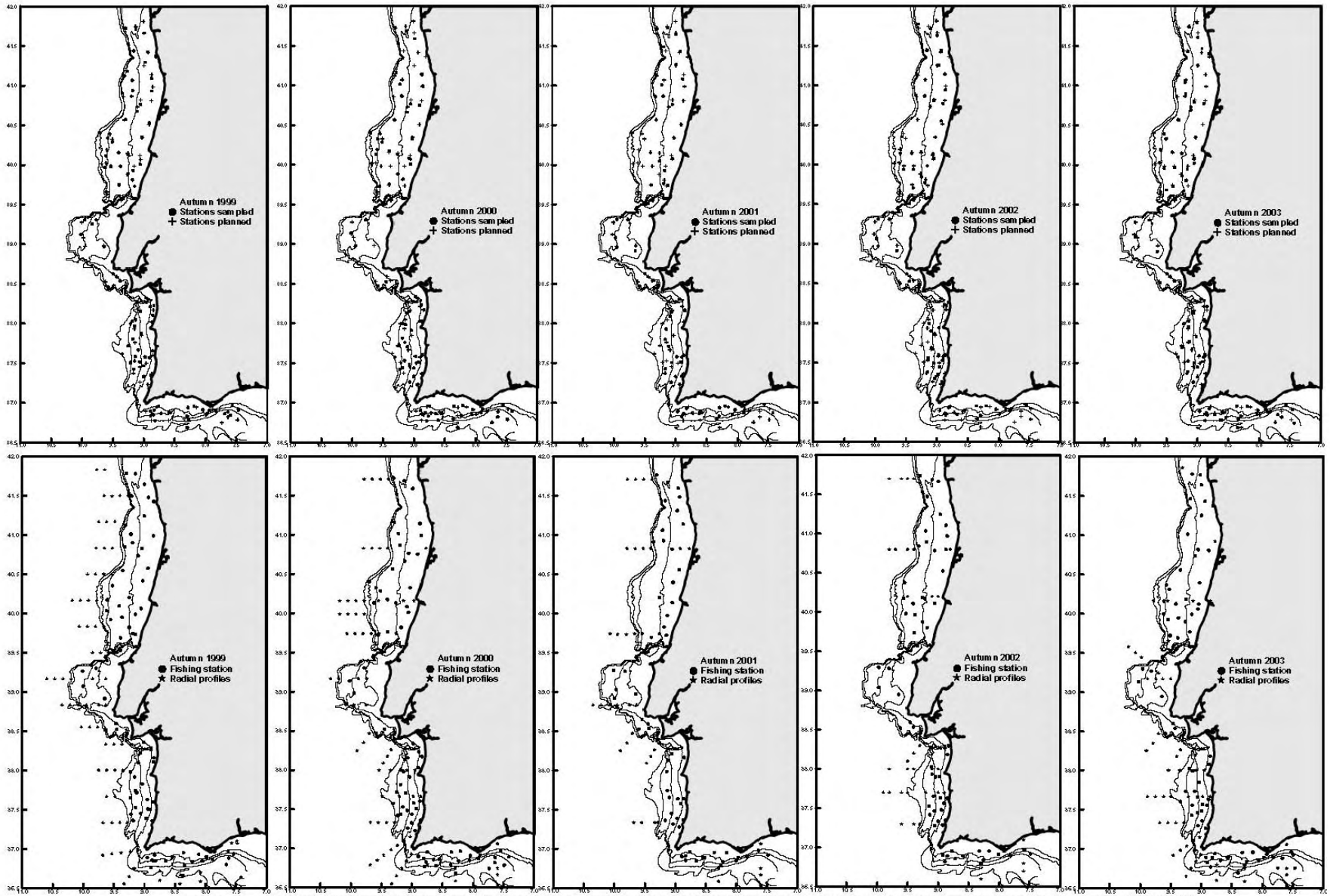

Figure 1 - Planned and sampled fishing stations (upper panel) and CTD stations (lower panel) in Portuguese Groundfish Surveys 1999-2003

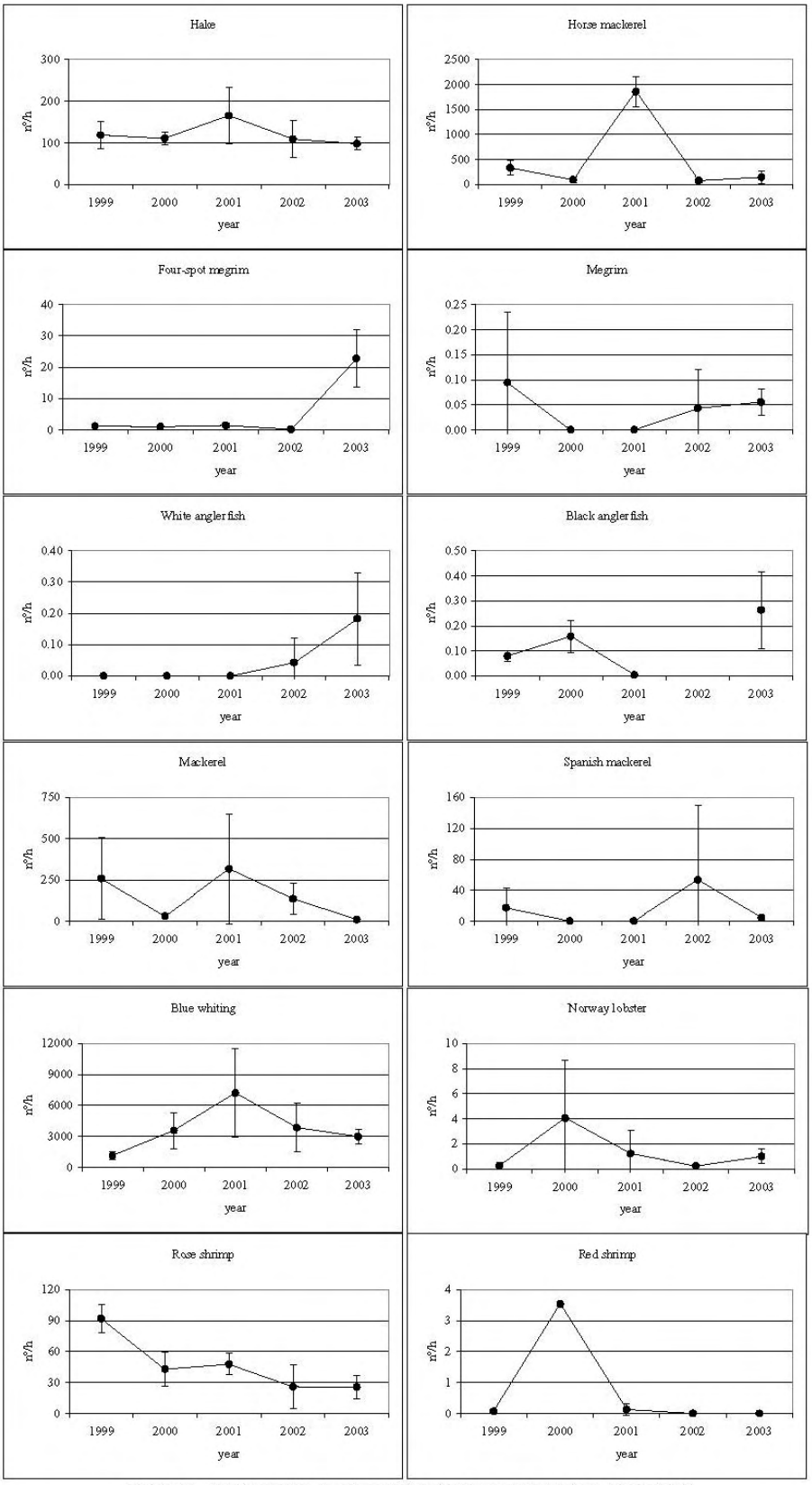

Figure 2 a - Evolution of the abundance indices for Autumn surveys from 1999 to 2003.

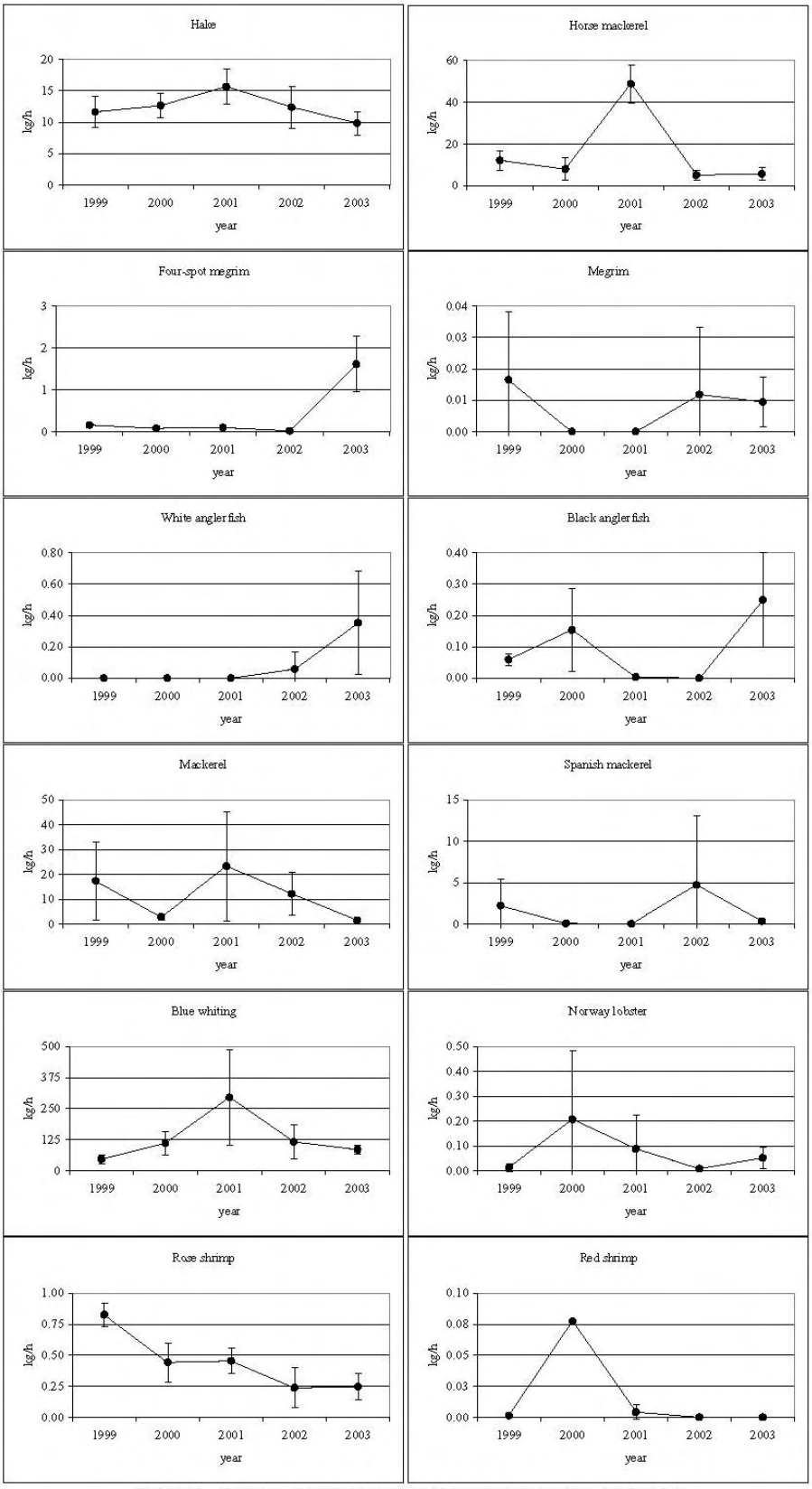

Figure 2 b - Evolution of the biomass indices for Autumn surveys from 1999 to 2003.

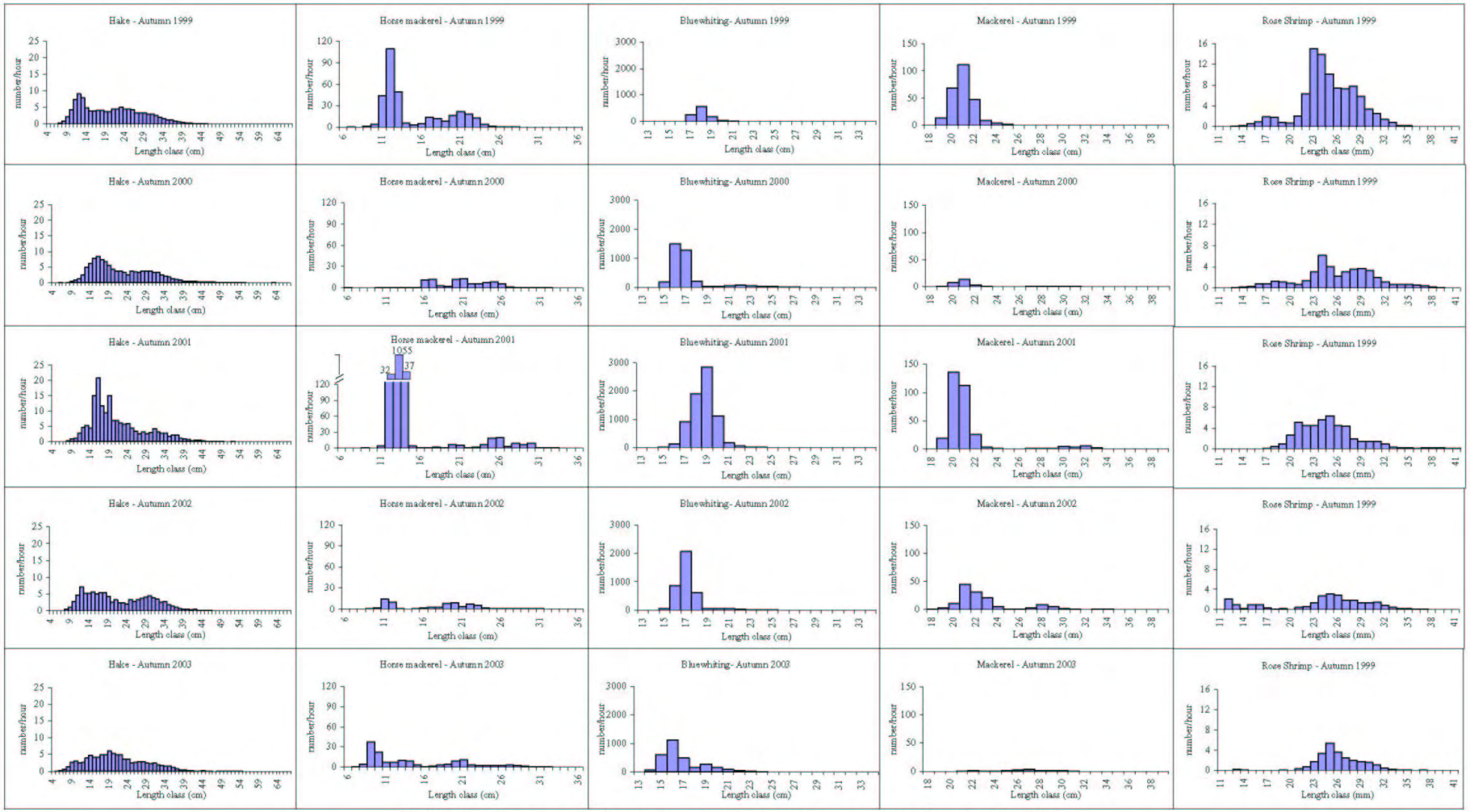

Figure 3 - Abundance indice by length class in Autumn surveys from 1999 to 2003

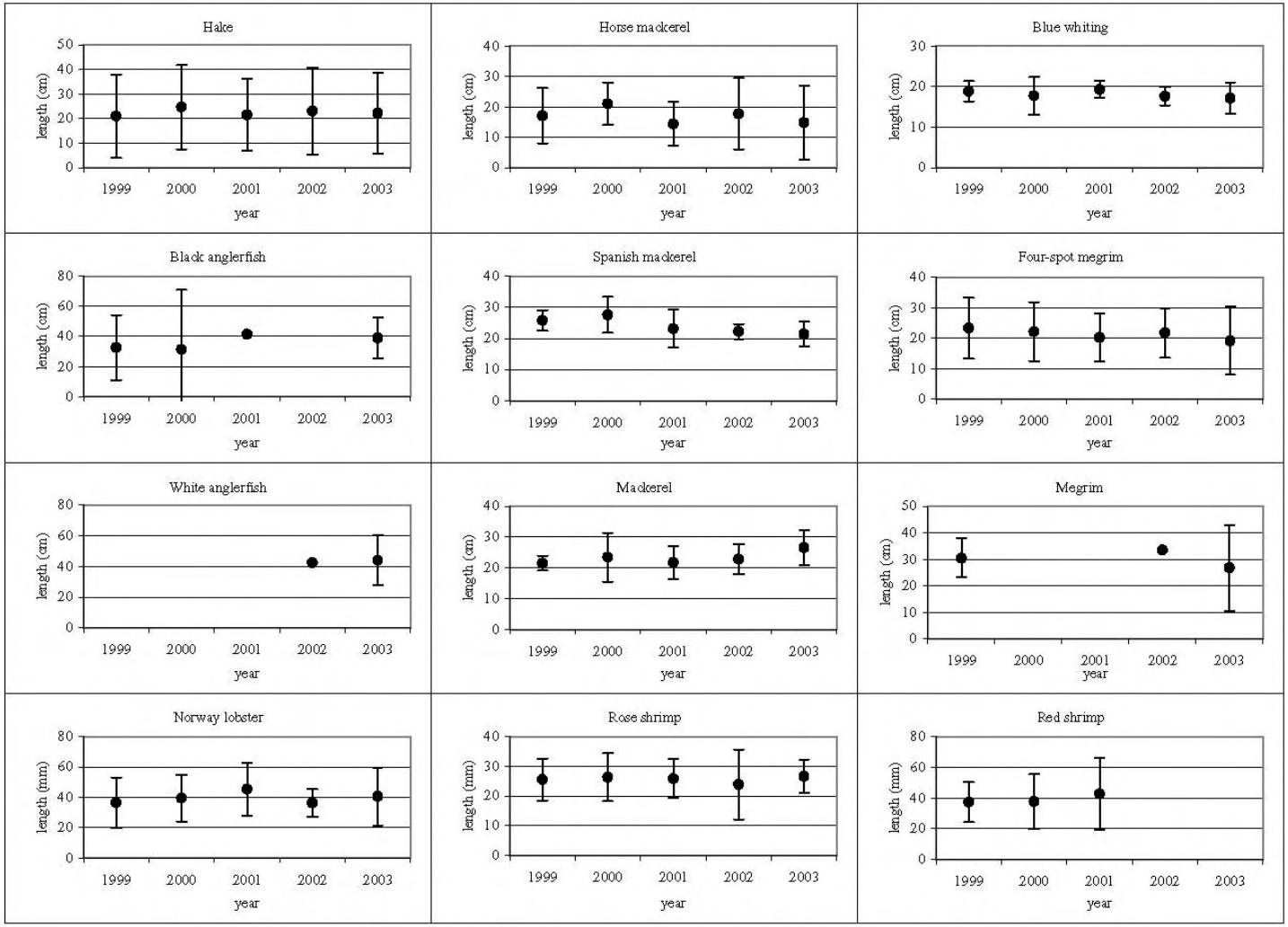

Figure 4 - Mean length by survey and 2 times the standard deviation for Autumn surveys from 1999 to 2003.

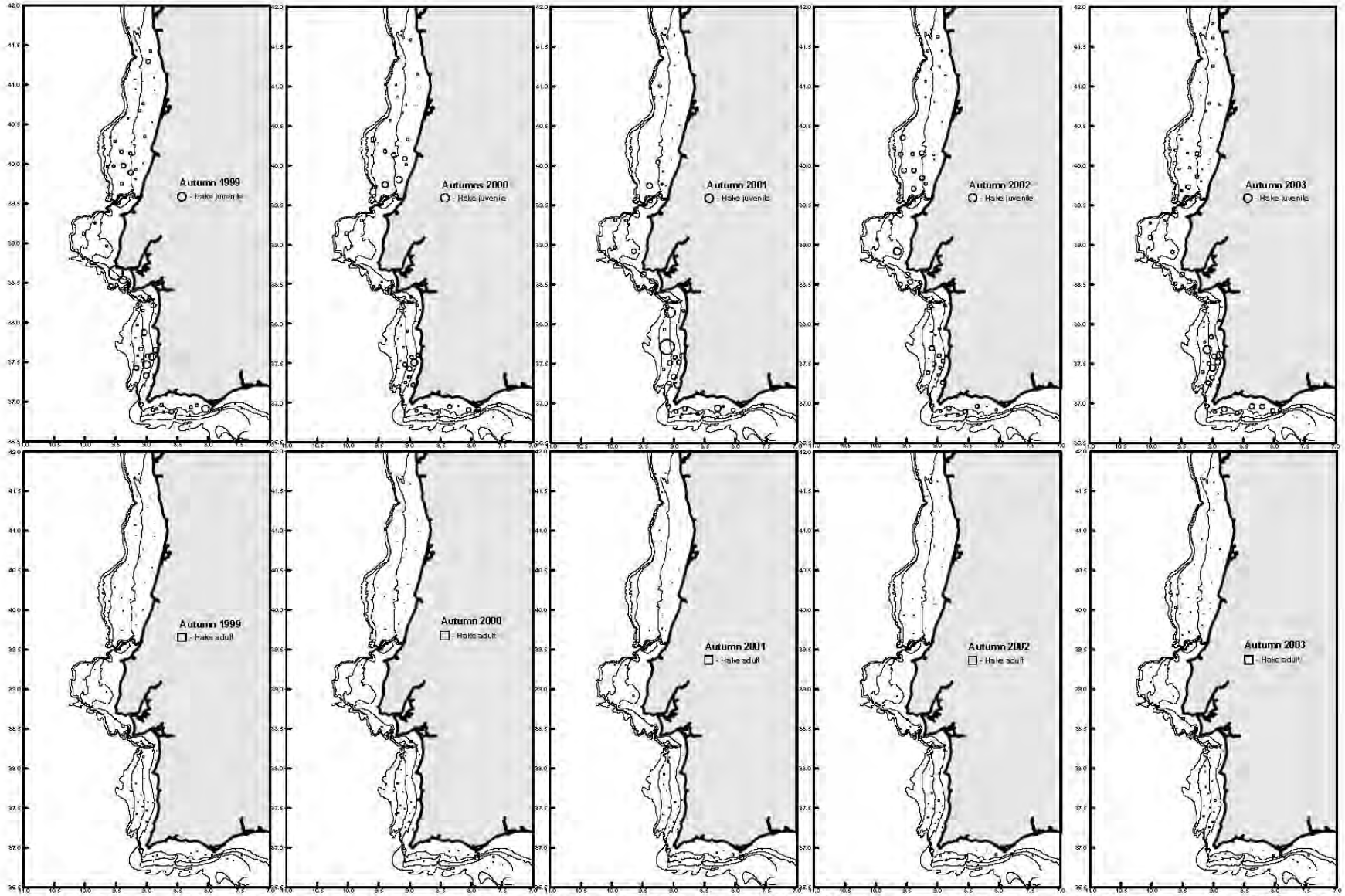

Figure 5 - Hake, square root of number per 30 minutes tow in Portuguese Groundfish Surveys from 1999 to 2003. Juvenile and Adult components. Min.: ∘ □ - 0 Max.: ○ □ - 1264

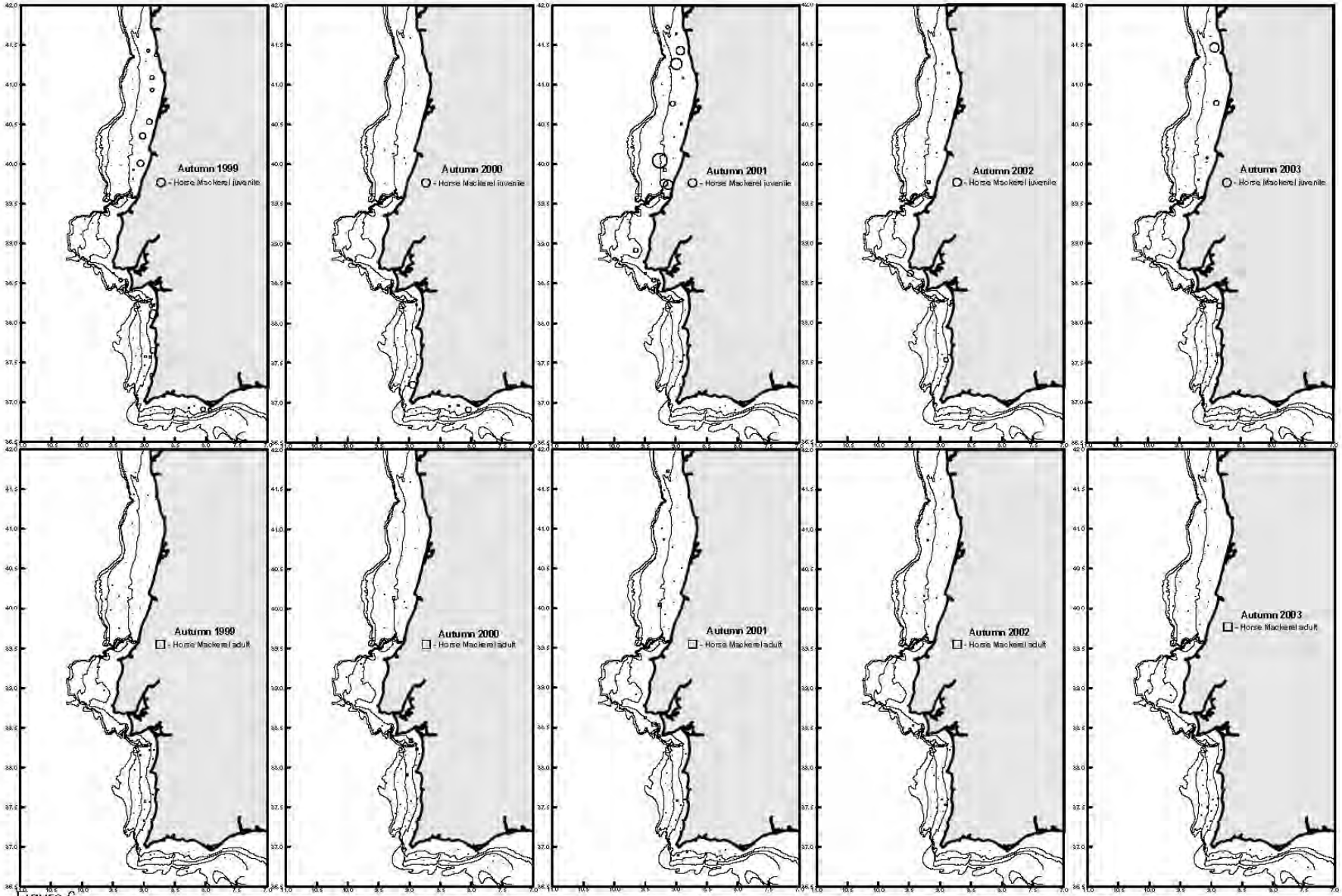

Figure 6 -
Horse mackerel, square root of number per 30 minutes tow in Portuguese Groundfish Surveys from 1999 to 2003. Juvenile and Adult components. Min.: - 0 Max.: - 7070

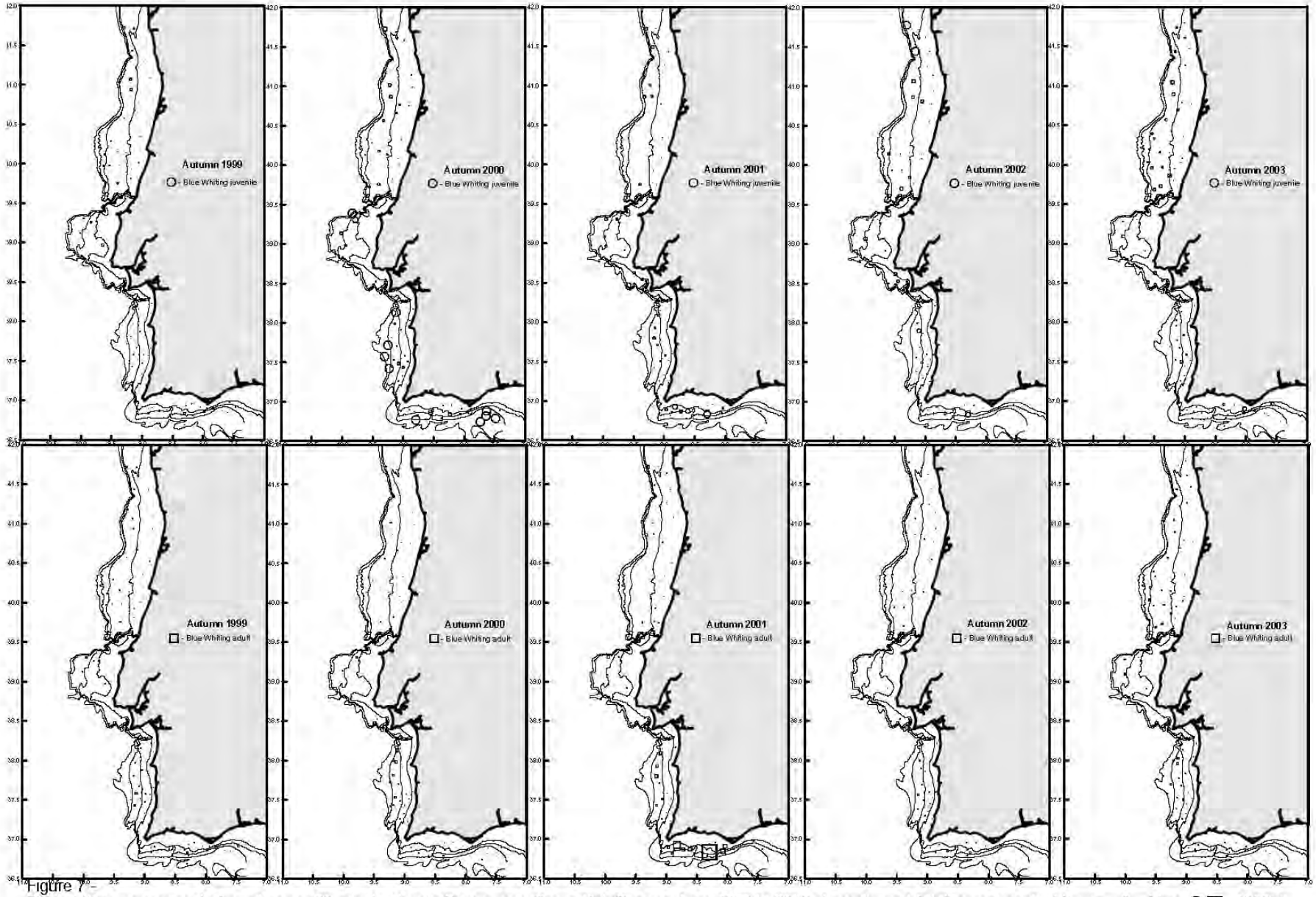

Figure 7 -
Blue whiting, square root of number per 30 minutes tow in Portuguese Groundfish Surveys from 1999 to 2003. Juvenile and Adult components. Min.○□ - 0 Max.:○□ - 109055

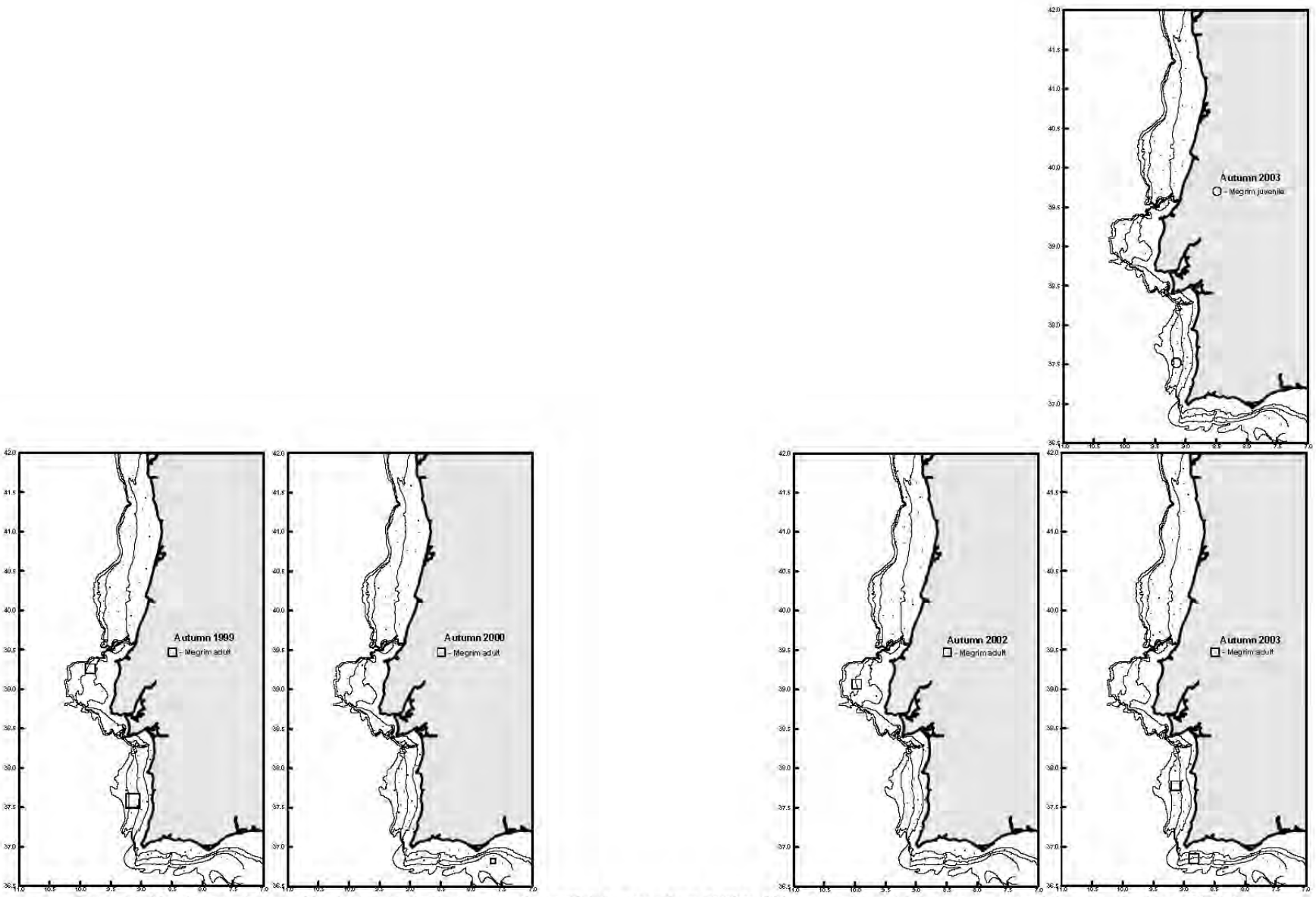

Figure 8 - Megrim, number per 30 minutes tow in Portuguese Groundfish Surveys from 1999 to 2003. Juvenile and Adult components. Min. ▫ ▫ - 0 Max. ○ □ - 2

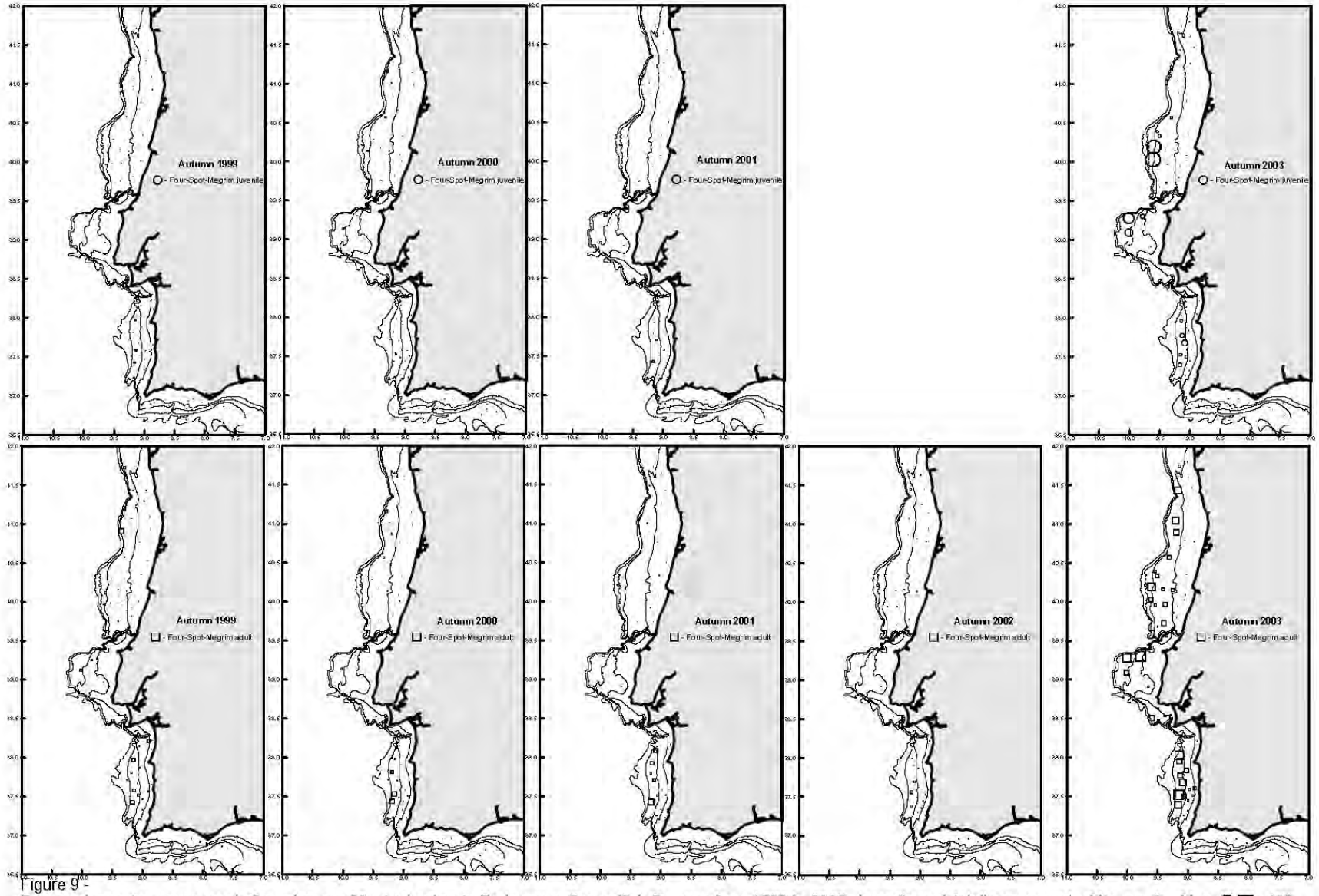

Figure 9 -
Four-spot megrim, square root of number per 30 minutes tow in Portuguese Groundfish Surveys from 1999 to 2003. Juvenile and Adult components. Min. ○ □ - 0 Max. ○ □ - 102

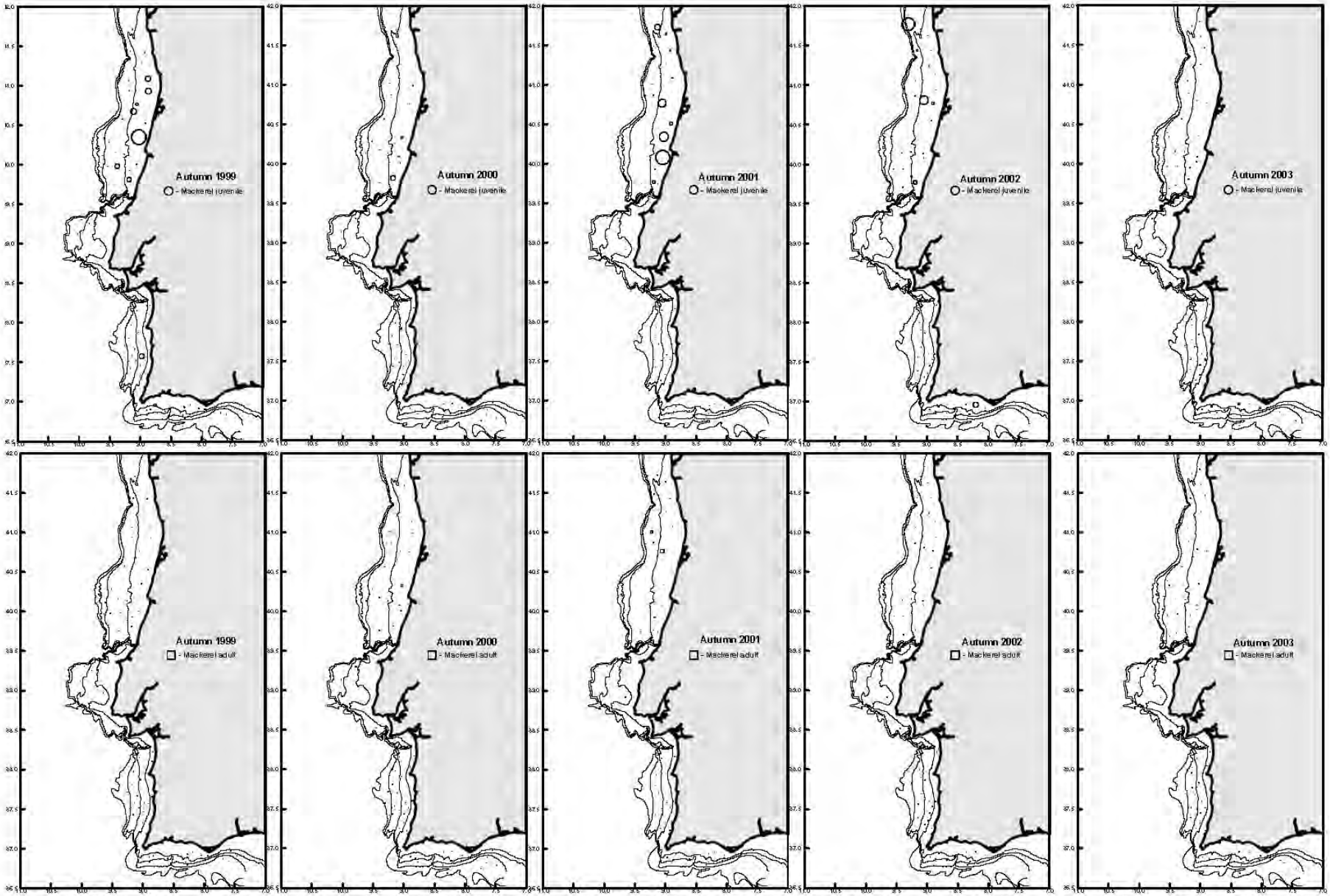

Figure 10 - Mackerel, square root of number per 30 minutes tow in Portuguese Groundfish Surveys from 1999 to 2003. Juvenile and Adult components. Min.: ▫ ▫ - 0 Max.: ○ □ - 3554

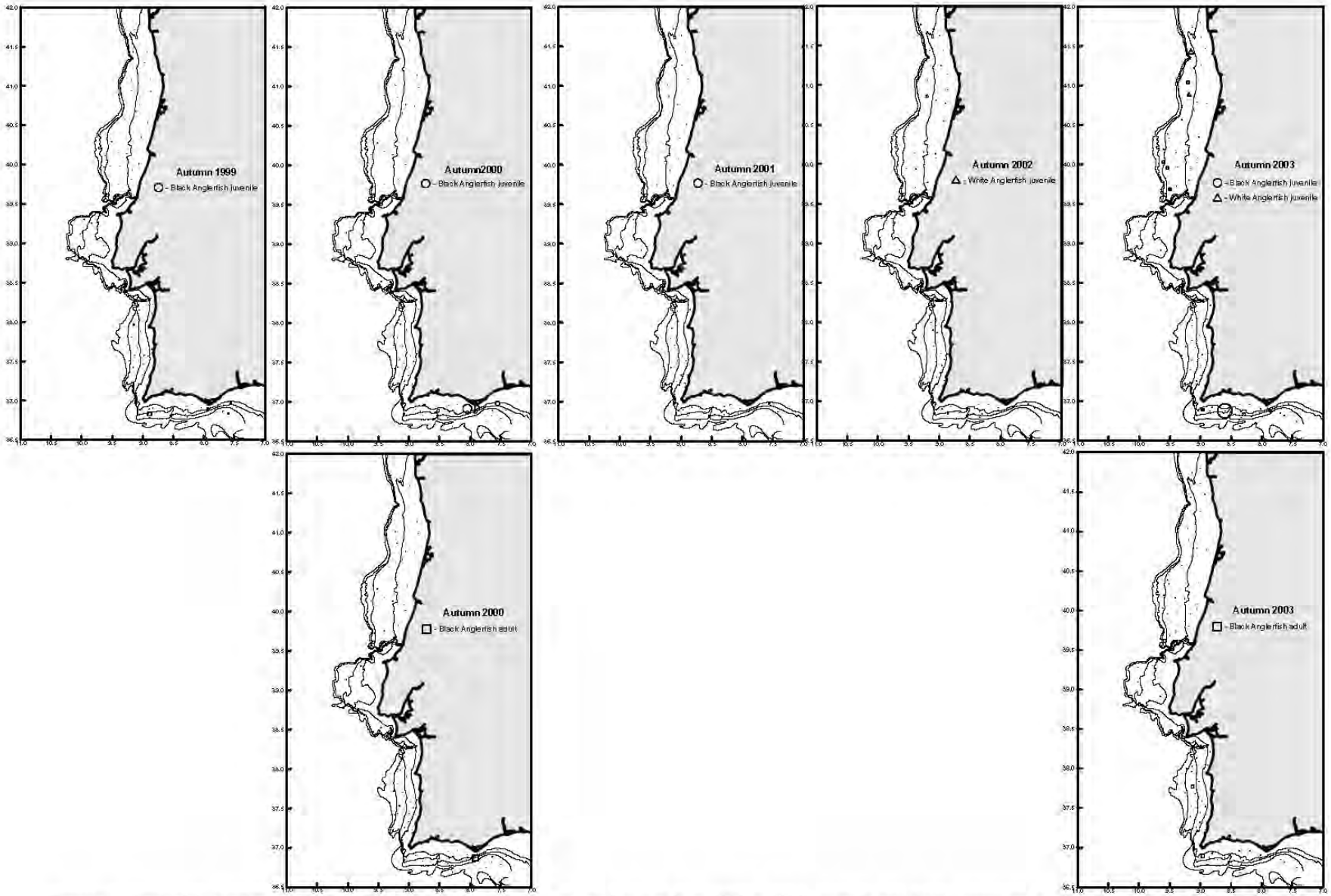

Figure 11 - Anglerfish, number per 30 minutes tow in Portuguese Groundfish Surveys from 1999 to 2003. Juvenile and Adult components. Min.: ○□△ - 0 Max.: ○□△ - 5

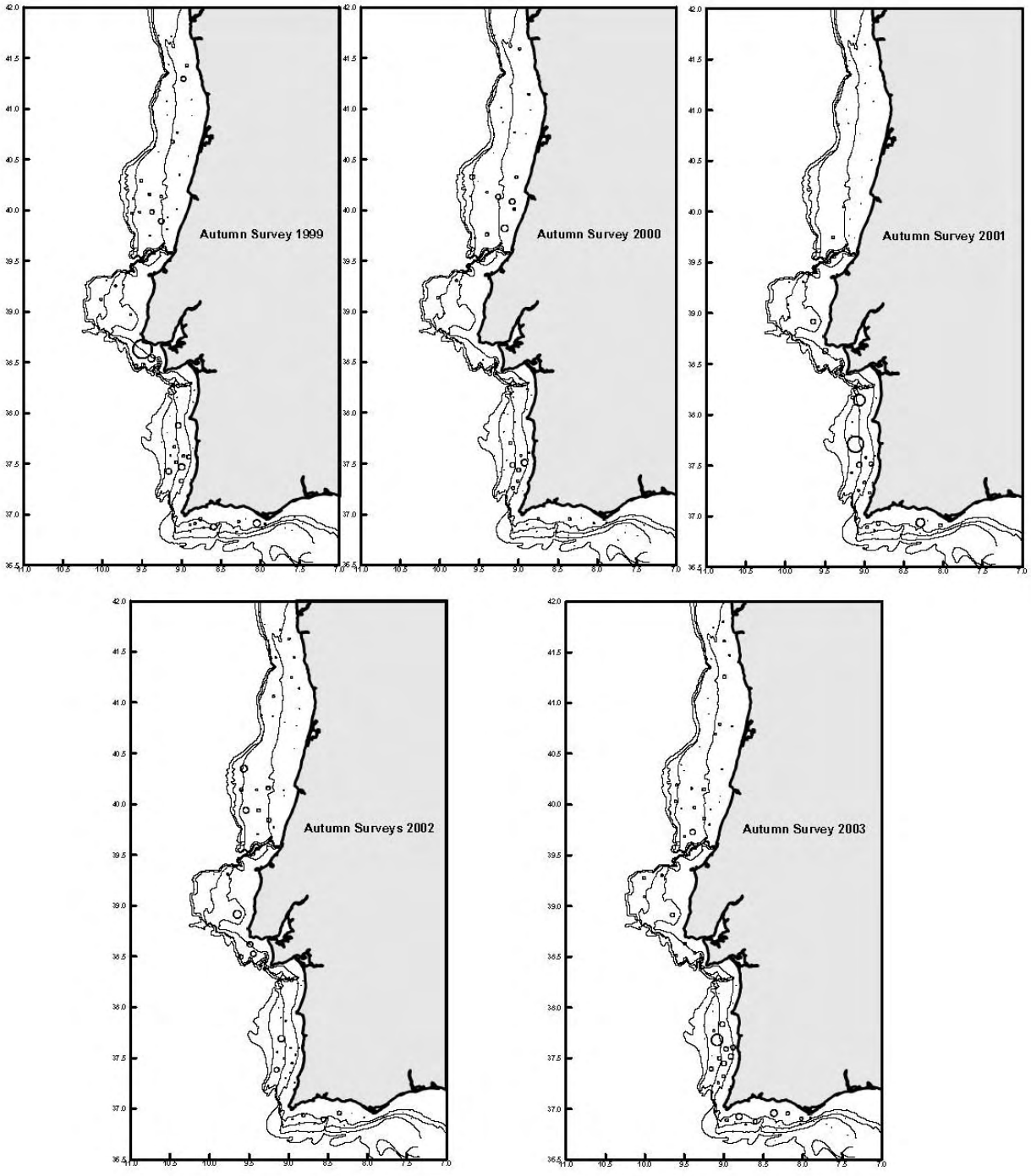

Figure 12 - Hake age 0, square root of number per 30 minutes tow in Portuguese Groundfish Surveys from 1999 to 2003.
Min.: ∘- 0 Max.: ○ - 908

Table 3 - Source for length split. L50% was used for all species.

* - approximate value	Sex combined (cm)			References
Species	L25	L50	L75	
Hake *Merluccius merluccius*	31.0	36.0	41.0	Cardador, F.; Morgado, C.; Lucio, P.; Pineiro, C.; Sainza, M.; Santurtun, M., 1999. New Maturity Ogive for the Southern Stock of Hake (ICES Divisions VIIIc+Ixa). WD to be presented at WGSSDS - Copenhagen 1-10 September 1999 Global (AZTI+IEO+IPIMAR) **Source for WGHMM02**
White anglerfish *Lophius piscatorius*	51.90	68.15	84.39	BIOSDEF, 1998. Biological Studies of Demersal Fish. Final Report to the Commission of European Communities, Part II (White Anglerfish north - histology) **Source for WGHMM02**
Black anglerfish *Lophius budegassa*	36.1	44.7	53.4	Duarte, R.; Azevedo, M.; Landa, J.; Pereda, P., 2001. Reproduction of anglerfish (*Lophius budegassa* Spinola and *Lophius piscatorius* Linnaeus) from the Atlantic Iberian Coast. Fisheries Research 51 pp 349-361. Same as Biosdef; **Source for WGHMM02**
Megrim *Lepidorhombus whiffiagonis*	17.0	19.0	20.9	BIOSDEF, 1998. Biological Studies of Demersal Fish. Final Report to the Commission of European Communities, Part I **Source for WGHMM02**
Four-spot-megrim *Lepidorhombus boscii*	15.6	16.9	18.2	BIOSDEF, 1998. Biological Studies of Demersal Fish. Final Report to the Commission of European Communities, Part I **Source for WGHMM02**
Horse Mackerel *Trachurus trachurus*		23.61*		WGMHSA02, Source not available
Mackerel *Scomber scombrus*		30.2*		WGMHSA02, source not available
Blue whiting *Micromesistius poutassou*		19.0		Silva, A., Pestana, G., Dias, C., Godinho, S., 1996. Preliminary results on the distribution and spawning of blue whiting, *Micromesistius poutassou*, off the Portuguese coast. ICES CM 1996/H:16 Source for WGNPWB not available

* - The ages were converted in length using mean length at age from the WG, then the length where 50% are mature was

APPENDIX V: LIST OF PARTICIPANTS - INTERNATIONAL BOTTOM TRAWL SURVEY WORKING GROUP

Lisbon, 23–26 March 2004

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