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Report of the Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP)

7–13 April 2010

Copenhagen, Denmark

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CIEM Conseil International pour l'Exploration de la Mer

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Contents

1 Executive summary

In 2010, WGDEEP assessed the status of deep-water fish stocks in the ICES area and gave advice on their management. Exploratory analytical assessments were carried out for a number of stocks (roundnose grenadier in the Celtic Sea, tusk in Va and XIV and greater forkbeard in all subareas). The assessments for roundnose grenadier and tusk were considered by a benchmark workshop in February 2010 (WKDEEP) and are considered to be suitable for use in assessment as indicative of trends. For other stocks, trends in catch, survey and commercial cpue series and age and length composition were used as the basis for assessment.

Ling (*Molva molva*)

Re-examination of the commercial cpue for Norwegian longliners used in previous years to assess several ling stocks suggests that the historical data (pre-1995) cannot be directly compared to recent data (post-2000) as a result of changes in gear and fishing practice. In Subareas I and II, fisheries since 2000 do not appear to have had a detrimental effect on the stock and cpue has steadily increased. However the state of the stock relative to historical levels is unknown. In Division Va, survey biomass index shows increasing abundance since 2000. The levels are currently at a similar high level as in the start of the series and there are indications that fishing mortality may have declined in recent years. In Division Vb, abundance indices suggest that the stock has been stable since the mid-1990s; however the state of the stock relative to historical levels is unknown. The cpue series of the main fleet in Divisions IVa, VIa, and VIb suggest that the abundance has remained stable since 2000.

Blue ling (*Molva dypterygia*)

Icelandic surveys indicate increasing biomass of blue ling in Va and XIV since 2000; however, cpue series show that biomass remains at a low level relative to the early years of the fishery. In Vb, VI, and VII cpue information (French tallybook and cpue series) suggests that the abundance of blue ling remains stable at a low level. In other areas (Subdivisions I, II, IIIa, IVa, VIII, IX, and XII) trends in landings suggest serious stock depletion, at least in Subareas IIa and IIb.

Tusk (*Brosme brosme*)

As noted for ling, re-examination of the Norwegian cpue series has altered the perception of some stocks. In Subareas I and II, cpue has increased since 2000; however the state of the stock relative to historical levels is unknown. The stock in Va and XIV was assessed using a Gadget model. Trends from the model are consistent with survey indices and show increasing biomass and falling F since 2000. On the Mid-Atlantic Ridge catches of tusk are very minor and there is insufficient information on which to assess the state of the stocks. At Rockall, cpue indices show no apparent trend. In other areas, the cpue series of the main fleet in Divisions IVa, VIa, and VIb suggest that the abundance has remained stable since 2000; however the state of the stock relative to historical levels is unknown.

Greater silver smelt (*Argentina silus*)

In Subdivision Va, winsorised survey indices suggest that the state of the stock has remained stable since 2000, however, reduction in mean age in the catch since the 1990s indicate that the stock is depleted.

Orange roughy (*Hoplostethus atlanticus*)

In Subarea VI orange roughy catches increased rapidly in the late 1980s and subsequently dropped to a low level. It is presumed that the aggregations were fished out. Orange roughy fisheries in Subarea VII have exhibited a similar pattern to that in VI. High catches have not been sustained by individual fleets and have dropped to low levels, suggesting sequential depletion. It is not clear if there are unfished aggregations remaining in Subarea VII. Overall, landings have declined to very low levels in each management area (VI, VII and other).

Roundnose grenadier (*Coryphaenoides rupestris*)

No directed fishery has taken place since 2007, due to retirement of the fishers. A decrease in mean length of the in the catch from 1987 to 2004 and 2005 indicates heavy exploitation on this stock.

In Vb, VI, VII and XIIb, the results of a Bayesian production model that was benchmarked by WKDEEP in 2010 suggest that biomass has decreased since the start of the fishery; however this model is only indicative of trends. Data from the French tallybook program show that biomass has been stable since 2000 and this is consistent with Scottish and Irish surveys. French cpue series show a strong decline in biomass between 1989 and 2000.

The state of the stock on the Mid-Atlantic Ridge is uncertain. Soviet data suggest a high stock biomass (400 000–700 000 t) in 1970–1980s but a decreasing trend of the cpue indicate that the abundance was reduced to a low level in recent years. Moreover, Russian trawl acoustic survey in 2003 showed relatively low biomass of the pelagic component of stock, an increasing depth of the aggregations, and a higher number of small immature fish.

Black scabbard fish (*Aphanopus carbo*)

In the northern area, French cpue data indicate a decline in abundance since 1990 while data from the French tallybook program indicate stable biomass levels since 2000. Data from Scottish and Irish surveys can be interpreted to indicate episodes of recruitment of small individuals in shallower depths.

In the southern area, lpue series of Division IXa suggest that the biomass has been relatively stable since 1995.

Greater forkbeard (*Phycis blennoides*)

A benchmark assessment on this stock was carried out by WKDEEP 2010 and it was agreed that the stock should be assessed using trends in indices of biomass and numbers from the Spanish Porcupine Bank survey and French, Irish and Scottish IBTS surveys. The available biomass indices have fluctuated without any consistent trend since 2000. This indicates that the current level of exploitation is not having a detrimental effect on the stock. However this time-series are short and levels relatively to the historical values are not known.

Alfonsino (*Beryx spp.*)

Standardized cpue from the Azores longline commercial fishery indicates an overall slowly decreasing trend for *Beryx decadactylus*.

Red (blackspot) seabream (*Pagellus bogaraveo*)

Based on historical catches, the stock in VI, VII, and VIII appears to be severely depleted. The stock in Subarea IX is depleted and there is no evidence of a significant recovery of the stock resulting from the local recovery plan.

A benchmark assessment on the stock in Subarea X was carried out by WKDEEP 2010 and it was agreed that the stock should be assessed using trends in survey and commercial cpue series disaggregated to the finest possibly geographical resolution. The available indices showed no clear trend in biomass since 1990.

2 Opening of the meeting/Introduction

2.1 Participants

Tom Blasdale (Chair)	UK
Neil Campbell	UK
Guzman Diez	Spain
Leonie Dransfeld	Ireland
Ivone Figueiredo	Portugal
Elena Guijarro Garcia	Spain
Elvar Hallfredsson	Norway (by correspondance)
Hege Overboe Hansen	Norway
Kristin Helle	Norway
Juan Gil Herrera	Spain
Phil Large	UK
Pascal Lorance	France
Jan-Henning Lindemann	European Commission observer
Lise Helen Ofstad	Faroes (by correspondance)
Alexei Orlov	Russian Federation
Lionel Pawlowski	France
Sten Munch-Peterson	Denmark
Mário Rui Pinho	Portugal
Jakúp Reinert	Faroes (by correspondance)
Ruben Roa	Spain
Gudmundur Thordarson	Iceland
Vladimir Vinnichenko	Russian Federation

2.2 Background

The first ICES Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources was held in 1994 (ICES C.M. 1995/Assess:4). It provided the background information on what was known about deep-water fisheries within the ICES area and compiled landings data from both official statistics, where available, and from individual members of the Study Group. The Report also summarized the current status of knowledge of the biology of these deep-water species. At this time ling, blue ling and tusk were the responsibility of the Northern Shelf Working Group.

The Study Group met by correspondence in 1995 (ICES C.M.1995/Assess:21) but had little to report. The next meeting of the Study Group was in February 1996 (ICES C.M.1996/Assess:8). Its terms of reference were to: (a) compile and analyse available data on a number of deep-water species (namely argentines, orange roughy, roundnose grenadier, black scabbard fish, golden eye perch (*Beryx splendens*) and red (blackspot) sea bream (*Pagellus bogaraveo*)) in the ICES area and, if possible, provide assessments of the state of the stocks and the level of exploitation, and (b) provide information on the stocks and state of exploitation of the stocks of blue ling, ling, and tusk in Subareas IIa, IVa, V, VI, VII and XIV and identify outstanding data requirements. The Study Group met by correspondence in 1997 (ICES C.M.1997/Assess:17) and, in addition to updating descriptions of fisheries, the available information on length/age-at-maturity, growth and fecundity of deep-water species, including blue ling, ling and tusk, was presented in tabular form. The available information on discards was also compiled.

The terms of reference for the 1998 meeting of the Study Group included the additional request to consider the possibility of carrying out assessments of fisheries for deep-sea resources and developing advice consistent with the precautionary approach. The layout of the report (ICES CM 1998/ACFM:12) was modified to conform to the format of an assessment working group report and the existing data were reformatted to allow for year on year updating. The possibilities for carrying out age-structured assessments were very limited, but several provisional assessments were carried out using DeLury constant recruitment and Schaefer production models. The catch and effort assessment methods used by the Group suggested that time-series of effort and cpue may be particularly valuable for the assessment of deep-water species. The Study Group therefore recommended that member states maintain and refine long-term dataseries and where possible collate historical data. The Study Group recommended that the members be encouraged to provide discard and fish community data.

The Study Group worked by correspondence in 1999 and updated landings statistics and data on biological characteristics. The next (and final) meeting as a study group was held in 2000 (ICES CM 2000/ACFM:8), and in addition to carrying out the tasks requested in the previous years, more attempts were made to carry out assessments using catch and effort methods. This was successful for some of the species in some areas, and the results were used for evaluations consistent with the precautionary response. The Report was structured so that species-specific sections were provided for those species for which sufficient information was available to provide evaluations of stock status was possible, at least in some areas. As in previous years, it was recognized that the input data remain generally unsatisfactory and that the assessment results should be interpreted with caution. However, it was also concluded that available information demonstrated that many stocks were very probably being exploited at too high levels and some were depleted. An evaluation of the state of the deep-sea stocks was provided by ACFM later that year (ICES 2000, ICES Coop. Res. Rep. 242 (2)).

In 2001 the Study Group was re-established as the Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP), and again worked by correspondence to update landings, fishery descriptions, discard and biological data, but assessments were not updated. The Working Group was requested to provide a document on the applicability of fishery-independent surveys for assessment purposes. This document was an integral part of the Report (ICES CM 2001/ACFM:23). The Report should also address issues raised in special requests to ICES from NEAFC, the Government of Norway, and the EU. These requests were considered by ACFM in the May and October sessions (ICES 2001, ICES Coop. Res.rep. 246(3), p. 625–641).

The Terms of Reference for the 2002 meeting of WGDEEP included the evaluation of stock status, and it was therefore a central aim to carry out or update assessments for as many stocks as possible. Data constraints limited the assessment efforts at the meeting held in Horta in the Azores, but the general status descriptions were updated based on whatever data were provided (ICES CM 2002/ACFM:16).

In 2003 the Group worked by correspondence and updated landings and other datasets, and furthermore considered special requests from NEAFC regarding baseline levels of effort underlying advice in 2002, new reporting areas, and geographical distribution of aggregation areas for selected species. Prior to the 2004 meeting a stronger effort was made to stimulate intersessional efforts on data collection and compilation, and the running of preliminary assessments.

In 2004, WGDEEP updated fishery descriptions, biological parameters and time-series of abundance indices. Assessments were attempted for some stocks and preliminary results were demonstrated (ICES CM 2004/ACFM:15, Ref :G).

In 2005, WGDEEP was initially due to meet by correspondence with the main aim of updating landings statistics and the scientific basis underlying the population dynamics of deep-water species. However, because of requests from the NEAFC and the EC, a plenary meeting was organized in the end of the year. No assessments were carried out (ICES CM 2005/ACFM:07, Ref:D,G).

In 2006, WGDEEP has provided assessments and management recommendations for deep-sea stocks and fisheries, and it has also addressed specific issues related to area closures, mixed fisheries and the identification of survey needs (ICES CM 2006/ACFM:28). The methods applied were very much dependent on data availability. These included XSA (red sea bream in X), separable VPA (red sea bream in IX, roundnose grenadier in Vb, VI and VII), CSA (blue ling in Vb, VI and VII), and also plain examination of trends in survey abundance indices, cpue, length and depth distributions. The format of the report was modified, so assessments and recommendations were as much as possible structured by ecoregion and stock, and not by species. RGDEEP, the Group which reviewed the WGDEEP Report, generally supported this approach, but it also noted the lack of scientific evidence underlying the identification of deep-sea stocks.

In 2007, in addition to updating fishery information, WGDEEP had a TOR to hold a three day workshop on stock discrimination. The Group evaluated techniques that could be use for stock discrimination in deep-water species and examined the available information to identify stock units in the ICES area. Information for most species was not sufficient to discriminate stocks and the WG recommended that there was no reason to change from the current practice in ICES. However, for tusk there was genetic evidence available that allowed five separate stock units to be identified. WGDEEP recommended that these be adopted for future assessments.

The Group also addressed a request from NEAFC to consider coordination of deep-water surveys. Surveys be coordinated in three group; arctic fishery, the Northeast Atlantic Continental Slope and the Mid-Atlantic Ridge and offshore seamounts.

In 2008, WGDEEP provided assessments and management advice for deep-sea stocks and fisheries and addressed NEAFC requests relating to blue ling spawning aggregations, analysis of VMS data and discrimination of fisheries into management types (ICES CM 2008/ACOM:14). The methods applied included XSA (red sea bream in X), and separable VPA (red sea bream in IX, roundnose grenadier in Vb, VI and VII); however, deterioration in the quality of time-series used in earlier assessments meant that some assessments could not be updated. ICES advice on deep-water stocks in 2008 relied heavily on commercial and survey abundance indices, landings trends and biological characteristic of the stocks.

2.3 Terms of reference and special requests

The terms of reference of the Working Group were as follows:

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

b) Impacts of human activities on cold-water corals and sponge aggregations (OSPAR request 2010/5). Provide advice on impacts of human activities on cold-water corals and deep-sea sponge aggregations including:

i) total amounts and % of these habitats affected by human activity over the past decade, on a year-by-year basis, in the OSPAR Maritime Area;

ii) specific sites within the Northeast Atlantic where records show that more than 100 kg of live coral of 1000 kg of live sponges have been have been trawled as a result of human activities in the past;

iii) what is known about the status of coral reefs and sponge aggregations in these areas;

iv) recovery rates of these species if and when damaged or removed;

v) possibilities for re-creation of these habitats.

The request (OSPAR request 2010/5) has been allocated to WGDEC but WGDEEP is requested to provide contributions before 15 March to WGDEC.

Comment and make proposals for improvements on draft of a Best Practice Manual for scientific surveys in areas closed to fishing (NEAFC request).

2.4 General approach to addressing Terms of Reference

ToR a) address generic ToRs for Fish Stock Assessment Working Groups

All the stocks assessed by WGDEEP were scheduled for advice in 2009 and so only generic ToR a–h of the generic ToR for assessment Working Groups applied;

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

b) Update, quality check and report relevant data for the Working Group:

i) Load fisheries data on effort and catches (landings, discards, bycatch, including estimates of misreporting when appropriate) in the INTERCATCH database by fisheries/fleets. Data should be provided to the data coordinators at deadlines specified in the ToRs of the individual groups. Data submitted after the deadlines can be incorporated in the assessments at the discretion of the Expert Group chair;

ii) Abundance survey results;

iii) Environmental drivers;

iv) Propose specific actions to be taken to improve the quality of the data (including improvements in data collection).

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

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

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

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

i) Input data (including information from the fishing industry and NGO that is pertinent to the assessments and projections);

ii) Where misreporting of catches is significant, provide qualitative and where possible quantitative information and describe the methods used to obtain the information;

iii) Stock status and 2011 catch options;

iv) Historical performance of the assessment and brief description of quality issues with the assessment;

v) Mixed fisheries overview and considerations;

vi) Species interaction effects and ecosystem drivers;

vii) Ecosystem effects of fisheries;

viii) Effects of regulatory changes on the assessment or projections.

g) Where appropriate, check for the need to reopen the Advice in autumn based on the new survey information and the guidelines in AGCREFA;

h) Set MSY reference points (F_{MSY} and MSY $B_{trigger}$) according to the ICES MSY framework and following the guidelines developed by WKFRAME1 and WKFRAME2.

In accordance with the requirements from ICES that advice for 2010 should be given in relation to the MSY framework, WGDEEP gave consideration to how appropriate MSY reference points could be defined for data poor species and carried out exploratory exercises for a number of stocks. The results of this work are presented in Section 3.2.3. The overall conclusion was that considerable further work will be required in order to define appropriate MSY reference points for the stocks assessed by WGDEEP. This work will be carried out in WGDEEP 2011.

ToR b) Impacts of human activities on cold-water corals and sponge aggregations (OSPAR request 2010/5). Provide advice on impacts of human activities on cold-water corals and deep-sea sponge aggregations including

This ToR was primarily considered by WGDEC with input by correspondence from WGDEEP members. The ToR was not considered in any detail at the WGDEEP 2010 meeting but several WGDEEP members provided written comments on the WGDEC draft.

3 Overview

3.1 Data availability

3.1.1 Landings

3.1.2 Discards

Several EU countries have initiated observer programs as in accordance with their obligations under EC regulations 2347/2002 (regulating deep-water fisheries) and 1639/2000 (minimum and extended sampling programmes). Only France and Portugal supplied discard data to the Working Group in 2009 (see Section 3.4 for details). Discarding is known to be high in some deep-water fisheries and it is imperative that such data is collected and made available to the Working Group.

3.1.3 Fishing effort

Logbook data

Fishing effort time-series were reported for:

- Icelandic trawlers and longliners harvesting blue ling, ling, tusk and greater argentine in Division Va;
- Faroese longliners and pair-trawlers harvesting ling in Division Vb;
- Norwegian longliners from a reference fleet harvesting ling and tusk, mainly in Subareas I and II;
- Portuguese (mainland) longliners harvesting black scabbardfish in Subareas VIII and IX;
- Azorean longliners harvesting red (blackspot) seabream and alfonsinos in Division Xa.

VMS data

WGDEEP had in the past stressed the need of getting access to VMS data, in relation to some terms of references (e.g. stock assessment) and specific NEAFC requests (e.g. evaluation of the impact of area closures). In 2008, NEAFC provided ICES with a full extraction of its VMS database over the period 2001–2006. This comprised the geo-localisation of fishing vessels' positions in the international waters within the NEAFC regulatory area. In 2007, the NEAFC sent to ICES an update of this database, also including catch data which potentially could be linked with VMS records. However, these data were submitted close before the start of WGDEEP07, and there was not sufficient time for the Group to make use of them in relation to the 2007 NEAFC requests (see Sections 14–17).

During the 2008 meeting, WGDEEP commenced exploratory analysis of these data. Some shortcomings in data quality were encountered but in general, the data will make a valuable contribution to ICES understanding of fisheries in this area. The data proved useful in corroborating information received from other sources on the location of blue ling spawning aggregations and has potential for use in the differentiation of fisheries for management purposes. A fuller analysis of the quality and use of the data is presented in Section 16.

In national waters, access to VMS data continues to be problematic.

3.1.4 Research surveys

In 2007, WGDEEP reviewed the deep-water surveys currently conducted in the ICES area and made recommendations for coordination of surveys. The ICES Planning Group for the North East Atlantic Continental Slope Survey (PGNEACS) met for the first time in 2008 and made considerable progress in coordinating the Scottish and Irish surveys. Recommendations were made for the coordination of Portuguese French and Norwegian surveys under this group.

The text below summarises the national surveys, which were made available to WGDEEP08.

Faroe Islands

The Faroese groundfish surveys for cod, haddock and saithe is a fixed station trawl survey conducted annually on the Faroe Plateau. The spring survey (conducted in February–March) began in 1994 and covers 100 stations; while the autumn survey (conducted in August) began in 1996 covering 200 stations. The surveys also yield useful information on many other species. It needs to be kept in mind that the spring surveys are restricted to depths shallower than 500 m, so it only covers a part of the distribution area of deep-water species. The autumn survey was expanded in 2000 to cover depths to 1200 m.

Greenland

Greenland has conducted stratified random bottom trawl surveys in ICES XIVb since 1998 (except 2001) covering depths between 400 and 1500 m. The survey is aimed at Greenland halibut but estimates of biomass and abundance and length frequencies on roundnose and roughhead grenadier are also available. Information on sex, length and weight on the very few tusk, ling, smoothheads, argentines and different species of elasmobranchs have also been recorded. The utility of this survey for assessment purposes can not yet be evaluated.

Iceland

The Icelandic groundfish survey, which has been conducted annually since 1985, yields information on the variation in time of the fishable biomass of many exploited stocks in Division Va, and also useful information on many other species. More than 500 stations are fished annually, but the survey depth is restricted to the shelf and slope shallower than 500 m. Therefore the survey area only covers part of the distribution area of ling and blue ling as their distribution extends into greater depths. Another annual deep-water groundfish survey has been carried out all around Iceland since 1996. Although the main target species in this survey are Greenland halibut (*Reinhardtius hippoglossoides*) and deep-water redfish (*Sebastes mentella*), data for all species are collected. These data include length distributions and number of all species caught as well as weight, sex and maturity stages of selected ones.

Ireland

The Marine Institute ran ten deep-water surveys along the northeastern shelf edge between 1992 and 1999, five each by trawl and longline. This survey programme was an important source of information on the distribution and abundance of deep-water fishes during the early development of the commercial fishery, and provided samples of deep-water fish for biological analysis. The surveys have also produced catch per unit of effort (cpue) and discarding information.

In 2006 the Marine Institute recommenced its deep-water survey programme with a slope survey covering the continental slope in Area VIa and the northern Porcupine Bank in Area VIIc. Overall, 27 hauls were carried out at four depths, 500 m, 750 m, 1000 m and 1500 meters. The survey attempted to standardise gear, sampling strategy and protocols with the Scottish survey as much as possible. As part of this standardisation and intercomparison, RV Celtic Explorer carried out eight comparative tows with the Scottish research vessel, RV Scotia. The objective of the survey was to collect abundance data and biological information on the main deep-water fish species, including weight, length and maturity, and also to collect benthic invertebrates and bottom sediment samples. CTD transects, grab sampling, and cetacean studies were also carried out. It is envisaged that this survey will provide a time-series for cpue for the main deep-water species in the survey area in future.

Portugal (Azores)

Since 1995, a longline survey has been conducted annually by the Department of Oceanography and Fisheries at the University of the Azores (DOP), during springtime, covering the main areas of distribution of demersal species (the coast of the islands, and the main fishing banks and seamounts), with the primary objective of estimating fish abundance for stock assessment (Pinho, 2003).

The survey has supplied information needed to estimate the relative abundance of commercially important deep-water species, from ICES Area X, based on the common assumption that catch rate (cpue) is proportional to species abundance, cpue=q.N, where q is catchability, which is assumed constant, and N is the abundance.

Bottom longline was adopted as a sampling survey technology in the Azores because the sea-bottom is very rough, which does not permit use of other gears (e.g. trawl), and also due to a combination of behavioral and physiological factors of the demersal species (e.g. deep-water species are difficult to detect acoustically, particularly those living near the seabed, and mark recapture studies are ineffective for some of the species because they die when brought to surface).

Spain

From 2001 a new bottom-trawl survey started in the Porcupine bank to estimate abundance indices of commercial species and the distribution patterns of the demersal and benthic species in the area. Porcupine 2005 survey was organized by the IEO and counted with the collaboration on board the cruise of scientists from the Marine Institute of Ireland and from AZTI. The area covered in Porcupine 2005 survey is the Porcupine bank extending from longitude 12° W to 15° W and from latitude 51° N to 54° N, covering depths between 150 and 800 m. The cruise was carried out between September and October on board R/V "Vizconde de Eza. Trawling time was set to 30 minutes between the end of wire shutting and starting to pull it back and towing speed was set to 3.5 kn.

UK (Scotland)

A deep-water trawl survey of the continental slope to the west of Scotland has been carried out biennially in September by FRS, The Marine Laboratory since 1998. In 2005, it was combined with the Rockall Haddock survey, upgrading both to annual status. A TV sled survey for deep-water *Nephrops* burrows is carried out at night at selected sites on Rockall and the slope, and TV drop frame deployments are also carried out as part of collaboration with JNCC (Joint Nature Conservation Committee) to map habitat in these areas. The survey contains stations extending from the Wyville-

Thomson Ridge in the north to south of the Hebridean Terrace, although coverage has varied from year to year. Fishing is stratified by depth and currently ranges from 400–1900 m.

3.1.5 Abundance indices

Due to the sparsity of survey data currently available, the WGDEEP has relied heavily on cpue to reflect changes in stock abundance. Although new deep-water surveys are expected to provide abundance indicators in the long term, the WG will still have to rely on commercial cpue trends in the coming years.

WG members have adopted different strategies to standardise fishing effort and cpue. Sumarised below.

Cpue from logline fisheries in the Azores

GLM was used as the standardization method to adjust the cpue trends of several species from the Azores bottom longline fishery, namely of blackspot seabream, alfonsino, golden eye perch, bluemouth rockfish and greater forkbeard. Factors for year, month, boat class and target species effects were used to adjust the nominal catch per unit of effort. Once the effects of the month, boat class and target species are removed, the remaining year effect was assumed to be proportional to abundance. Trips with zero catches were not included in the calculations. The analyses were conducted for cpue in biomass (kg of fish per 1000 hooks) and for cpue in number (number of fish per 1000 hooks).

GLMs are convenient as they make use of accepted methods to select variables in models, and also since the coefficients derived from these analyses can be directly used to standardise fishing effort and catch rates. However, GLMs are subject to a number of limitations. First, fisheries data are generally unbalanced (e.g. not all vessels are present over all time-series). Second, the underlying functional form is linear, by construction. However, the linkage between cpue and stock abundance could be of a more complex nature, e.g. including non-linear effects. Hinton and Maunder (2004) reviewed non-linear modelling alternatives which have been or could be used in relation to cpue analyses. These include non-linear models such as General Additive Models (Bigelow *et al*., 1999), neural networks (Warner and Misra, 1996), regression trees (Watters and Deriso, 2000), and also habitat-based models (Bigelow *et al*., 2002; Maunder *et al*., 2002).

Cpue from the French trawl fishery to the west of the British Isles

Several problems have been seen previously in the French time-series of cpues.

In the 1990s, i.e. the first decade of the mixed fishery targeting roundnose grenadier, black scabbardfish and sikis sharks, cpues were shown to vary of over three different French sub-fleets. Only the cpue for a sub-fleet of large high-sea trawlers prosecuting a pure deep-water activity was considered as a reliable indicator of stocks abundance (Lorance and Dupouy, 2001). Due to disruption of the time-series of French catch statistics database, such cpue could not be updated in the 2000s.

In 2006, a working document showed that several factors affected the French cpues. In particular the fishery have been exploiting new fishing grounds in the 2000s and the cpues in these new grounds were higher that in grounds fished since the early 1990s, driving an increase in global cpues. The cpue per small areas showed different trends (Figure 3.1.2) (Biseau, 2006WD). In addition, due to changes in the national fishery statistics system, the effort data before and after 1999 were not fully consistent.

Use of total cpue for all the French fleet is problematic because the composition of the fleet has varied over time with changing proportions of large high-sea trawlers (more than 45 m overall length and 1400 kw power) and medium size high-sea trawlers (28–40 m overall length, less than 1000 kw).

Nevertheless, for each of roundnose grenadier, black scabbardfish and orange roughy, four time-series of cpue have been computed:

1) total annual catch divided by total effort;
2) total annual catch in a reference area divided by total effort in the same area;
3) the same as (2) by a reference fleet;
4) the same as (2) for the reference fleet considering only directed effort (i.e. effort from sub-trip where the species makes at least 10% of the total catch).

The reference area was defined based upon the working paper from Biseau (2006) as represented in Figure 3.1.1.

Cpue from Norwegian longline fisheries

This procedure was adopted to derive catch rates for a reference Norwegian fleet harvesting blue ling, ling and tusk. This reference fleet, which comprises four vessels, has been used to provide abundance indices, in the form of catch rates, since 2001. Data from the reference fleet were combined with log-book data for the entire high-seas longliners fleet, which were available over the period 2000–2006 (see WGDEEP06 WD3 for full details). A similar approach has been undertaken to identify a reference Faroese fleet in relation to the ling and tusk assessments.

3.1.6 Stock structure

This Report presents the status and advice of deep-sea species by individual stock component. The identification of stock structure has been based upon the best available knowledge to date (see the species specific chapters for more details). However, it has to be stressed that overall, the scientific basis underlying the identity of deep-sea stocks is currently weak. In most of the cases, the identification of stock is based on either theoretical considerations on the mixing of populations in relation to the hydrological and geological characteristics of fishing grounds, or comparison of trends in catch rates, or consistency with management units. Therefore, the WG considers that the stock definitions proposed in this Report are only preliminary. There are currently genetic studies on-going to improve the knowledge of the stock structure of a number of species. The WG recommends that increased research effort be devoted to clarify the stock identity of the different deep-sea species investigated by ICES.

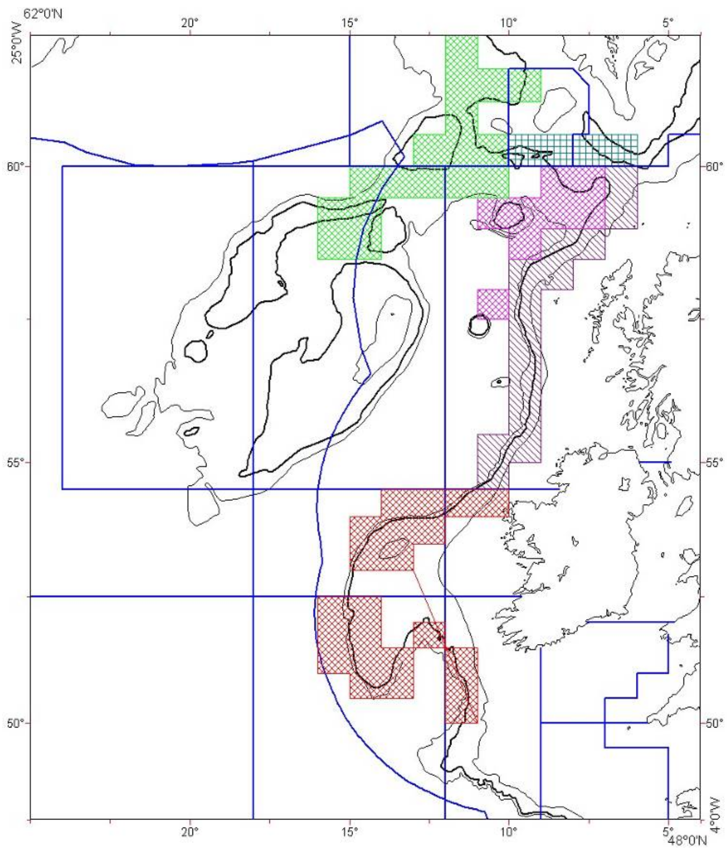


Figure3.1.1. Areas used to compute cpue of French vessels (green: New grounds in Vb and VI; dark green: reference area in Vb; pink: others in VI; purple: continentalslope in VI; red reference in VII).

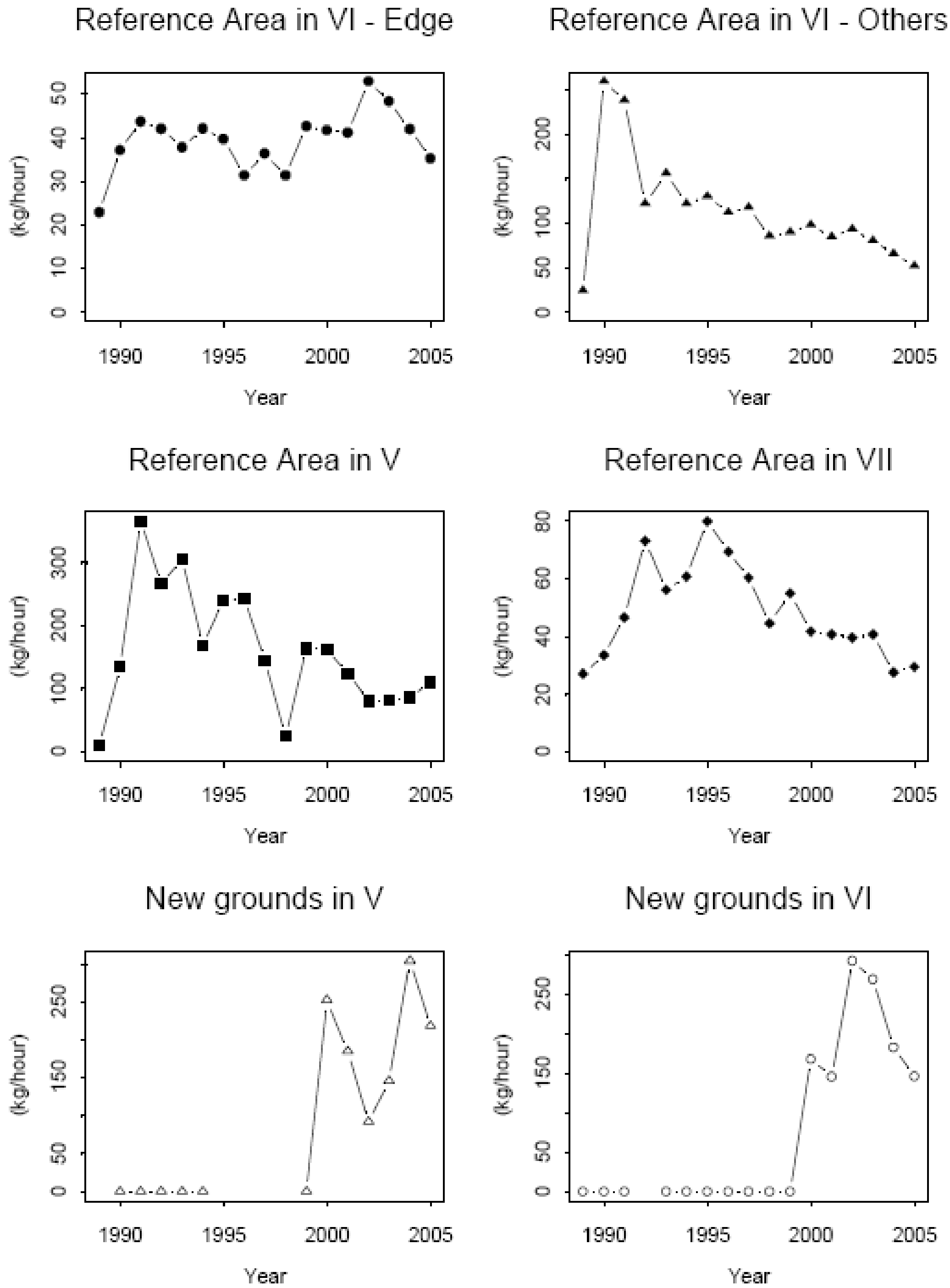


Figure 3.1.2. Cpues of roundnose grenadier in different parts of Division Vb and Subareas VI and VII. Reference areas were exploited since the begining of the fishery in the late 1980s, new grounds have not been intensively exploited by French trawlers before the 2000s (see Figure 3.1.1 for a map).

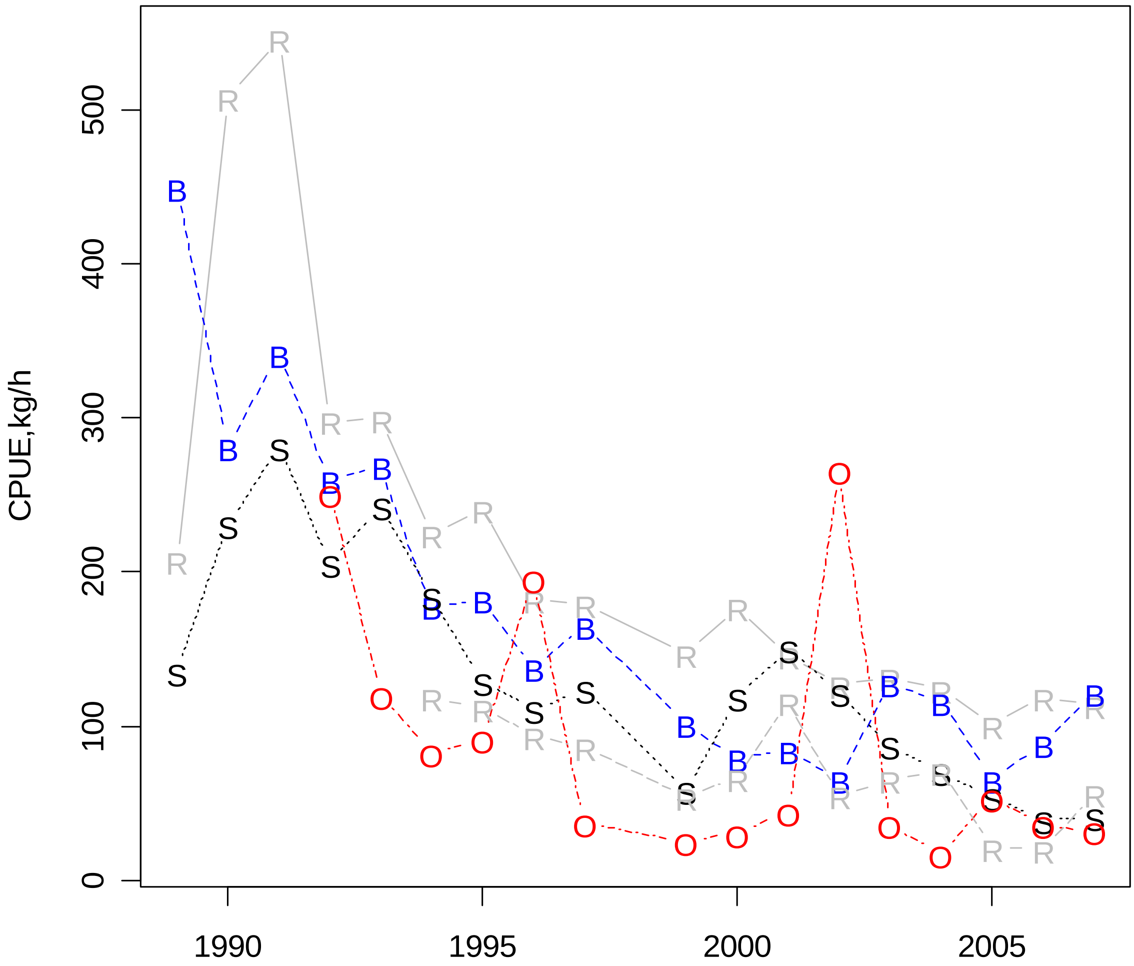


Figure 3.1.3. Directed cpue from the reference fleet (a fleet of large high-sea trawlers doing a pure deep-water fishing). R: roundnose grenadier, B: blue ling; S: black scabbardfish; O: orange roughy.

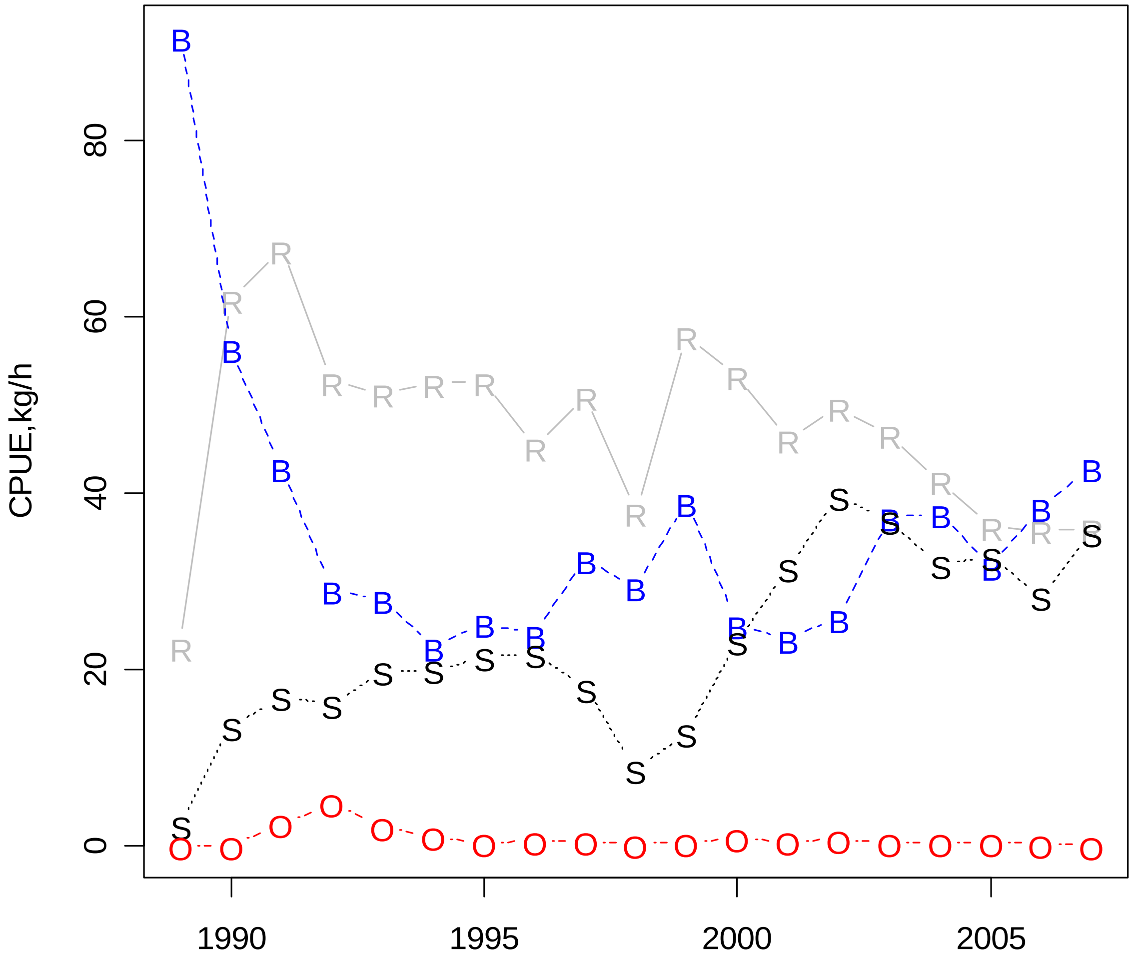


Figure 3.1.4. Total cpue for all French vessels in the reference area. R: roundnose grenadier, B: blue ling; S: black scabbardfish; O: orange roughy.

3.2 Methods and software

This Section summarizes the methods and software used by the Working Group historically and any new methods and software used in 2010. (separated into methods agreed for Benchmarked stocks and those that are exploratory).

3.2.1 Historical

3.2.1.1 Methods

Catch curve analysis

The Group were aware of the assumption of constant recruitment implied when constructing catch curves within years. Lack of historical data frequently required this course of action rather than the preferred option of analysing individual year classes by cohort.

Depletion models

A catch and effort data analysis package (CEDA) was used to apply modified Delury constant recruitment models when sufficient data were available. The Working Group recognized that depletion models in general assume that data are from a single-stock (i.e. there is no immigration or emigration) and that this approach should not be applied to components of stocks or fisheries. Notwithstanding these assumptions, and the lack of knowledge regarding the stock structure of deep-water species, the Group still felt these methods were worth trying as an investigative tool. The general procedure adopted was to use sensitivity analysis to evaluate the effect on results (residual plots, goodness-of-fit, parameter estimates, principally carrying capacity, catchability and current population size) of a range of assumptions for stock size in the first year as a proportion of carrying capacity and error models. Indexed recruitment depletion models could not be attempted because of a lack of recruit data.

Production models

ASPIC and CEDA was also used to fit dynamic (i.e. non-equilibrium) production models. Again sensitivity analysis of outputs was used to evaluate the effect of error models and ratio of initial to virgin biomass and time-lag. For some of the stocks assessed, available time-series data of cpue comprise a gradual decline across the period studied. The Working Group was aware that the results from production models in these circumstances (the so called 'one way trip') can be unreliable.

Attempts have been made to apply a Bayesian approach to a Schaefer model using WINBUGS free software. There are uncertainties about the key population parameters for deep-water fish species and a Bayesian approach is a natural way to portray those uncertainties and to express the risks that are associated with alternative management measures. It is becoming commonly accepted that Bayesian methods can produce less biased estimates when compared with frequentist approaches based on maximum likelihood estimators (Nielsen and Lewi, 2002).

VPA analysis

The Lowesoft VPA package has been used to carry out Shepherd/Laurec analyses to detect trends in catchability, and separable VPA and extended survivors analysis (XSA) to produce estimates of stock, where possible.

Stock reduction models

Stock reduction analysis is a developed form of a delay-difference model (Quinn and Deriso, 1999). The method uses biologically meaningful parameters and information for time delays as a result of growth and recruitment to predict the basic biomass dynamics of the populations without requiring information on age structure. Thus it can be considered to be a conceptual hybrid between dynamic surplus production and full age based models (Hilborn and Walters, 1992). A full description of the general approach can be found in Kimura and Tagart, 1982, Kimura *et al.*, 1984 and Kimura, 1985; 1988.

The stock reduction model used is part of programme suite (PMOD) developed by Francis, 1992; 1993 and Francis *et al.*, 1995. Simple deterministic and enhanced stochastic models are included, but given the paucity of the available data it was decided to use the former. The method requires time-series data of annual catches, one or more abundance index and a range of biological parameters. A Beverton and Holt stock and recruitment relationship with a steepness of 0.75 was used throughout (Francis, 1993).

The method provides an estimate of virgin biomass (B0) and current biomass from which a depletion ratio can be calculated. The stock reduction model developed by Francis also provides an estimate of the annual mean catch that can be taken, consistent with a 10% probability of spawning-stock biomass falling below 20% of virgin SSB. In New Zealand and Australian fishery this catch is termed the maximum constant yield (MCY). Given that age of recruitment and age of maturity are reasonably similar for some species e.g. blue ling, 20% of virgin SSB can be considered to be broadly equivalent to 20% of virgin exploitable biomass. It should be possible, therefore, to estimate a sustainable constant catch broadly consistent with a high probability of maintaining exploitable biomass above the limit reference level for deep-water stocks in the ICES area.

Catch Survey Analysis (CSA)

CSA (Mesnil, 2003) is an assessment method that aims to estimate absolute stock abundance given a time-series of catches and relative abundance indices, typically from research surveys. This is done by filtering measurement error in the latter through a simple two-stage population dynamics model known as the Collie-Sissenwine, 1983 model. The population dynamics are described by the following model:

$$N_{y+1} = (N_y + R_y)e^{-M} - C_y e^{-M(1-\tau)} \quad [1]$$

where:

y : time-step, typically annual. Years may be defined either on a calendar basis or as the interval between regular surveys. The year range is [1, Y].

Ny : population size, in number, of fully recruited animals at start of year y;

Ry : population size, in number, of recruits at start of year y;

Cy : catch in number during year y (known);

M : instantaneous rate of natural mortality (equal for both stages, assumed);

τ : fraction of the year when the catch is taken, e.g. 0 if the fishing season is early in the year, or 0.5 if the catch is taken midway through the year or, by resemblance with Pope's (1972) cohort approximation, evenly over the year.

Estimating the time-series of Ny and Ry given the catches is the basic task of any assessment but, as with other methods, this requires additional information in the form of relative indices ny and ry of abundance for each stage, typically from surveys, which are assumed to be proportional to absolute population sizes Ny and Ry. The indices are deemed to be measured with some (lognormal) observation error:

$$n_y = q_n N_y \exp(\eta_y); y = 1, Y \quad [2]$$

$$r_y = q_r R_y \exp(\delta_y); y = 1, Y - 1 \quad [3]$$

where:

qn and qr : catchability coefficients of fully recruited and recruits, respectively, in the survey, supposed to be constant with time;

η and δ : normally distributed random variables.

A constraint must be imposed whereby the survey catchability of the recruits is some fraction s of that of the fully recruited:

$$s = q_r / q_n \qquad [4]$$

Gadget

Gadget is a shorthand for {G}lobally applicable {A}rea {D}isaggregated {G}eneral {E}cosystem {T}oolbox which is a statistical model of marine ecosystems. Gadget is a simulation model designed as a multispecies-multiarea model but can also be used as a single species model. The model operates as an age and length based cohort model, where all the selection curves depend on the length of the fish and information on age is not a prerequisite but can be utilized if available.

***Ad hoc* methods**

Where *ad hoc* methods have been used these are described in the relevant species assessment sections.

3.2.1.2 Software

Assessment software used at recent Working Groups includes CEDA (Catch Effort data analysis, produced by MRAG Ltd, 27 Campden Street, London W8 7EP, UK.) ASPIC, PMOD (stock reduction programme), the Lowestoft VPA package, Winbugs (version 1.4 http://www.mrc-bsu.cam.ac.uk/bugs/winbugs) and CSA. The software and a detailed description of the Gadget model can be found at www.hafro.is/gadget.

3.2.2 Assessments in 2010

3.2.2.1 Methods and data used in Benchmarked stocks

The first Benchmark WG (WKDEEP) for deep-water stocks was held in February 2010. The Report has yet to be signed off by the Chair so the description below of the methods used for each benchmark stock is preliminary.

Roundnose grenadier in Vb,VI,VII and XIIb

Bayesian surplus production model (based on Pella Tomlinson biomass dynamic model)

Software used: FLBayes package version 1.4, FLCore 1.99-91, R 2.9.2 (URL: http://code.google.com/p/wgdeep-rng/)

Model Options chosen:

Initial parameters

- Age-at-maturity: 11 (variance 0.1)
- Longevity: 50 (variance 0.1)
- Priors for Q (logQ.mean = 0, loqQ.var = 100)
- Priors for K (K.mean = log(100 000) , K.var = 1)
- Priors for r (r.mean = mean(log(r.mc)), r.var = mean(var(r.mc)))
- sigma.shape = 2
- sigma.rate = 1

3.2.2.2 Multi-year catch curve

A multi year catch curve (MYCC) model developed as part of the EU-DEEPFISHMAN project, returns realistic trends in total mortality Z per year. Absolute level may have to interpret with caution. Nevertheless, this model should be used further, to derive an indicator of total mortality and to explore the stock dynamic. Input data are age distribution of the landings or of the catch (landings and discards) per year. The model was run on age 25–46+ (fully recruited stock). The model requires some parameter to be fixed.

- M=0.1 (depending on model setting)
- Coefficient of variations of the recruitement (CVrec= 0.1)
- Coefficient of variations of the landings or catch (CVo=0.1 : CV of observations

3.2.2.3 Other indicators of trends

Biological indicators such as trends in mean length, ratio of mature/immature provide valuable insights of the state of stocks. Information from length distribution of landings and discards in addition to information on fishing depths are useful indicators of trends in the fishery and in the population structures.

Lpues data based upon French tallybooks are used as indicators of trends and also in the assessment. Catch rates from surveys are used to check the consistency of the analysis on the commercial cpues.

Input data types and characteristics:

- Landings data are used from 1988 in Vb, VI, VII and XIIb (the later when available).
- Lpues from French tallybooks from 2000 (past lpues may be included when data will be available). Lpues are provided by region and are combined. The weight of each region is the proportion between the local and the total landings.

Greater silver smelt in all areas

For Division Va, greater silver smelt is assessed based on trends in survey biomass indices (standard un-winsorized and winsorized) from the Icelandic Autumn survey and changes in age distributions form commercial catches and surveys. Supplementary data used includes relevant information from the fishery and surveys such as changes in spatial (geographical and depth range) and temporal distribution, length distributions and maturity ogives.

For other areas: For Division Vb, trends in biomass were derived from the Faroese summer survey and mean length for the mature and immature greater silver smelt from the spring- and summer surveys for cod, haddock and saithe. For Subarea VII, biomass indices and length frequencies were derived for the greater silver smelt from the Spanish Porcupine survey.

Tusk in Va

A Gadget model was accepted as indicative of stock trends. The method comprises simulation runs with defined functional forms and parameter values, and produces a modelled population, with modelled surveys and catches. These surveys and catches are compared against the available data to produce a weighted likelihood score. Optimisation routines then attempt to find the best set of parameter values. Growth is modelled by calculating the mean growth for fish in each length group for each time step, using a parametric growth function. In the tusk model a von Bertanlanffy function has been employed to calculate this mean growth. The actual growth of fish in a given length cell is then modelled by imposing a beta-binomial distribution around this mean growth. This allows for the fish to grow by varying amounts, while preserving the calculated mean. The beta-binomial is described in Stefansson (2001). The beta-binomial distribution is constrained by the mean (which comes from the calculated mean growth), the maximum number of length cells a fish can grow in a given time step (which is set based on expert judgement about the maximum plausible growth), and a parameter β, which is estimated within the model. In addition to the spread of growth from the beta-binomial distribution, there is a minimum to this spread due by discretisation of the length distribution.

The population is defined by 10 cm length groups, from 20–110 cm and the year is divided into four quarters. The age range is 2 to 20 years, with the oldest age treated as a plus group. Recruitment happens in the first and was set at age 2. The length-at-recruitment is estimated and mean growth is assumed to follow the von Bertalanffy growth function estimated by the model.

Weight–length relationship

Natural mortality was assumed to be 0.2 $year^{-1}$

The commercial landings are modelled as one fleet (1979–2009) with a selection pattern described by a logistic function and the total catch in tonnes specified for each quarter. The Icelandic survey (1985–2009), on the other hand is modelled as one fleet with constant effort and a nonparametric selection pattern that is estimated for each length group (one 10 cm length group).

The data used are:

Length disaggregated survey indices (10 cm increments) from the Icelandic groundfish survey in March 1985–2009.

Length distribution from the Icelandic commercial catch since 1979. The sampling effort was though relatively limited until the 1990s.

Landings data divided into four month periods per year (quarters).

Age–length keys and mean length-at-age from the Icelandic commercial fishery.

Red (blackspot) seabream in Subarea X

This stock should be assessed based on i) trends in the mean length of mature and immature from longline survey using the entire survey area and individual survey statistical areas; ii) trend in abundance in survey and standardize commercial cpue series.

Data: Azorean longline survey abundance indices from 1995–onwards.

Annual survey length compositions abundance by area from 1995–onwards.

Annual landings data from 1990–onwardsband GLM standardized cpue from 1990 onwards.

Greater forkbeard in all areas

Survey based population indicators of greater forkbeard should be calculated from all relevant surveys. The recommended indicators are: abundance, log abundance, mean length, quantiles of mean length, biomass, per strata and for the whole survey. Interpretation of trends by survey and strata should be used to define the overall trend in areas where greater forkbeard is caught.

The surveys to be used are: the Spanish IBTS in the Cantabrian sea (Division VIIIb), French western IBTS survey (EVHOE) in the Bay of Biscay (VIIIab and Celtic Sea (VIIf,g,h,j), Spanish survey on the Porcupine Bank, Irish bottom trawl survey and Scottish IBTS in VIa.

Exploratory assessments

An exploratory assessment method for Greater forkbeard was attempted using a new version of the Stock Depletion Model (SDM) developed by Roa-Ureta and based on a generalisation of the model described by Roa-Ureta and Niklitschek (2007). The model follows the daily catch and effort dynamics covered three years (2003 to 2005) of daily activity by the trawling, gillnet and longline Spanish fleets operating in Subareas III,,VI,VI,VII,VIII,IX,X,XII. In this data-poor situation there is no biological sampling of the catch and the catch is reported in biomass, so the model had to be transformed from a model predicting catch in numbers to a model predicting catch in biomass. Secondly, there have been three Spanish fleets using different gears catching greater forkbeard as a bycatch. Thus the model was adapted to deal simultaneously with the information coming from multiple fleets. With these considerations the model is:

$$\chi_t = e^{-M/2} g(K)_{t,\tilde{a}-1/2} \sum_{i=1}^{f} \left(B_0 e^{-Mt} g(K)_{t,\tilde{a}} - e^{-M/2} g(K)_{t,\tilde{a}-1/2} \sum_{j<t} \chi_{f,j} e^{-(t-j-1)M} g(K)_{t,\tilde{a}-j-1} \right)^{\beta_f} q_f E_{f,t}^{\alpha_f} + \varepsilon_t,$$

$$\varepsilon_t = \sum_{i=1}^{f} \varepsilon_{i,t} \sim \text{Normal}\left(0, \sigma_C^2 = \sum_{i=1}^{f} \sigma_i^2\right)$$

$$g(K)_{t,\tilde{a}} = \left(\frac{1-e^{-K(t+\tilde{a})}}{1-e^{-K(t+\tilde{a}-1)}} \right)^3, g(K)_{t,\tilde{a}-1/2} = \left(\frac{1-e^{-K(t+\tilde{a}-1/2)}}{1-e^{-K(t+\tilde{a}-1)}} \right)^3, g(K)_{t,\tilde{a}-j-1} = \left(\frac{1-e^{-K(t+\tilde{a}-j-1)}}{1-e^{-K(t+\tilde{a}-j-2)}} \right)^3$$

where t is a daily time step, χ is the observed catch as a random variable, $e^{-M/2}$ is the daily natural change due to daily natural mortality rate M, $g(K)$ is the daily natural change in biomas due to individual growth, f is the number of fleets, B_0 is the biomass at the start of the year, β is an abundance hyper-response parameter (accounting for nonlinearities in the relation between catch and abundance), q is a scaling parameter (catchability), E is the observed effort, α is an effort hyper-response parameter (accounting for nonlinearities in the relation between catch and effort), ε is a normal random variable composed of independent normal random deviates from each fleet, with pooled variance σ^2_C. The transformation to catch in biomass involved the inclusion of a model of biomass growth by individual fish to account for natural change in biomass due to individual growth. As it can be seen from the equations for $g(K)$, we assumed a von Bertalanffy individual growth model. There was no firm knowledge about the value of K so we used the relation of K with M, namely K=(2/3)M (Jensen, 1996). M in turn was assumed as coming from the empirical relation between M and longevity of Hewitt and Hoenig (2005). M=0.003693956 day^{-1}. The transformation to catch in biomass also involved some assumption about the mean age of fish at the start of each year. We assumed that they had the geometric mean age ($\tilde{a}$) as computed using a maximum age of 20 years old (Cohen *et al.*, 1990) plus five years for improbable observation of extreme values, and four years as the age of recruitment to the fishery.

The model was programmed in R (R Development Core Team, 2009) as a function to be called by setting up initial parameter values by exploratory analysis. The fit was done maximising the profile likelihood function by recourse to the optim function and the Nelder-Mead algorithm.

3.2.3 Implementation of the ICES MSY concept and an historical summary of Biological Reference Points and Harvest Control Rules previously explored by WGDEEP

3.2.3.1 Implementation of the ICES MSY concept

WGDEEP had very little time to assimilate the guidance on the implementation of the ICES MSY concept from WKFRAME, however a number of recommended approaches for data-poor stock were explored, mainly using southern blue ling (Vb,VI and VII) as a case study. These were:

Depletion corrected average catch ((MacCall, 2009)

The depletion-corrected average catch (DCAC) formula is an extension of the potential-yield formula, and it provides useful estimates of sustainable yield for data-poor fisheries on long-lived species. Over an extended period (e.g. a decade or more), the catch is divided into a sustainable yield component and an unsustainable "windfall" component associated with a one-time reduction in stock biomass. The size of the windfall is expressed as being equivalent to a number of years of sustainable production, in the form of a "windfall ratio". The DCAC is calculated as the sum of catches divided by the sum of the number of years in the catch series and this windfall ratio. Input information includes the sum of catches and associated number of years, the relative reduction in biomass during that period, the natural mortality rate (M, which should be 0.2 $year^{-1}$), and the assumed ratio of FMSY to M. These input values are expected to be approximate, and based on the estimates of their imprecision, the uncertainty can be integrated by Monte Carlo exploration of DCAC values.

This method was applied to blue ling in Vb,VI and VII harvested for 43 years, from 1966 to 2008. M was fixed at 0.22 yr^{-1} from results of applying Hewitt and Hoening (2005) empirical relation with longevity, assumed to be 20 yr for blue ling. A rather conservative stance was adopted assuming that the ratio of F at MSY to M was 0.8. The delta-depletion value is rather uncertain so a simple sensitivity analysis was carried out assuming values in the set {0.2, 0.3, 0.4, 0.5, 0.6, 0.7}. Finally, for the three unknown parameters (M, F_{MSY}/M, and Δ), standard error values were obtained by assuming reasonable coefficients of variation, following recommendations by MacCall (2009). The known parameter values (number of years of fishery and total catch in that period) were set at their values and the unknown parameters were collected from normal distributions in a Monte Carlo simulation experiment to obtain resampled 95% confidence intervals for MSY for each value of Δ. This procedure was applied using the program DCAC from NOAA Fisheries Toolbox (http://nft.nefsc.noaa.gov/).

The method produced results that were fairly robust to different depletion-delta scenarios (Table 3.2.1). These scenarios probably have covered the real depletion exerted in the stock over the 43 yr of the fishery. According to the model, the estimated MSY lies fairly certainly between 7000 and 11 000 tonnes.

Table 3.2.1. MSY results from the DCAC model and Monte Carlo simulation experiment to assess statistical uncertainty.

	Depletion-Delta					
Input	0.2	0.3	0.4	0.5	0.6	0.7
Nº years	43	43	43	43	43	43
Total catch (tonnes)	475 330	475 330	475 330	475 330	475 330	475 330
M (year-1)	0.22	0.22	0.22	0.22	0.22	0.22
FMSY/M	0.8	0.8	0.8	0.8	0.8	0.8
CV of M	50%	50%	50%	50%	50%	50%
CV of FMSY/M	25%	25%	25%	25%	25%	25%
CV of depletion-delta	50%	50%	50%	50%	50%	50%
Output						
Monte Carlo 95% CI of MSY						
Lower bound (tonnes)	9599	9006	8482	8016	7599	7222
Upper bound (tonnes)	10 927	10 865	10 803	10 742	10 681	10 622

Catch curve analysis

Base upon the age–length key and the size distribution of the landings in 2009, sampled monthly, a preliminary catch curve was calculated for southern blue ling. The size of aged fish ranged from 70 to 133 cm and estimated ages ranged from 7 to 20 years. The catch curve was made across ages 10 to 20, as younger ages reflecting partial recruritment from age 7 to 10.

The curve (Figure 3.2.1) indicates a total mortality (Z) of 0.26. An estimate of M is can be estimated using the relationship (Annala, J. H., Sullivan, K. J., (1996)):

M = LN(100)/maximum age

The maximum age can be set at the age where 1% of a year class is still alive. Based on Faroese and French age readings, it is reasonable to assume the maximum age for blue ling is around 30 years. Given this and the relationship above, M may be in the order of 0.17. The catch curve results suggest, therefore, that F in 2009 may be around the level of M, wich is very likely below F_{msy}.

This approach should be considered preliminary as age estimations for blue ling are not validated, and no routine age estimation has been carried out in previous years. The age composition, observed in a single year, may also represent a biased view of the stock dynamic due to assumptions made for constant recruitment and fishing mortality.

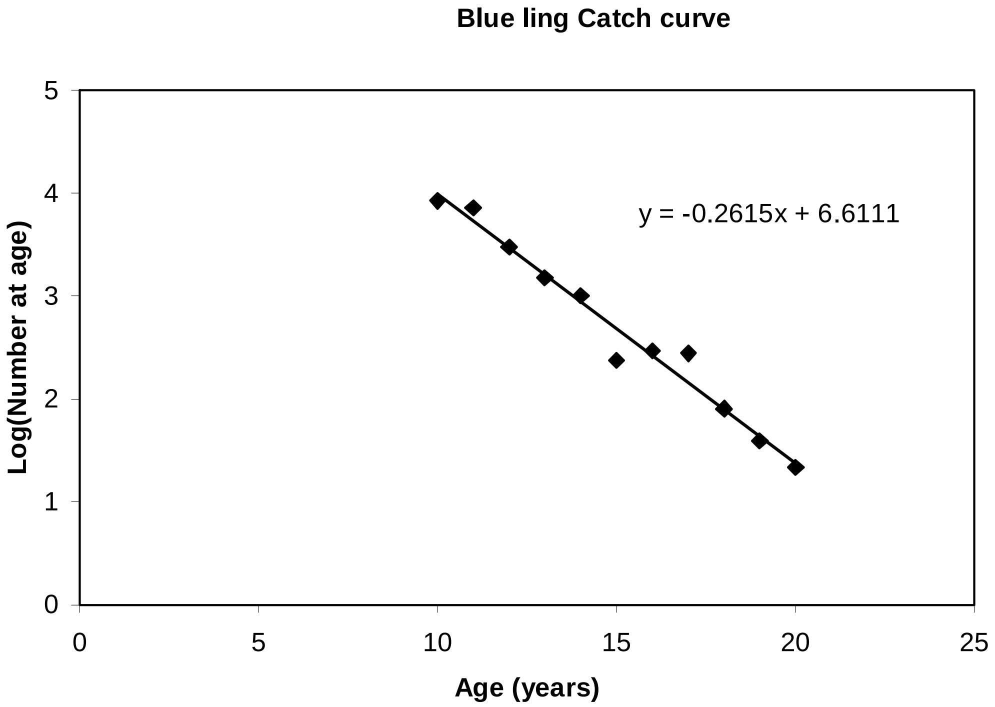


Figure 3.2.1. Catch curve of blue ling, from age estimation on a sample of 149 fish taken from French Auction Market in 2009 (sampling carried out under DCF).

Risk based framework: Productivity-susceptibility Analysis (PSA)

PSA is one of the methods suggested by ICES WKFRAME as suitable to assess the vulnerability of stocks that are data-poor. The method was developed by Hobday (2007) for the Australian Fisheries management administration with collaboration of CSIRO, and has been adopted by Marine Stewardship council (MSC) and the National Marine Fisheries Services NMFS-NOAA for assessing data deficient fisheries.

Stock productivity (calculated using life history characteristics) and stock susceptibility (calculated as the scaled product specified parameters), is used to evaluate the vulnerability of the stock to a fishery.

Stock **productivity** is determined as the average risk score of the following seven attributes:

1) average age-at-maturity;
2) average size-at-maturity;
3) average maximum age;
4) average maximum size;
5) fecundity;
6) reproductive strategy;
7) trophic level.

Scores for each attribute are based on cut-off scores as published in the MSC guidelines.

Stock susceptibility is determined as the scaled product of the following:

1) Availability (distribution and behavioural characteristics that would impact susceptibility): Availability considers overlap of fishing effort with a species distribution;

2) Encounterability (habitat and bathymetry): Encounterability considers the likelihood that a species will encounter fishing gear that is deployed within the geographic range of that species (based on two attributes: adult habitat and bathymetry);

3) Selectivity: Selectivity considers the potential of the gear to capture or retain species (size-at-maturity, maximum size and desirability);

4) Post Capture Mortality (condition and subsequent survival of a species that is caught): Post capture mortality considers the condition and subsequent survival of a species that is captured and released (or discarded).

Table 3.2.2. Summary of attributes for the scoring of productivity and susceptibility (NMFS 2009).

		Attribute
Productivity		Average age at maturity
		Average size at maturity
		Average maximum age
		Average maximum size
		Fecundity
		Reproductive Strategy
		Trophic Level
	Aspects of Susceptibility	**Attribute**
Susceptibility	Availability	Global distribution
		Behavioral characteristics
	Encounterability	Habitat
		Bathymetry
	Selectivity	Average size at maturity
		Average maximum size
		Desirability
	Post Capture Mortalty	Survival after capture and release

A custom-made spreadsheet from the MSC guidelines was used to calculate overall PSA vulnerability scoresas follows:

1) Score productivity attributes (average);

2) Score susceptibility scores (scaled-product);

3) Calculate the risk score; calculated as the Euclidian distance.

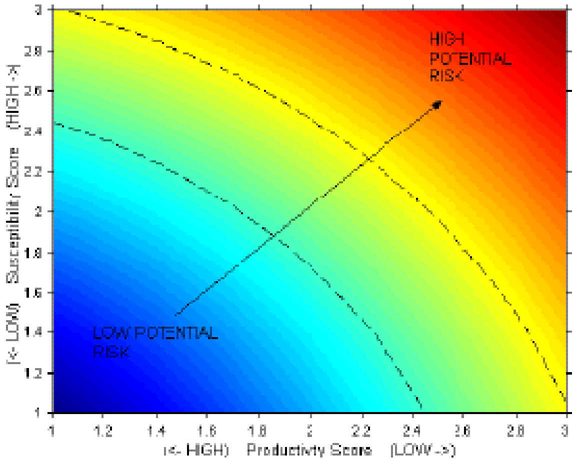


Figure 3.2.2. The PSA plot. The *x*-axis includes attributes that influence the productivity of a unit, or its ability to recover after impact from fishing. The *y*-axis includes attributes that influence the susceptibility of the unit to impacts from fishing. The combination of susceptibility and productivity determines the relative risk to a unit, i.e. units with high susceptibility and low productivity are at highest risk, while units with low susceptibility and high productivity are at lowest risk. The contour lines divide regions of equal risk and group units of similar risk levels (Hobday *et a*l., 2007).

PSA was trialled on information for the following species taken in the French mixed deep-water trawl fishery VI and VII :- orange roughy, roundnose grenadier, greater forkbeard, Portuguese dogfish, leafscale gulper shark (Table 3.2.3 and Figure 2.3.3, below).

Table 3.2.3. Individual productivity and susceptibility scores, and calculated risk categories by species.

	Productivity Scores [1 3]								Susceptibility Scores [1 3]						PSA scores (autom	
COMMON_NAME	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level (fishbase)	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	Color on PSA plot	PSA Score	Risk Category Name
Orange Roughy	3	3	1	1	**2**	1	3	2.00	2	2	3	3	1.88		2.74	Med
Black Scabbard	2	3	**2**	2	2	1	3	2.14	3	2	**2**	3	1.88		2.85	Med
greater forkbeard	1	2	1	1	1	1	3	1.43	2	1	3	3	1.43		2.02	Low
Roundnose grenadier	2	2	**2**	1	1	1	3	1.71	2	2	2	2	1.38		2.20	Low
Portuguese dogfish	2	3	1	2	2	3	3	2.29	3	3	2	3	2.33		3.26	High
leafscale gulper shark	2	3	1	2	2	3	3	2.29	3	2	2	3	1.88		2.96	Med

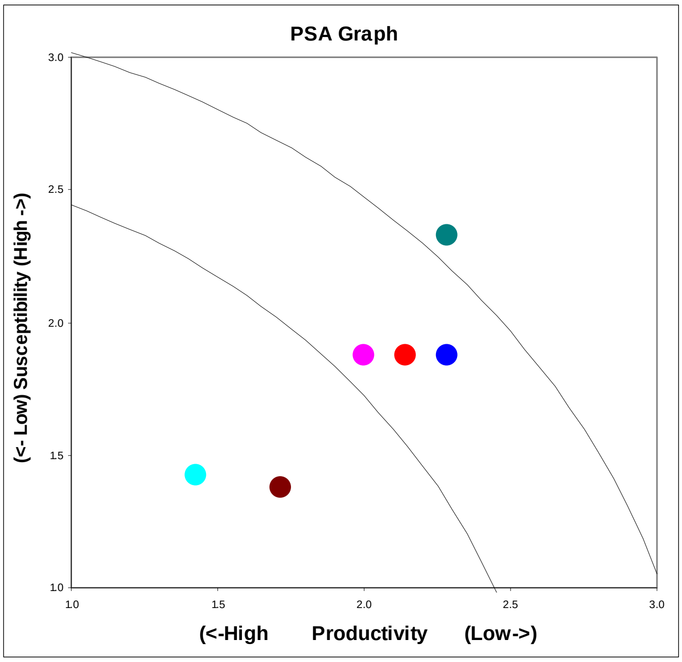


Figure 3.2.3. PSA plot for French mixed trawl fishery in VI and VII.

There is a high bias to size; i.e. a slow growing small fish has automatically a lower vulnerability than a fast growing long fish. For example, orange roughy and black scabbardfish obtain very similar productivity risk scores, whereas grenadier receives a much lower productivity risk score. A possible adaptation would be to rescale the scoring of the age scales to take into account the longevity of deep-water species. The method is very sensitive to lower susceptibility scores; for example the two shark species.

Potential usage

- PSA does not give an MSY proxy but is evaluates potential vulnerability to fishing;
- Can evaluate the overall vulnerability of a fishing community to a particular fishing activity, and highlight the more vulnerable components of this community;
- Allows to see the fishery in a multispecies context, and can highlight problems when giving MSY for single species;
- The analysis could differentiate between target species, bycatch species and discarded species and evaluate the vulnerability of these different components.

This method should be further evaluated at a future benchmark workshop for assessing ecosystem effects of a fishery in an ecosystem.

3.2.4 Biological reference points

In 2005, WGDEEP reviewed the biological reference points (BRPs) used in the WG since 1998. These were proposed for data poor situation by ICES SGPA and NAFO in 1997 and are as follows:

$U_{lim} = 0.2 * U_{max}$ (may be a smoothed abundance index)
$U_{pa} = 0.5 * U_{max}$

Where U is the index of exploitable biomass.

$\mathbf{F}_{lim} = F_{35\ \%SPR}$
$\mathbf{F}_{pa} = M$

Historically, WGDEEP has applied these BRPs to all stocks, but the F reference points have not been used because reliable estimates of F have not been available. In 2005, the WG proposed that that the F reference points should remain unchanged but the biomass reference points should be adjusted to take into account differences in life-history characteristics between species (e.g growth rate, age-of-maturity, etc.). Table 3.2.4 provides some background to group species according to these biological characteristics. The WG grouped the different species into two categories, one including slow-growing late-maturing species (category 1: orange roughy, roundnose grenadier, deep-water squalids), and another one including relatively quick-growing early-maturing species (category 2: all other species).

It was suggested that the current 50% and 20% thresholds might be reasonable to define the PA BRPs of category 2 species. As for category 1 species, the WG was of the opinion that thresholds should reflect the specific vulnerability of these species to exploitation and their capacity to recover. To quantify these thresholds, two different options were suggested in 2005:

1) The thresholds should be higher than those suggested for category 2 species (respectively 50% and 20% of the virgin biomass for U_{pa} and U_{lim}), and their values should be decided by managers;
2) The thresholds should be set provisionally at 75% and 50% of the virgin biomass for U_{pa} and U_{lim} respectively, to accommodate the PA approach in a data poor context.

The WG could not agree on which option to choose and to date no guidance from managers or ICES (from ISGMAS, for example) was available.

At the 2006 WG, the WG again could not agree a way forward and decided to request advice from ACFM on this issue. The WG recognized that it is desirable that BRPs based on SSB and F levels, instead of cpue levels, should be introduced as more reliable stock assessments become available.

In recent years ACFM in their advice has not specified biological reference points for deep-water species because of concerns that U_{max} (usually the initial value of an abundance index) may not represent virgin biomass when fishing has taken place previously.

The WG consider that this is a valid comment for some species, however for others, where abundance indices commence at the start of the fishery, orange roughy for example; the reference points used previously by WGDEEP remain useable.

Biological indicators such as trends in mean length, ratio of mature/immature continue to provide a valuable insight of the state of stocks.

In the longer term, the WG considers, in line with other ICES assessment WGs, that ICES should develop an MSY-based positive target strategy, rather than current risk avoidance strategies. Experience from around the world suggests that strategies building in positive targets can control fishing mortality more effectively. However, it is recognized that the current level of information available on deep-water species does not allow the calculation of MSY-based BRPs in the short term. When data become available in the longer term, MSY-based BRPs should be calculated and used as benchmarks in substitution to the current U_{pa} and U_{lim}.

The EU Project DEEPFISHMAN, which will develop a monitoring, assessment and management framework for deep-water stocks in the NE Atlantic, has a dedicated workpackage to develop suitable BRPs for deep-water species. The project commences in April 2009 and completes in March 2012.

3.2.5 Harvest control rules

In the short term, for both category 1 and 2 species (as defined in Section 3.3.1), ICES advice could in principle be provided in a similar way to that given for other stocks for which stock assessments are routinely carried out. For example:

If $U < U_{lim}$, fishery should cease;

If $U_{lim} < U < U_{pa}$, exploitation should be reduced until $U > U_{pa}$;

If $U > U_{pa}$, exploitation should be set so that U remains above U_{pa}.

The main difference in advice between species belonging to categories 1 and 2 would be the recovery time. For category 2 species, multi-annual HCR may be contemplated, so the recovery time of stocks should be allowed to exceed one year. For category 1 species, multi-annual plans for stock recovery should not be contemplated.

The above HCRs can also be applied to mixed-species fishery. From a biological point of view, and more precisely for the sake of biodiversity preservation, the WG suggests that the poorest or the most vulnerable stock should be a reasonable candidate to set the HCR. However, the WG was of the opinion that the decision weight allocated to each stock should be left to managers. In the longer term, HCR should be elaborated on the newly calculated BRPs, as described above. In addition, HCR should accommodate pertinent environmental issues in a quantitative way.

The EU Project DEEPFISHMAN has a dedicated work-package to develop suitable HCRs for deep-water species.

Table 3.2.4. Deep-water species in the ICES area ranked according to (1) longevity and (2) growth rate (summarized from WGDEEP 2001). Species have been clustered into two groups according to their biological characteristics. The numbers given are only indicative as age-reading is poor for most of these species (cf WGDEEP 2001).

SPECIES	LONGEVITY (YEARS)	GROWTH RATE (K (Y-1))	CLUSTER
Orange roughy	125	0.06–0.07	1
Roundnose grenadier	>60	0.06–0.13	1
Deep-water squalid sharks:			1
Centroscymnus coelolepis	Not known	Not known	
Centrophorus squamosus	60–70	Not known	
Blue ling	30	Not known	2
Argentine	35	0.17–0.20	2
Ling	20	Not known	2
Tusk	20?	Not known	2
Black scabbardfish	8–12 from whole otoliths 25 from sections	0.25	2
Red (blackspot) sea bream	16	0.10–0.17	2
Greater forkbeard	15?	Not known	2
Alfonsino:			2
Beryx decadactylus	13	0.11–0.17	
Beryx splendens	11	0.13–0.14	

4 Area overviews

4.1 Stocks and fisheries of Greenland and Iceland Seas

4.1.1 Fisheries overview

There is no directed fishery for any of the species dealt with in this Working Group in ICES XIV. A number of the species are, however, taken as very small bycatches in the fishery for Greenland halibut in XIVb. Roundnose grenadier is the only species for which catches have been reported though the years. There were no catches reported by Greenland in 2006 and other countries (EU, Norway) fishing in the area have reported catches of in total 79 tons of roundnose grenadier in 2006 to the Greenland authorities.

Since the mid-seventies stocks in Division Va have mainly been exploited by Icelandic vessels. However, vessels of other nationalities have also operated in the pelagic fishery on capelin, herring and blue whiting and few trawlers and longliners targeting for deep-sea redfish, tusk and ling have been operating in the region.

Fisheries in Icelandic waters are characterized by the most sophisticated technological equipment available in this field. This applies to navigational techniques and fish-detection instruments as well as the development of more effective fishing gear. The most significant development in recent years is the increasing size of pelagic trawls and with increasing engine power the ability to fish deeper with them. There have also been substantial improvements with respect to technological aspects of other gears such as bottom trawl, longline and handline. Each fishery uses a variety of gears and some vessels frequently shift from one gear to another within each year. The most common demersal fishing gear are otter trawls, longlines, seines, gillnets and jiggers whereas the pelagic fisheries use pelagic trawls and purse-seines. At present there are approximately 1400 Icelandic vessels operating in the fisheries. The definition of types of vessels may be very complicated as some vessels are operating both as large factory fishing for demersal species and as large purse-seiners and pelagic trawlers fishing for pelagic fish during different time of the year.

Demersal fisheries take place all around Iceland including variety of gears and boats of all sizes. The most important fleets targeting them are:

Large and small trawlers using demersal trawl. This fleet is the most important one fishing cod, haddock, saithe, redfish as well as a number of other species. This fleet is operating year around; mostly outside 12 nautical miles from the shore.

- Boats (<300 GRT) using gillnet. These boats are mostly targeting cod but haddock and a number of other species are included. This fleet is mostly operating close to the shore.
- Boats using longlines. These boats are both small boats (<10 GRT) operating in shallow waters as well as much larger vessels operating in deeper waters. Cod and haddock are the main target species of this fleet but a number of deep-sea species are also caught, some of them in directed fisheries.
- Boats using jiggers. These are small boats (<10 GRT). Cod is the most important target species of this fleet with saithe following as the second most important species.

- Boats using Danish seine. (20–300 GRT). The most important species for this fleet are cod and haddock but this fleet is the most important fleet fishing for a variety of flat fish like plaice, dab, lemon sole and witch.

The total catch in Icelandic waters in 2006 amounted to 874 thousand tonnes where pelagic fish amounted to 357 thousand tonnes, and deep-sea species amounted to around 18 000 tonnes (Figure 4.1.1; Table 4.1.1).

Total of 603 vessels reported landed of deep-sea species in 2006, from less than 10 kg to more than 1100 t, as can be seen in the Table below:

2006	Ling	Blue ling	Tusk	Gr. silver smelt
No vessels	528	220	535	43
max catch	308	125	450	1143
min catch	< 0.1	< 0.1	< 0.1	< 0.2
Mean	11.9	7.9	9.5	113.5

4.1.2 Trends in fisheries

Tusk, ling and blue ling remains the most important "deep-sea species" in Icelandic waters. In recent years, about 120 vessels were engaged in these fisheries with registered catches from less than 100 kg to nearly 1000 tonnes. In 2007 about 7000 tonnes of deep-water species were caught in bottom-trawl, whereof 4100 were greater silver smelt. There has been an increase in the landings of ling, tusk and blue ling in the last five years (Figure 4.1.1), the increase in the two former stocks as a consequence of increase in quota (a TAC is not set for blue ling). In 2008 the longline fishery for blue ling seems to have changed from almost a pure bycatch fishery to a more targeted fishery (Figure 4.1.3). This trend is against ICES advice (ACOM May 2008) which states that *"There should be no directed fisheries for blue ling in Areas Va and XIV and measures should be implemented to minimize bycatches in mixed fisheries. Blue ling is susceptible to sequential depletion of spawning aggregations and therefore closed areas to protect spawning aggregations should be maintained and expanded where appropriate."*

Table 4.1.1 gives the catches of the Icelandic fleet of the most important deep-sea species taken by different gears in 2007 and 2008 and Table 4.1.2 gives the total landings of deep-sea species from Subdivision Va since 19994.

4.1.3 Technical interactions

The ling, blue ling and tusk in Icelandic waters constitute only a minor portion of the total demersal removal from the Icelandic Ecosystem (Figure 4.1.2). These three species are to some extent bycatch in fisheries targeting other species; both in the longline (Figure 4.1.3) and the bottom-trawl (Figure 4.1.4) fisheries. As stated above, this may be changing in the longline fishery for blue ling, but also for ling and tusk. Greater silver smelt on the other hand is targeted in the trawl fishery (Figure 4.1.4)

The geographical distribution of bottom-trawl catches of ling and blue ling overlap to a large extent with those that are the main target species, among other being Greenland halibut, *Sebastes sp*., saithe and cod (Figure 4.1.5).

However some limited targeted longline fishery of ling and in particular tusk takes place. For the latter species, there are indications that the fishery in the southwest of the Icelandic fishing area on the Reykjanes is directed at tusk, with relatively little catch of other species (Figure 4.1.6).

4.1.4 Ecosystem considerations

A number of recent initiatives have attempted to map the presence of cold-water corals in Icelandic waters through questionnaires to fisher and ROV surveys (ICES 2004, 2005 and 2006). *Lophelia pertusa* occurs near the shelf break off the south and west coasts at a depth range of 100–800 m in water temperatures of 5.5–7.3°C. Large coral areas are known on the Reykjanes Ridge, in the Hornafjarðardjúp deep and in the Lónsdjúp deep (SE Iceland). However, there were indications that the coral distribution has been significantly reduced in the last 20–30 years. Since January 1st 2006, five areas, covering 80 km^2 have been closed to all fishing except those targeting pelagic fish.

4.1.5 Management measures

The Ministry of Fisheries is responsible for management of the Icelandic fisheries and implementation of the legislation. The Ministry issues regulations for commercial fishing for each fishing year, including an allocation of the TAC for each of the stocks subject to such limitations.

A system of transferable boat quotas was introduced in 1984. The agreed quotas were based on the Marine Research Institute's TAC recommendations, taking some socio-economic effects into account, as a rule to increase the quotas. Until 1990, the quota year corresponded to the calendar year but since then the quota, or fishing year, starts on September 1 and ends on August 31 the following year. This was done to meet the needs of the fishing industry.

In 1990, an individual transferable quota (ITQ) system was established for the fisheries and they were subject to vessel catch quotas. The quotas represent shares in the national total allowable catch (TAC) for each species, and most of the Icelandic fleets operate under this system.

With the extension of the fisheries jurisdiction to 200 miles in 1975, Iceland introduced new measures to protect juvenile fish. The mesh size in trawls was increased from 120 mm to 155 mm in 1977. Mesh size of 135 mm was only allowed in the fisheries for redfish in certain areas. Since 1998 a mesh size of 135 is allowed in the codend in all trawl fisheries not using "Polish cover". A quick closure system has been in force since 1976 with the objective to protect juvenile fish. Fishing is prohibited for at least two weeks in areas where the number of small fish in the catches has been observed by inspectors to exceed certain percentage. If, in a given area, there are several consecutive quick closures the Minister of Fisheries can with regulations close the area for longer time forcing the fleet to operate in other areas. Such permanent closure took place at several places along the south–southeast area for tusk in 2003 (Figure 4.1.5). Inspectors from the Directorate of Fisheries supervise these closures in collaboration with the Marine Research Institute. In 2005, 85 such closures took place.

In addition to allocating quotas on each species, there are other measures in place to protect fish stocks. Based on knowledge of the biology of various stocks, many areas have been closed temporarily or permanently aiming at protect juveniles. Figure 4.1.7 shows map of such legislation that was in force in 2004. Some of them are temporarily, but others have been closed for fishery for decades.

Table 4.1.1. Overview of the Icelandic deep-sea landings (in tonnes) in Icelandic waters (Va) in 2007 and 2008 by gear type.

Species	Fishing Gear	2007	2008
Ling	Bottom-trawl	1395	1509
	Danish seine	238	290
	Gillnet	633	476
	Lobster trawl	243	416
	Longline	4042	5002
	Other gears	49	35
	Total	6600	7736
Blue ling	Bottom-trawl	1483	2081
	Danish seine	44	54
	Gillnet	22	28
	Lobster trawl	55	29
	Longline	375	1454
	Other gears	17	7
	Total	1995	3653
Tusk	Bottom-trawl	95	114
	Gillnet	38	43
	Hook	9	5
	Lobster trawl	9	12
	Longline	4833	6756
	Other gears	2	2
	Total	5986	6932
Greater silver smelt	Bottom-trawl	4108	8774
	Pelagic trawl	108	4
	Total	4226	8778

Table 4.1.2. Total landings of deep-sea species in ICES Subdivison Va.

SPECIES	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ALFONSINOS (*Beryx* spp.)													0	0	0
ARGENTINES (*Argentina silus*)	492	808	3367	13387	6704	5657	3043	4960	2683	3645	4481	4775	4227	8778	10 829
BLUE LING (*Molva dypterigia*)	1635	1323	1344	1154	1877	1711	941	1377	1158	1204	1539	1836	2162	3788	4233
BLACK SCABBARDFISH (*Aphanopus carbo*)			1		9	18	8	13	0	0	19	23	1	0	15
BLUEMOUTH (*Helicolenus dactylopterus*)													0	0	0
GREATER FORKBEARD (*Phycis blennoides*)											0	0	1	3	2
LING (*Molva molva*)	4192	4060	3933	4302	4647	3743	3346	4518	4264	4606	4488	7405	7640	9284	10 492
MORIDAE												0	0	0	0
ORANGE ROUGHY (*Hoplostethus atlanticus*)	64	40	79	28	14	68	19	10	+		9	2	0	4	1
RABBITFISH (*Chimaerids*)	106	21	15	29	2	5						1	1	1	2
ROUGHHEAD GRENADIER (*Macrourus berglax*)		15	4	1		2	1	4	33	3	5	7	2	0	5
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	398	140	198	120	129	54	40	60	57	181	76	62	16	29	46
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)													0	0	0
SHARKS, VARIOUS	45	65	70	87	45	45	57				54	0	2	43	0
SILVER SCABBARDFISH (*Lepidopus caudatus*)													0	0	0
SMOOTHHEADS (*Alepocephalidae*)	1												0	0	0
TUSK (*Brosme brosme*)	6225	6102	5394	5171	7264	6391	4823	5578	5596	4836	3842	6599	7552	8637	8252
WRECKFISH (*Polyprion americanus*)													0	0	0

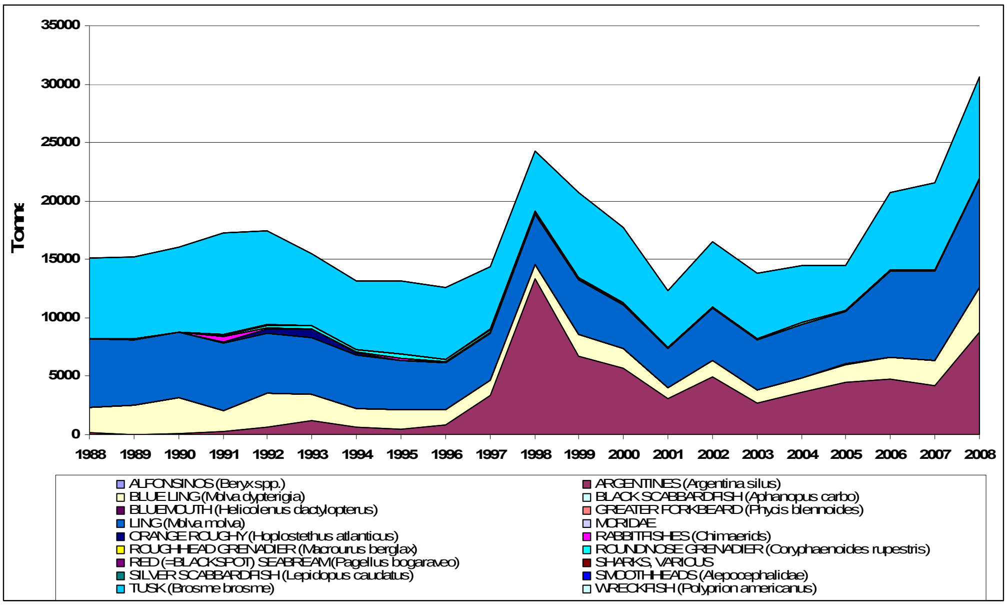


Figure 4.1.1. Fishery of deep-sea species in sub-Division Va 1988–2008, by species.

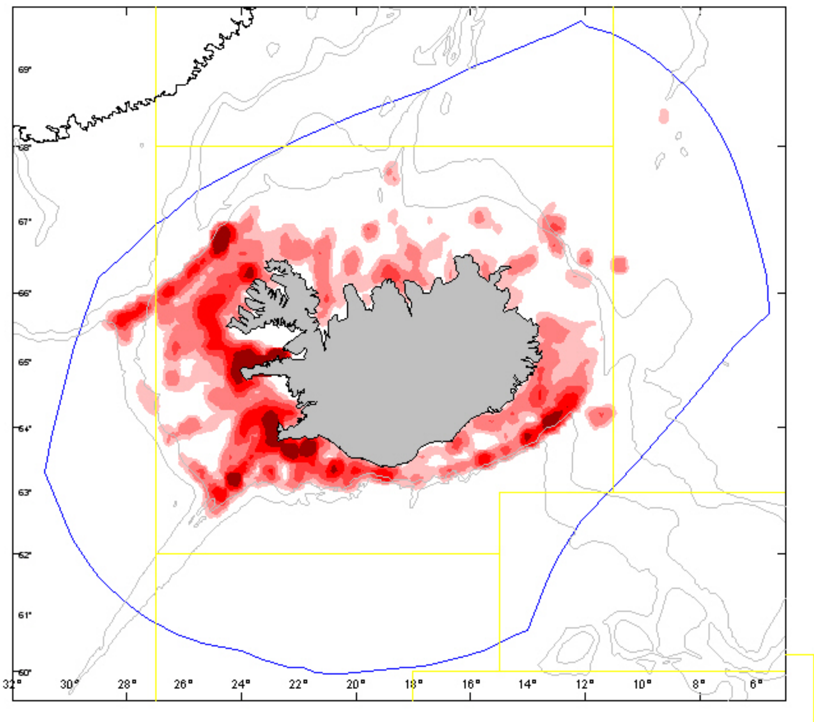


Figure 4.1.2. The spatial distribution of the total removal of all species by the Icelandic demersal fishing fleet in the Icelandic EEZ in 2007. The EEZ is shown as a blue line, regular thin lines show major ICES areas and contour lines indicate 500 and 1000 m depth.

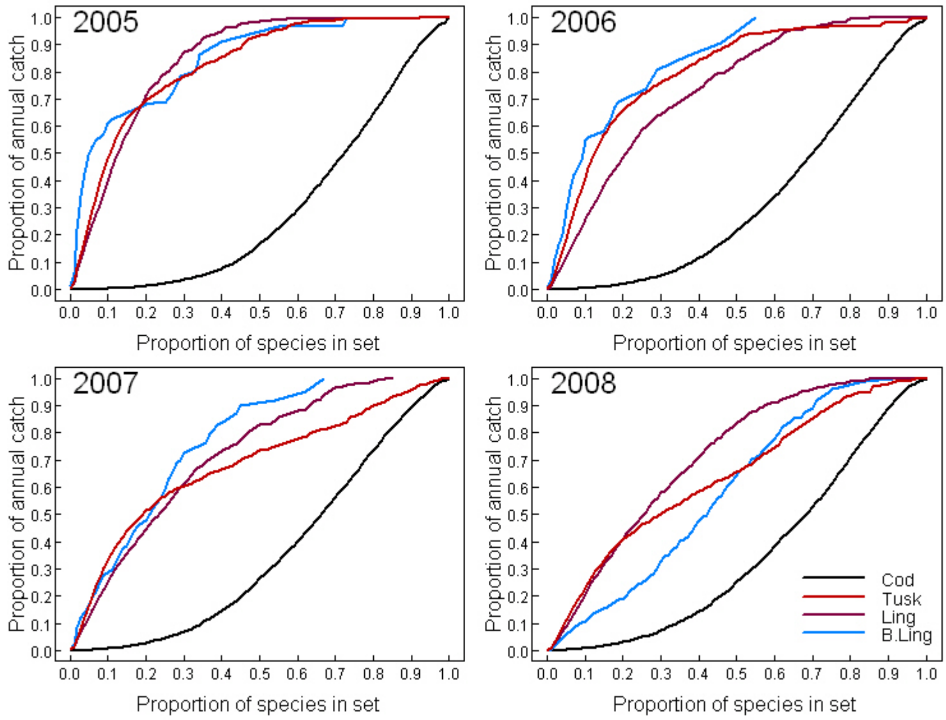


Figure 4.1.3. Cumulative plot for longline in 2005–2008. An example describes this probably best. Looking at the figure for 2005 above it can be seen from the solid line that 50% of the catch of ling comes from sets where tusk is less than 15% of the total catch whereas only unsignificant % of the catch of cod sets where it is less than 15% of the total catch in each set. Over 90% of ling catches are caught where ling is less than about 30% of total catches in given set. For comparison, only around 15% of cod is caught in sets where cod is less than 50% of the total catch.

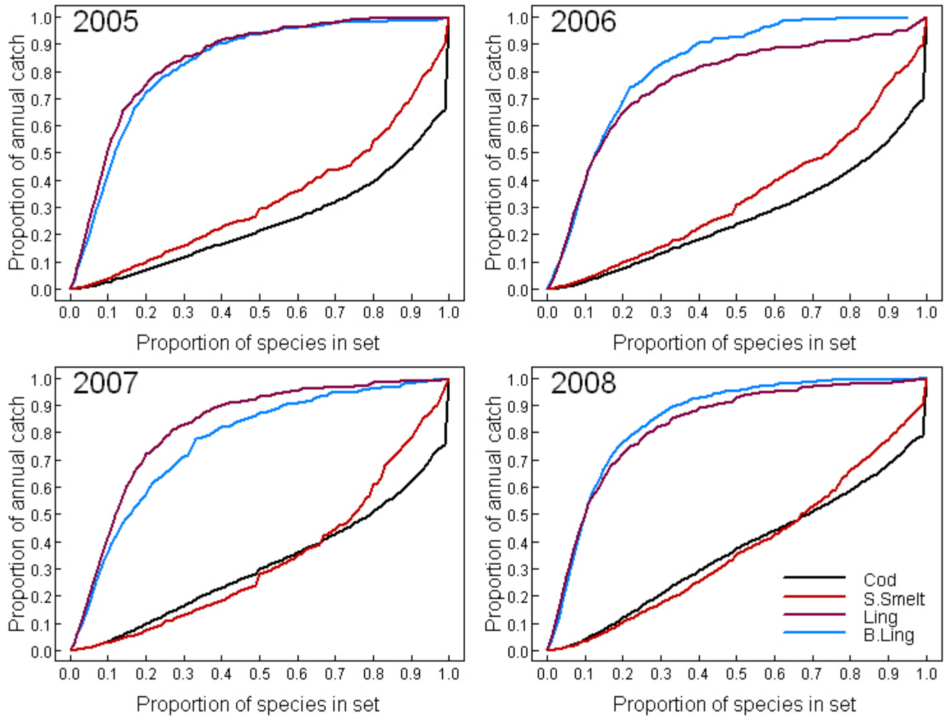


Figure 4.1.4. Cumulative plot for bottom trawl in 2005–2008. See Figure 5.1.2 for details.

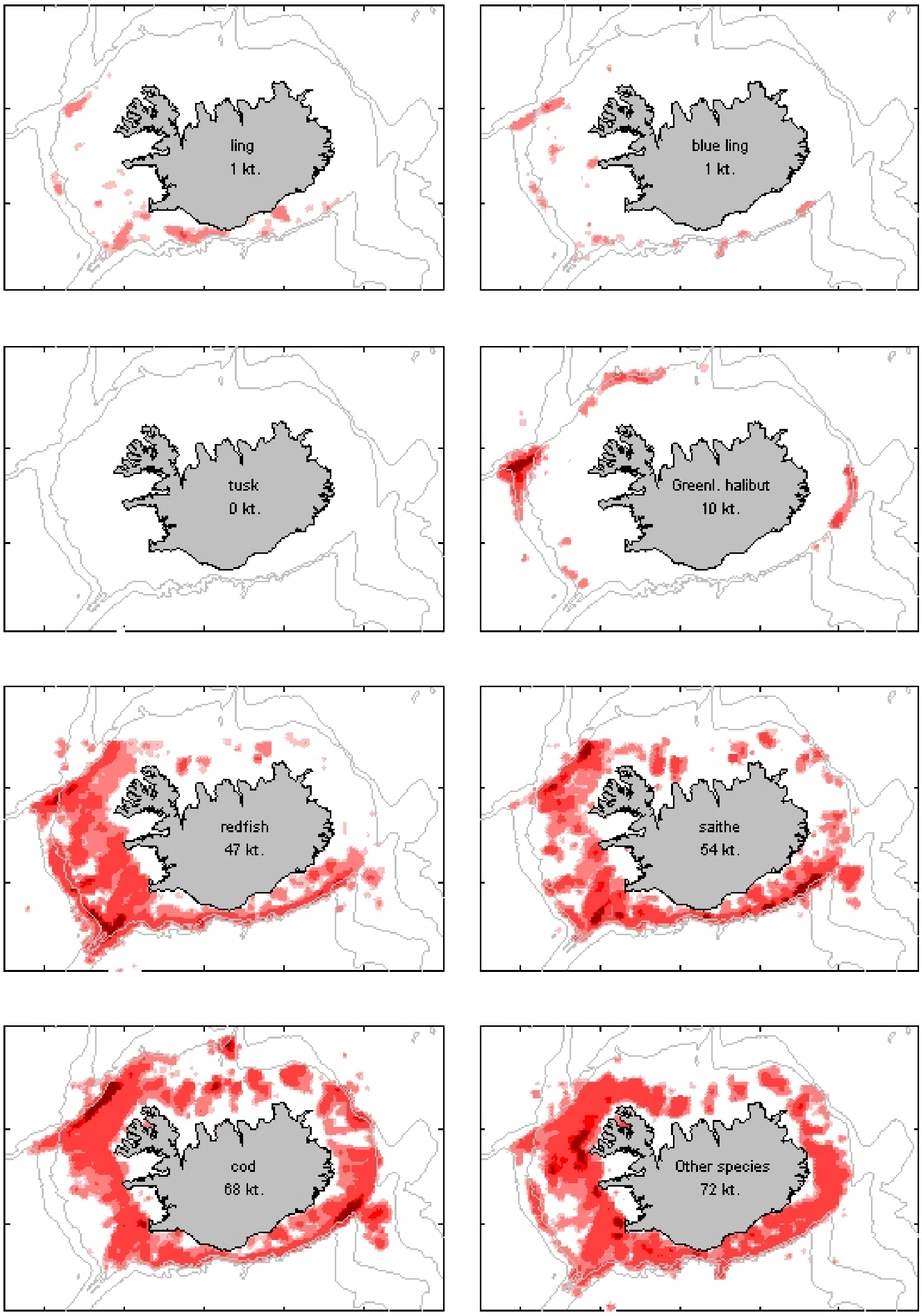


Figure 4.1.5. Spatial distribution of the removal of various species by the bottom trawling in 2007. The densities scale is comparable among the figures. The total catch by species is shown in units of thousand tonnes (kilotonnes). The grey lines correspond to 500 and 1000 meter depth contours.

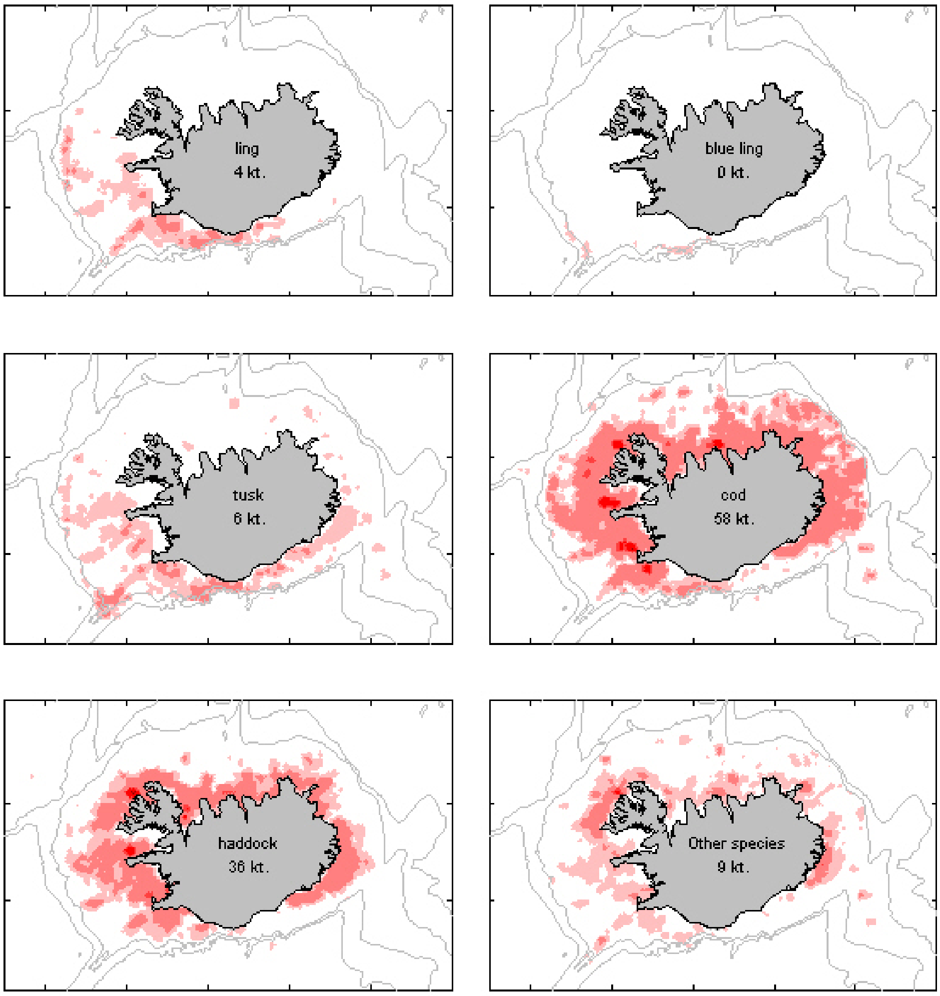


Figure 4.1.6. Spatial distribution of the removal of various species by the long lining in 2007. The densities scale is comparable among the figures. The total catch by species is shown in units of thousand tonnes (kilotonnes). The grey lines correspond to 500 and 1000 meter depth contours.

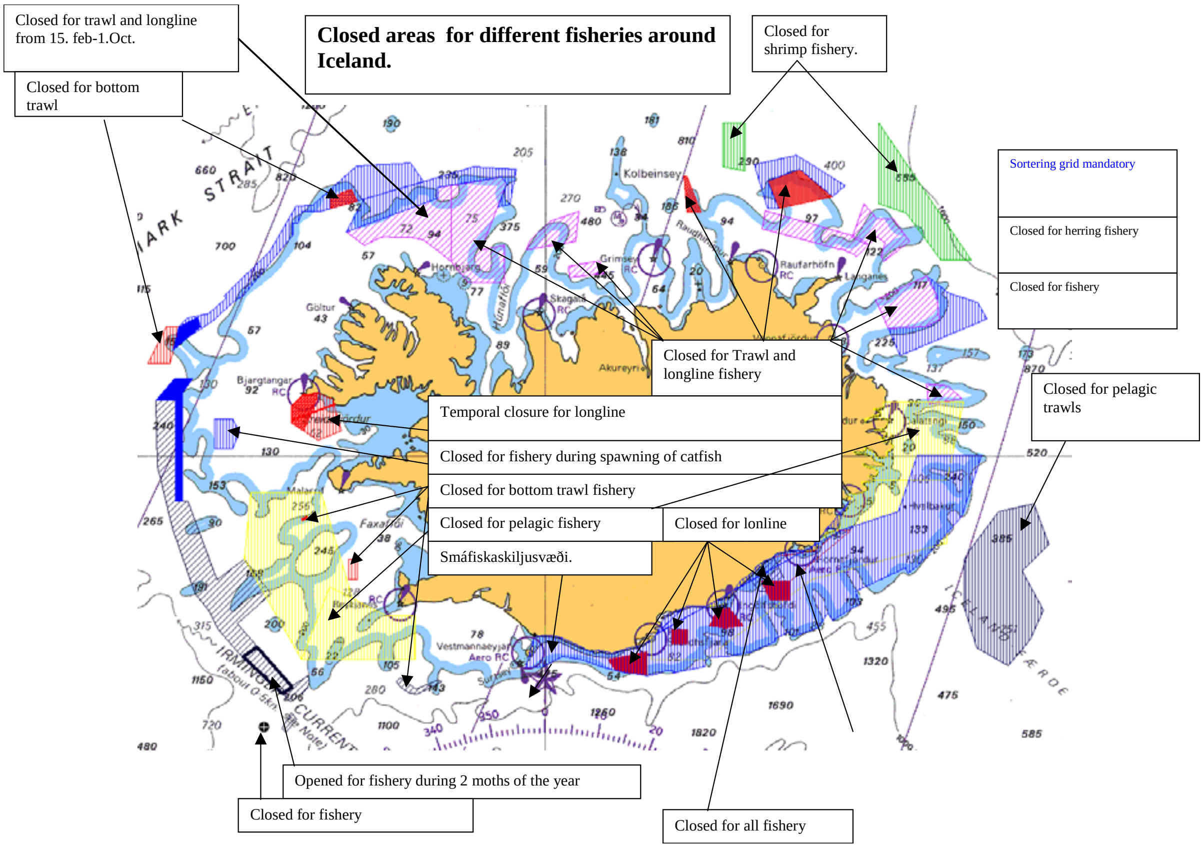


Figure 4.1.7. Overview of closed areas around Iceland. The boxes are of different nature and can be closed for different time period and gear type.

4.2 Stocks and fisheries of the Barents Sea and Norwegian Sea

4.2.1 Fisheries overviews I and II

In Subareas I and II three species, ling (*Molva molva*), tusk (*Brosme brosme*) and Greater silver smelt (*Argentina silus*) make up almost 99 per cent of the landed catches (Table 4.2.1 and Figure 4.2.1). Ling and tusk are mainly caught by longliners and a small proportion is caught in gillnets. Greater silver smelt are caught by bottom and mid-water trawls. Minor catches of other species, which are mainly taken as bycatches, include roughhead grenadier (*Macrourus berglax*), greater forkbeard (*Phycis blennoides*), roundnose grenadier (*Coryphaenoides rupestris*), rabbitfish (Chimaerids) and blue ling (*Molva dypterigia*). Norway lands by far the largest amount of the three species. The Faroes, France, Germany, Russia, Scotland, Ireland and England and Wales report small bycatch landings of ling, blue ling and tusk. Occasional landings of these species in the direct fishery for greater silver smelt were reported by the Netherlands and as bycatches by Germany, Russia, Scotland and the Faroes.

Longline fisheries

The longline fishery for ling (*Molva molva*) and tusk (*Brosme brosme*) has for many years been the most targeted deep-sea fishery in Norway (e.g. Bergstad and Hareide, 1996). The number of fishing vessels over 21 m targeting ling, tusk and blue ling has declined from 72 in 2000 to 34 in 2009 (Table 4.2.2). The number of vessels declined during this period mainly as a consequence of changes in the laws concerning quotas for catching cod.

Trawl fisheries

Argentina silus has been targeted in trawl fisheries off mid-Norway (Division IIa) since the late 1970s, especially in the southern south-east area off the coast of Norway. Recently the fishery has changed to be dominated by semi-pelagic trawlers operating further north but still along the coast off Norway. This fishery has continued, as described in ICES C.M. 1996/ Assess:8, but the effort directed at *A. silus* varies and is highly correlated with market demand. In Division IIa landings declined from approximately 10 000–11 000 t in the mid 1980s to about half that level in the early 1990s. During the period 2004–2006 there was a large increase in landings resulting in a 2007 Norwegian TAC set to 12 000 tons. The landings in 2009 have decreased to a level below the TAC.

In the late 1990s there used to be a minor trawl fishery in mid-Norway (IIa) targeting roundnosed grenadier *Coryphaenoides rupestris* and *Argentina silus*. Details on this fishery were given in the report of the EC FAIR project (Gordon, 1999). This fishery is no longer executed.

Gillnet fisheries

There is a targeted gillnet fishery for ling (*Molva molva*) on the upper slope off mid-Norway (Area IIa). This fishery started in 1979 as a targeted fishery for blue ling. The catches of blue ling declined throughout the following decade to the extent that the fishery has since the 1990s become almost entirely focused on ling.

4.2.2 Trends in fisheries

Landing statistics for Subareas I and II for the period 1988–2009 are given in Table 4.2.1.

Tusk, ling and blue ling

There was a steady decline in the landings of tusk during the period 1988 through 2005 and the landed catches have declined from almost 20 000 tons at the end of the eighties to about 7000 tons in 2005. During the last years the reported catches has increased significantly (peaked in 2008 to about 12 000 tonnes). Preliminary landings for 2009 is about 9 500 tonnes. The landings of ling have remained stable at between 7000 and 8000 tons, but also ling had an increase in the 2006 landings to almost 9000 tons and in 2008 the landings passed 11 300 tons. Preliminary landings for ling is again back to stable levels before 2006. Blue ling landings declined markedly from 1988 through 1993, and the catches have been at a low level until 2008 (Figure 4.2.2).

Greater silver smelt

During the period 1988–2000 there was a slight downwards trend in the landed catches. In 2000, 2004 through 2006 there was a doubling in the landed catches to about 22 000 tons. Preliminary data demonstrate that the catches have declined to about 12 000 tons in 2009 (Figure 4.2.2) and to a level below the TAC set for this area.

4.2.3 Ecosystem considerations

The ICES Subareas I and II are mainly represented by the Norwegian Sea and the Barents Sea. The underwater ridge between Scotland and Greenland is the main southern barrier for this area with average depth of 1600 meters containing two deep basins of 3000–4000 meters. The current systems in the Norwegian Sea is mainly dependent on the bottom topography; the warm Atlantic water transported into the Norwegian Sea resulting in relatively high temperatures in this area until it meets the cold and less salt water from the north. This creates distinct fronts which are closely related to bottom topography. The topography and large variations in depth gives a variated bottom fauna with large consentrations of coral reefs.

Along the coast of northern Norway and in the Norwegian Sea a large number of coral reefs have recently been discovered. These are Lophelia reefs that represent an important natural resource with a high associated biodiversity and great abundance of fish. To protect the coral reefs from destruction caused by fishing activities the fishers have been urged to be careful when fishing close to the reefs. Five areas have also been closed to fisheries using towed gears, but longliners can fish in these areas.

Cold-water corals are particularly abundant along the Norwegian Continental shelf, between 200–400m depths. Fosså *et al*., 2000 estimated that between 1500–2000 km^2 of the Norwegian EEZ is covered by this habitat. Recent surveys using ROVs and manned submersibles have also found dense populations of gorgonian corals *Paragorgia arborea* and *Primnoa resedaeformis* associated with *Lophelia* pertusa (ICES, 2006). These reefs represent an important natural resource with a high associated biodiversity and a high abundance of fish. However, it was estimated that between 30 and 50% of the Norwegian reef areas have been impacted by trawling (Fosså *et al*., 2000). A number of areas have been closed to towed fishing gears although long lining is still permitted. While such static gear has a smaller impact than trawling, increased intensity of such activity has the potential, over time, to cause significant damage through localized physical destruction of the coral structure from anchors and snagged gear.

A number of seamounts occur in these areas. Two are listed in the WGDEC 2006 Report, Eistla and Gjalp, both with summit depths below the daytime depth of the deep-scattering layer, but at depths shallower than 2000 m. Little is known about the fauna of these seamouts or the level of fishing activity, but such habitats are known generally to be areas where there are often higher levels of productivity with associated dense aggregations of fish.

4.2.4 Management measures

There is no regulation of the Norwegian fishery for ling, tusk and blue ling in Subareas I and II.

The total TAC for greater silver smelt in subarea I and II is 12 111 tonnes (2010). The Norwegian greater silver smelt fishery has since 2007 been regulated by a Norwegian TAC. In addition, the EU sets TACs and quotas applicable to EC vessels fishing in community waters and international waters of Subarea I and II.

Table 4.2.1. Overview of landings in SubAreas I and II. * Preliminary data.

SPECIES	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
ALFONSINOS (*Beryx* spp.)																		
ARGENTINES (*Argentina silus*)	11 351	8390	9120	7741	8234	7913	6807	6775	6604	4463	8261	7163	6293	14 369	7407	8917	16 162	17 093
BLUE LING (*Molva dypterigia*)	3537	2058	1412	1479	1039	1020	422	364	267	292	279	292	252	209	150	148	175	198
BLACK SCABBARDFISH (*Aphanopus carbo*)																		
BLUEMOUTH (*Helicolenus dactylopterus*)																		
GREATER FORKBEARD (*Phycis blennoides*)			23	39	33	1								8	318	155	75	51
LING (*Molva molva*)	6126	7368	7628	7793	6521	7093	6322	5954	6346	5409	9200	7651	5964	4957	7132	6157	6560	6313
MORIDAE																		
ORANGE ROUGHY (*Hoplostethus atlanticus*)																		
RABBITFISH (*Chimaerids*)												1	6	5	15	57	21	66
ROUGHHEAD GRENADIER (*Macrourus berglax*)			589	829	424	136				17	55		48	94	29	77	79	77
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)		22	49	72	52	15	15	7	2	106	100	46		2	12	4	27	13
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)																		
SHARKS, VARIOUS	37	15											1					
SILVER SCABBARDFISH (*Lepidopus caudatus*)																		
SMOOTHHEADS (*Alepocephalidae*)																		
TUSK (*Brosme brosme*)	14 403	19 350	18 628	18 306	15 974	17 585	12 566	11 617	12 795	9426	15 353	17 183	14 008	12 061	12 191	7940	7426	7050
WRECKFISH (*Polyprion americanus*)																		

Table 4.2.1. Overview of landings in SubAreas I and II, continued.

SPECIES	2006	2007	2008	2009
ALFONSINOS (*Beryx* spp.)				
ARGENTINES (*Argentina silus*)	21 685	13 273	11 876	11929
BLUE LING (*Molva dypterigia*)	202	262	333	285
BLACK SCABBARDFISH (*Aphanopus carbo*)				
BLUEMOUTH (*Helicolenus dactylopterus*)			2	
GREATER FORKBEARD (*Phycis blennoides*)	49	47	117	76
LING (*Molva molva*)	8845	10 338	11 339	8400
MORIDAE				
ORANGE ROUGHY (*Hoplostethus atlanticus*)				
RABBITFISH (*Chimaerids*)	28	63	80	88
ROUGHHEAD GRENADIER (*Macrourus berglax*)	78	50	55	53
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	8	12	9	9
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)				
SHARKS, VARIOUS			1	
SILVER SCABBARDFISH (*Lepidopus caudatus*)				
SMOOTHHEADS (*Alepocephalidae*)				
TUSK (*Brosme brosme*)	9988	10 744	11 883	9629
WRECKFISH (*Polyprion americanus*)				

Table 4.2.2. Number of vessels exceeding 21 m in the Norwegian longliner fleet during the period 1995–2009.

Year	Number of longliners
1995	65
1996	66
1997	65
1998	67
1999	71
2000	72
2001	65
2002	58
2003	52
2004	43
2005	39
2006	35
2007	38
2008	36
2009	34

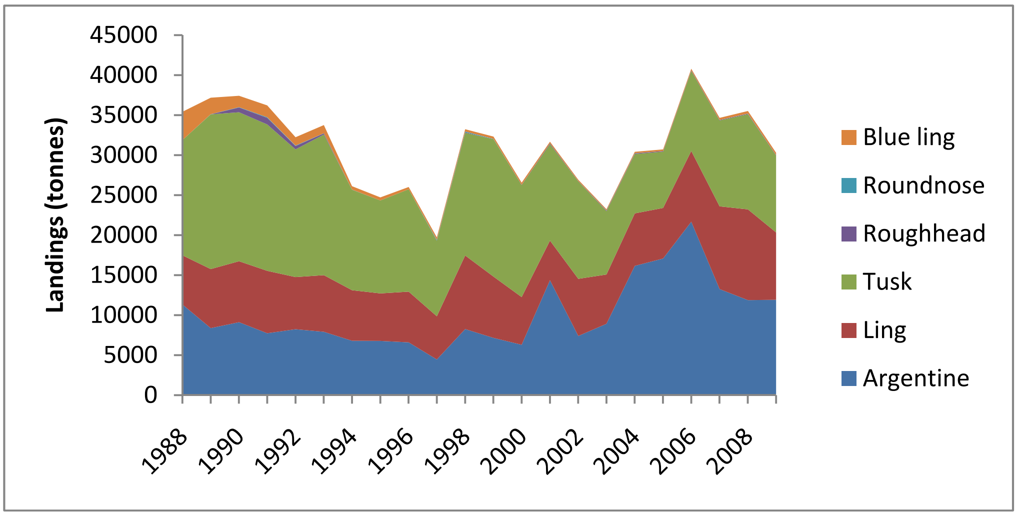


Figure 4.2.1. Trends in the landings in Subareas I and II. Landings of roundnose and roughhead grenadier are insignificant in subareas I and II. * Preliminary data.

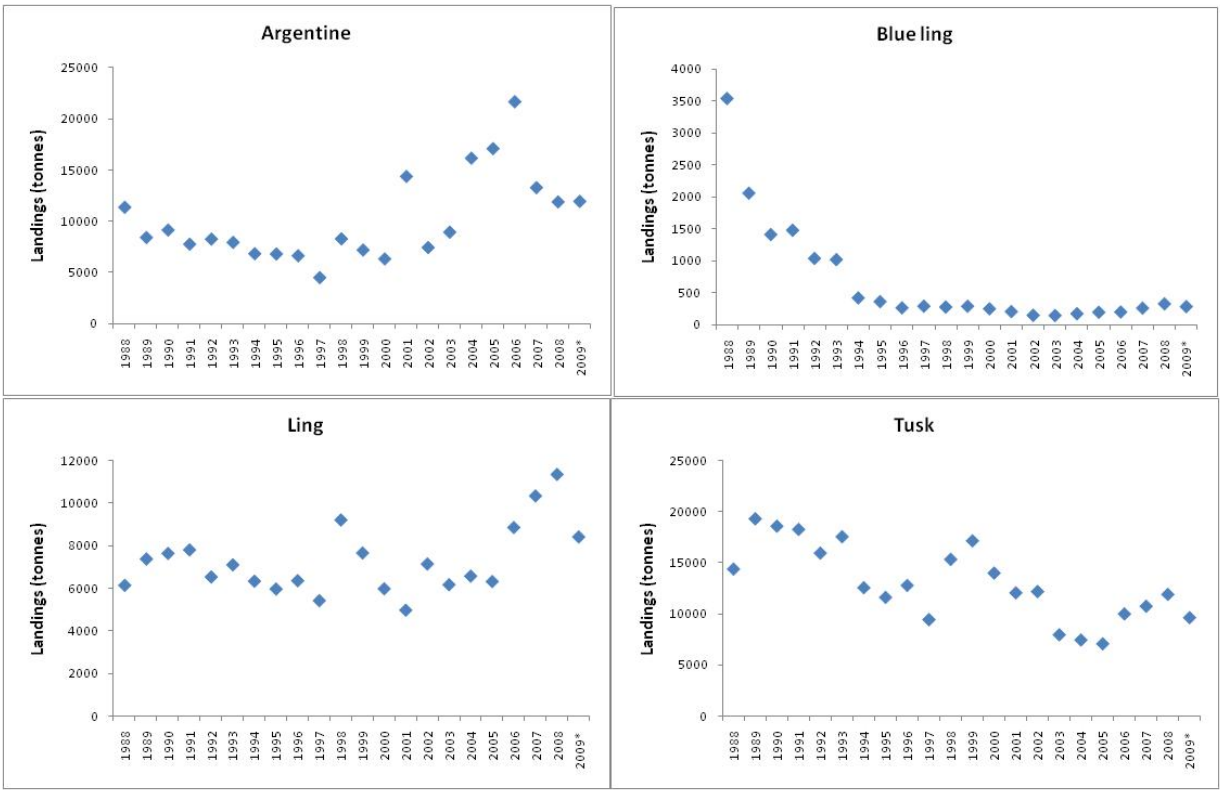


Figure 4.2.2. Trends in the landings of argentines, tusk, ling and blue ling in Subareas I and II. Landings axex are in different scales. * Preliminary data.

4.3 Stocks and fisheries of the Faroes

4.3.1 Fisheries overview

Fisheries in Faroese waters (Division Vb)

The fishery around the Faroe Islands has for centuries been an almost free international fishery involving several countries. Up to 1959, all vessels were allowed to fish around the Faroes outside the 3 nm zone. During the 1960s, the fisheries zone was gradually expanded, and in 1977 an EEZ of 200 nm was introduced in the Faroe area. The demersal fishery by foreign nations has since decreased and Faroese vessels now take most of the catches. The main fisheries in Faroese waters are mixed-species, demersal fisheries and single-species, pelagic fisheries. The demersal fisheries are mainly conducted by Faroese vessels, but vessels from other nations are still participating like Norwegian longliners and EU trawlers licensed through bilateral and multilateral agreements. The major part of the pelagic fisheries is conducted by foreign vessels through similar agreements.

4.3.2 Trends in fisheries

Except for the traditional longline fisheries for tusk and ling, which have been well established for decades, the Faroese deep-water fisheries started in the late 1970s following the expansion of the national EEZs to 200 nm and a wish to reallocate fishing effort from traditional shelf fisheries. In the first years all fishing was within the Faroese EEZ. Later, the fishery gradually expanded to more distant areas and to include more and more species/stocks.

The main deepwater fleet consist of about 13 otterboard trawlers with engines larger than 2000 Hp. They have traditionally targeted saithe, redfish *(Sebastes spp.)*, Greenland halibut, blue ling and to a lesser degree black scabbardfish *(Aphanopus carbo)* and roundnose grenadier *(Coryphaenoides rupestris)*. There has been an increased effort in recent years in Faroese waters as the deep-water fleet has reduced its effort in other areas. This has resulted in increased effort on black scabbardfish, roundnose grenadier and blue ling in Vb with a corresponding increase in the landings of these species.

The traditional longline fleet fishing ling, tusk and blue ling consist of 24 longliners larger than 110 GRT; they are mainly targeting cod and haddock and in years where the availability of these species is high and market conditions satisfactory, they spend very little effort in deep water. Recently, a directed longline fishery with one vessel on deep-water sharks (*Centroscymnus coelolepis* and *Centrophorus squamosus*) was initiated; however, there has been no such fishery in 2002 and 2003 and the same applies for 2006 onwards.

In the 1990s, a gillnet fishery directed at monkfish *(Lophius piscatorius)* and Greenland halibut *(Reinhardtius hippoglossoides)* developed in Vb and is now well established; bycatches in this fishery are among others deep-sea redcrab and blue ling. More recently exploratory trap fisheries for deep-sea red crab have been performed.

A trawl fishery for greater silver smelt (*Argentina silus*) has been expanding rapidly in recent years. Three pair trawlers, which otherwise mainly target saithe (*Pollachius virens*), hold licences to this fishery that mainly takes place in late spring and summer. Small quantities of Greater silver smelt are also taken as bycatch in the blue whiting fishery and in the deep-water fishery for e.g. red fish and blue ling.

Updated total international landings of deep-sea species in Division Vb are given in Table 4.3.1 and Figure 4.3.1.

4.3.3 Technical interaction

As explained above, several fleets are fishing deep-sea species in Vb, either regularily targeting these species or now and then participate in such fisheries depending on availability of other targets. While greater silver smelt is taken only by 3 pair trawlers with special licenses for this fishery, grenadiers and black scabbard fish are targeted by the larger otter board trawlers (>2000 HP).

The text table below shows the 2007–2009 shares by Faroese fleet categories in % of ling, blue ling and tusk, respectively.

	Year	Longliners <110 GRT	Longliners >110 GRT	OB trawlers <1000 HP	OB trawlers >1000 HP	Pair-trawlers <1000 HP	Pair-trawlers >1000 HP	Others
Ling	2007	9	48	2	19	5	15	2
	2008	8	65	1	8	3	10	5
	2009	3	56	1	3	5	30	2
Blue ling	2007	0	16	0	83	+	+	1
	2008	0	24	0	69	0	1	5
	2009	0	29	0	64	1	2	4
Tusk	2007	9	74	1	10	1	3	2
	2008	9	81	0	6	1	2	1
	2009	4	80	0	5	1	8	1

Although the proportions by fleet of these three species do vary annually, ling is on average over many years a 60% line fishery and 40% trawl fishery; blue ling is mainly a trawl fishery whereas longlines mainly take tusk. If Norwegian vessels are included, most of the ling is taken by longline.

4.3.4 Ecosystem considerations

The waters around the Faroe Islands are in the upper 500 m dominated by the North Atlantic current, which to the north of the islands meets the East Icelandic current. Clockwise current systems create retention areas on the Faroe Plateau (Faroe shelf) and on the Faroe Bank. In deeper waters to the north and east is deep Norwegian Sea water, and to the south and west is Atlantic water. From the late 1980s the intensity of the North Atlantic current passing the Faroe area decreased, but it has increased again since. The productivity of the Faroese waters was very low in the late 1980s and early 1990s. This applies also to the recruitment of many fish stocks, and the growth of the fish was poor as well. From 1992 onwards the conditions have returned to more normal values, which also is reflected in the fish landings. There has been observed a very clear relationship, from primary production to the higher trophic levels (including fish and seabirds), in the Faroe shelf ecosystem, and all trophic levels seem to respond quickly to variability in primary production in the ecosystem (Gaard *et al.*, 2001).

Existing and former areas of *Lophelia* coral have been mapped around the Faroes through questionnaires to fishermen (Frederiksen *et al.*, 1992; Jákupsstova *et al.*, 2002). An estimated 11 000 km^2 of living coral are found in Faroese waters, although this is estimated to be a significant reduction from earlier times (ICES, 2005). Some of these coral areas have in recent years been closed to fishing and mapping of these areas is ongoing with the purpose of a further expansion of closed areas.

4.3.5 Management measures

Since 1 June 1996, a management system based on a combination of area closures and individual transferable effort quotas in days within fleet categories have been in force. The individual transferable effort quotas apply to 1) the longliners less than 110 GRT, the jiggers, and the single trawlers less than 400 HP, 2) the pair trawlers and 3) the longliners greater than 110 GRT. One fishing day by longliners less than 100 GRT is considered equivalent to two fishing days for jiggers in the same gear category. Longliners less than 110 GRT could therefore double their allocation by converting to jigging. The allocation of number of fishing days is based on areas shallower than about 200 m. Holders of individual transferable effort quotas who fish in deeper waters can fish for 3 days for each day allocated. The single trawlers greater than 400 HP are not regulated through number of fishing days, but the numbers of fishing licenses have been settled for this fleet as well as for the gillnetters and they are regulated by depth of fishing as well. Trawlers are not allowed to fish within the 12 nautical mile limit and large areas on the shelf are closed to them. Inside the 6 nautical miles limit only longliners less than 110 GRT and jiggers less than 110 GRT are allowed to fish. The Faroe Bank shallower than 200 m is closed to all trawl and gillnet fisheries.

Technical measures such as area closures during the spawning periods, to protect juveniles and young fish and mesh size regulations are a natural part of the fisheries regulations.

As mentioned above, vessels from other nations are licensed to fish in Faroese waters through bilateral and multilateral agreements. Only Norway and EU have permission to fish deep-water species. The TACs for 2009 and 2010 are shown in the text Table below. In the agreement with Norway it is stated that the maximum bycatch of roundnose grenadier/black scabbardfish in the blue ling/ling fishery is 25%.

	2009		2010	
	Norway	EU	Norway	EU
Blue ling/ling	2525	3065	2425	2700
Tusk	1847		1774	
Roundnose grenadier/Black scabbardfish	631	1080	606	952

Table 4.3.1. Deep-sea landings in Division Vb.

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
ALFONSINOS (Beryx spp.)			5		4			1									
ARGENTINES (Argentina silus)	287	227	2888	60	1443	1063	960	12286	9498	8433	17570	8214	5204	10081	7471	6552	6451
BLUE LING (Molva dypterigia)	9526	5264	4799	2962	4702	2836	1644	2440	1602	2798	2584	2932	2524	2119	2020	3815	2699
BLACK SCABBARDFISH (Aphanopus carbo)		166	419	152	33	287	160	424	186	68	180	172	311	795	1751	1633	862
BLUEMOUTH (Helicolenus dactylopterus)												64	16				3
DEEP WATER CARDINAL FISH (Epigonus telescopus)												8	2	7			1
GREATER FORKBEARD (Phycis blennoides)	2	1	38	53	49	27	4	9	7	7	8	34	32	100	148	73	48
LING (Molva molva)	4488	4652	3857	4512	3614	2856	3622	4070	4896	5657	5359	5238	3785	4588	4138	4893	5967
MORIDAE				5								1		100	19	2	
ORANGE ROUGHY (Hoplostethus atlanticus)			22	48	13	37	170	420	79	18	3	5	155	5	1	5	7
RABBITFISHES (Chimaerids)								1				3	54	96	64	61	96
ROUGHHEAD GRENADIER (Macrourus berglax)										6	9	58	1	4	3	12	9
ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	1	258	1549	2311	3817	1681	668	1223	1078	1112	1667	1996	1791	2016	1025	1532	1579
RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)																	
SHARKS, VARIOUS			140	78	164	478	192	262	380	308	433	470	409	543			
SILVER SCABBARDFISH (Lepidopus caudatus)																	
SMOOTHHEADS (Alepocephalidae)																	6
TUSK (Brosme brosme)	5665	5122	6181	6266	5391	3439	4316	3978	3310	3319	2710	3964	2700	3993	3003	3292	3643
WRECKFISH (Polyprion americanus)																	

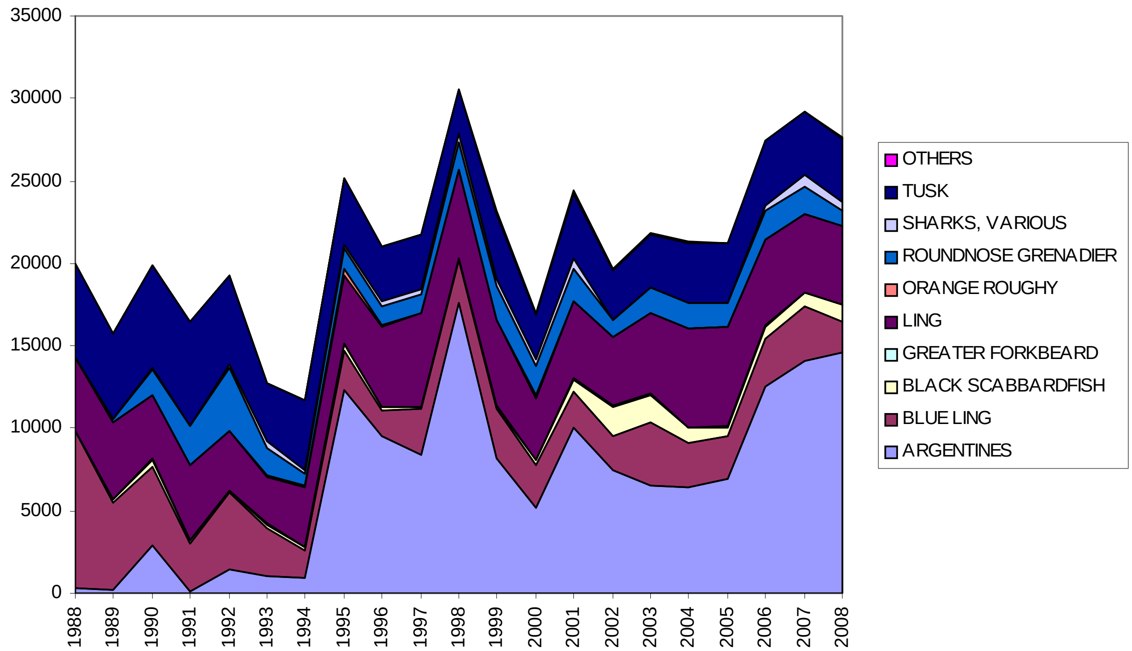


Figure 4.3.1. Deep-sea landings in Division Vb.

4.4 Stocks and fisheries of the Celtic Seas

4.4.1 Fisheries overview

Deepwater Trawl fisheries are conducted in areas VI and VII, principally by French, Irish Spanish and Scottish vessels until 2009, French vessels have operated a mixed deep-water fishery mainly targeting roundnose grenadier, black scabbardfish, blue ling and siki sharks on the continental slope and offshore banks of Subarea VI and VII. In 1998–2002 about 45 vessels from this fleet landed more than 5 tonnes of roundnose grenadier, this number decreased to 19 in 2007 and 11 in 2008. Blue ling was the main target species from the early 1970s to the late 1980s, then fishing for roundnose grenadier, black scabbardfish and siki sharks developed. Some vessels from the same fleet also conducted a targeted fishery for orange roughy mainly in 1991–1992 in Division VIa and until mid-2000s in Subarea VII.

The Irish deep-water fishery is based on the flat grounds and targets orange roughy, black scabbard, roundnose grenadier and siki sharks. A number of Scottish vessels target monkfish (*Lophius spp)* on the continental slope of Subarea VIa and on the Rockall Bank. This fishery has a bycatch of deep-water species including ling, blue ling and siki sharks and a small number of these vessels occasionally fish in deeper water targeting roundnose grenadier, black scabbardfish and siki sharks. Spanish trawlers targeting Hake in Area VII and VI (on Porcupine, Rockall and Red Sole banks) have a bycatch of deep-water species including ling, blue ling, greater forkbeard and bluemouth.

A fleet of 29 Spanish stern bottom freezer trawlers fish in international waters of the Hatton Bank (ICES XIIb and VIb1). The presence of the majority of the vessels in this area is discontinuous. Vessels conduct fishing trips of variable duration. Fishing operations are conducted in a depth range of 800–1600 m, mainly at depths >1000 m or deeper. Roundnose grenadier and Baird's smoothhead (3000–13 000 t per year in 1997–2005) are the most important species in the catches. Black scabbardfish (1000 t in 2002, then decreasing) and blue ling (600–1000 t/year) are also caught in significant amounts. Spanish landings formerly reported as roughhead grenadier have been included in the roundnose grenadIer landings time series because roughhead grenadier was not recorded in significant quantities in the Spanish observer program, and is not known to occur in significant quantities on the Hatton Bank, were the Spanish fishery operates. The time-series of Spanish landings back to 2002 was updated during WGDEEP2010 as landings per ICES Division were provided. Nevertheless, landings per ICES rectangles were not available.

A fleet UK registered gillnetters have, until recently, operated in Areas VI and VII targeting hake, monkfish and deep-water sharks, this fishery was stopped or seriously reduced as a result of regulation of deep-water gillnetting (see below, management measures).

UK registered longliners target hake with a bycatch of ling and blue ling.

There is a UK trap fishery for deep-water red crab *Chaceon affinis* in *S*ubarea VI and VII.

4.4.2 Trends in fisheries

Total landings of deep-water species from Subareas VI and VII are given in Table 4.4.1.

4.4.3 Technical interactions

Although a few of the French trawlers working in Subareas VI and VII are dedicated to deep-water fishing, the majority also fish on the continental shelf targeting saithe with a bycatch of other demersal species (megrim, monkfish). The catch of ling is also most likely to come mainly from fishing activity on the shelf or shelf break between 200 and 400 m depth than from fishing targeting deep-water species. Vessels can move rapidly between fisheries and often target both deep-water and shelf species in the course of a single trip. None of the Scottish vessels fishing deep-water stock is dedicated to deep-water trawling and vessels move between traditional fisheries for gadoid species on the shelf and in the North Sea, slope fisheries for monkfish and megrim, and genuine deep-water fisheries according to the availability of fishing opportunities. The Scottish bottom-trawl fishery targeting monkfish and megrim extends to depths of 800 m or more and has a bycatch deep-water species.

Although considered as deep-water species by this WG, the depth range of ling, tusk and greater forkbeard in Subareas VI and VII extends onto the continental shelf and large quantities of these species are caught by a number of fleets and a variety of gears. Juveniles of some of the species considered by this WG are distributed in relatively shallow water and so are caught and discarded by other fisheries. This particularly applies to bluemouth, which is discarded in large quantities by vessels fishing on the continental shelf in Division VIa and on the Rockall Bank, and to greater forkbeard in Subarea VII. Before the collapse of the stock red seabream also occurred on the shelf and juveniles were coastal in summer (Guéguen, 1969; Olivier, 1928; Priol, 1932).

As a consequence of regulations banning deep-water gillnetting below 600 m, interactions of the UK gillnet fishery with deep-water species are small.

The Spanish fleet fishing on the Hatton Bank is not exclusive to this area and also works on a variety of grounds in the North Atlantic (East and West).

4.4.4 Ecosystem considerations

The Rockall Trough lies in Subarea VI to the west of Scotland and Ireland which is bounded to the North by the by the Wyville Ridge at a depth of about 500 m. This is a major faunal barrier and there is little similarity between the fish assemblages on either side of the ridge (Bergstad *et al.*, 1999; Gordon, 2001). To the west and northwest, the Rockall Trough is separated from the Icelandic basin by the Rockall Plateau and a chain of northern banks including the Rosemary, Bill Bailey and Hatton. To the south there is a gradual increase in depth onto the abyssal plain. To the west of Ireland the slope on the western edge of the Porcupine Bank is steep, while to the south, the Porcupine Seabight has more gentle slopes. The fish populations have been relatively well described in this region compared with other deep-water areas (e.g. Gordon and Duncan, 1985a and b; Gordon, 1986; Gordon and Bergstad, 1992). At depths between about 400 and 1500 m there may be between 40 and 50 demersal species present depending on gear type. Maximum species diversity occurs between 1000–1500 m before declining markedly with depth. Some deep-water species are slow growing, long-lived, late maturing and have low fecundity. Orange roughy is so far the most extreme exemple of slow growing species. Some other deep-water species such as geater forkbeard and black scabbardfish are much faster growing and blue is considered to have a typical gadoid life history. Therefore deep-water species display a wide diversity of life-history characteristics. Fishing has a greater effect on species with low population productivity (Jennings *et al.*, 1998;

Jennings *et al*., 1999), making them particularly vulnerable to overexploitation. This applies to both the target and non-target species. A large proportion of deep-water trawl catches (upwards of 50%) can consist of unpalatable species and numerous small species, including juveniles of the target species, which are usually discarded (Allain *et al*., 2003). The main species in the discards of the trawl fishery in by far the Baird's smoothhead (*Alepocephalus bairdii*) however, a large number of other non marketable bentho-pelagic species are discarded. The survival of these discards is unknown, but believed to be virtually zero because of fragility of these species and the effects of pressure changes during retrieval (Gordon, 2001). Therefore such fisheries tend to deplete the whole fish community biomass. Depletion of dominant species can induce major changes to fish communities through removing key predatory or forage species. A study of the impacts of deep-water fishing to the West of Britain using historical survey data found some evidence of changes in size spectra and a decline in species diversity between pre- and post-exploitation data, but the scarce and unbalanced nature of the time-series hampered firm conclusions (Basson *et al*., 2001). A presence/absence analyses indicated a very likely decline in the abundance of the Portuguese dogfish since the 1980s, which was consistent with assessments for this species. Deep-water sharks, which demonstrate a greater diversity on the slope compared with continental shelf, at temperate latitudes, are important predators and their removal through targeted fisheries and bycatch in trawl fisheries for other species such as roundnose grenadiers is likely to have a major impact on the ecosystem. Although at worldwide scale there are more shark species in shallow waters than at slope depths, in the north-East Atlantic and the Mediterranean the species richness of demersal sharks is higher along the slope (35 deep-water species vs 22 occurring on the shelf). Contrarily, ray species are more numerous on the shelf. Rays are caught is small numbers by deep-waters fisheries, as rather rare species they may be severely impacted by fishing but this is difficult to assess because as rare species they would require high sampling intensity. Lastly chimaeras (5 species) form a third group of *Chondrichthyans*, which life-history and populations' dynamics is poorly known or unknown and which occur only in deep water.

The deepfish project carried a trophic web modelling using Ecopath with Ecosym (EwE). The model reflected well the reported declining trend in biomass for most fish species since the onset of fishing. The model was used to make predictions on the future of the fishery if fishing is sustained at the 2009 levels to 2020. The model suggests that current TACs should lead to recovery of some species (roundnose grenadier, deep-water sharks), while for others the TAC would need to be lowered further still (black scabbardfish). For other species (blue ling, orange roughy) results were unreliable. In order to demonstrate the benefits of taking an ecosystem view of the fishery, the model was used to investigate interactions between fish and fisheries in the model area. The hypothetical removal of the blue whiting fishery from 2007 to 2020 revealed the importance of this species in the diet of many demersal fish species and the importance of interactions between the blue whiting and demersal fisheries (Howell *et al*., 2009).

The effects of fishing on the benthic habitat relates to the physical disturbance by the gear used. This includes the removal of physical features, reduction in complexity of habitat structure and resuspension of sediment. Benthic fauna in deep waters are understood to be diverse but of low productivity. Little information is available on the effects of trawling on deep-sea soft sediment habitats. Cryer *et al*., 2002 used suite of multivariate analyses to infer that trawling probably changes benthic community structure and reduces biodiversity over broad spatial scales on the continental slope in a similar fashion to coastal systems. More attention has been paid to biogenic habitat that occurs along the slope, mainly the cold-water corals, which, in the Northeast Atlantic include the azooxanthellate scleractinarian corals *Lophelia pertusa*, *Madrepora oculata*, *Solenosmilia variabilis*, *Desmophyllum cristagalli,* and *Enallopsammia rostrata*. The main reef building species is *L. pertusa*. The other coral species often occur in association with *Lophelia pertusa* and none has been found forming reefs without *L. pertusa* being present. No exhaustive description of the distribution of *L. pertusa* exists, but it is found on the continental slopes off Norway, Iceland, Faroes, the UK, France, Spain and Portugal as well as the Mid Atlantic Ridge (ICES, 2003; 2004 and 2005; Rogers, 1999). The extent of individual reefs varies. Some biogenic seamounts are reported as up to 200 m high, and several km long (Rogers, 1999; Freiwald *et al.*, 1999). A dense and diverse range of megafauna are associated to *Lophelia* reefs. This includes fixed (anthipatarians, gorgonians, sponges) and mobile invertebrates (echinoderms, crustaceans). The species richness of macrofauna associated to coral reefs has been found to be up to three times higher than on surrounding sedimentary seabed (Mortensen *et al*., 1995). Several species of deep-water fish occur associated with corals, some in more abundance than in surrounding non-coral areas, but the functional links between fish and coral are still to be fully elucidated. However, it is accepted that generally, structurally complex habitats, such as corals, offer a greater diversity of food and physical shelter to fish and other macrofauna. Other deep-water biogenic habitats with structures that stand proud of the seabed include sponge and xenophyophore fields, seafans and seapens (octocorals). Any long-lived sessile organisms that stand proud of the seabed will be highly vulnerable to destruction by towed demersal fishing gear. There are a number of documented reports of damage to *Lophelia* reefs in various parts of the Northeast Atlantic by trawl gear where trawl scars and coral rubble have been observed (e.g. Hall- Spencer*, et al.*, 2002). Damage can also be caused on a smaller scale by static gears such as gillnets and longlines (Grehan *et al*., 2003). The degree of this damage depends on fishing effort (ICES, 2007b). The recovery rates for damaged coral are likely to be extremely slow (Risk, 2002). In Divisions VI, VII and XIIb there are a number of known areas of cold-water corals. These include the shelf break to the west and north of Scotland, Rockall Bank, Hatton Bank and the Porcupine Bank. The best known site is the Darwin Mounds, located at 1000 m to the south of the Wyville Thompson Ridge. Some of these areas have been heavily impacted by deep-water trawling activities (Hall-Spencer, 2002; Grehan *et al.*, 2003). In 2005, WGDEC recommended a number of areas on Rockall that would be appropriate to closure to protect cold-water corals from trawling activity. The choice of these sites was based on examination of scientific and anecdotal fishers' records of coral occurrence and VMS data indicating where fishing activity occurred.

Seamounts are widely recognized to be areas of high productivity where dense aggregations of fish can occur. The special hydrographic conditions and good availability of hard bottom are favourable for sessile suspension-feeders, which often dominate the community on seamounts (Genin *et al*., 1986). Within ICES area VI there are three documented seamounts; Rosemary, Anton Dohrn and Hebrides Terrace. The first two of these have summits above the daytime depth of the deep scattering layer. These seamounts have been exploited since the 1990s, probably by vessels fishing for the orange roughy.

As a consequence of the reduction in TACs, the number of vessels and the fishing have decreased. Because the quotas are restrictive, the incentive to explore new fishing ground is minimized and trawlers fish repeatedly on the same trawl tracks, where the available quotas can be fished without risk to the fishing gears. Some fleet also operate mainly on sedimentary bottom such as the slope to the west of Scotland (eastern side of the Rockall Trough).

4.4.5 Management measures

Since 2003, Black scabbardfish (*Aphanopus carbo*), Blue ling (*Molva dypterygia*), Greater silver smelt (*Argentina silus*), Ling (*Molva molva*), Orange roughy (*Hoplostethus atlanticus*), Red sea bream (*Pagellus bogaraveo*), Roundnose grenadier (*Coryphaenoides rupestris*) and Tusk (*Brosme brosme*) have been subject to TACs and quotas in EC waters and for Community vessels fishing elsewhere.

Under Council Regulation (EC) No 2347/2002, Member States must ensure that fishing activities which lead to catches and retention on board of more than 10 tonnes each calendar year of deep-sea species by vessels flying their flag and registered in their territory are subject to a deep-sea fishing permit. Member states are obliged to calculate the aggregate power and the aggregate volume of their vessels, which, in any one of the years 1998, 1999 or 2000, landed more than 10 tonnes of any mixture of the deep-sea species. The aggregate volume of vessels holding deep-sea fishing permits may not exceed this figure.

Council Regulation (EC) No 27/2005 obliged Member States to ensure that, for 2005, the fishing effort levels, measured in kilowatt days absent from port, by vessels holding deep-sea fishing permits did not exceed 90% of the average annual fishing effort deployed by that Member State's vessels in 2003 on trips when deep-sea fishing permits were held and deep-sea species were caught. For 2006 this limit was further reduced to 80% of 2003 levels.

Council Regulation (EC) No 51/2006 banned the use of gillnets by Community vessels at depths greater than 200 m in ICES Divisions VIa, b and VII b, c, j, k. In 2006 a derogation was introduced allowing the setting of gillnets with mesh sizes between 120 and 150 mm down to depths of 600 m. In 2008, this measure was extended to cover Subareas III and IV. This remains a "*transitional measures to allow these fisheries to take place under certain conditions* [...] *until more permanent measures are adopted*" included in the general TAC regulation (Council regulation (EC) N° 40/2008 of the council of 16/01/2008) however it is expected that this will become a permanent provision in a Technical measures Regulation to be adopted later in 2008. NEAFC has also banned deep-water gillnetting in international waters at depth below 200 m, until management measures can be put in place. It was unclear to the WG whether this measure, effective from 01/02/2006 and still appearing on the NEAFC website as a 2008 measure was still valid or have been updated.

Landings of the main deep-water species caught in Subareas VI and VII are managed by TACs since 2003 for black scabbardfish, argentine, tusk, blue ling, ling, roundnose grenadier, orange roughy and red (blackspot) sea bream (EC regulation n° 2340/20024 of the council of 16 December 2002). In 2005, TACs were introduced for deep-water sharks and greater forkbeard (EC regulation n° 2270/2004 of the council of 22 December 2004). TACs are revised every second year. They were reduced at each revision (for 2005/2006, 2007/2008 and 2009/2010). No EU-TAC (zero TAC) are set for orange roughy and deep-sea sharks from 2010 and this is expected to be kept in place until sustainable conditions and level of exploitation are defined.

From 2009, EU-TACs for blue ling and greater silver smelt in Subareas, II, IV, V, VI and VII are set within the annual TAC regulation because the TAC level depends upon annual negotiation between Norway and EU.

From 2009, in order to protect the spawning aggregations of blue ling in the ICES Subarea VIa, some areas have been defined were fishing for blue ling is strongly limited (vessels should not keep more than 6 tonnes of blue ling) from 1st of March to May 31. This regulation might be in force until significant rebuilding of the blue ling stock is observed.

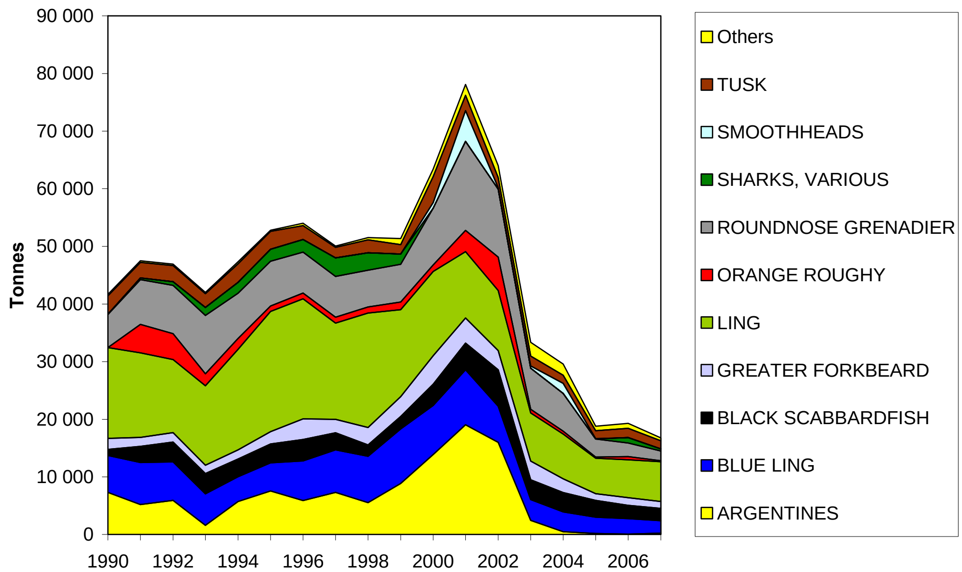


Figure 4.4.1. Landings of deep-water species from Subareas VI and VII.

Table 4.4.1. Deep-sea landings in Division VI and VII.

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
ALFONSINOS (*Beryx* spp.)		12	8		3	1	5	3	178	25	81	75	133	186	94	82	62	15	0	64	22
ARGENTINES	10 438	25 559	7294	5197	5906	1577	5707	7546	5863	7301	5555	8856	13 863	19 050	15 985	2444	480	178	55	257	4035
BLUE LING	9285	9434	6396	7319	6697	5471	4309	4892	6928	7361	8004	9472	8525	9534	6252	3605	3437	2839	2705	2257	1820
BLACK SCABBARDFISH		154	1060	2759	3436	3529	3101	3278	3689	2995	1967	2166	3712	4623	6327	3458	3355	2880	2320	2353	2397
BLUEMOUTH		127	100	128	159	152	117	71	87	88	145	354	332	279	196	397	433	43	35	338	105
DEEP WATER CARDINAL FISH						30	217	91	45	49	115	258	287	385	974	1075	869	684	330	226	23
GREATER FORKBEARD	1898	1815	1921	1574	1640	1462	1571	2138	3590	2335	3040	3430	4919	4349	3352	3257	2400	1176	1298	1974	1271
LING (*Molva molva*)	28 092	20 545	15 766	14 684	12 671	13 763	17 439	20 856	20 838	16 668	19 863	15 087	14 613	11 528	10 435	8321	7762	6154	6605	7366	5665
MORIDAE				1	25							20	146	190	158	327	71	0	3	64	481
ORANGE ROUGHY		8	17	4908	4523	2097	1901	947	995	1039	1071	1337	1158	3692	5788	622	490	206	521	185	94
RABBITFISH							2					236	355	722	573	474	433	6	24	391	353
ROUGHHEAD GRENADIER						18	5	4	13	12	10	34	10	44	19	12	13	2	75	39	6
ROUNDNOSE GRENADIER	32	2440	5730	7793	8338	10121	7860	7767	7095	7070	6364	6538	9845	15 456	11 777	7134	6548	3141	2360	1804	1489
RED (=BLACKSPOT) SEABREAM	252	189	134	123	40	22	10	11	29	56	17	23	20	51	25	38	31	36	54	135	56
SHARKS, VARIOUS	85	40	43	254	639	1392	1864	2099	2176	3240	3023	1791	8		1				956	948	849
SILVER SCABBARDFISH						2						18	15		1				342	67	0
SMOOTHHEADS				31	17								978	5305	260	393	1765	45	3	0	3
TUSK (*Brosme brosme*)	3002	4086	3216	2719	2817	2378	3233	3085	2417	1832	2240	1647	4504	2688	1794	1719	1411	1386	1601	1398	1594
WRECKFISH	7		2	10	15				83		12	14	14	17	9	2	2			2	3

4.5 North Sea (IIIa and IV)

4.5.1 Fisheries overview

4.5.2 Trends in fisheries

An overview of total landings is shown in Figure 4.5.1 and Table 4.5.1. At present, the main fisheries currently targeting deep-sea species in the IIIa and IV are the following:

- Bycatches of ling and tusk are taken in the U.K. demersal trawl fisheries.
- Fisheries for deep-sea shrimp (*Pandalus borealis*) carried out by Denmark, Norway and Sweden in Skagerrak (IIIa) and in the Norwegian Deep in the eastern part of the northern North Sea (IVa). The gears (trawls) used in these fisheries are small meshed (mesh size 35–45 mm). Bycatches of deep-sea fish species, such as Anglerfish, tusk, ling and witch flounder, are also landed. Also bycatches of Roundnose grenadier in this fishery have occasionally been landed for reduction, depending on the quantities. Introduction of sorting grids in recent years has probably reduced the amounts of some of this bycatch. Further information on the shrimp fisheries and their bycatches is found in the Reports of NIPAG (NAFO-ICES *Pandalus* Assessment Group).
- Bottom trawl fisheries by Denmark and Norway and U.K. mainly in the northern and northeastern North Sea directed at mixed demersal species including ling, tusk and anglerfish and *Nephrops*.
- Minor fisheries in Skagerrak (IIIa) by Denmark and Sweden targeting witch flounder. These are mainly trawl fisheries, but also Danish seine has been used. Further information is found in ICES WGNEW Report.
- A Danish trawl fishery directed for roundnose grenadier in the deeper parts of Skagerrak was carried out by very few vessels from the 1980s up to 2006.
- Previously directed mid-water trawl fisheries for greater silver smelt in IVa were conducted, mainly from Norway. Today this species is caught only as bycatch in this area.

Table 4.5.2 gives an overview of the 2009 landings by country for the area.

The fishery for roundnose grenadier in Skagerrak

As mentioned above, minor catches of roundnose grenadier are taken as bycatch by shrimp (*Pandalus*) trawlers in IIIa (Skagerrak) and occasionally landed (mainly for reduction). However, from the late 1980s until 2006 a Danish directed fishery for roundnose grenadier was conducted in the deeper part of Skagerrak at depths of 400–650 meters. The geographical area of exploitation was very small, constituting of only few ICES rectangles. This fishery for roundnose grenadier began in 1987 as an exploratory fishery, following exploratory efforts by Denmark and Norway for new fish resources in the 1980s. However, in Norway and Sweden directed fisheries for this species never developed.

During most of the period, up to 2002, the Danish directed fishery has mainly been conducted by the same single vessel accounting for more than 80% of the total landings. The gear (trawl) used was characterised by a mesh size <70 mm in the codend, most often 55 mm. Vessel sizes are around 30 m. Due to the prevailing market conditions the majority of the catch was landed for oil and meal. Almost all catches were landed in ports of Hirtshals and Skagen. In 2006 the economic value of the landings was around €225 000.

The development of this fishery during the recent decade has been remarkable considering the small area. From a level of around 2000 t up to 2002, taken by a mainly a single vessel, total landings increased to nearly 12000 t in 2005. Landings decreased, however, in 2006 to around 2300 tons due to catch restrictions following a revised EU Norway agreement aimed at this fishery. A total of only 2–3 vessels participated significantly in the fishery during the period of peak catches, 2002–2005, see Section 10.3. Since 2007 there has been no directed fishery, not because of the catch restrictions introduced in 2006 or signs of stock decline, but because the remaining single fisher retired without any successors.

At present the only scientific data on the development of this stock are provided by the ongoing Norwegian trawl survey in IIIa and IVa for shrimp (*Pandalus*) begun in 1984. Size frequency data for roundnose grenadier from this survey indicate that the stock in 2008 and 2009 are dominated by smaller fish than in the 1980s. However, any long-term effects of the heavy Danish commercial exploitation of this stock during the first half of the 2000s has not yet been detected.

4.5.3 Technical interactions

The mixed demersal trawl fisheries are directed at roundfish species (cod, saithe, ling and tusk). A considerable part of these fisheries are carried out in the Norwegian Deep within the Norwegian EEZ. Anglerfish and *Nephrops* also constitute a significant part of the catches from this area.

The fishery for *Pandalus* is classified as a small meshed fishery and the bycatch landings are restricted by the general 10% (weight) regulation. Apart from the bycatch of the deep-sea species mentioned above, bycatches of cod, ling and saithe are common in this fishery.

The above mentioned directed fishery for roundnose grenadier exploited the aggregations of this species in the deepest part of Skagerrak, and the reported bycatch in this fishery was rather insignificant, consisting of: Greater silversmelt, rabbitfish, blue ling and lantern shark.

4.5.4 Ecosystem considerations

The deep waters of Division IIIa and Subarea IV are small and geographically isolated from other deep-sea areas. It is likely that the deep-water fauna in this region, such as Roundnose grenadier, constitute separate stocks to those in the North Atlantic (Bergstad, 1990; Bergstad and Gordon, 1994; Mauchline *et al*., 1994; Bergstad *et al*., 2003), and could therefore be particularly vulnerable to localized population depletion through heavy exploitation, see Section 10.3. There are a number sites in the north-east Skagerrak where the cold-water coral, *Lophelia pertusa* are known from and recent observations have suggested that some have been destroyed or severely damaged by trawling activities in relatively recent times (Lundälv and Jonsson, 2003). This damage was thought likely to be caused by trawling for *Pandalus borealis*.

4.5.5 Management measures

Management of fisheries in IIIa

ICES Subdivision IIIa is shared between the EU and Norway. However, according to the tri-lateral treaty between Denmark, Norway and Sweden (Skagerrak Treaty) fishing vessels from each of the three countries may operate freely in each country's waters. Normally, bi-lateral EU-Norway agreements on the shares of TACs for the exploited fish stocks are the bases for further national management of the fisheries in IIIa. The special case of the management of the Danish fishery for roundnose grenadier in IIIa and the development of this fishery in 2006 and 2007 is described in Section 10.3.

Management of fisheries in IV

The North Sea is shared between the EU and Norway, and consequently the management in the EU zone are managed according to EU regulation, while the fisheries in the Norwegian zone IV are managed according to Norwegian regulations following the EU-Norway negotiations.

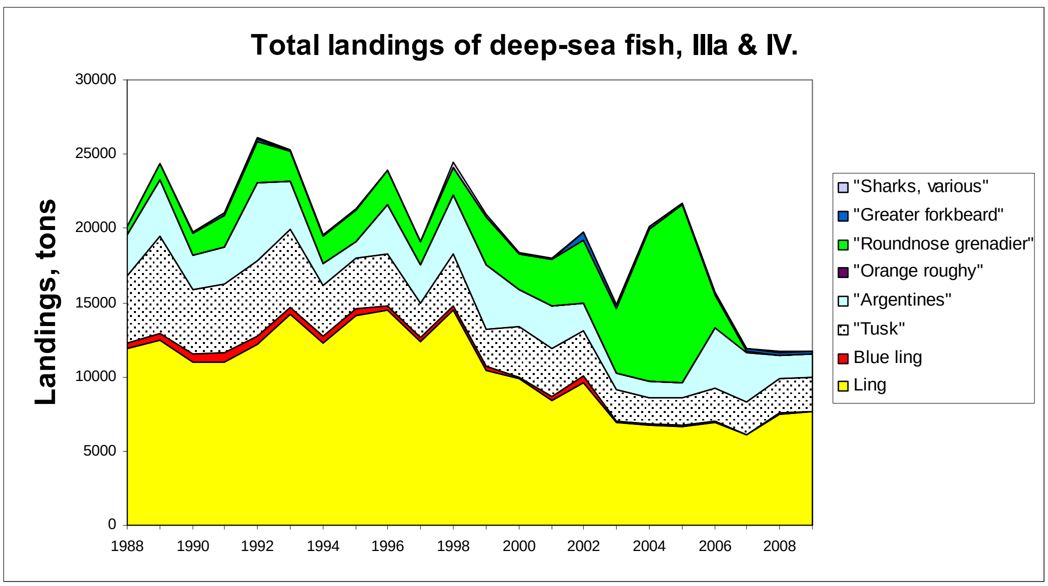


Figure 4.5.1. Overview of deep-sea species landings, over 1988–2008 (tonnes).

Table 4.5.1. Landings of Deep-sea species in Division III and IV, 1997–2009.

SPECIES	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ALFONSINOS (*Beryx* spp.)											0	0	0
ARGENTINES (*Argentina silus*)	2598	3982	4319	2471	2925	1811	1166	1105	1021	4018	3343	1571	1572
BLUE LING (*Molva dypterigia*)	291	292	271	144	276	386	120	94	115	138	63	83	81
BLACK SCABBARDFISH (*Aphanopus carbo*)	2	9	7	5	12	24	4	4	2	13	1	0	4
BLUEMOUTH (*Helicolenus dactylopterus*)	1		8					2	0		0	0	0
GREATER FORKBEARD (*Phycis blennoides*)	7	12	31	11	26	585	233	142	88	142	239	245	146
LING (*Molva molva*)	12 325	14 472	10 472	9858	8396	9642	6928	6770	6653	6918	6060	7512	7702
MORIDAE										0	0	0	0
ORANGE ROUGHY (*Hoplostethus atlanticus*)									0	0	14	0	0
RABBITFISHES (*Chimaerids*)	38	56	45	33	20	24	25	40	168	14	18	21	7
ROUGHHEAD GRENADIER (*Macrourus berglax*)	5	1		4	10	3	2	1	38		0	0	0
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	1533	1854	3187	2406	3121	4258	4319	10 267	11 942	2272	26	1	2
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)									0	0	0	0	0
SHARKS, VARIOUS	32	359	201	36	62				16	22	22	56	10
SILVER SCABBARDFISH (*Lepidopus caudatus*)											0	0	0
SMOOTHHEADS (*Alepocephalidae*)											0	0	0
TUSK (*Brosme brosme*)	2341	3474	2498	3411	3204	3082	2056	1733	1839	2204	2199	2251	2282
WRECKFISH (*Polyprion americanus*)											0	0	0

Table 4.5.2 Landings (t) by country, division and species in 2009 for Division IIIa and Subarea IV.

Country	Division	Greater Silver smelt	Blue Ling	Ling	Roundnose Grenadier	Tusk	Witch Flounder	Lantern sharks	Rabbitfish	Sharks	Greater forkbeard	Others
DK	III a	0	0	65	2	1	531	0	1			
	IV a	19	1	427	0	48	235	0	0			
	IV b	0	0	38	0	1	100	0	0			
	IV c			0				0	0			
UK-E+W												
	IVa			19		3						
	IVb			29								0
	IVc											
UK-Scot												
	IVa		7	2223	+	92				1	2	+
	IVb			18		1					+	+
	IVc											
FRO												
	IVa			7		1						
	IVb											
	IVc											
NOR												
	IIIa	0	0	62	0	17			0			
	IVa	1566	69	4612	0	2108			6		142	
	IVb	0		58		3			0			
	IVc											
FRA												
	IVa		12	92	6				0		3	8
	IVb		2	0	0	7			0		1	
	IVc			0								
		1585	91	7650	8	2282	866	0	7	1	148	8

4.6 Stocks and fisheries of the South European Atlantic Shelf

4.6.1 Fisheries overview

In ICES Subarea VIII there are two main **Spanish fishing fleets** defining the fisheries:

- The trawl fishery targets species such as hake, megrim, anglerfish, and *Nephrops* but also has variable bycatch of deep-water species. These include *Molva spp*., *Phycis phycis*, *Phycis blennoides*, *Conger conger*, *Helicolenus dactylopterus*, *Polyprion americanus*, *Beryx* spp and *Pagellus bogaraveo*.
- Longline fishery mainly targets deep-water species on conger, greater forkbeard, deep-water sharks and ling.

The **French trawler fishery** mainly target demersal and pelagic species on the shelf with a small bycatch of deep-water species such as bluemouth and greater forkbeard. To the north of Subarea VIII, **a small handline fishery** targeting mainly bass and pollack (*Pollachius pollachius*) has a bycatch of red (blackspot) seabream. In recent years, some landings of orange roughy caught to the north of Subarea VIII have occurred, from artisanal trawlers targeting this species. This activity was stopped due to low quota.

In ICES Subarea IX on the contrary there is a main directed **Portuguese longline fishery** for black scabbard fish (*Aphanopus carbo*) with a bycatch of the deep-water sharks, and also and **Spanish longline** (Voracera) fishery for *Pagellus bogaraveo*. There is also a bottom-trawl fishery at the southern part of the Portuguese continental coastal, targeting crustaceans some on deeper grounds such as *Nephrops norvegicus* and *Aristeus antennatus*. Typical bycatches species of this fishery are: bluemouth (*Helicolenus dactylopterus*), greater forkbeard (*Phycis blennoides*), conger eel (*Conger conger*), blackmouth dogfish (*Galeus melastomus*), kitefin shark (*Dalatias licha*), and gulper shark (*Centrophorus squamosus*).

There has been a small expansion of UK (England and Wales) gillnet fisheries into Subareas VIII and IX. In Subarea VIII but landings are on a small scale.

4.6.2 Trends in fisheries

Although since 1988 from six to seventeen deep species are usually landed in Areas VIII and IX, the catches of *Aphanopus carbo* (47.2%) *Lepidopus caudatus* (14%) *Pagellus bogaraveo* (10.3%), *Molva molva* (6.6%), *Phycis blennoides* (6.3%), *Polyprion americanus* (4%), *Beryx* spp (2.5%), *Helicolenus dactylopterus* (2.9%) and *Argentina sphiraena* (2.2%) represent on average the 96 % of total subareas' landings.

Since 1989 on average 6215 t of these species are landed from these Subareas, but in 1995 an important peak of 12 678 t is observed due to an increase of *L. caudatus* landings in Subarea IX (Table 4.6.1).

Black scabbardfish (*Aphanopus carbo*) *and* silver scabbardfish (*Lepidopus caudatus*)

*Aphanopus carb*o and *Lepidopus caudatus* are the main species landed in both subareas combined, but it is worthy of remark that most of *A. carbo* and *L. caudatus* landings come from Subarea IX. Landings of Black scabbard fish never has been lower than 2400 t/year, and in 1993 reached its higher value (4524 t). Since this year the trend indicates a decrease until 2000, and after this year the average landings have been 2929 t/year.

The trend of Silver scabbard fish landings is very variable along the period 1988–2006. Landings of this species have been always lower than Black scabbardfish ones, except in 1995 in which 5672 t were reached. In 2000 only 16 t are recorded but in 2006 the landings of this species were increased to 931 t in 2009 (Figure 4.6.1).

Red Seabream (*Pagellus bogaraveo*) and Ling (*Molva molva*)

Since the collapse of the Bay of Biscay stock in the early 1980s, the main landings of Red seabream since 1988 come from Subarea IX. In European Atlantic Shelf from 1988 to 1998 the landings rank between 666 and 1175 t (on average 958 t), but, from 1999 to 2009 the total landings have been always below 751 t (on average 639 t).

Almost the 100% of total landings of ling come from Subarea VIII. The series shows a continuous decrease of catches from 1991 to 1994. Since this year a clear increase is observed, and in 1998 the peak of the series (1799 t) is raised. However since the peak in 1998 landings of this species have been decreased strongly (Figure 4.6.1).

Geater forkbeard (*Phycis blennoides*), Wreckfish (*Polyprion americanus*) and Alfonsinos (*Beryx* spp.)

Since 1998 the 97% of Greater forkbeard landings in Southern European Atlantic shelf belongs to Subarea VIII. The landings in the combined areas show a clear increase from 1988 to 1998, and although the peak in 1998 has been never reached again the average of landings from 1999 onwards has been increase at 387 t/year.

The wreckfish landings don't not show a clear trend, in 1994 shows a peak of 440 ton but since this year the trend in landings is negative until 2004. Since this year the werckfish shows an important increase in the landings, reaching the peak of the series with 504 ton in 2007. In last two years the landings have stabilized around 315 t/year.

The most important landings of Alfonsinos in Subareas VIII and IX ware recorded in since 1995. From 1995 to 2004 an increase of landing trends is observed but since that year decreased to reach only 65 t in 2009 (Table 4.6.1).

Deep-water red crab (*Chaceon* spp.)

The fishery of this species started in 2006 and in this year and in 2007 305 t and 83 t were recorded respectively. The main bycatch of this new fishery in 2006 was the deep-water sharks.

4.6.3 Technical interactions

The new small England and Wales gillnet fisheries fishing deep-water crabs and sharks in Subareas VIII and IX are probably the consequence of the displacement of gillnet effort as result of the 2006 gillnet ban in depths greater than 600 m in ICES Subareas VI and VII. This fishery was active until 2007 but the level of catches is much lower than in 2006 and apparently disappeared in 2008 because there were no reported landings beyond this date.

An update of information of gear interaction of Spanish fleet fishing deep-water species during the period 2005–2008 is shown in Table 4.6.2.

4.6.4 Ecosystem considerations

Chaceon affinis is normally found on seamounts and escarpments at depths over 500 m., and has already been shown to be vulnerable in certain areas of the Atlantic.

Deep-water conditions are more conducive to net loss, and there is strong evidence of net dumping and significant levels of ghost fishing in the deep water north east Atlantic fishery for monkfish. There is a need to evaluate the scale of this problem in Subareas VIII and IX.

In Subarea VIII there are historic records of impacts on deep-water ecosystems, in particular corals (Joubin, 1922).

4.6.5 Management measures

In 2009 and 2010 TACs for the most of deep-water species are set at lower levels than previous years, and a TAC 0 has been adopted in 2010 for some species as orange roughy in Subareas I, II, III, IV, V, VIII, IX, X, XI, XII and XIV, and deep-water sharks in V, VI, VII, VIII, IX and X).

The ban on deep-water gillnetting in depths greater than 600 m does not apply to Subareas VIII and IX. There are no TACs or quotas for deep-water crab in Subareas VIII and IX.

Table 4.6.1. Overview of landings in Subareas VIII and IX.

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	20
Alfonsinos (*Beryx* spp.)			1		1		2	82	88	135	269	201	167	229	237	109	280	191	94	71	101	65
Argentines (*Argentina silus*)															191	37	23	202		1	11	1
Blue Ling (*Molva dypterigia*)										14	33	4	4	6	29	22	22	61	351	36	56	16
Black Scabbardfish (*Aphanopus carbo*)	2602	3473	3274	3979	4398	4524	3434	4272	3689	3555	3152	2752	2404	2767	2725	2664	2502	2770	2726	3480	3644	36
Bluemouth (*Helicolenus dactylopterus*)		2	5	12	11	8	4			1	3	29	33	34	18	124	135	206	279	356	345	24
Deep water cardinal fish (*Epigonus telescopus*)												3	5	4	8	5	10	9	11	6	320	13
Greater forkbeard (*Phycis blennoides*)	81	145	234	130	179	395	320	384	456	361	665	377	411	494	489	422	482	337	316	166	562	20
Ling (*Molva molva*)	1028	1221	1372	1139	802	510	85	845	1041	1034	1799	451	331	577	439	450	527	487	355	321	296	32
Moridae								83	52	88			26	20	8	12	11	15	9	18	9	6
Orange roughy (*Hoplostethus atlanticus*)	0	0	0	0	83	68	31	7	22	24	15	40	52	20	20	31	43	27	43	1	9	17
Rabbitfishes (*Chimaerids*)												2	2	7	6	2	6	5	10	3	3	1
Roughhead grenadier (*Macrourus berglax*)																			3	0	0	0
Roundnose grenadier (*Coryphaenoides rupestris*)			5	1	12	18	5		1		20	16	5	7	3	2	2	7	28	11	5	2
Red (blackspot) seabream (*Pagellus bogaraveo*)	826	948	906	666	921	1175	1135	939	1001	1036	981	647	691	553	489	560	574	584	656	718	751	80
Silver scabbardfish (*Lepidopus caudatus*)	2666	1385	584	808	1374	2397	1054	5672	1237	1725	966	3069	16	706	1832	1681	854	526	620	654	846	93
Smoothheads (*Alepocephalidae*)										7											0	0
Tusk (*Brosme brosme*)	1										1								1	0	0	0
Wreckfish (*Polyprion americanus*)	198	284	163	194	270	350	410	394	294	222	238	144	123	167	156	243	141	196	333	504	317	31
Deep water red crab (*Chaceon* spp)*																			305	83	0	0
Lesser silver smelt (*Argentina sphiraena*)**																131	189	223	264	180	244	15

*** new species included for the WG2007.**

**** new species included for the WG2008.**

Table 4.6.2. Quantitative description of fishing gears and landings (t) interaction of Spanish fleets in Subareas VIII and IX.

LANDINGS (TON)		2005		2006		2007		2008		2009*	
Species	Gear	VIII	IX	VIII	IX	VIII	IX	VIII	IX	VIII	IX
Molva molva	Longliners	47	0	48	0	32	0	34	0	0	0
	Gillnets	16	0	8	0	7	0	1	0	0	0
	Bottom-trawl	12	0	17	0	8	1	8	0	1	0
	Others	66	0	0	0	0	0	0	0	0	0
Aphanopus carbo	Longliners	0	0	0	0	0	0	0	0	0	0
	Gillnets	0	0	0	0	0	0	0	0	0	0
	Bottom-trawl	1	0	0	0	1	0	0	0	1	0
	Others	0	0	0	0	0	0	0	0	0	0
Pagellus bogaraveo	Longliners	44	334	28	369	83	404	20	439	16	594
	Gillnets	6	0	7	0	17	2	4	1	7	0
	Bottom-trawl	16	2	21	4	47	1	15	3	1	0
	Others	24	29	1	66	2	0	2	0	0	0
Phycis spp	Longliners	148	0	80	1	294	3	20	14	20	5
	Gillnets	8	0	21	1	41	4	3	29	1	4
	Bottom-trawl	97	39	84	28	113	55	56	0	58	53
	Others	0	18	0	42	0	0	0	0	0	0
Beryx spp	Longliners	21	0	26	3	47	1	4	0	4	5
	Gillnets	35	0	13	0	9	1	1	0	1	5
	Bottom-trawl	19	0	7	2	3	4	5	1	3	0
	Others	62	6	1	2	0	0	0	0	0	0
Polyprion americanus	Longliners	15	0	2	1	42	6	2	3	1	5
	Gillnets	0	0	0	0	2	6	0	0	0	4
	Bottom-trawl	0	1	0	3	0	5	1	0	0	1
	Others	0	5	0	10	0	0	0	0	0	0
Lepidopus caudatus	Longliners	0	449	0	563	0	645	0	842	0	894
	Gillnets	0	0	0	0	0	0	0	0	0	0
	Bottom-trawl	0	0	0	0	0	3	0	0	0	4
	Others	0	59	0	51	0	0	0	0	0	0
Argentina sphyraena	Longliners	0	0	0	0	0	0	0	0	0	0
	Gillnets	0	0	0	0	0	0	0	0	0	0
	Bottom-trawl	32	0	261	3	184	1	237	1	0	0
	Others	0	4	0	0	0	0	0	0	0	0

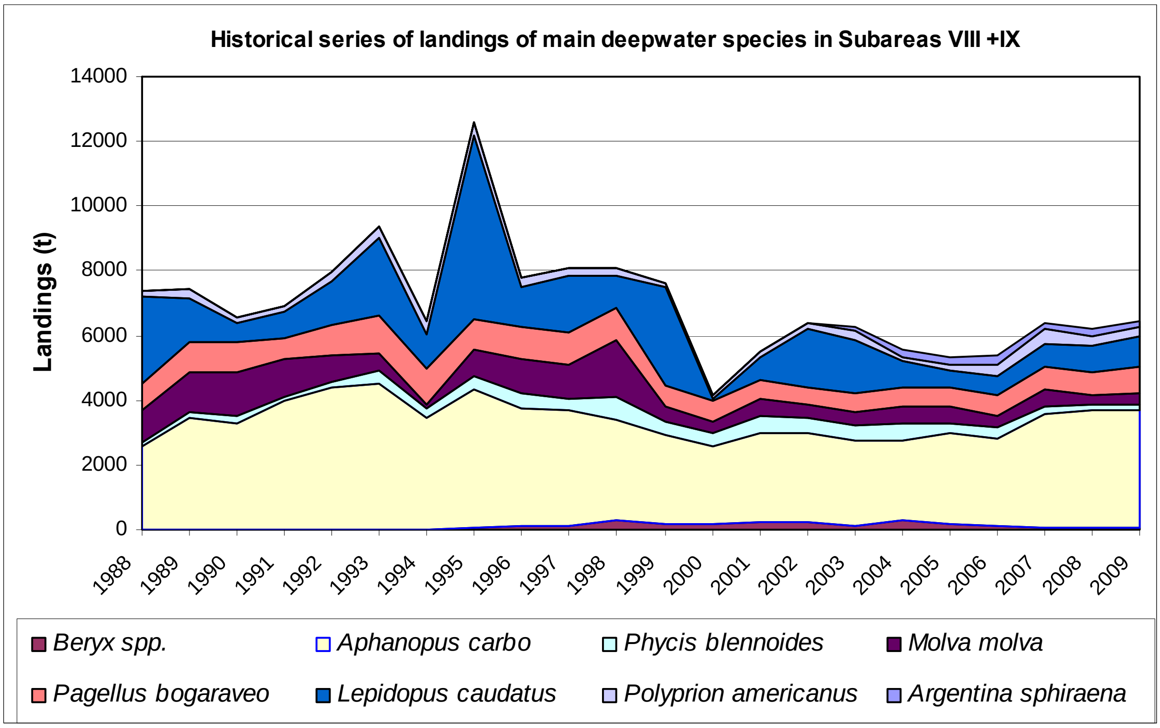


Figure 4.6.1. Historical series of eight main species landed in combined Subareas VIII and IX since 1988.

4.7 Stocks and fisheries of the Oceanic northeast Atlantic

4.7.1 Fisheries overview

The Mid-Atlantic Ridge (MAR) is the spreading zone between the Eurasian and American plate. The ridge is continually being formed as the two plates spread at a rate of about 2 cm/year. In the Ices area it extends over 1500 nautical miles from the Iceland to the Azores crossing the Azores archipelago between the Western and central islands groups. It is characterised by a rough bottom topography comprising underwater mountain chains, a central rift valley, recent volcanic terrain, fracture zones, and seamounts. In these areas two different types of fisheries occur. Industrial oceanic fisheries in the central region and northern parts of the Mid-Atlantic ridge. There is an artisanal fishery inside the Azorean EZZ and this is targeted at stocks which may extend south of the ICES Area.

This Section deals with fisheries on the Mid-Atlantic Ridge and the Azores.

Azores EEZ

The Azores deep-water fishery is a multispecies and multigear fishery. The dynamic of the fishery seems to be dominated by the main target species *Pagellus bogaraveo*. However, others commercially important species are also caught and the target species change seasonally according abundance, species vulnerability and market.

The fishery is clearly a typical small scale one, where the small vessels (<12 m; 90% of the total fleet) predominate, using mainly traditional bottom longline and several types of handlines. The ecosystem is a seamount type with fishing operations occurring in all available areas, from the islands coasts to the seamounts within the Azorean EEZ. The fishery takes place at deeps until 1000 m, catching species from different assemblages, with a mode on the 200–600 m strata, the intermediate strata where the most commercially important species occur.

Mid-Atlantic Ridge

The Northern Mid-Atlantic Ridge (MAR) is a huge area located between Iceland and Azores. There are more than 40 seamounts of commercial importance (Table 4.7.2). The deep-water fishery on the MAR started in 1973, when dense concentrations of roundnose grenadier (*Coryphaenoides rupestris)* were discovered. Later aggregations of alfonsino *(Beryx splendens)*, orange roughy *(Hoplostethus atlanticus)*, cardinal fish *(Epigonus telescopus)*, tusk (*Brosme brosme*), 'giant' redfish (*Sebastes marinus)* and blue ling (*Molva dypterigia)* were found. Trawl and longline fisheries were conducted in Subareas XII, X, XIV and V (Figure 4.7.2) by Russian, Icelandic, Faroese, Polish, Latvian and Spanish vessels.

4.7.2 Trends in fisheries

Azores EEZ

Since mid-nineties the landings of deep-water species show a decreasing tendency (Figure 4.7.1, Table 4.7.1), reflecting the change in the fleet behaviour, that has since started to target on blackspot seabream.

Since 2000, the use of bottom longline in the coastal areas has significantly been reduced, as a result of the interdiction by the local authorities of the use of longlines in the coastal areas on a range of 3 miles from the islands coast. As a consequence, the smaller boats that operate in this area have changed their gears to several types of handlines, which may have increased the pressure on some species. The deep-water bottom longline is at present mostly a seamount fishery.

Also in one other fleet component, the medium size boats, ranging from 12 to 16 meters, a change from bottom longline to handlines has been observed during the last 5 or 6 years. All this changes in the fishing pattern of the fleet may explain the changes in the landings of some species that were more vulnerable to the use of bottom longlines.

Mid-Atlantic Ridge

The greatest annual catch of roundnose grenadier (almost 30 000 t) on the MAR was taken by the Soviet Union in 1975, fluctuating in subsequent years between 2800 to 22 800 t. The fishery for grenadier declined after the dissolution of the Soviet Union in 1992. In the last 15 years, there has been a sporadic fishery (Figure 4.7.2) by vessels from Russia (annual catch estimated at 200–3200 t), Poland (500–6700 t), Latvia (700–4300 t) and Lithuania (data on catch are not available). Grenadier has also been taken as bycatch in the Faroese orange roughy fishery and Spanish blue ling fishery. During the entire fishing period to 2009, the catch of roundnose grenadier from the northern MAR amounted to more than 232 000 t, mostly from ICES Subarea XII.

The deep-water fisheries off Iceland tend to be on the continental slopes although a short-lived fishery on spawning blue ling (*Molva dypterygia*) was reported on a "small steep hill" at the base of the slope near the Westman Islands. The fishery began in 1979, peaked at 8000 t in 1980 and subsequently declined rapidly. French trawlers found small seamount in southerly areas of the Reykjanes Ridge and were fishing for blue ling there in 1993 with 390 t of catch. Maximum Icelandic catch in that area was more 3000 t also in 1993, it declined sharply to 300 and 117 t for next two years and no fishery was reported later (Figure 4.7.2). Fishery on the seamount resumed by Spanish trawlers in 2000s with biggest catch about 1000 t.

Orange roughy occurs in restricted areas of the MAR, where it can be abundant on the tops and the slopes of narrow underwater peaks. These are generally difficult to fish, although in 1991 a single trawler made some noteworthy catches of orange roughy off the south coast of Iceland. In 1992 the Faroe Islands began a series of exploratory cruises for orange roughy beginning in their own waters and later extending into international waters. Exploitable concentrations were found in late 1994 and early 1995. Several vessels began a commercial fishery but only one vessel managed to maintain a viable fishery. Most of the fishery took place on five banks. In the northern area (ICES Sub area XII) catches peaked in 1995–1998 (570–802 t), and since then have generally been less than 300 t (Figure 4.7.2). Catches from 6 to 470 t per annum were also made in ICES Subarea X in 1996–1998, 2000–2001, 2004–2009. The black scabbard fish was the main bycatch species and in recent years it amounted bulk of catches (313 t for both Subareas in 2009).

In 1983–1987, dives with a Soviet submersible discovered aggregations of tusk and northern wolffish (*Anarhichas denticulatus)* on the Northern MAR seamounts, and a bottom longline fishery subsequently developed. Catches of tusk were taken on 20 seamounts in the area between 51–57° N. The highest catch rates were on a seamount named Hekate, with 813 kg per 1000 hooks.

In 1996 a small fleet of Norwegian longliners began a fishery for 'giant' redfish and tusk on the Reykjanes Ridge. The fishery was mainly conducted close to the summits of seamounts and a new type of vertical longline was developed for the fishery (Figure 4.7.2). The fishery continued in 1997, but experienced an 84% decrease in cpue. Norway carried out two exploratory longline surveys in 1996 and 1997. Fishery in that area was resumed in 2005–2007 and 2009 by Russian longliners.

Spain carried out five limited exploratory trawl surveys to seamounts on the MAR between 1997–2000 and a longline survey in 2004 but except for sporadic fisheries in the northern area (Division XIVb) there has been a decline in interest.

The first commercial catches of alfonsino in this area were taken by pelagic trawling on the Spectr seamount in 1977 and this and other seamounts were exploited in 1978 and 1979. No commercial fishing took place during the 1980s but nine exploratory and research cruises yielded about 1000 t of mixed deepwater species, mostly alfonsino, but also commercial catches of cardinal fish, orange roughy, black scabbardfish and silver roughy (*Hoplostethus mediterrraneus)*. A joint Russian-Norwegian survey in 1993 used a bottom trawl to survey three seamounts and a catch of 280 t, mainly alfonsino and cardinal fish, was taken from two of them. Orange roughy, black scabbard fish and wreckfish *(Polyprion americanus)* were also of commercial importance. Commercial fishing yielded more than 2800 t over the next seven years (Figure 4.7.2). In recent years there have been no indications of fishery of alfonsino. Since the discovery of the seamounts in the North Azores area Soviet and Russian, vessels have taken about 6000 t, mainly of alfonsino. Vessels from the Faroe Islands and the UK have also small catches of the species in the area.

4.7.3 Technical interactions

Azores EEZ

The fishery is multispecies and so technological interactions are observed. In the past the bycatch of this fishery was considered insignificant, according to a pilot study conducted in 2004 (ICES, 2006). However, reported discards from observers on longliner fishery during 2007 and 2008 suggests that for some species the discards may be important. Actually, commercial value species like red blackspot seabream and wreck fish, among others, are also discarded. These changes may be probably due to the management measures introduced, particularly the TAC/quotas, minimum size and fishing area restrictions that changed the fleet behaviour on targeting, expanding the fishing areas for more offshore seamounts and deeper strata. Fisheries occurring outside the ICES area to the south of the Azores EEZ may be exploiting the same stocks as considered here.

Mid-Atlantic Ridge

The possible interactions between local fishing grounds (e.g. seamounts) and the status of the stocks at larger scale are unknown. In particular, seamount aggregating species such alfonsinos and orange roughy are sensitive to sequential local depletion. However, no data were available to assess such effects. Little is understood about the stock structure of these species and it is possible that the industrial fleets fishing on the MAR may be fishing the same stocks that are exploited by the Azorean fishery.

The separation of fishing activities and catch on the MAR and Hatton Bank have been problematic as both these areas are parts of ICES Subarea XII. The Spanish fishery on the Hatton bank is not known to operate of the MAR. However, this fishery is operated by large high-sea freezer trawlers that also fish in the Northwest Atlantic (NAFO area) and could therefore do some fishing also on the northern MAR. The Spanish fishery produces only small landings of aggregating seamount species (orange roughy, alfonsinos) and target mainly roundnose grenadier. Therefore it is unlikely to interact with fisheries in the southern MAR and other fisheries for roundnose grenadier. Landings of non-aggregating species (mainly roundnose grenadier) on the northern ridge have been small over recent years.

4.7.4 Ecosystem considerations

Azores EEZ

The Azores are considered a "seamount ecosystem area" because of its high seamount density. The Azores, as most of the volcanic islands don't have a coastal platform and are surrounded by extended areas of great depths, punctuated by some seamounts where the fisheries occur. The average depth in the Azores EEZ is of 3000 meters, and only 0.8% (7715 km^2) has depths less than 600 meters while 6.8% are between 600 and 1500 meters. The deep water fishery in the Azores is mostly a seamount fishery where only bottom longlines and handlines are used.

Mid-Atlantic Ridge

Most of Divisions XIIa, XIIc, Xb, XIVb1 and Va are covered in abyssal plain with an average depth of >ca. 4000 m which currently remains largely unexploited. The major topographic feature is the Northern part of the MAR, located between Iceland and the Azores. Numerous seamounts of variable heights occur all long this ridge along with isolated seamounts in other areas such as Altair and Antialtair. The physical structure of seamounts often amplify water currents and create unique hard substrata environments that are densely populated by filter-feeding epifauna such as sponges, bivalves, brittle stars, sea lilies and a variety of corals such as the reef-building cold-water coral *Lophelia pertusa*. This benthic habitat supports elevated levels of biomass in the form of aggregations of fish such as orange roughy, alfonsinos, etc. and a number of seamounts have been targeted by commercial fleets. Such habitats are however highly susceptible to damage by mobile bottom fishing gear and the fish stocks can be rapidly depleted due to the life-history traits of the species which are slow growing and longer-living than non-seamount species.

The MAR is isolated from the continental slope except for the relatively continuous shallower connections via the Greenland and Scotland ridges, and some seamount chains, e.g. the New England seamounts provide other linkages to the continents. Along with much of the general biology, the intraspecific status of species inhabiting the MAR is unclear. Based on geographical patterns it is probable that MAR stocks are isolated from the others in the North Atlantic and endemism, especially amongst benthic species may be high and therefore particularly vulnerable.

The recent efforts to study the distribution and biology of the MAR through the MAR-ECO project will yield a better insight into the status of this remote eco-system (http//:www.mar-eco.no).

4.7.5 Management of fisheries

Azores EEZ

The only known deep-water fisheries in ICES Subdivision Xa are those from the Azores. The fisheries management is based on regulations issued by the European Community, by the Portuguese government and by the Azores regional government. Under the EC Common Fisheries Policy, TACs were introduced for some species, e.g. blackspot seabream, black scabbardfish, and deep-water sharks, in 2003 (EC. Reg. 2340/2002) and maintained in 2004 (EC. Reg. 2270/2004), 2006 (EC. Reg. 2015/2006) and 2008 (EC Reg. 1359 2008). A specific access requirements and conditions applicable to fishing for deep-water stocks was established (EC. Reg 2347/2002). Fishing with trawl gears is forbidden in the Azores region. A box of 100 miles limiting the deep-water fishing to vessels registered in the Azores was created in 2003 under the management of fishing effort of the common fishery policy for deep-water species (EC Reg. 1954/2003). Some technical measures were also introduced by the Azores regional government since 1998 (including fishing restrictions by area, vessel type and gear, fishing licence based on landing threshold and minimum lengths).

In order to reduce effort on traditional stocks, fishermen are encouraged by local authorities to exploit the deeper strata (>700 m), but the poor response of the market has been limiting the expansion of the fishery.

Mid-Atlantic Ridge

EC vessels fishing on the MAR are covered by community TAC. There are NEAFC regulation of efforts in the fisheries for deep-water species and closed area to protect vulnerable habitats.

Table 4.7.1. Overview of landings in Subareas X (a1,a2,b) and XII (c, a1, b1) (does not include information from XIIb, Western Hatton Bank).

SPECIES	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ALFONSINOS (*Beryx* spp.)	631	550	983	229	175	229	199	243	172	139	157	192	211	250	312
ARGENTINES (*Argentina silus*)		1			2					4					
BLUE LING (*Molva dypterigia*)	602	814	438	451	1363	607	675	1270	1069	644	35	65	1		
BLACK SCABBARDFISH (*Aphanopus carbo*)	304	455	203	253	224	357	134	1062	502	384	198	73		80	162
BLUEMOUTH (*Helicolenus dactylopterus*)	589	483	410	381	340	452	301	280	338	282	190	209	275	281	267
DEEP WATER CARDINAL FISH (*Epigonus telescopus*)						3		14	16	21	4	10	7	7	7
GREATER FORKBEARD (*Phycis blennoides*)	75	47	32	39	41	100	91	63	56	46	1	134	201	18	26
LING (*Molva molva*)	50	2	9	2	2	7	59	8	19		2				1
MORIDAE						1	88	113	140	91		127	86		68
ORANGE ROUGHY (*Hoplostethus atlanticus*)	676	1289	814	806	441	447	839	28	201	711	324	104	20	108	26
RABBITFISHES (*Chimaerids*)			32	42	115	48	79	98	81	128	193				22
ROUGHHEAD GRENADIER (*Macrourus berglax*)					3	7	10	7	2	28	8	8			6
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	644	1739	8622	11979	9696	8602	7926	11 468	10 805	10 748	513	86	2	13	5
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)	1096	1036	1012	1114	1222	947	1034	1193	1068	1075	1383	958	1070	1089	1042
SHARKS, VARIOUS	1385	1264	891	1051	50	1069	1208	35	25	6	14	104	63	12	1
SILVER SCABBARDFISH (*Lepidopus caudatus*)	789	815	1115	1186	86	28	14	10	25	29	31	35	55	63	64
SMOOTHHEADS (*Alepocephalidae*)		230	3692	4643	6549	4146	3592	12538	6883	4368	6872				
TUSK (*Brosme brosme*)	18	158	30	1	1	5	52	27	83	16	66.26	64	19		2
WRECKFISH (*Polyprion americanus*)	240	240	177	139	133	268	229	283	270	189	279	497	664	513	382

Table 4.7.2. Summary data on seamount fisheries on the MAR.

Main species	Discovery		No. of commercial seamounts	Maximum catch/yr ('000 t)
	Year	Country		
Coryphaenoides rupestris	1973	USSR	34	29.9
Beryx splendens	1977	USSR	4	1.1
Hoplostethus atlanticus	1979	USSR	5	0.8
Molva dypterigia	1979	Iceland	1	8.0
Epigonus telescopus	1981	USSR	1	0.1
Aphanopus carbo	1981	USSR	2	1.1
Brosme brosme	1984	USSR	15	0.3
Sebastes marinus	1996	Norway	10	1.0

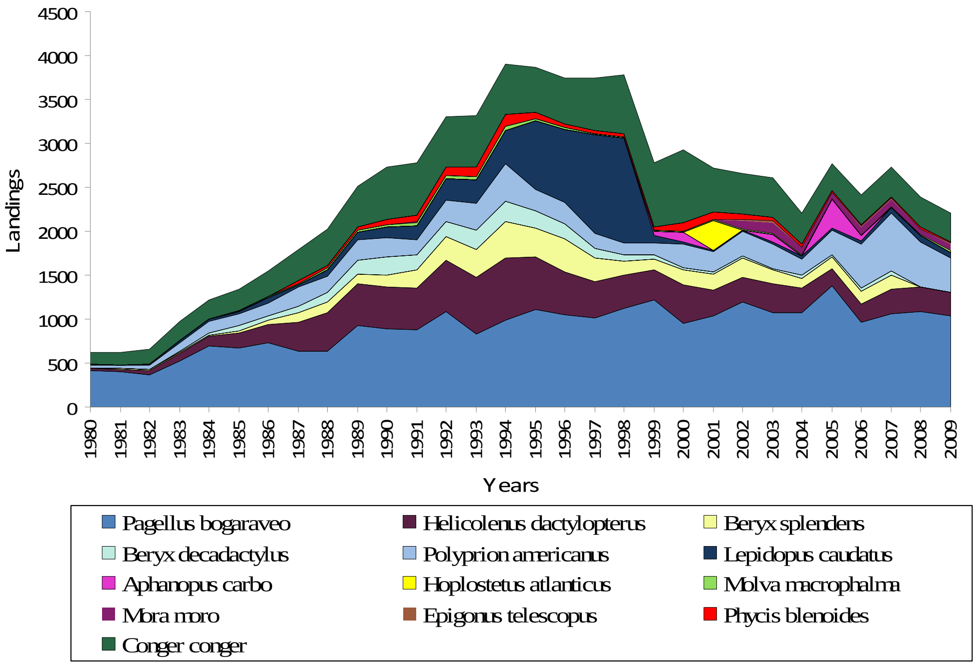
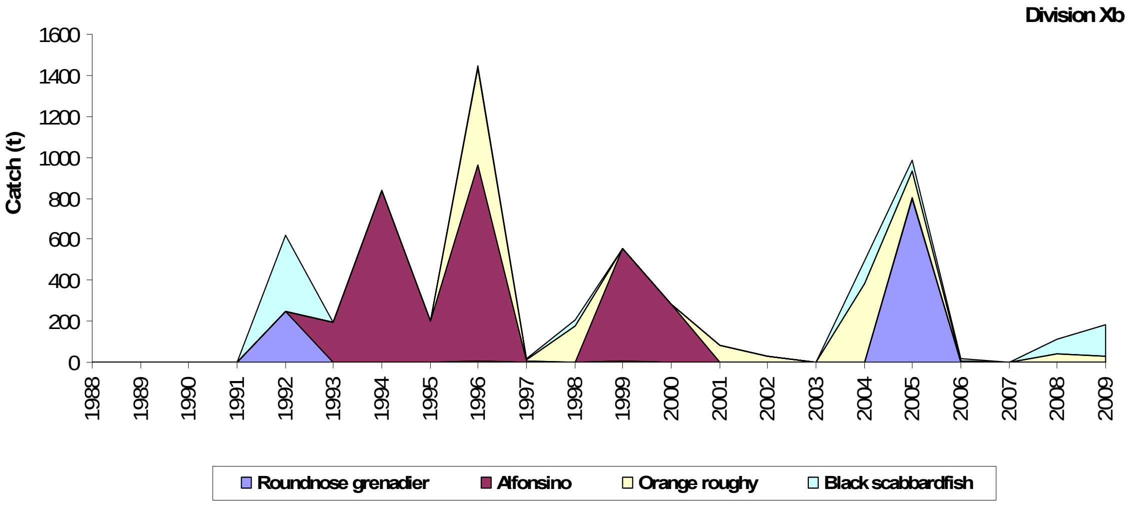
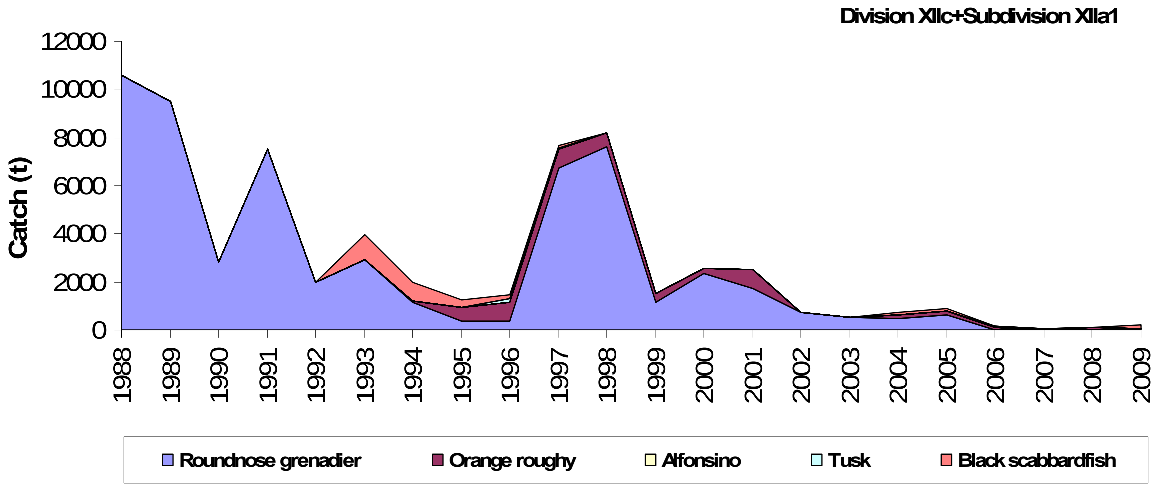


Figure 4.7.1. Annual landings of major deep-water species in Azores from hook and line fishery (1980–2009).





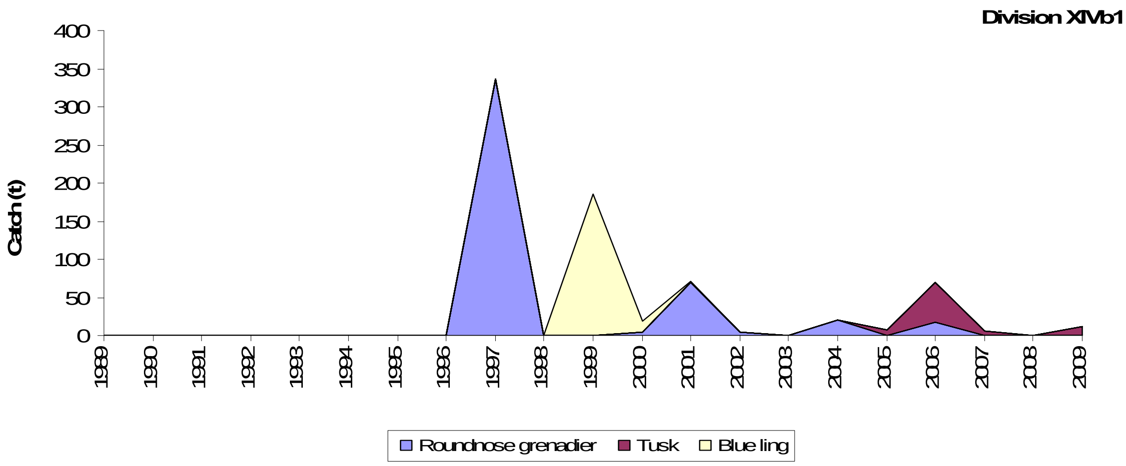


Figure 4.7.2. Annual catch of major deep-water species on MAR in 1988–2009.

5 Ling (*Molva molva*) in the Northeast Atlantic

5.1 Stock description and management units

WGDEEP 2006 indicated: '*There is currently no evidence of genetically distinct populations within the ICES area. However, ling at widely separated fishing grounds may still be sufficiently isolated to be considered management units, i.e. stocks, between which exchange of individuals is limited and has little effect on the structure and dynamics of each unit. It was suggested that Iceland (Va), the Norwegian Coast (II), and the Faroes and Faroe Bank (Vb) have separate stocks, but that the existence of distinguishable stocks along the continental shelf west and north of the British Isles and the northern North Sea (Subareas IV, VI, VII and VIII) is less probable. Ling is one of the species included in a recently initiated Norwegian population structure study using molecular genetics, and new data may thus be expected in the future*'.

WGDEEP 2007 examined available evidence on stock discrimination and concluded that available information is not sufficient to suggest changes to current ICES interpretation of stock structure.

5.2 Ling (*Molva Molva*) in Division Vb

5.2.1 The fishery

A general description of the fisheries in this area is provided in Section 4.3

5.2.2 Landings trends

Landings data for this stock are available from 1904 onwards; landing statistics for ling by nation for the period 1988–2009 are given in Tables 5.2.0a–5.2.0c and Figure 5.2.1. Total landings in Division Vb have in general been very stable since the 1950s varying between about 4000 and 7000 tonnes without any trend. The preliminary landings of ling in 2009 are 4630 tonnes, of which Norway took about 620 tonnes, Scotland about 270 tonnes and the Faroe Islands about 3740 tonnes.

The 2007–2009 Faroese landings (in %) by fleet were:

Year	Longliners <110 GRT	Longliners >110 GRT	OB trawlers <1000 HP	OB trawlers >1000 HP	Pairtrawlers <1000 HP	Pairtrawlers >1000 HP	Others
2007	9	48	2	19	5	15	2
2008	8	65	1	8	3	10	5
2009	3	56	1	3	5	30	2

5.2.3 ICES Advice

The latest Advice from ICES ACOM is from May 2008: ICES reiterates the Advice that effort should not be allowed to increase and to collect information that can be used to evaluate a long-term sustainable level of exploitation.

5.2.4 Management

For the Faroese fleets, there is no species-specific management of ling in Vb, although licenses are needed in order to fish. The main fleets targeting ling are each year allocated a total allowable number of fishing days to be used in the demersal fishery in the area. The minimum landing size is 60 cm. Other nations are regulated by TACs. Details on management measures in Faroese waters are given in Section 4.3.5.

5.2.5 Data available

Data on length, weights and age are available for ling from the Faroese landings; Table 5.2.1 gives an overview of the levels of sampling since 1996. There are also catch and effort data from logbooks for the Faroese longliners and pair trawlers. From the two annual Faroese groundfish surveys on the Faroe Plateau especially designed for cod, haddock and saithe biological data (length and weight) as well as catch and effort data are available. In addition, there are also data available on catch, effort and mean length from Norwegian longliners fishing in Faroese waters (WD by Helle *et al.*, 2009), but no such data were provided for 2008 and 2009.

5.2.5.1 Landings and discards

Landings were available for all relevant fleets. No estimates of discards of ling are available. But since the Faroese fleets are not regulated by TACs and there in addition is a ban on discarding in Vb, incentives for illegal discarding are believed to be low. The landings statistics are therefore regarded as being adequate for assessment purposes.

5.2.5.2 Length compositions

Length distributions for ling are available from the Faroese commercial landings (Figure 5.2.2) and two Faroese groundfish surveys designed for cod, haddock and saithe in Division Vb. There are also length distributions from the Norwegian longliners “reference fleet” for the period 2003–2005 (WGDEEP Report 2007). The length distributions for the Norwegian longliners fishing in Faroese waters, in the period 2003–2005, were almost identical to the ones for the Faroese longliners in the same period. A few length measurements for ling (N=74) from Russian longliners showed a higher length composition (WD by Vinnichenko *et al.*, 2009). The Faroese trawlers have about the same length distribution as the Faroese longliners.

5.2.5.3 Catch-at-age

Catch-at-age data were provided for Faroese landings in Vb 1996–2007 (WGDEEP Report 2008). No new catch-at-age data are available for 2008–2009. The age distribution in the sampling of commercial landings from longliners and trawlers are presented in Figure 5.2.3; these represent only the sampled individuals since they have not been raised to respective catches.

5.2.5.4 Weight-at-age

Mean weight-at-age data are provided for the Faroese fishery in Vb 1996–2007 (WGDEEP Report 2008). No new data are presented for 2008–2009.

5.2.5.5 Maturity and natural mortality

Ling become mature at ages 5–7 (60–75 cm lengths) in most areas, with males maturing at a slightly lower age than females (Magnusson *et al.*, 1997). No annual measurements of maturity-at-age were available and knife-edge maturity for age 7 and older has been assumed for previous assessments.

A natural mortality of 0.15 is assumed for all ages.

5.2.5.6 Catch, effort and research vessel data

<u>Commercial cpue series</u>. There are catch per unit effort (cpue) data available for three different commercial series, for Faroese longliners, Faroese pair trawlers and Norwegian longliners (Figures 5.2.4–5.2.5). It was no new data to update the Norwegian se-

ries to 2009. Both the Faeroese and the Norwegian cpue series indicate a positive trend since 2001.

The Faroese cpue data are from all available logbooks, for the period 1986–2009, from 6–10 pair trawlers (HP>1000) and 5 longliners (GRT>110). These data are stored in a database at the Faroe Marine Research Institute. The data are quality controlled and corrected if necessary. The effort obtained from the logbooks is estimated as number of fishing (trawling) hours from the trawlers, as 1000 hooks from the longliners and the catch as kg stated in the logbooks. The third series is data from the Norwegian longliners “reference fleet”.

Sets where they catch ling and the catch of ling and tusk combined represented more than 60% of the total catch and depth was >150 m were selected for the longliner cpue series. The bycatch series for ling from the Faroese pair trawlers > 1000 HP is limited to hauls where they catch ling and the catch of saithe is more than 60 % of the total catch in the haul and depth was >150 m.

Only the Faroese longline series (directed effort measured as number of 1000 hooks) has been used as tuning series in previous exploratory assessments.

Fisheries independent cpue series. Cpue estimates (kg/hour) for ling are available from two annual groundfish surveys on the Faroe Plateau designed for cod, haddock and saithe (Figure 5.2.6). Both surveys are restricted to the area on the Faroe Plateau and do as such not cover the whole distribution area for ling. These series have so far not been used for tuning because no age data are available.

The spring survey has been carried out in February–March since 1982 (100 fixed stations), and the summer survey in August–September since 1996 (200 fixed stations). For the spring survey, however, data are only available for the period 1994–2008 due to problems with extraction of older data from the database.

5.2.6 Data analyses

5.2.6.1 Cpue trends

The only information on abundance trends can be derived from the cpue data from the Faroese longliners and Norwegian longliners (Figure 5.2.4), from the Faroese pair trawlers (bycatch) (Figure 5.2.5) and from the Faroese groundfish surveys (Figure 5.2.6).

Norwegian longline cpue suggests a decline in abundance between 1973 and 1989 and appears to be relatively stable at a lower level thereafter. However, these estimates cannot be compared because of the switch from hand baited lines to autolines. The autoline was introduced to the Norwegian fleet in 1977, and most of the large vessels had installed it by 1985. The data used for the period 1972–1994 are, therefore, early on only hand baited lines, then a mix of both hand baited and autolines and finally only autolines. This is a very important change and correction factors for these changes are not available. During the hand baited period, the cpue estimates are very high, afterwards cpue declined during the transition period and finally when only autolines were employed, the cpue is at the same level as that of the new time-series.

Both the Faeroese and the Norwegian cpue series indicate a positive trend since 2001.

Norwegian and Faroese longliners are comparable and both have ling (and tusk) as target species.

5.2.6.2 Exploratory analysis

The 2007 WGDEEP Report show an analytical assessment exercise on ling in Vb (WGDEEP Report 2008). No new exercise has been attempted since.

5.2.6.3 Catch-at-age analysis

No new data.

5.2.7 Comments on assessment

No new assessment.

5.2.8 Management consideration

All available data indicate that the stock has not declined over all since the middle of the 1980s and there should be no need to change the advice given by ICES (ACOM) in May 2008: ICES reiterates the advice that effort should not be allowed to increase and to collect information that can be used to evaluate a long-term sustainable level of exploitation.

Table 5.2.0a. Ling in Vb1. Nominal landings (1988–2009).

Year	Denmark (2)	Faroes	France	Germany	Norway	E&W (1)	Scotland (1)	Russia	Total
1988	42	1383	53	4	884	1	5		2372
1989		1498	44	2	1415		3		2962
1990		1575	36	1	1441		9		3062
1991		1828	37	2	1594		4		3465
1992		1218	3		1153	15	11		2400
1993		1242	5	1	921	62	11		2242
1994		1541	6	13	1047	30	20		2657
1995		2789	4	13	446	2	32		3286
1996		2672			1284	12	28		3996
1997		3224	7		1428	34	40		4733
1998		2422	6		1452	4	145		4029
1999		2446	18	3	2034	0	71		4572
2000		2103	8	1	1305	2	61		3480
2001		2069	14	3	1496	5	99		3686
2002		1638	6	2	1640	3	239		3528
2003		2139	13	2	1526	3	215		3898
2004		2733	15	1	1799	3	178	2	4731
2005		2886	3		1553	3	175		4620
2006	3	3563	6		850		136		4558
2007	2	3004	8		1071		6		4091
2008		3354	4		740	32	25	11	4166
2009*		3471	2		419		270		4162

***Preliminary. (1) Includes Vb2. (2) Greenland.**

Table 5.2.0b. Ling in Vb2. Nominal landings (1988–2009).

Year	Faroes	France	Norway	Total
1988	832		1284	2116
1989	362		1328	1690
1990	162		633	795
1991	492		555	1047
1992	577		637	1214
1993	282		332	614
1994	479		486	965
1995	281		503	784
1996	102		798	900
1997	526		398	924
1998	511		819	1330
1999	164	4	498	666
2000	229	1	399	629
2001	420	6	497	923
2002	150	4	457	611
2003	624	4	927	1555
2004	1058	3	247	1308
2005	575	7	647	1229
2006	472	6	177	655
2007	327	4	309	640
2008	458	2	120	580
2009*	270	0	198	468

Table 5.2.0c. Ling in Vb. Nominal landings (1988–2009) (* preliminary data).

Year	Vb1	Vb2	Vb
1988	2372	2116	4488
1989	2962	1690	4652
1990	3062	795	3857
1991	3465	1047	4512
1992	2400	1214	3614
1993	2242	614	2856
1994	2657	965	3622
1995	3286	784	4070
1996	3996	900	4896
1997	4733	924	5657
1998	4029	1330	5359
1999	4572	666	5238
2000	3480	629	4109
2001	3686	923	4609
2002	3528	611	4139
2003	3898	1555	5453
2004	4731	1308	6039
2005	4620	1229	5849
2006	4558	655	5213
2007	4091	640	4731
2008	4166	580	4731
2009*	4162	468	4630

***Preliminary.**

Table 5.2.1. Ling in Vb. Overview of the sampling of the commercial landings.

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lengths	6399	7900	5912	4536	3512	3805	4299	6585	6827	7167	6503	4031	2579	4605
Weights	410	541	538	360	360	420	180	360	1169	3217	4038	1713	1945	4348
Ages	1084	1526	1081	480	360	420	300	661	659	540	276	120	60	232

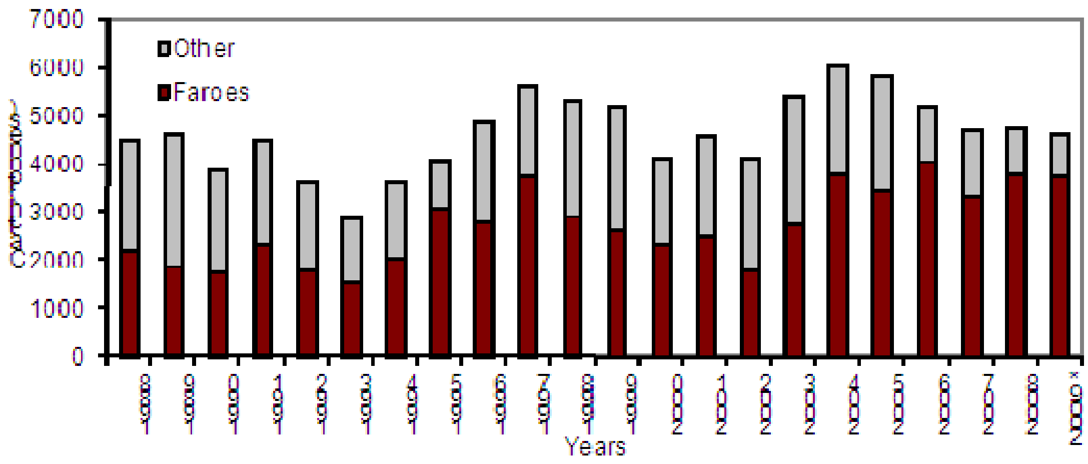


Figure 5.2.1. Ling in Vb. Nominal landings (thousand tonnes) 1988-2009 (* preliminary data).

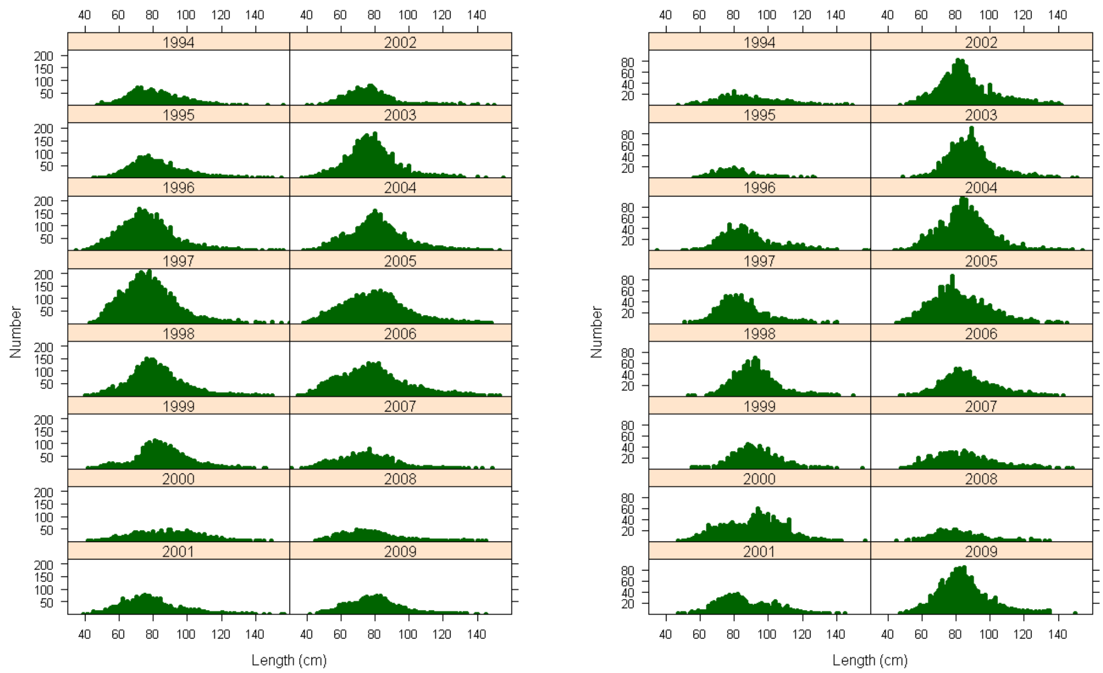


Figure 5.2.2. Ling in Vb. Length distributions in the sampling of the landings from Faroese longliners >110 GRT (left) and pair trawlers > 1000 HP (right). The numbers on the y-axes do not reflect the total catches and should only be regarded as relative values for each year separately; the length range can however be compared from year to year.

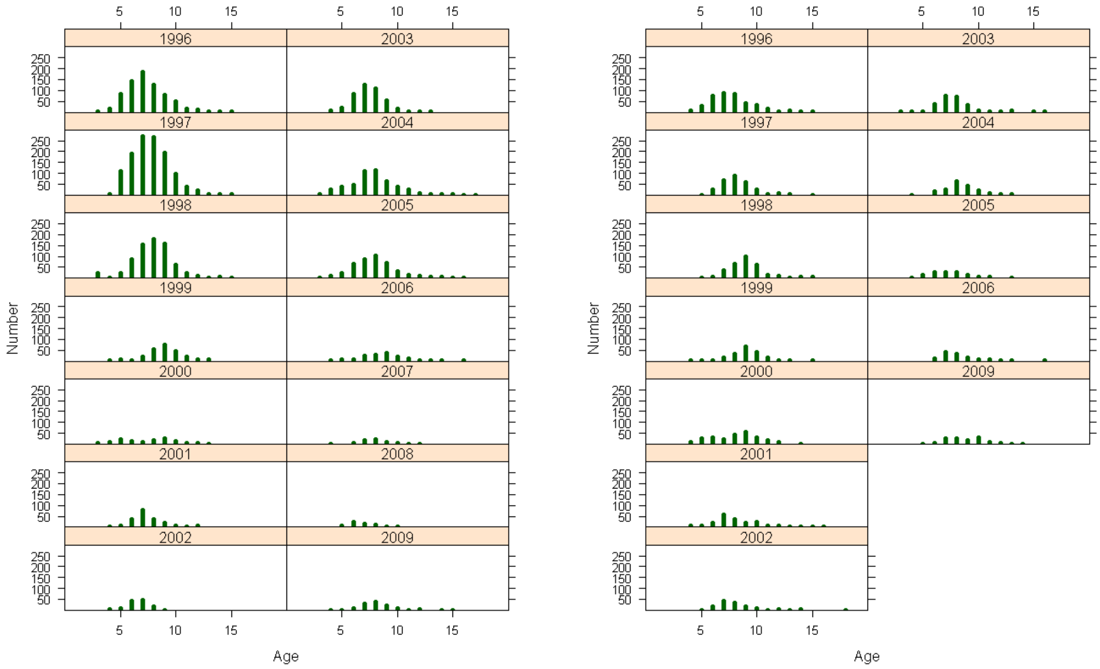


Figure 5.2.3. Ling in Vb. Age distribution in the landings from Faroese longliners >110 GRT (left) and pair trawlers >1000 HP (right, no age information for 2007–2008). The numbers on the y-axes do not reflect the total catches and should only be regarded as relative values for each year separately; the age range can however be compared from year to year.

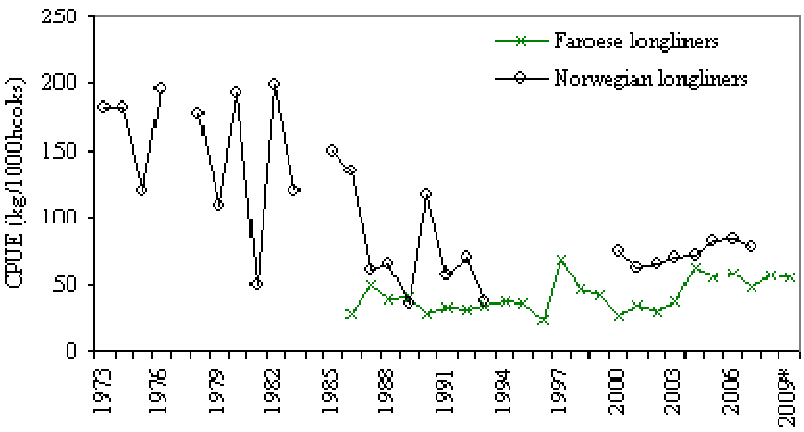


Figure 5.2.4. Ling in Vb. Cpue (kg/1000 hooks) from Faroese longliners >110 GRT and Norwegian-longliners (* preliminary data).

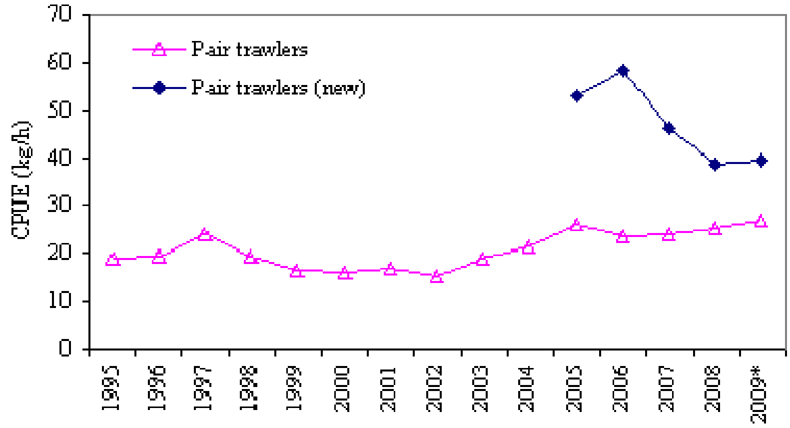


Figure 5.2.5. Ling in Vb. Cpue (kg/hour) from Faroese pair trawlers (bycatch serie) (* preliminary data). Pair trawlers- are the one that have been in the fleet for a long time and pair trawlers (new)- are the ones that are newbuilt and have a higher capacity.

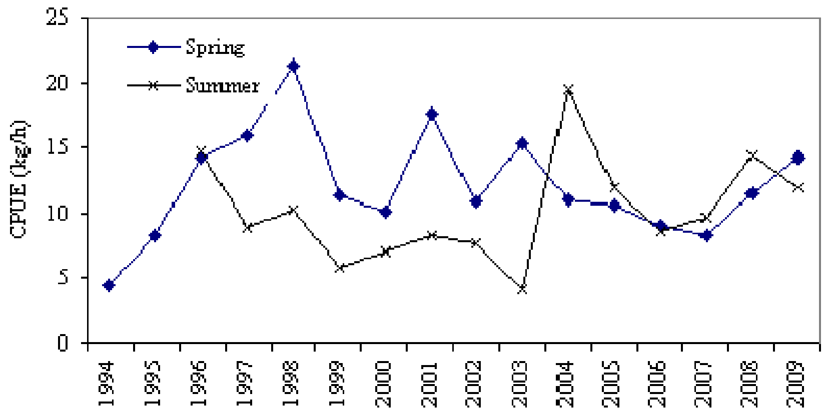


Figure 5.2.6. Ling in Vb. Cpue (kg/h) in the two annual Faroese groundfish surveys on the Faroe Plateau designed for cod, haddock and saithe.

5.3 Ling (*Molva Molva*) in Subareas I and II

5.3.1 The fishery

Ling has been fished in these Subareas for centuries, and the historical development is described in, e.g. Bergstad and Hareide (1996). In particular, the post-World War II increase in catch, because of a series of technical advances, is well documented. Currently the major fisheries in Subareas I and II are the Norwegian longline and gillnet fisheries, but there are also bycatches by other gears, i.e. trawls and handlines. Around 50% of the Norwegian landings are taken by longlines and 45% by gillnets, partly in the directed ling fisheries and partly as bycatch in fisheries for other groundfish. Other nations catch ling as bycatch in their trawl fisheries.

5.3.2 Landings trends

Landing statistics by nation in the period 1988–2009 are in Tables 5.3.0a–d. During the period 2000–2005 the landings varied between 6000 and 7000 tonnes, which are about the same catches as in the preceding decade. In 2007 and 2008 the landings increased to over 10 000 tonnes. Preliminary landings for 2009 show a decrease to 8086 tonnes. This decrease is occurs at the same time as increased quotas of Arctio-Norwegian cod and is likely to result from vessels switching to targeting cod (Figure 5.3.1).

5.3.3 ICES Advice

ICES Advice in 2008 was: *Cpue in Areas I and II has been at a reduced level. ICES reiterates the Advice to constrain catches to 6000 t and to collect information that can be used to evaluate a long-term sustainable level of exploitation.*

5.3.4 Management

There is no quota set for the Norwegian fishery for ling but the vessels participating in direct catch for ling and tusk in Subareas I and II are required to have a specific licence. This licensing scheme combined with regulations aimed at other groundfish species, e.g. cod and haddock (see Section 4.2.1) has resulted in a large decrease in fishing vessels and hence the fishing pressure on ling. The quota for the EU in Areas I and II in the Norwegian zone for bycatch species such as ling and tusk is in 2010 set to 5000 tons. There is no minimum landing size in the Norwegian EEZ. The quota for the EU in Areas I and II in the Norwegian zone (Norwegian exclusive stocks) for bycatch species such as ling and tusk is in 2010 set to 350 tonnes.

The quota in EU and international waters was set at 38 tonnes in 2010.

5.3.5 Data available

5.3.5.1 Landings and discards

Landings were available for all relevant fleets. New discard data were not available, but within the Norwegian EEZ discarding is prohibited and assumed to be minor.

5.3.5.2 Length compositions

Length compositions and mean lengths from 1976 to the present, based on data from Norwegian longliners, are in Bergstad and Hareide, (1996); Helle and Pennington, WD6, 2007 and Helle *et al.*, WD 2, 2009. During this period the mean length has varied around 86 cm without any clear trend.

5.3.5.3 Age compositions

No new age compositions were available.

5.3.5.4 Weight-at-age

No new data were presented.

5.3.5.5 Maturity and natural mortality

No new data were presented.

5.3.5.6 Catch, effort and research vessel data

Catch and effort data for Norwegian longliners were presented (Figure 7.3.2). No research vessel data were available.

The extensive Norwegian longliner cpue data based on private skippers' logbooks presented in the 1996 Report of SGDEEP were not updated after 1994. In order to resume the cpue-series Norway started in 2001 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2009 (only seven logbooks have been entered for 2009 and the estimates are therefore preliminary). Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 tonnes in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day.

An analyses based on these data is in Helle and Pennington, WD, 2010.

5.3.6 Data analyses

No analytical assessments were done.

The only source of information on abundance trends was the cpue series from the Norwegian longliners presented by Helle and Pennington (WD, 2010). The number of longliners has declined in recent years (Table 5.3.1.), from 72 to 34 in the period 2000–2009. The numbers of fishing days per vessel have remained relatively stable during the last years. (Table 5.3.2). The number of hooks set per day and the total set per year has had a slight increase over the period 2000–2009 in Subareas I and II (Table 5.3.3 and 5.3.4).

Table 5.3.5 gives estimates of cpue based on the Norwegian official logbooks. In Figure 7.3.1. the data for 2000–2009 are shown together with the data for the period 1971–1994 (considered earlier by WGDEEP and presented in Bergstad and Hareide, 1996). There is a gap in the time-series between 1995 and 2000, and due to data limitations, it was not possible to estimate cpue for all years in the early period.

In earlier reports the new data has been compared with the historic time-series. These estimates cannot be compared because of the switch from hand baited lines to autolines. The autoline was introduced to the Norwegian fleet in 1977, and most of the large vessels had installed it by 1985. The data used for the period 1972–1994 are, therefore, early on only hand baited lines, then a mix of both hand baited and autolines and finally only autolines. This is a very important change and correction factors for these changes are not available. During the hand baited period, the cpue estimates are very high, afterwards cpue declined during the transition period and finally when only autolines were employed, the cpue is at the same level as that of the new time-series.

Comments on the assessment

The historical data show no apparent trend while the new series starting in 2000 show a clear upward trend for the period 2001–2009. However, these estimates cannot be compared because of the switch from hand baited lines to autolines.

The cpue series used in this assessment are derived from longline fisheries and it has been uncertain whether the fisheries were targeting ling or other species. After suggestions from the fishermen two possible solutions were tested. The first was to base the cpue series on all catches for which either ling or tusk made up more than 30% of the total catch. The second method was to use only the catches for which tusk and ling together made up more than 50% of the total catch. The new cpue series are shown in Helle and Pennington, WD 2010. These estimates show that ling to a very large degree is a bycatch species in Area IIa (Figure 5.3.3.) Figure 5.3.4 shows the percent of day catches when ling was targeted (>30% of the total day catch).

5.3.7 Management considerations

Legislation enacted since 2000 for regulating the cod fishery caused a continuous reduction in the number of longliners in the fishery for tusk, ling and blue ling and by 2009 there were only 34 vessels above 21 m in the fishery. Because of the reduction; in number of vessels (52% reduction since 2000), the total number of hooks employed (22% reduction since 2002) and the total number of weeks fished (41% since 2001–2002), it is quite clear that there has been a significant reduction in effort (for details see Helle and Pennington, WD 2010). The decrease in total effort occurred even though there was an increase in the number of hooks set per vessel/day, and it is quite likely that the amount of applied effort has been reduced to the 1998-level.

Table 5.3.0a. Ling I. WG estimates of landings.

Year	Norway	Iceland	Scotland	Faroes	Total
1996	136				136
1997	31				31
1998	123				123
1999	64				64
2000	68	1			69
2001	65	1			66
2002	182		24		206
2003	89				89
2004	323			22	345
2005	107				107
2006	58				58
2007	96				96
2008	55				55
2009	236				236

***Preliminary**

Table 5.3.0b. Ling IIa. WG estimates of landings.

Year	Faroes	France	Germany	Norway	E & W	Scotland	Russia	Ireland	Total
1988	3	29	10	6070	4	3			6119
1989	2	19	11	7326	10	-			7368
1990	14	20	17	7549	25	3			7628
1991	17	12	5	7755	4	+			7793
1992	3	9	6	6495	8	+			6521
1993	-	9	13	7032	39	-			7093
1994	101	n/a	9	6169	30	-			6309
1995	14	6	8	5921	3	2			5954
1996	0	2	17	6059	2	3			6083
1997	0	15	7	5343	6	2			5373
1998		13	6	9049	3	1			9072
1999		12	7	7557	2	4			7581
2000		9	39	5836	5	2			5891
2001	6	9	34	4805	1	3			4858
2002	1	4	21	6886	1	4			6917
2003	7	3	43	6001		8			6062
2004	15	0	3	6114		1	5		6138
2005	6	5	6	6085	2		2		6106
2006	9	8	6	8685	6	1	11		8726
2007	18	6	7	9970	1	0	55	1	10 058
2008	22	4	7	11 040	1	1	29	0	11 104
2009	10	2	7	8041	0	9	17		8086

***Preliminary**

Table 5.3.0c. Ling IIb. WG estimates of landings.

Year	Norway	E & W	Faroes	Total
1988		7		7
1989		-		
1990		-		
1991		-		
1992		-		
1993		-		
1994		13		13
1995		-		
1996	127	-		127
1997	5	-		5
1998	5	+		5
1999	6			6
2000	4	-		4
2001	33	0		33
2002	9	0		9
2003	6	0		6
2004	77			77
2005	93			93
2006	64			64
2007	180		0	180
2008	162	0	0	161
2009	84			84

***Preliminary**

Table 5.3.0d. Ling I and II. Total landings by subareas or Divisions.

Year	I	IIa	IIb	All areas
1988		6119	7	6126
1989		7368		7368
1990		7628		7628
1991		7793		7793
1992		6521		6521
1993		7093		7093
1994		6309	13	6322
1995		5954		5954
1996	136	6083	127	6346
1997	31	5373	5	5409
1998	123	9072	5	9200
1999	64	7581	6	7651
2000	69	5891	4	5964
2001	66	4858	33	4957
2002	206	6917	9	7132
2003	89	6062	6	6157
2004	345	6138	77	6560
2005	107	6106	93	6306
2006	58	8726	64	8848
2007	96	10 058	180	10 334
2008	80	11 104	161	11 345
2009*	236	8086	84	8406

*** Preliminary**

Table 5.3.1 Summary statistics for the Norwegian longliner fleet during the period 1995–2008 (vessels exceeding 21 m). This list only includes vessels that landed 8 tonnes or more of ling, blue ling and tusk in a given year.

Year	Number of longliners
1995	65
1996	66
1997	65
1998	67
1999	71
2000	72
2001	65
2002	58
2003	52
2004	43
2005	39
2006	35
2007	38
2008	36
2009	42

Table 5.3.2 Estimated number of days that the Norwegian longliner fleet (selected using criteria described in the text) operated in Subareas I and II in the period 2000–2007.

Ling	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
IIa	23	40	50	40	37	51	54	65	52	61

Table 5.3.3. Estimated number of hooks that the Norwegian longliners set per day in Subarea I and II in the fishery for tusk, ling and blue ling during the period 2000–2007. n= the total number of days with hook information contained in the logbooks.

All	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009	
	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n
I	31 688	353	33 325	163	35 432	263	35 045	376	32 431	433	32 671	316	33 182	187	34 380	318	36833	96	40018	113
IIa	31 439	1916	30 703	2196	33 431	2031	34 766	1839	33 475	1389	32 861	1248	35 140	1252	35 207	2103	36890	1500	37727	604
IIb	35 409	71	34 638	315	34 756	45	34 776	67	31 859	217	35 082	207	39 298	57	37 881	328	39650	297	41300	30

Table 5.3.4. Estimated total number of hooks (in thousands) the Norwegian longliner fleet used in Subareas I and II for the years 2000–2007 in the fishery for tusk, ling and blue ling.

All	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
I	20 534	10 831	20 551	21 868	27 891	29 306	12 775,07	19 081	9282	21770
IIa	117 708	127 724	143 486	131 972	107 957	103 808	89 783	131 569	119524	111596
IIb	5099	20 263	4032	5425	15 069	19 155	4126	29 434	25693	5617

Table 5.3.5. Estimated mean cpue ([kg/hook]x1000) in IIa based on logbook data. Standard error (se) and number of catches sampled (n) is also given.

All vessels submitting logbooks.

Ling																														
	2000			2001			2002			2003			2004			2005			2006			2007			2008			2009		
Area	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se
IIA	23,93	1064	0,7	21,9	1352	0,6	24,2	1345	0,5	29,1	925	0,7	37,3	630	0,9	49,8	775	1,1	42,34	928	0,9	40,03	1334	0,6	47,57	859	0,9277	58,82	426	1,6753

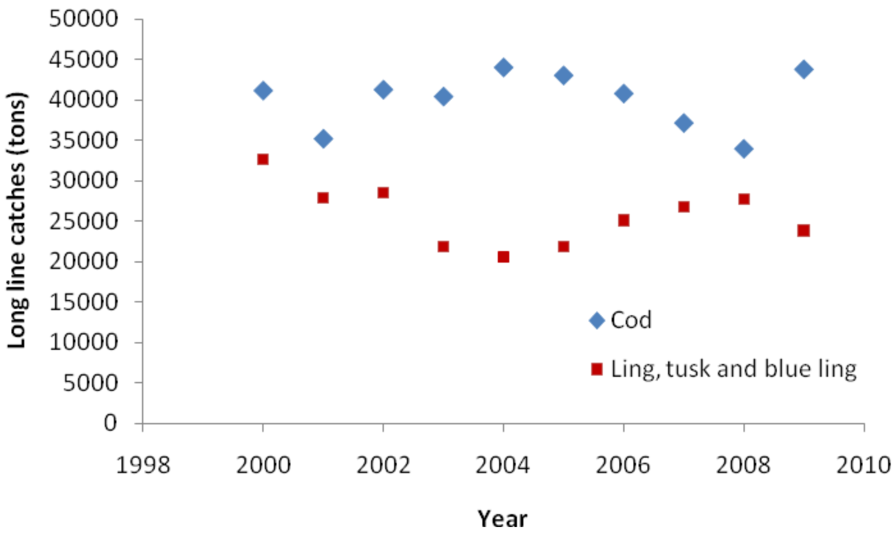


Figure 5.3.1. Total catch by the longliners of cod (diamonds) and the combined total catch of ling, tusk and blue ling (squares) Helle and Pennington, WD 2010.

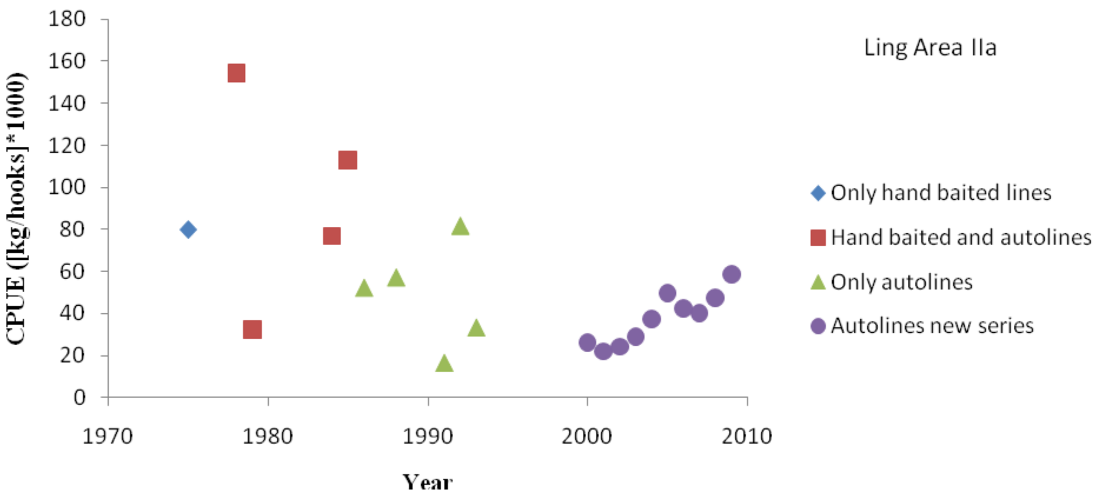


Figure 5.3.2. Ling in IIa. Estimates of cpue (kg/1000 hooks) based on skipper's logbooks (pre-2000) and official logbooks (post-2000). Combination of data from Bergstad and Hareide, 1996 and WD by Helle and Pennington., 2010 (preliminary estimates for 2009). The data used for the period 1971–1993 are, early on only hand baited lines (blue diamonds), then a mix of both hand baited and autolines (red squares) and finally only autolines (green triangles). The new dataseries is denoted by purple circles.

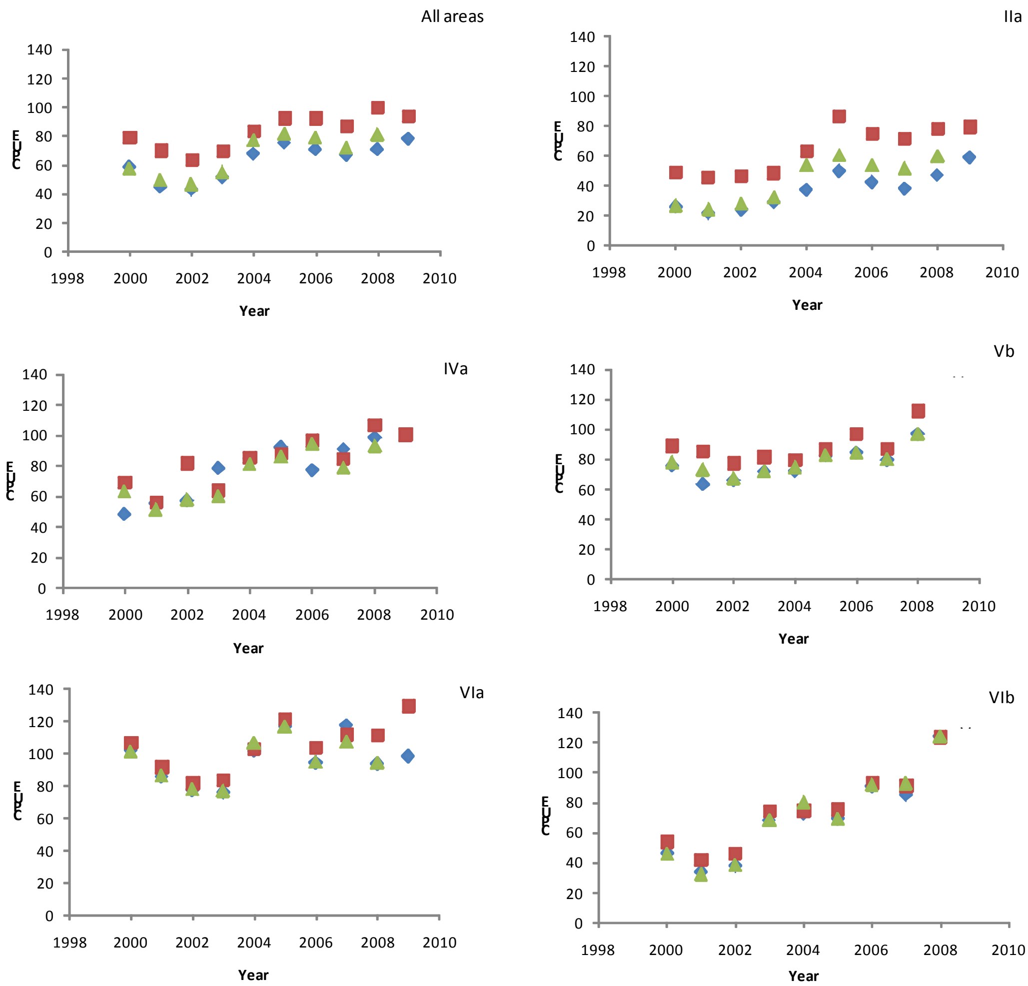


Figure 5.3.3. Cpue estimates for ling using all available data (blue diamonds), cpue estimates based on data if the total day catches of ling and tusk exceeded 50% (green triangles) and cpue estimates if the total day catches of ling exceeded 30% (red squares).

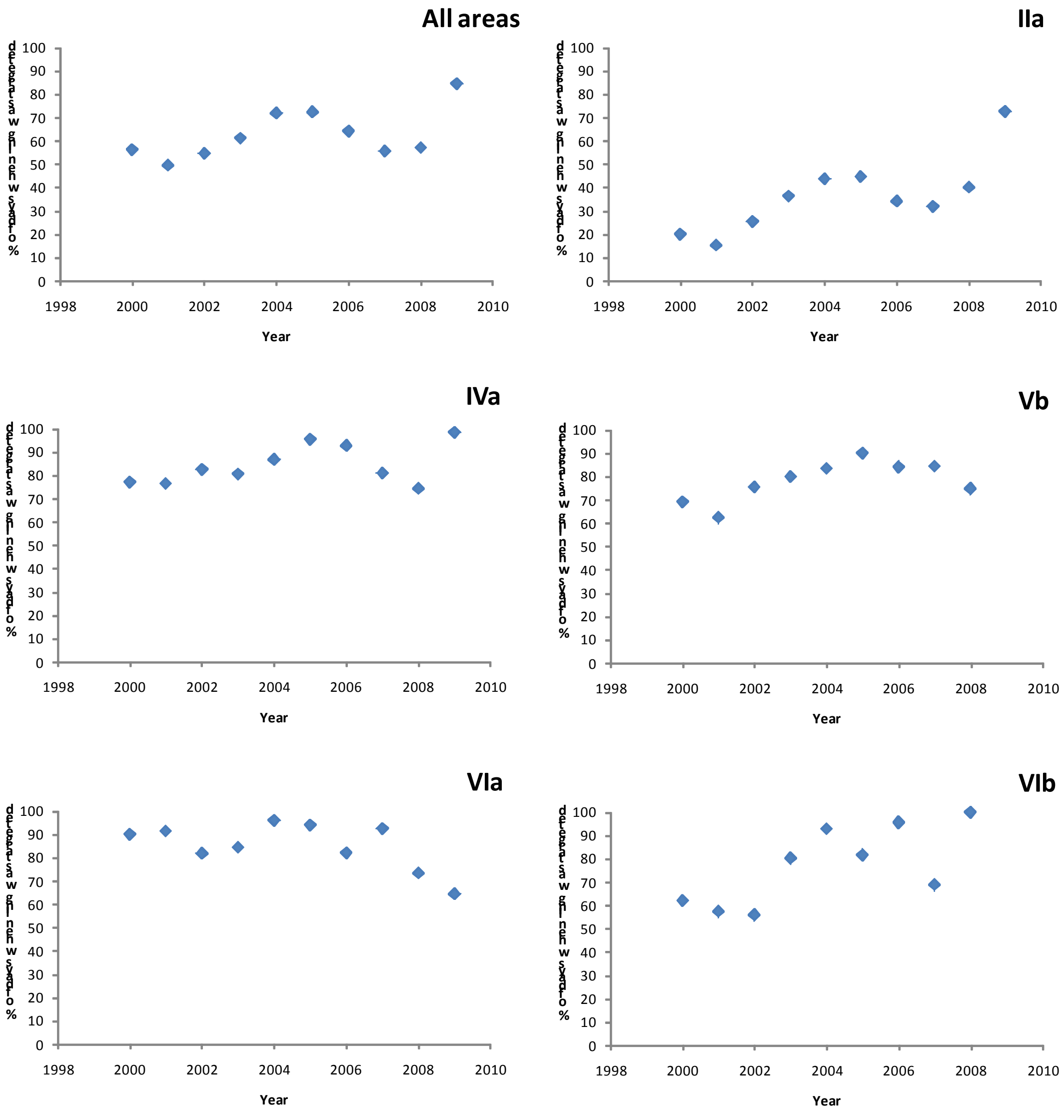


Figure 5.3.4. Percent of day catches when ling was targeted (>30% of the total day catch) (estimates for 2009 are preliminary).

5.4 Ling (*Molva Molva*) in Division Va

5.4.1 The fishery

The fishery for ling in Va has not changed substantially in recent years. Around 150 longliners annually report catches of ling, around 70 gillnetters and a similar number of trawlers (Table 5.4.1). Most of ling in Va is caught on longlines and the proportion caught by that gear has increased since 2000 to around 65% in 2009. At the same time the proportion caught by gillnets has decreased from 20–30% in 2000–2001 to 6–8% in 2008–2009. Catches in trawls have varied less and have been at around 20% of Icelandic catches of ling in Va (Table 5.4.2).

A minor change in the ling fishery in Va is that the longline fishery has changed from a bycatch fishery in 2000–2005 to a mixed fishery since then (Figure 5.4.1}). This change is most likely a result of increased abundance of ling in Va in recent years.

Most of the ling caught in Va by Icelandic longliners is caught at depths less than 300 meters and less than 500 meters by trawlers. The main fishing grounds for ling in Va as observed from logbooks are on the south, southwestern and western part of the Icelandic shelf (Figure 5.4.2). The main trend in the spatial distribution of ling catches in Va according to logbook entries is the decreased proportion of catches caught in the southeast and increased catches on the western part of the shelf. Around 40% of ling catches are caught on the southwestern part of the shelf (Figure 5.4.3).

5.4.2 Landings trends

In the 1950s until 1970 the total landings of Ling in Va amounted to 10 000 to 16 000 tonnes annually of which more than half was usually caught by foreign fleets. This changed with the extension of the Icelandic EEZ in the early 1970s when total landings fell to 4000–8000 tonnes of which the Icelandic fleet caught the main share. Between 1980 and 2000 catches varied between 3200 to 5800 tonnes. Since 2001 catches have increased substantially year on year and in 2009 amounted to 10 942 tonnes (preliminary). Of that Icelandic vessels caught 9613 tonnes or 92% of the total catches (Table 5.4.3).

5.4.3 ICES Advice

The latest Advice is from ICES in May 2008. ICES recommends constraining catches to 7500 t (recent average 2006–2007) and to collect information that can be used to evaluate a long-term sustainable level of exploitation.

5.4.4 Management

The Icelandic Ministry of Fisheries and Agriculture is responsible for management of the Icelandic fisheries and implementation of the legislation. The Ministry issues regulations for commercial fishing for each fishing year (1 September–31 August), including an allocation of the TAC for each stock subject to such limitations. Ling in Va has been managed by TAC since the 2001/02 fishing year.

Landings have exceeded both the advice given by MRI and the set TAC in all fishing years except 2001/02 (Table 5.4.4). The reasons for the implementation errors are transfers of quota share between fishing years, conversion of TAC from one species to another and catches by Norway and the Faroe Islands by bilateral agreement. The level of those catches is known in advance but not taken into consideration by the Ministry when allocating TAC to Icelandic vessels. There is no minimum landing size for ling in Va.

5.4.5 Data available

5.4.5.1 Landings and discards

Landings by Icelandic vessels are given by the Icelandic Directorate of Fisheries. Landings of Norwegian and Faroese vessels are given by the Icelandic Coast Guard. Discard is banned by law in the Icelandic demersal fishery and at present there is no information on ling discards.

5.4.5.2 Length compositions

An overview of available length measurements is given in Table 5.4.5.. Most of the measurements are from longlines, number of available length measurements have been increasing in recent years in line with increased landings.

Length distributions from the Icelandic longline fleet are presented in Figure 5.4.4. Mean length decreased from 2000 to 2008 from around 91 cm to 79 cm. However mean length increased in 2009 in the longline fishery to around 86 cm.

5.4.5.3 Age compositions

No data available. Otoliths have been collected randomly from the catch since 1980s, but no age readings have been done since 1998. Table 5.4.6 gives an overview of the un-aged otoliths collection in MRI-storage since 2000.

5.4.5.4 Weight-at-age

No data available.

5.4.5.5 Maturity and natural mortality

At 60 cm around 10% of ling in Va is mature, at 75 cm 50% of ling is mature and at 100 cm more or less every ling is mature. Ling is a relatively slow growing species, mean length in catch is around 80 cm which according to available ageing means that it is approximately eight years old.

No information is available on natural mortality of ling in Va.

5.4.5.6 Catch, effort and research vessel data

Catch per unit of effort and effort data from the commercial fleets

Figures 5.4.5 and 5.4.6 show catch per unit effort (cpue) and effort in the Icelandic longline fishery. The cpue is calculated using all longline data where catches of the species were registered, with no standardization attempted. The cpue estimates of ling in Va are not considered representative of stock abundance because they don't take account of changes in fishing technology.

Icelandic survey data

Indices: The Icelandic spring ground-fish survey, which has been conducted annually in March since 1985, gives trends on fishable biomass of many exploited stocks on Icelandic fishing grounds. In total, about 550 stations are taken annually at depths down to 500 meters. The survey area does cover the most important distribution area of the ling fishery. Figure 5.4.7 shows both a recruitment index and the trends in biomass. Survey length distributions are shown in Figures 5.4.8 (abundance) and 5.4.9 (biomass).

In addition, the autumn survey was commenced in 1996 covering 150 stations of the 550 stations that have been taken in the spring survey (i.e. shallower than 500 m).

From its commencement in 1996 to 1999 an additional 150 stations were taken in deeper waters off the west, north, east and southeast continental slopes off Iceland (primarily targeting Greenland halibut). In 2000, 69 stations were added to the survey, covering the continental slopes to the south of Iceland and the Reykjanes ridge. Thus since 2000, the autumn survey has consisted of 369 stations, covering the continental shelf and slopes of Icelandic waters, to a depth down to 1200 m. Figure 5.4.7 shows both a recruitment index and the trends in various biomass indices all of which have been increasing in recent years.

Changes in spatial distribution as observed in surveys: According to the spring survey most of the increase in recent years in ling abundance is in the western area, however an increase can be seen in most areas (Figure 5.4.10). A similar pattern is observed in the autumn survey (Figure5.4.11).

5.4.6 Data analyses

The decrease in mean length from commercial catches since 2000 is likely the result of increased abundance of smaller fish (as observed in the spring survey, see later), rather than being a result of increasing targeting of smaller fish (Figure 5.4.4). The increase in 2009 may therefore be the result of growth rather than change in the fishery.

Ling commercial cpue has been relatively stable over the time period since 1991, with the highest observed values in the last three years (Figures 5.4.5 and 5.4.6). There are however very few recordings of ling where ling is more than a small fraction of the total catches in each set. The cpue data are thus considered to be a poor reflector of stock dynamics.

Ling in both in the spring and autumn surveys are mainly found in the deeper waters south and west off Iceland. Both the total biomass index and the index of the fishable biomass (>40 cm) in the March survey declined by half from the late 1980s to 1989, but gradually decreased until 1995 (Figures 5.4.7a and b). In the years 1995 to 2003 these indices were half of the mean from 1985–1989. In 2003 to 2007, the indices increased sharply and to their highest observed value in 2007 or about 2 times higher than that observed in the late 1980s. The indices then fell sharply again in 2008 and 2009 and are at present at a similar level as in the late 1980s. The index of the large ling (90 cm and larger) shows similar trend as the total biomass index (Figure5.4.7 c). The recruitment index of ling, defined here as ling smaller than 40 cm, also showed a similar increase in 2003 to 2007 and has since then decreased by around 25% from its record high in 2007 (Figure 5.4.7d). The consistently high indices in the spring survey in 2007 suggest that it may have been an outlier because of unexplained changes in catchability rather than actual change in stock size.

The shorter autumn survey shows that biomass indices were low from 1996 to 2000, but have increased since then (Figures 5.4.7 a, b, c). There is a consistency between the two survey series except the autumn survey biomass indices are still increasing in most recent years. All so there is an inconsistency in the recruitment indices (<40 cm), where the autumn survey show much lower recruitment, in absolute term compared with the spring survey (Figure 5.4.7d). This discrepancy is likely a result of much lower catchability of small ling (due to different gears) in the autumn survey, where ling less than 40 cm has rarely been caught.

Due to the above mentioned problems with the cpue series and the overall consistency in the survey indices, the Working Group has concluded that the fishery independent data are the best indicator of stock trends of ling. Although the spring survey may not cover the full distributional depth range of ling in Icelandic waters, it has in the past been used as the basis of the ICES Advice, since it covers longer historical time span than the autumn survey.

The relative changes relative fishing mortality(Fproxy = Yield/Survey biomass) for ling in Va (Figure 5.4.12) indicates that Fproxy increased in the period from 1985 until 2000, but may have declined from 2001 to 2002 and remained fairly constant until 2008 (2007 survey year an outlier). However in 2009 the Fproxy seems to have increased sharply again to a similar level as it was highest in the late 1990s early 2000s.

5.4.7 Comments on the assessment

No analytical assessment was conducted but Ling in Va might be a suitable candidate for the GADGET model which is currently being applied to Tusk in Va. Both the Icelandic March and October surveys series suggest that ling abundance increased considerably in the period 2001–2007. The spring survey indicates a considerable drop in biomass since 2007 to a level similar to that observed in the late 1980s. It should be noted that the 2007 survey indices may be an artefact of changed catchability in that year.

As mentioned in Section 5.4.6, the group suggest using survey indices as indicators of stock trends.

5.4.7.1 Management considerations

The biomass indices from the March ground-fish survey for the years 1985 to 2009 shows a clear increase since 2001 to 2007 when they were around two times higher than the survey indices in 1986. Since then the biomass indices have decreased to a similar level as in 1986.

Ling is caught in a mixed fishery by longliners and as a bycatch in the Icelandic trawl fishery that is mainly directed at cod.

Landings consistently exceeding set TAC are of concern in the management of ling in Va.

Table 5.4.1. Ling in Va. Number of Icelandic boats participating in the ling fishery in Va.

YEAR	LONGLINERS	GILLNETTERS	TRAWLERS
2000	159	88	67
2001	144	113	57
2002	128	92	55
2003	136	73	53
2004	142	66	68
2005	151	60	72
2006	167	51	81
2007	155	58	77
2008	138	42	77
2009	140	46	67

Table 5.4.2. Percentage of ling catches by gear type of the Icelandic fleet.

Gear	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Longlines	48.0	38.0	45.0	61.7	54.0	45.2	59.5	61.3	64.7	64.8
Gillnets	21.9	36.9	22.9	12.7	14.6	11.7	10.0	9.5	6.2	7.5
Trawls	22.7	17.2	23.3	16.2	17.6	25.1	19.8	21.2	19.5	16.0
Other	7.4	7.9	8.8	9.4	13.8	18.1	10.8	8.0	9.7	11.7

Table 5.4.3. Ling in Va. Nominal landings in Source STATLANT database.

Year	Belgium	Faroe	France	Germany	Iceland	Norway	UK	Total
1973	1080	984	0	586	3564	418	829	7461
1974	681	890	0	486	3868	318	532	6775
1975	736	732	23	375	3748	522	562	6698
1976	431	498	0	404	4538	502	268	6641
1977	442	613	0	254	3433	506	0	5248
1978	541	534	0	0	3439	484	0	4998
1979	508	536	0	0	3759	399	0	5202
1980	445	607	0	0	3149	423	0	4624
1981	196	489	0	0	3348	415	0	4448
1982	116	524	0	0	3733	612	0	4985
1983	128	644	0	0	4256	115	0	5143
1984	103	450	0	0	3304	21	0	3878
1985	59	384	0	0	2980	17	0	3440
1986	88	556	0	0	2946	4	0	3594
1987	157	657	0	0	4161	6	0	4981
1988	134	619	0	0	5098	10	0	5861
1989	95	614	0	0	4896	5	0	5610
1990	42	399	0	0	5153	0	0	5594
1991	69	530	0	0	5206	0	0	5805
1992	34	526	0	0	4556	0	0	5116
1993	20	501	0	0	4333	0	0	4854
1994	3	548	0	0	4049	0	0	4600
1995	0	463	0	0	3729	0	0	4192
1996	0	358	0	0	3670	20	0	4048
1997	0	299	0	0	3634	0	0	3933
1998	0	699	0	0	3603	0	0	4302
1999	0	500	0	0	3973	120	1	4594
2000	0	0	0	0	3196	67	3	3266
2001	0	362	0	2	2852	116	1	3333
2002	0	1629	0	0	2779	45	0	4453
2003	0	565	0	2	3855	108	5	4535
2004	0	739	0	1	3721	139	0	4600
2005	0	682	0	1	4311	180	20	5194
2006	0	960	0	1	6283	158	0	7402
2007	0	807	0	0	6592	185	0	7584
2008	0	1366	0	0	7736	176	0	9278
2009	0	1157	0	0	9613	172	na	10 942

Table 5.4.4. Ling in Va. Advice given by MRI, set national TAC by the Ministry of Fisheries and Agriculture and landings by fishing year (1 September–31 August). Landings for 2008/09 are preliminary.

FISHING	MRI	NATIONAL	LANDINGS
year	advice	TAC	
1999/00			3961
2000/01			3451
2001/02	3000	3000	2968
2002/03	3000	3000	3715
2003/04	3000	3000	4608
2004/05	4000	4000	5238
2005/06	4500	5000	6961
2006/07	5000	5000	7617
2007/08	6000	7000	8560
2008/09	6000	7000	10 489
2009/10	6000	7000	

Table 5.4.5. Ling in Va. Number of available length measurements from Icelandic commercial catches.

YEAR	LONGLINES	GILLNETS	D. SEINE	TRAWLS	LOBSTER TR.	TOTAL
2000	1624	566	0	383	0	2573
2001	1661	493	0	37	0	2191
2002	1504	366	0	221	0	2091
2003	2404	300	0	137	143	2984
2004	2640	348	46	141	0	3175
2005	2323	31	101	349	150	2954
2006	3354	645	0	1157	401	5557
2007	3531	0	76	400	0	4007
2008	5847	357	15	819	150	7188
2009	8445	410	0	366	450	9671

Table 5.4.5. Ling in Va. Number of available otoliths from Icelandic commercial catches.

YEAR	LONGLINES	GILLNETS	D. SEINE	TRAWLS	LOBSTER TR.	TOTAL
2000	650	200	0	150	0	1000
2001	550	193	0	37	0	780
2002	519	166	0	150	0	835
2003	900	100	0	100	50	1150
2004	750	100	46	100	0	996
2005	750	0	0	181	50	981
2006	1137	288	0	450	100	1975
2007	1250	0	50	100	0	1400
2008	1950	150	0	315	50	2465
2009	2350	150	0	200	150	2850

Table 5.4.1. Ling. Landings in ICES Division Va. Source: STATLANT database.

Year	Belgium	Faroe	France	Germany	Iceland	Norway	UK	Total
1973	1080	984	0	586	3564	418	829	7461
1974	681	890	0	486	3868	318	532	6775
1975	736	732	23	375	3748	522	562	6698
1976	431	498	0	404	4538	502	268	6641
1977	442	613	0	254	3433	506	0	5248
1978	541	534	0	0	3439	484	0	4998
1979	508	536	0	0	3759	399	0	5202
1980	445	607	0	0	3149	423	0	4624
1981	196	489	0	0	3348	415	0	4448
1982	116	524	0	0	3733	612	0	4985
1983	128	644	0	0	4256	115	0	5143
1984	103	450	0	0	3304	21	0	3878
1985	59	384	0	0	2980	17	0	3440
1986	88	556	0	0	2946	4	0	3594
1987	157	657	0	0	4161	6	0	4981
1988	134	619	0	0	5098	10	0	5861
1989	95	614	0	0	4896	5	0	5610
1990	42	399	0	0	5153	0	0	5594
1991	69	530	0	0	5206	0	0	5805
1992	34	526	0	0	4556	0	0	5116
1993	20	501	0	0	4333	0	0	4854
1994	3	548	0	0	4049	0	0	4600
1995	0	463	0	0	3729	0	0	4192
1996	0	358	0	0	3670	20	0	4048
1997	0	299	0	0	3634	0	0	3933
1998	0	699	0	0	3603	0	0	4302
1999	0	500	0	0	3973	120	1	4594
2000	0	0	0	0	3196	67	3	3266
2001	0	362	0	2	2852	116	1	3333
2002	0	1629	0	0	2779	45	0	4453
2003	0	565	0	2	3855	108	5	4535
2004	0	739	0	1	3721	139	0	4600
2005	0	682	0	1	4311	180	20	5194
2006	0	960	0	1	6283	158	0	7402
2007	0	807	0	0	6592	185	0	7584
2008[1)]		928			7736	180		8844

[1)] **Provisional figures.**

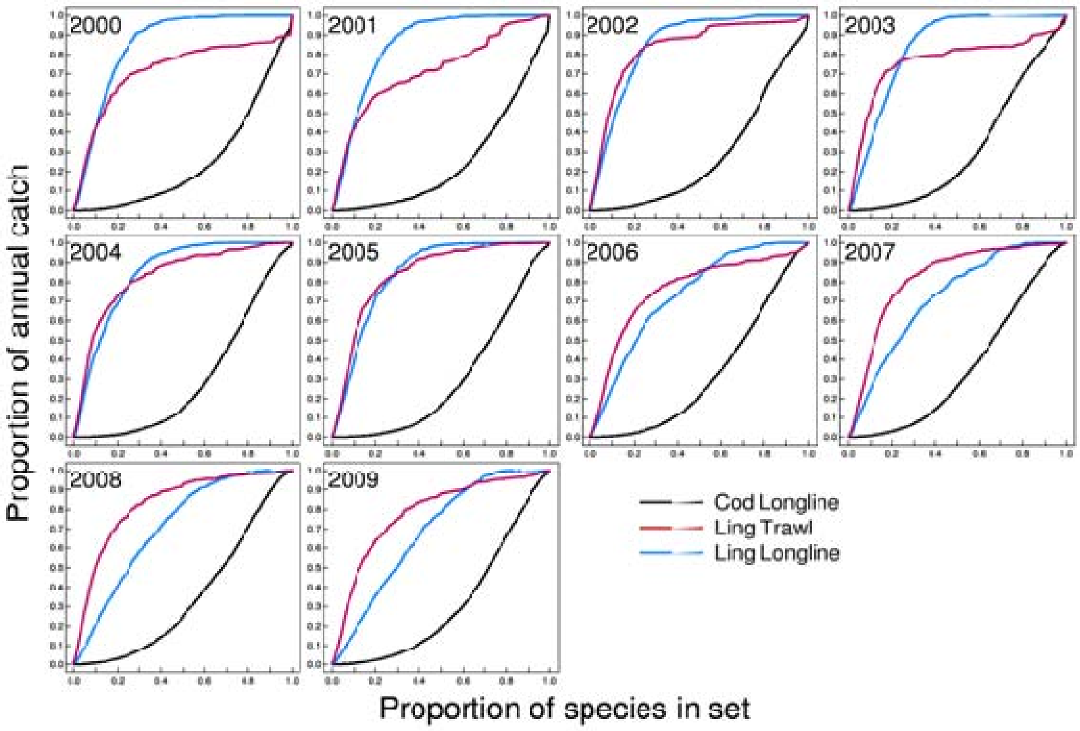


Figure 5.4.1. Ling in Va. Plot of the ling fishery in 2000 to 2009 and for comparison the cod longline fishery. This plot is best explained by an example. In 2005 around 20% of the annual catch of cod were caught where it was 50% or more of the catch in each set/haul so it can be considered a fairly directed fishery. On the other hand ling in the trawl fishery is mostly a bycatch as more than 90% of the annual catch is caught where ling is less than 40% of the catch in each set/haul.

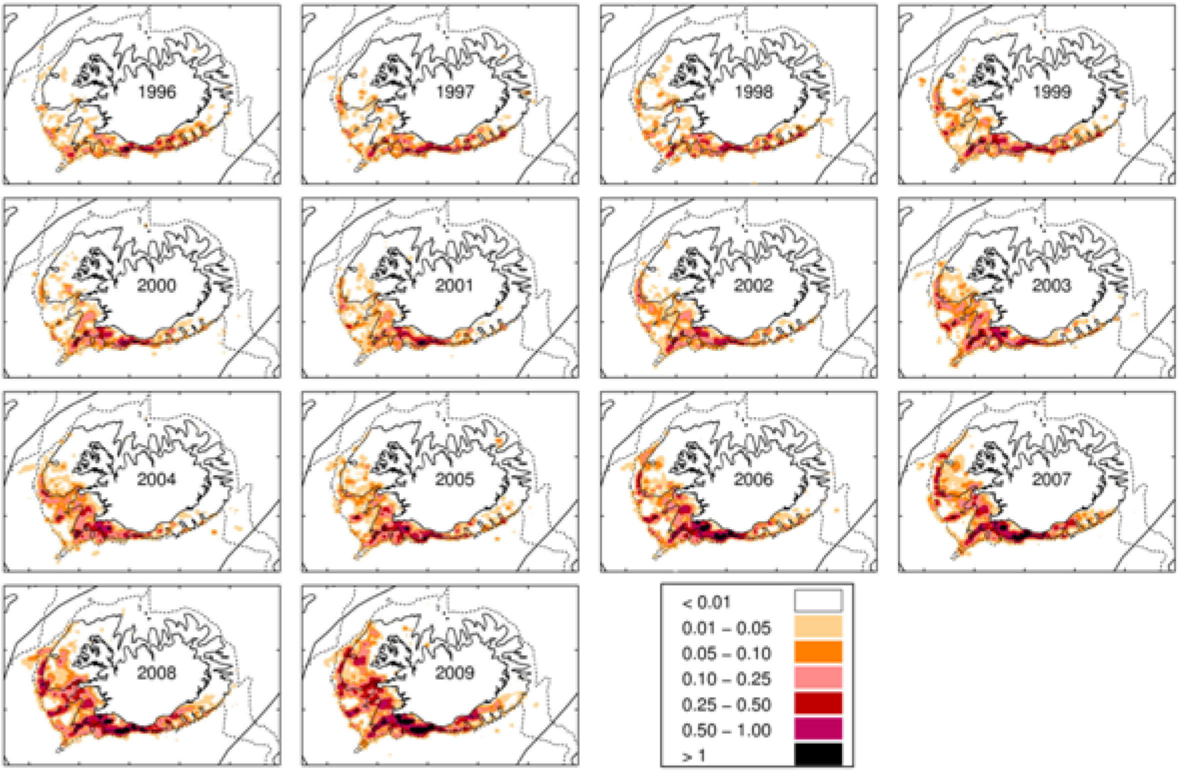


Figure 5.4.2. Ling in Va. Geographical distribution (tonnes/square mile) of the Icelandic ling fishery in 1996–2009 as reported in logbooks by the Icelandic fleet. All gears combined.

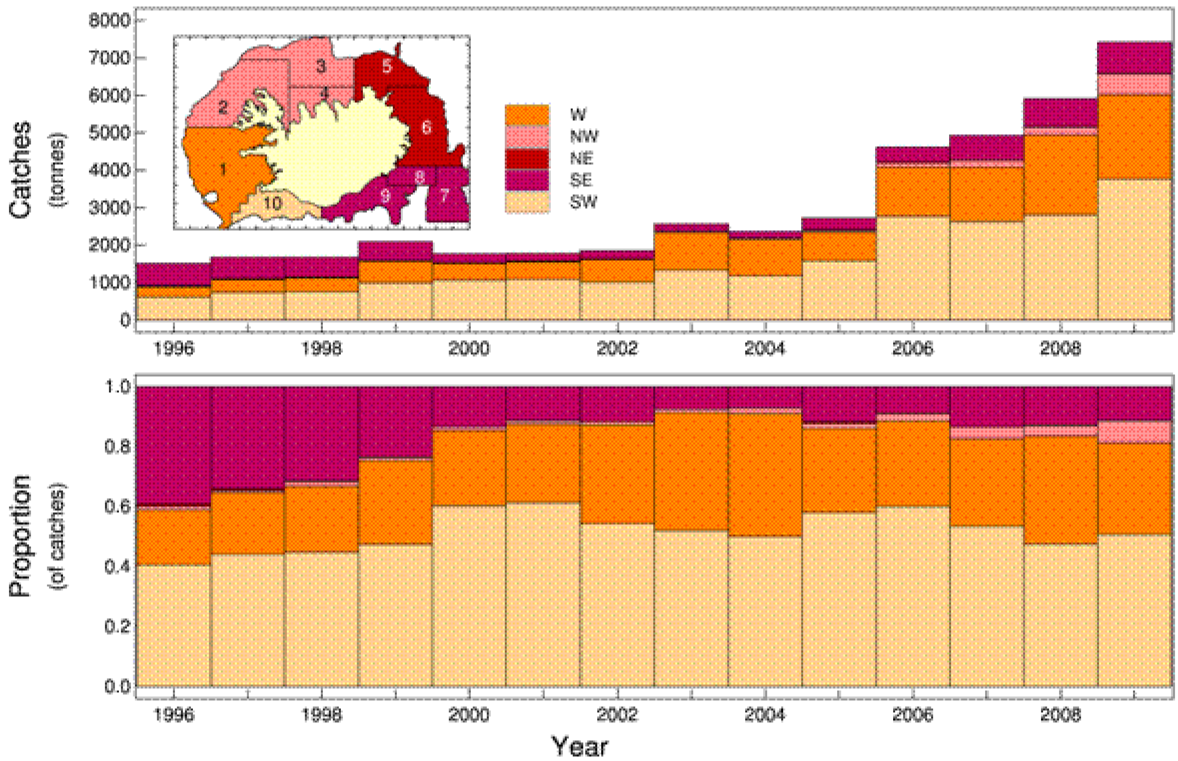


Figure 5.4.3. Ling in Va. Changes in spatial distribution of ling catches as recorded in Icelandic logbooks.

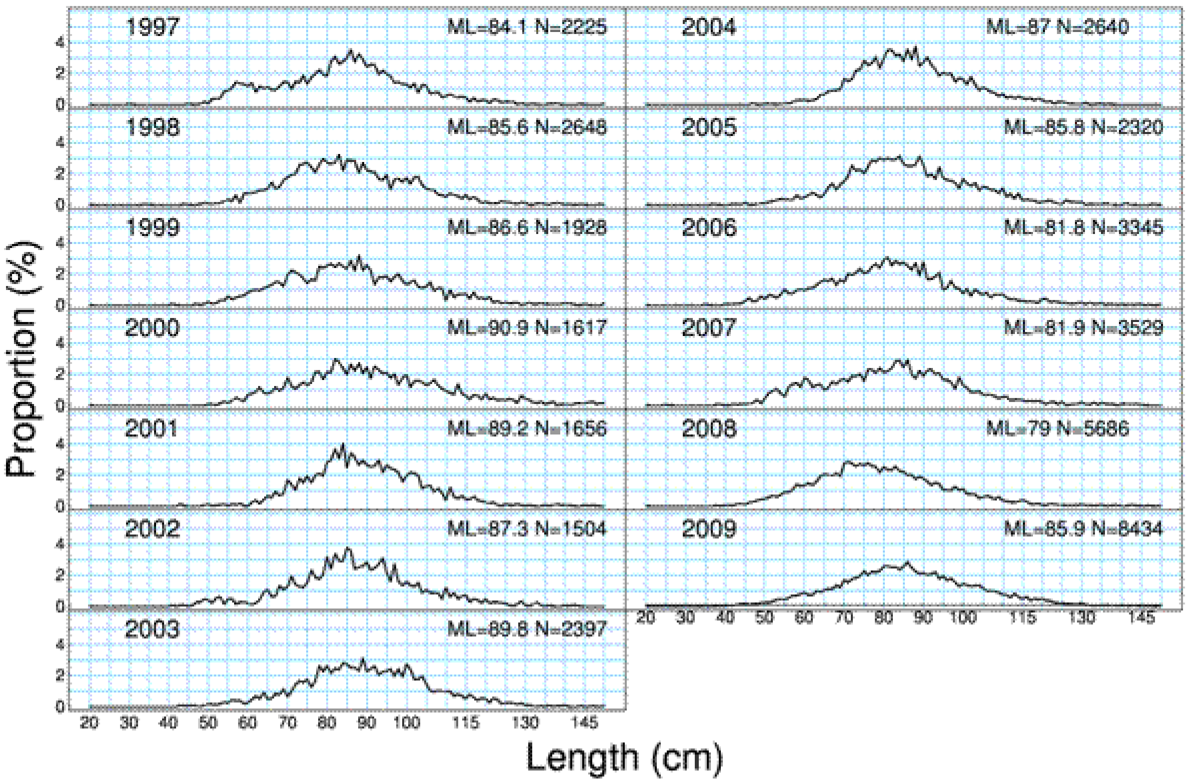


Figure 5.4.4. Ling Va. Length distributions from the Icelandic longlinefleet.

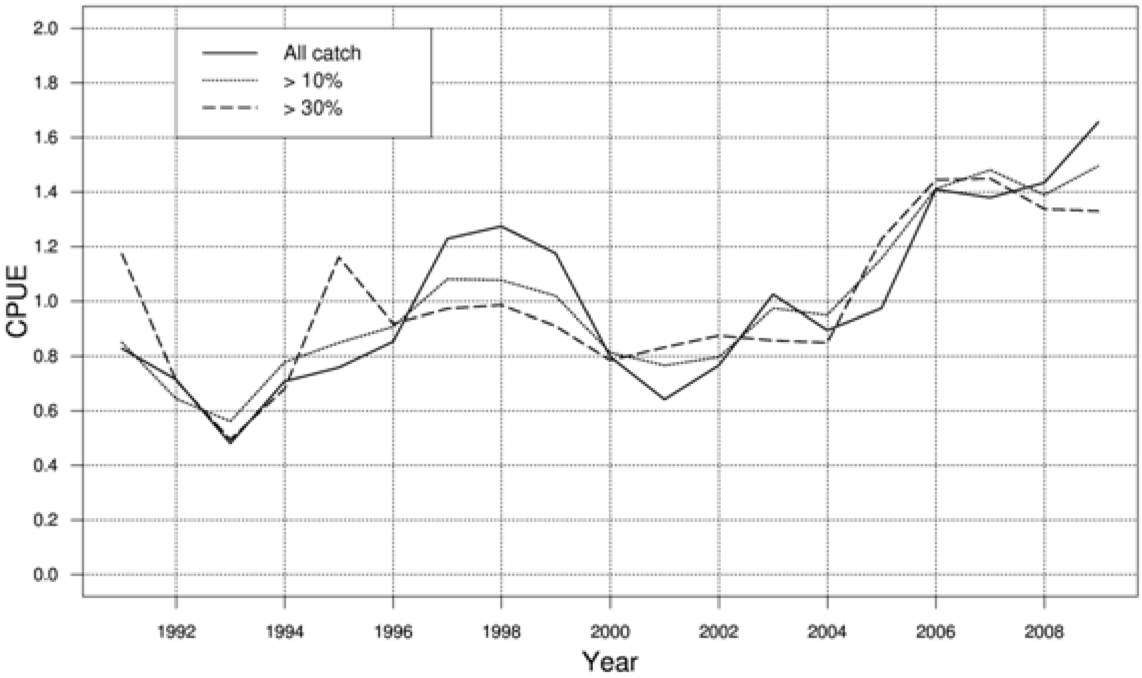


Figure 5.4.5. Ling in Va. Index of raw cpue (sum(yield)/sum(effort)) of ling from the Icelandic longline fishery based on logbooks 1991–2008. The criteria for the calculations were all sets where ling was reported in the logbooks and where ling composed at least 10% and 30% of the total catch in each set.

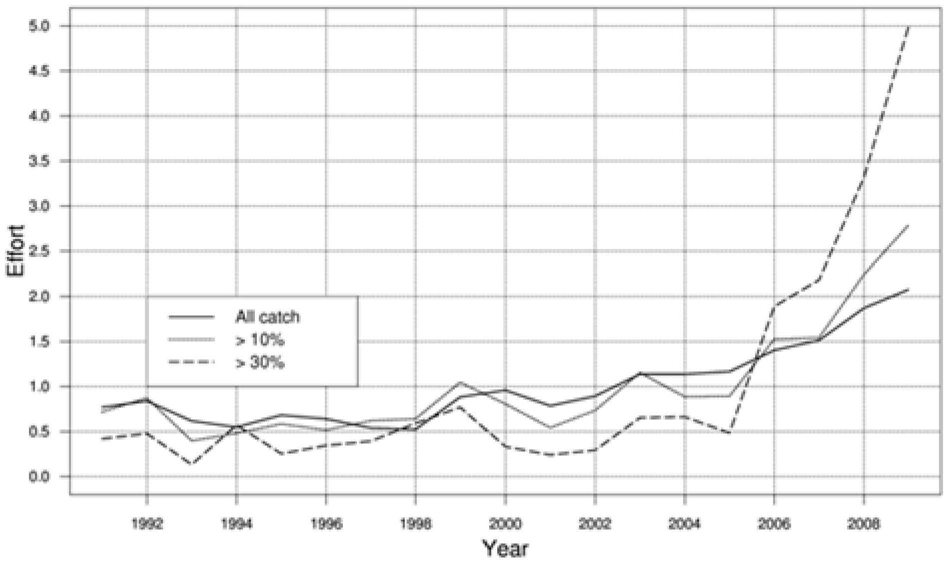


Figure 5.4.6. Ling in Va. Index of raw effort of ling from the Icelandic long-line fishery based on logbooks 1991–2008. The criteria for the calculations were all sets where ling was reported in the logbooks and where ling composed at least 10% and 30% of the total catch in each set.

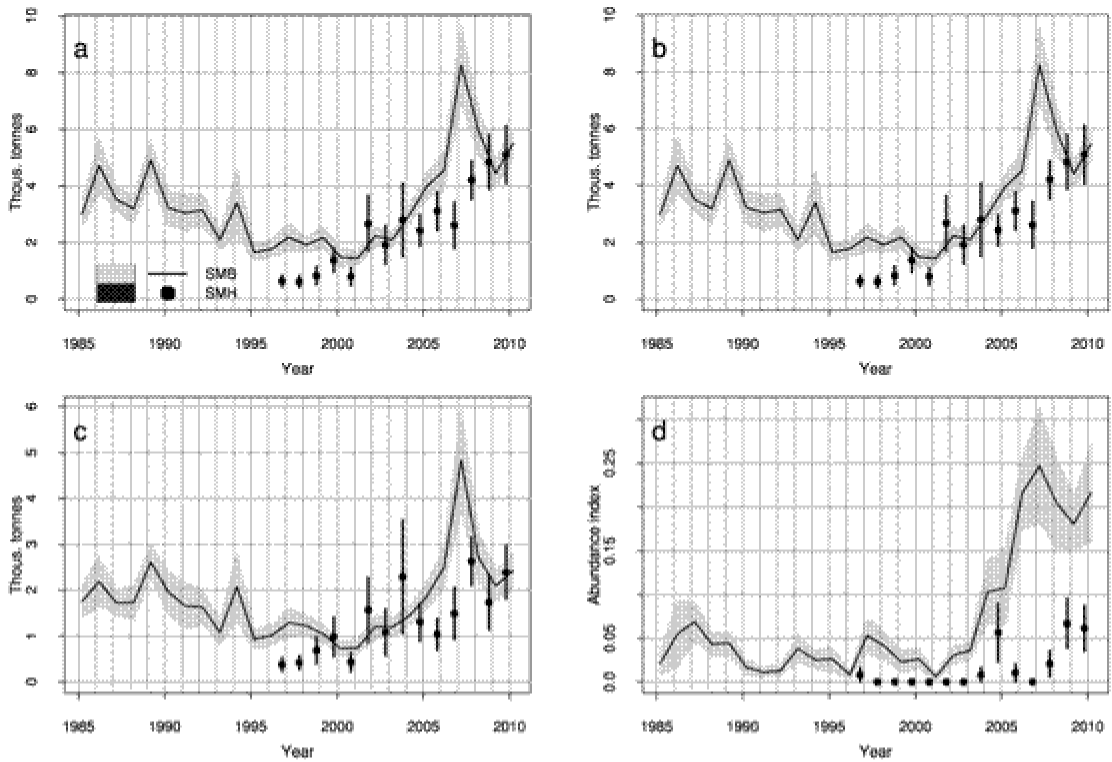


Figure 5.4.7. Ling in Va. Ling in Va. Shown are a) total biomass indices, b) biomass indices larger than 40 cm, c) biomass indices larger than 90 cm and d) abundance indices smaller than 40 cm. The lines with shades show the Spring Survey indices from 1985 (SMB) and the points with the vertical line show the Autumn Survey (SMH) from 1997. The shades and vertical line indicate +/- 1 standard error.

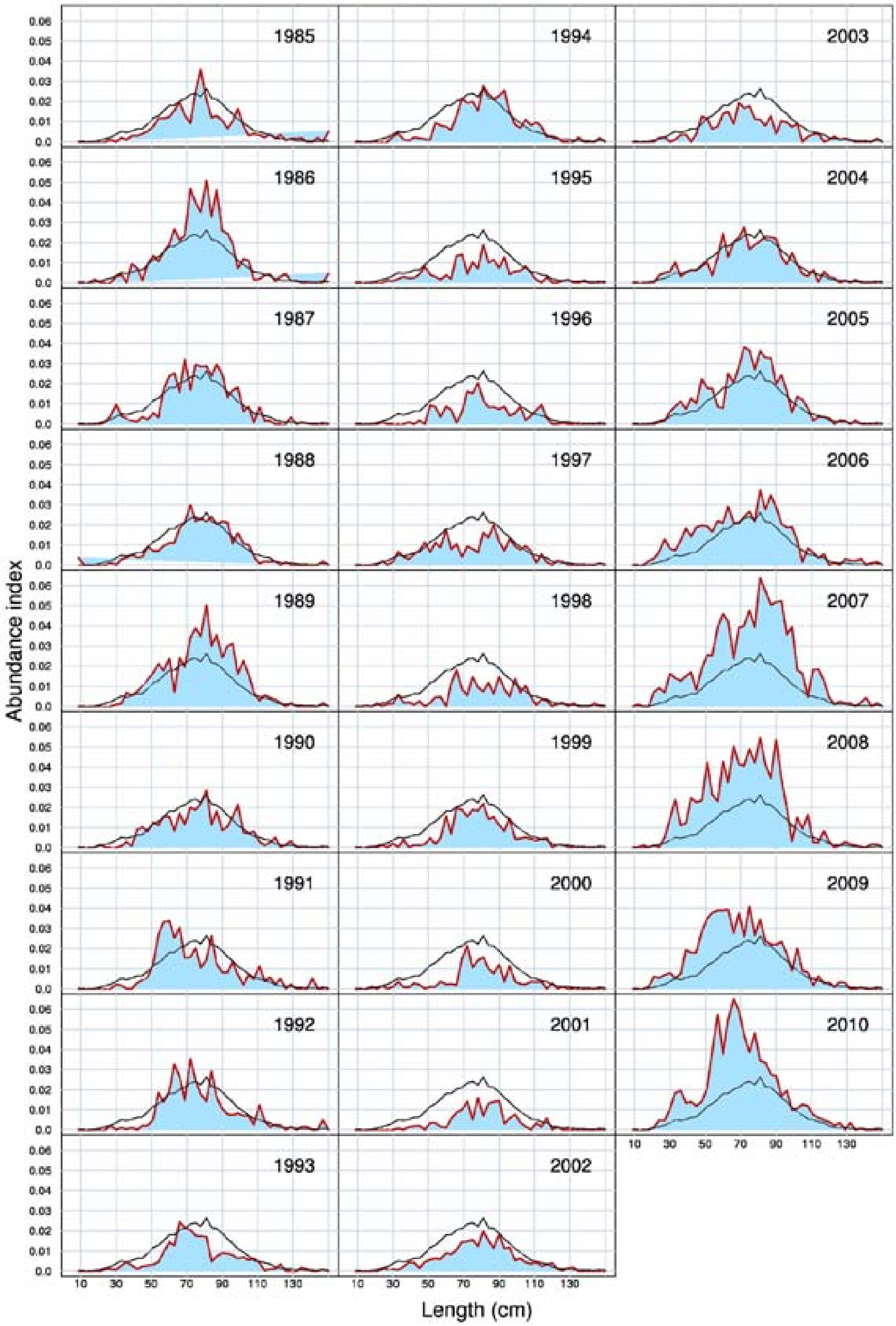


Figure 5.4.8. Ling in Va. Abundance indices by length (3 cm grouping) of from the spring survey 1985 to 2010. Black line is the average over the whole period.

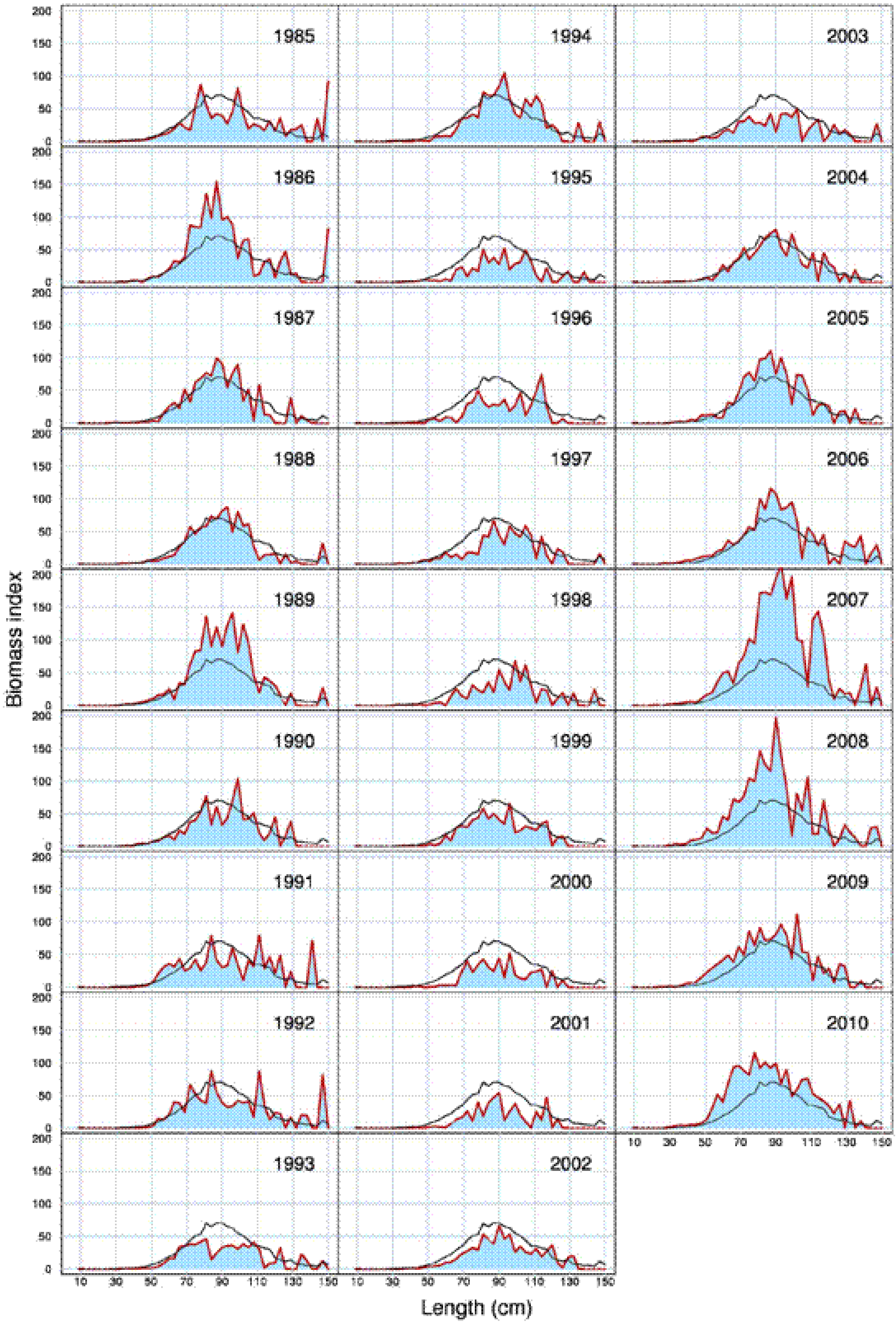


Figure 5.4.9. Ling in Va. Biomass indices by length (3 cm grouping) of from the spring survey 1985 to 2010. Black line is the average over the whole period.

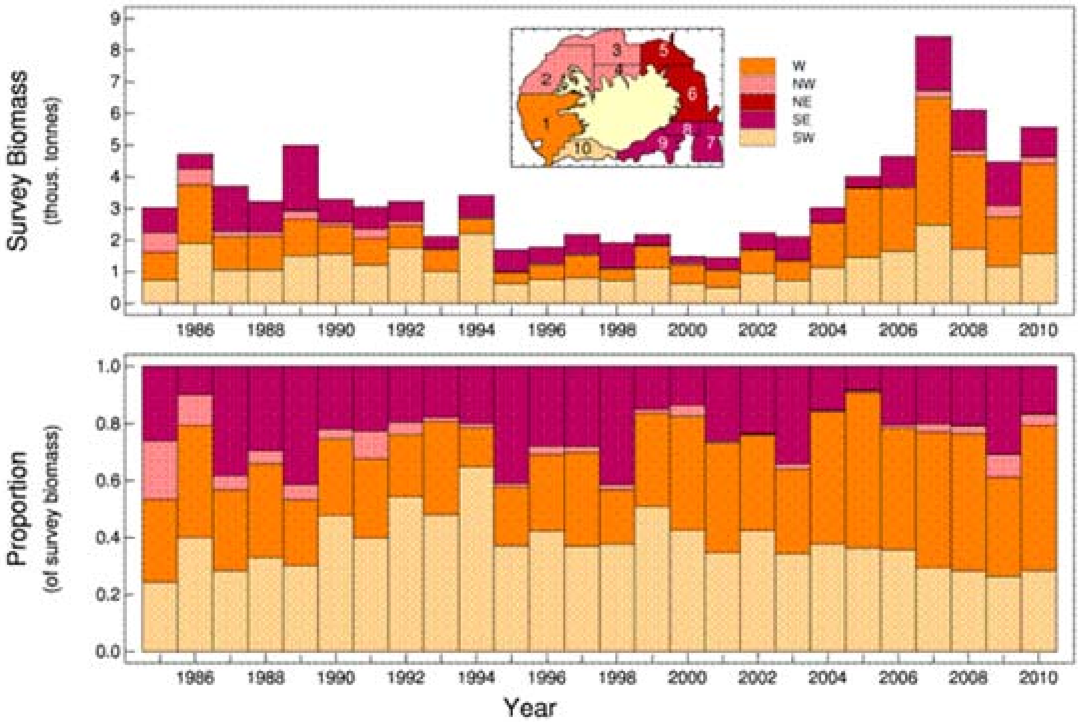


Figure 5.4.10. Ling in Va. Estimated survey biomass in the spring survey by year from different parts of the continental shelf (upper figure) and as proportion of total (lower figure).

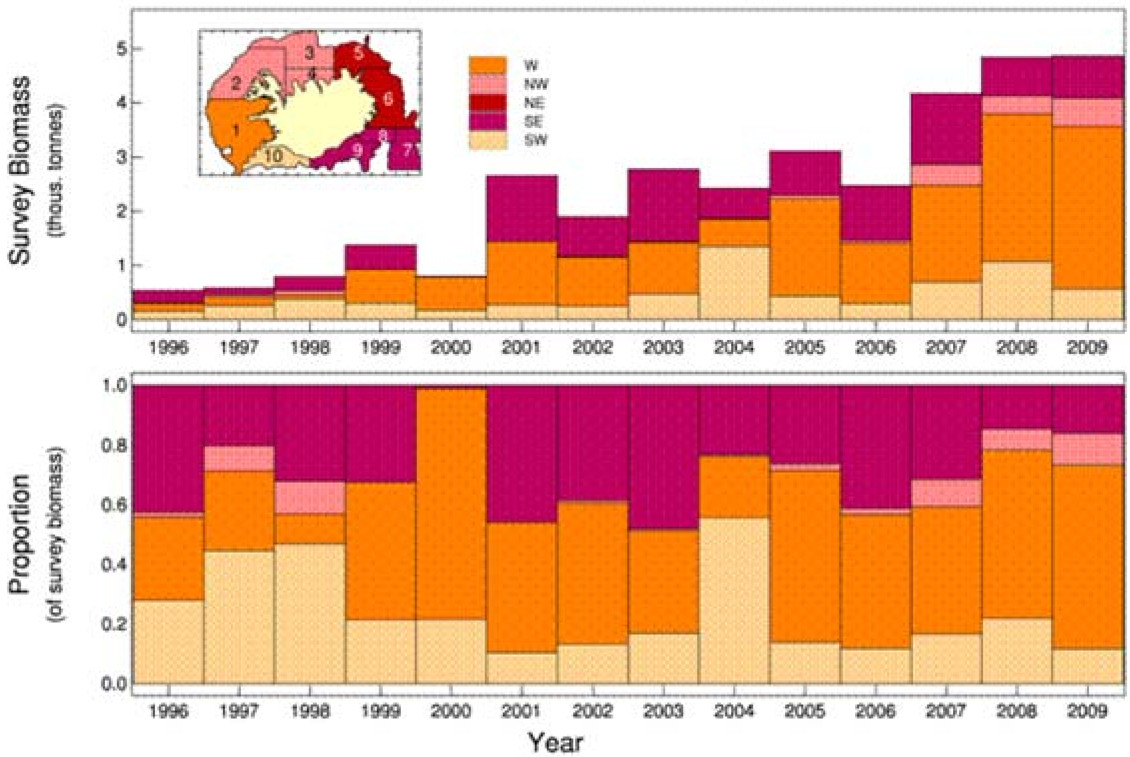


Figure 5.4.11. Ling in Va. Estimated survey biomass in the autumn survey by year from different parts of the continental shelf (upper figure) and as proportion of total (lower figure).

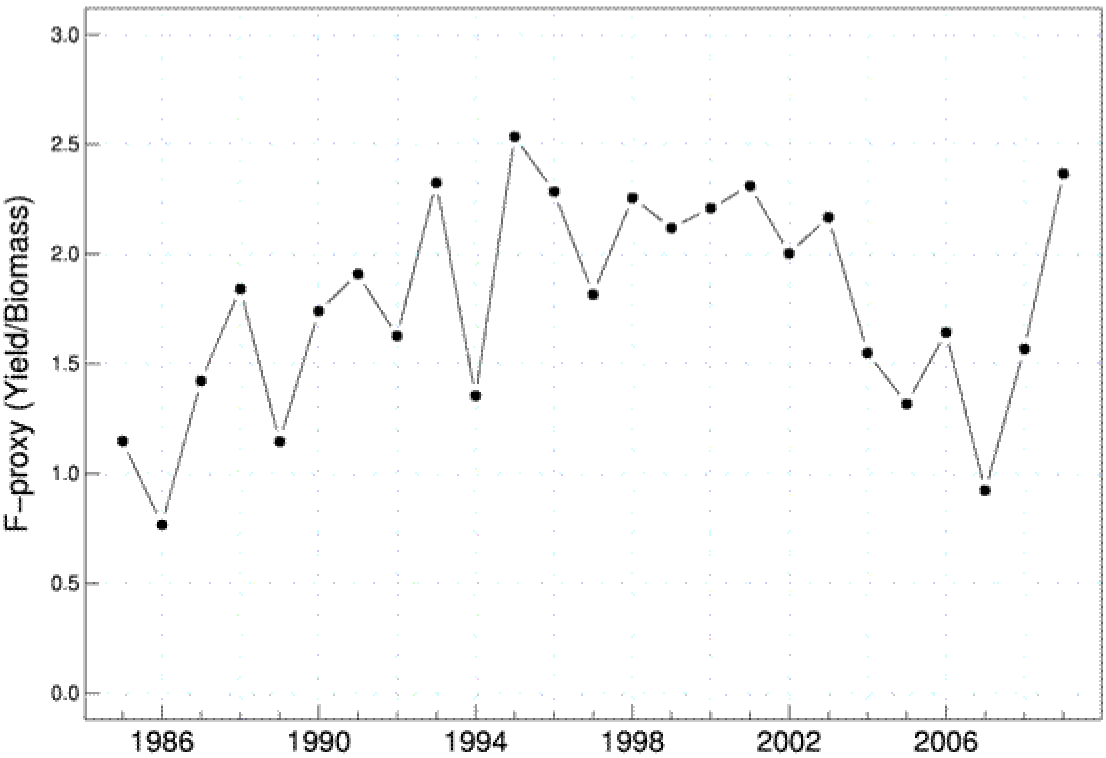


Figure 5.4.12. Ling in Va. Ling in Va.Estimates of trends in relative fishing mortality (Yield/Survey Biomass [>39 cm]).

5.5 Ling (*Molva Molva*) in areas (IIIa, IV, VI, VII, VIII, IX, X, XII, XIV)

5.5.1 The fishery

Significant fisheries for ling have been conducted in Subarea III and IV at least since the 1870s, pioneered by Swedish longliners. Since the mid-1900s and currently, the major targeted ling fishery in IVa is the Norwegian longliners conducted around Shetland and in the Norwegian Deep. There is little activity in IIIa. Of the total Norwegian 2009 landings about 83% were taken by longlines, 8% by gillnets, and the remainder by trawls. The bulk of the landings from other countries were taken by trawls as bycatches in other fisheries, and the landings from the UK (Scotland) are the most substantial. The comparatively low landings from the central and southern North Sea (IVb,c), are bycatches in various other fisheries.

The major directed ling fishery in VI is the Norwegian longline fishery. Trawl fisheries by the UK (Scotland) and France primarily take ling as bycatch.

In Subarea VII the Divisions b, c, and g–k provide most of the landings of ling. Norwegian landings, and some of Irish and Spanish are from targeted longline fisheries, whereas other landings are primarily bycatches in trawl fisheries. Data split by gear type were not available for all countries, but the bulk of the total landings (at least 60–70%) are taken by trawls in these areas.

In Subareas VIII and IX, XII and XIV all landings are bycatches in various fisheries.

5.5.1.1 Landings trends

Landing statistics by nation in the period 1988–2009 are given in Table 5.5.0. In Division IVa the total landings have varied between 10 000 and 13 000 t until 1998, then declined until 2003 to about half that level, and has remained stable since.

In Division VIa the statistics are incomplete for the period 1989–1993. In the period 1994–2008 when the data are complete, they demonstrate a declining trend towards a level less than half that in the 1990s. The Norwegian landings declined substantially since the mid-1990s compared with earlier years. In Division VIb landings decreased in the late 1990s and reach a minimum in 2002, after which a gradual increase has occurred. In 2009 the landings were above of the mean annual landings for the period 1988–1995.

In Subarea VII landings were around 10 000 t in the period 1995–1998. After this a gradual decrease and the preliminary estimate of catch for 2009 is only 1233.

In Subarea VIII annual ling landings have been only a few hundred tons since 1999, and in Subareas IX, XII, and XIV the landings have remained minor.

5.5.1.2 ICES Advice

ICES Advice in 2008 was: *the cpue in these areas has been at a reduced level. ICES reiterates the advice to constrain catches to 10 000 t and to collect information that can be used to evaluate a long-term sustainable level of exploitation.*

5.5.1.3 Management

Since 2003, the European Union has set TACs for EU vessels fishing in community waters and waters not under the control of Third Countries. Between 2003 and 2007, ling was covered by the biennial regulations for deep-water species; however, from 2008 it has been included in annual TAC regulation covering other species.

EU TACs for ling in 2010 are:

Subarea IIIa and EU waters of IIIc,d:	90 tonnes
EU waters of Subarea IV:	2428 tonnes
Subarea VI, VII, VIII, IX, X, XII, XIV:	7824 tonnes

There is no species-specific regulation in the Norwegian EEZ, but a TAC is negotiated for Norwegian vessels fishing in EU waters. The quota of ling to Norway in the EU zone was set for 2010 at 6140 tonnes. The quota to the EU in Norwegian waters of Area IV was 850 tonnes.

5.5.2 Data available

5.5.2.1 Landings and discards

Landings were available for all relevant fleets. Within the Norwegian EEZ and for Norwegian vessels fishing elsewhere discarding is prohibited and so there is no information on discarding. Discard data from some fleets have been reported previously to WGDEEP.

5.5.2.2 Length compositions

Length compositions/mean lengths from 1988 to present based on data from the Norwegian longliners are presented in Bergstad and Hareide, 1996 and Helle *et al.*, WD, 2010. In this period the mean length has varied around 88 cm without any clear trend. Russian investigations in Subdivision VIb1 showed that fish length varied from 49 to 143 cm, mainly 80–120 cm (Figure 5.5.1) (Vinnichenko *et al*., WD 2010).

5.5.2.3 Age compositions

No new age compositions were available.

5.5.2.4 Weight-at-age

No new data were presented.

5.5.2.5 Maturity and natural mortality

Russian investigations in Subdivision VIb1 showed that the bulk of catches was made up of mature fish. Males were the most abundant (58%). Most of them were either in the condition of post-spawning recovery or spawned a part of reproductive stock (maturity stage 6–4). Gonads of mature females were in the condition of post-spawning recovery (Figure 5.5.2). (Vinnichenko *et al*., WD 2010).

5.5.2.6 Catch, effort and research vessel data

Catch and effort data for Norwegian longliners were updated for the period up to 2009. Trends from Danish trawlers were presented. No research vessel data were available.

The extensive Norwegian longliner cpue series based on private skippers' logbooks presented in the 1996 Report were not updated after 1994.

In order to resume the cpue series Norway started in 2001 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2009 (only seven logbooks have been entered for 2009 and the estimates are therefore preliminary). Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 tonnes in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day.

An analyses based on these data is in Helle and Pennington, WD , 2010.

A cpue series for Danish trawlers fishing in IIIa and IV were available for the period 1992–2009 (Figure 5.5.5).

The historical series of lpues (kg/day) of the Basque Country OTB fleet in Subareas VI, VII and VIII since 1996 varies with no apparent trend since 2001 (Figure 5.5.6).

5.5.3 Data analyses

No analytical assessments attempted this year.

A source of information on abundance trends was the cpue series from the Norwegian longliners presented by Helle and Pennington (WD, 2010). The number of longliners has declined in recent years, from 72 to 34 in the period 2000–2009 (Table 5.3.1). The number of fishing days with ling catch has remained relatively stable in Division IVa. In Division VIa the number of fishing days have varied from 23 in 2005 to six days in 2009(preliminary data) with an average of 13 days (Table 5.5.1). The number of hooks set per day and the total set per year has remained rather stable in Subareas IVa, VIa and VIb (Tables 5.5.2 and 5.5.3).

Tables 5.5.4 gives estimates of cpue based on the Norwegian official logbooks and the same results are shown in Figure 5.5.3. In Figure 5.5.4 the data for 2000–2009 are shown together with the data for the period 1971–1994 (considered earlier by WGDEEP and presented in Bergstad and Hareide, 1996). There is a gap in the time-series between 1995 and 2000, and due to data limitations it was not possible to estimate cpue for all years in the early period.

There was an overall increase in cpue in Areas IVa, Vb and VIa, which indicates that current levels of exploitation are not having a detrimental effect on the stock. The current cpue levels are low compared with the historical cpue series, but these estimates cannot be compared because of the switch from hand baited lines to autolines. The autoline was introduced to the Norwegian fleet in 1977, and most of the large vessels had installed it by 1985. The data used for the period 1972–1994 are, therefore, early on only hand baited lines, then a mix of both hand baited and autolines and finally only autolines. This is a very important change and correction factors for these changes are not available. During the hand baited period, the cpue estimates are very high, afterwards cpue declined during the transition period and finally when only autolines were employed, the cpue is at the same level as that of the new time-series.

5.5.4 Comments on the assessment

The cpue series of the main fleet landing ling (Norwegian longliners) suggest that the abundance has increased after a probable decline in the 1970s to 1990s. It is, however, unclear whether these estimates can be compared because of the switch from hand baited lines to autolines. The estimates are only valid for the Divisions for which there is sufficient data (IVa, VIa, VIb). There was an increase in cpue for these areas from 2001–2003 through 2009, with a large increase in Area VIb.

The Danish series from trawlers extending back to 1992 display variation without any apparent trends until the two last years when there has been a slight increase (Figure 5.5.4).

The historical series of lpues (kg/day) of the Basque Country OTB fleet in Subareas VI, VII and VIII since 1996 varies with no apparent trend since 2001 (Figure 5.5.6).

5.5.5 Management considerations

Legislation enacted since 2000 for regulating the cod fishery caused a continuous reduction in the number of longliners in the fishery for tusk, ling and blue ling and by 2009 there were only 34 vessels above 21 m in the fishery. Because of the reduction; in number of vessels (52% reduction since 2000), the total number of hooks employed (22% reduction since 2002) and the total number of weeks fished (41% since 2001–2002), it is quite clear that there has been a significant reduction in effort (for details see Helle and Pennington, WD 2010). The decrease in total effort occurred even though there was an increase in the number of hooks set per vessel/day, and it is quite likely that the amount of applied effort has been reduced to the 1998-level.

Table 5.5.0. Ling IIIa, IVa, VI, VII, VIII, IX, XII and XIV. WG estimates of landings.

LING III

YEAR	BELGIUM	DENMARK	GERMANY	NORWAY	SWEDEN	E & W	TOTAL
1988	2	165	-	135	29	-	331
1989	1	246	-	140	35	-	422
1990	4	375	3	131	30	-	543
1991	1	278	-	161	44	-	484
1992	4	325	-	120	100	-	549
1993	3	343	-	150	131	15	642
1994	2	239	+	116	112	-	469
1995	4	212	-	113	83	-	412
1996		212	1	124	65	-	402
1997		159	+	105	47	-	311
1998		103	-	111	-	-	214
1999		101	-	115	-	-	216
2000		101	+	96	31		228
2001		125	+	102	35		262
2002		157	1	68	37		263
2003		156		73	32		261
2004		130	1	70	31		232
2005		106	1	72	31		210
2006		95	2	62	29		188
2007		82	3	68	21		174
2008		59	1	88	20		168
2009*		65	1	62	21		149

***Preliminary**

Table 5.5.0. (continued).

LING IVa

YEAR	BELGIUM	DENMARK	FAROES	FRANCE	GERMANY	NETH.	NORWAY	SWEDEN1)	E&W	N.I.	SCOT.	TOTAL
1988	3	408	13	1143	262	4	6473	5	55	1	2856	11 223
1989	1	578	3	751	217	16	7239	29	136	14	2693	11 677
1990	1	610	9	655	241	-	6290	13	213	-	1995	10 027
1991	4	609	6	847	223	-	5799	24	197	+	2260	9969
1992	9	623	2	414	200	-	5945	28	330	4	3208	10 763
1993	9	630	14	395	726	-	6522	13	363	-	4138	12 810
1994	20	530	25	n/a	770	-	5355	3	148	+	4645	11 496
1995	17	407	51	290	425	-	6148	5	181		5517	13 041
1996	8	514	25	241	448		6622	4	193		4650	12 705
1997	3	643	6	206	320		4715	5	242		5175	11 315
1998	8	558	19	175	176		7069	-	125		5501	13 631
1999	16	596	n.a.	293	141		5077		240		3447	9810
2000	20	538	2	147	103		4780	7	74		3576	9246
2001		702		128	54		3613	6	61		3290	7854
2002	6	578	24	117			4509		59		3779	9072
2003	4	779	6	121	62		3122	5	23		2311	6433
2004		575	11	64	34		3753	2	15		1852	6306
2005		698	18	47	55		4078	4	12		1537	6449
2006		637	2	73	51		4443	3	55		1455	6719
2007		412	-	100	60		4109	3	31		1143	5858
2008		446	1	182	52		4726	12	20		1820	7259
2009*		427	7	90	27		4612	7	19		2223	7412

***Preliminary. (1) Includes IVb 1988–1993.**

Table 5.5.0. (continued).

LING IVbc

Year	Belgium	Denmark	France	Sweden	Norway	E & W	Scotland	Germany	Netherlands	Total
1988					100	173	106	-		379
1989					43	236	108	-		387
1990					59	268	128	-		455
1991					51	274	165	-		490
1992		261			56	392	133	-		842
1993		263			26	412	96	-		797
1994		177			42	40	64	-		323
1995		161			39	301	135	23		659
1996		131			100	187	106	45		569
1997	33	166	1	9	57	215	170	48		699
1998	47	164	5		129	128	136	18		627
1999	35	138	-		51	106	106	10		446
2000	59	101	0	8	45	77	90	4		384
2001	46	81	1	3	23	62	60	6	2	284
2002	38	91		4	61	58	43	12	2	309
2003	28	0		3	83	40	65	14	1	234
2004	48	71		1	54	23	24	19	1	241
2005	28	56		5	20	17	10	13		149
2006	26	53		8	16	20	8	13		144
2007	28	42	1	5	48	20	5	10		159
2008	15	40	2	5	87	25	15	11		200
2009*	19	38	0	13	58	29	18	17	1	193

***Preliminary**

Table 5.5.0. (continued).

LING VIa

Year	Belgium	Denmark	Faroes	France [1]	Germany	Ireland	Norway	Spain[2]	E&W	IOM	N.I.	Scot.	Total
1988	4	+	-	5381	6	196	3392	3575	1075	-	53	874	14 556
1989	6	1	6	3417	11	138	3858		307	+	6	881	8631
1990	-	+	8	2568	1	41	3263		111	-	2	736	6730
1991	3	+	3	1777	2	57	2029		260	-	10	654	4795
1992	-	1	-	1297	2	38	2305		259	+	6	680	4588
1993	+	+	-	1513	92	171	1937		442	-	13	1133	5301
1994	1	1		1713	134	133	2034	1027	551	-	10	1126	6730
1995	-	2	0	1970	130	108	3156	927	560	n/a		1994	8847
1996			0	1762	370	106	2809	1064	269			2197	8577
1997			0	1631	135	113	2229	37	151			2450	6746
1998				1531	9	72	2910	292	154			2394	7362
1999				941	4	73	2997	468	152			2264	6899
2000	+	+		737	3	75	2956	708	143			2287	6909
2001				774	3	70	1869	142	106			2179	5143
2002				402	1	44	973	190	65			2452	4127
2003				315	1	88	1477	0	108			1257	3246
2004				252	1	96	791	2	8			1619	2769
2005			18	423		89	1389	0	1			1108	3028
2006			5	499	2	121	998	0	137			811	2573
2007			88	626	2	45	1544	0	33			782	3120
2008			21	1004	2	49	1265	0	1			608	2950
2009*			30	370		76	828	116	1			2	1423

***Preliminary. [1] Includes VIb until 1996 [2] Includes minor landings from VIb.**

Table 5.5.0. (continued).

LING VIb

Year	Faroes	France [2]	Germany	Ireland	Norway	Spain [3]	E & W	N.I.	Scotland	Russia	Total
1988	196		-	-	1253		93	-	223		1765
1989	17		-	-	3616		26	-	84		3743
1990	3		-	26	1315		10	+	151		1505
1991	-		-	31	2489		29	2	111		2662
1992	35		+	23	1713		28	2	90		1891
1993	4		+	60	1179		43	4	232		1522
1994	104		-	44	2116		52	4	220		2540
1995	66		+	57	1308		84		123		1638
1996	0		124	70	679		150		101		1124
1997	0		46	29	504		103		132		814
1998		1	10	44	944		71		324		1394
1999		26	25	41	498		86		499		1175
2000	+	18	31	19	1172		157		475	7	1879
2001	+	16	3	18	328		116		307		788
2002		2	2	2	289		65		173		533
2003		2	3	25	485		34		111		660
2004	+	9	3	6	717		6		141	182	1064
2005		31	4	17	628		9		97	356	1142
2006	30	4	3	48	1171		19		130	6	1411
2007	4	10	35	54	971		7		183	50	1314
2008*	69	6	20	47	1021		1		135	214	1513

***Preliminary. [1] Includes XII. [2] Until 1966 included in VIa. [3] Included in Ling VIa.**

LING VII

Year	France	Total
1988	5,057	5,057
1989	5,261	5,261
1990	4,575	4,575
1991	3,977	3,977
1992	2,552	2,552
1993	2,294	2,294
1994	2,185	2,185
1995	-1	
1996	-1	
1997	-1	
1998	-1	
1999	-1	

***Preliminary**

Table 5.5.0. (continued).

LING VIIa

Year	Belgium	France	Ireland	E & W	IOM	N.I.	Scotland	Total
1988	14	-1	100	49	-	38	10	211
1989	10	-1	138	112	1	43	7	311
1990	11	-1	8	63	1	59	27	169
1991	4	-1	10	31	2	60	18	125
1992	4	-1	7	43	1	40	10	105
1993	10	-1	51	81	2	60	15	219
1994	8	-1	136	46	2	76	16	284
1995	12	9	143	106	1	-2	34	305
1996	11	6	147	29	-	-2	17	210
1997	8	6	179	59	2	-2	10	264
1998	7	7	89	69	1	-2	25	198
1999	7	3	32	29		-2	13	84
2000	3	2	18	25			25	73
2001	6	3	33	20			31	87
2002	7	6	91	15			7	119
2003	4	4	75	18			11	112
2004	3	2	47	11			34	97
2005	4	2	28	12			15	61
2006	2	1	50	8			27	88
2007	2	0	32	1			8	43
2008	1	0	12	1			0	14
2009*	1	0	8	2			0	11

Preliminary. (1) French catches in VII not split into divisions, see Ling VII. (2) Included with UK (EW)

Table 5.5.0. (continued).

LING VII b, c

Year	France [1]	Germany	Ireland	Norway	Spain [3]	E & W	N.I.	Scotland	Total
1988	-1	-	50	57		750	-	8	865
1989	-1	+	43	368		161	-	5	577
1990	-1	-	51	463		133	-	31	678
1991	-1	-	62	326		294	8	59	749
1992	-1	-	44	610		485	4	143	1286
1993	-1	97	224	145		550	9	409	1434
1994	-1	98	225	306		530	2	434	1595
1995	78	161	465	295		630	-2	315	1944
1996	57	234	283	168		1117	-2	342	2201
1997	65	252	184	418		635	-2	226	1780
1998	32	1	190	89		393		329	1034
1999	51	4	377	288		488		159	1366
2000	123	21	401	170		327		140	1182
2001	80	2	413	515		94		122	1226
2002	132	0	315	207		151		159	964
2003	128	0	270			74		52	524
2004	133	12	255	163		27		50	640
2005	145	11	208			17		48	429
2006	173	1	311	147		13		23	668
2007	173	5	62	27		71		20	358
2008	122	16	40	0		14		63	255
2009*	50		63	0		17		1	131

***Preliminary. [1] See Ling VII. [2] Included with UK (EW). [3] Included with VIIg–k.**

Table 5.5.0. (continued).

LING VIId, e

Year	Belgium	Denmark	France (1)	Ireland	E & W	Scotland	Ch. Islands	Netherlands	Total
1988	36	+	-1	-	743	-			779
1989	52	-	-1	-	644	4			700
1990	31	-	-1	22	743	3			799
1991	7	-	-1	25	647	1			680
1992	10	+	-1	16	493	+			519
1993	15	-	-1	-	421	+			436
1994	14	+	-1	-	437	0			451
1995	10	-	885	2	492	0			1389
1996	15		960		499	3			1477
1997	12		1049	1	372	1	37		1472
1998	10		953		510	1	26		1500
1999	7		545	-	507	1			1060
2000	5		454	1	372		14		846
2001	6		402		399				807
2002	7		498		386	0			891
2003	5		531	1	250	0			787
2004	13		573	1	214				801
2005	11		539		236				786
2006	9		470		208				687
2007	15		428	0	267				710
2008*	5		348		214	2			569
2009	6		171		170			1	348

***Preliminary.**

Table 5.5.0. (continued).

LING VIIf

Year	Belgium	France [1]	Ireland	E & W	Scotland	Total
1988	77	-1	-	367	-	444
1989	42	-1	-	265	3	310
1990	23	-1	3	207	-	233
1991	34	-1	5	259	4	302
1992	9	-1	1	127	-	137
1993	8	-1	-	215	+	223
1994	21	-1	-	379	-	400
1995	36	110	-	456	0	602
1996	40	121	-	238	0	399
1997	30	204	-	313		547
1998	29	204	-	328		561
1999	16	108	-	188		312
2000	15	91	1	111		218
2001	14	114	-	92		220
2002	16	139	3	295		453
2003	15	79	1	81		176
2004	18	73	5	65		161
2005	36	59	7	82		184
2006	10	42	14	64		130
2007	16	52	2	55		125
2008	32	88	4	63		187
2009*	10	15	1	26		52

***Preliminary. [1] See Ling VII.**

Table 5.5.0. (continued).

LING VIIg–k

Year	Belgium	Denmark	France	Germany	Ireland	Norway	Spain [(2)]	E&W	IOM	N.I.	Scot.	Total
1988	35	1	-1	-	286	-	2652	1439	-	-	2	4415
1989	23	-	-1	-	301	163		518	-	+	7	1012
1990	20	+	-1	-	356	260		434	+	-	7	1077
1991	10	+	-1	-	454	-		830	-	-	100	1394
1992	10	-	-1	-	323	-		1130	-	+	130	1593
1993	9	+	-1	35	374			1551	-	1	364	2334
1994	19	-	-1	10	620		184	2143	-	1	277	3254
1995	33	-	1597	40	766	-	195	3046		-3	454	6131
1996	45	-	1626	169	771		583	3209			447	6850
1997	37	-	1574	156	674		33	2112			459	5045
1998	18	-	1362	88	877		1669	3465			335	7814
1999	-	-	1220	49	554		455	1619			292	4189
2000	17		1062	12	624		639	921			303	3578
2001	16		1154	4	727	24	559	591			285	3360
2002	16		1025	2	951		568	862			102	3526
2003	12		1240	5	808		455	382			38	2940
2004	14		982		686		405	335			5	2427
2005	15		771	12	539		399	313			4	2053
2006	10		676		935		504	264			18	2407
2007	11		661	1	430		423	217			6	1749
2008	11		622	8	314		391	130			27	1503
2009*	7		246	6	239		51	142			0	691

***Preliminary. [(1)] See Ling VII. [(2)] Includes VIIb, c. [(3)] Included in UK (EW).**

Table 5.5.0. (continued).

LING VIII

Year	Belgium	France	Germany	Spain	E & W	Scot.	Total
1988		1018			10		1028
1989		1214			7		1221
1990		1371			1		1372
1991		1127			12		1139
1992		801			1		802
1993		508			2		510
1994		n/a		77	8		85
1995		693		106	46		845
1996		825	23	170	23		1041
1997	1	705	+	290	38		1034
1998	5	1220	-	543	29		1797
1999	22	234	-	188	8		452
2000	1	227		106	5		339
2001		245		341	6	2	594
2002		316		141	10	0	467
2003		333		67	36		436
2004		385		54	53		492
2005		339		92	19		450
2006		324		29	45		398
2007		282		20	10		312
2008		294		36	15	3	345
2009*		146		29	7		182

LING IX

Year	Spain	Total
1997	0	0
1998	2	2
1999	1	1
2000	1	1
2001	0	0
2002	0	0
2003	0	0
2004		
2005		
2006		
2007	1	1

Table 5.5.0. (continued).

LING XII

Year	Faroes	France	Norway	E & W	Scotland	Germany	Ireland	Total
1988				-				0
1989				-				0
1990				3				3
1991				10				10
1992				-				0
1993				-				0
1994				5				5
1995	5			45				50
1996	-		2					2
1997	-		+	9				9
1998	-	1	-	1				2
1999	-	0	-	-	+	2		2
2000		1	-		6			7
2001		0	29	2	24		4	59
2002		0	4	4	0			8
2003			17	2	0			19
2004								
2005				1				1
2006	1							1
2007								0
2008								0
2009*		0	1					1

Table 5.5.0. (continued).

LING XIV

Year	Faroes	Germany	Iceland	Norway	E & W	Scotland	russia	Total
1988		3	-	-	-	-		3
1989		1	-	-	-	-		1
1990		1	-	2	6	-		9
1991		+	-	+	1	-		1
1992		9	-	7	1	-		17
1993		-	+	1	8	-		9
1994		+	-	4	1	1		6
1995	-	-		14	3	0		17
1996	-			0				0
1997	1			60				61
1998	-			6				6
1999	-			1				1
2000			26	-				26
2001	1			35				36
2002	3			20				23
2003				83				83
2004				10				10
2005								0
2006								0
2007				5				5
2008					1		1	2
2009*	+	3						3

***Preliminary.**

Ling. Total landings by Subarea or Division.

YEAR	III	IVA	IVBC	VIA	VIB	VII	VIIA	VIIBC	VIIDE	VIIF	VIIG-K	VIII	IX	XII	XIV	ALL AREAS
1988	331	11 223	379	14 556	1765	5057	211	865	779	444	4415	1028		0	3	41 056
1989	422	11 677	387	8631	3743	5261	311	577	700	310	1012	1221		0	1	34 253
1990	543	10 027	455	6730	1505	4575	169	678	799	233	1077	1372		3	9	28 175
1991	484	9969	490	4795	2662	3977	125	749	680	302	1394	1139		10	1	26 777
1992	549	10 763	842	4588	1891	2552	105	1286	519	137	1593	802		0	17	25 644
1993	642	12 810	797	5301	1522	2294	219	1434	436	223	2334	510		0	9	28 531
1994	469	11 496	323	6730	2540	2185	284	1595	451	400	3254	85		5	6	29 823
1995	412	13 041	659	8847	1638		305	1944	1389	602	6131	845		50	17	35 880
1996	402	12 705	569	8577	1124		210	2201	1477	399	6850	1041		2	0	35 557
1997	311	11 315	699	6746	814		264	1780	1472	547	5045	1034	0	9	61	30 097
1998	214	13 631	627	7362	1394		198	1034	1500	561	7814	1797	2	2	6	36 142
1999	216	9810	446	6899	1175		84	1366	1060	312	4189	452	1	2	1	26 013
2000	228	9246	384	6909	1879		73	1182	846	218	3578	339	1	7	26	24 916
2001	262	7854	284	5143	788		87	1226	807	220	3360	594	0	59	36	20 720
2002	263	9072	309	4127	533		119	964	891	453	3526	467	0	8	23	20 756
2003	261	6433	234	3246	660		112	524	787	176	2940	436		19	83	15 912
2004	232	6306	241	2769	1064		97	640	801	161	2427	492		0	10	15 240
2005	210	6449	149	3028	1142		61	429	786	184	2053	450		1	0	14 942
2006	188	6719	144	2573	1411		88	668	687	130	2407	398		1	0	15 414
2007	174	5858	159	3119	1314		43	358	710	125	1749	312		0	5	13 927
2008	168	7259	200	2950	1545		14	255	569	187	1503	345		0	1	14 996
2009*	149	7412	193	1423	2756		11	131	348	52	691	182		1	3	13 352

*Preliminary

Table 5.5.1. Estimated number of days that the Norwegian longliner fleet (selected using criteria described in the text, Section 4.2) operated in Subareas III to VII (not V) in the period 2000–2007.

Ling	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
IIIa	+			1					1	2
IVa	19	22	29	20	22	25	38	27	25	58
IVb	1	+		1				3		1
VIa	13	13	11	12	14	23	13	10	4	
VIb	4	5	7	4	5	8	7	6	11	
VIIc	3	1			1	+		1	9	6

Table 5.5.2. Estimated number of hooks that the Norwegian longliners set per day in Subarea III–IV and VI–XIV in the period 2000–2007. n= the total number of days with hook information contained in the logbooks.

All	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009	
	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n
IIIa	30 250	4					33 037	27							35 000	8	36 467	15	34 636	11
IVa	29 378	685	30 553	727	32 291	667	33 484	510	30 934	439	34 039	331	34 561	673	33 414	587	34 056	395	36 651	402
IVb	30 263	38	33 500	10	33 867	15	32 559	34							38 086	58	31 500	10	30 167	6
VIa	22 763	435	24 419	447	21 484	186	29 421	302	25 636	308	24 807	369	22 504	248	25 958	249	26 319	138	21 725	40
VIb	30 471	227	30 340	140	31 557	149	31 325	97	31 559	111	35 949	137	32 273	139	36 400	145	33 514	35		
VIIc	29 600	80	33 108	37					25 250	28	33 429	7			31 071	14				
XII	18 136	22	17 548	175			13 063	48												
XIVa	28 333	6																		
XIVb	2815	191	2465	135	9458	251	11 515	228	12 474	105	18 960	91					9464	45	7034	38

Table 5.5.3. Estimated total number of hooks (in thousands) the Norwegian longliner fleet used in Subareas III–IV and VI–XIV for the years 2000–2007 in the fishery for ling (with a bycatch of tusk and blue ling).

All	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
IIIa	218			1718					1313	2355
IVa	50 765	43 691	54 313	36 565	29 264	33 188	45 966	33 381	31 876	72 276
IVb	4358			1693				4228		1026
VIa	19 667	22 221	14 953	18 359	15 433	24 187	10 239	9604	9475	4432
VIb	21 939	11 833	14 642	9773	6785	11 216	7907	8081	2413	
VIIc	4262	2152			1086	521		1150		
XII	1306	5703		2038						
XIVb	1216	481	4389	5389	4827	3697			681	1196

Table 5.5.4. Estimated mean cpue ([kg/hook]x1000) in IIIa–IV and VI–XIV based on logbook data. Standard error (se) and number of catches sampled (n) is also given.

Official logbook data

Ling																														
	2000			2001			2002			2003			2004			2005			2006			2007			2008			2009		
Area	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se
IIIA	4,53	3	13,3							2,4	25	4,4										6,52	8	7,7	7,39	15	7,023	7,37	11	10,444
IVA	56,52	669	0,9	48,1	729	0,8	55,5	618	0,7	57,2	505	1,0	78,5	439	1,1	85,13	328	1,7	92,47	672	1,0	76,6	586	0,9	83,75	391	1,3744	98,74	402	1,7288
IVB	8,3	25	4,6	2,4	12	6,0	1,4	3	11,0	2,9	29	4,1										5,18	56	2,9	3,91	9	9,064	7,61	6	14,142
VIA	101,04	421	1,1	85,9	424	1,0	77,8	177	1,4	76,42	296	1,3	101,7	308	1,3	116,8	369	1,6	94,5	248	1,7	107,12	248	1,4	72,42	131	2,3777	98,36	40	5,4805
VIB	45,43	211	1,6	33,5	127	1,8	37,6	149	2,2	67,9	85	2,4	71,9	110	2,3	68,8	137	2,6	90,4	138	2,2	89,16	145	1,8	147	35	4,5973			
VIIC	82,9	78	2,6	78,4	37	3,4			0,0				122	28	4,5	66,4	7	11,6				79,18	14	5,9						
XIVA	3,75	6	9,4																						23,33	1				

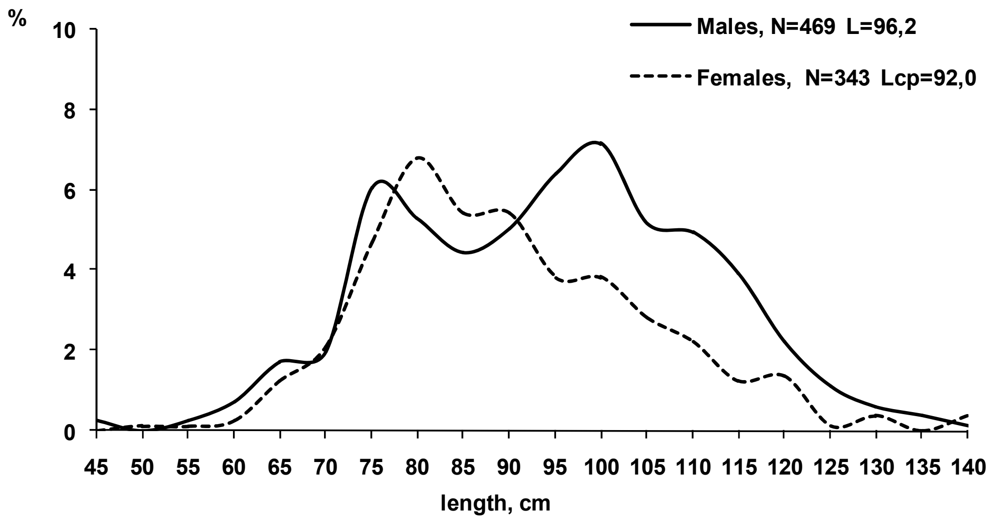


Figure 5.5.1. Length composition of ling on Rockall Bank in July 2009 (Vinnichenko *et al.*, WD 2010).

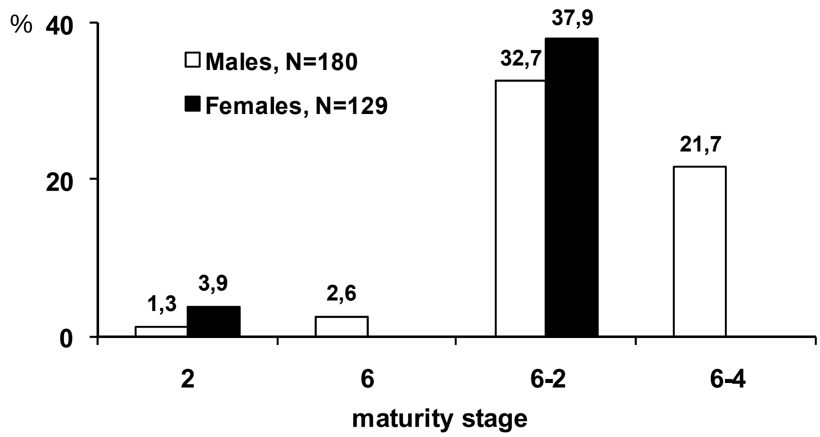


Figure 5.5.2. Maturity of ling on Rockall Bank in July 2009 (Vinnichenko *et al.*, WD 2010).

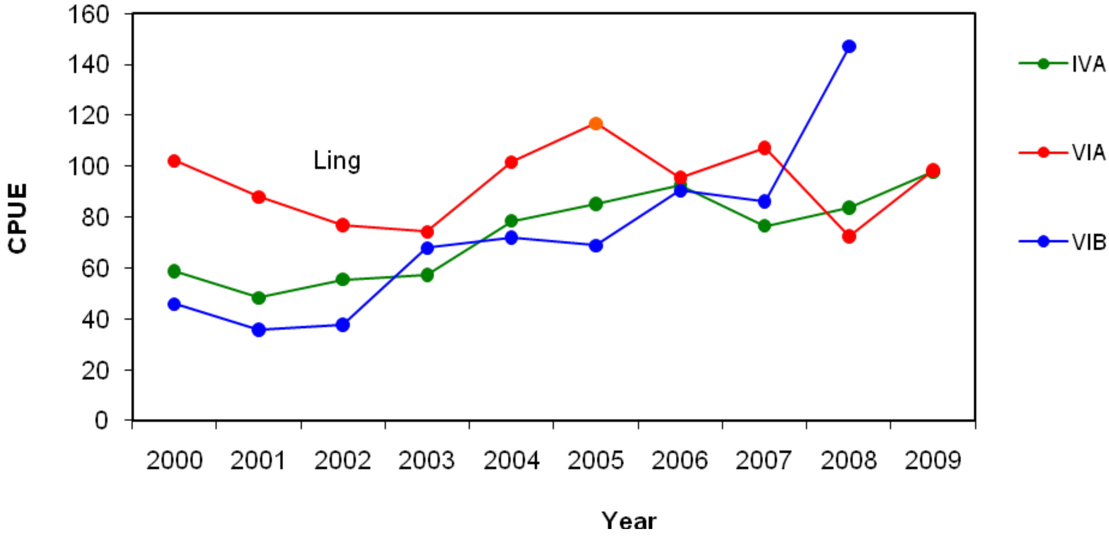
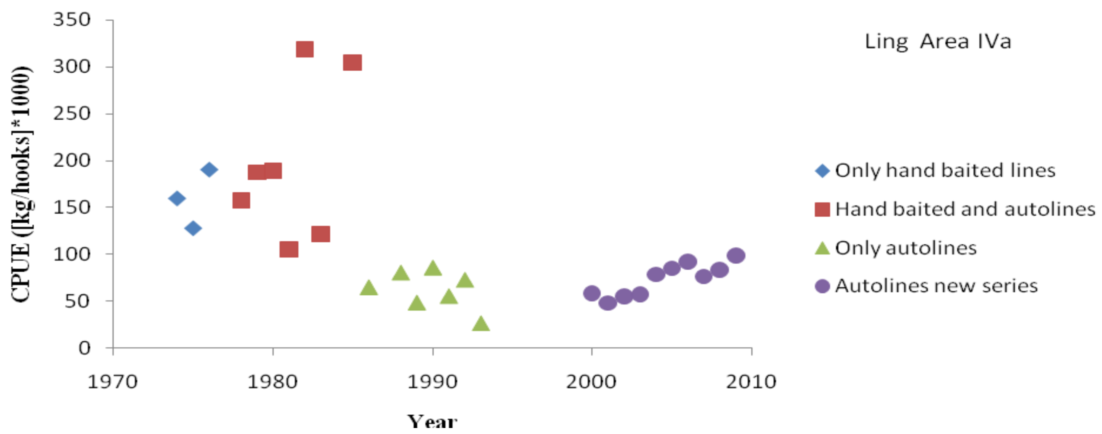
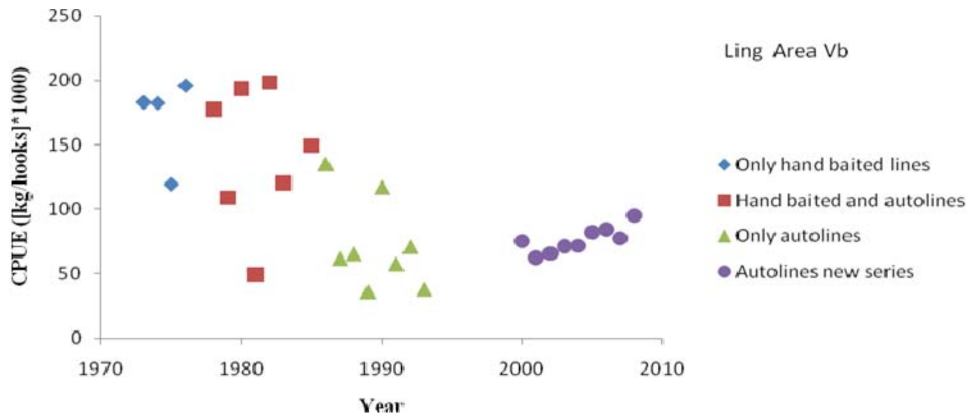
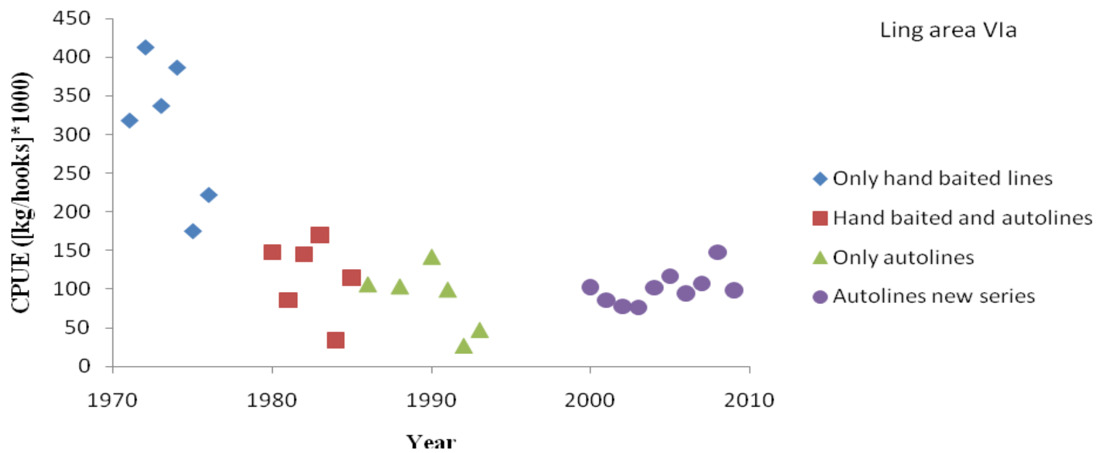


Figure 5.5.3. Estimated mean cpue ([kg/hook]x1000) based on data from the official logbooks for tusk and ling in each ICES Subarea and all areas combined for the years 2000–2009.


Ling Area IVa
CPUE ([kg/hooks]*1000)
350
300
250
200
150
100
50
0
1970
1980
1990
2000
2010
Year
Only hand baited lines
Hand baited and autolines
Only autolines
Autolines new series


Ling Area Vb
CPUE ([kg/hooks]*1000)
250
200
150
100
50
0
1970
1980
1990
2000
2010
Year
Only hand baited lines
Hand baited and autolines
Only autolines
Autolines new series


Ling area VIa
CPUE ([kg/hooks]*1000)
450
400
350
300
250
200
150
100
50
0
1970
1980
1990
2000
2010
Year
Only hand baited lines
Hand baited and autolines
Only autolines
Autolines new series

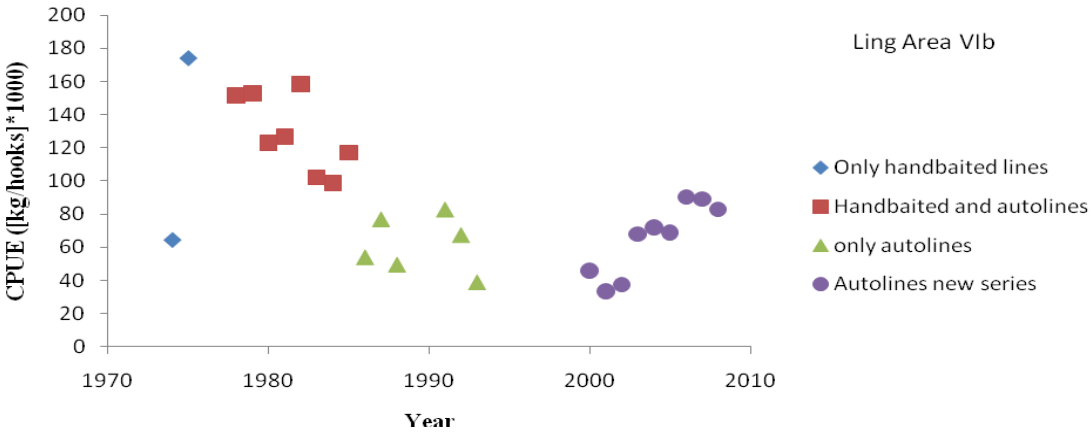


Figure 5.5.4. Estimates of cpue (kg/1000 hooks) of ling based on skipper's logbooks (pre-2000) and official logbooks (post-2000). Combination of data from Bergstad and Hareide, 1996 and Helle and Pennington., WD, 2010. Note gap in time-series between 1993 and 2000, and the differences in cpue scale between areas (preliminary estimates for 2009). The data used for the period 1971–1993 are, early on only hand baited lines (blue diamonds), then a mix of both hand baited and autolines (red squares) and finally only autolines (green triangles). The new dataseries is denoted by purple circles.

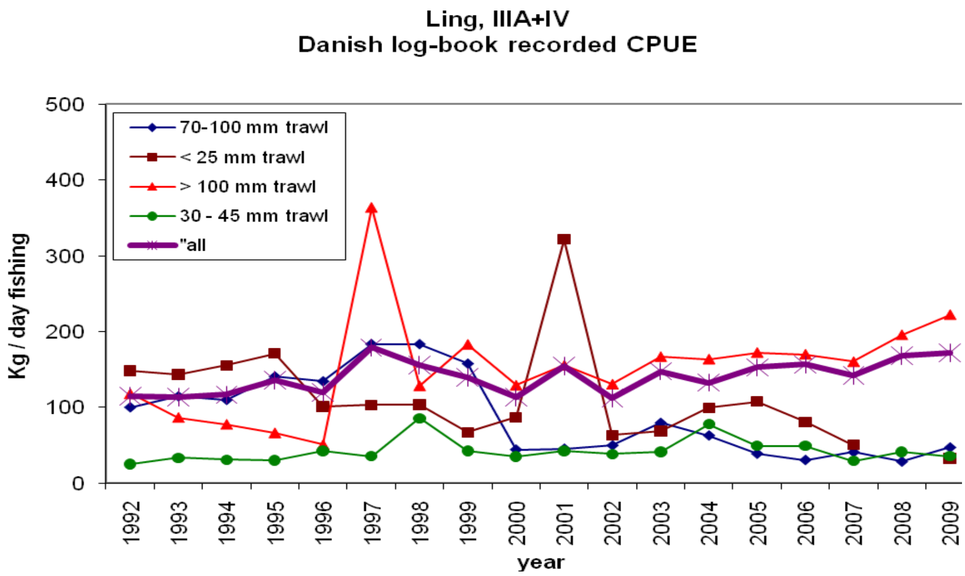


Figure 5.5.5. Cpue of ling for Danish trawlers in Subareas IIIa and IV. Based on logbook data.

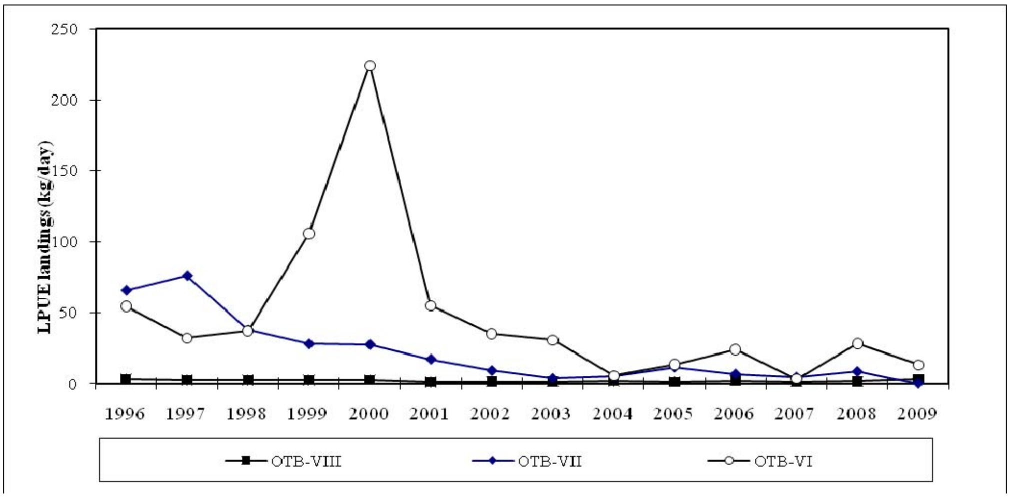


Figure 5.5.6. Historical series of lpues (kg/day) of the Basque Country OTB fleet in Subareas VI, VII and VIII since 1996.

6 Blue Ling (*Molva dypterygia*) in the Northeast Atlantic

6.1 Stock description and management units

Biological investigations in the early 1980s suggested that at least two adult stock components were found within the Area, a northern stock in Subarea XIV and Division Va with a small component in Vb, and a southern stock in Subarea VI and adjacent waters in Division Vb. However, the observations of spawning aggregations in each of these areas and elsewhere suggest further stock separation. This is supported by differences in length and age structures between areas as well as in growth and maturity. Egg and larval data from early studies also suggest the existence of many spawning grounds. The conclusion is that stock structure is uncertain within the areas under consideration.

However, as in previous years, on the basis of similar trends in the cpue series from Division Vb and Subareas VI and VII, blue ling from these areas has been treated for assessment purposes as a single southern stock. Blue ling in Va and XIV has been treated as a single northern stock. All remaining areas are grouped together as "other areas.

Catches data for blue ling in 2006 and 2007 aggregated at the level of statistical rectangle were provided to the Working Group by France, Ireland, the UK (England and Wales and Scotland) and Iceland. These are shown in Figures 6.1.1 and 6.2.2.

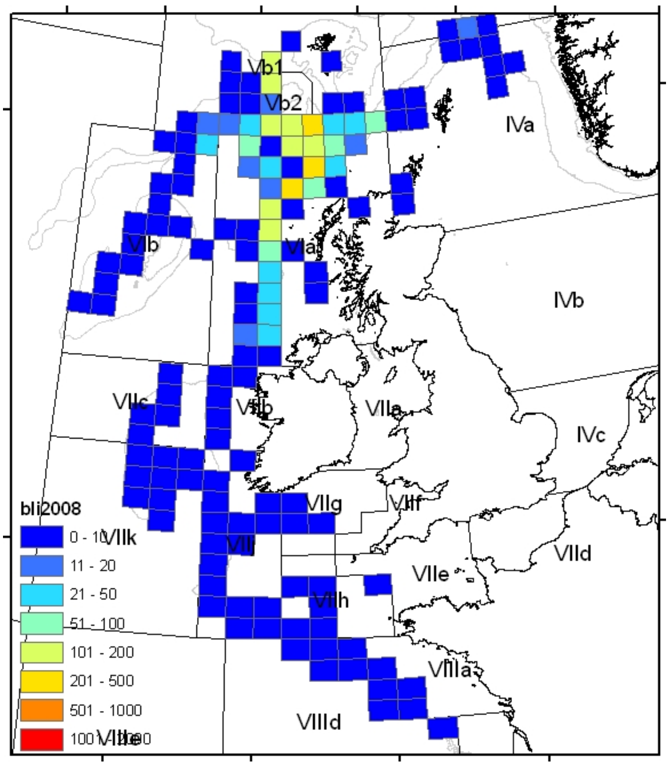


Figure 6.1.1. Catches of blue ling by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2008.

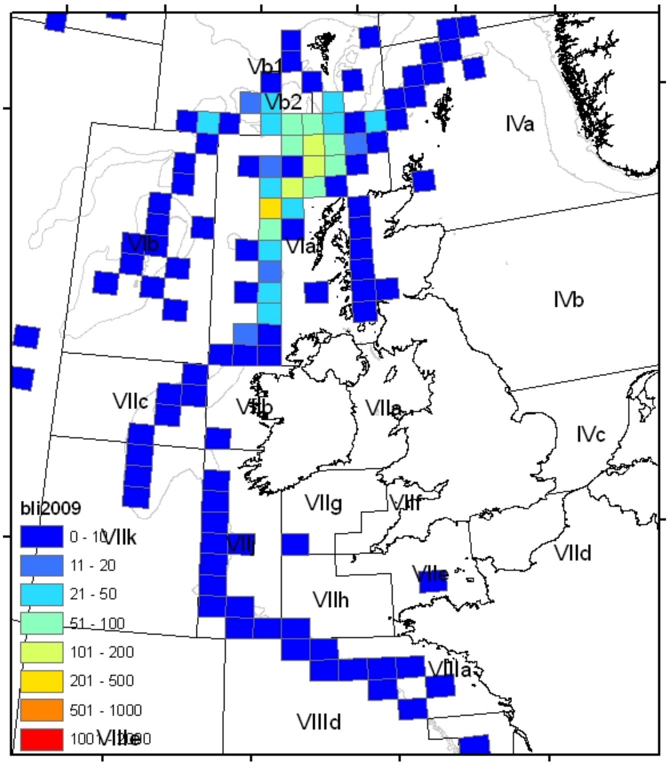


Figure 6.1.2. Catches of blue ling by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2009.

6.2 Blue Ling (*Molva* Dypterygia) In Division Va and Subarea XIV

6.2.1 The fishery

The change in geographical distribution of the Icelandic blue ling fisheries from 1996, to 2009 (Figure 6.2.1a) indicates that there has been an expansion of the fishery of blue ling to north-western waters. This increase is likely to be the result of increased availability of blue ling in the north-western area, rather than being the result of an increase in effort or reporting.

The fishery for blue ling in Va changed substantially in nature and extent in the early 1980s. At the start of this period catches were high (Figure 6.2.3), in part because of fisheries on spawning aggregations. These aggregations diminished relatively quickly and since the mid 1980s blue ling has largely been a bycatch in the redfish and Greenland halibut fishery. In 1993, the Icelandic fleet fished on aggregations of spawning blue ling in a small area on the Reykjanes ridge at the border between Subareas Va and XIV (Figure 6.2.2). This was a transient fishery that declined rapidly in the years thereafter.

Before 2008 the majority of the catches of blue ling in Va were caught by trawlers, as bycatch where the main target species are cod, haddock and other demersal species. 50% of the bottom trawl catches in 2007 were taken within the depth range of 300–700 and 50% of the longline catches was taken at depths greater than 400 m. In 2008 and 2009 there is a substantial change in the fishery for blue ling in Va as longliners started targeting blue ling (Figure 6.2.1.b). Subsequently the proportion of catches taken by longliners increased from 7–20% in 2001–2007 to around 40% in 2008–2009.

Historically the fisheries in Subarea XIV have been relatively small.

6.2.2 Landings trends

The gross fluctuation in catches in the late seventies, early eighties and again in the early nineties is most likely a reflection transient fisheries on spawning grounds (Figure 6.2.3).

As a result of depletion of fish on spawning grounds, total international landings in Va declined from around 8500 t in 1980 to a level of between 2000 and 3000 t in the late 1980s. Landings were at a historical low in the late 1990s, but have increased in recent years (Table 6.2.1a and Figure 6.2.3). The preliminary total landings in Va 2009 were 4233 t of which the Icelandic fleet caught 4132 t. Catches of blue ling in Va have nearly doubled since 2006, the main part of this increases can be attributed to increased targeting of blue ling by the longline fleet (Figure 6.2.1b).

Total international landings from XIV (Table 6.2.1b) have been highly variable over the years, ranging from a few tonnes in some years to around 3700 t in 1993 and 950 t in 2003. Most of the landings in 2003 were taken by Spanish trawlers (390 t), but there is no further information available on this fishery. These larger landings are very occasional and in most years total international landings have been between 50 and 200 t. Preliminary landings in 2009 were 7 t.

6.2.3 ICES Advice

The latest Advice is from ICES in May 2008 states: There should be no directed fisheries for blue ling in Areas Va and XIV and measures should be implemented to minimize catches in mixed fisheries. Blue ling is susceptible to sequential depletion of spawning aggregations and closed areas to protect spawning aggregations should therefore be maintained and expanded where appropriate.

6.2.4 Management

The Icelandic fishery is not regulated by a national TAC or ITQs. The only restrictions on the Icelandic fleet regarding the blue ling fishery was the introduction of closed areas in 2003 to protect known spawning locations of blue ling, which are in effect (Figure 6.2.2).

EU has in recent years had TAC of redfish in Va and small TAC of bycatch in that fishery which includes blue ling. No EU vessels fished for redfish in Va in 2009.

6.2.5 Data available

6.2.5.1 Landings and discards

Landings data are given in Tables 6.2.1 and 6.2.2. Discarding is banned in the Icelandic fishery. There is no available information on discarding of blue ling in Va and XIV.

6.2.5.2 Length compositions

Length distributions from the Icelandic trawl catches for the period 1996–2007 are shown in Figure 6.2.4 and from the Icelandic groundfish surveys (described later) in Figure 6.2.7. Detailed overview of the sampling from catches and surveys was given in WGDEEP 2007 Report. The sampling intensity in 2009 was similar as in recent years.

6.2.5.3 Age compositions

No new data were available. Existing data are not presented due to the difficulties in the ageing of this species.

6.2.5.4 Weight-at-age

No new data were available. Existing data are not presented because of difficulty with ageing.

6.2.5.5 Maturity and natural mortality

Length-at-maturity from available data since 1986 is shown in Figure 6.2.5. L_{50} was estimated at roughly 77 cm.

No information was available on natural mortality (M).

6.2.5.6 Catch, effort and survey data data

Effort and cpue data from the Icelandic trawl fleet are given in Table 6.2.3 and Figure 6.2.10.

The Icelandic spring groundfish survey, which has been conducted annually in March since 1985, gives fisheries-independent data for many exploited stocks in Va including blue ling (Figure 6.2.8) A total of more than 550 stations are taken annually in the survey at depths down to 500 meters. However, the spring survey area does not cover the most important distribution area of blue ling as their distribution area goes to greater depths (For details on the spring survey in Va, see the Stock Annex for tusk in Va).

In addition, an autumn survey was commenced in 1996 covering 150 stations of the 550 stations that have been taken in spring survey (i.e. shallower than 500 m). From its commencement in 1996 to 1999 an additional 150 stations were taken in deeper waters off the west, north, east and southeast continental slopes off Iceland (primarily targeting Greenland halibut). In 2000, 74 stations were added to the survey, covering the continental slopes to the south of Iceland and the Reykjanes ridge. The station coverage of the autumn survey from the year 2000 is thought to represent a reasonable coverage of the distribution of the blue ling fishery (Figures 6.2.1a and 6.2.9). For details on the autumn survey see the Stock Annex for tusk in Va.

Time-series stratified abundance and biomass indices from the spring and autumn trawl surveys are shown in Figure 6.2.6.

6.2.6 Data analyses

The annual number of length measurements from the Icelandic commercial trawl catches (Figure 6.2.4) are low, compared to the great length span of this species in commercial catches. The low sampling may thus not reflect the actual lengths of the catches. Notwithstanding, there is no evidence of an overall trend in the mean length.

Length distribution data from the spring trawl survey (Figure 6.2.7) are very different from those in the commercially fishery, comprising of a greater proportion of younger fish and a low proportion of larger fish (stock abundance for blue ling in Va peaks at depths at around 700 to 900 m). Therefore the length distributions from the autumn survey may better reflect the length distribution of the stock (Figure 6.2.8). In most years the length distribution in the autumn survey peaks between 70–80 cm, close to what is observed in the commercial trawl catches (Figure 6.2.4).

Cpue data derived from commercial trawl trips where blue ling accounts for more than 10% of catch have been considered to be a reliable index of abundance and show a persistent decline during the 1990s to a stable but very low level in recent years (Figure 6.2.11). Another cpue series based on hauls directed at blue ling (where blue ling accounts for more than 50%) shows strong perturbations in years of direct fishing on spawning aggregations. However, a cpue series where blue ling can be considered as bycatch (using hauls where blue ling is present, but less than 50% of the catch) is relatively stable. Effort indices or the number of hauls where blue ling is a bycatch (>10% and <50%) have been increasing in since 2004. First there the effort indices increased by 50% from 2004 to 2007. In 2007–2009 the indices increased drastically by 150–200%.

The spring survey covers only the shallower part of the depth distributional range of blue ling and shows high inter annual variance (Figure 6.2.6). It is thus unknown to what extent the spring indices reflect actual changes total ling biomass, given that is does not cover the depths were largest abundance of blue ling occur. It is however not driven by isolated large catches at a few survey stations. It decreased by 90% from 1985–1995. It remained very low until 2003, but in six last surveys (2004–2010) the index has increased from being 20% of the 1985 value to be similar to what it was in the 1980s. However, given the above, the recent increase observed in the spring survey should be treated with caution. Figure 6.2.6d, which shows the abundance of under 40 cm fish may provide an indication of abundance of pre-recruits.

The shorter autumn survey, which is more likely to reflect the true biomass dynamics than the spring survey does indicate that there has been some increase in the blue ling biomass since 2007. A large increase or more than 200% in the recruitment index was observed in 2008 but in the 2009 autumn survey it had decreased again by approximately 25% or to its second highest value (Figure 6.2.6).

Relative fishing mortality (Fproxy = Yield/Survey biomass) derived from the autumn survey (+40 cm) indicates that fishing mortality may have increased by more than 50% between 2005–2006 and 2009 (Figure 6.2.12).

This year no analytical assessments were attempted.

6.2.7 Comments on the assessment

Generating a cpue index that may reflect changes in abundance for blue ling is difficult, given the occasional opportunistic fisheries on discovered spawning grounds in some years. In such cases using tows where the proportion of blue ling is larger than a certain percentage may not be valid, when attempting to derive a reliable stock index. However, by using tows where the blue ling is only a bycatch (using tows were blue ling is less than 50% of catch) one may exclude these transient fisheries on spawning aggregations. However, due to time contraints, detailed work on establishing a cpue based on different criterion than has been done in the past was not possible prior to the commencement of the WG meeting this year.

At the 2004 WG, exploratory runs of Delury, surplus production and stock reduction models were carried out using total international catch data for Division Va and Subareas XIV combined (1966–2003) and cpue data from Icelandic spring groundfish trawl survey (1985–2003) (see above). Although the survey data are fisheries independent and are considered to be a better indicator of changes in stock abundance than longline and trawl data from Icelandic commercial vessels, the fits from the models were generally poor reflecting a high variability in the survey series, particularly in the early years.

The Icelandic autumn groundfish survey covers the full depth range of blue ling and should in years to come provide a reasonable basis for the assessment of this stock. Suitable assessments methods may be stock reduction or possibly CSA.

Relative fishing mortality may be indicative of true fishing mortality and should therefore be used in the absence of an analytical assessment as indicative of trends for assessment purposes.

6.2.8 Management considerations

The view was expressed that cpue from commercial fishing vessels, which is derived largely from data from spawning aggregations, is not a reliable indicator of exploitable biomass for this species because of sequential depletion. However all known spawning areas of blue ling in Va are now closed to fishing so as time goes by the years of fishing on spawning aggregations may be omitted from the series. Cpue data from the Icelandic trawl fleet suggest that the abundance of blue ling in Va in recent years is about 50% of that observed at the start of the series in the early 1990s. These data show no evidence of a recovery in stock. However there is high variance at the beginning of the time-series (1992–2000) compared with the realatively stable cpue since 2000. In contrast the autumn survey indicates increased biomass of blue ling in Va in 2008 and 2009. However the increased catches in these same years have resulted in an increase in relative fishing mortality to its highest value since 2001.

At previous Working Groups, available evidence has indicated that blue ling in Va is at a low level since the early 1990s. High landings in the 1980s suggest that historical stock abundance may have been even higher. Trends in the autumn survey indicate an increase in recent years, however; the increase in catches and relative fishing mortality may be in excess of the stock productivity. The increased targeting of blue ling by the longline fleet in 2008 and 2009 contradicts the latest Advice from ICES.

Closed areas to protect spawning aggregations should be maintained and expanded where appropriate.

Table 6.2.1. Blue ling: Landing in ICES Division Va.

Year	Faroe	Germany	Iceland	Norway	UK	Total
1973	74	1678	548	6	61	2367
1974	34	1959	331	140	32	2496
1975	69	1418	434	366	89	2376
1976	29	1222	624	135	28	2038
1977	39	1253	700	317	0	2309
1978	38	0	1237	156	0	1431
1979	85	0	2019	98	0	2202
1980	183	0	8133	83	0	8399
1981	220	0	7952	229	0	8401
1982	224	0	5945	64	0	6233
1983	1195	0	5117	402	0	6714
1984	353	0	3122	31	0	3506
1985	59	0	1407	7	0	1473
1986	69	0	1774	8	0	1851
1987	75	0	1693	8	0	1776
1988	271	0	1093	7	0	1371
1989	403	0	2124	5	0	2532
1990	1029	0	1992	0	0	3021
1991	241	0	1582	0	0	1823
1992	321	0	2584	0	0	2905
1993	40	0	2193	0	0	2233
1994	89	1	1542	0	0	1632
1995	113	3	1519	0	0	1635
1996	36	3	1284	0	0	1323
1997	25	0	1319	0	0	1344
1998	59	9	1086	0	0	1154
1999	31	8	1525	8	11	1583
2000	0	7	1605	25	8	1645
2001	95	12	752	49	23	931
2002	28	4	1256	74	10	1372
2003	16	16	1098	6	24	1160
2004	38	9	1083	49	20	1199
2005	24	25	1497	20	26	1592
2006	63	22	1734	27	9	1855
2007	78	0	1999	4	10	2091
2008	101		3653	4		3758
2009[1)]	87	0	4132	4	0	4233

[1)] **Provisional figures.**

Table 6.2.2. Blue ling: Landing in ICES Division XIV.Source: STATLANT database.

Year	Faroe	Germany	Greenland	Iceland	Norway	Russia	Spain	UK	Total
1973	0	50	0	10	0	0	0	0	60
1974	0	90	0	6	0	0	0	0	96
1975	0	285	0	90	3	0	0	0	378
1976	0	65	0	21	0	0	0	13	99
1977	0	491	0	0	0	0	0	6	497
1978	0	933	0	0	4	0	0	0	937
1979	0	1026	0	0	0	0	0	0	1026
1980	0	746	0	0	0	0	0	0	746
1981	0	1206	0	0	0	0	0	0	1206
1982	0	1946	0	0	0	0	0	0	1946
1983	0	621	0	0	0	0	0	0	621
1984	0	537	0	0	0	0	0	0	537
1985	0	315	0	0	0	0	0	0	315
1986	214	149	0	0	0	0	0	0	363
1987	0	199	0	0	0	0	0	0	199
1988	21	218	3	0	0	0	0	0	242
1989	13	58	0	0	0	0	0	0	71
1990	0	64	5	0	0	0	0	10	79
1991	0	105	5	0	0	0	0	45	155
1992	0	27	2	0	50	0	0	32	111
1993	0	16	0	3124	103	0	0	22	3265
1994	1	15	0	300	11	0	0	57	384
1995	0	5	0	117	0	0	0	19	141
1996	0	12	0	0	0	0	0	2	14
1997	1	1	0	0	0	0	0	2	4
1998	48	1	0	0	1	0	0	6	56
1999	0	0	0	0	1	0	66	7	74
2000	0	1	0	4	0	0	889	2	896
2001	1	0	0	11	61	0	1631	6	1710
2002	0	0	0	11	1	0	0	0	12
2003	0	0	0	0	36	0	670	5	711
2004	0	0	0	0	1	0	0	7	8
2005	2	0	0	0	1	0	176	8	187
2006	0	0	0	0	3	1	0	0	4
2007	19	0	0	0	1	0	0	0	20
2008	0.5				40				41
2009[1)]		0			3			4	7

[1)] Provisional figures.

Table 6.2.3. Blue ling. Registered catch, hours trawled and cpue from the Icelandic trawler fleet. Tows used for calculations of cpue are those where blue ling was more than 10% of total catch in each particular haul.

Year	Catch (t)	Hours	CPUE
1991	515	968	532
1992	643	1207	533
1993	3587	2805	1279
1994	659	1571	419
1995	406	1141	356
1996	185	764	242
1997	186	928	201
1998	267	1008	265
1999	723	2096	345
2000	236	1494	158
2001	132	934	141
2002	230	1846	124
2003	195	1492	131
2004	201	1355	148
2005	305	2302	133
2006	338	2813	120
2007	423	2304	184
2008	664	4895	136
2009	787	6641	118

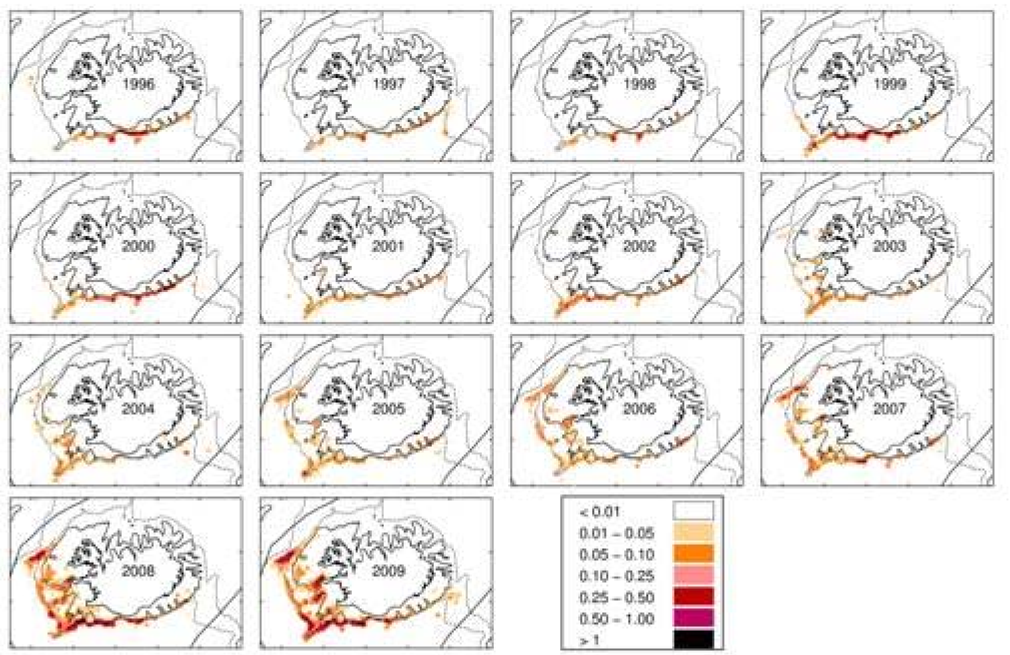


Figure 6.2.1a. Geographical distribution (tonnes/square mile) of the Icelandic blue ling fishery in 1996–2009 as reported in the logbooks. All gear types combined.

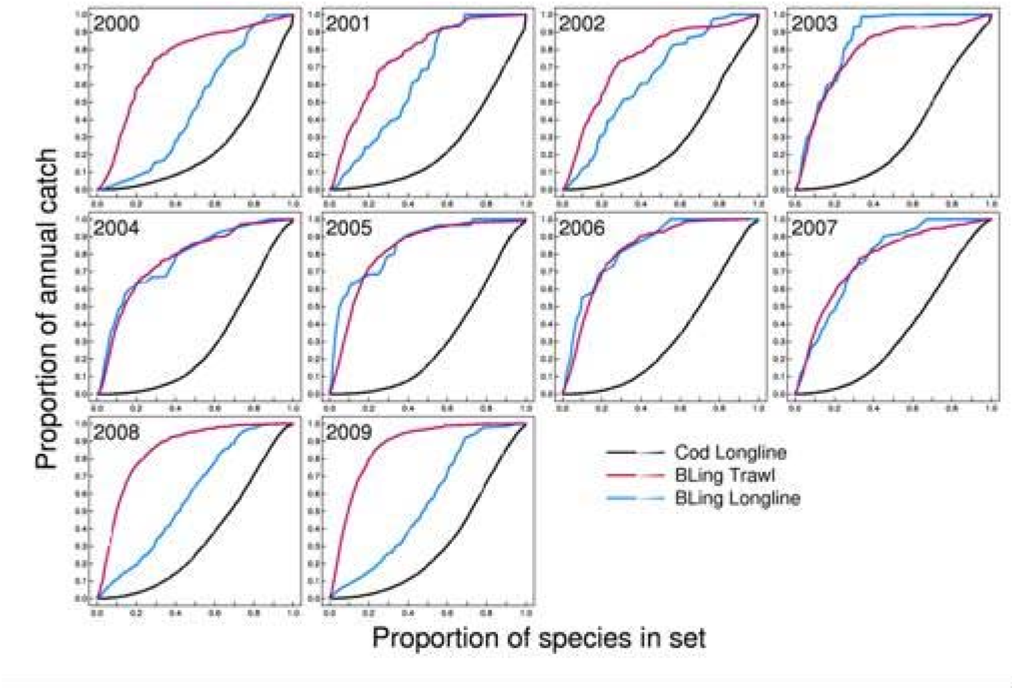


Figure 6.2.1b. Blue ling in Va. Plot of the fishery in 2000–2009 and for comparison the cod longline fishery. This plot is best explained by and example. In 2005 around 20% of the annual catch of cod (*y*-axis) were caught were it was 50% or more of the catch in each set/haul. So most of it was caught in a directed fishery. On the other hand blue ling in the trawl fishery is mostly a bycatch as more than 80% of the annual catch is caught where blue ling is less than 20% of the catch in each set/haul.

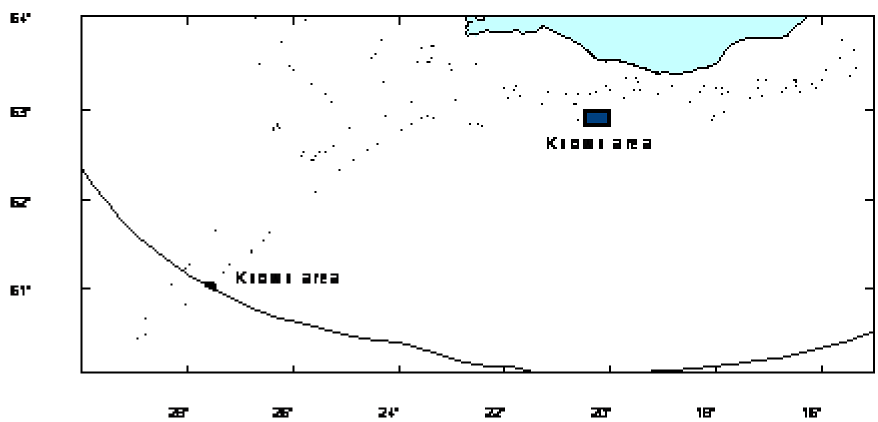


Figure 6.2.2. Known spawning grounds for blue ling in Icelandic waters.

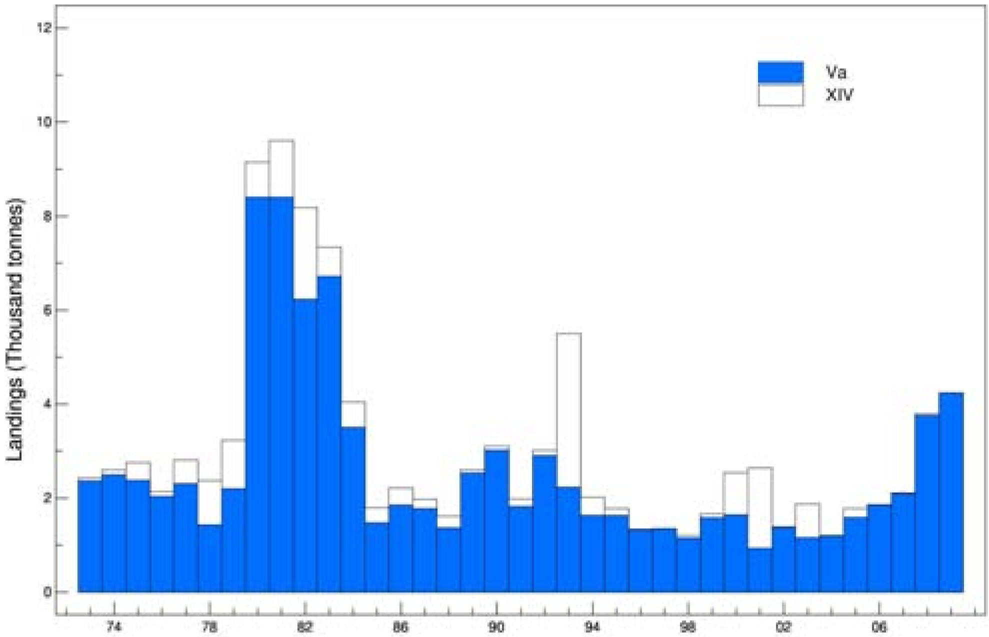


Figure 6.2.3. Blue ling in Va and XIV. Estimated total landings.

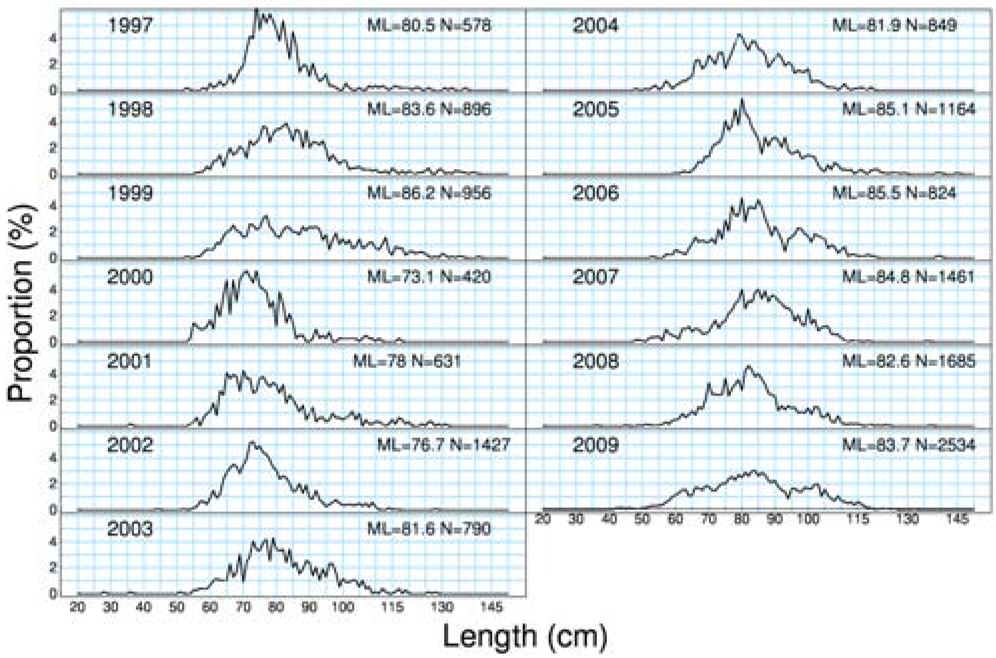


Figure 6.2.4. Length distribution of blue ling in the commercial catches (trawls) of the Icelandic fleet in Va 1996–2009. The number of measured fish (N) and mean length (ML) is also given.

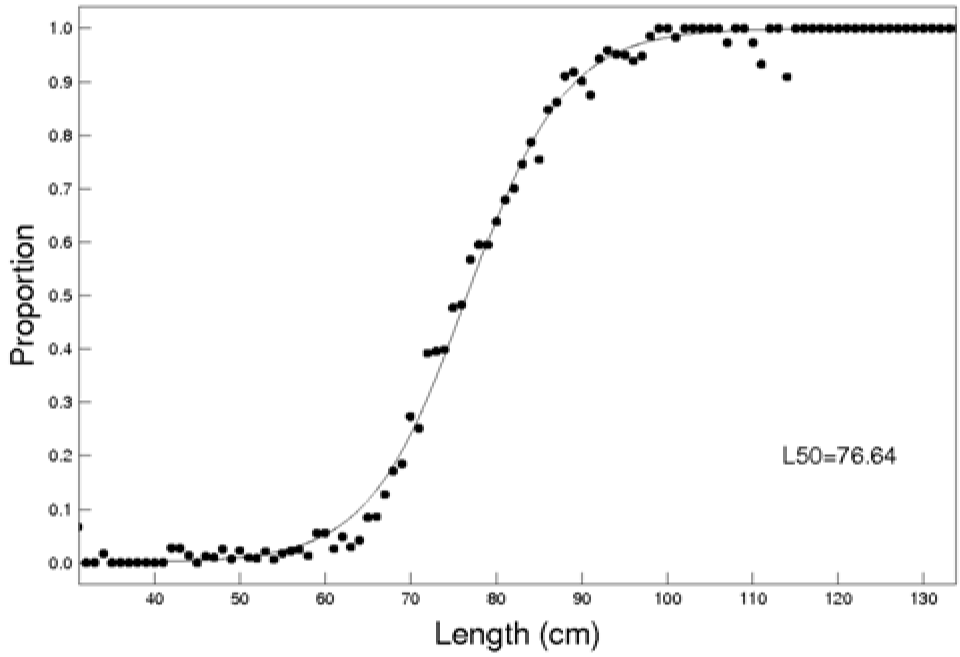


Figure 6.2.5. The proportion of mature of blueling as a function of length in Va, using both commercial catch and survey data. The data points show the observed proportion mature and the lines the fitted maturity. Also given is L50.

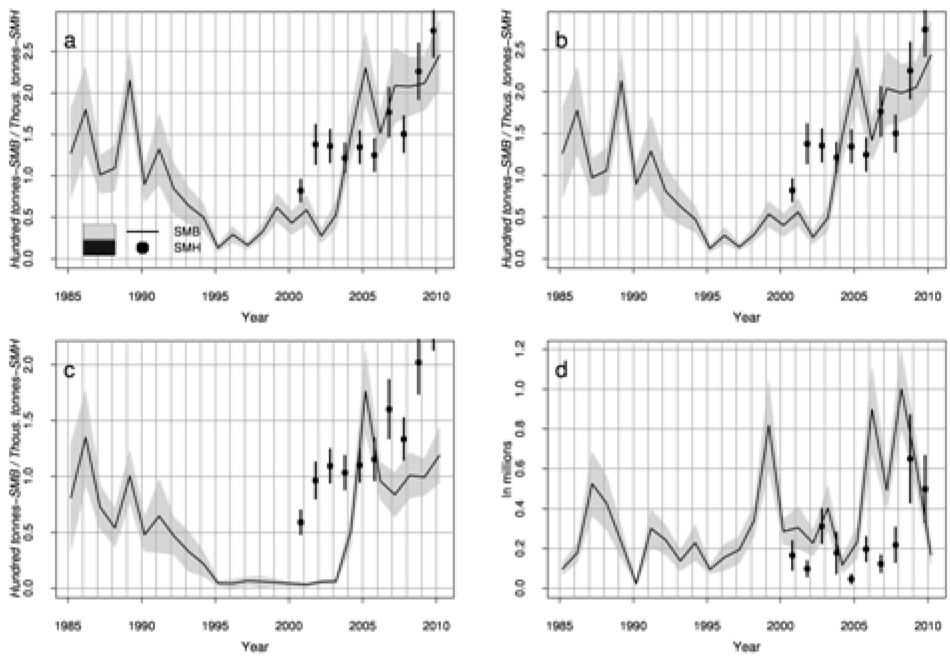


Figure 6.2.6. Abundance indices for blue ling in Icelandic groundfish survey in March 1985–2008 (SMB, line, shaded area) and October 1996–2008 (SMH, points, vertical lines). a) Total biomass index, b) Biomass of 40 cm and larger, c) Biomass 70 cm and larger, d) Abundance of <40 cm. The shaded area and the vertical bar show ±1 standard error of the estimate.

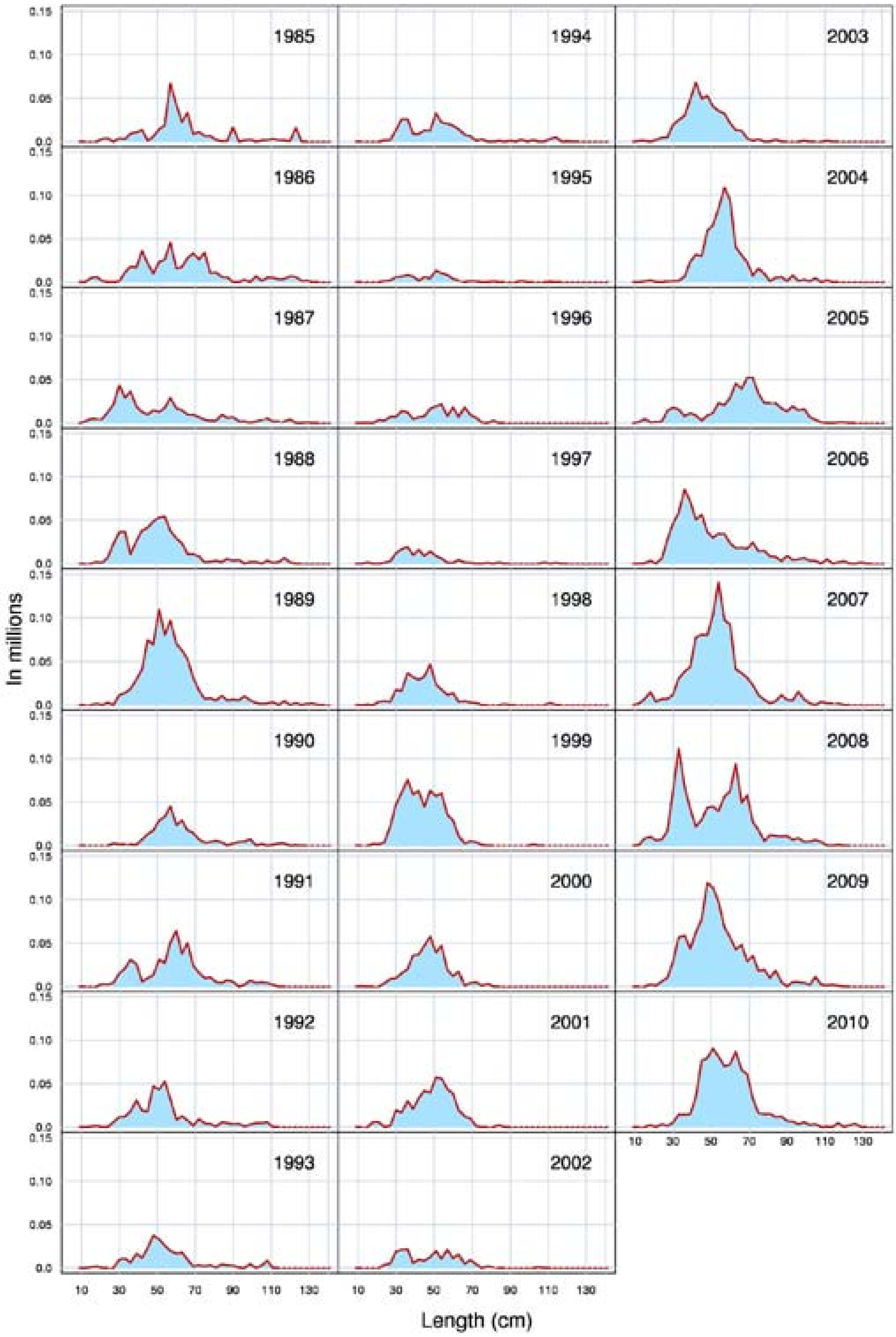


Figure 6.2.7. Length distributions of blue ling in the Icelandic groundfish survey in March 1985–2010.

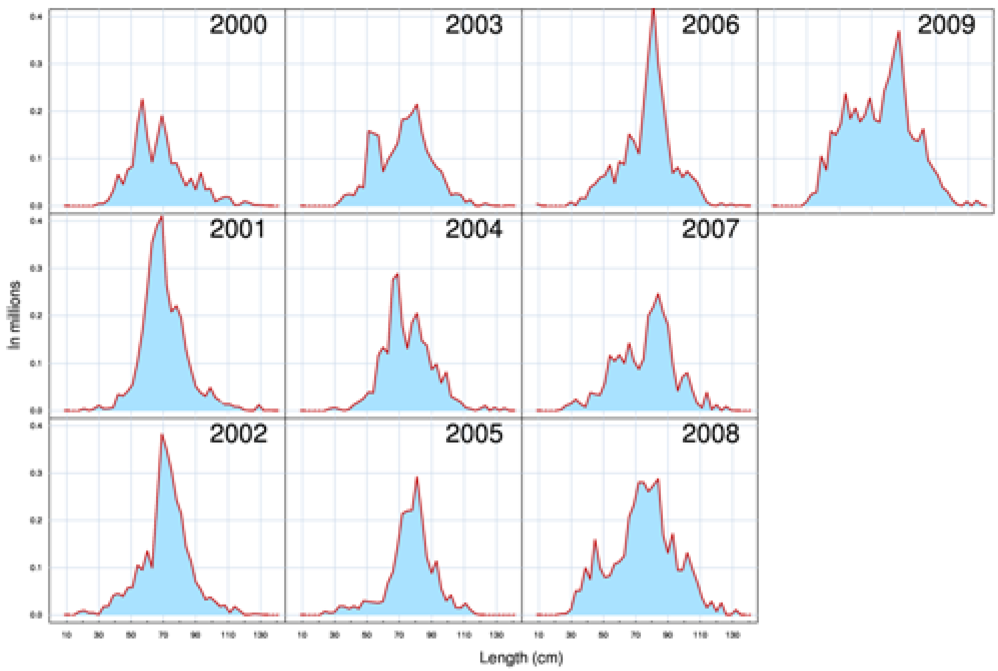


Figure 6.2.8. Length distributions of blue ling in the Icelandic groundfish survey in October 2000–2009.

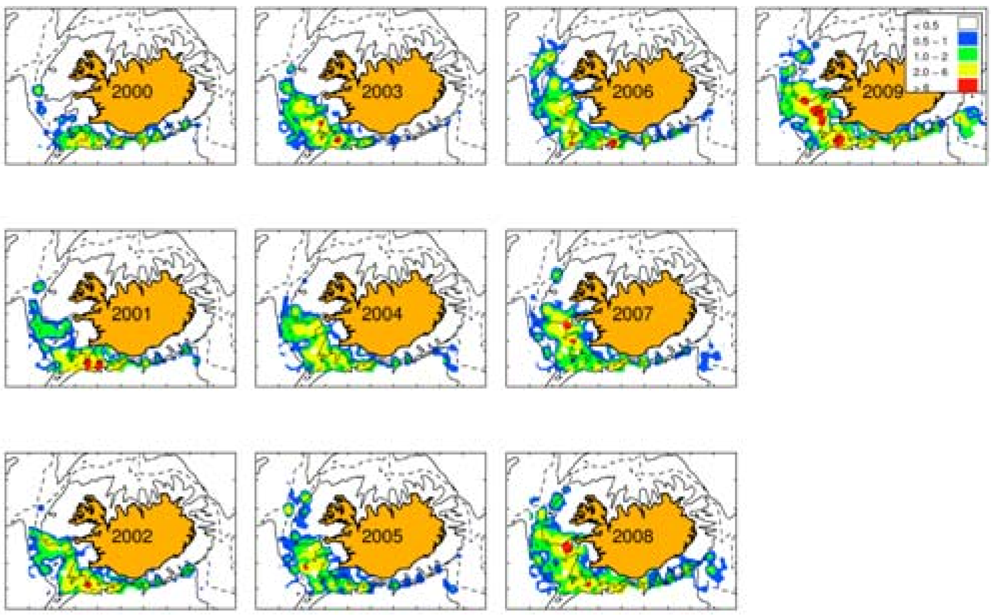


Figure 6.2.9. Distribution of blue ling in the groundfish survey in October 1999–2009.

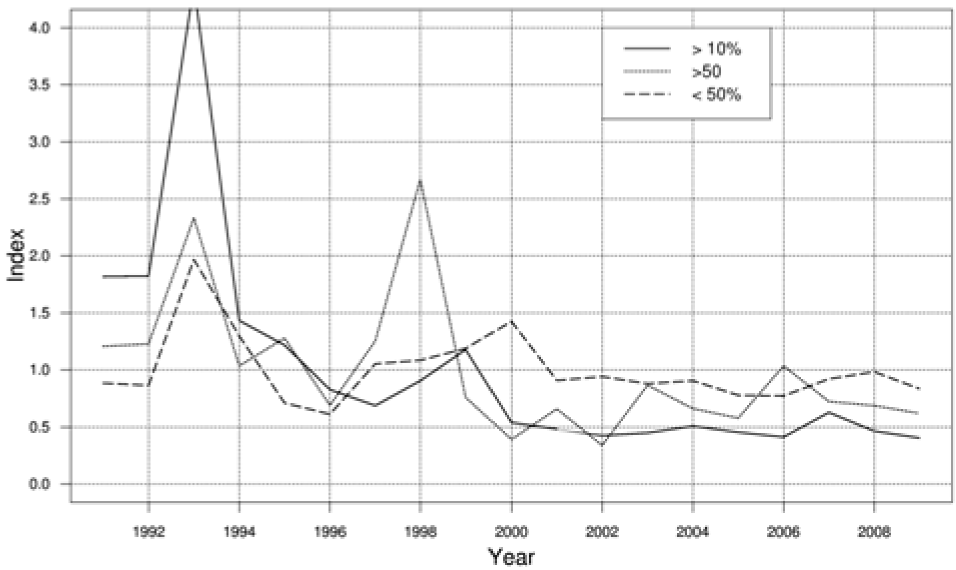


Figure 6.2.10. Index of raw cpue (sum(yield)/sum(effort)) of blue from the Icelandic bottom-trawl fishery based on logbooks 1991–2009. The criteria for the calculations were tows where blue ling composed at least 10% and 50% as well as less than 50% of the total catch.

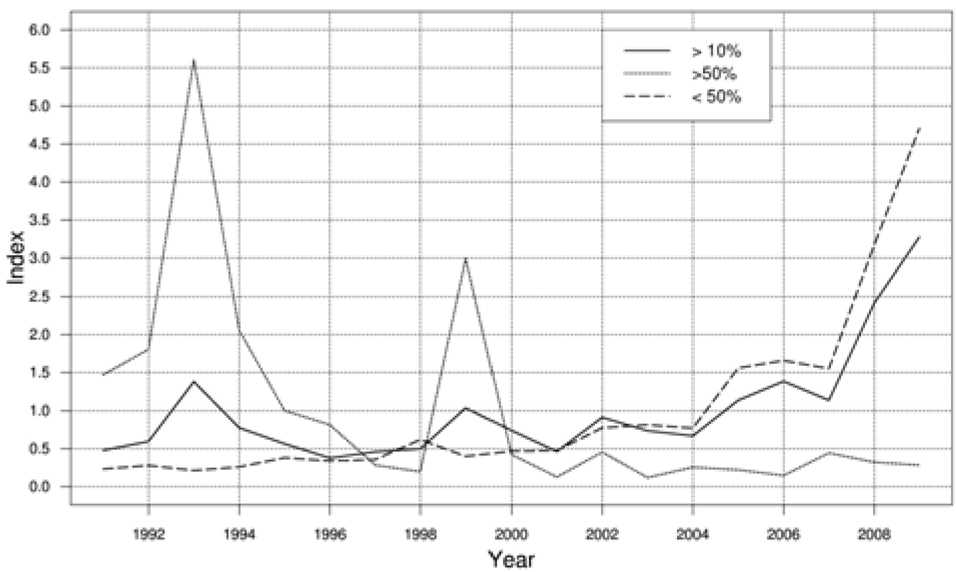


Figure 6.2.11. Index of fishing effort of blue ling from the Icelandic bottom-trawl fishery based on logbooks 1991–2008. The criteria for the calculations were tows where blue ling composed at least 10% and 50% as well as less than 50% of the total catch.

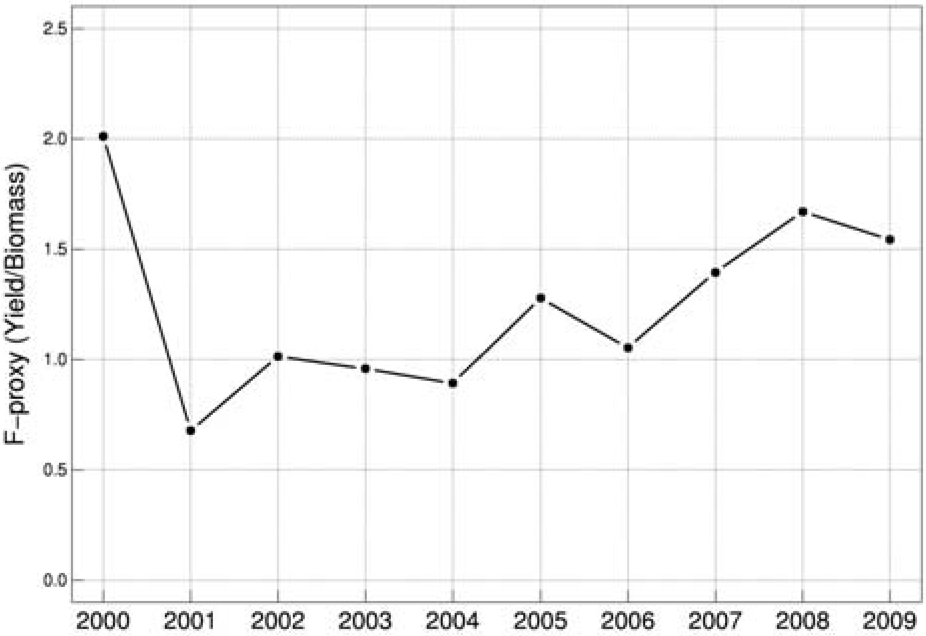


Figure 6.2.12. Changes in relative fishing mortalithy (Fproxy = Yield / Survey biomass).

6.3 Blue Ling (*Molva Dypterygia*) in Division Vb, Subarea VI and VII

6.3.1 The fishery

The main fisheries are those by Faroese trawlers in Vb and French trawlers in VI and, to a lesser extent, Vb. Total international landings from Subarea VII are very small and are bycatches in other fisheries.

Landings by Faroese trawlers are mostly taken in the spawning season. Historically, this was also the case for French trawlers fishing in Vb and VI. However, in recent years blue ling has been taken mainly as a bycatch in French trawl fisheries for roundnose grenadier, black scabbardfish and deep-water sharks.

6.3.2 Landings trends

The rapid increase in the size of this fishery in the early 1970s is considered to be related to the expansion of national fisheries limits to 200 nautical miles and the resultant displacement of fishing effort and the associated development of markets.

Total international landings from Division Vb (Table 6.3.0a–e and Figure 6.3.1) peaked in the late 1970s at around 21 000 t, stabilized in the 1980s at around 5000–10 000 t and have since declined to a stable low level of around 3000 t with a reduction in 2009 to around 1400 t.

The landings from Subarea VI peaked at about 18 000 t in 1973 and fluctuated throughout the 1980s within the range of 5000–10 000 t. and have since gradually declined to around 1300 t in 2009.

Landings from Subarea VII are comparatively small and are mostly less than 500 t per annum and have mostly declined in recent years to <100 t.

The overall trend in total international landings for all areas combined demonstrates a series of peaks in the 1970s and 1980s, then a strong decline until a smaller peak in the late 1990s and a gradual decline thereafter. It should be noted that EU TACs were introduced in 2003 and these may have had a limiting factor on landings by EU Member States.

6.3.2.1 ICES Advice

The latest Advice is from ICES in 2008 is: *There should be no directed fisheries for blue ling in Subdivisions Vb, VI, and VII and measures should be implemented to minimize bycatches in mixed fisheries. Blue ling is susceptible to sequential depletion of spawning aggregations and closed areas to protect spawning aggregations should therefore be maintained and expanded where appropriate.*

6.3.2.2 Management

Prior to 2009, EU deep-water TACs have been set on a biennial basis; however from 2009 onwards annual TACs will be applied for the components of this stock in Vb and in VI and VII.

For 2009, a combined EU TAC for blue ling and ling is set in Faroese waters of Vb at 3065 t, of which a bycatch of maximum of 1080 tonnes of roundnose grenadier and black scabbard fish to be counted against this quota.. The EU TAC for blue ling in VI and VII was 2009 t. Norway and the Faroes have a TAC of 150 t, which for Norway can be taken from IIa, IV, Vb, VI and VII. The EU TAC for EU and international waters of Subareas II, IV and V was 66 t.

For 2010, a combined EU TAC for blue ling and ling is set in Faroese waters of Vb at 2700 t. The EU TAC for blue ling in VI and VII is 1732 t. The EU TAC for Community and international waters of Subareas II, IV and V is 66 t.

In 2009, protection areas were introduced for spawning aggregations of blue ling on the edge of the Scottish continental shelf and at the edge of Rosemary Bank (both in VIa). Entry/exit regulations apply and vessels cannot retain >6 t of blue ling from these areas per trip. On retaining 6 t vessels must exit and cannot re-enter these areas before landing. These vessels cannot discard any quantity of blue ling.

From 2009 onwards, Member State Observer Sampling Plans, developed in accordance with EC Regulation 2347/2002, were to be revised to include a sampling protocol for sex and maturity of sampled blue ling (based on sampling advice provided by ICES in 2009).

According to landings data reported to ICES WGDEEP, the EU TAC in VI and VII in 2009 (2009 t) was not fully taken (total EU landings 1262 t. There is minimum landing size of 70 cm for blue ling landings in Faroese waters.

6.3.3 Data availability

6.3.3.1 Landings and discards

In 2008, the landings time-series from the southern blue ling stock was extended back to 1966 based upon North Western Working Group reports from 1989–1991 and data in Moguedet, (1988). Landings data in the 1980s for French freezer trawlers may be underestimated in some years.

Large French catches were reported as ling at the start of the fishery in 1973–1975. In order to derive a best estimate of blue ling landings, the average ling landings in the years preceding the start of the French blue ling fishery were subtracted from estimates of blue ling and ling combined.

Landings data are given in Table 6.3.0a–e. Landings data at the level of ICES statistical rectangles were provided by France, (UK) Scotland, UK (England and Wales) and Ireland and these have been aggregated by quarter and plotted to display the geographical distribution of the fishery in Figure 6.3.2. The figures presented are for 2008 and 2009 but plots back to 2001 are presented in ICES 2009.

Information collected under the French deep-water sampling programme indicates there are no discards of this species in the French trawl fishery. However, the French industry has reported low levels of discarding towards the end of 2009 when quotas were exhausted.

The only other discard data available are from the Spanish Observer Program for trawlers fishing in VIb. There are official records of blue ling catches in Division VIb for the period 2004–2009. During this time and in this division, observers have covered between 8% (2009) and 30% (2008) of the total number of fleet fishing days. It is reported that discards for this species are negligible, in the range of 0–0.5% of the catch.

6.3.3.2 Length compositions

Length composition data of blue ling from Faroese trawlers in Division Vb are presented in Figure 6.3.3. Further details can be found in WGDEEP10 WD Information on the mean length in annual landings was not available.

Time-series data (1984–2008, excluding 1985 and 1986) of the raised length composition of French trawl landings of blue ling in VIa are given in Figure 6.3.4. The trend in annual mean length in Division VIa is shown in Figure 6.3.5.

Mean lengths of blue ling from the Norwegian reference fleet in Divisions Vb, VIa, VIb are given Table 6.3.1.

6.3.3.3 Age compositions

Preliminary age estimates were made from French sampling of landings in 2009 according to the DCF (n = 754). There are also some existing historical data for some years and ICES areas. These are not presented as a result of the difficulties in the ageing of this species.

6.3.3.4 Weight-at-age

No new weight-at-age data were available. Existing data are sparse and are not presented because of difficulty in ageing.

6.3.3.5 Maturity and natural mortality

No new data on maturity were available. No information was available on natural mortality (M). However, an estimate of M is can be estimated using the relationship (Annala, J. H., Sullivan, K. J., (1996):

$$M = \ln(100)/\text{maximum age}$$

The maximum age can be set at the age where 1% of a year class is still alive. Based on Faroese and French age readings, it is reasonable to assume the maximum age for blue ling is around 30 years. Given this and the relationship above, M may be in the order of 0.15.

6.3.3.6 Catch, effort and RV data

Cpue data are available for Faroese trawlers in Division Vb 1994–2009 (Figure 6.3.6).

Catch, effort and cpue data from Faroese trawl surveys (1994–2009) are shown in Table 6.3.2 and Figure 6.3.7. Small numbers of juvenile blue ling are caught in the Faroese bottom-trawl surveys (Figure 6.3.8). Although only the small numbers of blue ling are caught, these data may provide useful information on changes in recruitment.

A French deep-water tallybook database (based on fishers' own records) developed by the French industry and updated to include data for 2009, was available. Based on these data, an analysis of blue ling lpue was carried out (Lorance *et al.*, 2010 in press). Lpue trends over years were estimated for five different areas (Figure 6.3.10). A description of the methodology used is given in the general section on data availability (Section 3.1.5). An index of annual abundance for the entire area was calculated by taking the simple average of the predicted annual mean lpue (from the GAM) across rectangles (Figure 6.3.11).

A new index was available from a Scottish deep-water survey to the west of Scotland. The fish community of the continental shelf slope to the northwest of Scotland has been surveyed by Marine Scotland - Science [formerly Fisheries Research Services, (FRS)] since 1996, with strictly comparable data available between 1998 and 2008. This has focussed on a core area between 55–59°N, with trawling undertaken at depths ranging from 300 to 1900 m with most of the hauls being conducted at fixed stations, at depths of around 500 m, 1000 m, 1500 m and 1800 m. Further hauls have been made on seamounts in the area, and on the slope around Rockall Bank, but these are exploratory, irregular and not included in the survey dataset. This survey was conducted biennially, in September, until 2004, since when it has been carried out on an annual basis. Locations of trawl sites between depths of 500–1500 m are shown in Figure 6.3.12. In total, the data set comprises 233 valid hauls, the distributions across years of which are shown in Table 6.3.3. From 1998 to 2008 the bottom trawl was rigged with 21″ rock-hopper ground gear, however in 2009, a switch was made to lighter ground gear, with 16″ bobbins. The trend in annual mean cpue is shown in Figure 6.3.13.

A new index was available from an Irish deep-water trawl survey of the fish community of the continental shelf slope to west and northwest of Ireland carried out since 2006. Methodology is standardised in accordance with the Scottish deep-water survey with trawling at fixed stations around 500 m, 1000 m, 1500 m and 1800 m. The gear used throughout the surveys series is the same as that used by Scotland in 2009. To be consistent across the years the haul data used for the cpue calculation only includes the areas that are covered in all four years and the depth bands (500–1500 m) that are covered in all four years. Locations of trawl sites are shown in Figure 6.3.14. In total, the data set comprised 42 valid hauls, the distributions across years of which are shown in Table 6.3.4. The mean catch per unit effort in each year is shown in Figure 6.3.15.

6.3.4 Data analyses

The trend in time-series data of international landings for this stock (Figure 6.3.1) shows a number of short-lived peaks and these probably reflect the sequential location and fishing down of spawning aggregations.

The index of abundance from French trawler logbook data, used as a basis for Advice in 2008, could not be updated in time for use at WGDEEP 2010. This index (Figure 6.3.16) is considered to be the most reliable indicator of stock because it is the longest time-series available (1989 onwards)). The index is currently only available up to 2008 and shows a persistent decline in abundance until 2000 to a low level thereafter with small annual perturbations. In recent years this series must be treated with caution as the number of vessels remaining in the reference fleet is very low. There are also concerns regarding changes in species directivity as the stock became depleted. However, the main driver of the declining trend in cpue is considered to be depletion.

French trawl abundance data, based on haul-by-haul data from fisher tallybooks, is only available back to 2001 (Figure 6.3.11), and indicates that abundance in recent years from 2007 has increased. However this index should be interpreted with caution because the data are quite noisy and this is reflected by the wide confidence limits about annual estimates.

A similar increase in abundance in recent years is also evident in the short time-series available from Scottish and Irish trawl surveys to the west of Britain (Figures 6.3.13 and 6.3.15). These data must also be treated with caution because the areas surveyed are small in relation to the area of the entire of the stock and the numbers of blue ling captured are small.

Notwithstanding, abundance data from French tallybooks and the Irish and Scottish surveys are consistent in that they all suggest evidence of a some increase in abundance in recent years.

Mean length in French trawl landings from VIb (Figure 6.3.5) shows a strong decline until the mid-1990s and stability thereafter, and this is consistent with the fishing down of stock.

In order to estimate the fishing mortality that would generate the current observed mean length in the population using the following simple simulation was carried out. Although age estimation of adult fish in blue ling has been reported to be difficult, available growth parameters from different authors are fairly consistent (Ehrich and Reinsch, 1985; Magnussen, 2007; Moguedet, 1988; Thomas, 1987). These growth parameters were used to calculate the mean length in a simulated stock with a natural mortality M=0.17 and a fishing mortality F in the range 0–0.5 (i.e. Z in the range 0.17–0.67). Growth parameters for males and females were used considering that they should represent upper and lower limits of the likely values for the total stock. Relative numbers-at-age were calculated as in a yield-per-recruit model with constant recruitment and the range of Z explored. Individuals were all assumed to have the mean length of their age group and the mean length of the population was calculated for each fishing mortality level.

The current mean length (mean 2005–2009=90 cm) of the landings is obtained with Fs lower than 0.2 for 7 out of the 10 sets of growth parameters and with higher fishing mortalities (up to 0.5) using the 3 other sets (Figure 6.3.17). The overall mean F across the 10 sets of growth parameter suggests an F in the order of 0.2.

This approach should be considered preliminary. Further development is needed.

The only other data analysis attempted this year was a catch curve analysis of age data from French landings in 2009. The size of aged fish ranged from 70 to 133 cm and estimated ages ranged from 7 to 20 years. The catch curve was made across ages 10 to 20, as younger ages reflecting partial recruitment from age 7 to 10.The curve (Figure 6.3.18) indicates a total mortality (Z) of 0.26. M was assumed to be 0.15 (see 6.3.1.5). The catch curve results suggest, therefore, that F in 2009 may be below the level of M.

This approach should be considered preliminary as age estimates for blue ling are not validated, and no routine age estimation has been carried out in previous years. The age composition, observed in a single year, may also represent a biased view of the stock dynamic due to assumptions made for constant recruitment and fishing mortality.

6.3.5 Comments on assessment

No analytical assessment (stock reduction, CSA, etc.) was carried out this year, however a range of methodologies (Bayesian production, length-based methods, stock reduction will be trialled in DEEPFISHMAN Project and available for the next advisory meeting of WGDEEP (2012).

A new FLR-based stock reduction program (based on the PMOD method described above in Section 3.2 was available from the DEEPFISHMAN project. This program is preliminary and at present only allows the use of one abundance index. The intention was to trial this FLR routine on southern blue ling (Vb,VI and VII), however the index of abundance from French trawlers, used as a basis for advice in 2008, could not be updated in time for use at WGDEEP 2010.

6.3.6 Management considerations

The WG is aware that cpue data for blue ling from commercial fishing vessels, which are derived largely from data from spawning aggregations, may not be a reliable indicator of exploitable biomass for this species because of sequential depletion. However, the Group felt that the important issues were the large scale of the decline in French trawl logbook cpue (Figure 6.3.16) and the suggested slight increase in recent years observed in the French tallybook cpue index. The latter is consistent with available survey indices.

Other relevant results include the results of a catch curve analysis (Figure 6.3.13) and those from simulation analyses of the relationship between mean length in catches and F, indicate that F in 2009 may be around the level of M.

However, all of the above should be interpreted cautiously because of a range of concerns expressed in Section 6.1.4

Previous assessments carried out in 2004 (using stock reduction) and 2006 (using CSA) indicated that exploitable biomass was at a historically low level. The information presented this year indicates that the stock remains at a low level but there appears in recent years to be some evidence of an increase in abundance.

Table 6.2.0a. Landings of Blue ling in Subdivision Vb1.

Year	Faroes	France(2)	Germany(2)	Norway(3)	E & W(2)	Scotland (1)	Ireland	Russia (2)	Total
1966		839		430					1269
1967			1006	238					1244
1968			1838	823					2661
1969			303	798					1101
1970			348	2718					3066
1971			1367	557					1924
1972			2730	1203					3933
1973	51	80	3009	4003	4				7147
1974	43	390	1808	1554	3				3798
1975	17	2147	1528	2492	1				6185
1976	42	10475	896	1482					12 895
1977	23	6977	870	858	4			12 500	21 232
1978	423	3369	744	237	35				4808
1979	1072	2683	691	331					4777
1980	1187	2427	5905	304		1			9824
1981	1481	371	2867	167					4886
1982	2761	843	2538	121					6263
1983	3933	668	222	256					5079
1984	6453	515	214	105					7287
1985	4038	1193	217	140					5588
1986	4830	2578	197	94					7699
1987	3361	3246	152	81					6840
1988	3487	3036	49	94					6666
1989	2468	1802	51	228					4549
1990	946	3073	71	450					4540
1991	1573	1013	36	196	1				2819
1992	1918	407	21	390	4				2740
1993	2088	192	24	218	19				2541
1994	1065	147	3	173					1388
1995	1606	588	2	38	4				2238
1996	1100	301	3	82					1486
1997	778	1656		65	11				2510
1998	1026	1411	0	24	1				2462
1999	1730	1068	4	38	4				2844
2000	1677	575	1	163	33			1	2450
2001	1407	439	4	130	11		2		1993
2002	1003	578		274	8				1863
2003	2465	1133		12	1				3611
2004	751	1132		20				13	1916
2005	1028	781		15	1				1825
2006	1276	839		21	1			16	2153
2007	1220	1167		212	8			36	2643
2008	642	865		35				110	1652
2009*	523	188		13				15	739

***Preliminary. (1) Included in Vb2. (2) Includes Vb2 (3) includes Vb2 up to 1974.**

Table 6.3.0b. Landings of Blue ling in Subdivision Vb2.

Year	Faroes	Norway	Scotland (1)	E & W	Total
1966					0

1967					0
1968					0
1969					0
1970					0
1971					0
1972					0
1973					0
1974					0
1975	1				1
1976	6	37			43
1977		86			86
1978	7	83			90
1979	14	87			101
1980	36	159			195
1981	48	93			141
1982	128	66			194
1983	463	182			645
1984	757	50			807
1985	396	70			466
1986	81	41			122
1987	209	90			299
1988	2788	72			2860
1989	622	95			717
1990	68	191			259
1991	71	51	21		143
1992	1705	256	1		1962
1993	182	22	91		295
1994	239	16	1		256
1995	162	36	4		202
1996	42	62	12		116
1997	229	48	11		288
1998	64	29	29		122
1999	15	49	24		88
2000	0	37	37		74
2001	0	69	63		132
2002		21	140		161
2003		84	120		204
2004	710	6	68		784
2005	609	14	68		691
2006	647	34	16		697
2007	632	6	16		654
2008	317		91		408
2009*	444	8	160		612

***Preliminary. (1) Includes Vb1.**

Table 6.3.0c. Landings of Blue ling in DivisionVIa.

Year	Faroes	France	Germany	Ireland	Norway	Spain (2)	E & W	Scotland	Lithuania(1)	Total
1966					20					20
1967			37		35					72
1968					126					126
1969			6		112					118
1970					176					176
1971					15					15
1972		696			14					710
1973		18 000			25					18 025
1974	33	15 000	1218		371		164			16 786
1975		5000	2941		20		8			7969
1976		5462	818		10		1			6291
1977		7940	470		16		556			8982
1978		5495	2498		19		21			8033
1979		3064	993		2		279			4338
1980		2124	773		10					2907
1981		3338	335		11			1		3685
1982		3430	79		16		99			3624
1983		5233	11		118		13			5375
1984		3653	183		45		5			3886
1985	56	5670	5		75		2			5808
1986		8254	7		47		2	1		8311
1987		9389	45		51		1			9486
1988	14	6614	2		29		2	1		6662
1989	6	7382	2		143					7533
1990		4882	44		54			1		4981
1991	8	4261	18		63		1	35		4386
1992	4	5483	4		129			24		5644
1993		4311	48	3	27		13	42		4444
1994		2999	24	73	90	433	1	91		3711
1995	0	2835		11	96	392	34	738		4106
1996	0	4115	4		50	681	9	1407		6266
1997	0	3845		1	29	190	789	1021		5875
1998	0	4644	3	1	21	142	11	1416		6238
1999	0	3730		10	55	119	5	1105		5024
2000		4544	94	9	102	108	24	1300		6181
2001		2869	6	52	117	797	116	2136		6093
2002		2177		62	61	285	16	2027		4628
2003	7	2010		2	106	195	3	428		2751
2004	10	2264		1	24	24	1	482		2806
2005	17	2032		2	33	210		390	29	2713
2006	13	1794		1	49	27	3	433		2320
2007	13	1814			31	49		113	1	2021
2008	14	1574			73	10		112		1783
2009*	11	1028			74	31		178		1322

***Preliminary. (1) Includes VIb for all countries up to (and including) 1974, (2) Includes VIb.**

Table 6.3.0d. Landings of Blue ling in DivisionVIb.

Year	Poland	Russia	Faroes	France	Germany	Norway	E & W	Scotland	Iceland	Ireland	Estonia	Total
1975			1			37						38
1976			13			6						19
1977			6	36		7						49
1978			3	58		8						69
1979			4	652	187	28						871
1980				3827	5526	8						9361
1981				534	3944	5						4483
1982				263	554	13		1				831
1983				243	38	50		2				333
1984			133	3281		43						3457
1985			11	7263	31	38						7343
1986			1845	2928	39	66	7	1				4886
1987			350	10	356	76	3	10				805
1988			2000	499	37	42	9	14				2601
1989			1292	61	22	217		16				1608
1990			360	703		127		2				1192
1991			111	2482	6	102	5	15				2721
1992			231	348	2	50	2	14				647
1993			51	373	109	50	66	57				706
1994			5	89	104	33	3	25				259
1995			1	305	189	12	11	38				556
1996			0	87	92	7	37	74				297
1997			138	331		6	65	562	1			1103
1998			76	469		13	190	287	122	11		1168
1999			204	690		9	168	2411	610	4		4096
2000				514		184	500	966		7		2171
2001			238	210	1	256	337	1803		4	85	2934
2002		3	79	345		273	141	497		1		1339
2003	4	2		510		102	14	113			5	750
2004	1	5	4	514		2	10	96			3	635
2005		15	1	235		1	9	80				341
2006			3	313		2	4	29				351
2007		1	15	109		4	7	30				166
2008		12	2	29		2	2	9				56
2009*		1		10		1		7				19

***Preliminary.**

Table 6.3.0e. Blue ling landings in Division Vb and Subareas VI and VII.

Blue ling	Vb	VI	VII	Total
1966	1269	20		1289
1967	1244	72		1316
1968	2661	126		2787
1969	1101	118		1219
1970	3066	176		3242
1971	1924	15		1939
1972	3933	710		4643
1973	7147	18 025		25 172
1974	3798	16 786		20 584
1975	6186	8007		14 193
1976	12 938	6310		19 248
1977	21 318	9031		30 349
1978	4898	8102		13 000
1979	4878	5209		10 087
1980	10 019	12 268		22 287
1981	5027	8168		13 195
1982	6457	4455		10 912
1983	5724	5708		11 432
1984	8094	7343		15 437
1985	6054	13 151		19 205
1986	7821	13 197		21 018
1987	7139	10 291		17 430
1988	9526	9263	22	18 811
1989	5266	9141	293	14 700
1990	4799	6173	223	11 195
1991	2962	7107	212	10 281
1992	4702	6291	406	11 399
1993	2836	5150	321	8307
1994	1644	3970	339	5953
1995	2440	4662	230	7332
1996	1602	6563	365	8530
1997	2798	6978	383	10 159
1998	2584	7406	598	10 588
1999	2932	9120	352	12 404
2000	2524	8352	284	11 160
2001	2125	9027	694	11 846
2002	2024	5967	489	8480
2003	3815	3501	121	7437
2004	2700	3441	60	6201
2005	2516	3054	72	5642
2006	2850	2671	67	5588
2007	3297	2187	163	5647
2008	2060	1839	33	3932
2009*	1351	1341	8	2700

***Provisional.**

Table 6.3.1. Unweighted estimates of the mean length in catches of blue ling by the Norwegian longline reference fleet during 2003–2007, along with standard errors (se) and number of fish measured.

BLUE LING								
ICES Area		2003	2004	2005	2006	2007	2008	2009
Vb	Mean		96,35	107,79	104,5	109,25	94,92	94,53
	se		1,32	3,81	5,2	3,29	7,68	3,72
	N		103	14	15	8	12	19
VIa	Mean	83,6				91,49		99,61
	se	1,88				0,57		2,53
	N	40				263		41
VIb	Mean	91,26				96,86		103,53
	se	0,16				1,55		3,93
	N	5743				36		17

Table 6.3.2. Blue ling catch, effort and cpue in the Faroese trawl surveys in Vb for cod haddock and saithe.

	SPRING SURVEY			SUMMER SURVEY		
	Catch (kg)	Effort (h)	cpue (kg/h)	Catch (kg)	Effort (h)	cpue (kg/h)
1994	83	91	0.91			
1995	82	91	0.90			
1996	122	100	1.22	710	200	3.55
1997	199	98	2.03	237	200	1.18
1998	79	99	0.80	477	201	2.37
1999	8	100	0.08	287	199	1.44
2000	45	100	0.45	203	200	1.02
2001	70	100	0.70	350	200	1.75
2002	36	100	0.36	119	199	0.60
2003	119	100	1.19	156	200	0.78
2004	105	100	1.05	825	200	4.13
2005	95	100	0.95	846	200	4.23
2006	110	100	1.10	330	200	1.65
2007	115	100	1.15	253	199	1.27
2008	43	99	0.43	175	200	0.88
2009	238	100	2.38	455	200	2.27

Table 6.3.3. Scottish deep-water survey: Number of valid hauls (depths 500–1500 m) and number of blue ling in recorded catches.

Year	Nos. valid hauls (500–1500 m)	Nos. blue ling recorded
1998	18	123
2000	24	51
2002	25	87
2004	21	76
2005	18	55
2006	27	64
2007	23	83
2008	36	126
2009	31	133

Table 6.3.4. Irish deep-water survey: Number of valid hauls (depths 500–1500 m) and number of blue ling in recorded catches.

Year	Hauls used for CPUE and nos fish	
2006	9	65f
2007	14	41f
2008	10	59f
2009	9	35f

Note: nos of fish are not standardised for tow duration which changed from 2 hrs to 1hr in 2009.

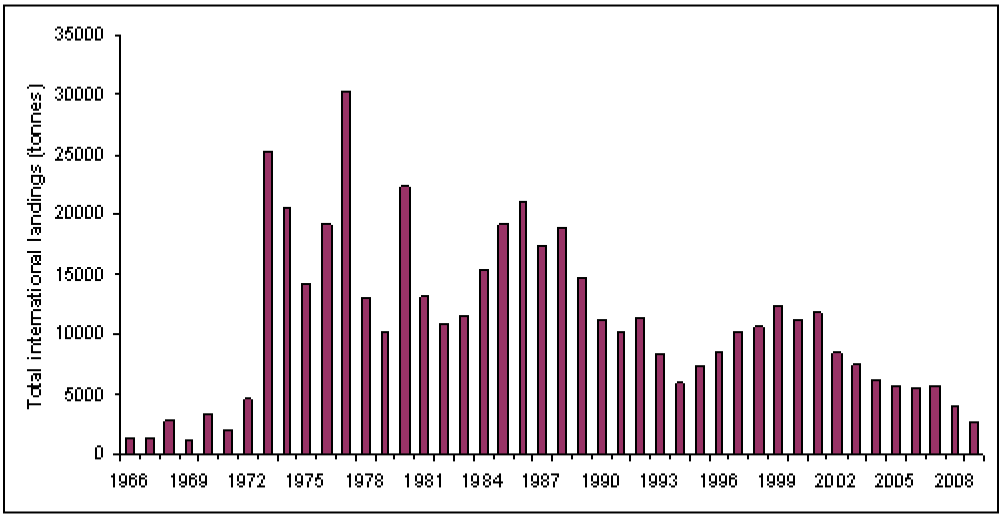


Figure 6.3.1. Trends in total international landings for southern blue ling (Vb, VI, VII).

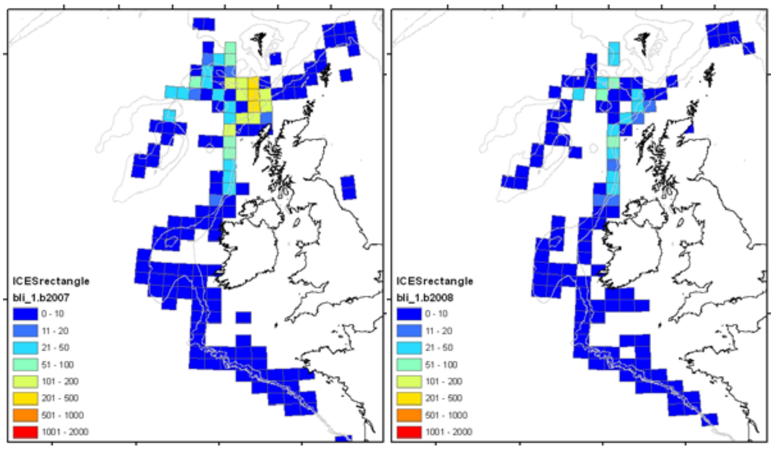


Figure 6.3.2. Geographical distribution of landings France, (UK) Scotland, UK (England and Wales) and Ireland at the level of ICES statistical rectangles. The figures presented are for 2007 and 2008 but plots back to 2001 are presented under TOR g).

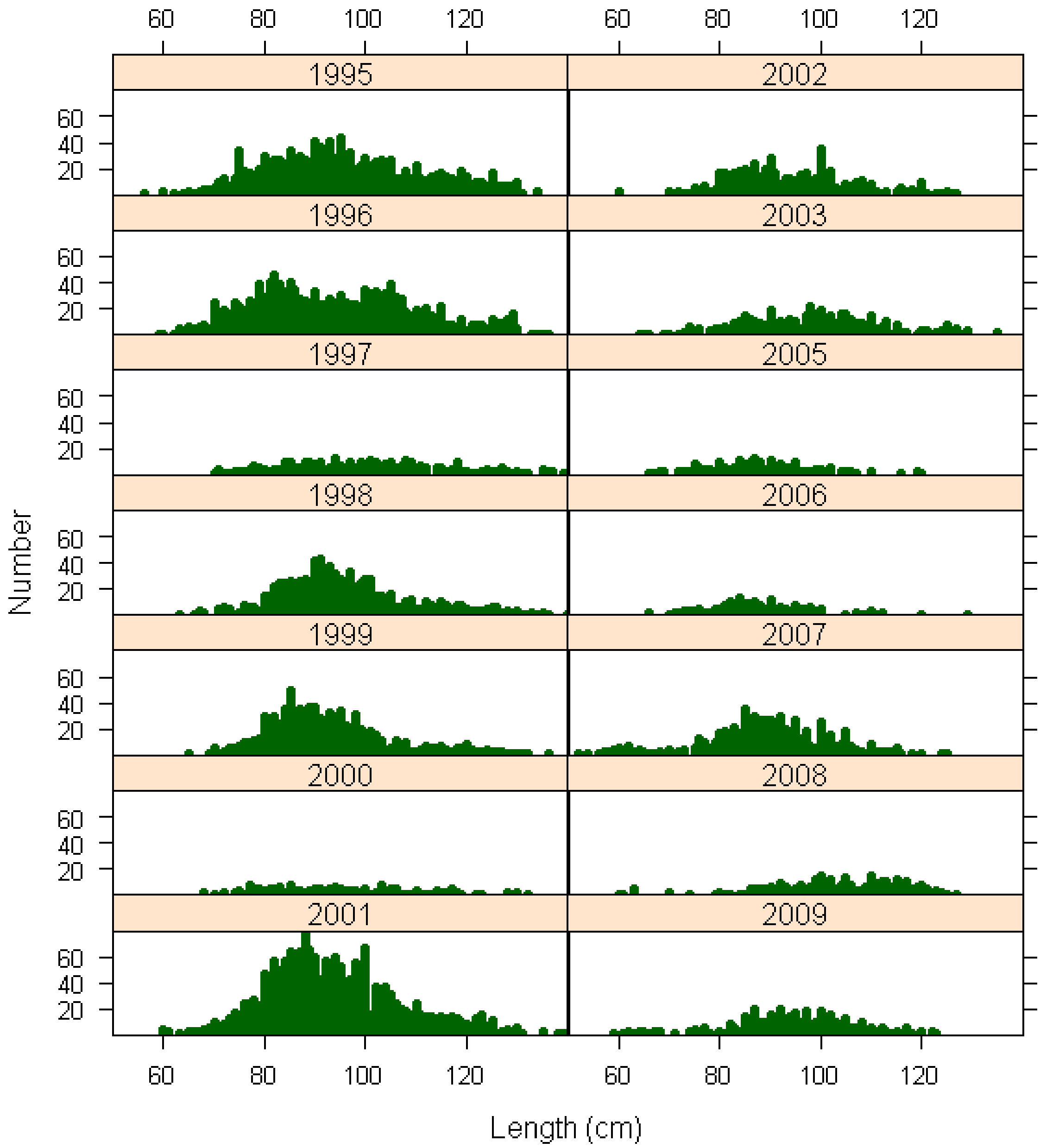


Figure 6.3.3. Blue ling in Vb (Faroes). Length distribution in the landings from Faroese otterboard trawlers >1000 HP (No length sampling was carried out in 2004).

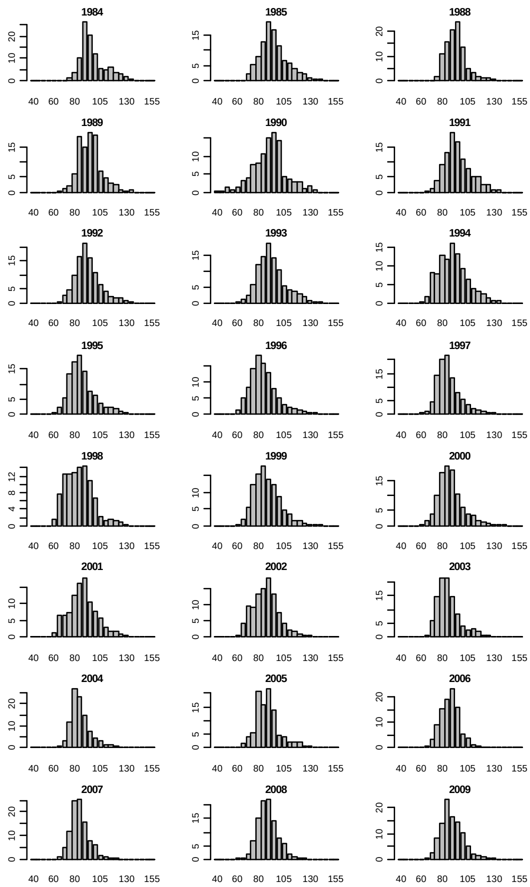


Figure 6.3.4. Length distribution in the landings of blue ling from French otter fishing in VIa.

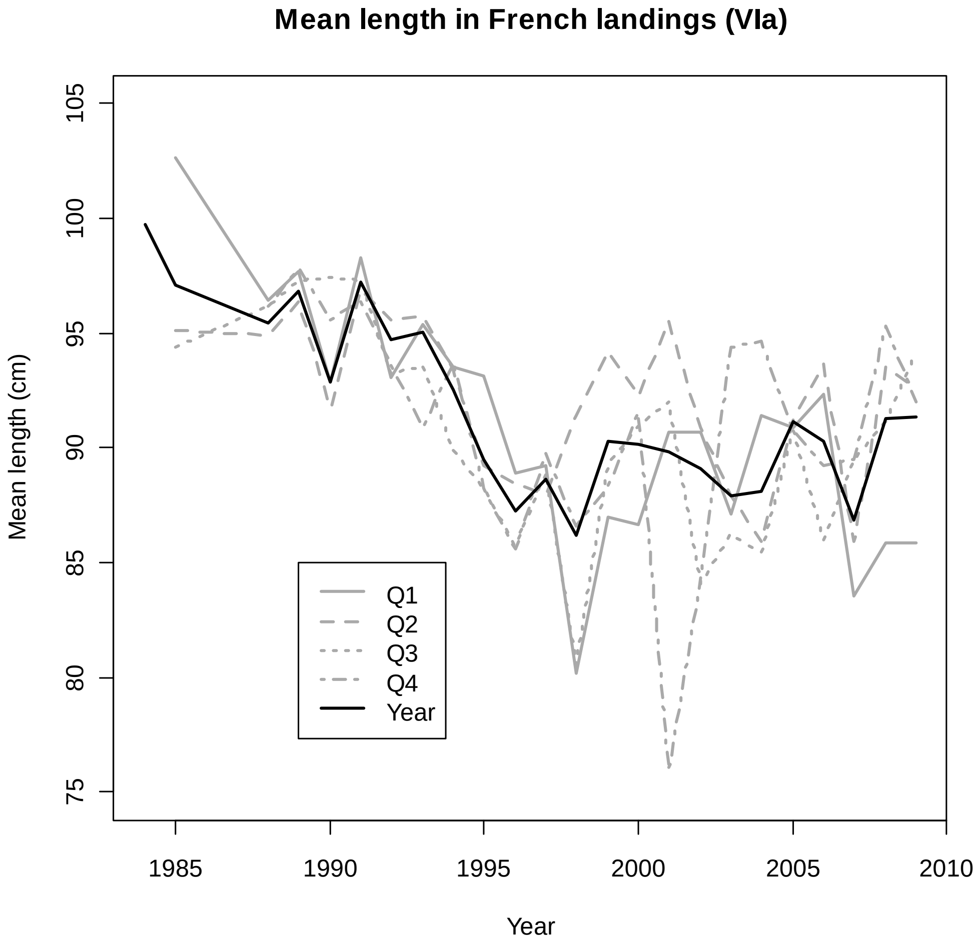


Figure 6.3.5. Mean length in French trawl landings from VIa.

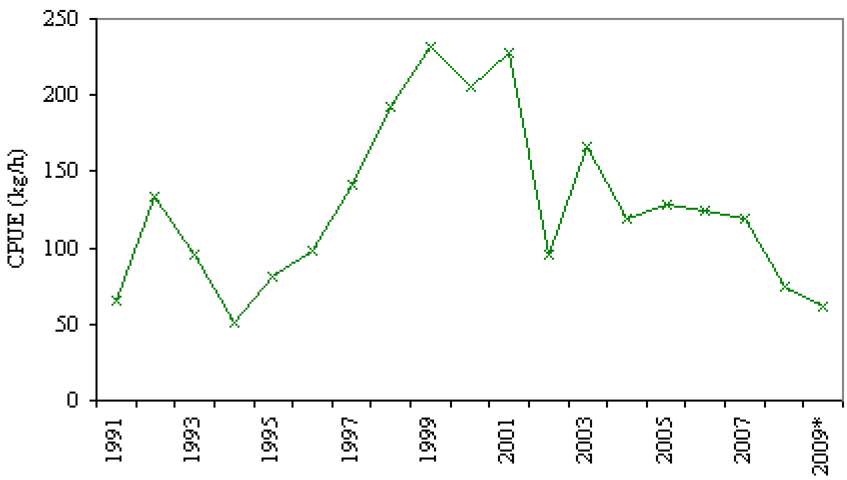


Figure 6.3.6. Blue ling in Vb (Faroes). Cpue series from Faroese otterboard trawlers >1000 HP in the bank area west of the Faroes (DB-DG, 9–14). Data for 2009 are provisonal.

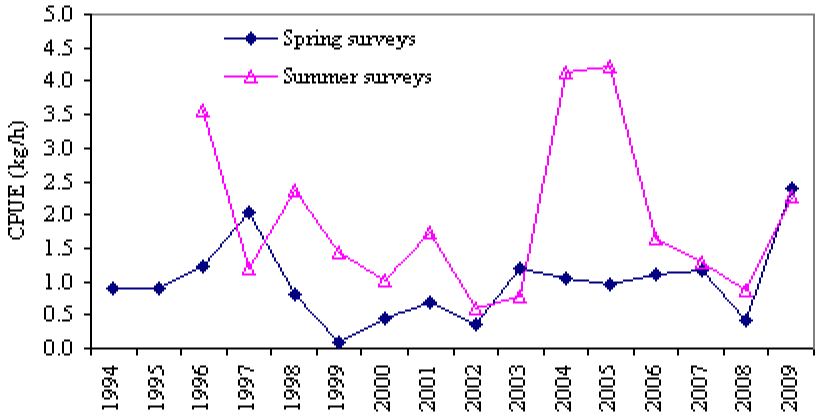


Figure 6.3.7. Blue ling cpue series from the annual Faroese spring- and summer surveys for cod, haddock and saithe in Vb (note that these stations are on the Faroe Plateau, less than 500 m depth).

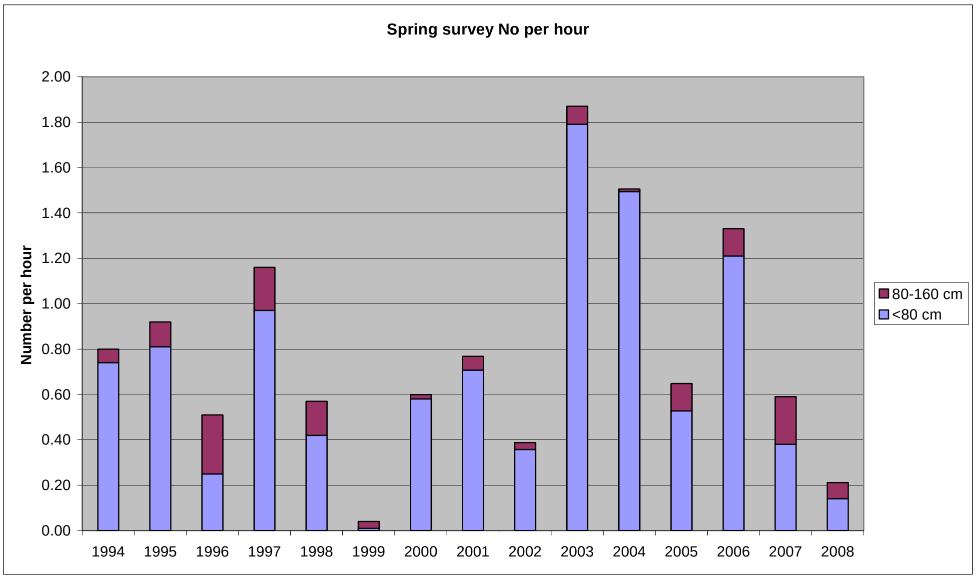


Figure 6.3.8. Number of juvenile (<80 cm) and adult (>80 cm) blue ling caught in the spring (top) and summer (bottom) Faroese surveys.

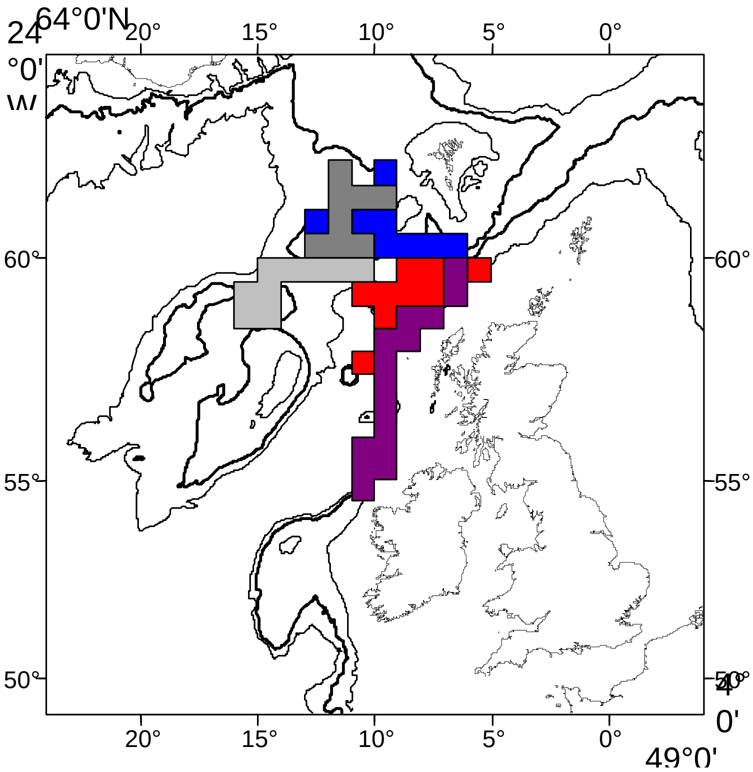


Figure 6.3.9. Areas used to calculate French lpues for blue ling: .dark grey: new grounds in Vb (new5); light grey: new grounds in VI (new6); red: others in VI (other6); purple: edge in VI (edge6); blue: reference grounds in Vb (ref5). Depth contours are 200, 1000 and 2000 m.

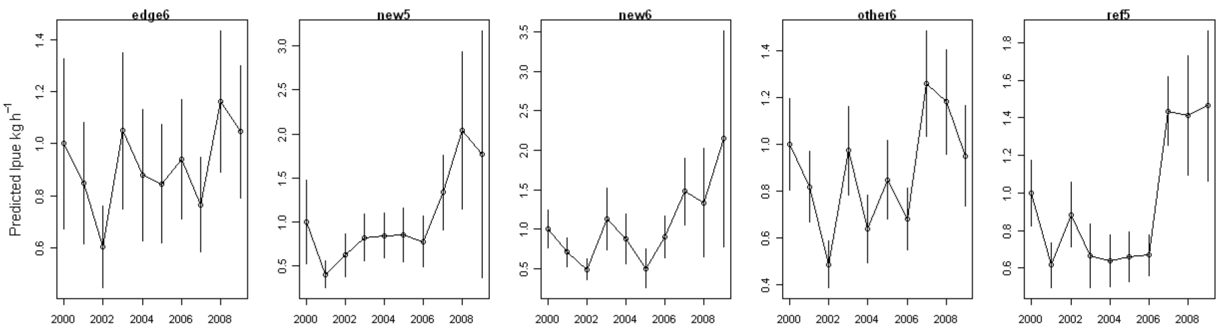


Figure 6. 3.10. Trends in standardized relative lpue of blue ling by area (from French trawl tallyook data), see Figure 3.1.1).

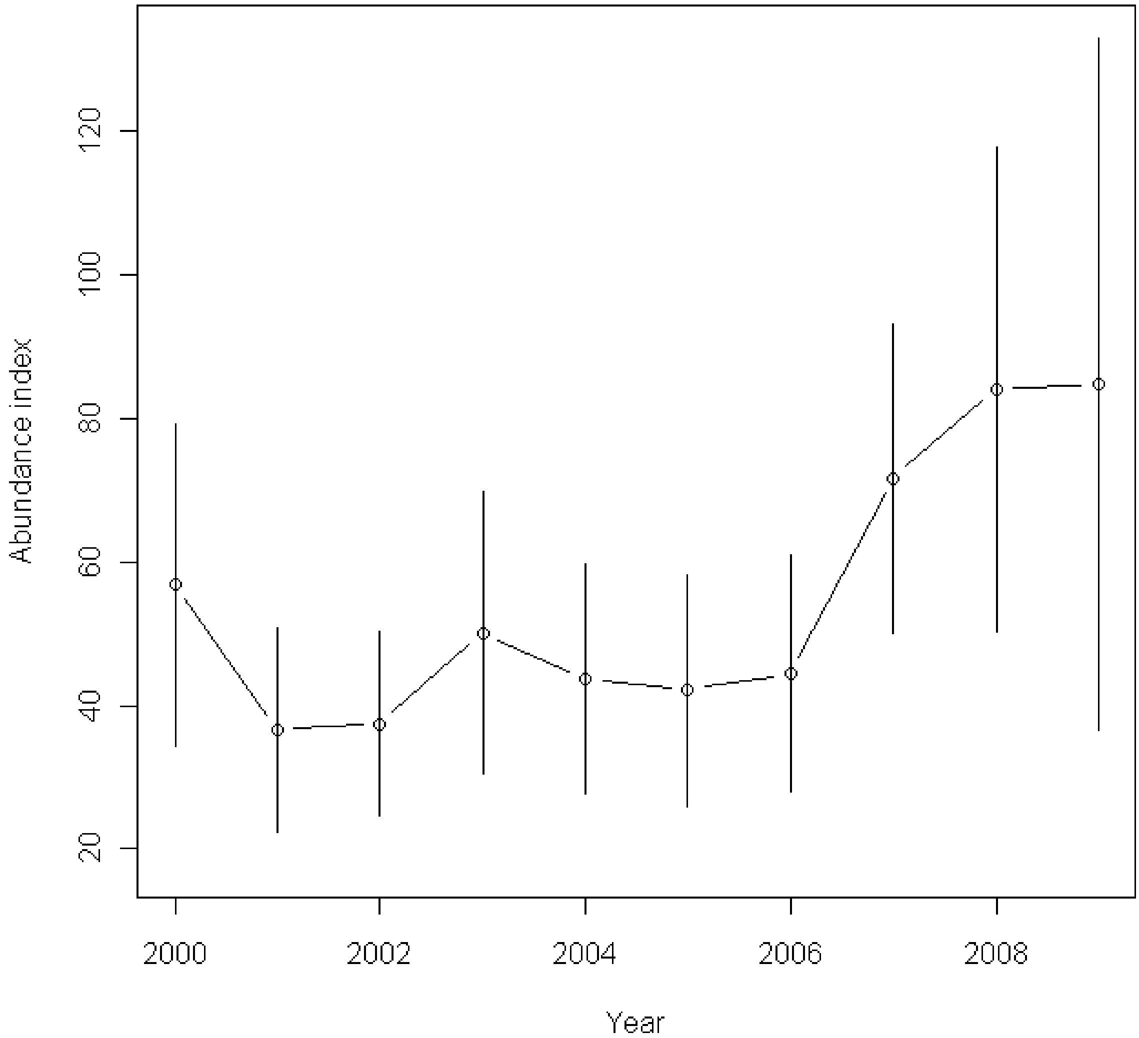


Figure 6. 3.11. Trends in annual mean lpue of blue ling by area (from French trawl tallybook data) See text for explanation).

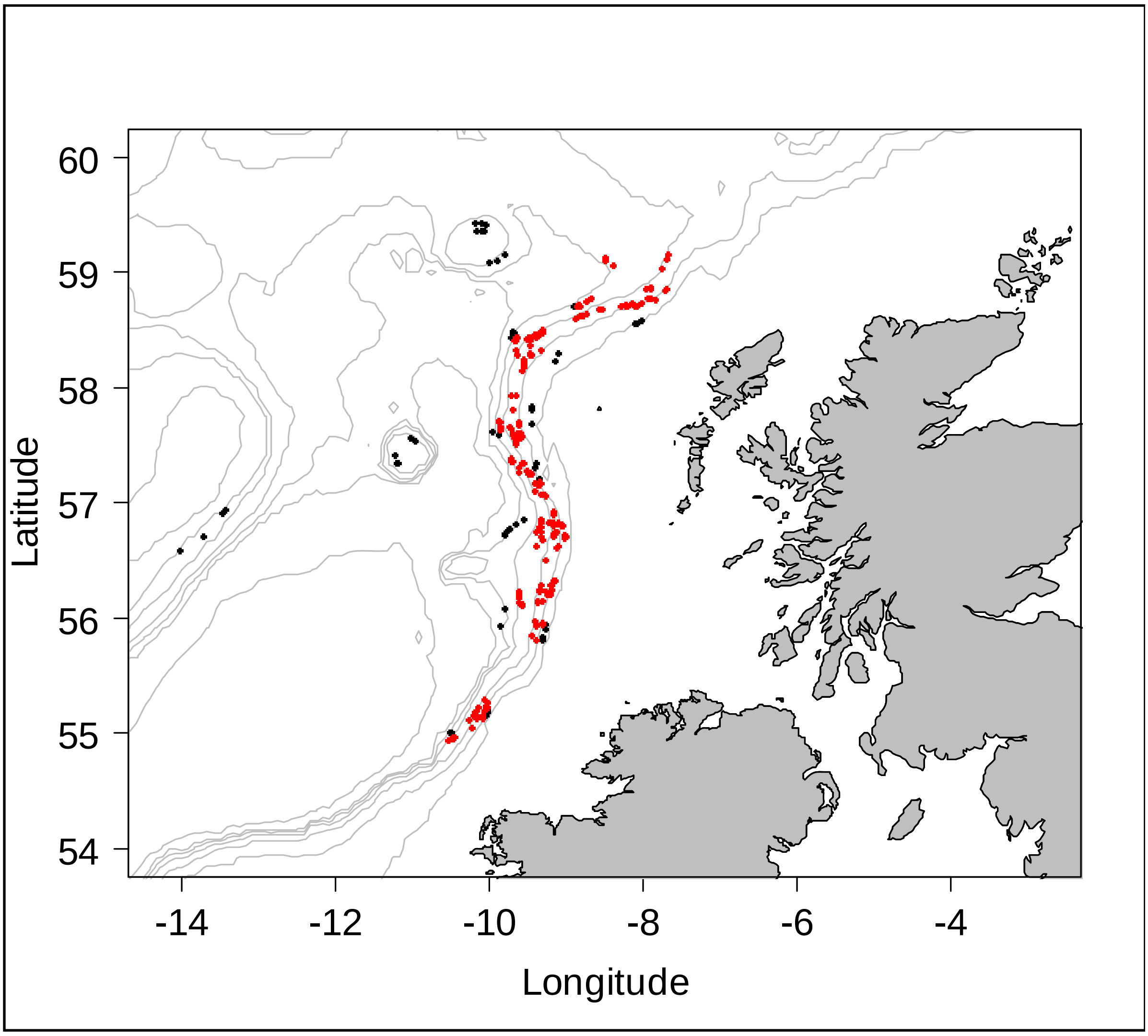


Figure 6.3.12. Sites of valid hauls in the 500–1500 m depth band in the Scottish Deepwater Survey dataset, 1998–2009 (in red). Valid hauls at other depths are shown in black.

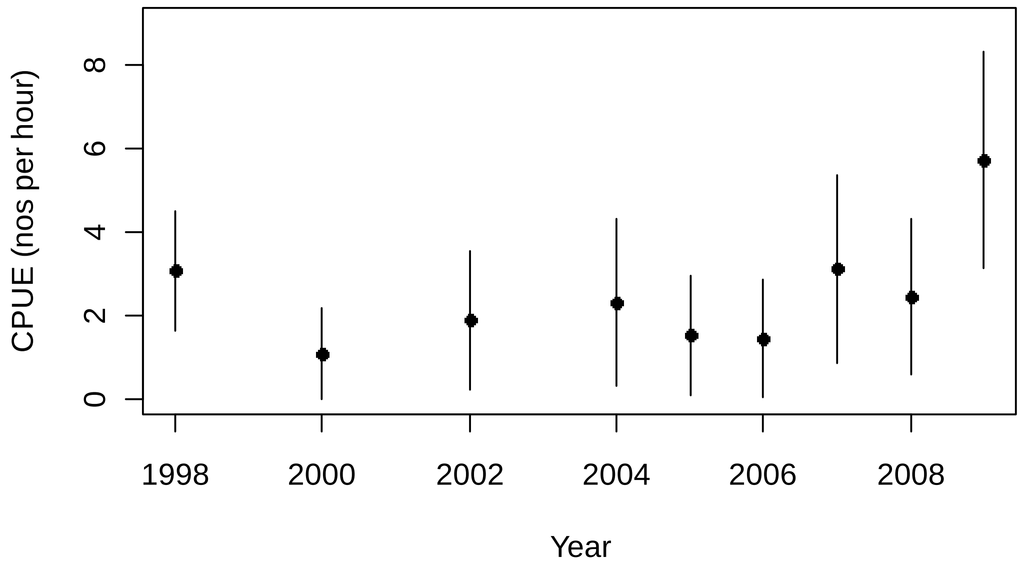


Figure 6.3.13. Scottish Deep-water Survey; trend in annual mean cpue (± 1 s.e.).

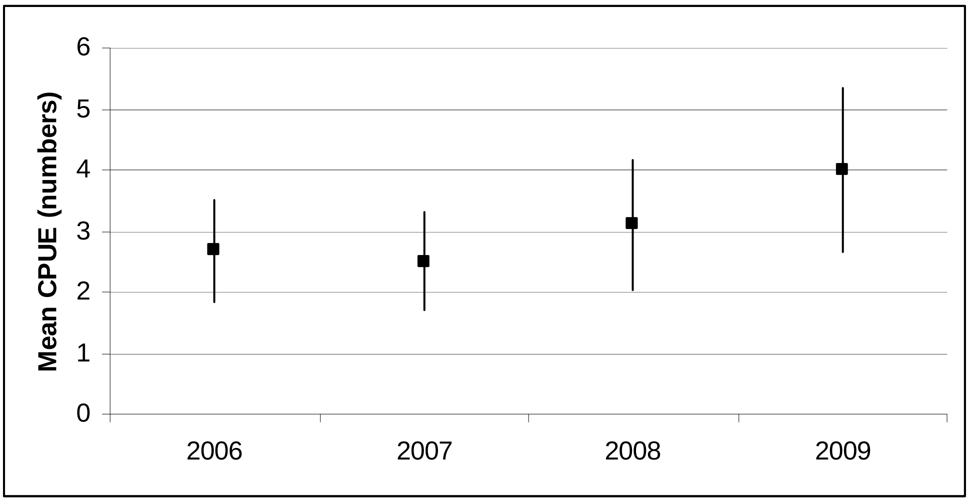


Figure 6.3.15. Irish Deep-water Survey; trend in annual mean cpue (± 1 s.e.).

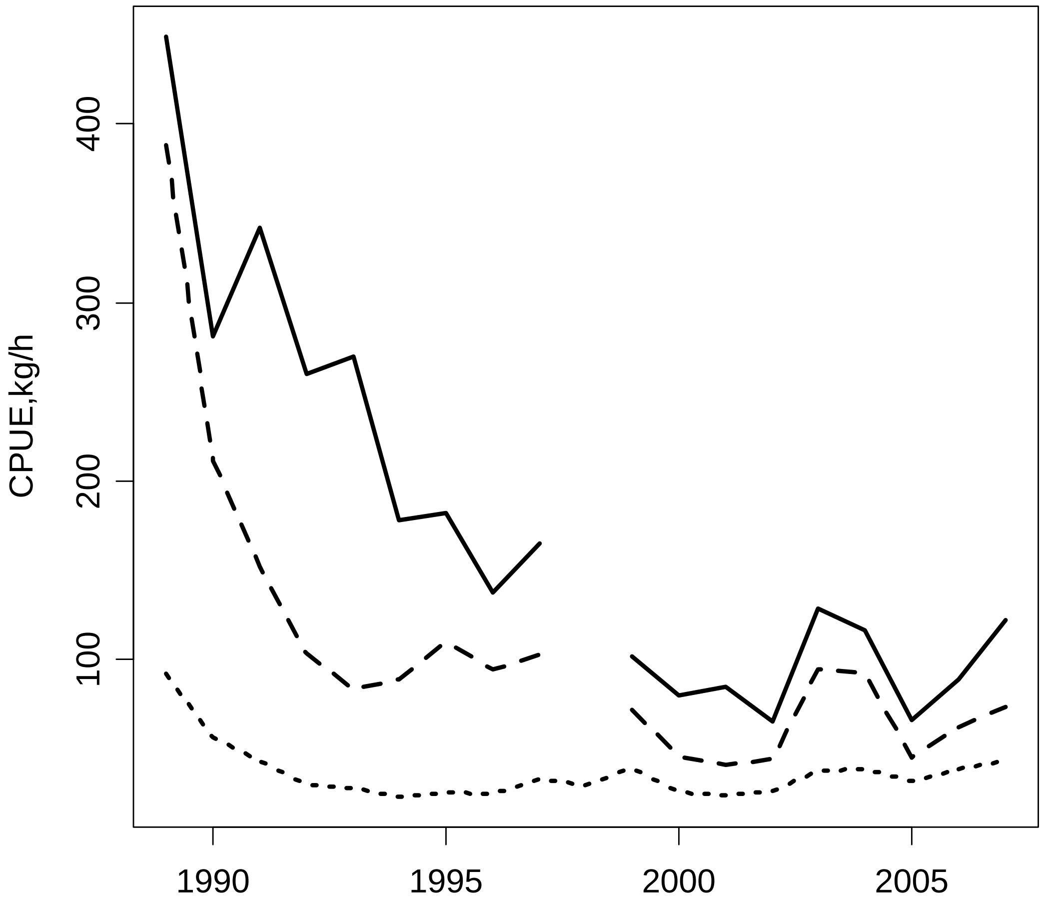


Figure 6.3.16. Blue ling lpues for French trawlers fishing in Vb and VI.(i) dotted line: lpue all vessels, (ii) dashed line: lpue of the reference fleet and (iii) solid line: directed lpue of the reference fleet (landings for fishing trip where blue ling>10% of total landings).

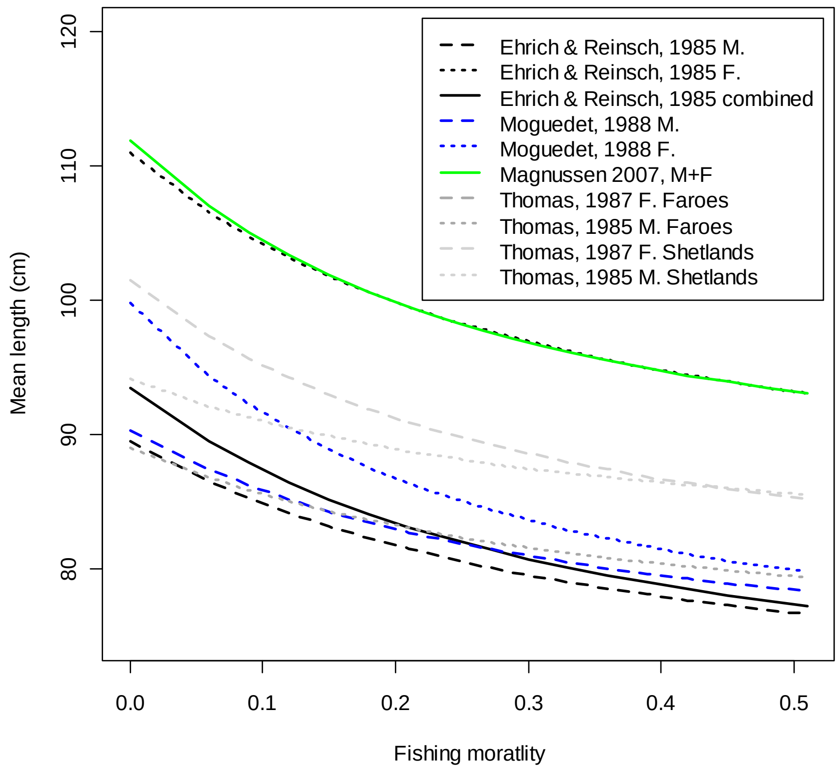


Figure 6.3.17. Mean length of a blue ling stock based upon a range of estimations of growth parameters and current mean length in the landings (horizontal line: 90 cm, overall mean length of the landings accross years 2005–2009= 90.2 cm).

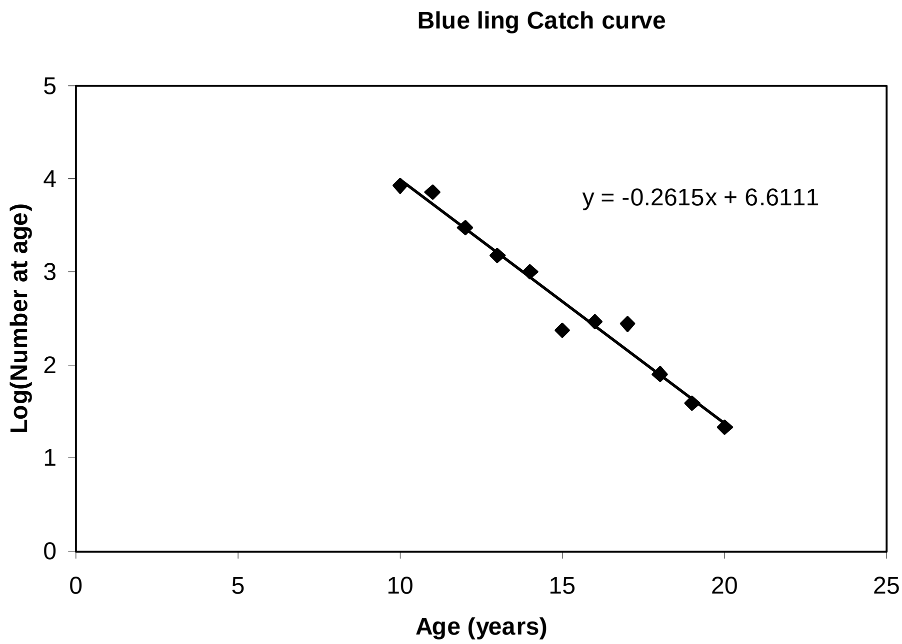


Figure 6.3.18. Catch curve of blue ling, from age estimation on a sample of 149 fish taken from French Auction Market in 2009 (sampling carried out under DCF).

6.4 Blue ling (*MOLVA DYPTERYGIA*) in I, II, IIIa, IV, VIII, IX, X, XII

6.4.1 The fishery

Blue ling has been an important bycatch in trawl fisheries for mixed deep-water species on Hatton Bank (Division XIIb). In other areas blue ling is taken in small quantities. There is also a small bycatch in Norwegian longline fisheries. Small reported landings in Subareas VIII, IX and X probably refer to *Molva macropthalma*.

6.4.2 Landings trends

Landings data are demonstrated in Table 6.4.0a–f and Figures 6.4.1–2. Both historically as well as in recent years, around 90% or more of the total landings in other areas were taken in Areas II, IV and XII combined. In Area II reported landings declined by 88% between 1988 until 1994. Since then the landings in Area II have varied between 150–400 tonnes, 15% of the mean for the years 1988–1993, and 7% of the 1988 level. In Area IV a reduction in landings appears from mid-1990s to a stable level in the last six years at 17% of pre-1995 level. In Area XII landings have been very variable throughout the time-series and the only apparent trend is a dramatic reduction during the years from 2002 to 2009.

6.4.3 ICES Advice

The latest Advice is from ICES in May 2008.

"There should be no directed fisheries for blue ling and measures should be implemented to minimize the bycatch of this species in mixed fisheries. Blue ling is susceptible to sequential depletion of spawning aggregations and therefore closed areas to protect spawning aggregations should be maintained and expanded where appropriate"

6.4.4 Management

In 2010 TACs for EU vessels in Subareas II, IV and V of 56 tonnes, and in Subarea III of 11 tonnes were set. A TAC of 2032 tonnes was also set for vessels in EU waters and international waters of Area VI and VII. Of this, the TAC for Norwegian vessels operating in EU waters of IIa, IV, Vb, VI and VII is 150 tonnes. No TAC has been set for Subarea XII.

6.4.5 Data availability

6.4.5.1 Landings and discards

Landings data are demonstrated in Table 6.4.1.

6.4.5.2 Length compositions

No length data are available.

6.4.5.3 Age compositions

No age data are available.

6.4.5.4 Weight-at-age

No weight-at-age data are available.

6.4.5.5 Maturity and natural mortality

No data were available.

6.4.5.6 Catch, effort and research vessel data

No data are available.

6.4.6 Data analyses

No data analytical assessments were carried out.

Declines in the catch series in IIa, IIIa and IV suggest that the stock in these areas may be depleted. Recent catches in Division IIa are stable at a very low level compared to historical catches and represent only a minor bycatch.

6.4.7 Comments on assessment

Not applicable.

6.4.8 Management considerations

In IIa, IIIa and IV there should be no directed fisheries for blue ling and measures should be implemented to minimize the bycatch of this species in mixed fisheries. Blue ling is susceptible to sequential depletion of spawning aggregations and therefore closed areas to protect spawning aggregations should be maintained and expanded where appropriate. Directed fisheries in other areas should be monitored closely.

Fisheries in Subarea XIIb probably belong to the same stock that is exploited in Subarea VI. Management in this area should be consistent with the Advice for Vb, VI and VII.

Table 6.4.0a. Blue ling (*Molva dypterygia*). Working Group estimates of landings (tonnes) in Subarea I. (* preliminary)

Year	Iceland	Norway	Germany	Total
1988				
1989				
1990				
1991				
1992				
1993				
1994		3		**3**
1995		5		**5**
1996				**0**
1997		1		**1**
1998		1		**1**
1999				**0**
2000		1		**1**
2000		3		**3**
2001		1		**1**
2002		1		**1**
2003				**0**
2004		1		**1**
2005		1		**1**
2006				**0**
2007				**0**
2008				**0**
2009*		1		**1**

Table 6.4.0b. Blue ling (*Molva dypterygia*). Working Group estimates of landings (tonnes) in Divisions IIa and b. (* preliminary)

Year	Faroes	France	Germany	Greenland	Norway	E & W	Scotland	Sweden	Russia	Total
1988	77	37	5		3416	2				**3537**
1989	126	42	5		1883	2				**2058**
1990	228	48	4		1128	4				**1412**
1991	47	23	1		1408					**1479**
1992	28	19		3	987	2				**1039**
1993		12	2	3	1003					**1020**
1994		9	2		399	9				**419**
1995	0	12	2	2	342	1				**359**
1996	0	8	1		254	2	2			**267**
1997	0	10	1		280					**291**
1998	0	3			272		3			**278**
1999	0	1	1		287		2			**291**
2000		2	4		240	1	2			**249**
2001	8	7			190	1	2			**208**
2002	1	1			129	1	17			**149**
2003	30				115		1	1		**147**
2004	28	1			144				1	**174**
2005	47	3			144	1			2	**197**
2006	49	4			149					**202**
2007	102	3			154		3			**262**
2008	105	9			208		11			**329**
2009*	56	1			219		9			**285**

Table 6.4.0c. Blue ling (*Molva dypterygia*). Working Group estimates of landings (tonnes) in Subarea III. (* preliminary)

Year	Denmark	Norway	Sweden	Total
1988	10	11	1	**22**
1989	7	15	1	**23**
1990	8	12	1	**21**
1991	9	9	3	**21**
1992	29	8	1	**38**
1993	16	6	1	**23**
1994	14	4		**18**
1995	16	4		**20**
1996	9	3		**12**
1997	14	5	2	**21**
1998	4	2		**6**
1999	5	1		**6**
2000	13	1		**14**
2001	20	4		**24**
2002	8	1		**9**
2003	18	1		**19**
2004	18	1		**19**
2005	48	1		**49**
2006	42			**42**
2007				**0**
2008		2		**2**
2009*		+		**0**

Table 6.4.0d. Blue ling (*Molva dypterygia*). Working Group estimates of landings (tonnes) in Division IVa. (* preliminary)

YEAR	DENMARK	FAROES	FRANCE (IV)	GERMANY	NORWAY	E & W	SCOTLAND	IRELAND	TOTAL
1988	1	13	223	6	116	2	2		**363**
1989	1		244	4	196	12			**457**
1990			321	8	162	4			**495**
1991	1	31	369	7	178	2	32		**620**
1992	1		236	9	263	8	36		**553**
1993	2	101	76	2	186	1	44		**412**
1994			144	3	241	14	19		**421**
1995		2	73		201	8	193		**477**
1996		0	52	4	67	4	52		**179**
1997		0	36		61	0	172		**269**
1998		1	31		55	2	191		**280**
1999	2		21		94	25	120	2	**264**
2000	2		15	1	53	10	46	2	**129**
2001	7		9		75	7	145	9	**252**
2002	6		11		58	4	292	5	**376**
2003	8		8		49	2	25		**92**
2004	7		17		45		14		**83**
2005	6		7		51		2		**66**
2006	6		6		82				**94**
2007	5		2		55				**62**
2008	2		9		63		+		**74**
2009*	1		12		69		7		**89**

Table 6.4.0e. Blue ling (*Molva dypterygia*). Working Group estimates of landings (tonnes) in Subarea XII.

Year	Faroes	France	Germany	Spain	E & W	Scotland	Norway	Iceland	Poland	Lithuania	Russia	Total
1988		263										**263**
1989		70										**70**
1990		5										**5**
1991		1147										**1147**
1992		971										**971**
1993	654	2591	90									**3335**
1994	382	345	25									**752**
1995	514	47			12							**573**
1996	445	60		264		19						**788**
1997	1	1		411	4							**417**
1998	36	26		375	1							**438**
1999	156	17		943	8	43		186				**1353**
2000	89	23		406	18	23	21	14				**594**
2001	6	26		415	32	91	103	2				**675**
2002	19			1234	8		9					**1270**
2003		7		1096		2	40		12	37		**1194**
2004		27		861							7	**895**
2005		10		657						8		**675**
2006		61		436							4	**501**
2007	1			353								**354**
2008				564								**564**
2009*		+		312							+	**312**

Table 6.4.0f. Blue ling. Total landings by Subarea/Division (landings from Areas VIII, IX and X given in previous reports are now considered to represent *Molva macropthalma*).

YEAR	I	II	III	IV	XII	TOTAL
1988		3537	22	363	263	4185
1989		2058	23	459	70	2610
1990		1412	21	501	5	1939
1991		1479	21	627	1147	3274
1992		1039	38	554	971	2602
1993		1020	23	415	3335	4793
1994	3	419	18	424	752	1616
1995	5	359	20	483	573	1440
1996	0	267	12	190	788	1257
1997	1	291	21	270	417	1000
1998	1	278	6	286	438	1009
1999	0	291	6	265	1353	1915
2000	1	249	14	130	594	988
2001	3	208	24	252	675	1162
2002	1	149	9	377	1270	1806
2003	1	147	19	101	1194	1462
2004	0	174	19	83	895	1171
2005	1	171	49	70	675	966
2006	0	202	42	94	501	839
2007	0	263	0	62	354	679
2008	0	329	2	74	564	969
2009*	1	285	0	89	312	687

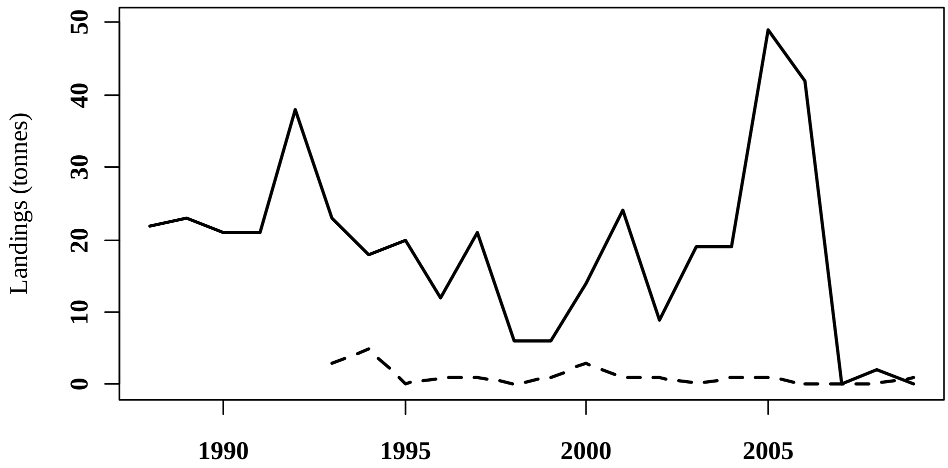


Figure 6.4.1 Landings of blue ling in Divisions IIa and b (solid line), Iva (broken line) and XII (dotted line).

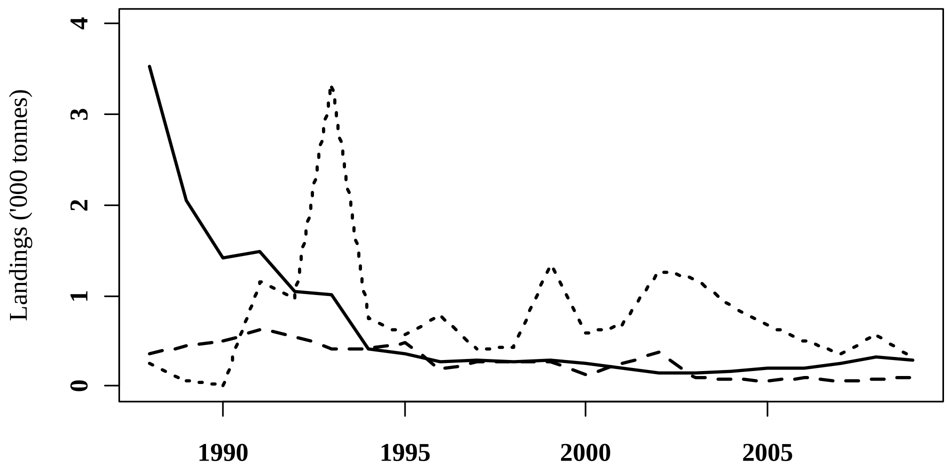


Figure 6.4.2. Landings of blue ling in Divisions I (broken line) and III(solid line).

7 Tusk (*Brosme brosme*)

7.1 Stock description and management units

In 2007, WGDEEP examined the available evidence of stock discrimination in this species. Based on the genetic investigation, the Group suggests the following stock units:

- Tusk in Va and XIV;
- Tusk on the Mid Atlantic Ridge;
- Tusk on Rockall (VIb);
- Tusk in I,II.

all other areas (IVa,Vb, VIa, VII,…) be assessed as one combined stock, until further evidence of multiple stocks become available in these areas purposes.

7.2 Tusk (*Brosme Brosme*) in Division Va and Subarea XIV

7.2.1 The fishery

Tusk in Va is caught in a mixed longline fishery, conducted in order of importance by Icelandic, Faroese and Norwegian boats. Between 150–240 Icelandic longliners report catches of tusk, but much fewer gillnetters and trawlers (Table 7.2.1). Most of tusk in Va is caught on longlines or around 97% of catches in tonnes and this has been relatively stable proportion since 1992 (Table 7.2.2).

A minor change in the tusk fishery in Va is that the longline fishery has changed from a bycatch fishery in 2000–2005 to a more mixed fishery since then (Figure 7.2.1.). This change is most likely a result of increased abundance of tusk in Va in recent years.

Most of the tusk caught in Va by Icelandic longliners is caught at depths less than 300 meters and less than 600 meters by trawlers. The main fishing grounds for tusk in Va as observed from logbooks are on the south, south-western and western part of the Icelandic shelf (Figure 7.2.2.).

The main trend in the spatial distribution of tusk catches in Va according to logbook entries is the decreased proportion of catches caught in the south east and increased catches on the western part of the shelf. Around 50 to 60% of tusk are caught on the south and western part of the shelf (Figure7.2.3).

Tusk in XIV is caught mainly as a bycatch by longliners and trawlers. Spatial distribution of catches according to logbooks is shown in Figure 7.2.25. The main area where tusk is caught in XIV is N63°–N66° and W32°–W40°, well away from the Icelandic EEZ.

7.2.1.1 Landings trends

The total annual landings from ICES Division Va was around 8200 tonnes in 2008 and 2009 (Table 7.2.3). Since 2000, the annual landings has gradually increased. The catch of the Icelandic fleet was in 2008 and 2009 a record high and had increased more than 50% since 2004. The foreign catch (mostly from the Faroe Islands, but also from Norway) of tusk in Icelandic waters has always been considerable. Until 1990, between 40–70% of the total annual catch from ICES Division Va was caught by foreign vessels but has since then been between 15–25%, mainly from the Faroe Islands.

Landings in XIV have always been low compared to Va rarely exceeding 100 tonnes. (Table 7.2.8).

7.2.1.2 ICES Advice

The latest Advice from ICES in May 2008 states: *Surveys indicate that the overall biomass is increasing but consists mostly of small individuals. ICES reiterates the earlier advice to constrain catches to 5000 t (average 2001–2004) to allow the juveniles to recruit to the adult stock. ICES also recommends collecting information that can be used to evaluate a long term sustainable level of exploitation.*

7.2.1.3 Management

The Icelandic Ministry of Fisheries and Agriculture is responsible for management of the Icelandic fisheries and implementation of the legislation. The Ministry issues regulations for commercial fishing for each fishing year (1 September–31 August), including an allocation of the TAC for each stock subject to such limitations.

Tusk was included in the ITQ in the 2001/2002 quota year, that is TAC was decided by the Ministry of Fisheries. In the beginning, the TAC was set as recommended by MRI but has for the past three fishing years been set higher than advice (Table 7.2.4). One reason is that no formal harvest rule exists for this stock. The landings (here shown by quota year) has always exceeded the adviced and set TAC by 30–40%.

The reasons for the large difference between annual landings and both adviced and set TAC is threefold: The first reason is that it is possible to transfer unfished quota between fishing years. Second it is possible to convert quota shares in one species to another and finally the national TAC is only allocated to Icelandic vessels. All foreign catch is outside the quota system. The tusk advice given by MRI for each quota year is, however, for all catch, including foreign catch.

There are bilateral agreements between Iceland, Norway and the Faroe Islands about a fishery of vessels in restricted areas within the Icelandic EEZ. Faroese vessels are allowed to fish 5600 tonnes of demersal fish species in Icelandic waters which includes maximum 1200 tonnes of cod and 40 tonnes of Atlantic halibut. The rest of the Faroese demersal fishery in Icelandic waters is mainly directed at tusk, ling, and blue ling.

In addition to above mentioned management measures there are areas that are closed for fishing where juvenile tusk has been observed in recent years along the south and southeast coast of Iceland. In addition, if length measurements taken by observers demonstrate that the number of tusk smaller than 55 cm in catches exceeds 25% of the tusk catch, and if tusk is more than 30% of the catches in given set, then an immediate closure of that area will take place for two weeks.

7.2.2 Data available

7.2.2.1 Landings and discards

Landings by Icelandic vessels are given by the Icelandic Directorate of Fisheries. Landings of Norwegian and Faroese vessels are given by the Icelandic Coast Guard. Discard is banned by law in the Icelandic demersal fishery and at present there is no information on tusk discards.

Landings for tusk in XIV are obtained from the STATLANT database. No information is available on discards in XIV.

7.2.2.2 Length compositions

An overview of available length measurements from Va is given in Table 7.2.4. Most of the measurements are from longlines, number of available length measurements have been increasing in recent years in line with increased landings.

Length distributions from the longline fishery are shown in Figure 7.2.4. Mean length has slightly increased in recent years, from 50.5 cm in 2002 to 55.3 in 2009.

No length composition data from commercial catches in XIV are available.

7.2.2.3 Age compositions

Table 7.2.6 gives an overview of otolith sampling intensity by gear types in 2000 to 2009 in Va. Before the WKDEEP-2010 meeting tusk otoliths from 1995 and 2009 were aged to use as input data for the Gadget model. Considerable discrepancy in age estimates was found between older ageing (readings done before 1998) and the current one. It was concluded that the older age estimates were unreliable and the new ones were adopted. In total 508 otoliths from 1995 and 1080 from 2009 were aged from commercial catches. The age distribution is presented in Figure 7.2.5.

No data is available from XIV.

7.2.2.4 Weight-at-age

Weight-at-age data from Va is only available from 1995 and 2009 (Table 7.2.7).

No data is available from XIV.

7.2.2.5 Maturity and natural mortality

At 45 cm around 20% of tusk in Va is mature, at 58 cm 50% of tusk is mature and at 80 cm more or less every tusk is mature.

No information is available on natural mortality of tusk in Va. In the Gadget model it is assumed to be 0.2 but different variants of natural mortality are tested.

No data is available for XIV.

7.2.2.6 Catch, effort and research vessel data

Catch per unit of effort and effort data from the commercial fleets

Figures 7.2.6 and 7.2.7 show catch per unit effort (cpue) and effort in the Icelandic longline fishery. The cpue is calculated using all longline data where catches of the species were registered, with no standardization attempted. The cpue estimates of tusk in Va are not considered representative of stock abundance.

Cpue estimations have not been attempted on available data from XIV.

Icelandic survey data (Va)

Indices: The Icelandic spring ground-fish survey, which has been conducted annually in March since 1985, gives trends on fishable biomass of many exploited stocks on Icelandic fishing grounds. In total, about 550 stations are taken annually at depths down to 500 meters. The survey area does cover the most important distribution area of the tusk fishery. Detailed description of the spring ground-fish survey is given in the Stock Annex for tusk in Va.

Figure 7.2.8 shows both a recruitment index and the trends in biomass. Survey length distributions are shown in Figures 7.2.9 (abundance) and 7.2.10 (biomass).

In addition, the autumn survey was commenced in 1996 and expanded in 2000. A detailed description of the autumn ground-fish survey is given in the Stock Annex for tusk in Va. Figure 7.2.9 shows both a recruitment index and the trends in various biomass indices all of which have been increasing in recent years.

Changes in spatial distribution as observed in surveys: According to the spring survey most of the increase in recent years in tusk abundance is in the western area, however an increase can be seen in most areas (Figure 7.2.10). A similar pattern is observed in the autumn survey (Figure 7.2.11).

German survey data (XIV)

Indices: The German groundfish survey was started in 1982 and is conducted in the autumn. It is primarily designed for cod but covers the entire groundfish fauna down to 400 meters. The survey is designed as a stratified random survey; the hauls are allocated to the strata off West and East Greenland both according to the area and the mean historical cod abundance at equal weights. Towing time is 30 min at 4.5 kn. (Ratz, H.-J. 1999: Structures and changes of the demersal fish assemblage off Greenland, 1982–1996. NAFO Sci. Coun. Studies,32:1–15).

In Figure 7.2.26 the catches, both in weight and numbers of tusk in the German groundfish survey are presented. No attempt is made to stratify the data. The catches seem to have been relatively large in the late eighties and to have been mainly composed of tusk larger than 30 cm. In the nineties catches were relatively small and in some years no tusk was caught. After 2000 catches of tusk in the German groundfish survey increased again and mostly consisted of tusk smaller than 30 cm but in recent years (2008 and 2009) the proportion of larger tusk has increased. The trend in the German survey catches is similar as observed in the surveys in Va (Figure 7.2.9).

Changes in spatial distribution as observed in surveys: When looking at the location of hauls were tusk was caught in the German groundfish survey (Figure 7.2.27) it seems that tusk is caught along most of the East Greenland shelf. There are temporal changes in the distribution. In the late eighties tusk was caught all along the shelf but with decreased catches in the nineties the distributional range shrank and then tusk was mostly caught in the north eastern part of the shelf, close to where it goes over to Iceland.

7.2.3 Data analyses

The following discussion applies to tusk in Va. Catches of tusk in XIV are low compared to catches in Va are unlikely to affect any of the conclusions following this paragraph. Additionally the limited survey trends available show similar trends as in Va.

Mean length in the commercial catches decreased between 2000 and 2002 possibly because of increased recruitment. Since 2002 mean length has increased again and in 2009 it mean length was at its highest in the time-series available (2000–2009) (Figure 7.2.4.).

Available cpue data is not considered representative of stock trends however in recent years the trend in the cpue data is similar as is observed from the spring survey.

The indices of total biomass and of fishable biomass (40 cm and larger) of tusk increased gradually from 2001, when it was below 50% of the 1985 value, to 2007 but have decreased slightly since then (Figure 7.2.8 a, b). In 2007–2009, the biomass indices were around 70% of the mean in 1985–1989. The recruitment index (tusk less than

30 cm) peaked in 2006 put has since then decreased rapidly and was in 2010 at a similar level as in the late 1990s early 2000s (Figure 7.2.8 d).

Relative fishing mortality (Fproxy = Yield/Summary biomass) has not changed considerably since 1992 with the exception of a small decline in 2001–2005 but has increased again to similar level as in 1992–2001 (Figure 7.2.12).

Stock assessment on Tusk in Va using Gadget

At WGDEEP in 2009 an exploratory stock assessment of tusk in Va using the Gadget model (**G**lobally applicable **A**rea **D**isaggregated **G**eneral **E**cosystem **T**oolbox, see www.hafro.is/gadget) was presented and the subsequently tusk in Va was benchmarked for 2010. At the Benchmark Meeting for Deep-sea Species in 2010 (WKDEEP) the Group concluded that the results of Gadget model for tusk in Va were indicative of trends. The Gadget setup presented at WKDEEP-2010 was preliminary and has been improved vastly since then. Therefore the Group suggests that the estimates from the model be used as basis for Advice on tusk in Va. A detailed description of the model and its setup is given in the Stock Annex for tusk in Va.

Data used and model settings

Data used for tuning are:

- Length disaggregated survey indices (10 cm increments) from the Icelandic groundfish survey in March 1985–2008.
- Length distribution from the Icelandic commercial catch since 1980 (longliners). The sampling effort was though relatively limited until the 1990s.
- Landings data divided into four month periods per year (quarters) (1980–2009).
- Age–length keys and mean length-at-age from the Icelandic commercial fishery (1995 and 2009).

Model parameters were estimated using data from 1978 to 2010 and forecast carried out to 2018. Four time-steps are used each year. Natural mortality is set to 0.2 for all age groups. The ages used were 2 to 20 years, where the oldest age is treated as a plus group (fish 20 years and older). Recruitment was set at age 2.

Estimated parameters are:

- Number of fish when the simulation starts (8 age groups).
- Recruitment each year (30 year classes).
- Length-at-recruitment (mean length and SD).
- The K parameters in the von Bertalanffy growth equation Linf is a constant in the model close to the highest observed length of tusk in Va.
- Parameter β that models the transition from one length class to the next.
- Selection pattern of the commercial fleet (L50 and slope).

Model settings used in the Gadget model for tusk in Va are described in more detail in the Stock Annex for tusk in Va.

Diagnostics

Likelihood profiles plot: The model converged when the likelihood score was 17 679 and the likelihood profiles are at minimum at the estimated parameter values

(Figure 7.2.13). However the likelihood surface may be quite shallow at least for some of the parameters as is seen in Figure 7.2.14 where the *y*-axis on the likelihood profile plot are fixed.

Observed and predicted proportions by fleets: Overall the fit of the predicted proportional length distributions is close to the observed distributions (Figures 7.2.15 and 7.2.16). In general for the commercial catch distributions the fit is better at the end of the time-series (Figure 7.2.15). The reason for this is firstly there is little data at the beginning of the time-series and the model may be constrained by the initial values.

Model fit and residuals: In Figure 7.2.17 the length disaggregated indices are plotted against the predicted numbers in the stock. The correlation between observed and predicted is good for the first three length groups (20–29, 30–39 and 40–49) wich are the main length groups of tusk caught in the spring survey. In the larger length groups the fit gets progressively worse. The residuals show fairly substantial positive and negative blocks however in a length based assessment such as this it is to be expected because of the auto-correlation between adjacent length groups. So the residuals presented in Figure 7.2.18 are not comparable to those from an age-based model. Another point worth noting is that the contrast (rapid increase and subsequent decrease) in the survey indices indicates that the index may not be linearly related to stock abundance.

Retrospcetive analysis: Due to time constrains analytical retrospective analysis from the Gadget model is only available for 2006 and 2007 as the model needs approximately around 14 hours for each run. The limited analysis presented in Figure 7.2.19 shows that the estimates from this year are slightly shifted compared to 2006 and 2007. The reason for this is the additional 'otolith-year' in 2009 and as the age likelihood component has a significant weight in the overall likelihood estimation this additional year of age data changes the estimation somewhat. With additional age data this shift might decrease.

The diagnostics from the Gadget model indicate that the fit is quite good and therefore the results may be plausible.

Results

The results are presented in Figure 7.2.20. Given the available data, the growth curve predicted by Gadget seems reasonable. Recruitment has been increasing since 2001. Similarly total biomass has been increasing since 2000 as a consequence of the good recruitment from 1997 whereas harvestable biomass (biomass available to the fishery according to the estimated selection curve) demonstrates only a slight increase and SSB demonstrates little change. The reason for this is the slow growth of tusk, i.e. it is not available to the fishery until it reaches approximately 5–6 years of age. Fishing mortality has decreased in recent years. The selection curves estimated indicate that tusk enters the fishery at around 45 cm and that selection curve from the survey (non-parametric) rises from 20 cm up to a peak at around 50 cm and then drops of rapidly (Figure 7.2.21).

Projections

Five different catch options were evaluated in the forecast for 2010 to 2018, 4 kt, 6 kt, 8 kt, 10 kt and 12 kt (Figure 7.2.22). In the forecasts recruitment (age 2) is assumed to be half of the 2007 (15 millions) which is a quite optimistic value. On the other hand as the species is relatively slow growing the assumptions on recruitment do not greatly affect the forecasts over the period studied. At least not for SSB, harvestable biomass and fishing mortality.

It is predicted that SSB will increase for catch levels of 6 kt and less, harvestable biomass will increase for catches of 6 kt and less. On the other hand total-stock biomass will decrease as it is most influenced by assumption of recruitment. Fishing mortality will decrease for all catch options of 6 kt and less (Figure 7.2.22).

Fmax and F0.1 were calculated by following one year class of million fishes for 29 years through the fisheries calculating total yield from the year class as function of fishing mortality of fully recruited fish. From the plot of yield vs. fishing mortality Fmax and F0.1 were estimated (Figure 7.2.23). In the model, the selection of the fisheries is length based so only the largest individuals of recruiting year classes are caught reducing mean weight of the survivors, more as fishing mortality is increased. This is to be contrasted with age based yield-per-recruit where the same weights-at-age are assumed in the landings independent of the fishing mortality even when the catch weights are much higher as the mean weight in the stock.

Alternative model settings

As for alternative scenarios Gadget was run assuming two different values of natural mortality namely M=0.1 and M=0.3. No marked difference in fitting the model was noted and the likelihood scores were quite similar for the values of natural mortality. The results showed all the same trends in SSB, biomass, recruitment and fishing mortality, there was only a upward or downward shift (Figure 7.2.24).

In the third alternative scenario the age data low weight in the likelihood score so that for all practical purposes it can be said it was omitted. When the age data is omitted the model converges at a much lower likelihood score than the base model (2800 compared to 17 000) but all the parameter estimates are less staple (inferred from likelihood profiles and starting the model from different initial values). The results differ from the base run in that the stock is assessed as considerably larger and fishing mortality lower (Figure 7.2.24).

7.2.4 Comments on the assessment

All the signs from commercial catch data and surveys indicate that tusk in Va is in a good state. It is not possible to apply an age-based assessment method on tusk in Va due to lack of time-series of age-structured data. However at the WKDEEP-2010 Benchmark meeting Gadget was adopted as an assessment tool tu be used on tusk in Va but only as indicative of trends. The model settings and diagnostics have been vastly improved since then and therefore it may be appropriate to use its predictions (short and medium term) to base advice on.

Even though Gadget setup has been improved additional age readings would be helpful and possibly to use the survey length distributions below 20 cm in fitting the model. However these slight improvements are unlikely to alter the estimates and predictions presented here significantly.

Previously the Group has pointed out that material to run age based assessment has been collected in Va, but otoliths have not been age read yet.

7.2.5 Management considerations

All indicators suggest that the state of tusk in Va is relatively good.

Tusk in Va is mainly caught in a mixed fishery by longliners and as a to a small extent as a bycatch in the trawl fishery.

However the fact that annual landings in Va have considerably exceeded both advice (national and ICES) and set TAC in recent years is of concern.

Limited data is available on tusk from XIV.

Table 7.2.1. Tusk in Va. Number of Icelandic boats participating in the fishery.

YEAR	LONGLINERS	GILLNETTERS	TRAWLERS
2000	236	20	13
2001	226	33	7
2002	192	18	10
2003	200	8	9
2004	190	5	10
2005	231	7	17
2006	228	11	12
2007	205	8	17
2008	170	16	30
2009	157	20	38

Table 7.2.2. Tusk in Va Annual landings (tonnes) of tusk of the Icelandic flees in 1992–2009.

Year	Catches				Proportional catches		
	Longline	Trawl	Other gear	Catches	Longline	Trawl	Other gear
1992	6121	132	195	6448	94.9%	2.0%	3.0%
1993	4299	118	314	4732	90.8%	2.5%	6.6%
1994	4124	105	384	4614	89.4%	2.3%	8.3%
1995	4830	109	289	5227	92.4%	2.1%	5.5%
1996	4934	101	182	5217	94.6%	1.9%	3.5%
1997	4639	77	128	4843	95.8%	1.6%	2.6%
1998	3942	77	101	4119	95.7%	1.9%	2.5%
1999	5588	94	93	5775	96.8%	1.6%	1.6%
2000	4585	95	60	4741	96.7%	2.0%	1.3%
2001	3263	74	88	3425	95.3%	2.2%	2.6%
2002	3729	75	130	3935	94.8%	1.9%	3.3%
2003	3917	55	57	4030	97.2%	1.4%	1.4%
2004	2996	84	43	3124	95.9%	2.7%	1.4%
2005	3358	135	40	3533	95.0%	3.8%	1.1%
2006	4902	91	60	5053	97.0%	1.8%	1.2%
2007	5829	95	60	5984	97.4%	1.6%	1.0%
2008	6755	114	64	6933	97.4%	1.6%	0.9%
2009	6755	108	93	6955	97.1%	1.6%	1.3%

Table 7.2.3. Tusk in Va. Nominal landings in 1973–2009.

Year	Faroe	Germany	Iceland	Norway	UK	Total
1973	3363	576	2366	911	391	7607
1974	3172	375	1857	893	230	6527
1975	2445	384	1673	975	254	5731
1976	2397	334	2935	1352	94	7112
1977	2818	212	3122	1796	0	7948
1978	2168	0	3352	812	0	6332
1979	2050	0	3558	845	0	6453
1980	2873	0	3089	928	0	6890
1981	2624	0	2827	1025	0	6476
1982	2410	0	2804	666	0	5880
1983	4046	0	3469	772	0	8287
1984	2008	0	3430	254	0	5692
1985	1885	0	3068	111	0	5064
1986	2811	0	2549	21	0	5381
1987	2638	0	2984	19	0	5641
1988	3757	0	3078	20	0	6855
1989	3908	0	3131	10	0	7049
1990	2475	0	4813	0	0	7288
1991	2286	0	6439	0	0	8725
1992	1567	0	6437	0	0	8004
1993	1329	0	4746	0	0	6075
1994	1212	0	4612	0	0	5824
1995	979	1	5245	0	0	6225
1996	872	1	5226	3	0	6102
1997	575	0	4819	0	0	5394
1998	1052	1	4118	0	0	5171
1999	1035	2	5794	391	2	7224
2000	1154	0	4714	374	2	6244
2001	1125	1	3392	285	5	4808
2002	1269	0	3840	372	2	5483
2003	1163	1	4028	373	2	5567
2004	1478	1	3126	214	2	4821
2005	1157	3	3539	303	41	5043
2006	1239	2	5054	299	2	6596
2007	1250	0	5984	300	1	7535
2008	959	0	6932	284	0	8175
2009	997	0	6955	300	0	8252

Table 7.2.4. Tusk in Va. TAC recommended by the Marine Research Institute, national TAC, total landings (in tonnes) and difference between total landings and recommended and national TAC in the quota years 2001/2002–2009/2010.

Fishing year	MRI advice	National TAC	Landings
2001/02		4500	4876
2002/03	3500	3500	5046
2003/04	3500	3500	4958
2004/05	3500	3500	4901
2005/06	3500	3500	5928
2006/07	5000	5000	7942
2007/08	5000	5500	7279
2008/09	5000	5500	8162
2009/10	5000	5500	

Table 7.2.5. Tusk in Va. Number of available length measurements from Icelandic commercial catches.

Year	Longlines	Gillnets	Lobster T	Trawls	Total
2000	2995	0	0	0	2995
2001	3097	0	151	0	3248
2002	2843	0	0	0	2843
2003	8444	0	0	0	8444
2004	3844	0	0	150	3994
2005	5785	0	0	21	5806
2006	4861	0	0	472	5333
2007	11841	167	0	150	12158
2008	20963	0	0	0	20963
2009	21151	0	0	0	21151

Table 7.2.6. Tusk in Va. Number of available otoliths from Icelandic commercial catches.

Year	Longlines	Gillnets	Lobster T	Trawls	Total
2000	849	0	0	0	849
2001	849	0	50	0	899
2002	851	0	0	0	851
2003	900	0	0	0	900
2004	500	0	0	50	550
2005	600	0	0	0	600
2006	750	0	0	150	900
2007	1050	67	0	50	1167
2008	1600	0	0	0	1600
2009	1250	0	0	0	1250

Table 7.2.7. Tusk in Va. Mean weight-at-age (g) from commercial catches (longlines) in 1995 and 2009.

Year	3	4	5	6	7	8	9	10	11	12
1995	na	na	1018	1290	1403	1724	2203	2770	3406	2974
2009	489	778	1035	1315	1535	1936	1948	na	na	na

Table 7.2.8. Tusk in XIV. Nominal landings by nations.

Year	Faroe	Germany	Iceland	Norway	Russia	Spain	UK	Total
1973	16	9	0	0	0	0	2	27
1974	259	2	15	0	0	0	1	277
1975	29	17	13	138	0	0	0	197
1976	0	5	89	47	0	0	1	142
1977	167	16	0	40	0	0	1	224
1978	0	47	0	38	0	0	0	85
1979	0	27	0	0	0	0	0	27
1980	0	13	0	0	0	0	0	13
1981	110	10	0	0	0	0	0	120
1982	0	10	0	0	0	0	0	10
1983	74	11	0	0	0	0	0	85
1984	0	5	0	58	0	0	0	63
1985	0	4	0	0	0	0	0	4
1986	33	2	0	0	0	0	0	35
1987	13	2	0	0	0	0	0	15
1988	19	2	0	0	0	0	0	21
1989	13	1	0	0	0	0	0	14
1990	0	2	0	7	0	0	0	9
1991	0	2	0	68	0	0	1	71
1992	0	0	3	120	0	0	0	123
1993	0	0	1	39	0	0	0	40
1994	0	0	0	16	0	0	0	16
1995	0	0	0	30	0	0	0	30
1996	0	0	0	157	0	0	0	157
1997	0	0	10	9	0	0	0	19
1998	0	0	0	12	0	0	0	12
1999	0	0	0	8	0	0	0	8
2000	0	0	11	11	0	3	0	25
2001	3	0	20	69	0	0	0	92
2002	4	0	86	30	0	0	0	120
2003	0	0	2	88	0	0	0	90
2004	0	0	0	40	0	0	0	40
2005	7	0	0	41	8	0	0	56
2006	3	0	0	19	51	0	0	73
2007	0	0	0	40	6	0	0	46
2008	0.2	0	0	7	0	0	0	7.2
2009	0	0	0	5	11	0	0	16

Russian catches were taken in Subdivision XIVb1 (Mid Atlantic Ridge).

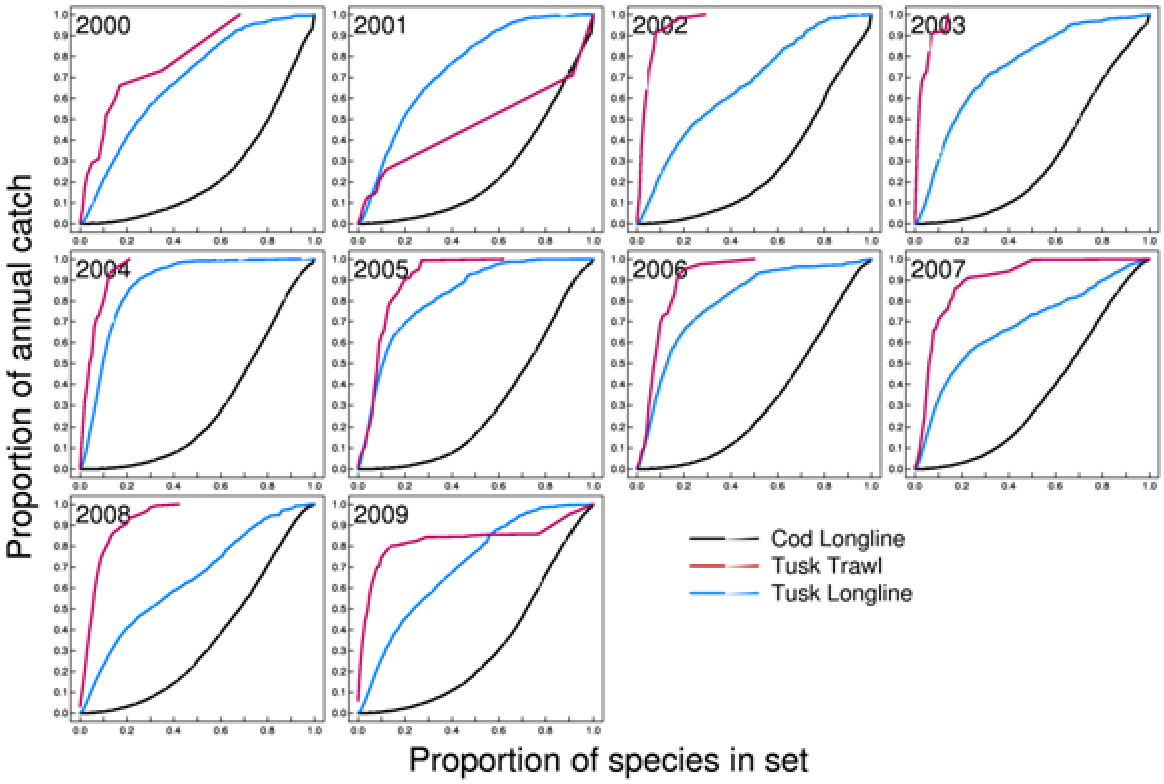


Figure 7.2.1. Tusk in Va. Plot of the tusk fishery in 2000 to 2009 and for comparison the cod longline fishery. This plot is best explained by an example. In 2005 around 20\% of the annual catch of cod were caught where it was 50\% or more of the catch in each set/haul, so it can be considered a fairly directed fishery. On the other hand tusk in the trawl fishery is mostly a bycatch as more than 80\% of the annual catch is caught where tusk is less than 10\% of the catch in each set/haul.

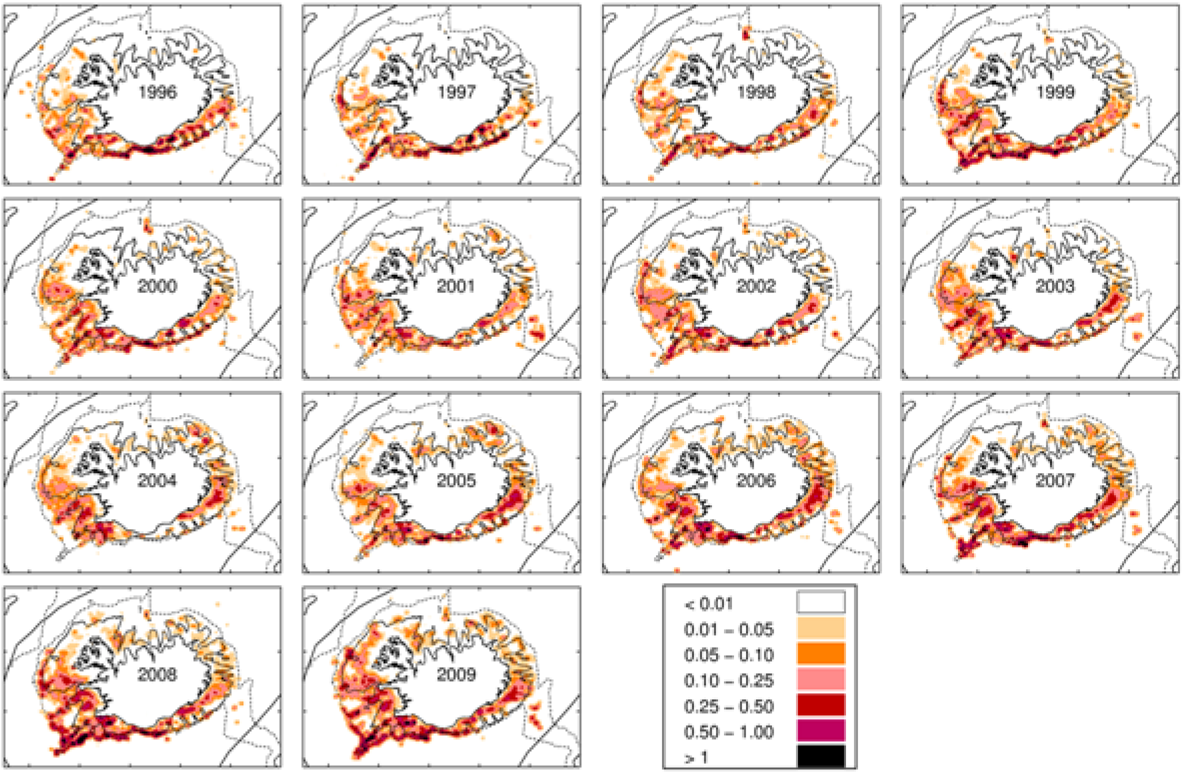


Figure 7.2.2. Tusk in Va. Geographical distribution (tonnes/square mile) of the Icelandic tusk fishery in 1996–2009 as reported in logbooks by the Icelandic fleet. All gears combined.

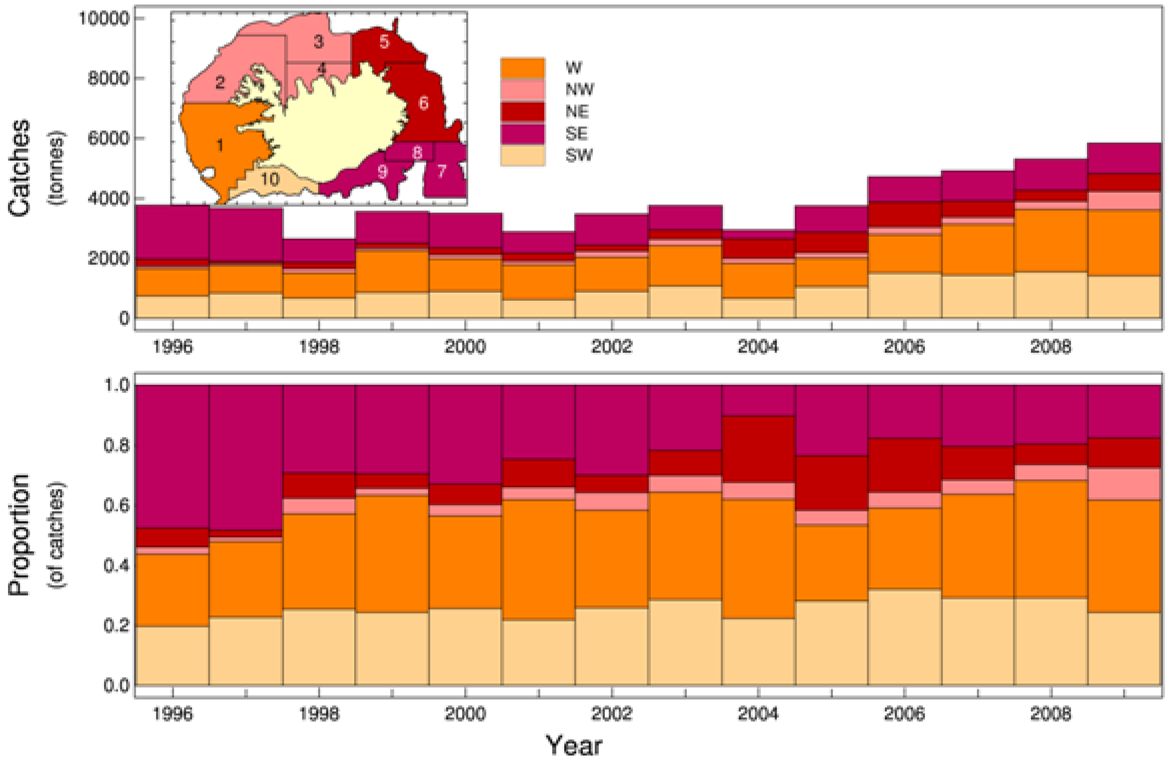


Figure 7.2.3. Tusk in Va. Changes in spatial distribution of tusk catches as recorded in Icelandic vessel logbooks.

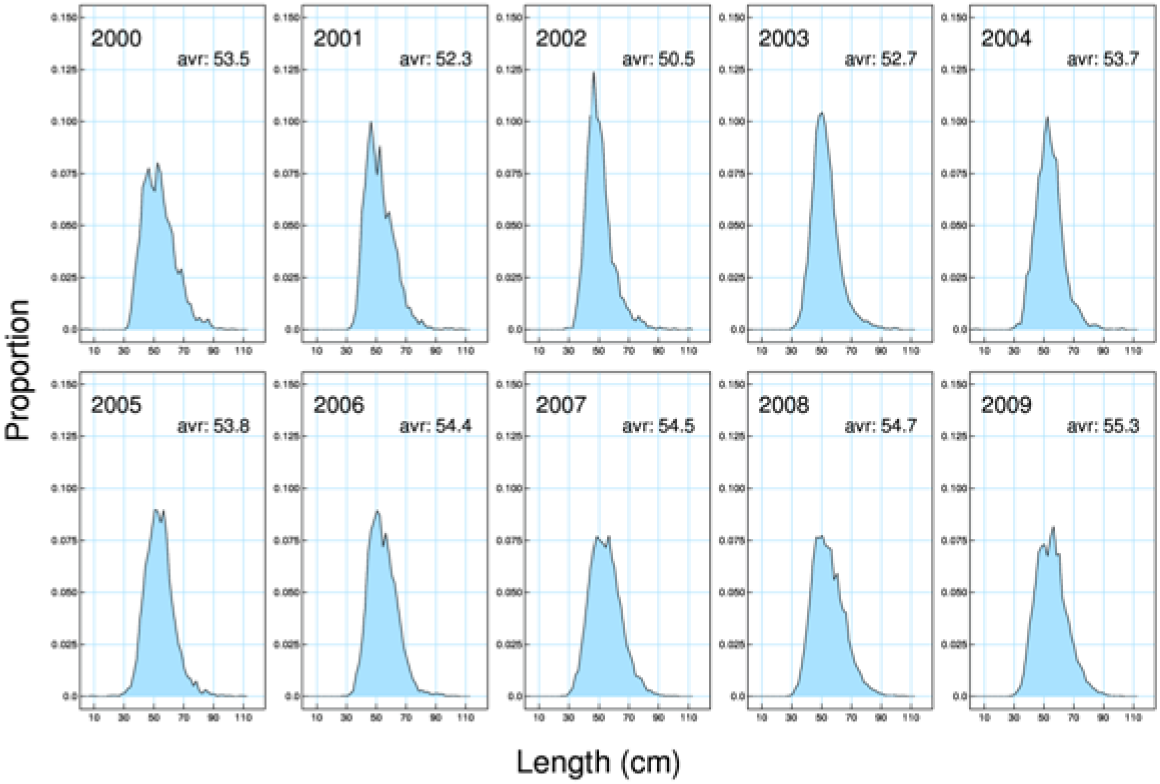


Figure 7.2.4. Tusk in Va. Length distributions from Icelandic commercial longline catches. Small numbers to the right refer to mean length.

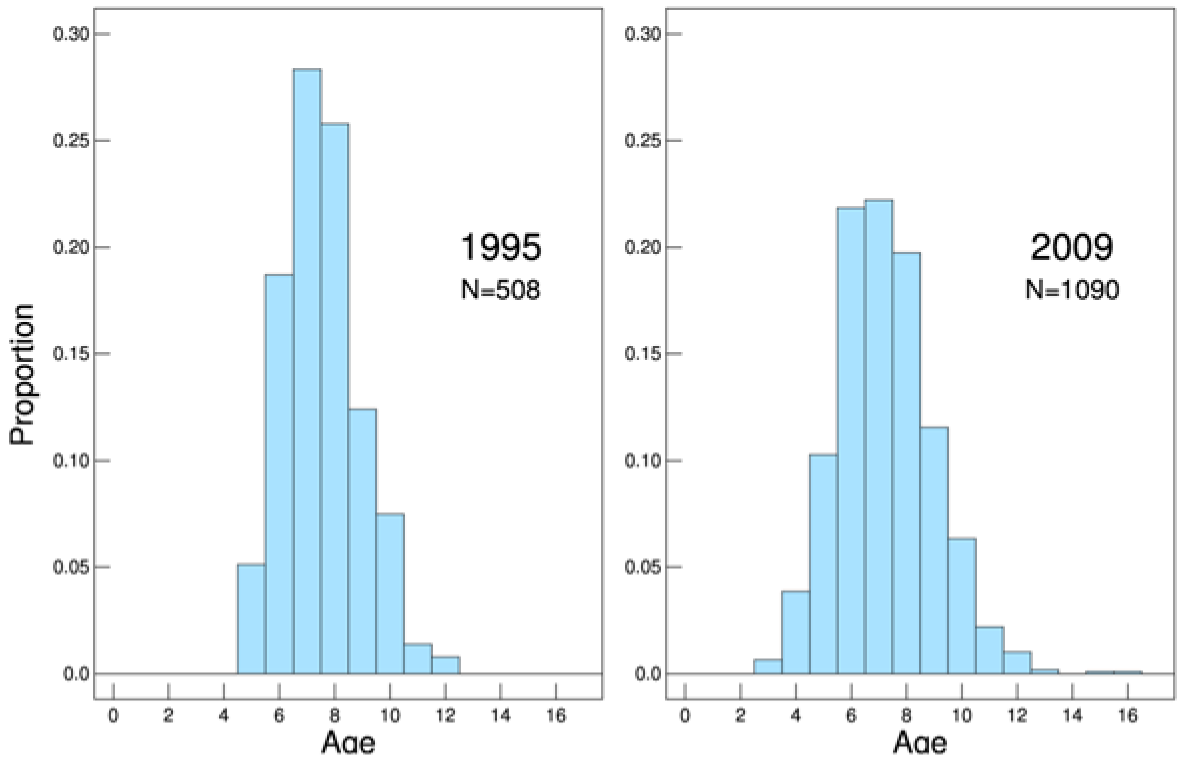


Figure 7.2.5. Tusk in Va. Age distribution as observed from aged otoliths from commercial longline catches in 1995 and 2009.

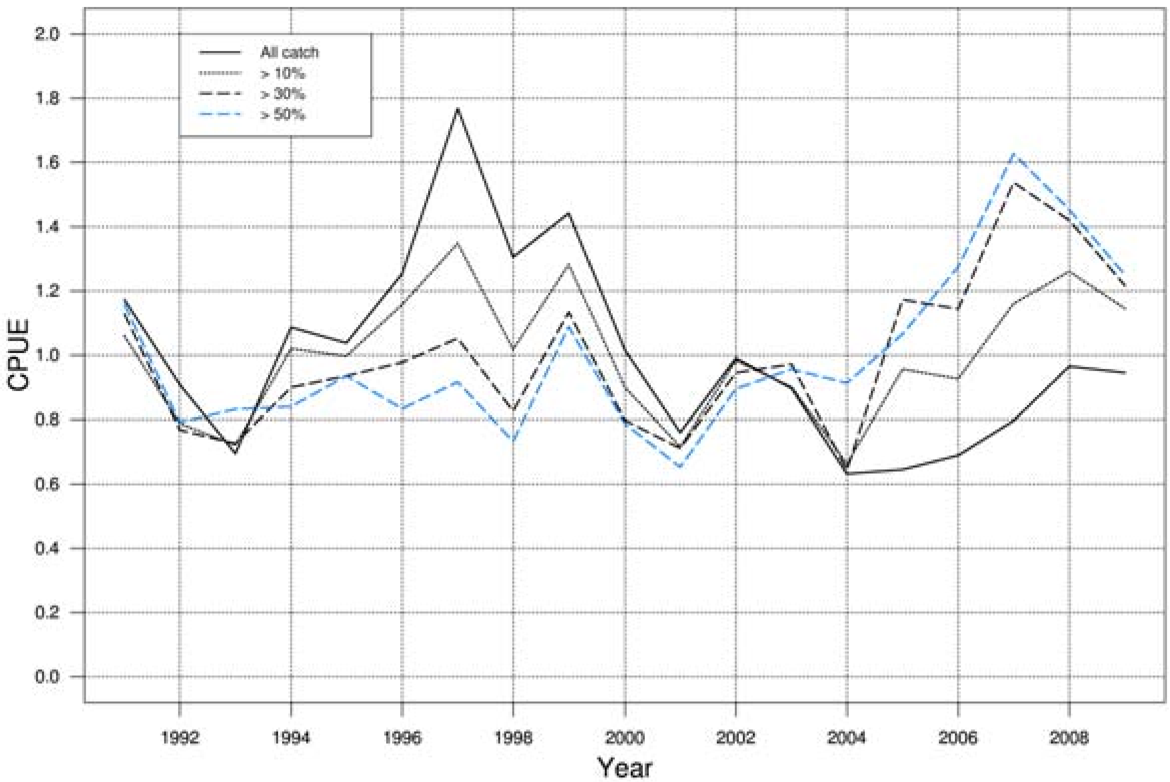


Figure 7.2.6. Tusk in Va. Index of raw cpue (sum(yield)/sum(effort)) of tusk from the Icelandic longline fishery based on logbooks 1991–2008. The criteria for the calculations were all sets where tusk was reported in the logbooks and where tusk composed at least 10%, 30\% or 50% of the total catch in each set.

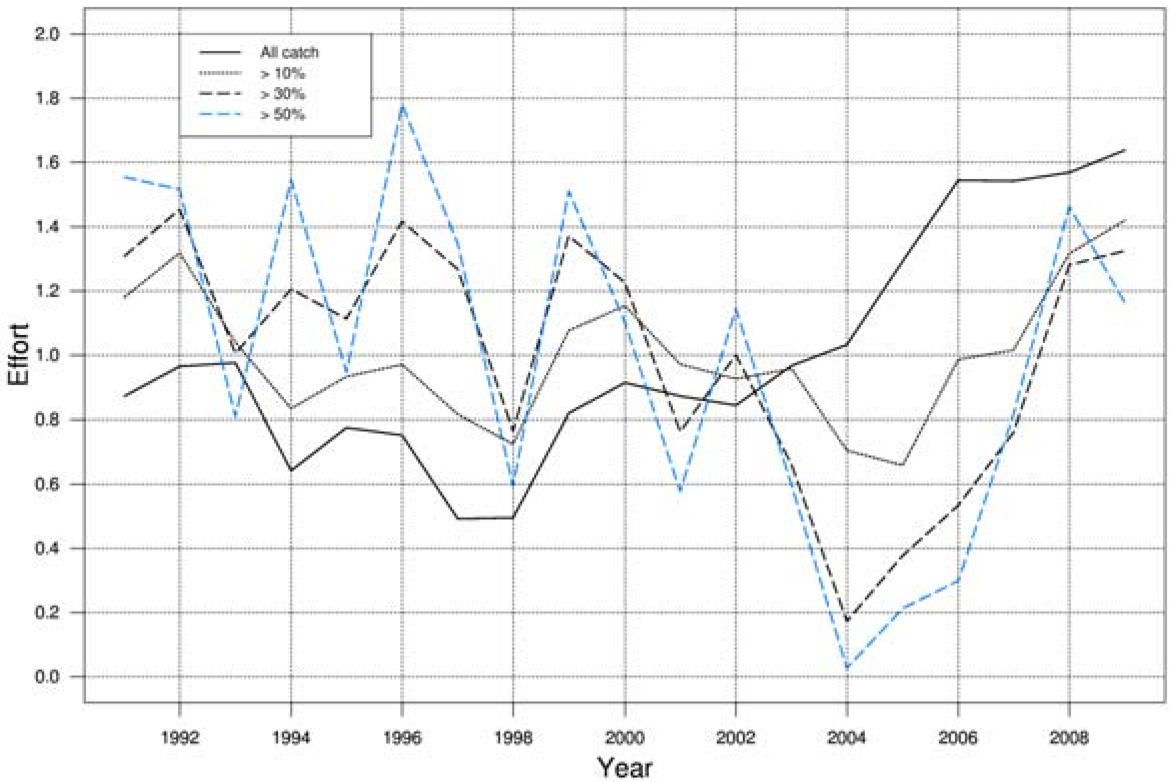


Figure 7.2.7. Tusk in Va. Index of raw effort of tusk from the Icelandic long-line fishery based on logbooks 1991–2008. The criteria for the calculations were all sets where tusk was reported in the logbooks and where tusk composed at least 10%, 30% or 50% of the total catch in each set.

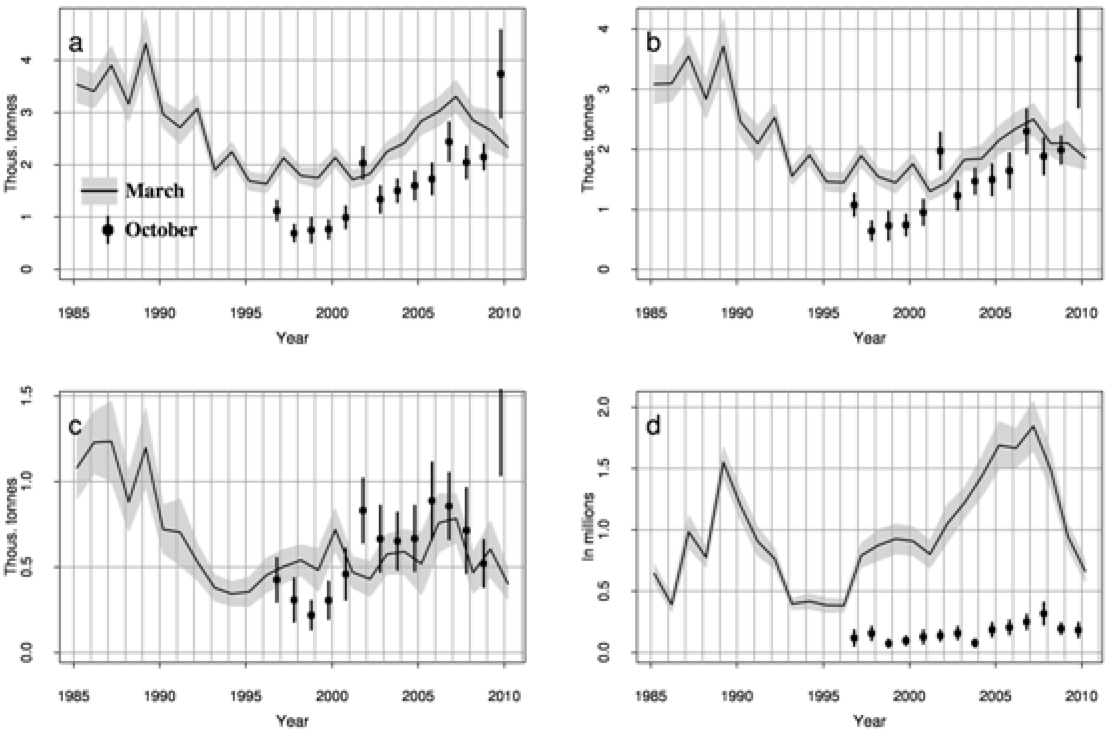


Figure 7.2.8. Tusk in Va. Indices in the Spring Survey (March) 1985–2009 (line, shaded area) and the Autumn Survey (October) 1996–2009 (dots, vertical lines). a) Indices of total biomass. b) Biomass index of fish >40 cm. c) Biomass index of fish >60$ cm. d) Index of fish <30 cm. Shaded area and the vertical lines indicate one standard deviation in the abundance estimates.

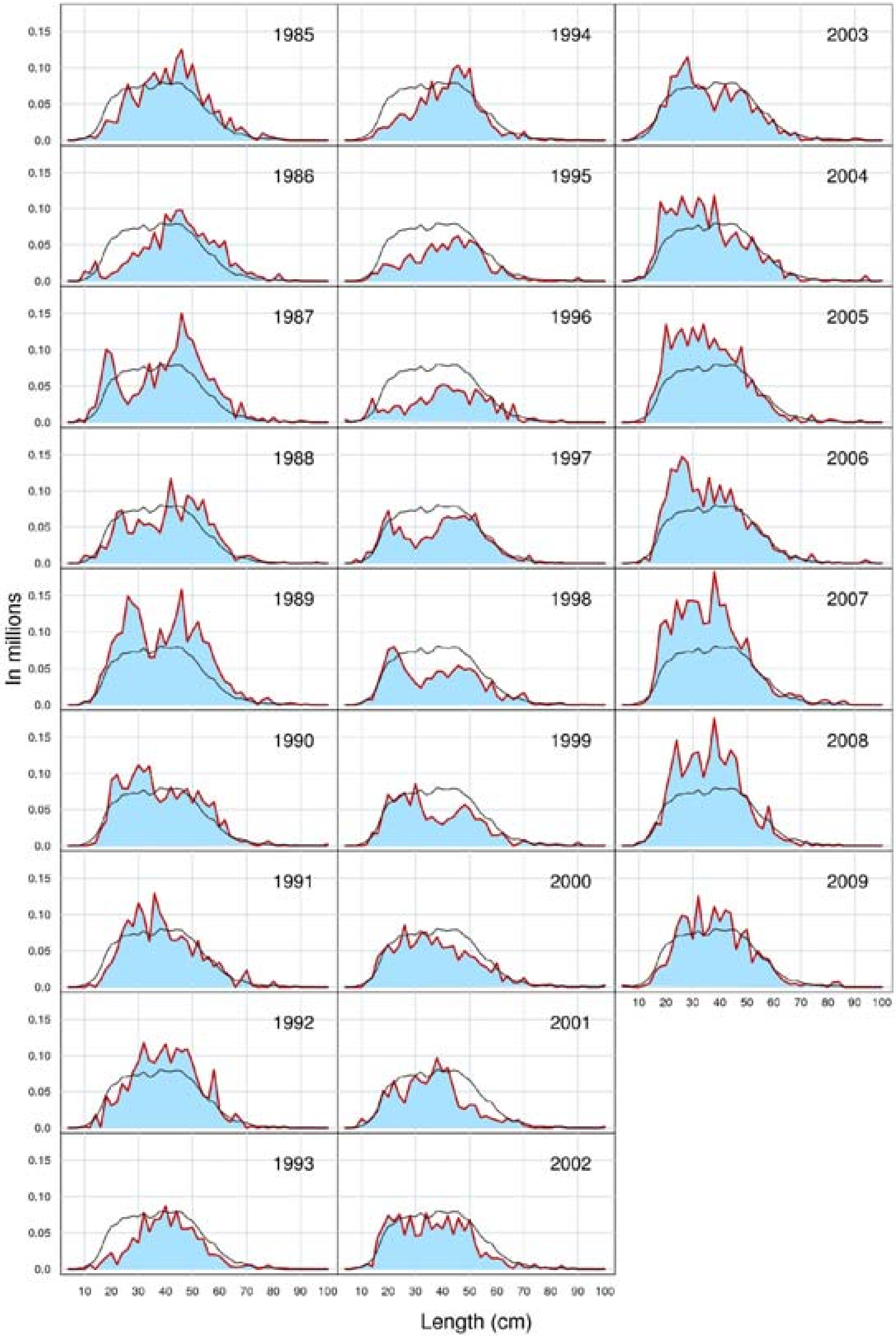


Figure 7.2.9. Tusk in Va. Length disaggregated abundance indices from the Spring Survey 1985–2009. Black line is the mean of the total indices from 1985–2009.

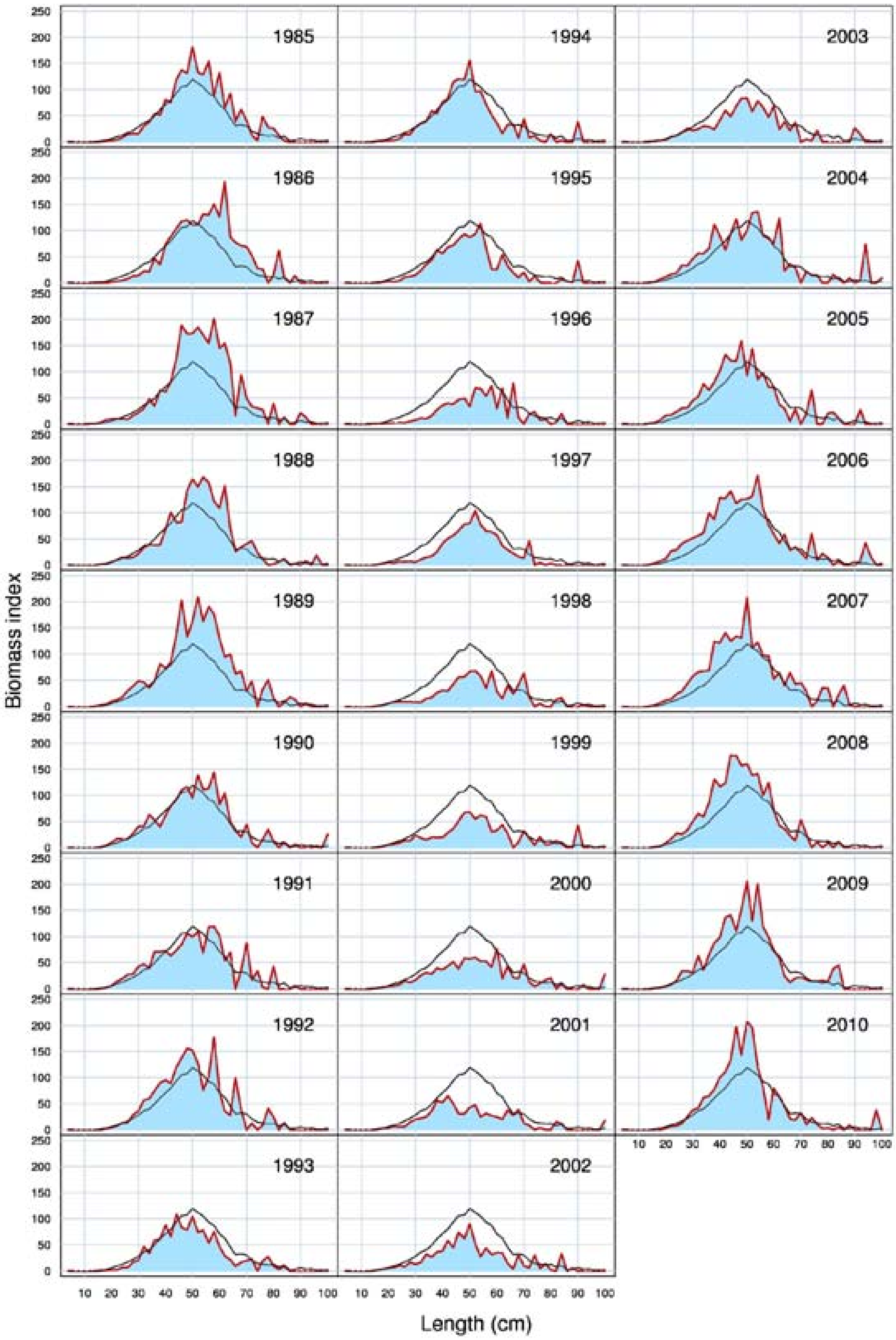


Figure 7.2.9. Tusk in Va. Length disaggregated biomass indices (blue) from the Spring Survey 1985–2009. Black line is the mean from 1985–2009.

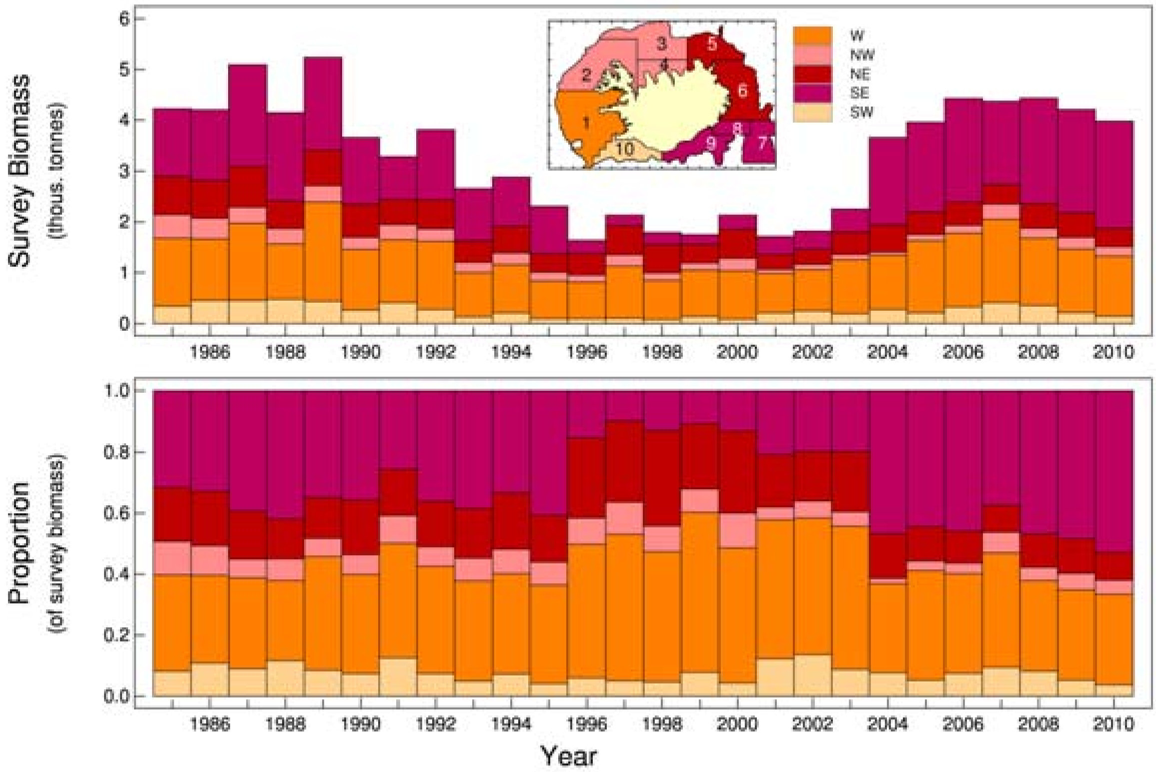


Figure 7.2.10. Tusk in Va. Estimated survey biomass in the spring survey by year from different parts of the continental shelf (upper figure) and as proportion of total (lower figure).

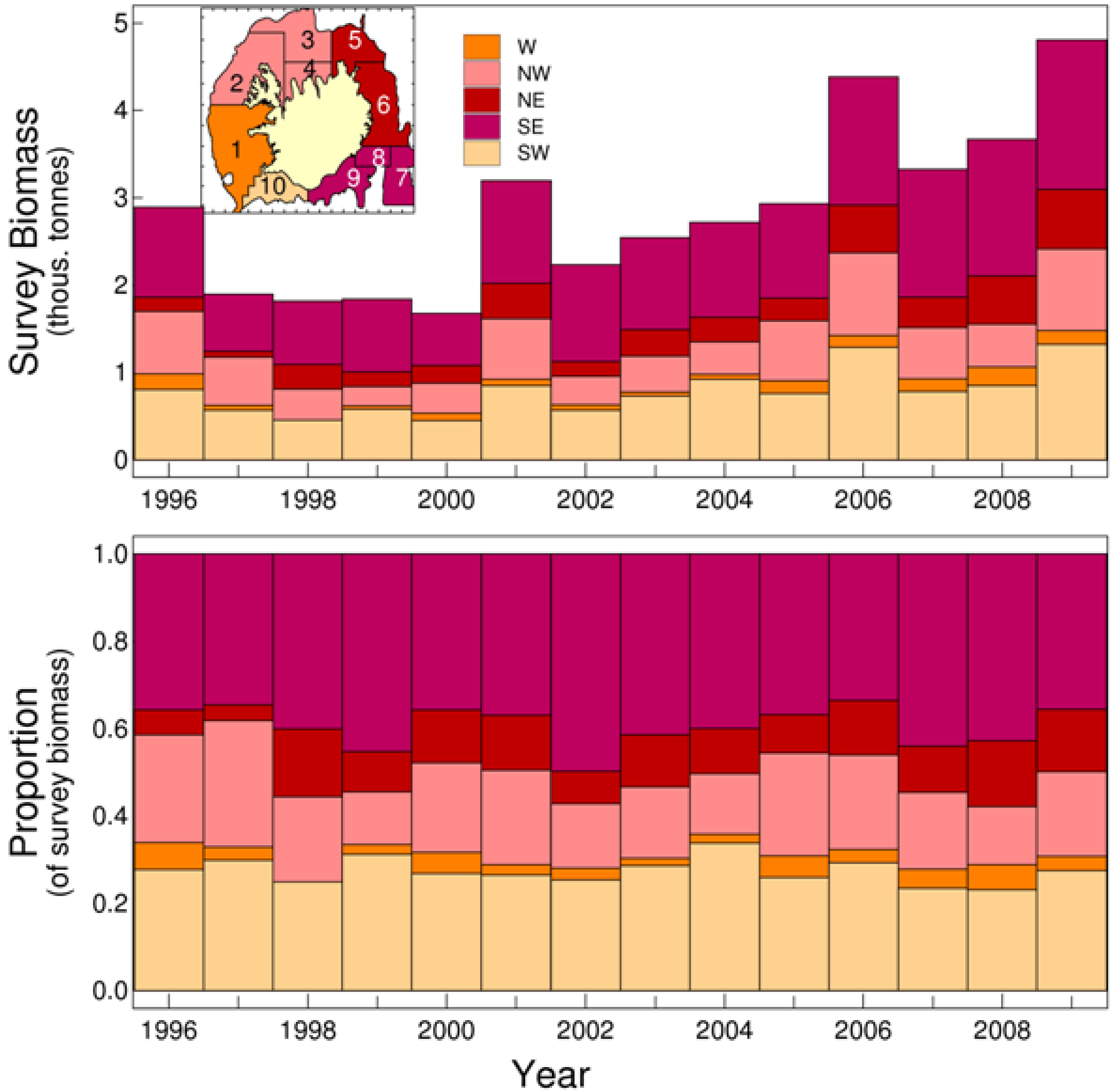


Figure 7.2.11. Tusk in Va. Estimated survey biomass in the autumn survey by year from different parts of the continental shelf (upper figure) and as proportion of total (lower figure).

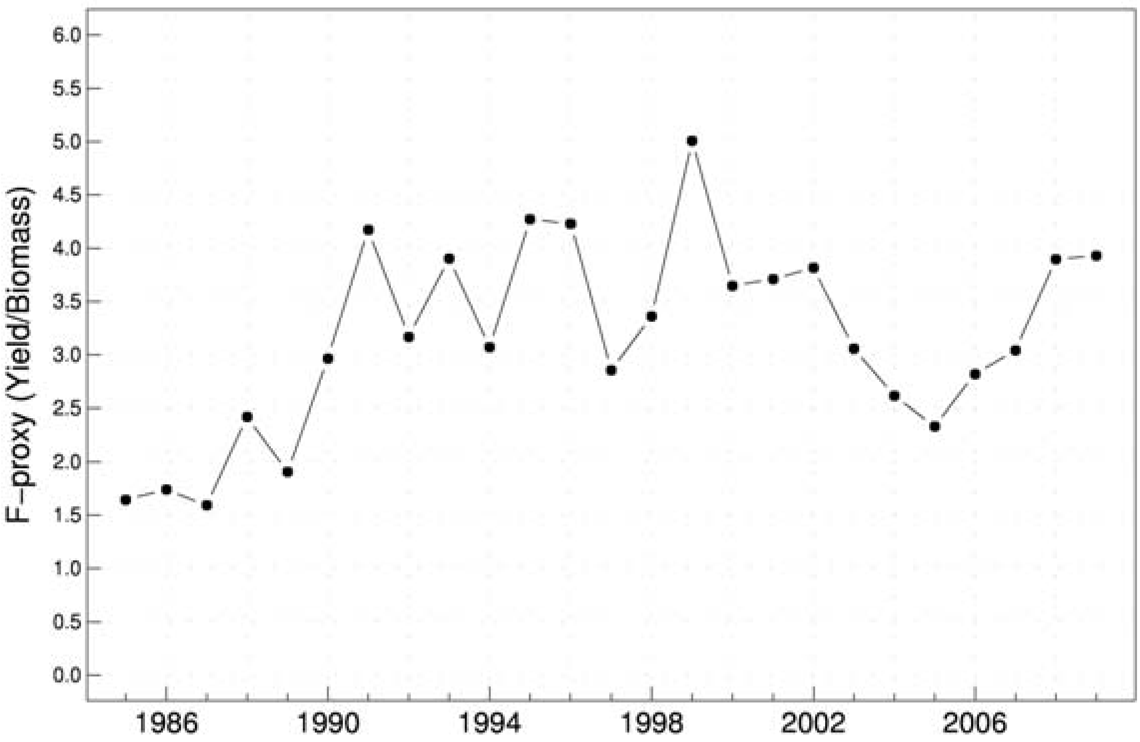


Figure 7.2.12. Tusk in Va. Relative fishing mortality (Fproxy = Yield / Survey Biomass).

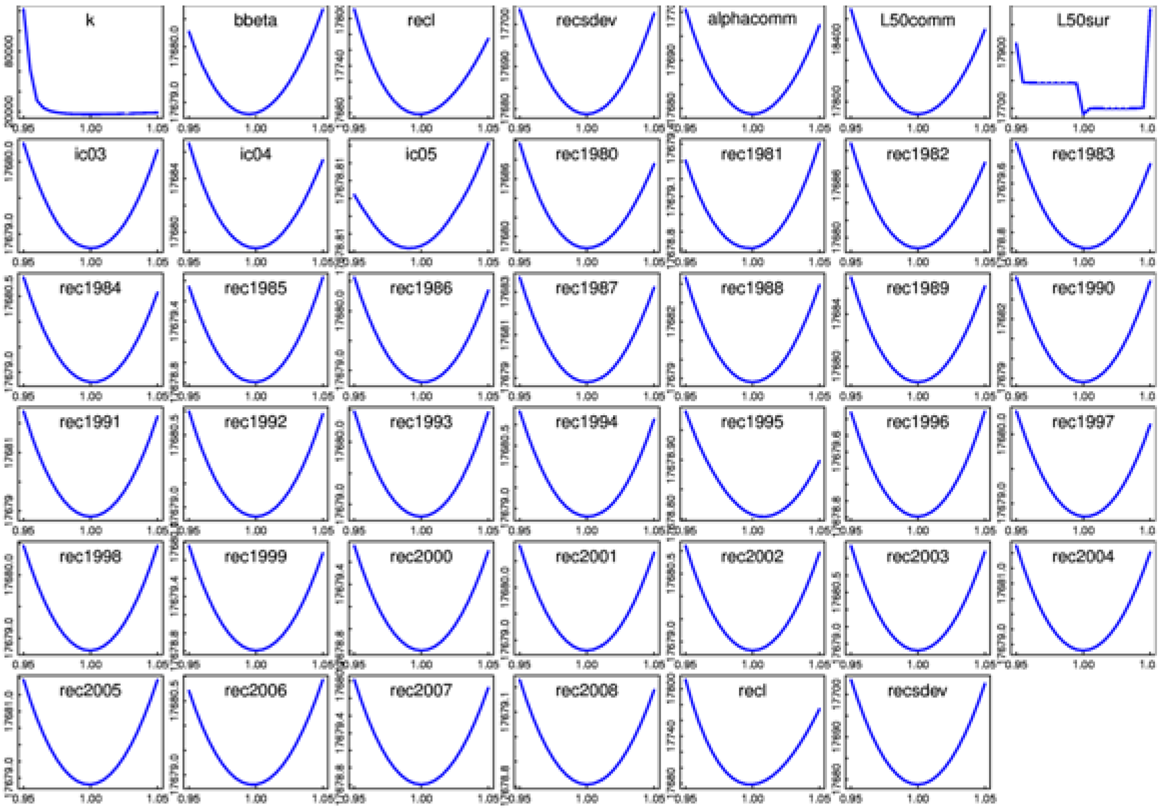


Figure 7.2.13. Tusk in Va. Likelihood profiles for the estimated parameters in the Gadget model for tusk in Va ('Free' *y-axis).*

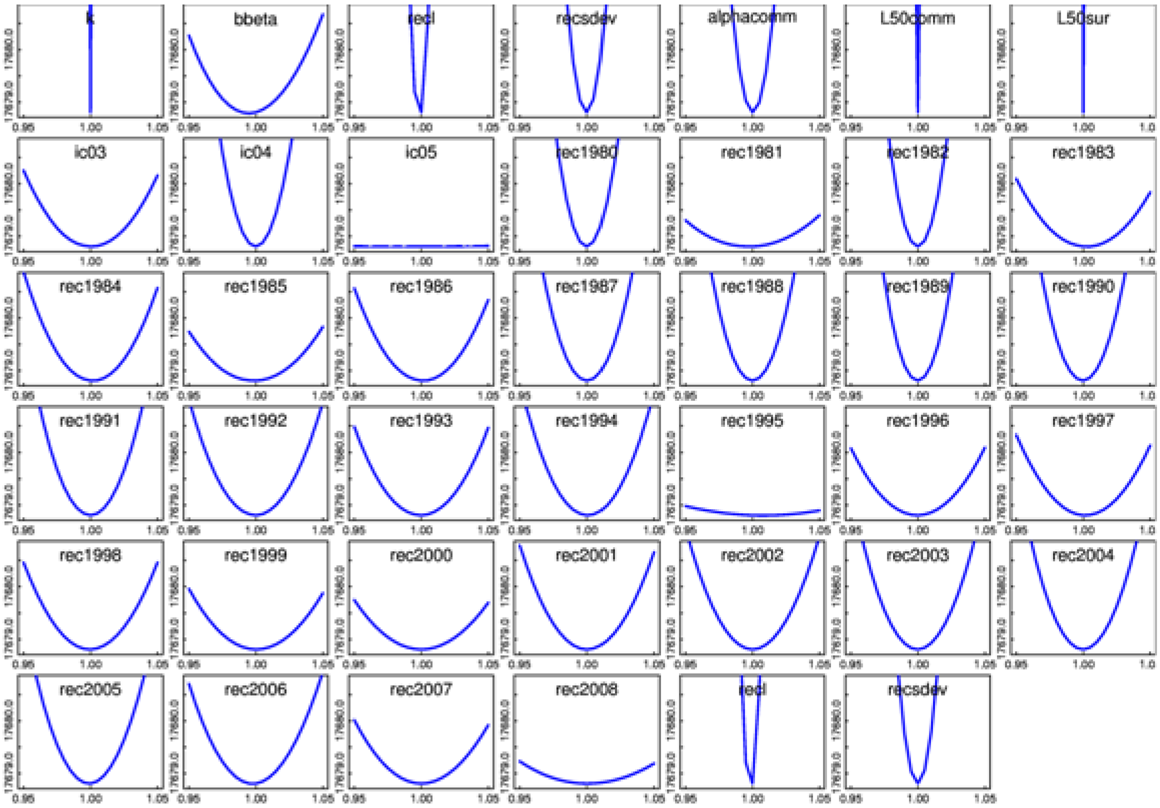


Figure 7.2.14. Tusk in Va. Likelihood profiles for the estimated parameters in the Gadget model for tusk in Va ('Fixed' *y-axis).*

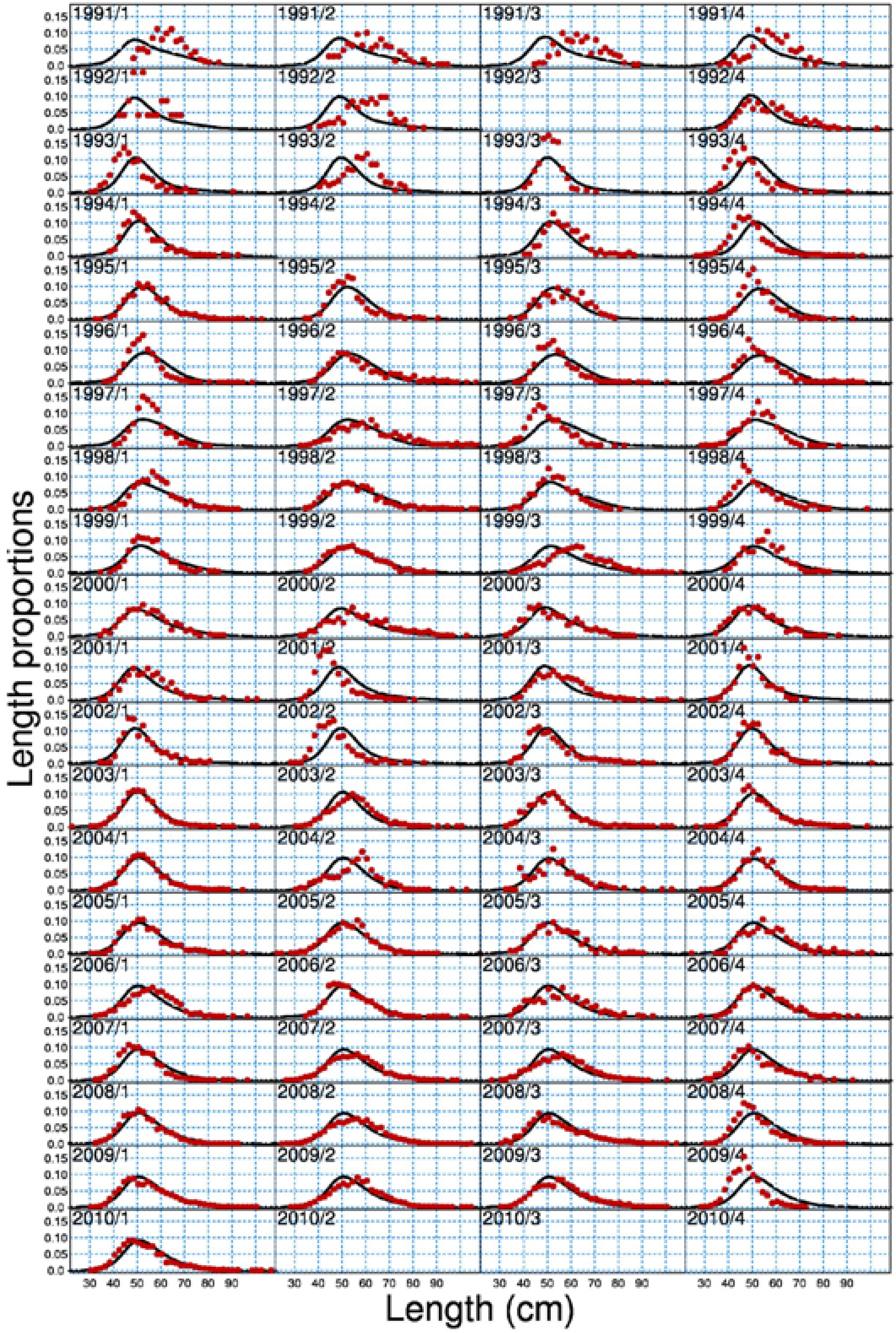


Figure 7.2.15. Tusk in Va. Predicted proportional length distributions (black lines) and observed proportional length distributions (red dots) by year (top to bottom) and step (left to right) from commercial catches.

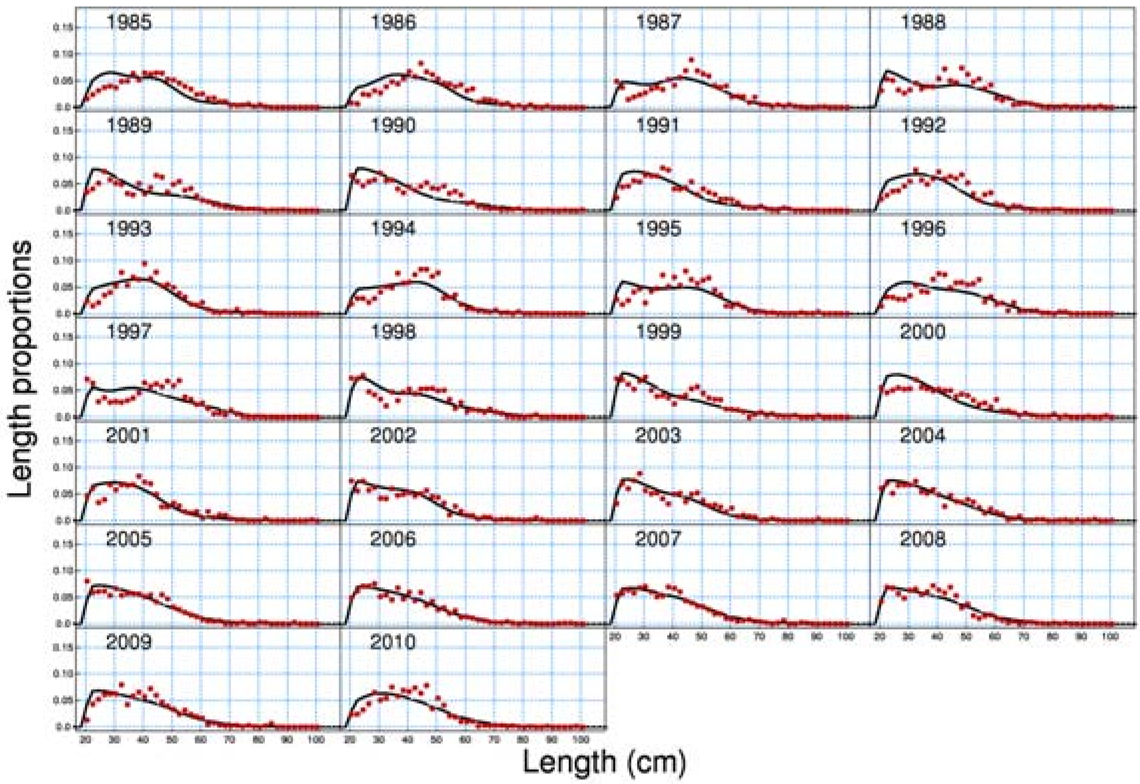


Figure 7.2.16. Tusk in Va. Predicted proportional length distributions (black lines) and observed proportional length distributions (red dots) by year from the spring survey.

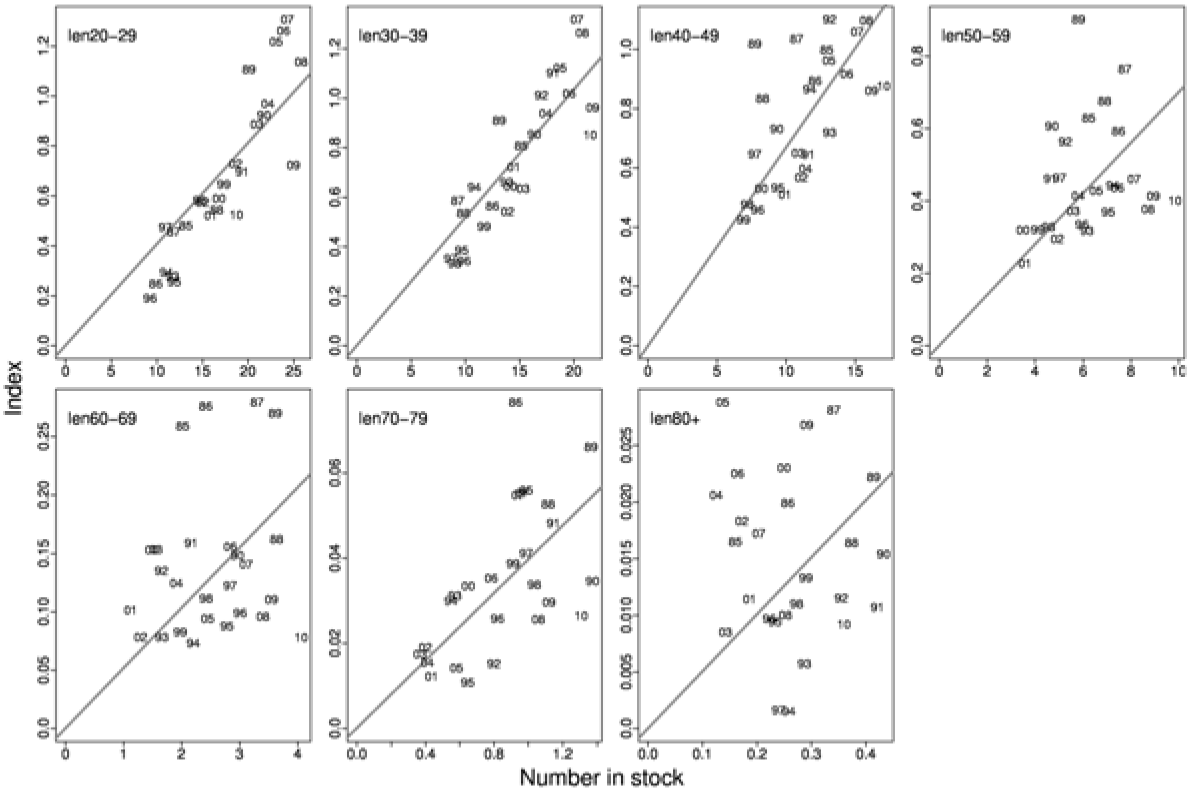


Figure 7.2.17. Tusk in Va. Estimates from the Gadget model plotted against observed values from the spring survey.

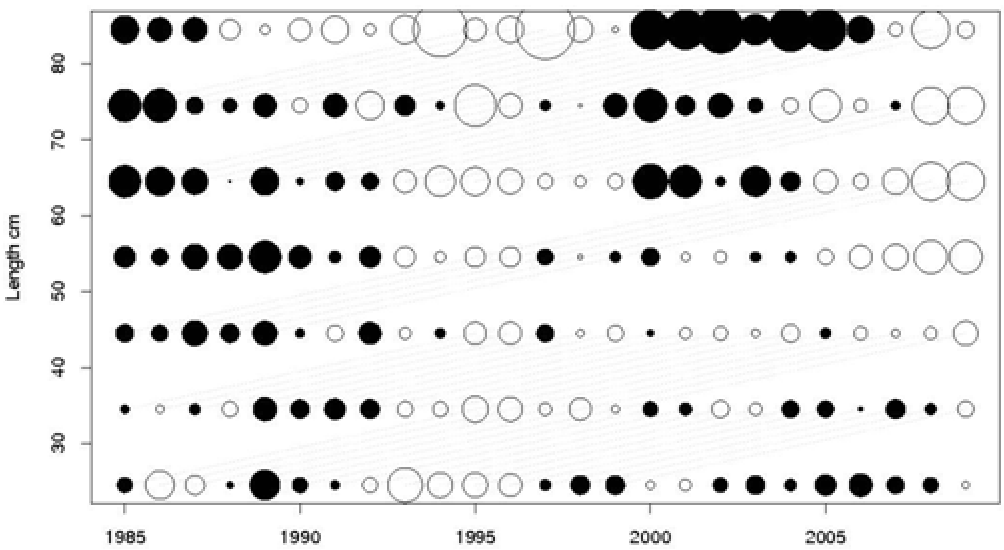


Figure 7.2.18. Tusk in Va. Residuals from the fit between model and survey indices. The shaded circles indicate positive trends (model below the survey). Largest residuals correspond to log(obs/mod)=1.

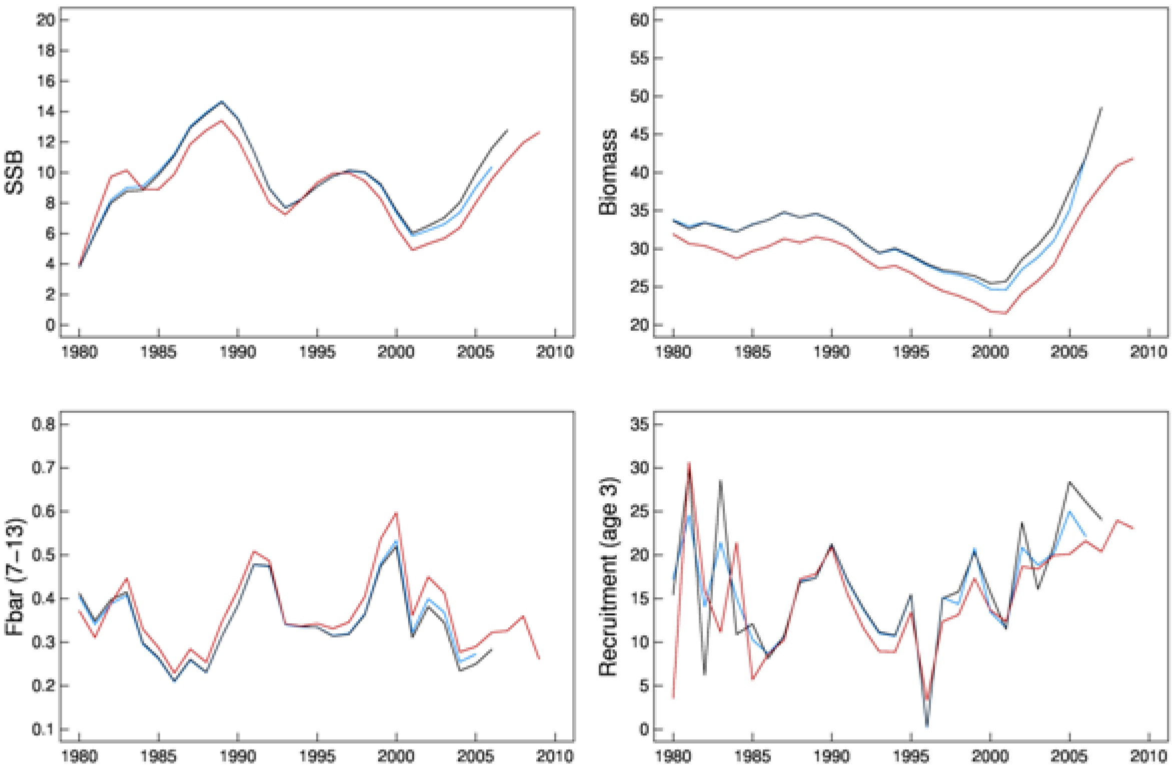


Figure 7.2.19. Tusk in Va. Retrospective analysis of the Gadged model predictions.for 2006(blue), 2007 (black) and 2009 (red).

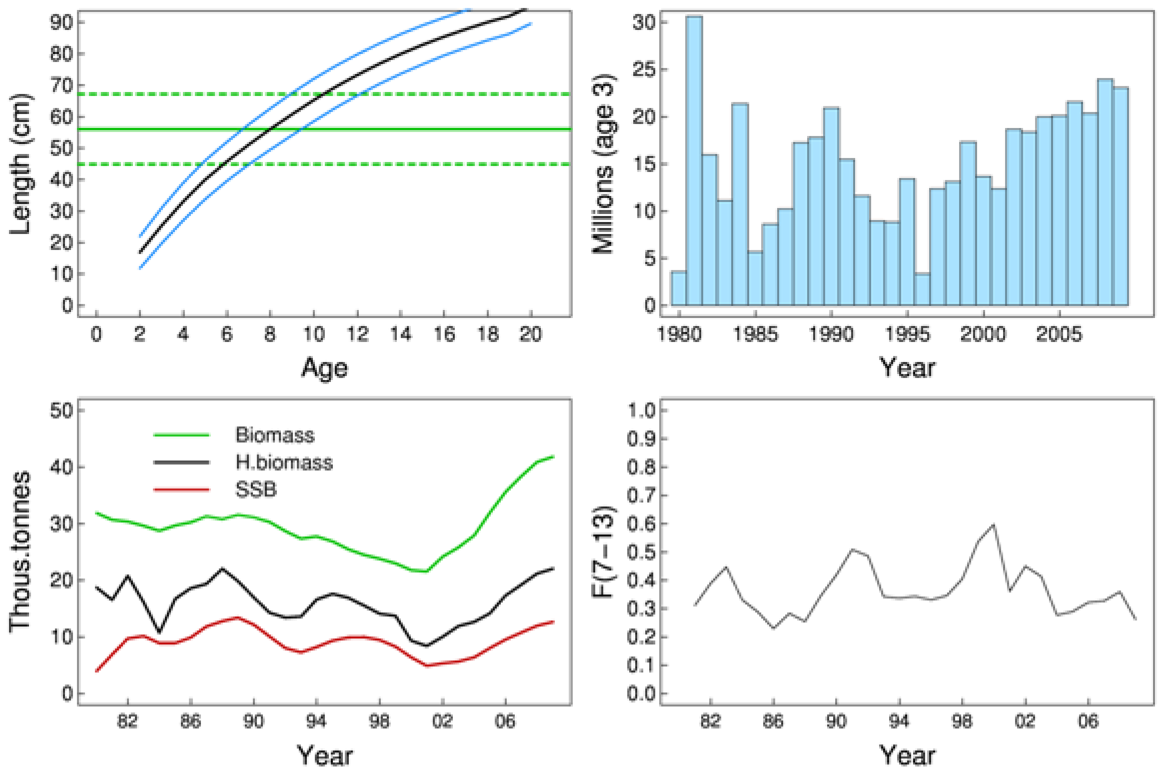


Figure 7.2.20. Tusk in Va. Results from the Gadget model. From left to right, top to bottom: Estimated mean growth from the model for 1980–2009 (+/- 1 standard deviation) Recruitment-at-age 3. Trends in biomass, harvestable biomass and spawning stock biomass (SSB). Trends in $F_{3\text{-}17}$.

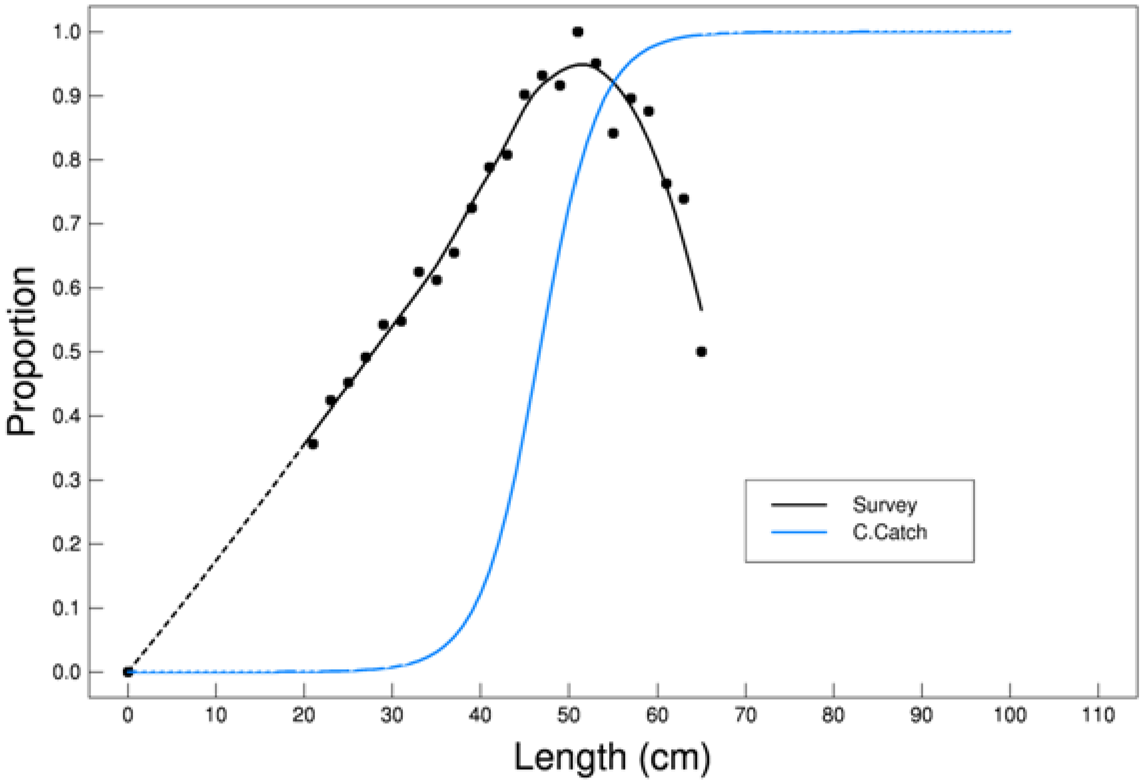


Figure 7.2.21. Tusk in Va. Estimated selection curves from the commercial catches (blue line) and the survey (black line).

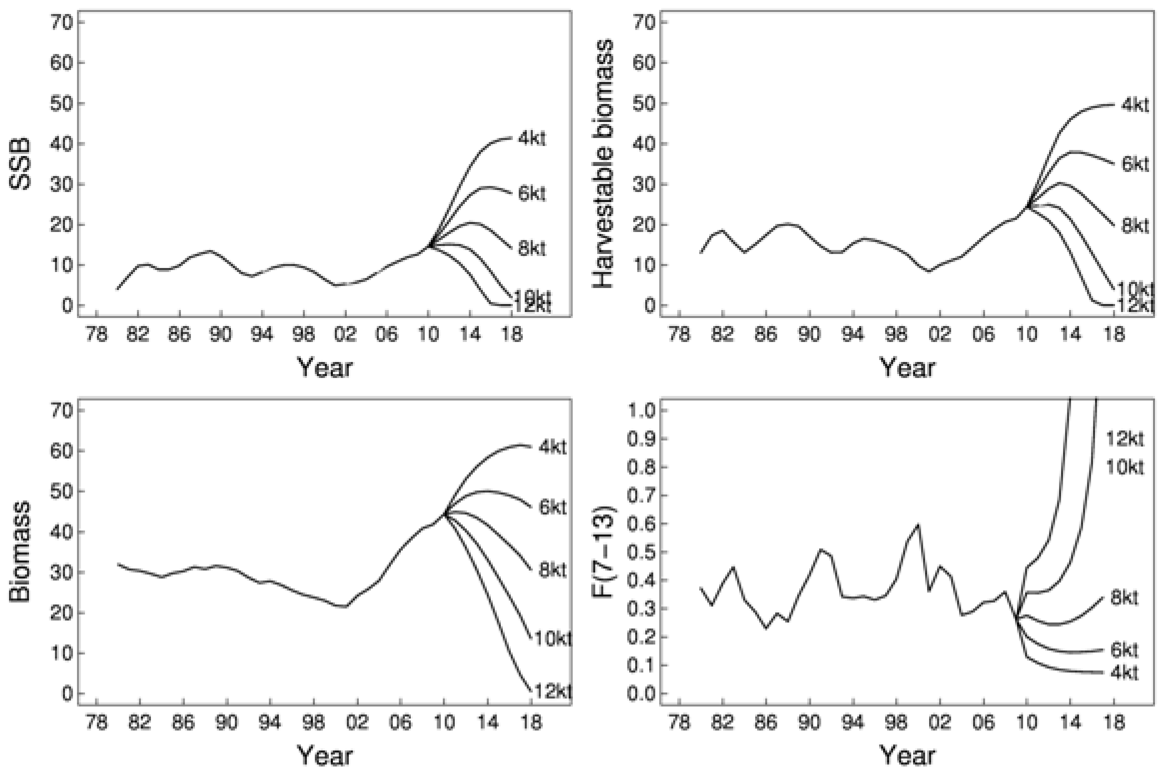


Figure 7.2.22. Tusk in Va. Forward projections by the Gadget model assuming fixed catches to 2018.

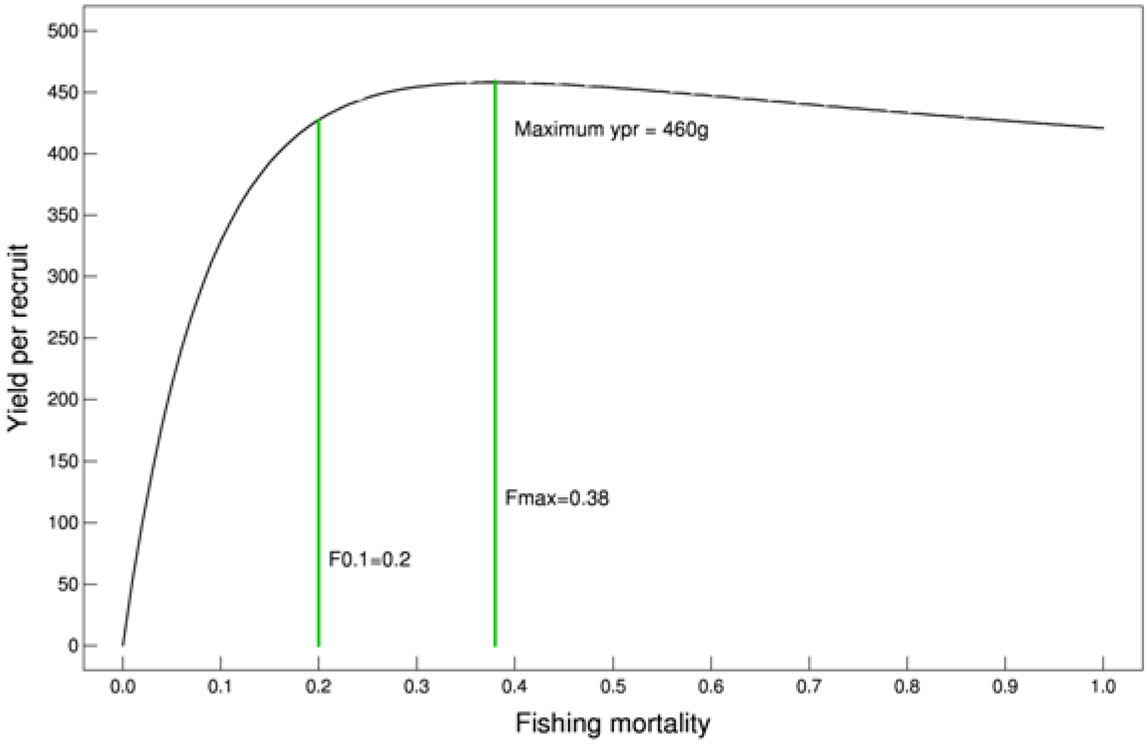


Figure 7.23. Tusk in Va. Estimates of yield per recruit from the Gadget model given different levels of fishing.

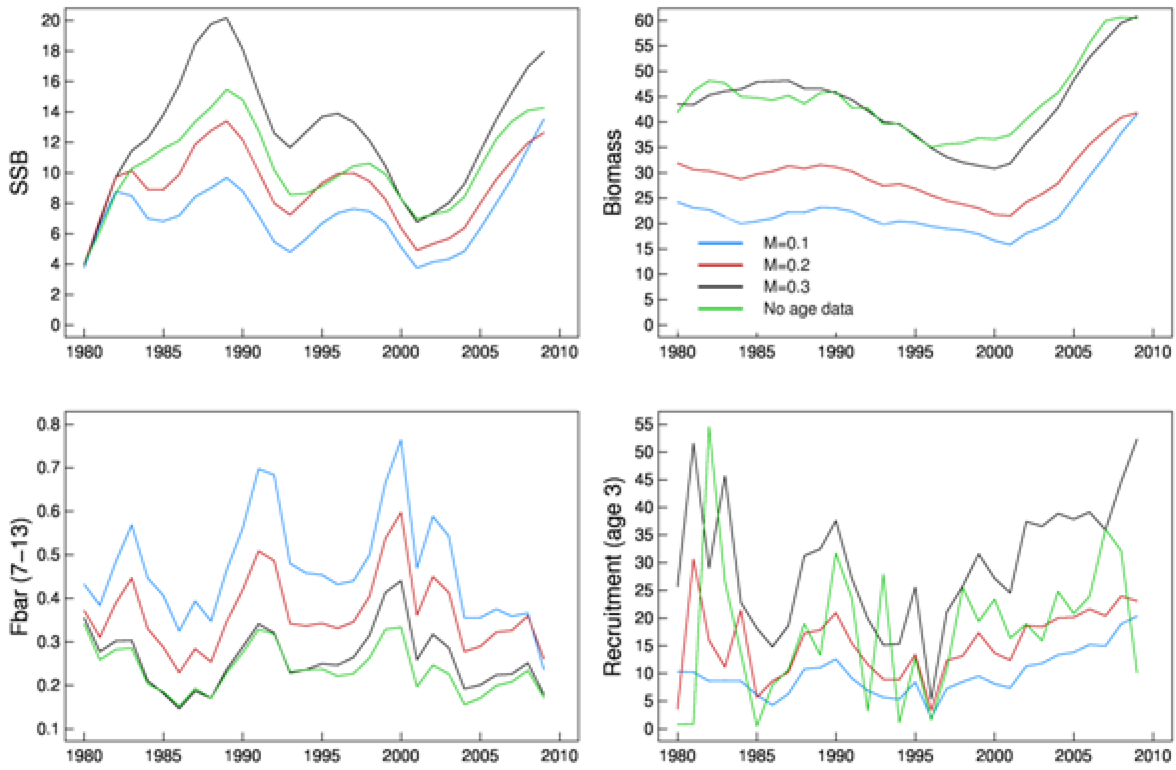


Figure 7.2.24. Tusk in Va. Results from Gadget assuming different values of M and omitting age data. The red line is the base run.

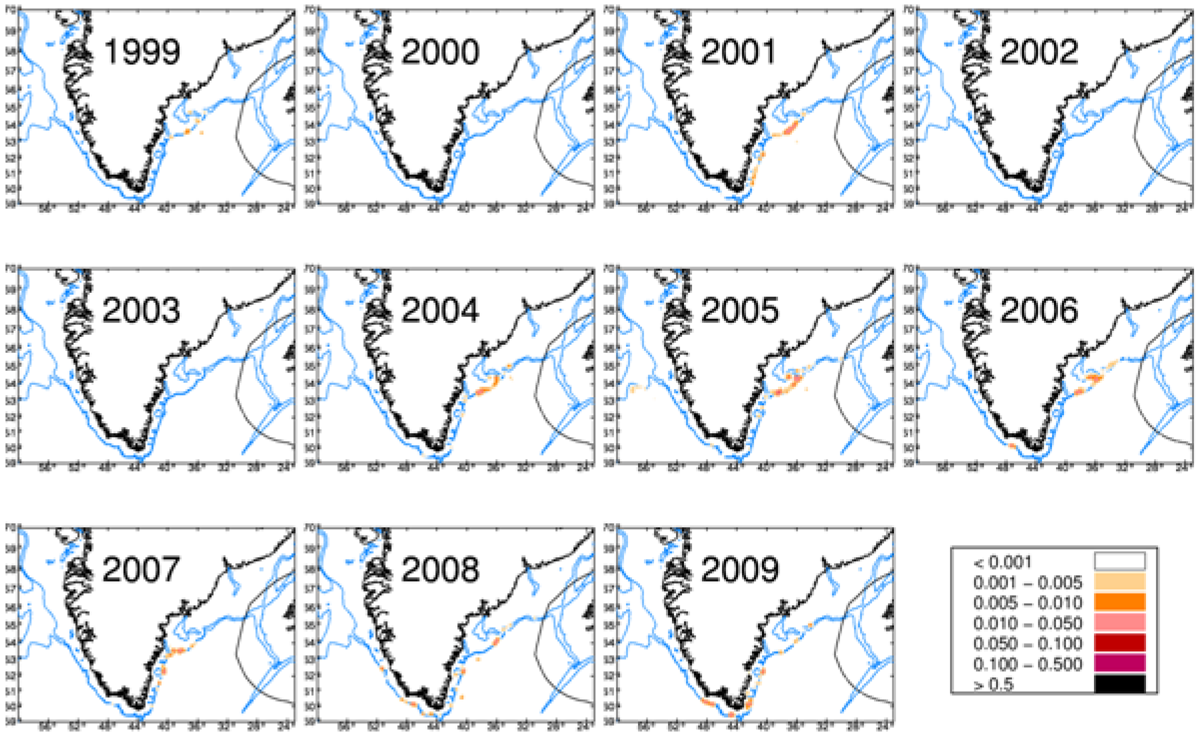


Figure 7.2.25. Tusk in XIV. Spatial distribution of catches in Greenland waters according to submitted logbook data (tonnes/square mile).

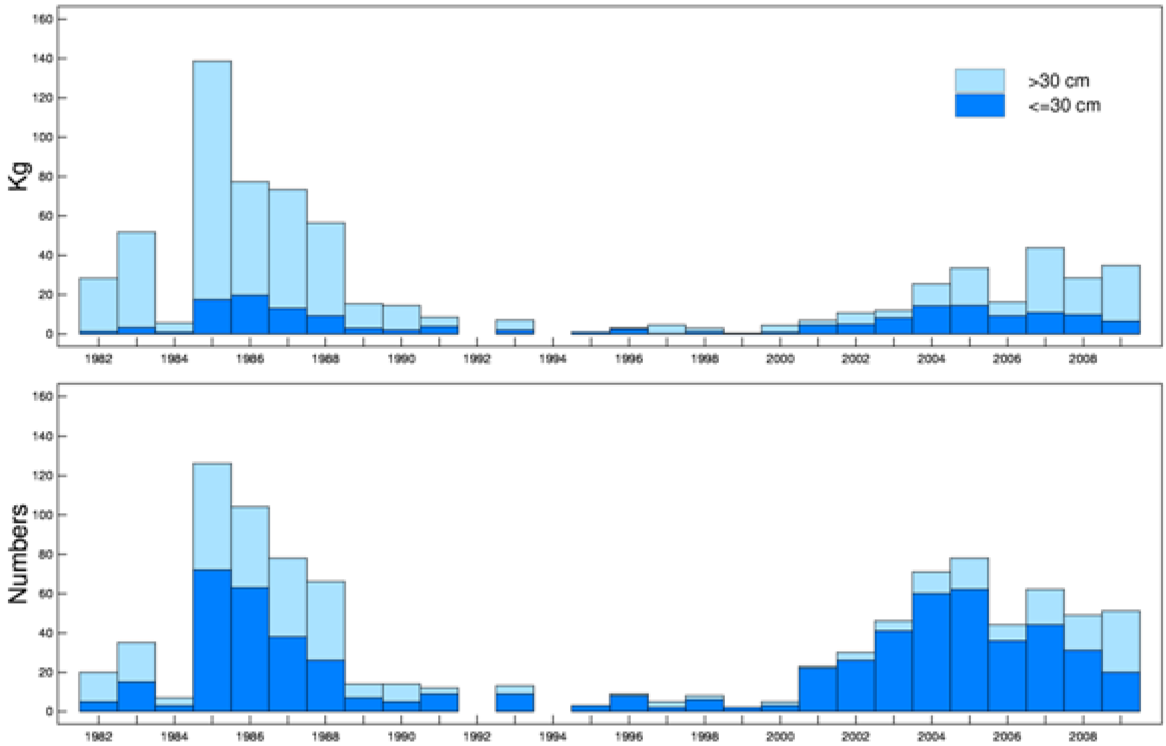


Figure 7.2.26. Tusk in XIV. Total catches (above) and total numbers caught (below) of tusk in the German groundfish survey in Greenland waters in 1982–2009 divided larger than 30 cm (light blue) and tusk smaller than 30 cm (blue).

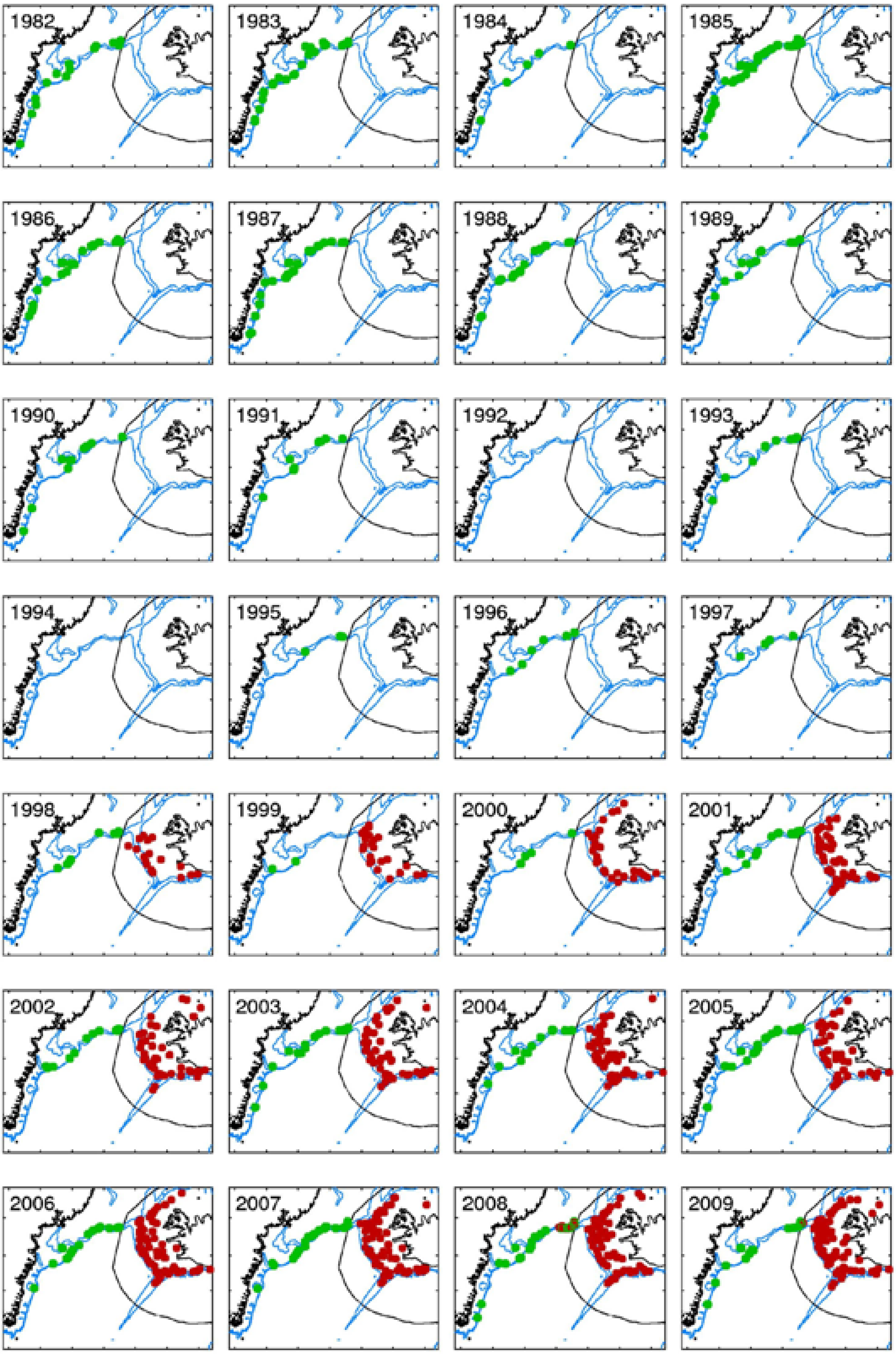


Figure 7.2.27. Tusk in XIV. Location of tusk catches in the German groundfish survey in 1982–2009 (green points) and in the Icelandic Autumn Survey is 1998–2009 (red points).

7.3 Tusk (*Brosme Brosme*) in Subareas I and II

7.3.1 The fishery

Tusk has been caught, primarily as a bycatch in the ling and cod fisheries, in these subareas for centuries, and the historical development is described by e.g. Bergstad and Hareide, 1996, including the post-World War II increase caused by a series of technical advances. Currently the major fisheries in Subareas I and II are the Norwegian longline and gillnet fisheries, but there are also bycatches by other gears, i.e. trawls and handlines. Of the Norwegian landings, usually around 85% is taken by longlines, 10% by gillnets and the remainder by a variety of other gears. Other nations catch tusk as a bycatch in trawl and longline fisheries.

Russian landings (121 tonnes) from Subdivisions IIa and IIb in 2009 were mainly taken as bycatch in longline fisheries. In Subarea I 1t was caught (Vinnichenko *et al.*, WD 2010).

7.3.1.1 Landings trends

Landing statistics by nation in the period 1988–2009 are given in Table 7.3.0a–d. Compared with the pre-2000 landings, recent landings were about halved. The preliminary landings for 2009 are 9629 tonnes which is a decrease compared with previous years.

7.3.1.2 ICES Advice

The advice statement from 2008 was: *Cpue in Areas I and II has been at a reduced level. ICES reiterate the advice to constrain catches to 5000 t and to collect information that can be used to evaluate a long-term sustainable level of exploitation.*

7.3.1.3 Management

There is no quota set for the Norwegian fishery for tusk but the vessels participating in direct catch for ling and tusk in Subareas I and II are required to have a specific licence. This licensing scheme combined with regulations aimed at other groundfish species, e.g. cod and haddock (see Section 4.2.1) has resulted in a large decrease in fishing vessels and hence the fishing pressure on tusk. The quota for the EU in Areas I and II in the Norwegian zone for bycatch species such as ling and tusk is in 2010 set to 5000 tons. There is no minimum landing size in the Norwegian EEZ.

The EU TAC (for community vessels fishing in community waters and waters not under the sovereignty or jurisdiction of third countries in I, II and XIV): was set at 24 tonnes in 2009, decreased to 20 tonnes in 2010.

7.3.2 Data available

7.3.2.1 Landings and discards

Landings were available for all relevant fleets. New discard data were not available, but within the Norwegian EEZ discarding is prohibited and assumed to be minor.

7.3.2.2 Length compositions

Length compositions/mean lengths from 1988 to present based on data from the Norwegian longliners are presented in Bergstad and Hareide, 1996 and Helle and Pennington, WD 2010. In this period the estimated mean length has varied around 50 cm without any clear trend.

7.3.2.3 Age compositions

No new age compositions were available.

7.3.2.4 Weight-at-age

No new data were presented.

7.3.2.5 Maturity and natural mortality

No new data were presented.

7.3.2.6 Catch, effort and research vessel data

Catch and effort data for Norwegian longliners were presented (Figure 7.3.1). No research vessel data were available.

The extensive Norwegian longliner cpue data based on private skippers' logbooks presented in the 1996 Report of SGDEEP were not updated after 1994.

In order to resume the cpue-series Norway started in 2001 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2009 (only seven logbooks have been entered for 2009 and the estimates are therefore preliminary). Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 tonnes in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day.

An analyses based on these data is in Helle and Pennington, WD, 2010.

7.3.3 Data analyses

No analytical assessments were possible due to lack of age-structured data and/or tuning-series.

The only source of information on abundance trends was the cpue series from the Norwegian longliners presented by Helle and Pennington (WD, 2010). The number of longliners has declined in recent years (Table 7.3.1.), from 72 to 34 in the period 2000–2009. The numbers of fishing days per vessel have remained relatively stable during the last years (Table 7.3.2). The number of hooks set per day and the total set per year has had a slight increase over the period 2000–2009 in Subareas I and II (Tables 7.3.3 and 7.3.4).

Table 7.3.5 gives estimates of cpue based on the Norwegian official logbooks. In Figure 7.3.1 the data for 2000–2009 are shown together with the data for the period 1971–1994 (considered earlier by WGDEEP and presented in Bergstad and Hareide, 1996). There is a gap in the time-series between 1995 and 2000, and due to data limitations it was not possible to estimate cpue for all years in the early period.

In earlier reports the new data has been compared with the historical time-series. It is unclear whether these estimates can be compared because of the switch from hand baited lines to autolines. The autoline was introduced to the Norwegian fleet in 1977, and most of the large vessels had installed it by 1985. The data used for the period 1972–1994 are, therefore, early on only hand baited lines, then a mix of both hand baited and autolines and finally only autolines. This is a very important change and correction factors for these changes are not available. During the hand baited period, the cpue estimates are very high, afterwards cpue declined during the transition period and finally when only autolines were employed, the cpue is at the same level as that of the new time-series.

7.3.4 Comments on the assessment

The historical data show no apparent trend while the new series starting in 2000 show a clear upward trend for the period 2004–2009.

However, these estimates cannot be compared because of the switch from hand baited lines to autolines.

The cpue series used in this assessment are derived from longline fisheries and it has been uncertain whether the fisheries were targeting tusk or other species. After suggestions from the fishermen two possible solutions were tested. The first was to base the cpue series on all catches for which either ling or tusk made up more than 30% of the total catch. The second method was to use only the catches for which tusk and ling together made up more than 50% of the total catch. The new cpue series are shown in Helle and Pennington, WD 2010. These estimates show that tusk to a very large degree is a bycatch species in Area IIa.

7.3.5 Management considerations

Legislation enacted since 2000 for regulating the cod fishery caused a continuous reduction in the number of longliners in the fishery for tusk, ling and blue ling and by 2009 there were only 34 vessels above 21 m in the fishery. Because of the reduction; in number of vessels, the total number of hooks employed and the total number of weeks fished, it is quite clear that there has been a significant reduction in effort. The decrease in total effort occurred even though there was an increase in the number of hooks set per vessel/day, and it is quite likely that the amount of applied effort has been reduced to the 1998-level.

Table 7.3.0a. Tusk I. WG estimates of landings.

Year	Norway	Russia	Faroes	Iceland	Ireland	Total
1996	587					587
1997	665					665
1998	805					805
1999	907					907
2000	738	43	1	16		798
2001	595	6		13		614
2002	791	8	n/a	0		799
2003	571	5			5	581
2004	620	2			1	623
2005	562					562
2006	442	4				446
2007	355	2				357
2008	627	7				634
2009*	869	1				870

***Preliminary.**

Table 7.3.0b. Tusk IIa. WG estimates of landings.

Year	Faroes	France	Germany	Greenland	Norway	E & W	Scotland	Russia	Ireland	Total
1988	115	32	13	-	14 241	2	-			14 403
1989	75	55	10	-	19 206	4	-			19 350
1990	153	63	13	-	18 387	12	+			18 628
1991	38	32	6	-	18 227	3	+			18 306
1992	33	21	2	-	15 908	10	-			15 974
1993	-	23	2	11	17 545	3	+			17 584
1994	281	14	2	-	12 266	3	-			12 566
1995	77	16	3	20	11 271	1				11 388
1996	0	12	5		12 029	1				12 047
1997	1	21	1		8642	2	+			8667
1998		9	1		14 463	1	1	-		14 475
1999		7	+		16 213		2	28		16 250
2000		8	1		13 120	3	2	58		13 192
2001	11	15	+		11 200	1	3	66	5	11 301
2002		3			11 303	1	4	39	5	11 355
2003	6	2			7284		3	21		7316
2004	12	2			6607		1	61	1	6684
2005	29	6			6249			37	3	6324
2006	33	9			9246	1		51	11	9351
2007	54	7			9856	0	5	85	12	10 019
2008	52	6			10 848	1	3	56	0	10 966
2009*	59	1			8328		1	82		8471

*** Preliminary.**

(1) Includes IIb.

Table 7.3.0c. Tusk IIb. WG estimates of landings.

Year	Norway	E & W	Russia	Ireland	Total
1988		-			0
1989		-			0
1990		-			0
1991		-			0
1992		-			0
1993		1			1
1994		-			0
1995	229	-			229
1996	161				161
1997	92	2			94
1998	73	+	-		73
1999	26		4		26
2000	15	-	3		18
2001	141	-	5		146
2002	30	-	7		37
2003	43				43
2004	114		5		119
2005	148		16		164
2006	168		23		191
2007	350		17	1	368
2008	271		11	0	313
2009*	249		39		288

Table 7.3.0d. Tusk I and II. WG estimates of total landings by Subareas or Divisions.

YEAR	I	IIA	IIB	ALL AREAS
1988		14 403	0	14 403
1989		19 350	0	19 350
1990		18 628	0	18 628
1991		18 306	0	18 306
1992		15 974	0	15 974
1993		17 584	1	17 585
1994		12 566	0	12 566
1995		11 388	229	11 617
1996	587	12 047	161	12 795
1997	665	8667	94	9426
1998	805	14 475	73	15 353
1999	907	16 250	26	17 183
2000	798	13 192	18	14 008
2001	614	11 301	146	12 061
2002	799	11 355	37	12 191
2003	581	7316	43	7940
2004	623	6684	119	7426
2005	562	6324	164	7050
2006	446	9351	191	9988
2007	357	10 019	368	10 744
2008	635	10 965	313	11 913
2009*	870	8471	288	9629

***Preliminary**

Table 7.3.1. Summary statistics for the Norwegian longliner fleet during the period 1995–2009 (vessels exceeding 21 m). This list only includes vessels that landed 8 tonnes or more of ling, blue ling and tusk in a given year.

Year	Number of longliners
1995	65
1996	66
1997	65
1998	67
1999	71
2000	72
2001	65
2002	58
2003	52
2004	43
2005	39
2006	35
2007	38
2008	36
2009	34

Table 7.3.2. Estimated number of days that the Norwegian longliner fleet (selected using criteria described in the text) operated in Subareas I and II and caught tusk in the period 2000–2009.

TUSK	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
I	3	1	5	5	6	5	1	5	4	3
IIa	34	57	66	58	60	69	67	89	92	75
IIb	1		2		1	2	1	3	4	

Table 7.3.3. Estimated number of hooks that the Norwegian longliners set per day in Subarea I and II in the period 2000–2006. n= the total number of days with hook information contained in the logbooks.

ALL	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009	
	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n
I	31 688	353	33 325	163	35 432	263	35 045	376	32 431	433	32 671	316	33 182	187	34 380	318	36 833	96	40 018	113
IIa	31 439	1916	30 703	2196	33 431	2031	34 766	1839	33 475	1389	32 861	1248	35 140	1252	35 207	2103	36 890	1500	37 727	604
IIb	35 409	71	34 638	315	34 756	45	34 776	67	31 859	217	35 082	207	39 298	57	37 881	328	39 650	297	41 300	30

Table 7.3.4. Estimated total number of hooks (in thousands) the Norwegian longliner fleet used in Subareas I and II for the years 2000–2007 in the fishery for tusk, ling and blue ling.

All	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
I	20 534	10 831	20 551	21 868	27 891	29 306	12 775,07	19 081	9282	21 770
IIa	117 708	127 724	143 486	131 972	107 957	103 808	89 783	131 569	119 524	111 596
IIb	5099	20 263	4032	5425	15 069	19 155	4126	29 434	25 693	5617

Table 7.3.5. Estimated mean cpue ([kg/hook]x1000) of tusk in Subarea I and II based on logbook data. Standard error (se) and number of catches sampled (n) is also given.

All vessels submitting logbooks:

		2000			2001			2002			2003			2004			2005			2006			2007			2008			2009	
Area	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se
I	21,6	189	2,1	18,8	53	3,2	4,2	115	2,0	11,9	141	1,7	3,8	122	2,2	3,5	73	3,7	7,8	18	9,5	7,95	108	2,7	6,78	32	6,38	1,58	23	7,95
IIA	59,5	1678	0,7	52,5	1959	0,5	47	1809	0,5	40,1	1473	0,5	36,1	1096	0,8	49,5	1060	1,0	56,3	1145	1,2	53,1	1853	0,7	57,5	1247	1,03	66,6	518	1,68
IIB	4,1	8	10,4	10,8	17	5,6				5,3	5	9,0	2,2	20	5,6	2,7	12	9,2	5,62	6	16,4	2,85	19	6,4	8,02	68	4,42			

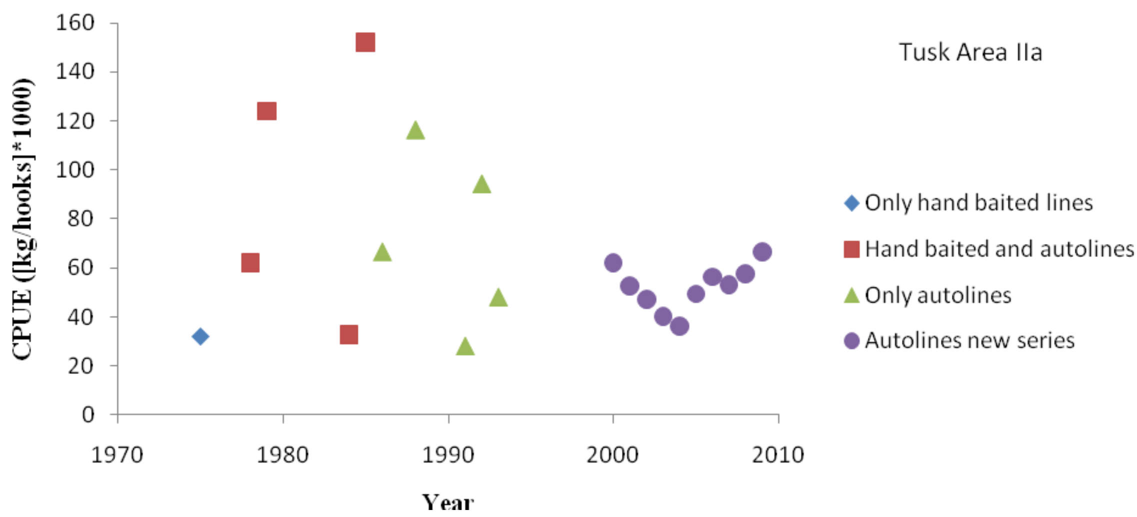


Figure 7.3.1. Estimates of cpue (kg/1000 hooks) of tusk based on skipper's logbooks (pre-2000) and official logbooks (post 2000). Combination of data from Bergstad and Hareide, 1996 and Helle *et al.*, WD8 2008. Note interruption in time-series in the period 1993–2000. The data used for the period 1971–1993 are, early on only hand baited lines (blue diamonds), then a mix of both hand baited and autolines (red squares) and finally only autolines (green triangles). The new dataseries is denoted by purple circles.

7.4 Tusk (*Brosme Brosme*) on the Mid-Atlantic Ridge (Subdivisions XIIa1 and XIVb1)

7.4.1 The fishery

Tusk is a bycatch species in the gillnet and longline fisheries in Subdivisions XIIa1 and XIVb1. Russia reported catches of tusk in 2005–2007 and 2009. During the period 1996–1997 Norway also had a fishery in this area.

7.4.1.1 Landings trends

Landing statistics by nation in the period 1988–2009 are in Table 7.4.0.

It should be noted that catches in XIIb, Hatton Bank, may have been included in these data.

The reported catches are generally very low in this area.

7.4.1.2 ICES Advice

The advice statement from 2008 was: *Fisheries on tusk should be accompanied by programmes to collect data on both target and bycatch fisheries. Fisheries should not be allowed to expand unless there is information that can be used to evaluate a long-term sustainable level of exploitation.*

7.4.1.3 Management

NEAFC recommends that in 2009–2010 the effort in areas beyond national jurisdiction shall not exceed 65 per cent of the highest level for deep-water fishing in previous years.

7.4.2 Data available

7.4.2.1 Landings and discards

Landings were available for all the relevant fleets. New discard data were not available.

7.4.2.2 Length compositions

No length compositions were available.

7.4.2.3 Age compositions

No age compositions were available.

7.4.2.4 Weight-at-age

No data were available.

7.4.2.5 Maturity and natural mortality

No data were available.

7.4.2.6 Catch, effort and research vessel data

No data were available.

7.4.3 Data analyses

There are insufficient data to assess this stock.

7.4.4 Comments on the assessment

No assessment was carried out this year.

7.4.5 Management considerations

There are currently sporadic fisheries in this area. Fisheries should only be permitted to develop where there is information to suggest that they are sustainable.

Table 7.4.0. Tusk XII. WG estimate of landings. It should be noted that catches in XIIb, Hatton Bank, may be included in these data.

TUSK XII							
Year	Faroes	France	Iceland	Norway	Scotland	Russia	Total
1988		1					1
1989		1					1
1990		0					0
1991		1					1
1992		1					1
1993		12	+				12
1994		1	+				1
1995	8	-	10				18
1996	7	-	9	142			158
1997	11	-	+	19			30
1998		1		-			1
1999		1		+	1		1
2000				5	+		5
2001		1		51	+		52
2002				27			27
2003				83			83
2004	2	2		7		5	16
2005	2	1					3
2006		0				64	64
2007		0				19	19
2008		0				0	0
2009*						11	0

***Preliminary.**

I think Norwegian cathes in 2000–2004 came from Hatton Bank (Division XIIb). You can find information for tusk fisheries on Hatton Bank and MAR in the WDs of Nils Roar Hareide.

Table 7.4.0 (continued). Tusk, total landings by Subareas or Division.

YEAR	XII	ALL AREAS
1988	1	1
1989	1	1
1990	0	0
1991	1	1
1992	1	1
1993	12	12
1994	1	1
1995	18	18
1996	158	158
1997	30	30
1998	1	1
1999	1	1
2000	5	5
2001	52	52
2002	27	27
2003	83	83
2004	16	16
2005	3	3
2006	64	64
2007	19	19
2008	0	0
2009*	0	0

***Preliminary.**

7.5 Tusk (*Brosme Brosme*) in VIb

7.5.1 The fishery

Tusk is a bycatch species in the trawl, gillnet and longline fisheries in Subarea VIb. Norway has traditionally landed the largest percentage of the total catch. Longliners catch about 90% of the Norwegian landings. Since the 12th of January 2007 parts of the Rockall bank has been closed to fishing with bottom trawls, gillnets and longlines. The areas closed are traditional areas fished by the Norwegian longline fleet.

In 2004 Russia started longline fishery of ling with bycatch of tusk in unternational waters of the Rockall Bank. Maximum catch (137 t) was taken in 2005. In recent years intensity of Russian longline fishery decreased. Small bycatches of tusk were also taken in the area by trawlers on haddock fishery.

7.5.1.1 Landings trends

Landing statistics by nation in the period 1988–2009 are in Table 7.5.0.

For Division VIb catches declined considerably in 2007 and 2008 compared with previous years but was up to previous level in 2009.

7.5.1.2 ICES Advice

ICES Advice in 2008 was: *Cpue in Rockall does not indicate any clear trends. Therefore, recent levels of catches do not appear to have had a negative impact. ICES recommends that catches should be constrained to 530 t (average 2003–2007) and to collect information that can be used to evaluate a long-term sustainable level of exploitation.*

7.5.1.3 Management

There are no management measures that apply exclusively to this area.

Norway, which also has a licensing scheme, could in 2008 catch 3400 tonnes and in 2009 catch 3350 tonnes in EU waters (Subareas V, VI and VIII). In 2010 the Norwegian quota in the EU zone is 2923 tonnes (up to 2000 tonnes are interchangeable with ling quota).

EU TACs cover Subarea V, VI, VII (EU and international waters) and is set at 294 tonnes in 2010.

NEAFC recommend in 2009 that the effort shall not exceed 65 per cent of the highest level put into deep-fishing in previous years.

7.5.2 Data available

7.5.2.1 Landings and discards

Landings were available for all relevant countries. Discard data were not available.

7.5.2.2 Length compositions

Length compositions and mean lengths from 1988 to the present, based on Norwegian longliner data, are in Bergstad and Hareide, 1996; Helle and Pennington, WD8, 2008 and Helle and Pennington, WD 2010. Some data on length from Russian catches are presented in Vinnichenko *et al*., WD 2005 and Vinnichenko *et al*., WD 2010.

7.5.2.3 Age compositions

No new age compositions were available.

7.5.2.4 Weight-at-age

No new data were presented.

7.5.2.5 Maturity and natural mortality

No new data were presented.

7.5.2.6 Catch, effort and research vessel data

The extensive Norwegian longliner cpue series, based on private skippers' logbooks, presented in the 1996 Report was not updated after 1994.

In order to resume the cpue-series Norway started in 2001 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2009 (only seven logbooks have been entered for 2009 and the estimates are therefore preliminary). Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 tonnes in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day.

An analyses based on these data is in Helle and Pennington, WD, 2010.

7.5.3 Data analyses

No analytical assessments were carried out.

One source of information on abundance trends was the cpue series based on the Norwegian long liners' data (see Helle and Pennington, 2010). The number of longliners has declined from 72 to 34 during the period 2000–2009. The number of fishing days with a tusk catch in Division VIb has remained very stable in the period 2000–2008 (Table 7.5.1). The number of hooks set per day and the total set per year has also remained stable in Subarea VIb (Table 7.5.2 and 7.5.3).

In Table 7.5.4 are estimates of cpue, which are based on the Norwegian official log-books. In Figure 7.5.2 the cpue series for 2000–2009 is compared with the cpue series for the period 1971–1994 (considered earlier by WGDEEP; see Bergstad and Hareide, 1996). There is a gap in the time series between 1995 and 2000, and due to data limitations it was not possible to estimate cpue for every year in the early period.

The cpue series shows no apparent trend in area VIb.

7.5.4 Comments on the assessment

The only cpue series available for VIb is based on the Norwegian longliners' data, and this series is very variable with no apparent trends.

7.5.5 Management considerations

The closure of parts of the Rockall bank area most likely caused the large reduction in Norwegian catch; this is confirmed by the total number of hooks set by the fleet in the area in 2008. None of the seven vessels which logbooks have been entered had been fishing in area VIa in 2009 and thus no data is available for that year. If the closing actually reduced fishing effort, then the management of this species would be in accordance with ICES Advice from 2004.

Table 7.5.0. Tusk VIb. WG estimate of landings.

YEAR	FAROES	FRANCE	GERMANY	IRELAND	ICELAND	NORWAY	E & W	N.I.	SCOT.	RUSSIA	TOTAL
1988	217		-	-		601	8	-	34		860
1989	41	1	-	-		1537	2	-	12		1593
1990	6	3	-	-		738	2	+	19		768
1991	-	7	+	5		1068	3	-	25		1108
1992	63	2	+	5		763	3	1	30		867
1993	12	3	+	32		899	3	+	54		1003
1994	70	1	+	30		1673	6	-	66		1846
1995	79	1	+	33		1415	1		35		1564
1996	0	1		30		836	3		69		939
1997	1	1		23		359	2		90		476
1998		1		24	18	630	9		233		915
1999				26	-	591	5		331		953
2000		2		22		1933	14		372	1	2344
2001	1	1		31		476	10		157	6	681
2002		8		3		515	8		88		622
2003		7		18		452	11		72	1	561
2004		9		1		508	4		45	60	627
2005		5		9		503	5		33	137	692
2006	10	1		16		431	2		25	2	487
2007	4	0		8		231	1		30	25	299
2008	41	0		2		190	0		16	44	293
2009*	70			3		376			17	3	469

***Preliminary**

Table 7.5.0 (continued).

Tusk, total landings in Subarea VIb.

Year	VIb	All areas
1988	860	860
1989	1593	1593
1990	768	768
1991	1108	1108
1992	867	867
1993	1003	1003
1994	1846	1846
1995	1564	1564
1996	939	939
1997	476	476
1998	915	915
1999	953	953
2000	2344	2344
2001	681	681
2002	622	622
2003	561	561
2004	627	627
2005	692	692
2006	487	487
2007	299	299
2008	293	293
2009*	469	469

***Preliminary.**

Table 7.5.1. Estimated number of days that the Norwegian longliner fleet (selected using criteria described in the text, Section 6) operated in Subarea VIb in the period 2000–2007. Data from 2008 was not available to the Working Group.

Tusk	2000	2001	2002	2003	2004	2005	2006	2007	2008
VIb	4	6	8	5	5	8	7	6	5

Table 7.5.2. Estimated number of hooks that the Norwegian longliners set per day in Subarea VIb in the period 2000–2007. n= the total number of days with hook information contained in the logbooks. Data from 2008 was not available to the Working Group.

All	2000		2001		2002		2003		2004		2005		2006		2007		2008	
	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n
VIb	30 471	227	30 340	140	31 557	149	31 325	97	31 559	111	35 949	137	32 273	139	36 400	145	33514	35

Table 7.5.3. Estimated total number of hooks (in thousands) the Norwegian longliner fleet used in Subarea VIb for the years 2000–2007 in the fishery for ling, tusk and blue ling. Data from 2008 was not available to the Working Group.

All	2000	2001	2002	2003	2004	2005	2006	2007	2008
VIb	21 939	11 833	14 642	9773	6785	11 216	7907	8081	2413

Table 7.5.4. Estimated mean cpue ([kg/hook]x1000) based on logbook data along with its standard error (*se*) and number of catches sampled for tusk in SubareaVIb.

	2000			2001			2002			2003			2004			2005			2006			2007			2008		
Area	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se
VIB	76,8	222	2,0	50,6	132	2,0	55,2	149	1,7	44,9	94	2,1	62,7	111	2,4	72,5	136	2,7	41,2	138	3,4	26,1	135	2,4	29,6	35	6,16

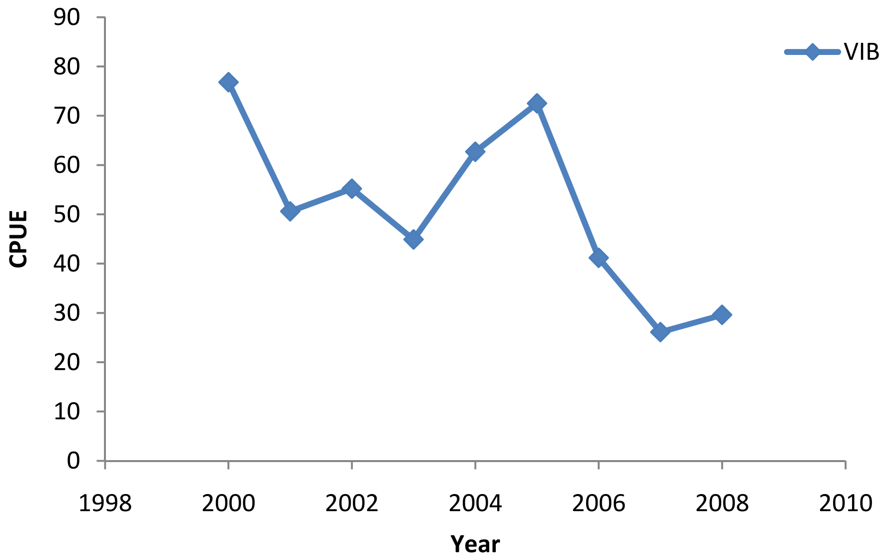


Figure 7.5.1. Estimated mean cpue([kg/hook]x1000) based on data from the logbooks for tusk in ICES Subarea VIb for the years 2000–2009 (preliminary estimates for 2009).

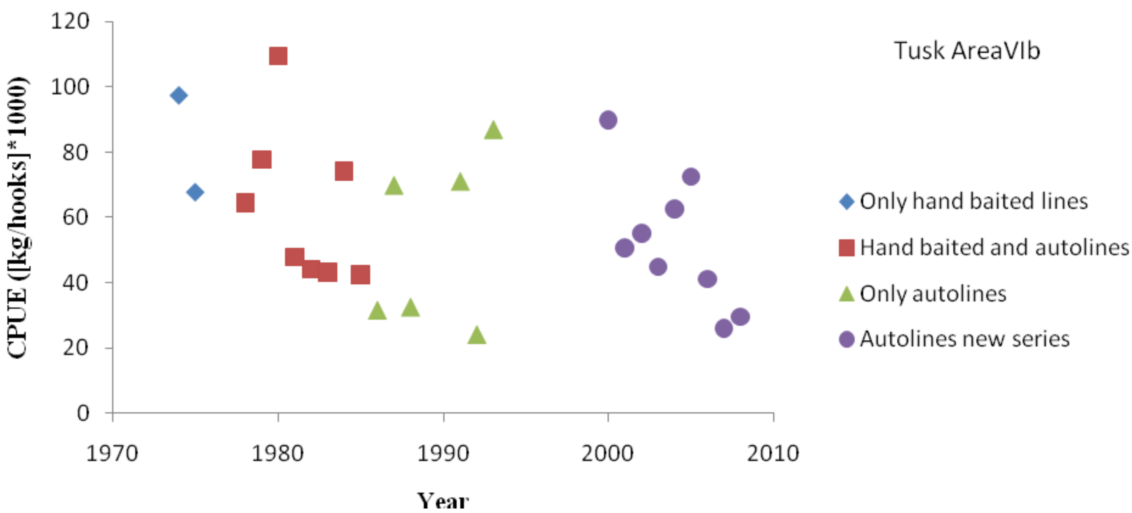


Figure 7.5.2. Estimates of cpue (kg/1000 hooks) of tusk based on skippers' logbooks (pre-2000) and official logbooks (post-2000) in Subarea VIb. Combination of data from Bergstad and Hareide, 1996 and WD by Helle *et al.*, 2009. Note gap in time-series between 1993 and 2000, and the differences in cpue scale between areas. The data used for the period 1971–1993 are, early on only hand baited lines (blue diamonds), then a mix of both hand baited and autolines (red squares) and finally only autolines (green triangles). The new data series is denoted by purple circles.

7.6 Tusk (*Brosme Brosme*) in other Areas (IIIa, IVa, Vb, VIa, VII, VIII, IX and other Areas of XII)

7.6.1 The fishery

Tusk is a bycatch species in trawl, gillnet and longline fisheries in these Subareas/Divisions. Norway has traditionally landed a dominant portion of the total, and around 90% of the Norwegian landings are taken by longliners.

7.6.1.1 Landings trends

Landing statistics by nation in the period 1988–2009 are given in Table 7.6.0.

For all Subareas/Divisions the catches have been at a stable level during the last four years.

7.6.1.2 ICES Advice

ICES Advice in 2008 was: *Cpue in these areas has been at a reduced level. ICES recommends to constrain catches to 5000 t (30% reduction) and to collect information that can be used to evaluate a long-term sustainable level of exploitation*.

7.6.1.3 Management

There is a licensing scheme and effort limitation in Vb. The minimum landing length for tusk in division Vb is 40 cm. Norway has a bilaterally agreed quota in Vb and the quota for 2010 is 1774 tons. Norway also has a licensing scheme in EU waters and could in 2008 and 2009 catch 3350 tons in each year. In 2010 the Norwegian quotas in the EC zone is 2923 tons. The quota for the EU in the Norwegian zone (Area IV) is set at 170 tons.

EU TACs for areas partially covered in this section are in 2010:

- Subarea III: 24 tonnes ;
- Subarea IV: 196 tonnes;
- Subarea V, VI, VII (EU and international waters): 294 tonnes.

NEAFC recommends that in 2009 the effort in areas beyond national jurisdiction shall not exceed 65 per cent of the highest level for deep-water fishing in previous years.

7.6.2 Data available

7.6.2.1 Landings and discards

Landings were available for all relevant countries. Discard data were not available.

7.6.2.2 Length compositions

Length compositions/mean lengths from 1988 to present based on data from the Norwegian longliners are presented in Bergstad and Hareide, 1996 and Helle and Pennington, WD 2010. In this period the mean length has varied around 50 cm without any clear trend.

Length distributions from Faroese longliners in Vb were presented for the period 1995–2009. No trend in the composition can be seen in this series (Figure 7.6.6).

Length composition of tusk in longline catches in the southern part of Faroes Fishing Zone (Division Vb) in June–July 2008 (Figure 7.6.7).

Russian investigations in Division Vb showed that fish length in 2009 varied from 42–90 cm, mainly 53–66 cm (Figure 7.6.8) (Vinnichenko *et al.*, WD 2010).

7.6.2.3 Age compositions

No new age compositions were available.

7.6.2.4 Weight-at-age

No new data were presented.

7.6.2.5 Maturity and natural mortality

Russian investigations in Division Vb showed that the ratio of males to females was close to equal. The bulk of catches was made up of mature specimens. Most of them had gonads at the stage of post-spawning recovery. Moreover, a small number of fish were in the pre- and post-spawning conditions Figure 7.6.9) (Vinnichenko *et al.*, WD 2010).

7.6.2.6 Catch, effort and research vessel data

Catch and effort data for Norwegian and Faroese longliners and Danish trawlers were presented. Abundance indices and length frequency data from the Faroese groundfish surveys were presented.

The extensive Norwegian longliner cpue series based on private skippers' logbooks presented in the 1996 Report were not updated after 1994.

In order to resume the cpue-series Norway started in 2001 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2009 (only seven logbooks have been entered for 2009 and the estimates are therefore preliminary). Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 tonnes in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day.

An analyses based on these data is in Helle and Pennington, WD, 2010.

A cpue series for Danish trawlers fishing in IVa was available for the period 1992–2009.

Data from Faroese summer and autumn surveys were available for the period 1994 onwards. A cpue series for the Faroese longliners (>100 GRT) for the period 1987–2009 was also available.

7.6.3 Data analyses

No analytical assessments attempted this year.

One source of information on abundance trends in Area IVa was the cpue series from the Norwegian longliners presented by Helle and Pennington (WD, 2010). The number of longliners has declined in recent years, from 72 to 34 in the period 2000–2009. The number of fishing days with tusk catch has remained relatively stable in Division IVa. In Division VIa the number of fishing days have varied from 23 in 2005 to 6 days in 2009(preliminary data) with an average of 13 days (Table 7.6.1). The number of hooks set per day and the total set per year has remained rather stable in Subareas IVa, Vb and IV (Tables 7.6.2 and 7.6.3).

Tables 7.6.4 gives estimates of cpue based on the Norwegian official logbooks and the same results are shown in Figure 7.6.1. In Figure 7.6.2 the data for 2000–2009 are shown together with the data for the period 1971–1994 (considered earlier by WGDEEP and presented in Bergstad and Hareide, 1996). There is a gap in the time-series between 1995 and 2000, and due to data limitations it was not possible to estimate cpue for all years in the early period.

There was an overall increase in cpue in Areas IVa, Vb and VIa, which indicates that current levels of exploitation are not having a detrimental effect on the stock. The current cpue levels for Areas IVa and Vb are low compared with the historical cpue series, but these estimates cannot be compared because of the switch from hand baited lines to autolines. The autoline was introduced to the Norwegian fleet in 1977, and most of the large vessels had installed it by 1985. The data used for the period 1972–1994 are, therefore, early on only hand baited lines, then a mix of both hand baited and autolines and finally only autolines. This is a very important change and correction factors for these changes are not available. During the hand baited period, the cpue estimates are very high, afterwards cpue declined during the transition period and finally when only autolines were employed, the cpue is at the same level as that of the new time-series.

Cpue of tusk for Danish trawlers in Subareas IVa based on logbook data show a declining trend in for the period 1992–2005 followed by a slight increasing trend for the period 2006 through 2009 (Figure 7.6.3).

The Faroese groundfish survey series from Vb (Table 7.6.6, Figure 7.6.4) show a decreasing trend until 2000 and subsequently an increasing trend. For the longer series from commercial longliners, there is a general declining trend since 1986, perhaps with a levelling off in the last decade (Figure 7.6.5).

7.6.4 Comments on the assessment

The cpue series of the main fleet landing tusk (Norwegian long liners) suggest that the abundance has increased after a probable decline in the 1970s to 1990s. It is, however, unclear whether these estimates can be compared because of the switch from hand baited lines to autolines. The estimates are only only valid for the Divisions for which there is sufficient data (IVa, Vb, VIa,). There was an increase in cpue for these Areas from 2002–2003 through 2009, with an exceptionally large increase in Area VIa. The estimate for Area IVa show a decline in 2009, but these data are preliminary and must be considered with caution.

The Danish cpue for IVa trawlers for the last two decades show a recent increase and this corresponds with the Norwegian longline data from the same period and area.

In Vb the groundfish survey series indicate a recent increase in abundance; this is also reflected in the longline cpue series for commercial vessels. The trend in the Faeroese cpue data is similar to the Norwegian longliner data.

The only cpue series available for VIa are the Norwegian longliners, and these show a very large increase in cpue over the period 2003 through 2009.

7.6.5 Management considerations

Legislation enacted since 2000 for regulating the cod fishery caused a continuous reduction in the number of longliners in the fishery for tusk, ling and blue ling and by 2009 there were only 34 vessels above 21 m in the fishery. Because of the reduction; in number of vessels, the total number of hooks employed and the total number of weeks fished, it is quite clear that there has been a significant reduction in effort. The decrease in total effort occurred even though there was an increase in the number of hooks set per vessel/day, and it is quite likely that the amount of applied effort has been reduced to the 1998-level.

Table 7.6.0. Tusk IIIa, IV, Vb, VI, VII, VIII, IX. WG estimate of landings.

TUSK IIIa

Year	Denmark	Norway	Sweden	Total
1988	8	51	2	61
1989	18	71	4	93
1990	9	45	6	60
1991	14	43	27	84
1992	24	46	15	85
1993	19	48	12	79
1994	6	33	12	51
1995	4	33	5	42
1996	6	32	6	44
1997	3	25	3	31
1998	2	19		21
1999	4	25		29
2000	8	23	5	36
2001	10	41	6	57
2002	17	29	4	50
2003	15	32	4	51
2004	18	21	6	45
2005	9	30	5	44
2006	4	21	4	29
2007	1	19	1	21
2008	0	43	1	44
2009*	1	17	21	39

***Preliminary.**

TUSK IVa

YEAR	DENMARK	FAROES	FRANCE	GERMANY	NORWAY	SWEDEN(1)	E & W	N.I.	SCOTLAND	IRELAND	TOTAL
1988	83	1	201	62	3,998	-	12	-	72		4,429
1989	86	1	148	53	6,050	+	18	+	62		6,418
1990	136	1	144	48	3,838	1	29	-	57		4,254
1991	142	12	212	47	4,008	1	26	-	89		4,537
1992	169	-	119	42	4,435	2	34	-	131		4,932
1993	102	4	82	29	4,768	+	9	-	147		5,141
1994	82	4	86	27	3,001	+	24	-	151		3,375
1995	81	6	68	24	2,988		10		171		3,348
1996	120	8	49	47	2,970		11		164		3,369
1997	189	0	47	19	1,763	+	16		238	-	2,272
1998	114	3	38	12	2,943		11		266	-	3,387
1999	165	7	44	10	1,983		12		213	1	2,435
2000	208	+	32	10	2,651	2	12		343	1	3,259
2001	258		30	8	2443	1	11		343	1	3095
2002	199		21		2438	1	8		294		2961
2003	217		19	6	1560		4		191		1997
2004	137	+	14	3	1370	+	2		140		1666
2005	123	17	11	4	1561	1	2		107		1826
2006	155	8	14	3	1854		5		120		2159
2007	95	0	22	4	1975	1	6		74	3	2180
2008	57	0	17	2	1975		3		85	1	2140
2009*	48		7		2108	7	3		92		2265

(1) Includes IVb 1988–1993.

***Preliminary.**

Table 7.6.0 (continued).

Tusk IVb

Year	Denmark	France	Norway	Germany	E & W	Scotland	Ireland	sweden	Total
1988		n.a.		-	-				
1989		3		-	1				4
1990		5		-	-				5
1991		2		-	-				2
1992	10	1		-	1				12
1993	13	1		-	-				14
1994	4	1		-	2				7
1995	4	-	5	1	3	2			15
1996	4	-	21	4	3	1			33
1997	6	1	24	2	2	3			38
1998	4	0	55	1	3	3			66
1999	8	-	21	1	1	3			34
2000	8		106	+	-	2			116
2001	6		45(1)	1	1	3			56
2002	6		61	1	1	2			71
2003	2		5	1					8
2004	2		19	1		1			23
2005	2		4	1					7
2006	2		30						32
2007	1		6				8		15
2008	0		69			0	2		71
2009*	1		3			1	0	13	18

(1) Includes IVc.

***Preliminary.**

TUSK Vb1

Year	Denmark	Faroes[4]	France	Germany	Norway	E & W	Scotland [1]	Russia	Total
1988	+	2827	81	8	1143	-			4059
1989	-	1828	64	2	1828	-			3722
1990	-	3065	66	26	2045	-			5202
1991	-	3829	19	1	1321	-			5170
1992	-	2796	11	2	1590	-			4399
1993	-	1647	9	2	1202	2			2862
1994	-	2649	8	1 [2]	747	2			3407
1995		3059	16	1 [2]	270	1			3347
1996		1636	8	1	1083				2728
1997		1849	11	+	869		13		2742
1998		1272	20	-	753	1	27		2073
1999		1956	27	1	1522		11[3]		3517
2000		1150	12	1	1191	1	11[3]		2367
2001		1916	16	1	1572	1	20		3526
2002		1033	10		1642	1	36		2722
2003		1200	11		1504	1	17		2733
2004		1705	13		1798	1	19		3536
2005		1838	12		1398		24		3272
2006		2736	21		778		24	1	3559
2007		2291	28		1108	2	2	37	3431
2008		2824	18		816	18	13	109	3689
2009*		2553	10		499	4		34	3066

1)Included in Vb_2 until 1996.

(2)Includes Vb_2.

(3)Reported as Vb.

(4) 2000–2003 Vb1 and Vb2 combined.

***Preliminary.**

Table 7.6.0 (continued).

TUSK Vb2

Year	Faroe	Norway	E & W	Scotland [1]	Total
1988	545	1061	-	+	1606
1989	163	1237	-	+	1400
1990	128	851	-	+	979
1991	375	721	-	+	1096
1992	541	450	-	1	992
1993	292	285	-	+	577
1994	445	462	+	2	909
1995	225	404	-2	2	631
1996	46	536			582
1997	157	420			577
1998	107	530			637
1999	132	315			447
2000		333			333
2001		469			469
2002		281			281
2003		559			559
2004		107			107
2005		360			360
2006		317			317
2007		344			344
2008		61			61
2009*		164			164

[1]Includes Vb1.

[2]See Vb_1.

[3]Included in Vb_1.

***Preliminary.**

TUSK VIa

Year	Denmark	Faroes	France (1)	Germany	Ireland	Norway	E & W	N.I.	Scot.	Spain	Total
1988	-	-	766	1	-	1310	30	-	13		2120
1989	+	6	694	3	2	1583	3	-	6		2297
1990	-	9	723	+	-	1506	7	+	11		2256
1991	-	5	514	+	-	998	9	+	17		1543
1992	-	-	532	+	-	1124	5	-	21		1682
1993	-	-	400	4	3	783	2	+	31		1223
1994	+		345	6	1	865	5	-	40		1262
1995		0	332	+	33	990	1		79		1435
1996		0	368	1	5	890	1		126		1391
1997		0	359	+	3	750	1		137	11	1261
1998			395	+		715	-		163	8	1281
1999			193	+	3	113	1		182	47	539
2000			267	+	20	1327	8		231	158	2011
2001			211	+	31	1201	8		279	37	1767
2002			137		8	636	5		274	64	1124
2003			112		4	905	3		104	0	1128
2004		1	140		22	470			93	0	726
2005		10	204		7	702			96	0	1019
2006		5	239		10	674	16		115	0	1059
2007		39	261		3	703	9		70	0	1085
2008		30	307		1	964	0		44	0	1346
2009*		33	194		4	898	0		83	2	1214

Not allocated by divisions before 1993.

* Preliminary.

Table 7.6.0 (continued).

TUSK VIIa

Year	France	E & W	Scotland	Total
1988	n.a.	-	+	+
1989	2	-	+	2
1990	4	+	+	4
1991	1	-	1	2
1992	1	+	2	3
1993	-	+	+	+
1994	-	-	+	+
1995	-	-	1	1
1996	-	-		
1997	-	-	1	1
1998	-	-	1	1
1999	-	-	+	+
2000		-	+	+
2001		-	1	1
2002	n/a	-	-	-
2003		-	-	-
2004				
2005				
2006				
2007				
2008				
2009*				

***Preliminary.**

TUSK VIIb,c

Year	France	Ireland	Norway	E & W	N.I.	Scotland	Total
1988	n.a.	-	12	5	-	+	17
1989	17	-	91	-	-	-	108
1990	11	3	138	1	-	2	155
1991	11	7	30	2	1	1	52
1992	6	8	167	33	1	3	218
1993	6	15	70	17	+	12	120
1994	5	9	63	9	-	8	94
1995	3	20	18	6		1	48
1996	4	11	38	4		1	58
1997	4	8	61	1		1	75
1998	3		28	-		2	33
1999	-	16	130	-		1	147
2000	3	58	88	12		3	164
2001	4	54	177	4		25	263
2002	1	31	30	1		3	66
2003	1	19		1			21
2004	2	19					21
2005	4	18				1	23
2006	4	23	63			0	90
2007	2	4	7				13
2008	2	2	0				4
2009*	0	3	0				3

***Preliminary.**

Table 7.6.0 (continued).

TUSK VIIg–k

Year	France	Germany	Ireland	Norway	E & W	Scotland	Spain	Total
1988	n.a.		-	-	5	-		5
1989	3		-	82	1	-		86
1990	6		-	27	0	+		33
1991	4		-	-	8	2		14
1992	9		-	-	38	-		47
1993	5		17	-	7	3		32
1994	4		12	-	12	3		31
1995	3		8	-	18	8		37
1996	3		20	-	3	3		29
1997	4	4	11	-		+	0	19
1998	2	3	4	-		1	0	10
1999	2	1	-	-		+	6	8
2000	2		5	-	-	+	6	13
2001	3		-	9	-	+	2	14
2002	1				1		3	5
2003	1		1				1	3
2004	1						0	1
2005	1						1	2
2006	1		1				1	3
2007	1						1	1
2008	0						0	0
2009*	0		0		0	0	0	0

***Preliminary.**

TUSK VIIIa

Year	E & W	France	Total
1988	1	n.a.	1
1989	-	-	-
1990	-	-	-
1991	-	-	-
1992	-	-	-
1993	-	-	-
1994	-	-	-
1995	-	-	-
1996	-	-	-
1997	+	+	+
1998	-	1	1
1999	-	-	0
2000	-		-
2001	-		-
2002	-	+	+
2003	-	-	-
2004		1	
2005			
2006			
2007			
2008			
2009*			

***Preliminary.**

Table 7.6.0 (continued).

Tusk, total landings by Subareas or Division.

Year	III	IVa	IVb	Vb1	Vb2	VIa	VIIa	VIIb,c	VIIg-k	VIIIa	All areas
1988	61	4429		4059	1606	2120		17	5	1	12 298
1989	93	6418	4	3722	1400	2297	2	108	86		14 130
1990	60	4254	5	5202	979	2256	4	155	33		12 948
1991	84	4537	2	5170	1096	1543	2	52	14		12 500
1992	85	4932	12	4399	992	1682	3	218	47		12 370
1993	79	5141	14	2862	577	1223		120	32		10 048
1994	51	3375	7	3407	909	1262		94	31		9136
1995	42	3348	15	3347	631	1435	1	48	37		8904
1996	44	3369	33	2728	582	1391		58	29		8234
1997	31	2272	38	2742	577	1261	1	75	19		7016
1998	21	3387	66	2073	637	1281	1	33	10	1	7510
1999	29	2435	34	3517	447	539		147	8	0	7156
2000	36	3260	116	2367	333	2011		164	13		8300
2001	57	3095	56	3526	469	1767	1	263	14		9248
2002	50	2961	71	2722	281	1124		66	5		7280
2003	51	1997	8	2733	559	1128		21	3		6500
2004	45	1666	23	3536	107	726		21	1		6125
2005	44	1826	7	3272	360	1019		23	2		6553
2006	29	2159	32	3559	317	1059		90	3		7248
2007	21	2180	15	3431	344	1085		13	1		7090
2008	44	2140	71	3689	61	1346		4	0		7355
2009*	39	2265	18	3066	164	1214		3	0		6769

***Preliminary.**

Table 7.6.1. Estimated number of days that the Norwegian longliner fleet (selected using criteria described in the text, Section 6) operated in Subareas III to IX (not Va,VIb) in the period 2000–2009.

Tusk	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
IVa	18	22	28	19	21	25	37	26	30	56
IVb	1			2						
Vb	11	18	20	25	34	21	11	15	14	
VIa	12	14	12	12	14	23	13	10	15	6
VIb	4	6	8	5	5	8	7	6	5	
VIIc	2	1			1	0		0		

Table 7.6.2. Estimated number of hooks that the Norwegian longliners set per day in Subarea IIIa–VIIc for the period 2000–2007. n= the total number of days with hook information contained in the logbooks.

All	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009	
	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n	Average	n
IIIa	30 250	4					33 037	27							35 000	8	36 467	15	34 636	11
IVa	29 378	685	30 553	727	32 291	667	33 484	510	30 934	439	34 039	331	34 561	673	33 414	587	34 056	395	36 651	402
IVb	30 263	38	33 500	10	33 867	15	32 559	34							38 086	58	31 500	10	30 167	6
Vb	24 594	411	26 760	613	25 939	475	29 513	515	31 804	693	29 885	374	27 943	159	30 681	355	27 968	188		
VIa	22 763	435	24 419	447	21 484	186	29 421	302	25 636	308	24 807	369	22 504	248	25 958	249	26 319	138	21 725	40
VIIc	29 600	80	33 108	37					25 250	28	33 429	7			31 071	14				

Table 7.6.3. Estimated total number of hooks (in thousands) the Norwegian longliner fleet used in Subareas IIIa–VIIc for the years 2000–2007 in the fishery for ling, tusk and blue ling.

All	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
IIIa	218			1718				0	1313	2355
IVa	50 765	43 691	54 313	36 565	29 264	33 188	45 966	33 381	31 876	72 276
IVb	4358			1693				4228		1026
Vb	23 020	31 309	30 089	38 367	46 497	24 476	10 758	17 028	11 075	
VIa	19 667	22 221	14 953	18 359	15 433	24 187	10 239	9604	9475	4432
VIIc	4262	2152			1086	521		1150	0	

Table 7.6.4. Estimated mean cpue ([kg/hook]x1000) based on logbook data along with its standard error (*se*) and number of catches sampled for tusk.

Tusk

	2000			2001			2002			2003			2004			2005			2006			2007			2008			2009		
Area	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se	cpue	n	se
IVA	35,7	664	1,2	32,6	721	0,8	25	649	0,9	29,8	496	0,9	49,3	437	1,2	36,4	329	1,8	44,6	664	1,6	51,23	583	1,2	59,43	395	1,8348	31,24	389	1,9338
IVB	18,1	17	7,2	16,5	2	12,4				7,22	13	5,6																		
VB	56,8	405	1,5	50,2	608	1,0	50,1	473	1,0	53,7	514	0,9	59,3	693	0,9	66,5	374	1,7	98,9	159	3,2	64,7	353	1,5	78,9	188	2,6594			
VIA	48	430	1,4	40,7	444	1,1	45,9	186	1,6	36,13	300	1,2	50,26	307	1,4	59,1	368	2,7	106,3	247	2,6	66,12	249	2,4	126,44	137	3,1129	141,53	40	6,0241
VIIC	62,7	60	3,8	4,8	25	4,6							7,05	23	5,2	15,9	7	12,0				5,14	10	8,8						

Table 7.6.5. Tusk in Vb (Faroes). Abundance index from spring and summer survey.

	Spring survey			Summer survey		
	Catch (kg)	Effort (h)	cpue (kg/h)	Catch (kg)	Effort (h)	cpue (kg/h)
1994	429	91	4.71			
1995	300	91	3.29			
1996	142	100	1.42	467	200	2.33
1997	331	98	3.38	311	200	1.56
1998	261	99	2.63	463	201	2.31
1999	143	100	1.43	157	199	0.79
2000	104	100	1.04	163	200	0.81
2001	198	100	1.98	331	200	1.66
2002	245	100	2.45	167	199	0.84
2003	302	100	3.02	123	200	0.62
2004	201	100	2.01	708	200	3.54
2005	210	100	2.10	968	200	4.84
2006	386	100	3.86	427	200	2.14
2007	391	100	3.91	391	199	1.97
2008	204	99	2.06	847	200	4.24
2009	378	100	3.78	712	200	3.56

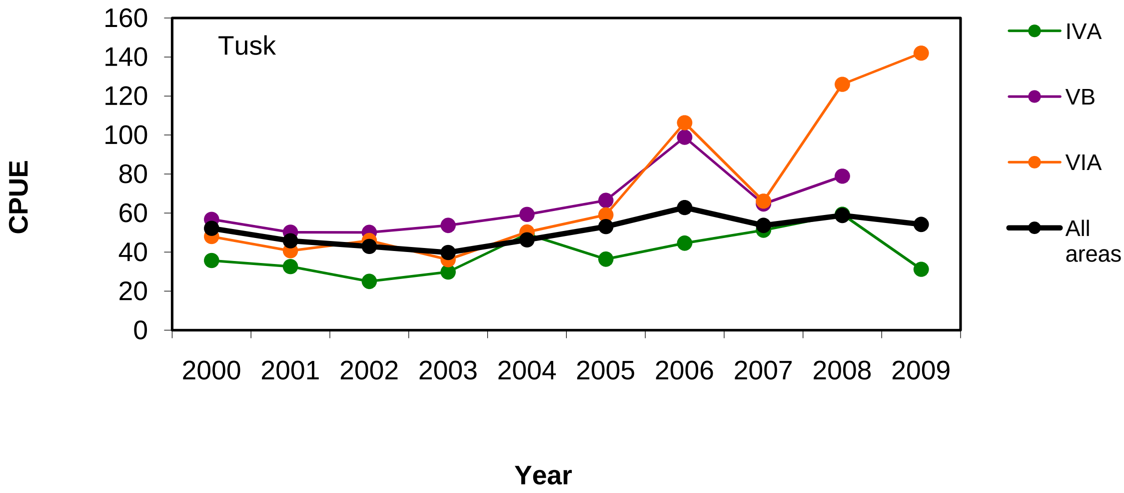


Figure 7.6.1. Estimated mean cpue([kg/hook]x1000) based on data from the Norwegian logbooks for tusk in each ICES Subarea III to IX (except Va, VIb) and all areas combined for the years 2000–2007. Data from 2008 was not available to the Working Group.

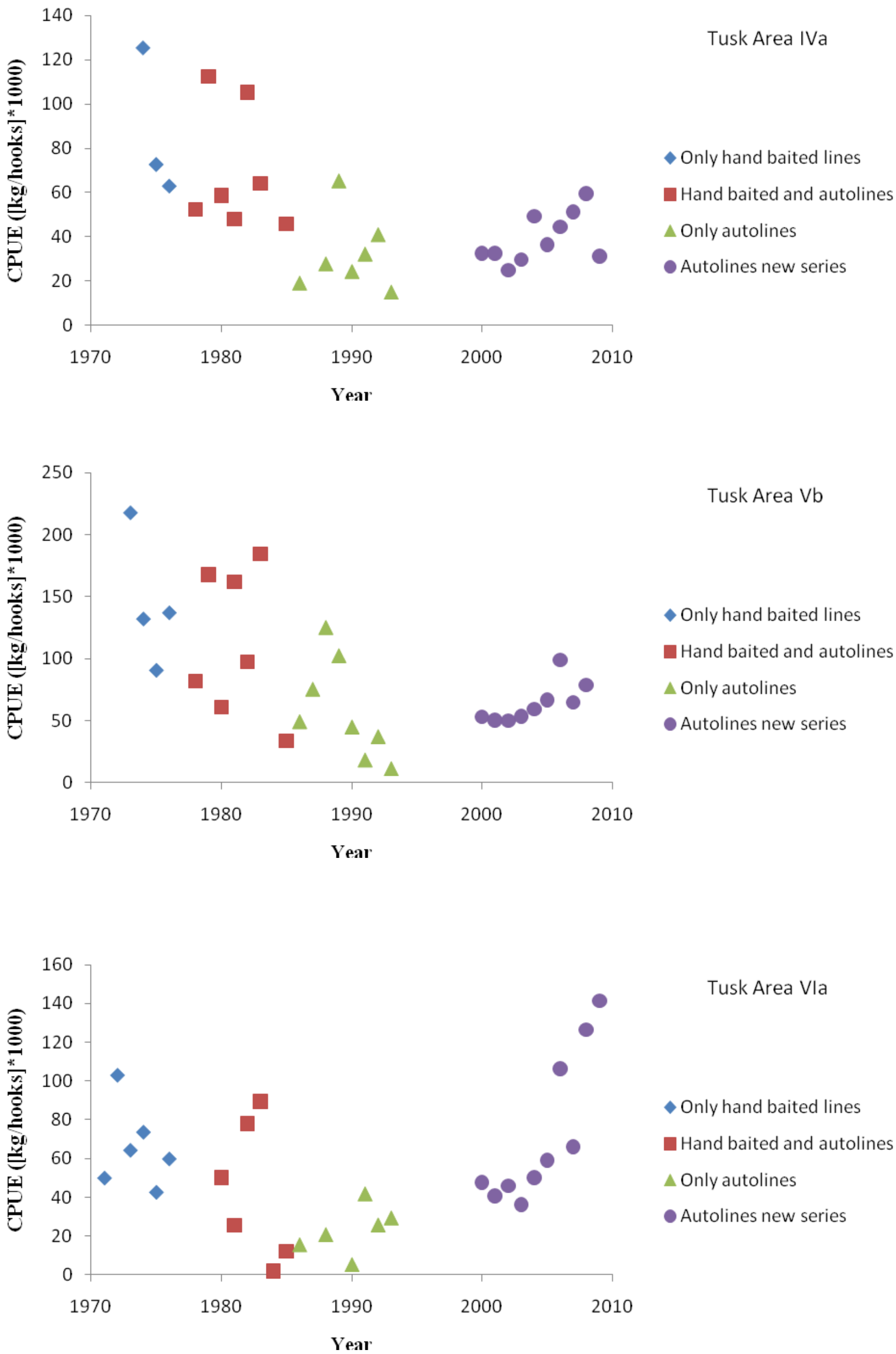


Figure 7.6.2. Estimates of cpue (kg/1000 hooks) of tusk in Subareas IVa ,Vb and VIa based on skippers' logbooks (pre-2000) and official logbooks (post-2000). Combination of data from Bergstad and Hareide, 1996 and Helle *et al.*, WD2, 2009. Note gap in time-series between 1993 and 2000, and the differences in cpue scale between areas. (Preliminary estimates for 2009). The data used for the period 1971–1993 are, early on only hand baited lines (blue diamonds), then a mix of both hand baited and autolines (red squares) and finally only autolines (green triangles). The new dataseries is denoted by purple circles.

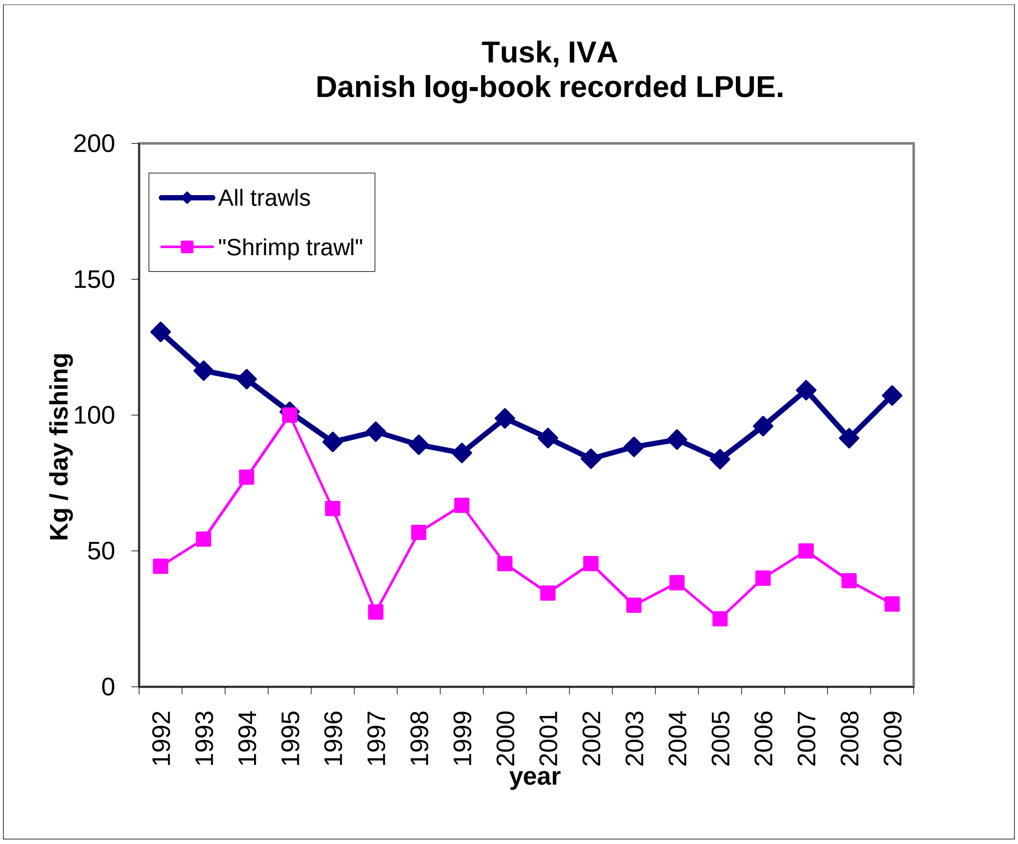


Figure 7.6.3. Tusk in IVa. Cpue of tusk for Danish. Based on logbook data.

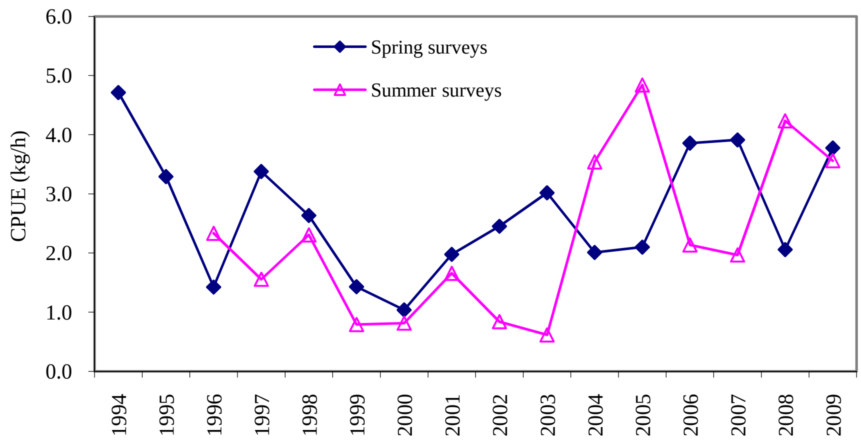


Figure 7.6.4. Tusk in Vb (Faroes). Cpue in spring and autumn bottom-trawl survey.

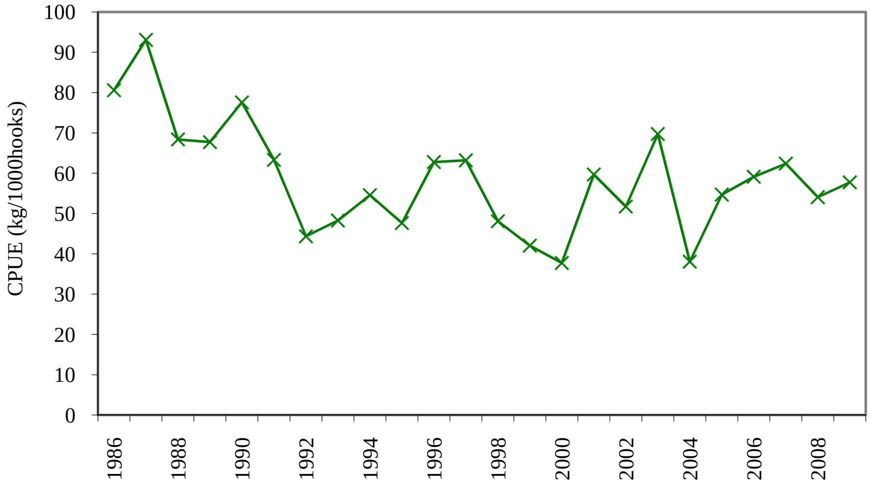


Figure 7.6.5. Tusk in Vb (Faroes). Cpue (kg/1000hooks) from longliners > 100 GRT.

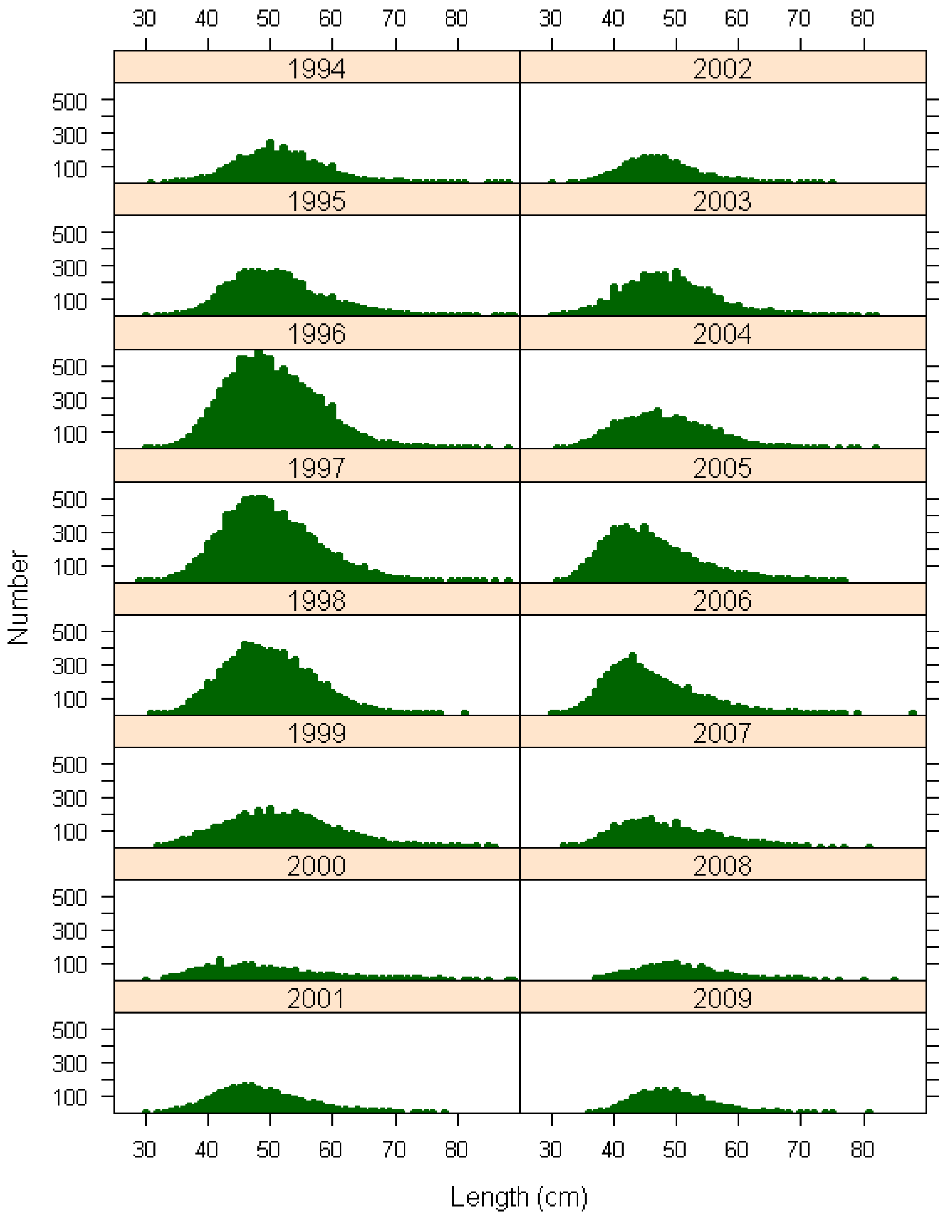


Figure 7.6.6. Tusk in Vb (Faroes). Length distribution from the Faroes groundfish survey.

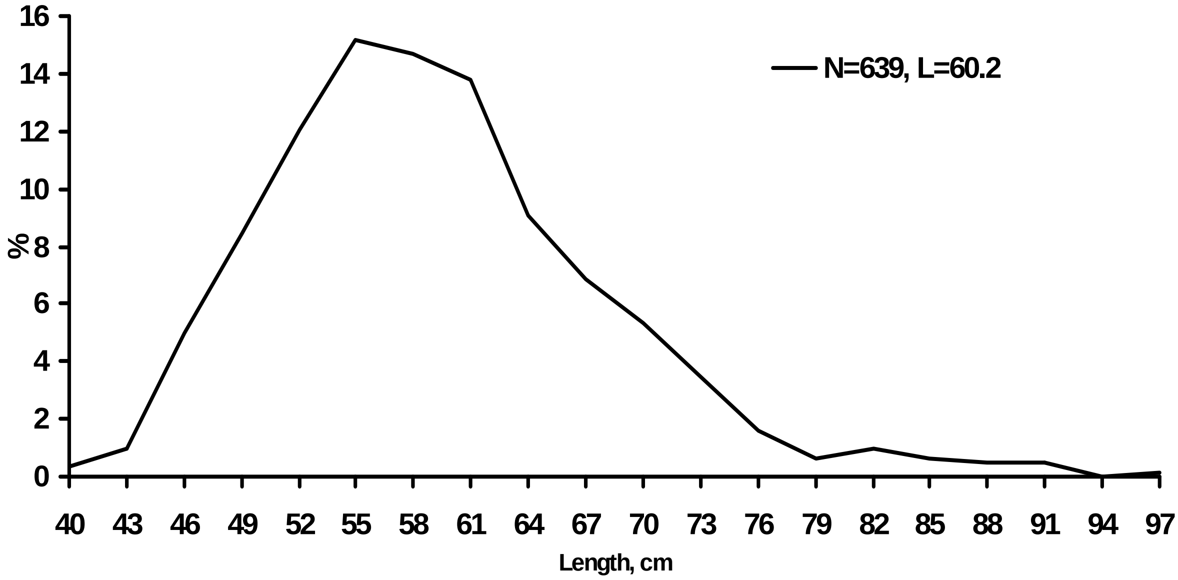


Figure 7.6.7. Length composition of tusk in longline catches in the southern part of Faroes Fishing Zone (Division Vb) in June–July 2008.

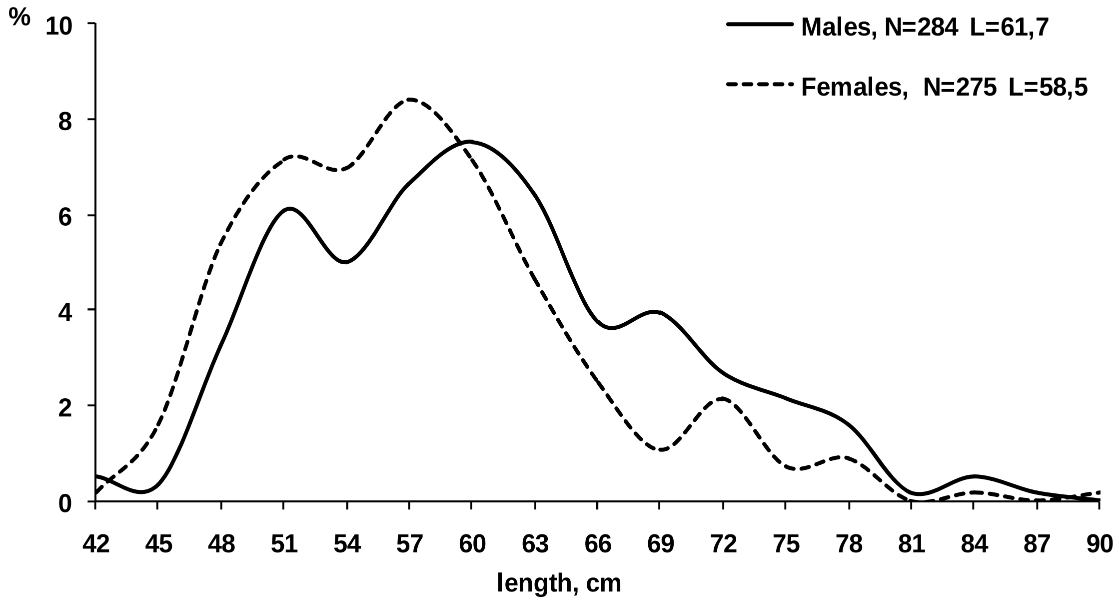


Figure 7.6.8. Length composition of tusk in Faeroes Fishing Zone in June–August 2009.

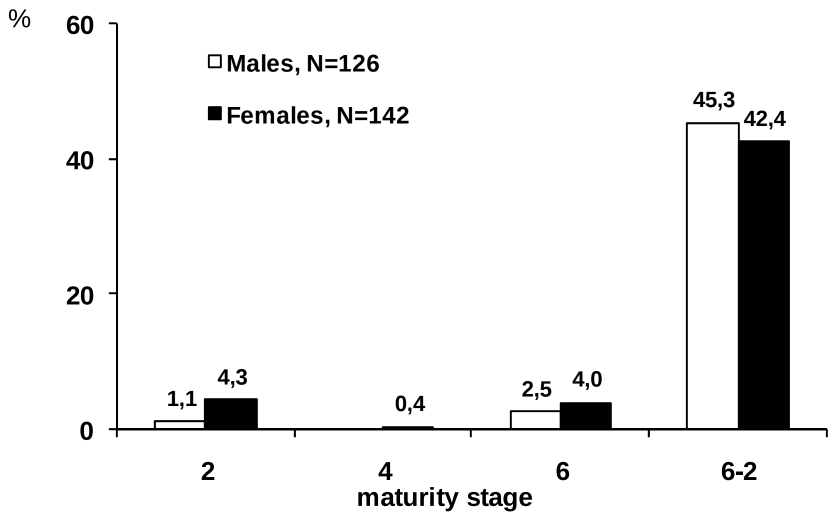


Figure 7.6.9. Maturity of tusk in Faeroes Fishing Zone in June–August 2009.

Stock Annex: Tusk in ICES Division Va and XIV

Stock	Tusk (Division Va)
Working Group	WKDEEP
Date	February 2010
Revised by	Kristjan Kristinsson, Gudmundur Thordarson

A. General

A.1. Stock definition

Tusk in Icelandic and Greenland waters (ICES Divisions Va and XIV respectively) is considered as one stock unit and is separated from the tusk found on the mid-Atlantic Ridge, on Rockall (VIb), and in Divisions I and II. This stock discrimination is based on genetic investigation (Knutsen *et al.*, 2009) and was reviewed at the WGDEEP meeting in 2007.

A.2. Fishery

The tusk in ICES Division Va is mainly caught by Iceland (75—85% of the total annual catches in recent years), but the Faroe Islands and Norway also important fishing nations. Foreign catches of tusk in Va, mainly conducted by the Faroese fleet, has always been considerable but have decreased since 1990, whereas the Icelandic catches have increased.

Over 95% of the Icelandic tusk catch in Va comes from longliners and mainly caught as either bycatch in other fisheries or in mixed fishery. The Icelandic longline fleet mainly targets cod and haddock where tusk is often caught as bycatch. The directed fishery for tusk has traditionally been little but has increased in recent years. Tusk is then often caught with ling and blue ling along the south and southwest coast of Iceland.

In recent years between 150–250 longliners have annually reported tusk catches, whereof 80–85% have been caught by about 20–25 vessels (annual catch of each vessel from about 50 tonnes up to 800 tonnes).

Since 1991, 60–80% of the catches have been taken within the depth range of 100–300 m, with 80–95% of the catches taken at depth less than 400 m. In some years, about 20% of the annual tusk catch has been taken at depths between 600–700 m.

The longline fleet in Icelandic waters is composed of both small boats (<10 GRT) operating in shallow waters as well as much larger vessels operating in deeper waters. Cod and haddock are the main target species of this fleet but tusk, ling and blue ling are also caught, sometimes in directed fisheries. The 10 longline vessels that fish about 65% of the total tusk catch in Va are vessels between 300–600 GRT.

Tusk fishery in ICES Division XIV has traditionally been very little, with less than 100 t caught annually. The tusk is caught as bycatch in other fisheries.

A.3. Ecosystem aspects

Tusk in Icelandic waters is mainly found on the continental shelf and slopes of south-east, south, and west of Iceland at depths of 0–1000 m, but mainly at depths between 100–500 m.

A.4. Management

The Ministry of Fisheries is responsible for management of the Icelandic fisheries and implementation of the legislation. The Ministry issues regulations for commercial fishing for each fishing year, including an allocation of the TAC for each of the stocks subject to such limitations. Below is a short account of the main feature of the management system and where applicable emphasis will be put on tusk.

A system of transferable boat quotas was introduced in 1984. The agreed quotas were based on the Marine Research Institute's TAC recommendations, taking some socio-economic effects into account, as a rule to increase the quotas. Until 1990, the quota year corresponded to the calendar year but since then the quota, or fishing year, starts on September 1 and ends on August 31 the following year. This was done to meet the needs of the fishing industry. In 1990, an individual transferable quota (ITQ) system was established for the fisheries and they were subject to vessel catch quotas. The ITQ system allows free transferability of quota between boats. This transferability can either be on a temporary (one year leasing) or a permanent (permanent selling) basis. This system has resulted in boats having quite diverse species portfolios, with companies often concentrating/specializing on particular group of species. The system allows for some but limited flexibility with regards converting a quota share of one species into another within a boat, allowance of landings of fish under a certain size without it counting fully in weight to the quota, and allowance of transfer of unfished quota between management years. The objective of these measures is to minimize discarding, which is effectively banned. Since 2006/2007 fishing season, all boats operate under the TAC system.

In the beginning, only few commercial exploited fish species were included in the ITQ system, but many other species have gradually been included. Tusk was included into the ITQ system in the 2001/2002 quota year.

Landings in Iceland are restricted to particular licensed landing sites, with information being collected on a daily basis time by the Directorate of Fisheries in Iceland (the enforcement body). All fish landed has to be weighted, either at harbour or inside the fish processing factory. The information on each landing is stored in a centralized database maintained by the Directorate and is available in real time on the internet (www.fiskistofa.is). The accuracy of the landings statistics are considered reasonable.

All boats operating in Icelandic waters have to maintain a logbook record of catches in each haul/set. The records are available to the staff of the Directorate for inspection purposes as well as to the stock assessors at the Marine Research Institute.

With some minor exceptions it is required by law to land all catches. Consequently, no minimum landing size is in force. To prevent fishing of small fish various measures such as mesh size regulation and closure of fishing areas are in place.

A system of instant area closure is in place for many species, including tusk. The aim of the system is to minimize fishing on juveniles. For tusk, an area is closed temporarily (for 2 weeks) for fishing if on-board inspections (not 100% coverage) reveal that more than 25% of the catch is composed of fish less than 55 cm in length. Since tusk is often bycatch in other fisheries, this rule does only apply when the tusk catch is more than 30% of the total catch in a set/haul. Because of repeated instant area closures off the south and southeast coast of Iceland in 2003, four areas were closed permanently for longline fishery in order to protect juvenile tusk (Figure 1).

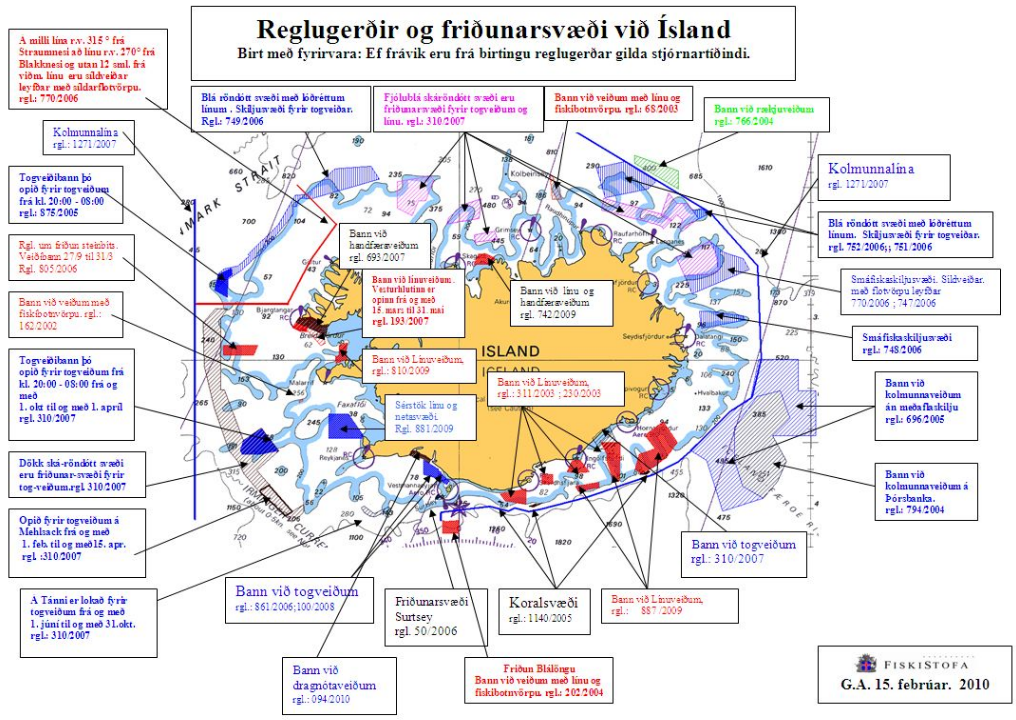


Figure 1. Marine protected areas in Icelandic waters. These areas are closed for various types of fisheries and may be closed permanently (all year around) or temporarily (closed part of the years. Four areas marked red south and southeast of Iceland (reference to the box *Bann við Línu-veiðum, rgl.: 311/2003; 230/2003*) are areas permanently closed for longline fisheries in order to protect juvenile tusk. Trawling does not occur within these areas. Figure provided by Directorate of Fisheries in Iceland.

B. Data

B.1. Commercial catch

Landings and discards

The text Table below shows which data from landings is supplied from ICES Division Va.

ICES Division Va	Kind of data				
Country	Caton (Catch in weight)	Canum (catch-at-age in numbers)	Weca (weight-at-age in the catch)	Matprop (proportion mature-by-age)	Length composition in catch
Iceland	x	Two years	Two years		x
The Faroe Islands	x				x
Norway	x				

Icelandic tusk catch in tonnes by month, area and gear are obtained from Statistical Iceland and Directorate of Fisheries. Catches are only landed in authorized ports where all catches are weighed and recorded. The distribution of catches is obtained from logbook statistic where location of each haul, effort, depth of trawling and total catch of tusk is given. Logbook statistics are available since 1991. Landings of Norwegian and Faroese vessels are given by the Icelandic Coast Guard and reported to the Directorate of Fisheries.

Discard is banned in the Icelandic demersal fishery and there is no information available on possible discard of tusk.

B.2. Biological

Biological data from the commercial longline catch are collected from landings by scientists and technicians of the Marine Research Institute (MRI) in Iceland. The biological data collected are length (to the nearest cm), sex and maturity stage (if possible since most tusk is landed gutted), and otoliths for age reading. Most of the fish that otoliths were collected from were also weighted (to the nearest gram). Biological sampling is also collected directly on board on the commercial vessels during trips by personnel of the Directorate of Fisheries in Iceland or from landings (at harbour). These are only length samples.

The general process of the sampling strategy is to take one sample of tusk for every 180 tonnes landed. This means that between 30–40 samples are taken from the commercial longline catch each year. Each sample consists of 150 fishes. Otoliths are extracted from 50 fish which are also length measured and weighed gutted. In most cases the tusk is landed gutted so it not possible to determine sex and maturity. If tusk is landed un-gutted, the un-gutted weight is measured and the fish is sex and maturity determined. The remaining 100 in the sample are only length measured.

Age reading of tusk from the commercial catch is not done on regular basis and otoliths from only two years have been age read.

Earlier observations indicates that tusk becomes mature-at-age of about 8–10 years or at around the length of 56 cm. However, new ageing of tusk otoliths from 1995 and 2009 suggest that tusk grows considerably faster than previously assumed. The new age-readings are considered more plausible than the older estimates as they results in more similar estimates of growth of tusk in Va as has been reported in other management units.

The mean length-at-maturity is close to the mean length of tusk in the commercial catches. This means that a large proportion of the tusk is caught as immature.

No estimates of natural mortality are available for tusk in Va and XIV. In the Gadget model (see below) natural mortality is assumed to be 0.2 $year^{-1}$.

The biological data from the fishery is stored in a database at the Marine Research Institute. The data is used for description of the fishery and as input data for the GADGET model.

B.3. Surveys

Iceland

Two bottom-trawl surveys, conducted by the Marine Research Institute in Va, are considered representative for tusk are the Icelandic Groundfish Survey (IGS or the Spring Survey) and the Autumn Groundfish Survey (AGS or the Autumn Survey) The Spring Survey has been conducted annually in March since 1985 on the continental shelf at depths shallower than 500 m and has a relatively dense station-net (approx. 550 stations). The Autumn Survey has been conducted in October since 1996 and covers larger area than the Spring Survey. It is conducted on the continental shelf and slopes and extends to depths down to 1500 m. The number of stations is about 380 so the distance between stations is often greater. The main target species in the Autumn Survey are Greenland halibut (*Reinhardtius hippoglossoides*) and deep-water redfish (*Sebastes mentella*).

The text in the following description of the surveys is mostly a translation from Björnsson *et al*. (2007). Where applicable the emphasis has been put on tusk.

B.3.1. Spring survey in Va

From the commencing of the Spring Survey the stated aim has been to estimate abundance of demersal fish stocks, particularly the cod stock with increased accuracy and thereby strengthening the scientific basis of fisheries management. That is, to get fisheries independent estimates of abundance that would result in increased accuracy in stock assessment relative to the period before the Spring Survey. Another aim was to start and maintain dialogue with fishermen and other stakeholders.

To help in the planning, experienced captains were asked to map out and describe the various fishing grounds around Iceland and then they were asked to choose half of the tow-stations taken in the survey. The other half was chosen randomly.

B.3.1.1. Timing, area covered and tow location

It was decided that the optimal time of the year to conduct the survey would be in March, or during the spawning of cod in Icelandic waters. During this time of the year, cod is most easily available to the survey gear as diurnal vertical migrations are at minimum in March (Pálsson, 1984). Previous survey attempts had taken place in March and for possible comparison with that data it made sense to conduct the survey in March.

The total number of stations was decided to be 600 (Figure 2). The reason of having so many stations was to decrease variance in indices but was inside the constraints of what was feasible in terms of survey vessels and workforce available. With 500–600 tow-stations the expected CV of the survey would be around 13%.

The survey covers the Icelandic continental shelf down to 500 m and to the EEZ-line between Iceland and Faroe Islands. Allocation of stations and data collection is based on a division between Northern and Southern areas. The Northern area is the colder part of Icelandic waters where the main nursery grounds of cod are located, whereas the main spawning grounds are found in the warmer Southern area. It was assumed that 25–30% of the cod stock (in abundance) would be in the southern area at the survey time but 70–75% in the north. Because of this, 425 stations were allocated in the colder northern area and 175 stations were allocated in the southern area. The two areas were then divided into ten strata, four in the south and six in the north.

Stratification in the survey and the allocation of stations was based on pre-estimated cod density patterns in different "statistical squares" (Palsson *et al*., 1989). The statistical squares were grouped into ten strata depending on cod density. The number of stations allocated to each stratum was in proportion to the product of the area of the stratum and cod density. Finally the number of stations within each stratum was allocated to each statistical square in proportion to the size of the square. Within statistical squares, stations were divided equally between fishermen and fishery scientist at the MRI for decisions of location. The scientist selected random position for their stations, whereas the fishermen selected their stations from their fishing experience. Up to 16 stations are in each statistical square in the Northern area and up to seven in the Southern are. The captains were asked to decide the towing direction for all the stations.

B.3.1.2. Vessels, fishing gear and fishing method

In the early stages of the planning it was apparent that consistency in conducting the survey on both spatial and temporal scale was of paramount importance. It was decided to rent commercial stern-trawlers built in Japan in 1972–1973 to conduct the survey. Each year, up to five trawlers have participated in the survey each in a dedicated area (NW, N, E, S, SW). The ten Japan-built trawlers were all build on the same plan and were considered identical for all practical purposes. The trawlers were thought to be in service at least until the year 2000. This has been the case and most of these trawlers still fish in Icelandic waters but have had some modifications since the start of the survey, most of them in 1986–1988.

The survey gear is based on the trawl that was the most commonly used by the commercial trawling fleet in 1984–1985. It has relatively small vertical opening of 2–3 m. The headline is 105 feet, fishing line is 63 feet, foot-rope 180 feet and the trawl weight 4200 kg (1900 kg submerged).

Length of each tow was set 4 nautical miles and towing speed at approx. 3.8 nautical miles per hour. Minimum towing distance so that the tow is considered valid for index calculation is 2 nautical miles. Towing is stopped if wind is more than 17–21 m/sec, (8 on Beaufort scale).

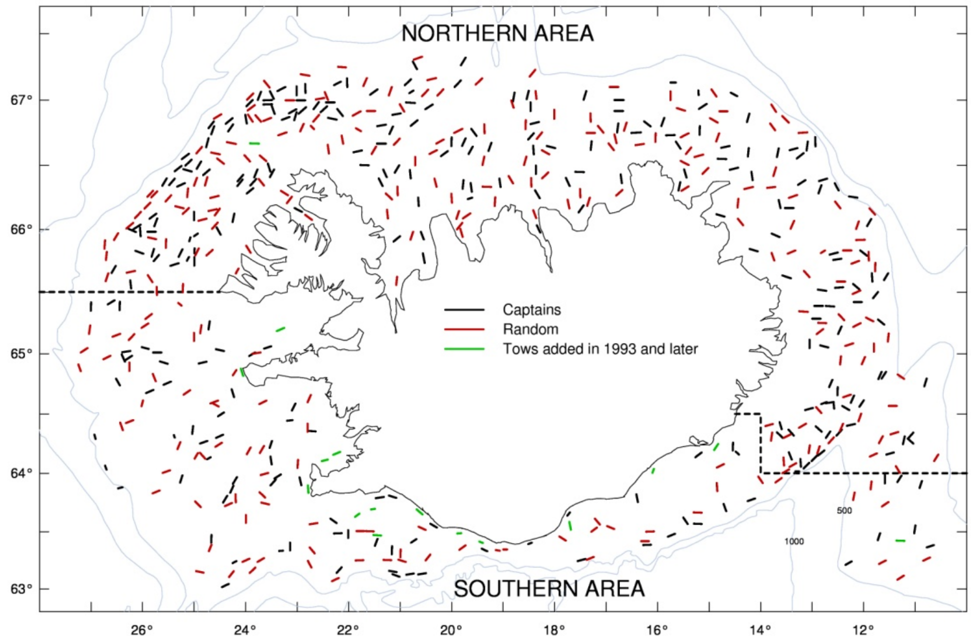


Figure 2. Stations in the Spring Survey in March. Black lines indicate the tow-stations selected by captains of commercial trawlers, red lines are the tow-stations selected randomly, and green lines are the tow-stations that were added in 1993 or later. The broken black lines indicate the original division of the study area into Northern and Southern area. The 500 and 1000 m depth contours are shown.

B.3.1.3. Later changes in vessels and fishing gear

The trawlers used in the survey have been changed somewhat since the beginning of the survey. The changes include alteration of hull shape (bulbous bow), the hull extended by several meters, larger engines, and some other minor alterations. These alterations have most likely changed the qualities of the ships but it is very difficult to quantify these changes.

The trawlers are now considered old and it is likely that they will soon disappear from the Icelandic fleet. Some search for replacements is ongoing. In recent years, the

MRI research vessels have taken part in the Spring Survey after elaborate comparison studies. The r/v Bjarni Sæmundsson has surveyed the NW-region since 2007 and r/v Árni Friðriksson has surveyed the Faroe-Iceland ridge in recent years and will in 2010 survey the SW-area.

The trawl has not changed since the start of the survey. The weight of the otter-boards has increased from 1720–1830 kg to 1880–1970 kg. The increase in the weight of the otter-boards may have increased the horizontal opening of the trawl and hence decreased the vertical opening. However, these changes should be relatively small as the size (area) and shape of the otter-boards is unchanged.

B.3.1.4. Later changes in trawl-stations

Initially, the numbers of trawl stations surveyed was expected to be 600 (Figure 2). However, this number was not covered until 1995. The first year 593 stations were surveyed but in 1988 the stations had been decreased down to 545 mainly due to bottom topography (rough bottom that was impossible to tow), but also due to drift ice that year. In 1989–1992, between 567 and 574 stations were surveyed annually. In 1993, 30 stations were added in shallower waters as an answer to fishermen's critique.

In short, until 1995 between 596 and 600 stations were surveyed annually. In 1996 14 stations that were added in 1993 were omitted. Since 1991 additional tows have been taken at the edge of the survey area if the amount of cod has been high at the outermost stations.

In 1996, the whole survey design was evaluated with the aim of reduce cost. The number of stations was decreased to 532 stations. The main change was to omit all of the 24 stations from the Iceland-Faroe Ridge. This was the state of affairs until 2004 when in response to increased abundance of cod on the Faroe-Iceland ridge 9 stations were added. Since 2005 all of the 24 stations omitted in 1996 have been surveyed each year.

In the early 1990s there was a change from Loran C positioning system to GPS. This may have slightly changed the positioning of the stations as the Loran C system was not as accurate as the GPS.

B.3.2. Autumn survey in Va

The Icelandic Autumn Survey has been conducted annually since 1996 by the MRI. The objective is to gather fishery independent information on biology, distribution and biomass of demersal fish species in Icelandic waters, with particular emphasis on Greenland halibut (*Reinhardtius hippoglossoides*) and deep-water redfish (*Sebastes mentella*). This is because the Spring Survey does not cover the distribution of these deep-water species. Secondary aim of the survey is to have another fishery independent estimate on abundance, biomass and biology of demersal species, such as cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and golden redfish (*Sebastes marinus*), in order to improve the precision of stock assessment.

B.3.2.1. Timing, area covered and tow location

The Autumn Survey is conducted in October as it is considered the most a suitable month in relation to diurnal vertical migration, distribution and availability of Greenland halibut and deep-sea redfish. The research area is the Icelandic continental shelf and slopes within the Icelandic Exclusive Economic Zone to depths down to 1500 m. The research area is divided into a shallow-water area (0–400 m) and a deep-water area (400–1500 m). The shallow-water area is the same area covered in the

Spring Survey. The deep-water area is directed at the distribution of Greenland halibut, mainly found at depths from 800–1400 m west, north and east of Iceland, and deep-water redfish, mainly found at 500–1200 m depths southeast, south and southwest of Iceland and on the Reykjanes Ridge.

B.3.2.2. Preparation and later alterations to the survey

Initially, a total of 430 stations were divided between the two areas. Of them, 150 stations were allocated to the shallow-water area and randomly selected from the Spring Survey station list. In the deep-water area, half of the 280 stations were randomly positioned in the area. The other half were randomly chosen from logbooks of the commercial bottom-trawl fleet fishing for Greenland halibut and deep-water redfish in 1991–1995. The locations of those stations were, therefore, based on distribution and pre-estimated density of the species.

Because MRI was not able to finance a project in order of this magnitude, it was decided to focus the deep-water part of the survey on the Greenland halibut main distributional area. For this reason, important deep-water redfish areas south and west of Iceland were omitted. The number and location of stations in the shallow-water area were unchanged.

The number of stations in the deep-water area was therefore reduced to 150. A total of 100 stations were randomly positioned in the area. The remaining stations were located on important Greenland halibut fishing grounds west, north and east of Iceland and randomly selected from a logbook database of the bottom-trawl fleet fishing for Greenland halibut 1991–1995. The number of stations in each area was partly based on total commercial catch.

In 2000, with the arrival of a new research vessel, MRI was able finance the project according to the original plan. Stations were added to cover the distribution of deep-water redfish and the location of the stations selected in a similar manner as for Greenland halibut. A total of 30 stations were randomly assigned to the distribution area of deep-water redfish and 30 stations were randomly assigned to the main deep-water redfish fishing grounds based on logbooks of the bottom trawl fleet 1996–1999.

In addition, 14 stations were randomly added in the deep-water area in areas where great variation had been observed in 1996–1999. However, because of rough bottom which made it impossible to tow, five stations have been omitted. Finally, 12 stations were added in 1999 in the shallow-water area, making total stations in the shallow-water area 162. Total number of stations taken since 2000 has been around 381 (Figure 3).

The r/v "Bjarni Sæmundsson" has been used in the shallow-water area from the beginning of the survey. For the deep-water area MRI rented one commercial trawler 1996–1999, but in 2000 the commercial trawler was replaced by the r/v "Árni Friðriksson".

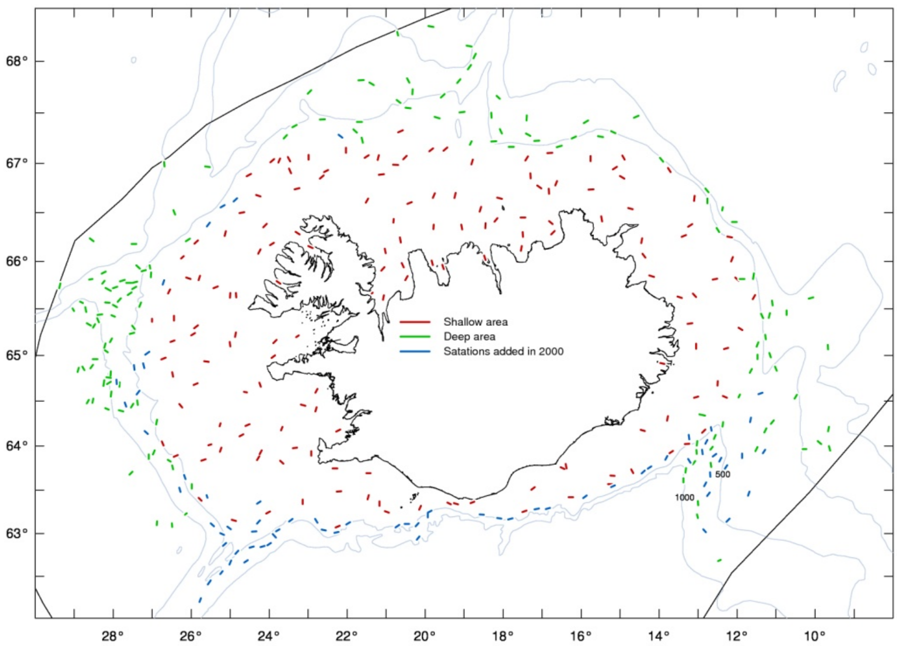


Figure 3. Stations in the Autumn Groundfish Survey (AGS). R/v "Bjarni Sæmundsson" takes stations in the shallow-water area (red lines) and r/v "Árni Friðriksson" takes stations in the deep-water areas (green lines), the blue lines are stations added in 2000.

B.3.2.3. Fishing gear

Two types of the bottom survey trawl "Gulltoppur" are used for sampling: "Gulltoppur" is used in the shallow water and "Gulltoppur 66.6m" is used in deep waters. The trawls were common among the Icelandic bottom-trawl fleet in the mid 1990s and are well suited for fisheries on cod, Greenland halibut and redfish.

"Gulltoppur", the bottom trawl used in the shallow water, has a headline of 31.0 m, and the fishing line is 19.6 m. The deep-water trawl, "Gulltoppur 66.6m" has a headline of 35.6 m and the fishing line is 22.6 m.

The towing speed is 3.8 knots over the bottom. The trawling distance is 3.0 nautical miles calculated with GPS when the trawl touches the bottom until the hauling begins (i.e. excluding setting and hauling of the trawl).

B.3.3. Data sampling

The data sampling in the Spring and Autumn surveys is quite similar. In short there is more emphasis on stomach content analysis in the Autumn Survey than the Spring Survey. For tusk, the sampling procedure is the same in both surveys except tusk is weighed un-gutted and stomach content analysed in the Autumn survey.

B.3.3.1. Length measurements and counting

All fish species are measured for length. For the majority of species including tusk, total length is measured to the nearest cm from the tip of the snout to the tip of the longer lobe of the caudal fin. At each station, the general rule, which also applies to tusk, is to measure at least 4 times the length interval of a given species. Example: If the continuous length distribution of tusk at a given station is between 15 and 45 cm, the length interval is 30 cm and the number of measurements needed is 120. If the catch of tusk at this station exceeds 120 individuals, the rest is counted.

Care is taken to ensure that the length measurement sampling is random so that the fish measured reflect the length distribution of the haul in question.

B.3.3.2. Recording of weight, sex and maturity stages

Sex and maturity data has been sampled for tusk from the start of both surveys. Tusk is weighted as un-gutted in the Autumn Survey.

B.3.3.3. Otolith sampling

For tusk a minimum of one otolith in the Spring and Autumn Surveys is collected and a maximum of 25. Otoliths are sampled at a four fish interval so that if in total 40 tusks are caught in a single haul, 10 otoliths are sampled.

B.3.3.4. Stomach sampling and analysis

Stomach samples of tusk are routinely sampled in the Autumn Survey.

B.3.3.5. Information on tow, gear and environmental factors

At each station/haul relevant information on the haul and environmental factors, are filled out by the captain and the first officer in co-operation with the cruise leader.

Tow information

- **General:** Year, Station, Vessel registry no., Cruise ID, Day/month, Statist. Square, Sub-square, Tow number, Gear type no., Mesh size, Briddles length (m).
- **Start of haul:** Pos. N, Pos. W, Time (hour:min), Tow direction in degrees, Bottom depth (m), Towing depth (m), Vert. opening (m), Horizontal opening (m).
- **End of haul:** Pos. N, Pos. W, Time (hour:min), Warp length (fm), Bottom depth (m), Tow length (naut. miles), Tow time (min) , Tow speed (knots).
- **Environmental factors:** Wind direction, Air temperature °C, Wind speed, Bottom temperature °C, Sea surface, Surface temperature °C, Towing depth temperature °C, Cloud cover, Air pressure, Drift ice.

Greenland

Two research vessel series from Greenland waters are conducted annually, but very little tusk is caught.

B.3.2.4. Data processing

B.3.2.4.1. Abundance and biomass estimates at a given station

As described above the normal procedure is to measure at least 4 times the length interval of a given species. The number of fish caught of the length interval L_1 to L_2 is given by:

$$P = \frac{n_{measured}}{n_{counted} + n_{measured}}$$

$$n_{L_1 - L_2} = \sum_{i=L_1}^{i=L_2} \frac{n_i}{P}$$

Where $n_{measured}$ is the number of fished measured and $n_{counted}$ is the number of fish counted.

Biomass of a given species at a given station is calculated as:

$$B_{L_1-L_2} = \sum_{i=L_1}^{i=L_2} \frac{n_i \alpha L_i^{\beta}}{P}$$

Where Li is length and alpha and beta are coefficients of the length–weight relationship.

B.3.2.4.2. Index calculation

For calculation of indices the Cochran method is used (Cochran, 1977). The survey area is split into sub-areas or strata and an index for each subarea is calculated as the mean number in a standardized tow, divided by the area covered multiplied with the size of the subarea. The total index is then a summed up estimates from the subareas.

A 'tow-mile' is assumed to be 0.00918 square nautical mile. That is the width of the area covered is assumed to be 17 m (17/1852=0.00918). The following equations are a mathematical representation of the procedure used to calculate the indices:

$$I_{strata} = \frac{\sum_{strata} Z_i}{N_{strata}}$$

$$\sigma^2_{strata} = \frac{\sum_{strata} (Z_i - I_{strata})^2}{N_{strata} - 1}$$

$$I_{region} = \sum_{region} I_{strata}$$

$$\sigma^2_{strata} = \sum_{region} \sigma^2_{strata}$$

$$CV_{region} = \frac{\sigma_{region}}{I_{region}}$$

Where *strata* refers to the subareas used for calculation of indices which are the smallest components used in the estimation, *I* refers to the stations in each subarea and region is an area composed of 2 or more subareas. *Zi* is the quantity of the index (abundance or biomass) in a given subarea. *I* is the index and sigma is the standard deviation of the index. CV refers to the coefficient of variation.

The sub-areas or strata used in the Icelandic groundfish surveys (same strata division in both surveys) are shown in Figure 3. The division into strata is based on the so-called BORMICON areas and the 100, 200, 400, 500, 600, 800 and 1000 m depth contours.

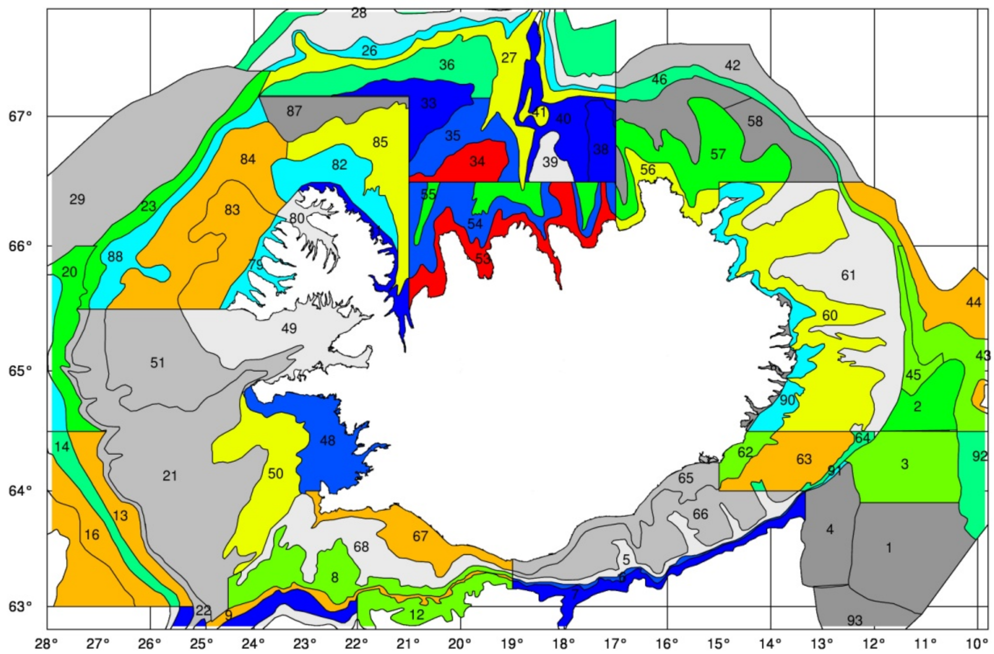


Figure 3. Subareas or strata used for calculation of survey indices in Icelandic waters.

B.4. Commercial cpue

Data used to estimate cpue for tusk in Division Va since 1991 were obtained from logbooks of the Icelandic longline fleet. Only sets were used where catches of tusk was registered, but also for sets where tusk constituted tom more than 10% and 30% of the catch.

Non-standardized cpue and effort is calculated for each year which is simply the sum of all catch divided by the sum of number of hooks.

B.5. Other relevant data

No other relevant data available.

C. Historical stock development

C.1. Description of gadget

Gadget is shorthand for the "Globally applicable Area Disaggregated General Ecosystem Toolbox", which is a statistical model of marine ecosystems. Gadget (previously known as BORMICON and Fleksibest). Gadget is an age–length structured forward-simulation model, coupled with an extensive set of data comparison and optimisation routines. Processes are generally modelled as dependent on length, but age is tracked in the models, and data can be compared on either a length and/or age scale. The model is designed as a multi-area, multi-area, multi-fleet model, capable of including predation and mixed fisheries issues; however it can also be used on a single species basis. Gadget models can be both very data- and computationally- intensive, with optimisation in particular taking a large amount of time. Worked examples, a detailed manual and further information on Gadget can be found on www.hafro.is/gadget. In addition the structure of the model is described in Björnsson and Sigurdsson (2004), Begley and Howell (2004), and a formal mathematical description is given in Frøysa *et al*. (2002).

Gadget is distinguished from many stock assessment models used within ICES (such as XSA) in that Gadget is a forward simulation model, and is structured be both age and length. It therefore requires direct modelling of growth within the model. An important consequence of using a forward simulation model is that the plus groups (in both age and length) should be chosen to be large enough that they contain few fish, and the exact choice of plus group does not have a significant impact on the model.

Setup of a Gadget run

There is a separation of model and data within Gadget. The simulation model runs with defined functional forms and parameter values, and produces a modelled population, with modelled surveys and catches. These surveys and catches are compared against the available data to produce a weighted likelihood score. Optimisation routines then attempt to find the best set of parameter values. Growth is modelled by calculating the mean growth for fish in each length group for each time step, using a parametric growth function. In the tusk model a von Bertanlanffy function has been employed to calculate this mean growth. The actual growth of fish in a given length cell is then modelled by imposing a beta-binomial distribution around this mean growth. This allows for the fish to grow by varying amounts, while preserving the calculated mean. The beta-binomial is described in Stefansson (2001). The beta-binomial distribution is constrained by the mean (which comes from the calculated mean growth), the maximum number of length cells a fish can grow in a given time step (which is set based on expert judgement about the maximum plausible growth), and a parameter β, which is estimated within the model. In addition to the spread of growth from the beta-binomial distribution, there is a minimum to this spread due by discretisation of the length distribution.

Catches

All catches within the model are calculated on length, with the fleets having size-based catchability. This imposes a size-based mortality, which can affect mean weight and length-at-age in the population (Kvamme, 2005). A fleet (or other preditor) is modelled so that either the total catch in each area and time interval is specified, or this the catch per timestep is estimated. In the hake assessment described here the commercial catch and the discards are set (in kg per quarter), and the surveys are modelled as fleets with small total landings. The total catch for each fleet for each quarter is then allocated among the different length categories of the stock according to their abundance and the catchability of that size class in that fleet.

Likelihood data

A significant advantage of using an age–length structured model is that the modelled output can be compared directly against a wide variety of different data sources. It is not necessary to convert length into age data before comparisons. Gadget can use various types of data that can be included in the objective function. Length distributions, age–length keys, survey indices by length or age, cpue data, mean length and/or weight-at-age, tagging data and stomach content data can all be used. Importantly this ability to handle length date directly means that the model can be used for stocks such as hake where age data is sparse or considered unreliable. Length data can be used directly for model comparison. The model is able to combine a wide selection of the available data by using a maximum likelihood approach to find the best fit to a weighted sum of the datsets.

Optimisation

The model has two alternative optimising algorithims linked to it, a wide area search simulated annealing Corona *et al*. (1987) and a local search Hooke and Jeeves algorithim HookeJeeves1961. Simulated annealing is more robust than Hooke and Jeeves and can find a global optima where there are multiple optima but needs about 2–3 times the order of magnitude number of iterations than the Hooke and Jeeves algorithim. The model is able to use both in a single run optimisation, attempting to utilize the strengths of both. Simulated annealing is used first to attempt to reach the general area of a solution, followed by Hooke and Jeeves to rapidly home in on the local solution. This procedure is repeated several times to attempt to avoid converging to a local optimum. The algorithms are not gradient based, and there is therefore no requirement on the likelihood surface being smooth. Consequently neither of the two algorithims returns estimates of the Hessian.

Likelihood weighting

The total objective function to be minimised is a weighted sum of the different components. Selection of the weights is based on expert knowledge about the quality of the data and the space-time coverage of each dataset.

Finding these weights is a lengthy procedure, but it does not generally need to be repeated for each assessment. Rather, the current weights can be used for several years. The weighted contribution of the datasets in a new assessment should be computed, and compared against the previous year. Provided the relative contributions are similar then the model results should be comparable between years.

C.2. Settings for the tusk assessment

Population is defined by 10 cm length groups, from 20–110 cm and the year is divided into four quarters. The age range is 2 to 20 years, with the oldest age treated as a plus group. Recruitment happens in the first and was set at age 2. The length-at-recruitment is estimated and mean growth is assumed to follow the von Bertalanffy growth function estimated by the model.

Weight Length relationship is obtained from spring survey data.

Natural mortality was assumed to be 0.2 $year^{-1}$. However differnt values of M are tested (0.1 and 0.3)

The commercial landings are modelled as one fleet (1980–2009) with a selection pattern described by a logistic function and the total catch in tonnes specified for each quarter. The survey (1985–2009), on the other hand is modelled as one fleet with constant effort and a nonparametric selection pattern that is estimated for each length group (one 10 cm length group).

Data used for the assessment are described below

- Length disaggregated survey indices (10 cm increments) from the Icelandic groundfish survey in March 1985–2009.
- Length distribution from the Icelandic commercial catch since 1979. The sampling effort was though relatively limited until the 1990s.
- Landings data divided into 4 month periods per year (quarters).
- Age–length keys and mean length-at-age from the Icelandic commercial fishery.

DESCRIPTION	PERIOD	BY QUARTER	AREA	LIKELIHOOD COMPONENT
Length distribution of landings	1981–1989, 1991–2009	YES	Iceland	ldist.catch
Length distribution of Icelandic GFS	1985–2010+	-	Iceland	ldist.survey
Abundace index of Icelandic GFS of 20–110 cm individuals	1985–2010+	-	Iceland	si20110
Age–length key of the landings	1995, 2009	YES	Iceland	alkeys.catch
Age–length key of the Icelandic GFS	1995, 2009	1st quarter	Iceland	alkeys.survey
Mean length by age of landings	1995, 2009	YES	Iceland	meanl.catch

Description of the likelihood components weighting procedure

COMPONENT	DESCRIPTION	QUARTERS	WEIGHT	TYPE
Bounds	Keeps estimates inside bounds	All	10	8
Understocking	Makes sure there is enough biomass	All	10e-6	2
Si2029	Survey Index 20–29 cm	1	50	1
Si3039	Survey Index 30–39 cm	1	50	1
Si4049	Survey Index 40–49 cm	1	20	1
Si5059	Survey Index 50–59 cm	1	20	1
Si60110	Survey Index 70–100 cm	1	5	1
Si2080-2	Survey Index (To get a smoothed estimate of the survey selection curve	1	0.1	1
Ldist.catch	Length distribution commercial catches (Longlines)	All	0.1	3
Ldist.survey	Length distribution from the spring survey	1	0.1	3
Alkeys.catch	Age–length data (1995, 2009) from commercial catches	All	5	3
Meanl.catch	Mean length-at-age from commercial catches	All	0.01	4
Alkeys.survey	Age–length data (1995, 2009) from the spring survey	1	5	3

The parameters estimated are:

- The number of fish by age when simulation starts (ages 3 to 5) - 3 parameters. Older ages are assumed to be a fraction of age 5;
- Recruitment each year (1980 and onwards);
- Parameters in the growth equation; Linf is constant at 120 cm and K is estimated;
- Parameter β that models the transition from one length class to the next;
- Length-at-recruitment (mean length and SD);
- The selection pattern of:

- The commercial catches (1980 and onwards - 2 params.
- Icelandic Spring survey - 1 parameter as the slope is kept constant.

40 parameters in total

The estimation can be difficult because of some or groups of parameters are correlated and therefore the possibility of multiple optima cannot be excluded. The optimisation was started with simulated anneling to make the results less sensitve to the initial (statring) values and then the optimisation was changed to Hooke and Jeeves when the 'optimum' was approached. The model run presented at WGDEEP-2010 was started using the initial values and bounds below:

Inital parameter values used and the bounds assigned.

Switch	Value	Lower	Upper	Optimise
Linf	120	50	200	0
K	90	0.1	1000	1
Bbeta	0.1	0.001	15	1
Ic03	4	0.001	15	1
Ic04	3	0.001	15	1
Ic05	2	0.001	15	1
Recl	15	5	40	1
Recsdev	4	0.01	15	1
Rec1980	2	0.01	15	1
Rec1981	2	0.01	15	1
Rec1982	2	0.01	15	1
Rec1983	2	0.01	15	1
Rec1984	2	0.01	15	1
Rec1985	2	0.01	15	1
Rec1986	2	0.01	15	1
Rec1987	2	0.01	15	1
Rec1988	2	0.01	15	1
Rec1989	2	0.01	15	1
Rec1990	2	0.01	15	1
Rec1991	2	0.01	15	1
Rec1992	2	0.01	15	1
Rec1993	2	0.01	15	1
Rec1994	2	0.01	15	1
Rec1995	2	0.01	15	1
Rec1996	2	0.01	15	1
Rec1997	2	0.01	15	1
Rec1998	2	0.01	15	1
Rec1999	2	0.01	15	1
Rec2000	2	0.01	15	1
Rec2001	2	0.01	15	1
Rec2002	2	0.01	15	1
Rec2003	2	0.01	15	1
Rec2004	2	0.01	15	1
Rec2005	2	0.01	15	1
Rec2006	2	0.01	15	1
Rec2007	2	0.01	15	1
Rec2008	2	0.01	15	1
Alphacomm	0.9	0.03	10	1
L50comm	40	20	50	1
L50sur	15	5	100	1

However multiple optimisation cycles were conducted to ensure that the model had converged to an optimum, and to provide opportunities to escape convergence to a local optimum.

The **diagnostics** run to analyze the model are:

- Likelihood profiles plot. To analize convergence and problematic parameters.
- Plot comparing observed and modeled proportions in fleets (catches). To analize how estimated population abundance and explotation pattern fits observed proportions.
- Plot for residuals in catchability models. To analyze precision and bias in abundance trends.
- Retrospective analysis. To analyze how additional data affects historical predictions of the model.

D. Short-term projection

Short and medium-term forecasts for tusk in Va and XIV can be done in gadget using the settings described below. However the model setup was not finalized at the Benchmark meeting (WKDEEP-2010). The Benchmark meeting concluded that the setup presented at the meeting as indicative of trends and suggested further improvements. If assessment improvements are address properly, WKDEEP agrees with the following parameters as input for short-term forecast.

Model used: Age–length forward projection

Software used: GADGET (script: run.sh)

Initial stock size: abundance-at-age and mean length for ages 0 to 20+

Maturity: Fixed maturity ogive

F and M before spawning: NA

Weight-at-age in the stock: modelled in GADGET with VB parameters and length–weight relationship

Weight-at-age in the catch: modelled in GADGET with VB parameters and length–weight relationship

Exploitation pattern:

Landings: logistic selection parameters estimated by GADGET.

Intermediate year assumptions: F = last assessment year F

Stock recruitment model used: geometric mean of years 1989–2007

Procedures used for splitting projected catches: driven by selection functions and provide by GADGET.

E. Medium-term projections (NA)

F. Long-term projections

Model used: Age–length forward projection

Software used: GADGET

Initial stock size: 1 year class of 1 million individuals

Maturity: Fixed maturity ogive

F and M before spawning: NA

Weight-at-age in the stock: modelled in GADGET with VB parameters and length–weight relationship

Weight-at-age in the catch: modelled in GADGET with VB parameters and length–weight relationship

Exploitation pattern:

Landings: logistic selection parameters estimated by GADGET.

Procedures used for splitting projected catches:

Driven by selection functions and provided by GADGET.

Yield-per-recruit is calculated by following one year class of million fishes for 29 years through the fisheries calculating total yield from the year class as function of fishing mortality of fully recruited fish. In the model, the selection of the fisheries is length based so only the largest individuals of recruiting year classes are caught reducing mean weight of the survivors, more as fishing mortality is increased. This is to be contrasted with age based yield-per-recruit where the same weights-at-age are assumed in the landings independent of the fishing mortality even when the catch weights are much higher as the mean weight in the stock.

G. Biological reference points

There are no reference points defined for this stock.

H. Other issues

I. References

Begley, J., and Howell, D. 2004. An overview of Gadget, the Globally applicable Area-Disaggregated General Ecosystem Toolbox. ICES C.M. 2004/FF:13, 15 pp.

Björnsson, H. And Sigurdsson, T. 2003. Assessment of golden redfish (*Sebastes marinus* L.) in Icelandic waters. Scientica Marina, 67 (Suppl. 1): 301:304.

Björnsson, Höskuldur, Jón Sólmundsson, Kristján Kristinsson, Björn Ævarr Steinarsson, Einar Hjörleifsson, Einar Jónsson, Jónbjörn Pálsson, Ólafur K. Pálsson, Valur Bogason and Þorsteinn Sigurðsson 2007. The Icelandic groundfish surveys in March 1985-2006 and in October 1996–2006 (*in Icelandic with English abstract*). Marine Research Institute, Report 131: 220 pp.

Cosewic. 2003.

Frøysa, K. G., Bogstad, B., and Skagen, D. W. 2002. Fleksibest – an age-length structured fish stock assessment tool with application to Northeast Arctic cod (*Gadus morhua* L.). Fisheries Research, 55: 87–101.

ICES. 2008. Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP), 3–10 March 2008, ICES Headquarters, Copenhagen. ICES CM 2008/ACOM:14. 531 pp.

ICES. 2009. Report of the Working Group on the Biology and Assessment of Deep Sea Fisheries Resources (WGDEEP), 9–16 March 2009, Copenhagen, Denmark. ICES CM 2009/ACOM:14. 511 pp.

Lumankov *et al*. 1985.

Knutsen, H., Jorde, P. E., Sannæs, H., Hoelzel, A. R., Bergstad, O. A., Stefanni, S., Johansen, T. and Stenseth, N. C. 2009. Bathymetric barriers promoting genetic structure in the deepwater demersal fish tusk (*Brosme brosme*). Molecular Ecology, 18: 3151–3162.

Pálsson, Ó. K. 1984. Studies on recruitment of cod and haddock in Icelandic waters. ICES CM 1984/G:6, 16p.

Pálsson, Ó. K., Jónsson, E. Schopka, S. A., and Stefánsson, G. 1989. Icelandic groundfish survey data used to improve precision in stock assessments. Journal of Northwest Atlantic Fishery Science, 9: 53–72.

8 Greater Silver Smelt

8.1 Stock description and management units

8.1.1 Current ICES structure

The current ICES structure for greater silver smelt is that ICES Subareas I, II, IV, VI, VII, VIII, IX, X, XII and XIV and Divisions IIIa and Vb, are treated as a single assessment unit. Only the greater argentine around Iceland (Division Va) is treated as a separate assessment unit.

The limited and hypothetical information on possible stocks was reported in the 1998 Study Group Report (CM 1998/ACFM:12), quote: "*Icelandic life-history studies suggest that a separate stock might exist in Subarea Va. Irish investigations on stock discrimination in areas VI and VII are inconclusive. A study by Ronan et al. (1993), using morphometrics (box truss analysis) and meristic measurements, suggests that populations from the north of Subarea VI and the south of Subarea VII form either end of a shape cline with fish in intermediary populations exhibiting a mixture of northern and southern morphologies. Norwegian investigations in 1984–1987 in Divisions IIa, IIIa and IVa appear to show two separate populations in winter but in summer the species is widely distributed (Bergstad, 1993)*". No new information was presented to the Working Group.

For the purpose of an exploratory assessment, WGDEEP in 2009 has made an assumption that greater silver smelt around Faroe Island can be treated as a separate assessment unit. However, available information is not sufficient to suggest changes to current ICES interpretation of stock structure.

In order to evaluate the stock structure further, sampling for genetic studies from the whole distribution area of greater silver smelt is needed. It is therefore recommended that such work should be initiated as soon as possible.

Greater silver smelt in all areas is suggested for benchmarking.

8.2 Greater Silver Smelt (*Argentina Silus*) in Division Va

8.2.1 The fishery

Greater silver smelt is mostly fished along the south and southwest coast of Iceland, at depths between 500 and 800 m. Greater silver smelt has been caught in bottom trawls for years as bycatch in the redfish fishery. Only small amounts were reported prior to 1996 as most of the greater silver smelt was discarded. However the discarding is not considered as significant because of the relatively large mesh-size used in the redfish fishery. Since 1997, direct fishery for greater silver smelt has been ongoing and the landings have increased significantly (Table. 8.2.1).

8.2.1.1 Fleets

In the period from 1996–2008 between 20–30 trawlers have reported catches of Greater Silver Smelt in Va (Table 8.2.2). The trawlers participating in the Greater Silver Smelt fishery also target redfish (*Sebastes marinus* and *S. mentella*) and to lesser extend Greenland halibut and blue ling.

The number of hauls has varied greatly but the number of hauls seems to be increasing in recent years. In most years between 70–90% of the Greater Silver Smelt catches are taken in hauls were the species is more than 50% of the catch.

8.2.1.2 Targeting and mixed fisheries issues in the Greater Silver Smelt fishery in Va

8.2.1.2.1 Targeting of Greater Silver Smelt by the fleet in Va

In Figure 8.2.1 an attempt is made to plot the targeting of the Greater Silver Smelt fishery in Va during 1993–2008 by looking at the relationship between the proportion of the species in each haul/set and the proportion of the annual catch. In short if the line rises rapidly up the *y*-axis (Proportion of annual catches), the fishery can be termed mainly a bycatch fishery. On the other hand if the line crawls along the *x*-axis (Proportion of species in set) and then rises rapidly the fishery can be termed directed-fishery.

At a quick glance on Figure 8.2.1 there does not seem to be much changes in the targeting of Greater Silver Smelt except maybe for the year 1998 when the species seems to have been targeted directly. The main points worth noting in Figure 8.2.1 is that the Greater Silver Smelt fishery before 1997 can be considered a bycatch fishery, and post-1998, as a mixed/directed fishery. The second point worth noting is the relative stability in the targeting of Greater Silver Smelt since 2004, where around 70% of the annual catch is taken in hauls where Greater Silver Smelt was more than 50% of the catch in a given haul.

8.2.1.2.2 Mixed fisheries issues: Species composition in the fishery

Redfish (*Sebastus marinus* and *S. mentella*) is the main species when it comes to mixed fishery of Greater Silver Smelt. Other species of less importance are Greenland halibut, blue ling and ling. Other species than these rarely exceed 10% of the bycatch in the Greater Silver Smelt fishery in Va.

8.2.1.3 Temporal and spatial development of the fishery

In this subsection an overview of catches in time and space is given. That is how the Greater Silver Smelt catch is taken over the year and from where it is mainly taken.

8.2.1.3.1 Catches by month

Table 8.2.3 gives an overview of the proportional catches by month of Greater Silver Smelt in Va. It should be noted that in 1998 a ban on targeting Greater Silver Smelt was put in effect in July as catches had reached more than 4 times previous years landings. The fishery has changed from taking mainly place in the summer to be spread out over the whole year.

8.2.1.3.2 Spatial distribution of catches through time

Spatial distribution of catches in 1996–2008 is presented in Figure 8.2.1. With the exception of 1996 most of the catches have been from the southern edge of the Icelandic shelf. However in recent years there has been a gradual increase in the proportion caught in the western area and even in the north-western area. The reason for this is the fleet is focusing on redfish and Greenland halibut but then takes few hauls of greater silver smelt in the area.

8.2.2 Landings trends

Landings of Greater Silver Smelt are presented in Table 8.2.1. Since directed fishery started in 1997–1998, the landings increased from 800 tonnes in 1996 to 13 000 tonnes in 1998. Between 1999 and 2007 catches varied between 2600 to 6700 tonnes. In 2008 landings increased substantially from 4200 tonnes in 2007 to almost 9000 tonnes in 2009 and then to 10 829 tonnes in 2009.

8.2.3 ICES Advice

The latest Advice is from ICES ACOM in May 2008 states: *As a consequence of its low productivity, greater silver smelt can only sustain low rates of exploitation. Fisheries on such species should always be accompanied by programmes to collect data on both target and by-catch fish. The target fishery should not be allowed to expand unless it can be demonstrated that it is sustainable.*

8.2.4 Management

The greater silver smelt fishery is at present not managed by quotas but rather as an exploratory fishery subject to licensing since 1997. Detailed description of regulations on the fishery of Greater Silver Smelt in Va is given in the Stock Annex.

8.2.5 Data available

8.2.5.1 Landings and discards

Landings by Icelandic vessels are given by the Icelandic Directorate of Fisheries. Discarding is banned in Icelandic waters and currently there is no available information on greater silver smelt discards. It is however likely that unknown quantities of greater silver smelt were discarded prior to 1996.

8.2.5.2 Length compositions

Table 8.2.4 gives the number of samples and measurements available for calculations of catch in numbers of Greater Silver Smelt in Va. Mean length in the catches has decreased since 1997 from around 45 cm down to 38 cm in 2008, however in 2009 the mean length in the catches increased slightly to approx 39 cm (Figure 8.2.3). The reasons for this may either be increased recruitment or depletion by the fishery.

8.2.5.3 Age compositions

Table 8.2.4 gives the number of samples and measurements available for calculations of catch in numbers of Greater Silver Smelt in Va.At the WKDEEP-2010 meeting estimates of catch in numbers were presented for 1997, 1998 and 2006–2008. A continuous downward trend in mean age in the commercial catches was noted. Preliminary estimates of catch in numbers from 2009 indicate that mean age in the catches is still decreasing (Figure 8.2.4). Estimates of catch in numbers are given in Table 8.2.5.

8.2.5.4 Weight-at-age

No marked changes can be observed in mean weight-at-age from commercial catches between 1997–1998 and 2006–2008 (Table 8.2.6.).

8.2.5.5 Maturity and natural mortality

Estimates of maturity ogives of greater silver smelt in Va were presented at the WKDEEP-2010 meeting for both age and length (WKDEEP-2010-GSS-04) using data collected in the Icelandic autumn survey (See annex for details). Males tend to on average to mature at a slightly higher age or at 6.5 compared to 5.6 for females but at a similar length as females 35.3 cm. Most of the Greater Silver Smelt caught in commercial catches in Va is mature.No information exists on natural mortality of greater silver smelt in Va.

8.2.5.6 Catch, effort and research vessel data

Catch per unit effort and effort data from the commercial fleets

At WKDEEP-2010 a glm cpue series was presented (WKDEEP-2010-GSS-05), however because of strong residual patterns the group concluded that the glm-cpue series was not suitable to use as an indicator of stock trends.

Index of 'raw' cpue and effort is presented in Figures 8.2.5 and 8.2.6. The cpue is simply the sum of all catch divided by the sum of the hours trawled. This is then divided by the proportion of Greater Silver Smelt in each haul. The traditional way has been to include all hauls that had more than 10%, 50% and 70% of Greater Silver Smelt.According to this method there has not been considerable changes in the raw-cpue in recent years (Figure 8.2.5) however the effort has increased considerably from 2007 to 2009 (Figure 8.2.6).The cpue is not considered to represent changes in stock abundance as the fishery is mostly controlled by market factors, oil prices and quota status in other species, mainly redfish.

Icelandic survey data

Indices: The Icelandic spring ground-fish survey, which has been conducted annually in March since 1985, gives trends on fishable biomass of many exploited stocks on Icelandic fishing grounds. In total, about 550 stations are taken annually at depths down to 500 meters. The survey area does not cover the most important distribution area of the greater silver smelt fishery in Va and is therefore not considered representative of stock biomass.In addition, the autumn survey was commenced in 1996 and expanded in 2000. A detailed description of the autumn ground-fish survey is given in the Stock Annex for greater silver smelt in Va. The survey is considered representative of stock biomass of greater silver smelt since it was expanded in 2000.

Greater Silver Smelt is among the most difficult demersal fish stocks to get reliable information on from bottom trawl surveys. This is in large part due to the fact that most of the Greater silver smelt caught in the survey is taken in few but relatively large hauls. This can result in very high indices with large variances particularly if the tow-station in question happens to be in a large strata with relatively few tow-stations. In an attempt to reduce variance in Winsorized-indices were presented at the WKDEEP-2010 and the Group concluded that they should be presented along with standard indices when giving advice for greater silver smelt in Va. A detailed description of index calculation and the Winsorization is given in the Stock Annex for greater silver smelt in Va.

In Figure 8.2.7 indices from the Autumn survey are presented. The Figure shows trends in total biomass, biomass at depths less than 400 meters, biomass at depths greater than 400 meters and finally a recruitment index which is the abundance of greater silver smelt less than 25 cm.

In Figure 8.2.8 winsorized length disaggregated indices are presented for the 'Total' region which is then divided by the 400 m depth contour. The main thing to note is that hardly any silver smelt smaller than 30 cm is found at depths greater than 400 m. Few Greater Silver Smelts longer than 45 cm are caught at depths above 400 m.

Spatial distribution as observed in surveys: Changes in the distribution of greater silver smelt in Va as observed from the Autumn survey are presented in Figure 8.2.9. In general there seems to be a slight increase in biomass in the northwestern part of the shelf and on the Faroe-Iceland ridge.

8.2.6 Data analyses

The information presented on greater silver smelt in Va gives a contradictory message on the state of the assessment unit. On one hand the biological information from the commercial catches shows a clear downward trend in terms of mean length and mean age. On the other hand the autumn survey gives the impression that the biomass may be increasing.

In the WGDEEP-2008 Report the possible explanations for the decrease in mean length form the catches were listed as:

- Change to a smaller mesh size in 2000;
- Changes in the depth distribution of catches;
- Overfishing of large fish.

It is unlikely that the change in mesh size in 2000 accounts for these changes as a similar shift is seen in the age distribution from the autumn survey as in the commercial catches. It should however be noted that the age data from the autumn survey in 1998 is from before the expansion of the survey, however if otoliths from comparable areas are compared between 1998 and 2007–2009 the trend is apparent. The number of comparable otoliths is however low and no firm conclusions can be drawn from the comparisons. Changes in the depth distribution are not significant enough to explain the shift; there has also been a slight shift to catch greater silver smelt in deeper waters in 2008–2009. Overfishing of large fish may therefore be the most plausible explanation however in the absence of an analytical assessment it is difficult to evaluate.

The trends in the autumn survey indicate that biomass and recruitment may be increasing. However greater silver smelt is difficult to assess in a trawl survey. The two approaches to calculate survey indices (winsorized and un-winsorized) do in all cases show the same trend except for recruitment. However the winsorized index which can be termed to be more conservative does not show a significant increase in the last two years. The un-winsorized recruitment index (Abundance <25 cm) shows a continuous upward trend whereas the winsorized index has hardly changed at all during the survey period. The reason for this is that small greater silver smelt appears to be caught in few large hauls and is therefore severely downgraded in the winsorized index.

In Figure 8.2.10 estimates of relative fishing mortality (Fproxy) are presented. It seems that the Fproxy decreased between 2000 and 2004. According to the winsorized index Fproxy has clearly increased since then but it is not as apparent when using the un-winsorized index to estimate Fproxy.

8.2.7 Comments on the assessment

At the WKDEEP-2010 an analytical assessment was attempted on greater silver smelt in Va. The model (Colraine) did not capture the trends in the data and it was therefore concluded that is was not suitable to be used as basis for Advice.

No analytical assessment was attempted at the meeting.

8.2.8 Management considerations

The status of greater silver smelt in Va is highly uncertain and the data presented could not be used to assess the stock status. The decrease in length in the commercial catches may have resulted from exploitation. Therefore the rapid expansion of the fishery in the last 2–3 years are a cause for concern and ways to stop further expansion or even reverse it should be taken.

Greater silver smelt being a deep-water slow growing species is only assumed to be able to sustain low rates of exploitation.

Table 8.2.1. Greater silver smelt in Va. Nominal landings in 1988–2009.

YEAR	LANDINGS
1988	206
1989	8
1990	112
1991	247
1992	657
1993	1255
1994	613
1995	492
1996	808
1997	3367
1998	13 387
1999	6704
2000	5657
2001	3043
2002	4960
2003	2686
2004	3637
2005	4481
2006	4775
2007	4226
2008	8778
2009	10829

Table. 8.2.2. Greater silver smelt in Va. Information on the fleet reporting catches of greater silver smelt.

Year	Number Trawlers	Number Hauls	Reported catch	No. Hauls which GSS >50% of catch	Proportion of reported catch in hauls were GSS> 50%
1996	22	298	250	32	0.42
1997	26	854	2257	397	0.854
1998	39	2587	11 132	1998	0.958
1999	24	1451	4456	858	0.877
2000	23	1263	3491	678	0.844
2001	26	767	1577	264	0.724
2002	32	1134	3127	512	0.782
2003	30	1127	1965	255	0.541
2004	27	1017	2688	345	0.707
2005	30	1368	3520	365	0.734
2006	31	1542	3725	402	0.72
2007	27	1260	3441	464	0.761
2008	31	3103	8407	865	0.665
2009	34	3410	10197	1018	0.697

Table. 8.2.3. Greater silver smelt in Va. Proportion of annual catches by month.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993	0.110	0.165	0.021	0.080	0.567	0.011	0.005	0.012	0.000	0.000	0.017	0.014
1994	0.000	0.027	0.003	0.057	0.608	0.250	0.006	0.023	0.007	0.015	0.005	0.000
1995	0.140	0.060	0.002	0.093	0.205	0.007	0.127	0.136	0.004	0.009	0.074	0.143
1996	0.154	0.054	0.081	0.119	0.045	0.016	0.004	0.000	0.115	0.049	0.188	0.175
1997	0.038	0.020	0.004	0.009	0.006	0.175	0.150	0.125	0.028	0.049	0.278	0.120
1998	0.036	0.020	0.021	0.047	0.276	0.489	0.095	0.009	0.003	0.002	0.002	0.001
1999	0.021	0.038	0.009	0.187	0.239	0.274	0.071	0.012	0.033	0.051	0.048	0.018
2000	0.079	0.059	0.031	0.055	0.155	0.263	0.066	0.014	0.056	0.073	0.109	0.041
2001	0.050	0.082	0.060	0.000	0.080	0.228	0.088	0.025	0.064	0.177	0.071	0.073
2002	0.035	0.139	0.093	0.138	0.134	0.088	0.126	0.027	0.026	0.049	0.060	0.085
2003	0.149	0.069	0.077	0.149	0.029	0.047	0.044	0.022	0.057	0.088	0.159	0.109
2004	0.113	0.166	0.116	0.243	0.011	0.014	0.017	0.028	0.070	0.113	0.083	0.026
2005	0.065	0.176	0.060	0.105	0.048	0.118	0.022	0.106	0.044	0.106	0.083	0.067
2006	0.101	0.081	0.055	0.154	0.191	0.073	0.027	0.041	0.036	0.097	0.096	0.049
2007	0.244	0.020	0.028	0.178	0.252	0.085	0.029	0.029	0.037	0.039	0.045	0.015
2008	0.042	0.049	0.063	0.069	0.057	0.047	0.067	0.117	0.083	0.227	0.119	0.060
2009	0.158	0.051	0.046	0.016	0.019	0.003	0.011	0.043	0.130	0.173	0.215	0.134

Table 8.2.4. Greater silver smelt in Va. Avaialable data for estimation of catch in numbers.

Year	No. Otoliths samples	No. Otoliths aged	No. Length samlpes	No. Length measurements	Landings (tonnes)
1986	0	0	0	0	53
1987	1	93	1	100	42
1988	0	0	0	0	206
1989	21	266	0	0	8
1990	0	0	0	0	112
1991	0	0	2	335	247
1992	0	0	0	0	657
1993	0	0	2	612	1255
1994	1	95	6	1003	613
1995	1	91	2	330	492
1996	0	0	0	0	808
1997	19	985	45	4863	3367
1998	24	890	141	14 911	13 387
1999	2	82	58	4163	6704
2000	0	0	27	2967	5657
2001	1	17	10	489	3043
2002	4	127	20	2220	4960
2003	0	0	63	5095	2686
2004	3	84	34	996	3637
2005	0	0	49	3708	4481
2006	10	465	29	4186	4775
2007	8	272	14	2158	4226
2008	31	1387	37	3378	8778
2009	36	1773	69	5236	10 829

Table 8.2.5. Greater silver smelt in Va. Catch in numbers (in millions). Estimates for 2009 are preliminary.

Year	4	5	6	7	8	9	10	11	12	13	14
1997	0	0	0	0.04	0.04	0.08	0.13	0.27	0.4	0.36	0.46
1998	0.11	0.07	0.48	0.22	0.32	0.23	0.51	0.45	0.94	1.98	1.29
2006	0.22	0.55	0.89	1.35	1.35	1.76	1.16	0.92	0.6	0.22	0.39
2007	0.25	0.22	0.92	0.63	1.25	1.26	1.56	1.25	0.74	0.26	0.16
2008	0.12	0.86	1.45	2.44	3.71	3.5	2.96	2.13	1.25	0.64	0.39
2009	*0.67*	*1.15*	*1.43*	*2.79*	*4.18*	*2.87*	*3.31*	*2.78*	*1.83*	*1.13*	*0.37*

Year	15	16	17	18	19	20	21	22	23	24	25
1997	0.41	0.38	0.54	0.5	0.35	0.33	0.18	0.07	0.06	0.06	0.02
1998	2.54	2.07	2.03	1.78	1.69	1.03	0.86	0.84	0.41	0.12	0
2006	0.12	0.22	0.18	0.06	0.05	0.12	0.05	0.05	0.02	0	0
2007	0.12	0.2	0.12	0.16	0.14	0.03	0.03	0	0	0	0
2008	0.34	0.21	0.12	0.18	0.15	0.21	0.11	0.05	0.04	0.05	0
2009	*0.24*	*0.38*	*0.3*	*0.2*	*0.21*	*0.09*	*0*	*0.03*	*0*	*0*	*0*

Table 8.2.6. Greater silver smelt in Va. Mean weight-at-age (g) from commercial catches. Estimates for 2009 are preliminary.

Year	4	5	6	7	8	9	10	11	12	13	14
1997	201	259	259	321	438	450	494	516	539	568	625
1998	104	197	256	292	356	406	458	515	516	561	567
2006	280	303	344	378	411	437	474	543	529	575	689
2007	220	266	345	384	418	432	442	478	531	528	543
2008	151	233	296	331	361	407	445	471	506	545	617
2009	*179*	*264*	*340*	*367*	*392*	*441*	*480*	*504*	*555*	*569*	*637*

Year	15	16	17	18	19	20	21	22	23	24	25
1997	692	765	806	846	829	891	853	985	1070	910	1011
1998	617	688	717	768	831	833	848	1022	977	973	
2006	740	806	727	778	683	818	683	683	539		
2007	637	670	787	699	734	922	838				
2008	600	682	766	773	699	764	706	588	720	674	
2009	*733*	*732*	*737*	*849*	*787*	*770*		*834*			

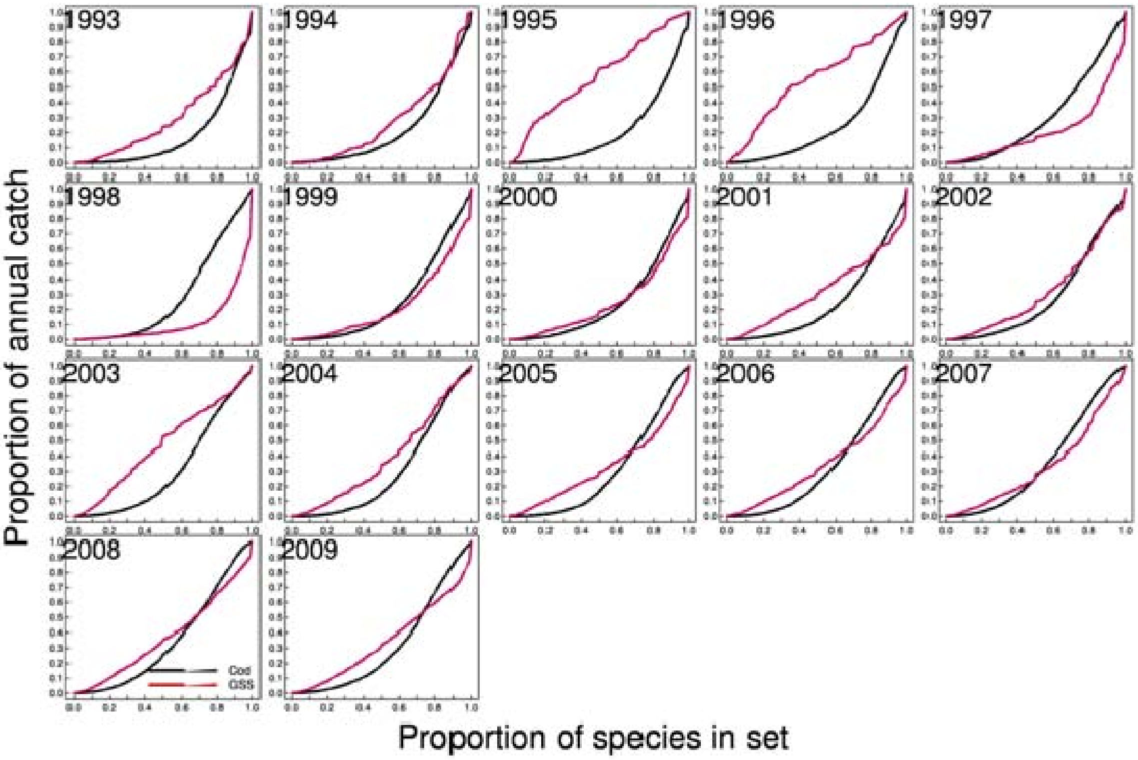


Figure 8.2.1.Greater silver smelt in Va. Plot of the fishery (red line) in 1993–2009 and for comparison the cod longline fishery. The plot is best explained by an example. In 2005 only 20% of the annual longline catch of cod was caught were it was less than 50% of the catch in the haul/set. So the longline fishery of cod can be considered a directed fishery.

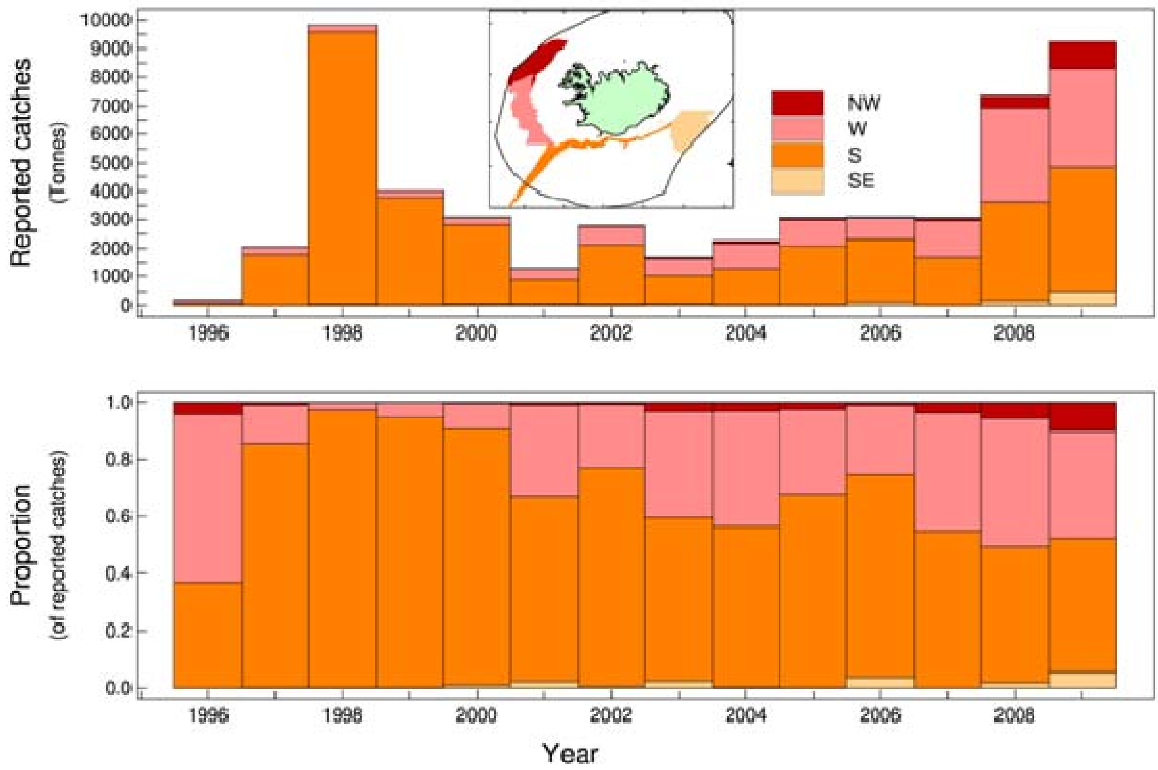


Figure 8.2.2. Greater silver smelt in Va. Catches defined by survey regions (See Stock Annex for details) by year. Above are the catches on absolute scale and below is in proportions.

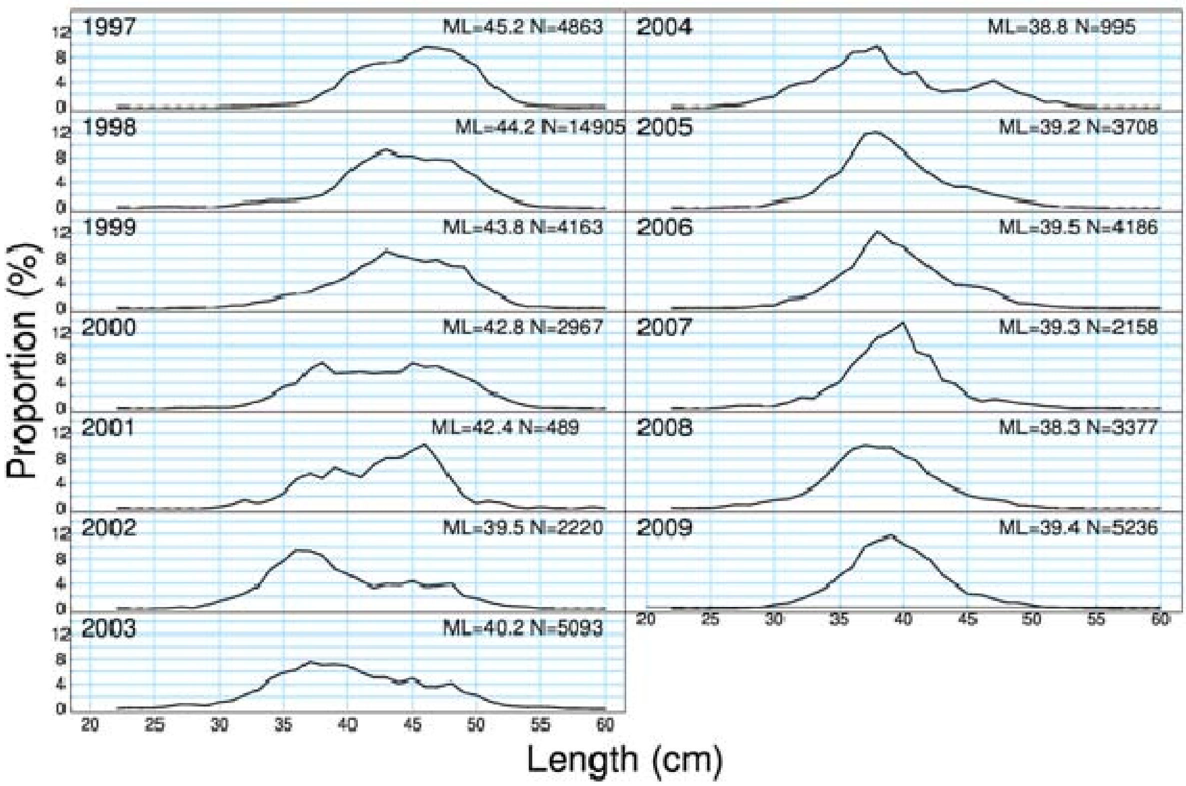


Figure 8.2.3. Greater silver smelt in Va. Length distributions from commercial catches.

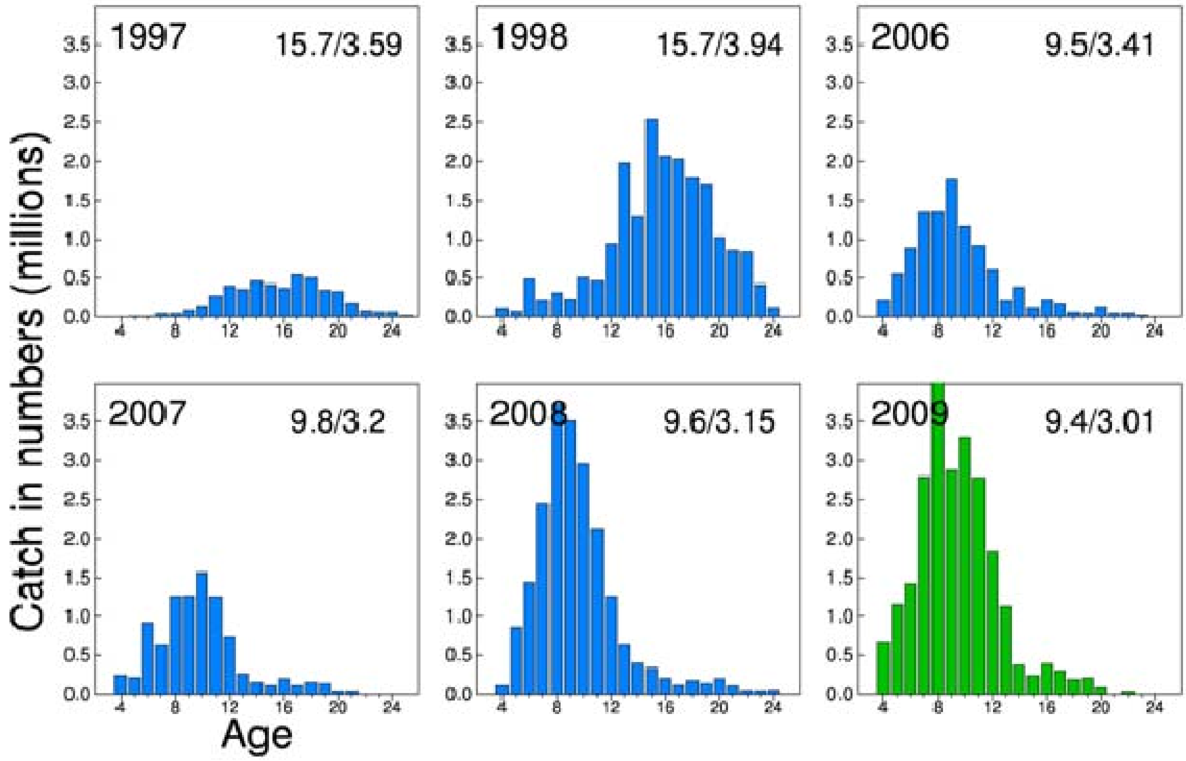


Figure 8.2.4. Greater silver smelt in Va.Catch in numbers, preliminary estimates for 2009.

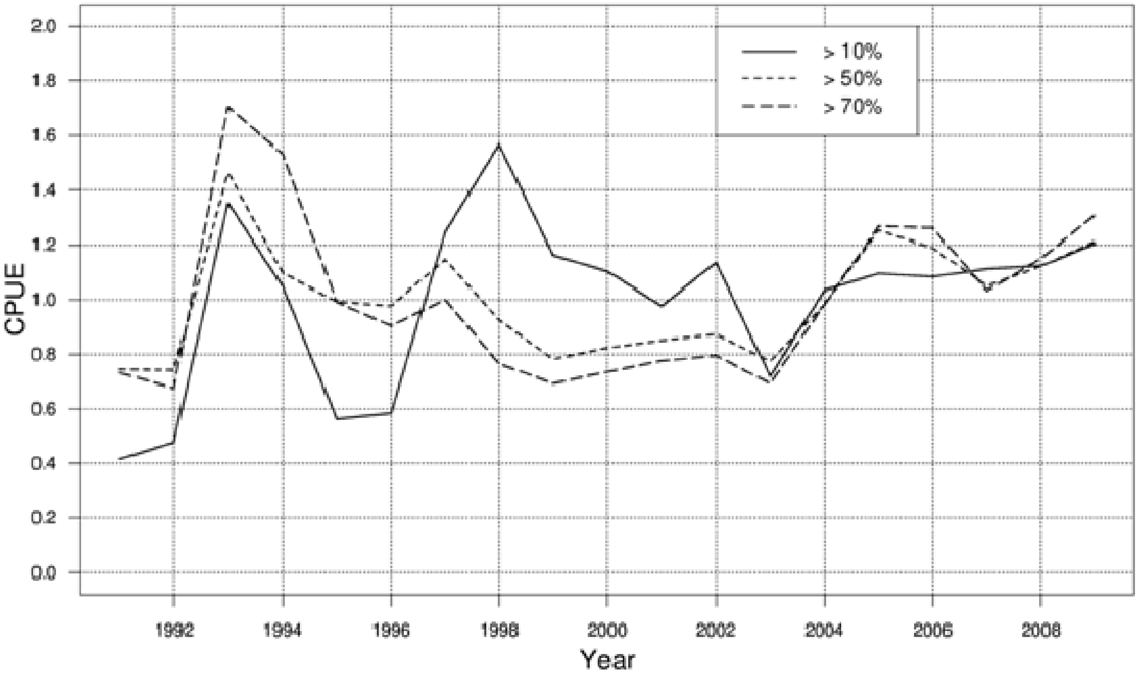


Figure 8.2.5. Greater silver smelt in Va.Index of raw cpue (sum(Yield)/sum(effort)) from the Icelandic bottom-trawl fishery in 1991–2009. The criteria for calculations were hauls where greater silver smelt composed at least 10%, 50% and 70% of the total catch.

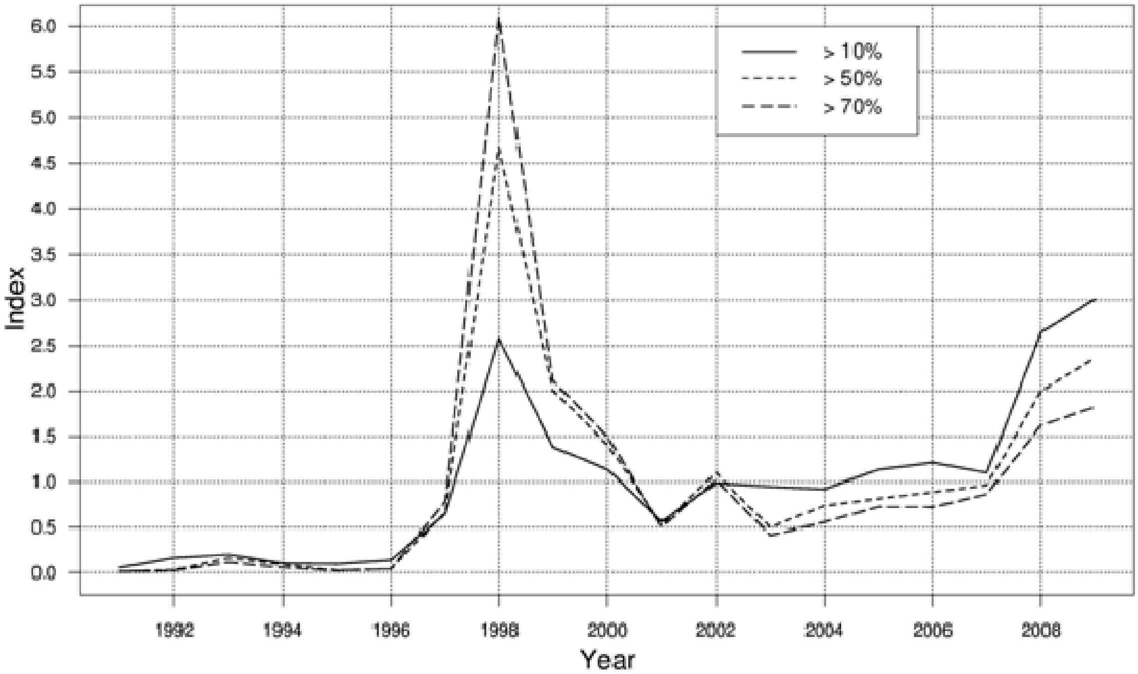


Figure 8.2.6. Greater silver smelt in Va.Index of fishing effort from the Icelandic bottom-trawl fishery in 1991–2009. The criteria for calculations were hauls where greater silver smelt composed at least 10%, 50% and 70% of the total catch.

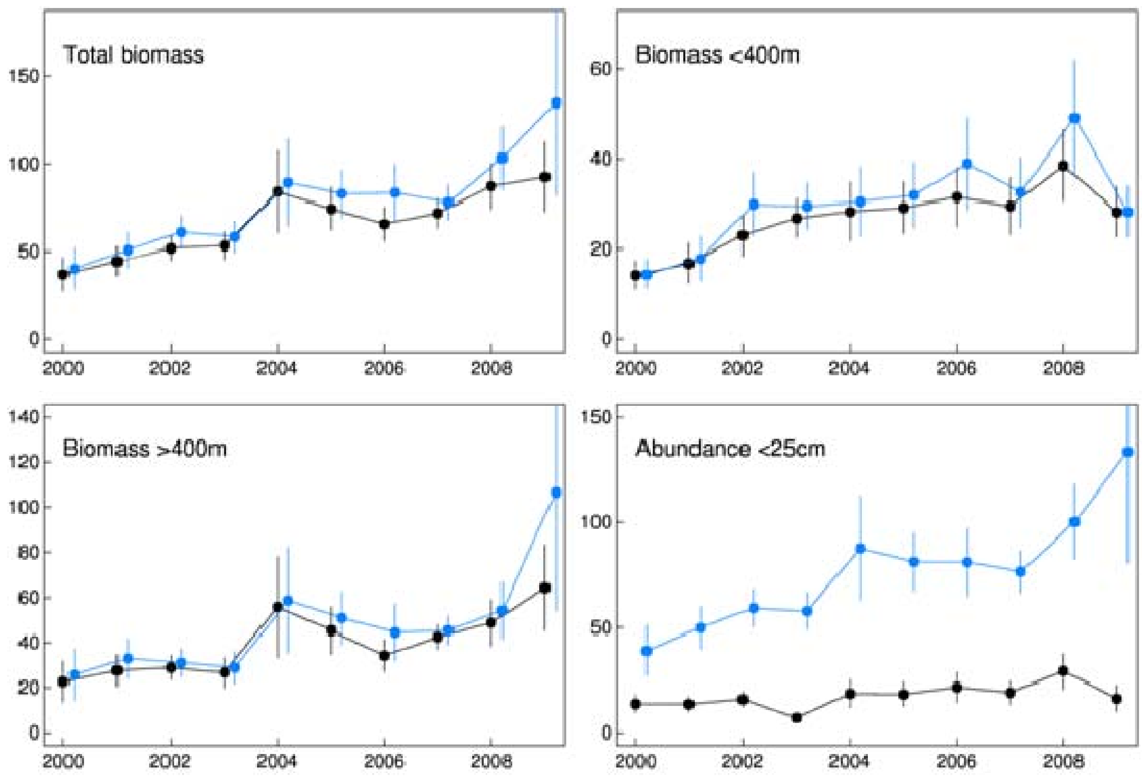


Figure 8.2.7. Greater silver smelt in Va. Indices from the autumn survey. Black lines are winsorized indices and blue un-winsorized indices. Vertical lines represent +/- 1 standard error.

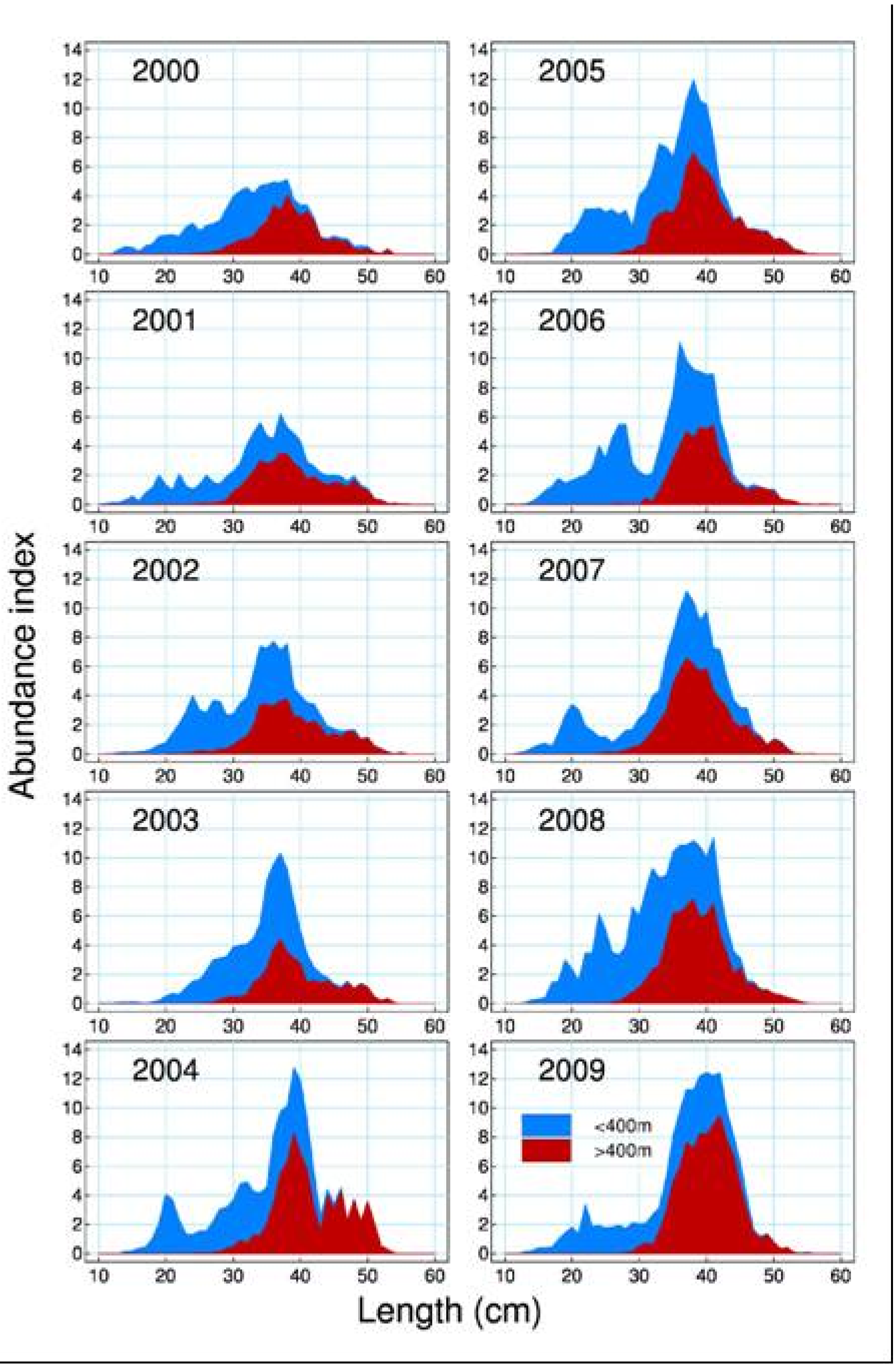


Figure 8.2.8. Greate silver smelt in Va. Winsorized length disaggregated indices from the autumn survey divided by the 400 m depth contour. Total abundance index is the sum of both red and blue curves.

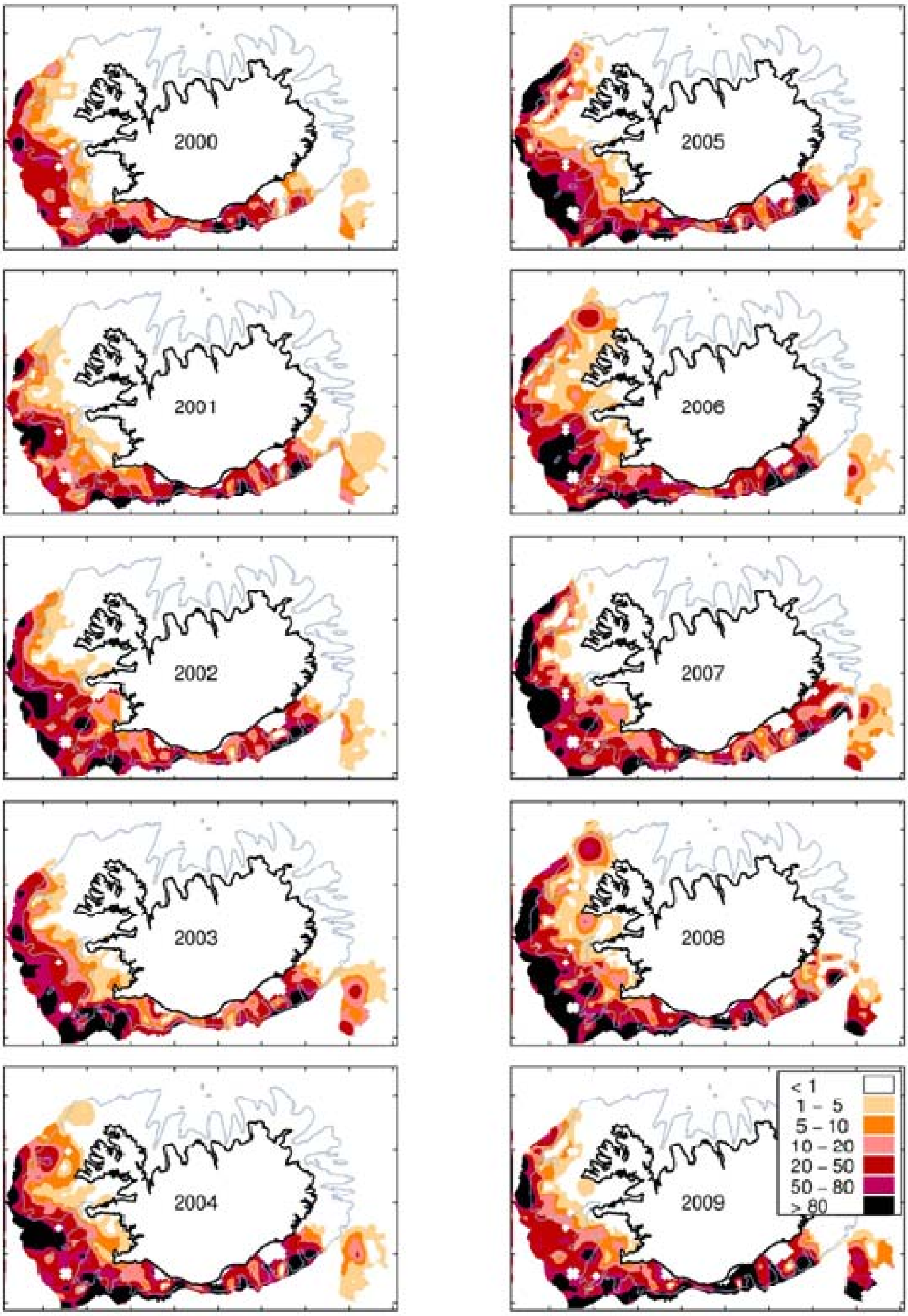


Figure 8.2.9. Greater silver smelt in Va. Contour plot of the stock distribution in Va as observed from the autumn survey (kg per standardized haul) in 2000–2009. The 500 m depth contour is shown as a blue line.

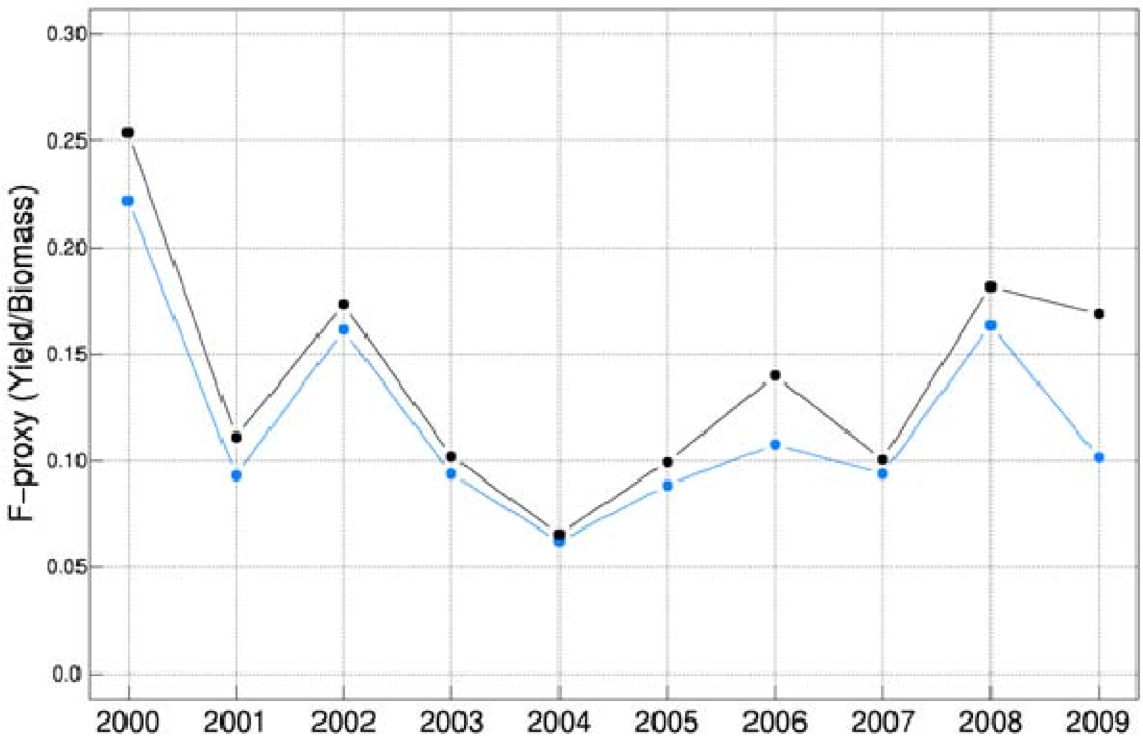


Figure 8.2.10. Greater silver smelt in Va. Estimates of trends in relative fishing mortality (Yield / Survey biomass). Black lines are when using the winsorized index on biomass estimates at depths greater than 400 m and blue lines are when using the un-winsorized index.

8.3 Greater Silver Smelt (*Argentina Silus*) in I, II, IIIa, IV, Vb, VI, VII, VIII, IX, X, XII, XIV

8.3.1 The fishery

Significant fisheries occur in Subareas I to VII; other areas have only minor bycatch of this species.

The present targeted fisheries for greater silver smelt are conducted with pelagic trawl operated very close to or at the seabed and depend on localization of aggregations.

In Subarea I and II the fishery for greater silver smelt is primarily prosecuted by licensed Norwegian trawlers that have this species as target. They operate specialised greater silver smelt "pelagic" trawls at the seabed (Hallfredsson and Svellingen, WD11, 2009). In 2004 an apparently exceptional Dutch fishery occurred. In recent years this fishery has normally ceased in late April as a result of rapidly declining catch rates (Bergstad *et al*., WD7, 2008). This is a notable change, as April–May was regarded the best months in Subarea II in the early 1980s.

In the Skagerrak IIIa, the greater silver smelt has periodically been targeted by Norwegian, Danish and Swedish bottom trawlers. During the last 10 years it is primarily a few Danish vessels that have conducted targeted fisheries for roundnose grenadier and greater silver smelt. However, there is also a bycatch in the Norwegian and Danish small-mesh bottom-trawl fisheries along the Norwegian Deep (primarily in IVa) that land the catch for reduction.

In the Faroes (Division Vb) especially two pairs of pairtrawlers have had a direct fishery for greater silver smelt, from early summer to autumn, for several years. In 2007 one more pair of trawlers was licensed. There is a minor bycatch of greater silver smelt in the fishery for blue whiting by pelagic trawlers in the Faroese fishing zone (Vb and VIa).

8.3.2 Landings trends

Table 8.3.1.1 lists the landings data for greater silver smelt (or argentine) *Argentina silus* by ICES Subareas/Divisions *Argentina sphyraena* may in some cases have been included in the landing figures (particularly in Subareas III and IV). This is because juveniles of the dominant species *Argentina silus* and the much smaller and less abundant *Argeninta sphyraena* may be difficult to separate in catches. Confusion arises because fleets tend to report all small specimens as *A. sphyraena* and big specimens as A. *silus*, and/or use the different names interchangeably depending on regional variations in vernacular names. Bergstad *et al*., WD7, 2008 reported that not a single specimen of *A. sphyraena* was caught in a survey on greater silver smelt in Subarea II, III and IV in 2007, and concluded, that the amount of lesser silver smelt would be insignificant in this area.

Landings since 1988 are mainly from the Areas I–VII. There are presently three main areas where directed fisheries are conducted, around Iceland (Va), around Faroese (Vb) and west of mid-Norway (IIa).

Landings by Norway from Subareas I and II declined in the 1990s from peak levels of 10 000 to 11 000 t in the 1980s. Landings were stable at 6–8000 tonnes until 2003 but do reach high levels some years (e.g. 14 357 tonnes in 2001). In 2004 to 2006 landings increased gradually to reach 21 700 tonnes in 2006. It is thought that these fluctuations reflect variation in the market demands rather than changes in abundance of *A.*

silus. In 2007–2009 the Norwegian catches have declined to around 12 000 tonnes per year in accordance to regulations.

Landings in Subareas III and IV varied between 1000 and almost 4500 t. The Danish quota (part of EU TAC) for 2003 onwards was 1388 t, and the annual landings are below this level. As a consequence of the introduction of the sorting grid to the shrimp fishery the bycatch of fish is very low in the Danish, Norwegian and Swedish fishery for *Pandalus borealis*. The Norwegian bycatch in the industrial fishery for Norway pout and blue whiting, based on sampling at fishmeal factories, is very variable but rarely exceed 10% of the total landings (Figure 8.1.2.1). The annual estimated quantities of both greater and lesser silver smelt in 2002–2005, 2007–2009 are 926, 376, 786, 1348, 2172, 868 and 377 tonnes. The Norwegian landings in Subarea IV in the same period were less than 20 tonnes, but increased and peaked in 2006 to 3500 tonnes and then declined to 1566 tonnes in 2009.

The landings of *A. silus* in Divisions Vb increased considerably from 1994–1998 as a direct fishery for the species started. After 1998 when 18 000 tonnes were landed, the landings were 6500 tonnes on average in 1999–2005. In 2006–2009 the landings increased to 12 500, 14 100, 14 600 and 14 200 tonnes respectively. The variations in the catches are largely as a consequence of market demands, and that a third pair of trawlers got licensed in 2007. Greater silver smelt is also taken as bycatch in the blue whiting fishery and in the deep-water fishery for e.g. red fish and blue ling. These bycatches are not recorded in the landings.

There has been a considerable decline in the landings of *A. silus* from Subareas VI and VII from a peak in the late 1980s to the mid 1990s, with the exception of the years 2000–2002, when the landings were between 14 000 and 19 000 tonnes. The landings have been restricted by TACs in this area. A main fleet producing catches of greater silver smelt is Dutch freezer trawlers operating in Vb, VI and VII, west and northwest of the Hebrides, from depths ranging from 600–700 m, and west of Ireland (Porcupine Bank) where smelt is a minor bycatch in the fishery directed at blue whiting (*Micromesistius poutassou*). The Dutch fleet apparently also operated in IIa in 2004. In 2004 the landings significantly exceeded the TAC for the Netherlands for Vb and VI.

Irish landings were very high in the late 1980s when an exploratory fishery was developed by large pelagic trawlers. However by the early 1990s landings had declined to a few hundred tonnes and directed fishing had ceased by 1993. There was some directed fishing for the species in subsequent years. In 2000 larger Irish pelagic trawlers began to direct effort at this species on the shelf edge of Subarea VIa. Landings reached over 4700 t in 2000 and were estimated at around 7500 t in 2001 and 2002. Figures for 2003 showed a very low landing of only 95 t. Because of a restrictive quota there was no Irish directed fishery for greater silver smelt. The landings by Scottish vessels also increased in 2000–2002 and between 65 and 75% of these landings were outside the UK. The Scottish landings also dropped abruptly to a very low level in 2003. In some of the years where landings are very high, there is possibly some misreporting but no documentation of quantities is available.

The Russian bycatch statistic of greater silver smelt in the commercial blue whiting fishery in Division Vb demonstrates considerable catch decline during recent years.

8.3.3 ICES Advice

As a consequence of its low productivity greater silver smelt can only sustain low rates of exploitation. Fisheries on such species should always be accompanied by programmes to collect data on both target and bycatch fish. The fishery should not be allowed to expand unless it can be demonstrated that it is sustainable.

8.3.4 Management

For a period after 1983 a precautionary unilateral annual TAC applied in IIa, but the landings never exceeded the quota and this regulation was abandoned in 1992. In 2007 a 12 000 tonnes TAC was introduced as a precautionary measure to reduce an increase in the fishery. This TAC has been the same for the years 2007–2009. In addition there is a licensing system that regulates number of trawlers that can take part in the aimed fishery, equipment restriction and an area- and time restriction. Bycatch of greater silver smelt in other fisheries is now regulated in the Norwegian EEZ not to exceed 10% in total catches and in individual catches.

There is no species-specific management of greater silver smelt in Vb, only minimum landing size (28 cm) and a licensing system. At present licenses are issued to three pairs of pairtrawlers.

The EU introduced TAC management in 2003, and for each year quotas were set for greater silver smelt. EU TACs as valid for community vessels fishing in community waters and waters not under the sovereignty or jurisdiction of third countries are in the Table below.

	2003/2004	2005	2006	2007	2008	2009	2010
Subarea III, IV	1566	1331	1331	1331	1331	1331	1278
Subarea V,VI, VII	6247*	5310	5310	5310	5311	5311	5099
Subarea I, II						116	111

8.3.5 Data available

8.3.5.1 Landings and discards

Argentina silus can be a very significant discard of the trawl fisheries of the continental slope of Subareas VI and VII particularly at depths 300–700 m (e.g. Girard and Biseau, WD 2004). No new information was provided.

8.3.5.2 Length compositions

Length distributions in samples taken from the Norwegian fisheries in IIa in 2009 (Figure 8.1.5.2.1) do not show profound changes compared to resent years (Hallfredsson, 2010 WD, WGDEEP 2010). Length distributions from a Norwegian survey in 2008 on greater silver smelt and from surveys targeting Greenland halibut 2003–2005 and beaked redfish 2008 in Subarea IIa were presented in WGDEEP Report 2009. (Hallfredsson and Svellingen, WD11, 2009).

The average length in Faroese commercial catches has decreased since 1994–2000 but seem to have stabilized since then (Figure 8.1.6.2) (Ofstad, WKDEEP 2010 WD: GSS-08). This is probably a natural reaction as a consequence of new fishery. Length distributions for two Faroese surveys in Vb (1994 onwards) showed no obvious trend (Ofstad, WKDEEP 2010 WD: GSS-08). The bathymetric distribution of greater silver smelt from Faroese surveys is clearly size-related with larger individuals dominating in the deeper areas, as was the case for on Porcupine bank survey data (WGDEEP Report 2009).

8.3.5.3 Age compositions

No new data on age distributions were presented to the Working Group.

The WGDEEP report 2009 presented age distributions on greater silver smelt from landings in Faroese area Vb and from Norwegian survey data in subarea IIa. Both showed a decline in average age since the early 1990s and 1980s respectively.

8.3.5.4 Weight-at-age

No new data.

8.3.5.5 Maturity and natural mortality

No new data on maturity and natural mortality were presented.

During the WKDEEP 2010 meeting, new data and analyses were presented on growth curves (age, length data), maturity ogives (age at first maturity, gonad stage), and distribution and timing of spawning from Iceland, Faroe Islands and Norway. These can be found in Ofstad, ICES-WKDEEP 2010, WD: GSS-07, Thordarson, ICES-WKDEEP-2010-GSS-04 and Hallfredsson, ICES-WKDEEP-2010-WD-GSS-07). Differences in growth and maturity curves between the main fishing grounds were regarded by the WKDEEP as indicating there could be differences in the growth rates and maturity of greater silver smelt between regions, but was not necessarily suggestive of different stocks. Nevertheless, it was also noted that differences in growth and maturity were potentially important considerations for stock assessment and fisheries management. They imply that the response of the species may differ between fisheries (e.g. greater silver smelt are faster growing off Iceland than in Norwegian waters), and this would be reflected in potentially different parameters of productivity in fisheries models (ICES WKDEEP, 2010 Report).

Earlier data from area Vb on average length-at-age have demonstrated that females grow more quikly than males from the age of about seven years onwards (Ofstad and í Homrum, WD14, 2009; Vinnichenko, WD9, 2007). In Division Vb the 50% maturity in greater silver smelt was reached at lengths of 33 cm and 35 cm for females and males, respectively. This corresponds to an age approximately six years for females and eight years for males. In weight it corresponded to 290 g for females and 340 g for males.

8.3.5.6 Catch, effort and research vessel data

Logbook catch and corresponding effort data for the Danish fleet in Division IIIa are available for the period 1992–2006 as demonstrated in the WGDEEP Report 2008. The Danish fisheries are reduced and insignificant in 2008 and 2009.

Cpue indices for greater silver smelt from two Faroese groundfish surveys for cod, haddock and saithe in Vb and distribution on the Faroe plateau are shown in Figure 8.1.6.1. (Ofstad, WKDEEP, 2010 WD: GSS-08).

Logbooks from three pairs of pairtrawlers (>1000 HP) fishing greater silver smelt in Faroese waters (Area Vb) are available (Ofstad and í Homrum, 2009, WD14).

Logbook data reveals that greater silver smelt is fished mostly in the area west of the Faroes and on the continental slope north and northwest of the Faroe Bank, at depths around 300–700 meters. To some extent, there is also being trawled on the Bill Bailey Bank and Lousy Bank and north of the Faroes (WGDEEP Report 2009)

Spanish research bottom-trawl surveys have been carried out in Subarea VII (Porcupine) since 2001. The catch rate and geographical distribution is shown in the WGDEEP Report 2009.

In April 2008 research survey was conducted in Norwegian waters with the intention to investigate acoustical target strength (TS) for greater silver smelt using an acoustical probe (Hallfredsson and Svellingen, WD11, 2009). On seven out of nine stations with the TS-probe, target strength estimations were achieved. The estimated mean TS varied from 35.8–39.5 dB and the estimated values of the B_{20} coefficient varied from 66.1 to 69.3. The results are in accordance to earlier findings and the preliminary recommended TS to length relation equation for greater silver smelt is TS=20logL+68.

Acoustic survey was conducted by IMR in 2009 with redfish and greater silver smelt as focus species. Highest registrations of greater silver smelt ware found at the slope north from 70°N (Figure 8.1.5.6.1) (Hallfredsson, 2010 WD, ICES WGDEEP 2010; Harbitz, WD, ICES WKDEEP 2010).

8.3.6 Data analyses

The assessment was conducted according to the Stock Annex.

The Faroese summer survey biomass index showed no strong trend between 1996 and 2008 (Figure 8.1.6.1). Length distributions form this area have not changed significantly over this period (Figure 8.1.6.2). In Subarea VII, Spanish bottom trawl survey biomass index shows a consistent decline from 2003 to 2008 (Figure 8.1.6.3). This decline has continued despite decreasing catches. The same size classes occurred in the length distribution across this period (Figure 8.1.6.4).

This indicates that there has been no change in the size of the stock in Subarea Vb but a decline in Subarea VII. It is not possible to assess the state of the stock relative to precautionary of MSY reference points.

Acoustic abundance estimates for greater silver smelt in Division IIa from Norwegian surveys in 1989–1992, 2007 and 2009 results do not indicate a decline in abundance in 2009 compared with earlier years (Hallfredsson, ICES WGDEEP 2010, WD; Harbitz, ICES WKDEEP 2010, WD).

The current ICES structure for greater silver smelt is that ICES Subareas I, II, IV, VI, VII, VIII, IX, X, XII and XIV and Divisions IIIa and Vb, are treated as one assessment unit. This unit was benchmarked in WKDEEP 2010 and the data available were not considered sufficient to recommend changes in assessment units. Only the greater silver smelt around Iceland (Division Va) is treated as a local assessment unit. Thus it is still of vital importance for the assessment of greater silver smelt to conduct research on stock structure in accordance to recommendations given by the WKDEEP 2010 meeting.

An exploratory assessment has earlier been trialled for Division Vb (WGDEEP Report 2009). The exercise carried out then was simply to trial an age based method (XSA) on what is a long lived bentho-pelagic species.

8.3.7 Comments on the assessment

The assessment was carried out according to the methodology described in the Stock Annex.

8.3.8 Management considerations

In 2002 the WG expressed concern about the apparent increase in the directed fishery in several subareas and especially the increased landings in Subarea VI. It was noted that the age range had been truncated which suggested high levels of exploitation. No new data could be used to determine if that trend had continued. Following years of very high landings, the reported landings dropped considerably in 2003, actually below the quota set for those areas. The Irish fleet discontinued target fisheries due to the restricted quota. Other fleets continued to pursue the fishery.

In 2003 quota management was introduced in EU waters. The total landing by EU vessels from Subareas V, VI and VII in 2004 was 6770 tonnes, somewhat exceeding the TAC of 6247 t. In addition, a very exceptional 4600 tonnes was taken by EU-vessels in IIa where no TAC applied. The Group was unable to determine if this was misreporting or landings produced by a fishery in the Norwegian EEZ not restricted by the EU TAC or Norwegian regulations. In 2005 there was only a very minor EU landing from IIa. From 2005 onwards the TAC in Subareas V, VI and VII is 5310 tonnes. The landings of EU-vessels have not exceeded the TAC.

A licensing scheme has been in place for several years in Norway and the Faroes. From 2007 there has been set a 12 000 tonnes Norwegian TAC as a precautionary measure to reduce the increase in the fishery in Subarea IIa. Bycatch of greater silver smelt in other fisheries is now regulated in the Norwegian EEZ not to exceed 10% in total catches and in individual catches. EU vessels are allowed to catch 111 tonnes in Area I and II.

Greater silver smelt can only sustain low rates of exploitation. Fisheries on such species should be permitted only when they are accompanied by programmes to collect data on both target and bycatch fish.

Table 8.3.1.1. Greater Silver Smelt I, II, IIIa, IV, Vb, VI, VII, VIII, IX, X, XII, XIV. WG estimates of landings in tonnes. *) landings in 2009 are preliminary.

Greater silver smelt (*Argentina silus*) I and II

Year	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	TOTAL
1988			11 332	5	14				**11 351**
1989			8367		23				**8390**
1990		5	9115						**9120**
1991			7741						**7741**
1992			8234						**8234**
1993			7913						**7913**
1994			6217			590			**6807**
1995	357		6418						**6775**
1996			6604						**6604**
1997			4463						**4463**
1998	40		8221						**8261**
1999			7145			18			**7163**
2000		3	6075		195	18	2		**6293**
2001			14 357		7	5			**14 369**
2002			7405			2			**7407**
2003		555	8345		7	2	4	4	**8917**
2004		4601	11 557		4				**16 162**
2005			17 063		16			14	**17 093**
2006			21 681		4				**21 685**
2007			13 272		1				**13 273**
2008			11 876						**11 876**
2009*			11 929						**11 929**

Greater silver smelt (*Argentina silus*) III and IV

YEAR	DENMARK	FAROES	FRANCE	GERMANY	NETHERLANDS	NORWAY	SCOTLAND	SWEDEN	IRELAND	TOTAL
1988	1062			1		1655				**2718**
1989	1322				335	2128	1			**3786**
1990	737			13		1571				**2321**
1991	1421		1		3	1123	6			**2554**
1992	4449			1	70	698	101			**5319**
1993	2347				298	568	56			**3269**
1994	1480					4	24			**1508**
1995	1061					1	20			**1082**
1996	2695	370				213	22			**3300**
1997	1332			1		704	19	542		**2598**
1998	2716			128	277	434		427		**3982**
1999	3772		82		7	5	452		2	**4320**
2000	1806		270			32	78	273	12	**2471**
2001	1653		28			3	227	1011	3	**2925**
2002	1161					1	161	484	4	**1811**
2003	1119				42	6	20		1	**1188**
2004	1036			4	42	17	12		46	**1157**
2005	733			1	28	11			18	**791**
2006	548					3468				**4016**
2007	243					3100				**3343**
2008	23	58				1548				**1629**
2009*	6					1566				**1572**

Table 8.3.1.1 (continued).

Greater silver smelt (*Argentina silus*) Vb

Year	Faroes	Russia/USSR	UK (Scot)	UK(EWN)	Ireland	France	Netherlands	Norway	TOTAL
1988	287								**287**
1989	111	116							**227**
1990	2885	3							**2888**
1991	59		1						**60**
1992	1439	4							**1443**
1993	1063								**1063**
1994	960								**960**
1995	5534	6752							**12 286**
1996	9495		3						**9498**
1997	8433								**8433**
1998	17 570								**17 570**
1999	8186		15	23		5			**8214**
2000	3713	1185	247			64			**5209**
2001	9572	414	94		1				**10 081**
2002	7058	264	144				5		**7471**
2003	6261	245	1				42		**6549**
2004	3441	702	42				2266		**6451**
2005	6939	59					11		**7009**
2006	12 524	35							**12 559**
2007	14 085	8						32	**14 093**
2008	14 930	19						3	**14 595**
2009*	14 200	28							**14 228**

Greater silver smelt (*Argentina silus*) VI and VII

YEAR	FAROES	FRANCE	GERMANY	IRELAND	NETHERLANDS	NORWAY	E&W	SCOTLAND	N.I.	RUSSIA	SPAIN	TOTAL
1988				5454		4984						**10 438**
1989	188			6103	3715	12184	198	3171				**25 559**
1990	689		37	585	5871			112				**7294**
1991		7		453	4723			10	4			**5197**
1992		1		320	5118			467				**5906**
1993					1168			409				**1577**
1994			43	150	4137			1377				**5707**
1995	1597		357	6	4136			146				**6242**
1996			1394	295	3953			221				**5863**
1997			1496	1089	4695			20				**7300**
1998			463	405	4687							**5555**
1999		21	24	394	8025			387		5		**8856**
2000		17	482	4703	3636			4965		29	34	**13 866**
2001		12	189	7494	3659			7620		76		**19 050**
2002			150	7589	4020			4197		29		**15 985**
2003			164	95	1933			89		163	7	**2451**
2004		147	652	46	3731			526		12	19	**5133**
2005	103	10	131	1	3465			75		4	19	**3808**
2006	53				1062							**1115**
2007	254				3866	3						**4122**
2008	991				3040	3				1		**4035**
2009*				0.5	1797	83		7		36		**1923**

Table 8.3.1.1 (continued).

Greater silver smelt (*Argentina silus*) VIII

YEAR	NETHERLANDS	TOTAL
2002	191	**191**
2003	37	**37**
2004	23	**23**
2005	202	**202**
2006		
2007		
2008		
2009*		

Greater silver smelt (*Argentina silus*) XII

Year	Faroes	Iceland	Russia	Netherlands	TOTAL
1988					
1989					
1990					
1991					
1992					
1993	6				**6**
1994					
1995					
1996	1				**1**
1997					
1998					
1999					
2000		2			**2**
2001					
2002					
2003					
2004			4		**4**
2005				322	**322**
2006					
2007					
2008					
2009*					

Table 8.3.1.1 (continued).

Greater silver smelt (*Argentina silus*) XIV

YEAR	NORWAY	ICELAND	TOTAL
1988			
1989			
1990	6		**6**
1991			
1992			
1993			
1994			
1995			
1996			
1997			
1998			
1999			
2000		217	**217**
2001	66		**66**
2002			
2003			
2004			
2005			
2007			
2008			
2009*			

Greater silver smelt (*Argentina silus*) (all areas)

YEAR	I + II	III + IV	VB	VI + VII	VIII	IX	XII	XIV	TOTAL
1988	11 351	2718	287	10 438					**24 794**
1989	8390	3786	227	25 559					**37 962**
1990	9120	2321	2888	7294				6	**21 629**
1991	7741	2554	60	5197					**15 552**
1992	8234	5319	1443	5906					**20 902**
1993	7913	3269	1063	1577			6		**13 828**
1994	6807	1508	960	5707					**14 982**
1995	6775	1082	12 286	6242					**26 385**
1996	6604	3300	9498	5863			1		**25 266**
1997	4463	2598	8433	7300					**22 794**
1998	8261	3982	17 570	5555					**35 368**
1999	7163	4320	8214	8856			2		**28 555**
2000	6293	2471	5209	13 866				217	**28 056**
2001	14 369	2925	10 081	19 050				66	**46 491**
2002	7407	1811	7471	15 985	191				**32 865**
2003	8917	1188	6549	2451	37				**19 142**
2004	16 162	1157	6451	5133	23		4		**28 930**
2005	17 093	791	7009	3808	202		322		**29 225**
2006	21 685	4016	12 559	1115	0		0		**39 375**
2007	13 273	3343	14 093	4122					**34 832**
2008	11 876	1629	14 595	4035	10	0.5			**32 500**
2009*	11 929	1572	14 228	1923		1.9			**27 857**

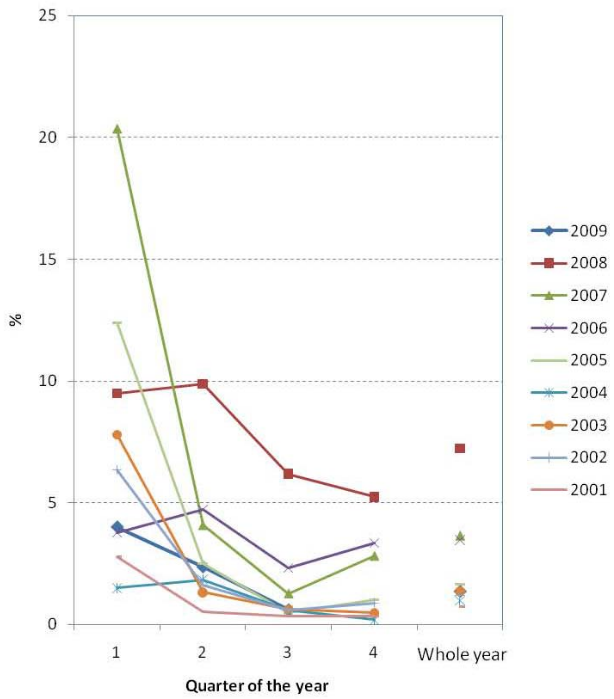


Figure 8.1.2.1. Percent of weight of greater silver smelt in total catch in Norwegian industrial trawling for Norway pout and blue whiting 2001–2009 (data from sampling at fishmeal factories in Norway) (Hallfredsson, 2010, ICES WGDEEP 2010, WD).

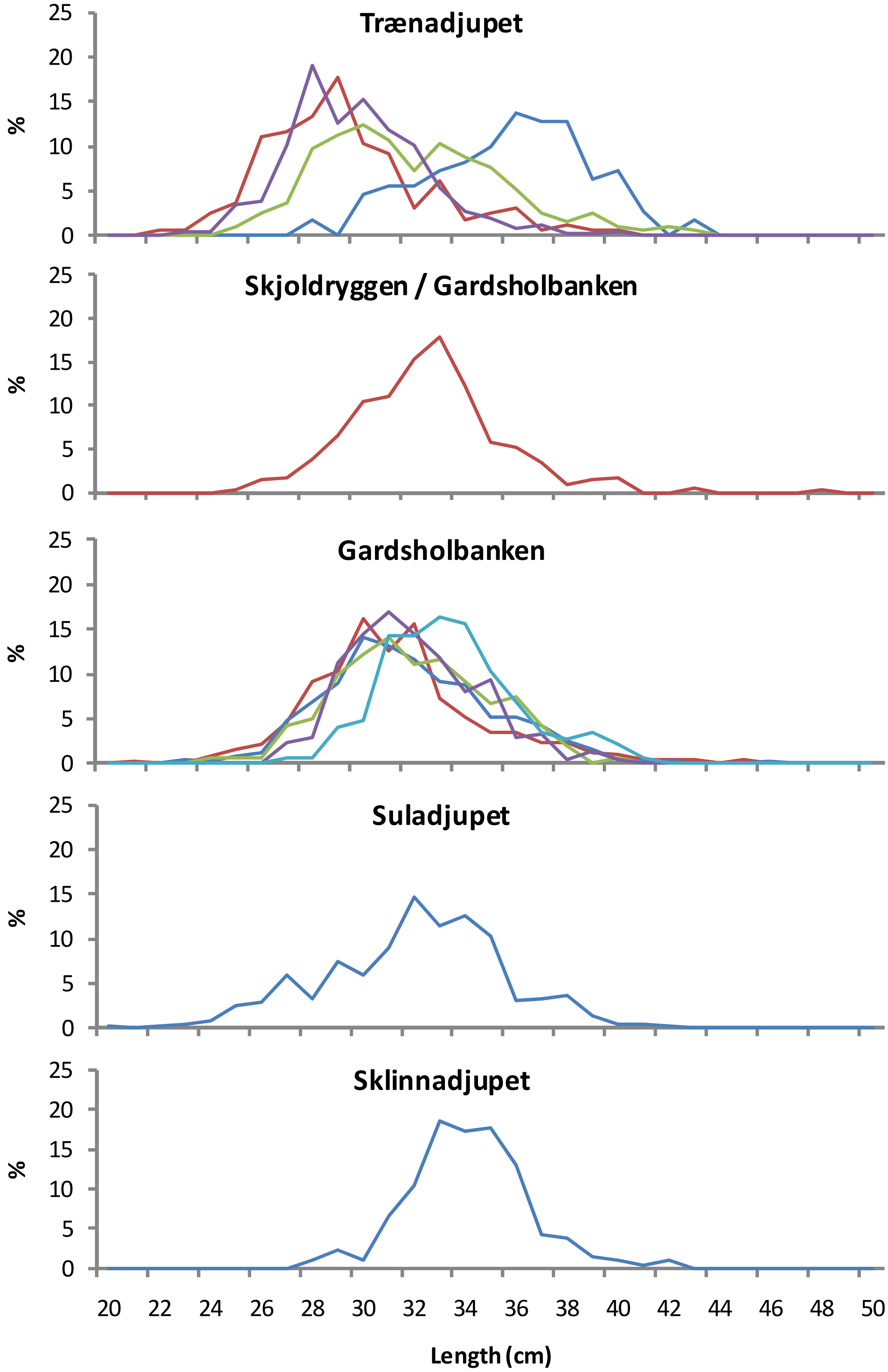


Figure 8.1.5.2.1. Length distributions per sample in Norwegian fisheries in Area IIa in 2009, sorted by fishing grounds within the main area for the direct fisheries (Hallfredsson, 2010, ICES WGDEEP 2010, WD).

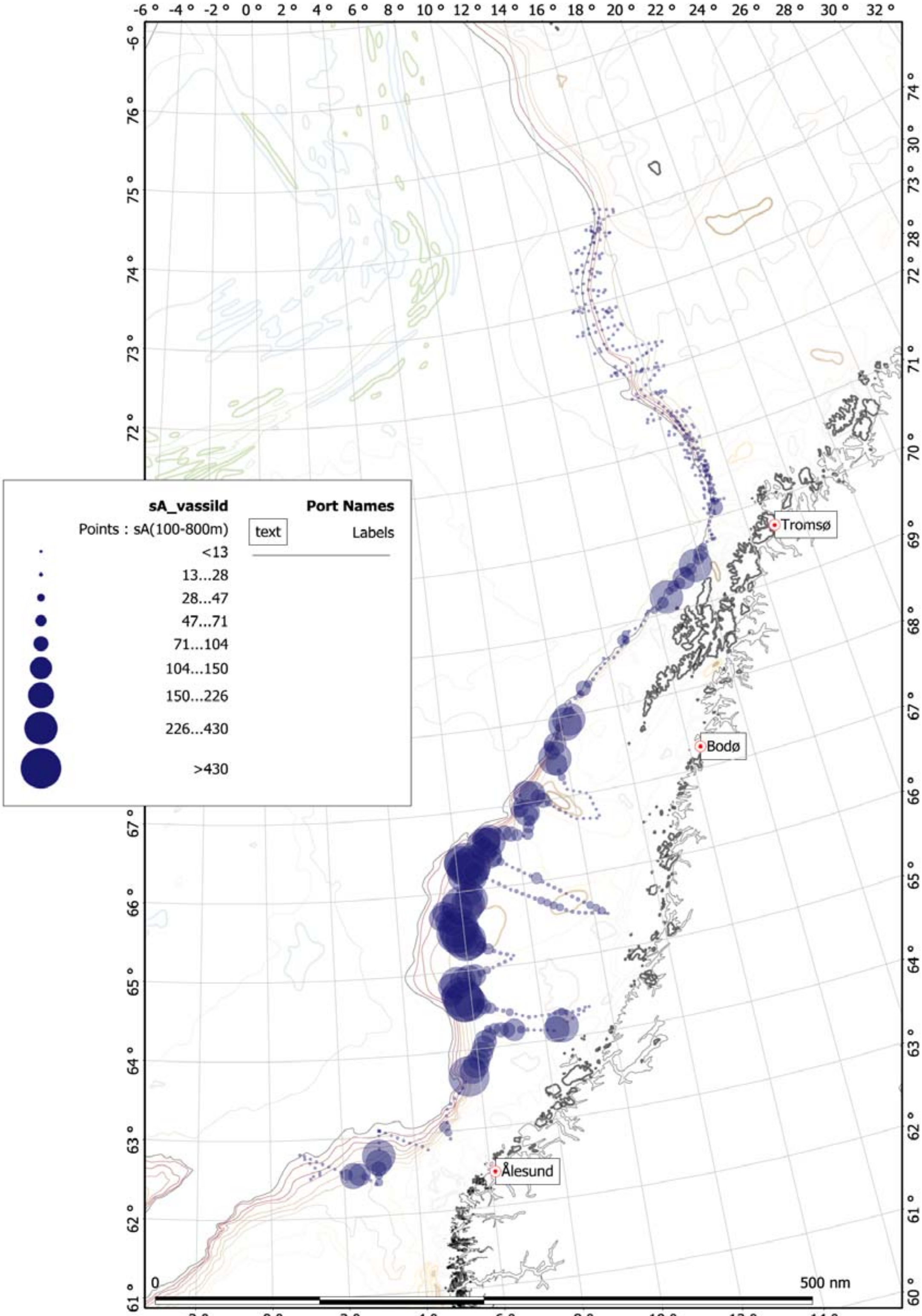


Figure 8.1.5.6.1. Registrations of greater silver smelt in Norwegian acoustical survey in March–April 2009. Blue line shows the survey transects with point-area proportional to SA-values allocated to greater silver smelt (Hallfredsson, 2010, ICES WGDEEP 2010, WD).

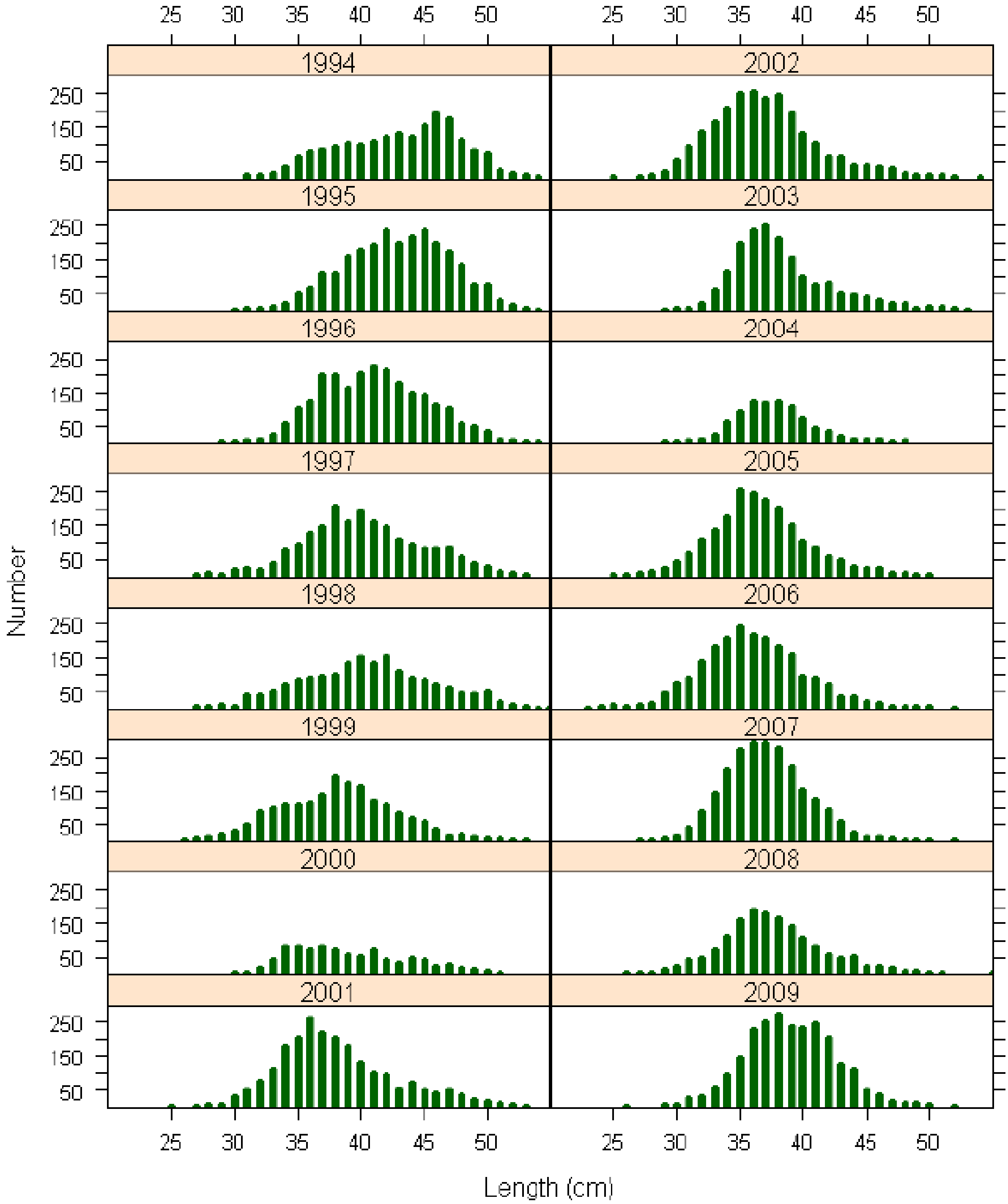


Figure 8.1.6.1. Cpue from Faroese surveys 1994–2009 in Vb (Ofstad, 2010, WKDEEP 2010 WD: GSS-08).

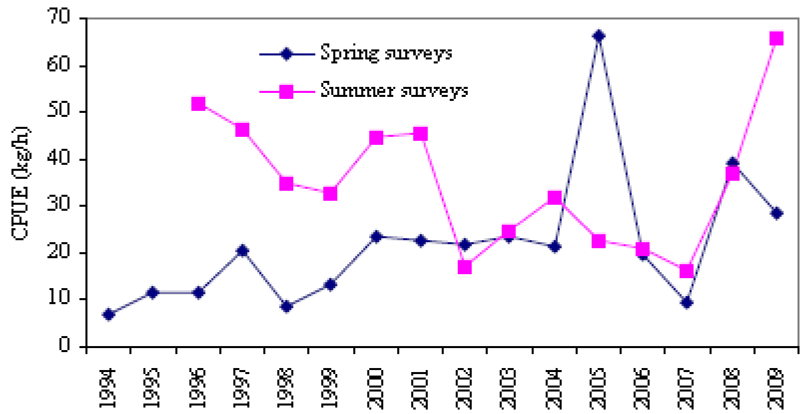
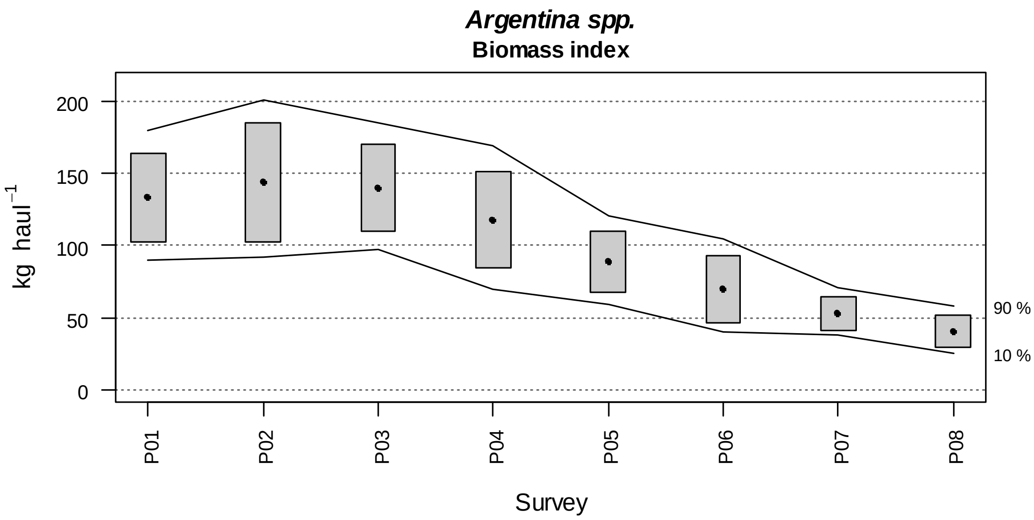


Figure 8.1.6.2. Length distributions of greater silver smelt in the Faroese landings 1994–2009 (Ofstad, 2010. WKDEEP 2010, WD: GSS-08).



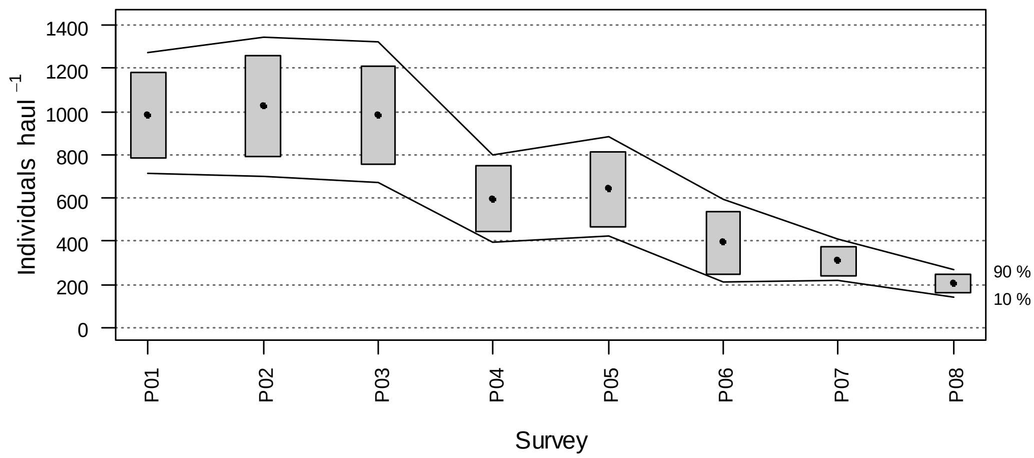


Figure 8.1.6.3. Changes in *Argentina* spp. biomass and abundance indices during Porcupine Survey time-series (2001–2008). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

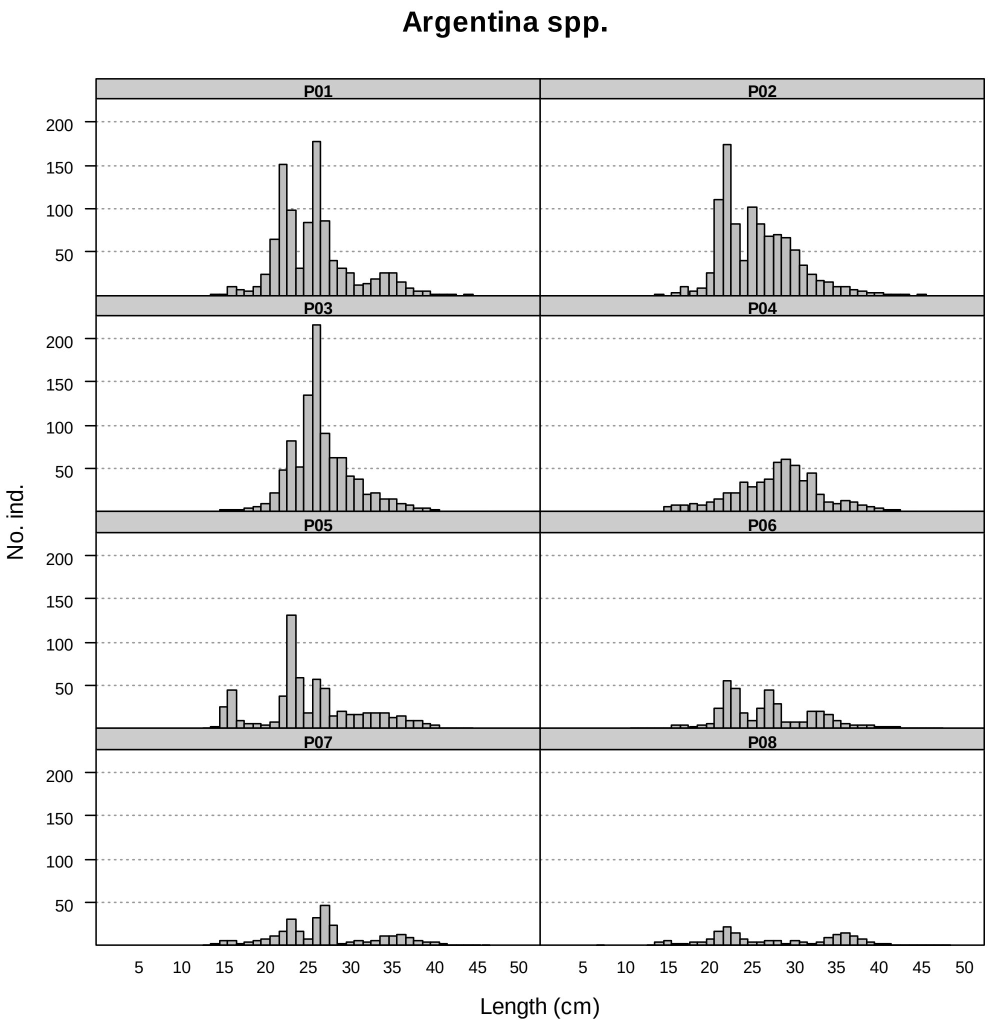


Figure 8.1.6.4. Mean stratified length distributions of *Argentina* spp. in Porcupine surveys (2001–2008).

Stock Annex: Greater Silver Smelt in Division Va

Stock	Greater Silver Smelt in Division Va
Working Group	WKDEEP
Date	February 2010
Revised by	Gudmundur Thordarson

A. General

A.1. Stock definition

Greater Silver Smelt (*Argentina silus*) stock in Division Va (Icelandic waters) is treated as a separate assessment unit is from greater silver smelt in Subareas I, II, IV, VI, VII, VIII, IX, XII, XIV and Divisions IIIa and Vb.

A.2. Fishery

Greater silver smelt is mostly fished along the south, southwest, and west coast of Iceland, at depths between 500 and 800 m.

Greater silver smelt was caught in bottom trawls for years as bycatch in the redfish fishery. Only small amounts were reported prior to 1996 as most of the greater silver smelt was discarded. Since 1997, direct fishery for greater silver smelt has been ongoing and the landings have increased significantly. In the beginning, the fishery was mainly located along the slopes of the south and southwest coast, but in recent years the fishery has expanded and significant catches are taken along the slopes west of Iceland.

The greater silver smelt fishery is at present not managed by quotas but rather as an exploratory fishery subject to licensing (see A.2.1) since 1997. Greater silver smelt is now mainly taken both in a directed fishery with, but also as a bycatch in the redfish fishery.

A.2.1. Fleet

Greater silver smelt in Va is caught only in bottom trawls, often as a bycatch or in conjunction with redfish and Greenland halibut fishing. Between 20 and 30 trawlers have participated in the fishery since 1996. In recent years, the majority of the greater silver smelt landings have been taken in hauls were the species was 50% or more of the catch in the haul. The trawlers that target greater are mainly freezer trawlers that are between 1000 and 2000 GRT. The fleet uses a bottom trawl with small mesh size belly (80 mm) and codend (40 mm).

A.2.2. Regulations

The greater silver smelt fishery is subject to regulation nr 717, 6th of October 2000 with amendments 1138/2005 from the Ministry of Fisheries. In short the regulation states among others that:

1) All fishing of greater silver smelt is subject to licensing by the Directorate of Fisheries that has to be renewed each year.

2) Fishing for Greater silver smelt is only allowed south and west of Iceland. That is west of W19°30 and south of N66°00 at depths greater than 220 fathoms (approx 430 m). Between W19°30 and W14°30 taking of greater silver smelt is allowed south of given line (Figure 1 and Table 1).

3) It is mandatory to keep logbooks were the date, exact position of haul, catch and depth are recorded.

4) Samples shall be collected, at least one from each fishing trip. The sample shall consist of randomly selected 100–200 specimens of greater silver smelt. The sample is frozen on board and sent to the Marine Research Institute in Reykjavik for further investigation.

5) Minimum mesh size in the trawl is 80 mm but 40 mm in the codend.

A revised regulation will soon come into effect that expands the fishing area north to 67°N and east to 12°W.

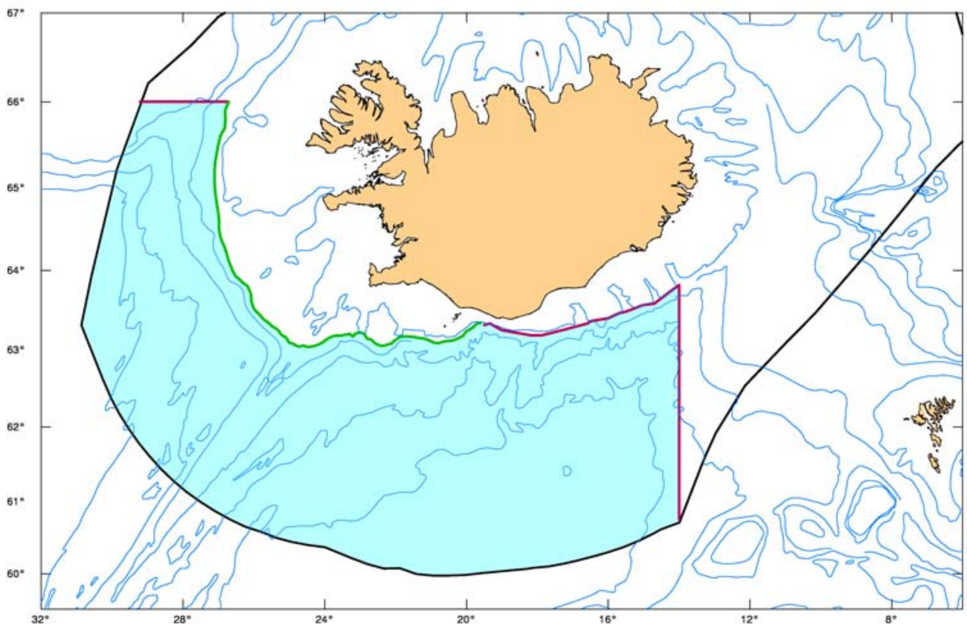


Figure 1. Area open to commercial fishing of Greater Silver Smelt in Va according to regulation nr 717, 6th of October 2000 with amendments 1138/2005 from the Ministry of Fisheries (the shaded blue area). The red-line off the south coast drawn according to Table 1 and the green line is an approximation of the 400 m depth contour.

A.3. Ecosystem aspects

Warming of sea temperature, have been documented in Va and an expansion of distributional area of warm water species such as anglerfish. The significance and reliability of such metrics is considered at the moment insufficient for their consideration in the provision of management advice of greater silver smelt in Va.

B. Data

B.1. Commercial catches

Icelandic commercial catches in tonnes by month and gear are provided by Statistical Iceland and the Directorate of Fisheries. Data on catch in tonnes from other countries are taken from ICES official statistics (STATLAN) and/or from the Icelandic Coast Guard. Annual landings are available from 1985 or from the commencing of the targeted fishery. The fishing statistics are considered accurate. Discards are not considered to be of relevance and therefore not included in the assessment. There are limited measurements of discard from 2002 to 2009. The distribution of catches is obtained from logbook statistics where location of each haul, effort, depth of trawling and total catch of greater silver smelt is given. From the logbook catch per unit of effort and effort is estimated.

B.2. Biological

Biological data from the greater silver smelt catch is collected onboard of the fishing vessel, as it is mandatory to send at least one sample from each fishing trip. The sample is sent to the Marine Research Institute and analyzed by scientists and technicians. Each sample consists of randomly selected 100–200 specimens of greater silver smelt. In each sample, otoliths are extracted from 50 specimens. The biological data collected are length (to the nearest cm), sex and maturity stage, and un-gutted weight (to the nearest gram). The rest of the sample is only length measured.

From 1987–1996, biological sampling from the catches were sporadic. Biological sampling of the catches has been generally considered sufficient since 1997. Age reading is considered accurate.

Greater silver smelt in Va reaches 50% maturity at around 36 cm or at around 6–8 years of age. The species enters the fishery at around 30 cm or 3–4 years of age. Only very few greater silver smelt have been measured 60 cm or larger.

B.3. Surveys

The annual Icelandic groundfish surveys give trends on fishable biomass of many exploited stocks on Icelandic fishing grounds. The main objective in the design of the surveys was to monitor the most important commercial stocks such as cod, haddock, saithe, and redfish. However the surveys are considered representative for many other exploited stocks of lesser economic importance.

B.3.1. The Icelandic groundfish survey in March

In the Icelandic groundfish survey which has been conduced annually in March since 1985 gives trends on fishable biomass of many exploited stocks on Icelandic fishing grounds. Total of more than 500 stations are taken annually in the survey at depths down to 500 meters. Therefore the survey area does not cover the most important distribution area of greater silver smelt and is not considered fully representative for greater silver smelt in Va.

B.3.2. The Icelandic groundfish survey in October (Autumn Survey)

The Icelandic Autumn Groundfish Survey (AGS) has been conducted annually since 1996 by the Marine Research Institute (MRI). The objective is to gather fishery independent information on biology, distribution and biomass of demersal fish species in Icelandic waters, with particular emphasis on Greenland halibut (*Reinhardtius hippoglossoides*) and deep-water redfish (*Sebastes mentella*). This is because the Icelandic Groundfish Survey (IGS) conducted annually in March does not cover the distribution of these deep-water species. Secondary aim of the survey is to have another fisheries independent estimate on abundance, biomass and biology of demersal species, such as cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and golden redfish (*Sebastes marinus*), in order to improve the precision of stock assessment.

AGS is conducted in October as it is considered the most a suitable month in relation to diurnal vertical migration, distribution and availability of Greenland halibut and deep-sea redfish. The research area is the Icelandic continental shelf and slopes within the Icelandic Exclusive Economic Zone to depths down to 1500 m. The research area is divided into a shallow-water area (0–400 m) and a deep-water area (400–1500 m). The shallow-water area is the same area as covered by IGS. The deep-water area is directed at the distribution of Greenland halibut, mainly found at depths from 800–1400 m west, north and east of Iceland, and deep-water redfish, mainly found at 500–1200 m depths southeast, south and southwest of Iceland and on the Reykjanes Ridge.

Initially, a total of 430 stations were divided between the two areas. Of them, 150 stations were allocated to the shallow-water area and randomly selected from the IGS station list. In the deep-water area, half of the 280 stations were randomly positioned in the area. The other half were randomly chosen from logbooks of the commercial bottom-trawl fleet fishing for Greenland halibut and deep-water redfish in 1991–1995. The locations of those stations were, therefore, based on distribution and pre-estimated density of the species.

Because MRI was not able to finance a project in order of this magnitude, it was decided to focus the deep-water part of the survey on the Greenland halibut main distributional area. For this reason, important deep-water redfish areas south and west of Iceland were omitted. The number and location of stations in the shallow-water area were unchanged.

The number of stations in the deep-water area was therefore reduced to 150. A total of 100 stations were randomly positioned in the area. The remaining stations were located on important Greenland halibut fishing grounds west, north and east of Iceland and randomly selected from a logbook database of the bottom trawl fleet fishing for Greenland halibut 1991–1995. The number of stations in each area was partly based on total commercial catch.

In 2000, with the arrival of a new research vessel, MRI was able finance the project according to the original plan. Stations were added to cover the distribution of deep-water redfish and the location of the stations selected in a similar manner as for Greenland halibut. A total of 30 stations were randomly assigned to the distribution area of deep-water redfish and 30 stations were randomly assigned to the main deep-water redfish fishing grounds based on logbooks of the bottom trawl fleet 1996–1999. The years 1996–1999 can not be used for abundance and biomass estimates of greater silver smelt since the AGS in those years did not cover adequately the distribution of the species.

In addition, 14 stations were randomly added in the deep-water area in areas where great variation had been observed in 1996–1999. However, because of rough bottom which made it impossible to tow, five stations have been omitted. Finally, 12 stations were added in 1999 in the shallow-water area, making total stations in the shallow-water area 162. Total number of stations taken since 2000 has been around 381 (Figure 2).

The R/V "Bjarni Sæmundsson" has been used in the shallow-water area from the beginning of the survey. For the deep-water area MRI rented one commercial trawler 1996–1999, but in 2000 the commercial trawler was replaced by the R/V "Árni Friðriksson".

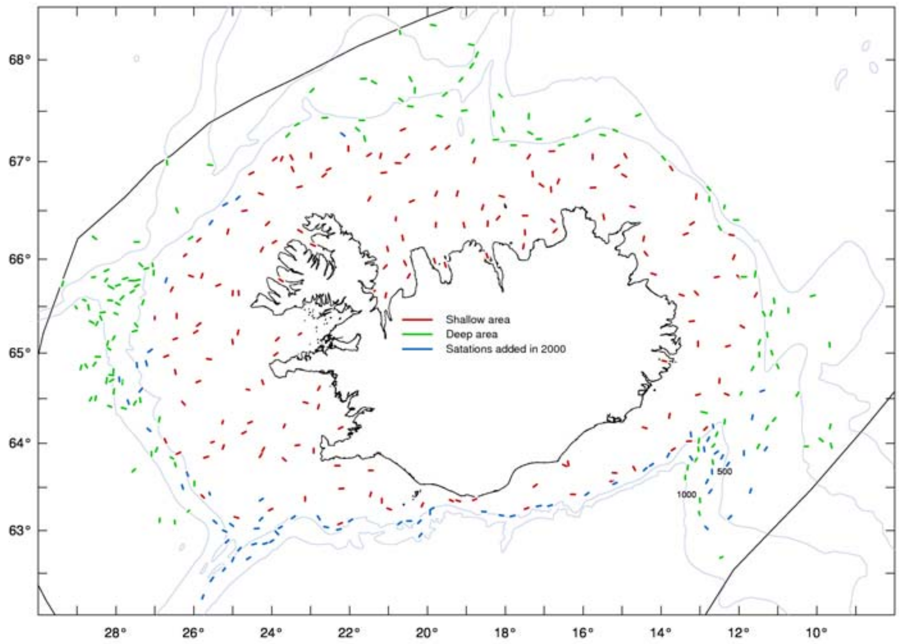


Figure 2. Stations in the Autumn Groundfish Survey (AGS). R/v "Bjarni Sæmundsson" takes stations in the shallow-water area (red lines) and r/v "Árni Friðriksson" takes stations in the deep-water areas (green lines), the blue lines are stations added in 2000.

B.3.2.1. Data collection (biological sampling)

B.3.2.1.1. Length measurement, counting (sub-sampling)

All fish species are measured for length. For the majority of species including greater silver smelt, total length is measured to the nearest cm from the tip of the snout to the tip of the longer lobe of the caudal fin. At each station, the general rule, which also applies to greater silver smelt is to measure at least 4 times the length interval of a given species. Example: If the continuous length distribution of greater silver smelt at a given station is between 15 and 45 cm, the length interval is 30 cm and the number of measurements needed is 120. If the catch of greater silver smelt at this station exceeds 320 individuals, the rest is counted.

Care is taken to ensure that the length measurement sampling is random so that the fish measured reflect the length distribution of the haul in question.

B.3.2.1.2. Recording of weight, sex and maturity stages

Sex and maturity data has not been collected from greater silver smelt sampled in the autumn survey, nor has silver smelt been weighted. Collection of this data is supposed to commence in 2010.

B.3.2.1.3. Otolith sampling and weighing

For greater silver smelt a minimum of 1 and a maximum of 25 otoliths are collected from each haul. Otoliths are sampled at a 30 fish interval so that if in total 300 greater silver smelt are caught in a single haul, 10 otoliths are sampled.

B.3.2.2. Station information

At each station relevant information on the haul and environmental factors, are filled out by the captain and the first officer in co-operation with the cruise leader.

Tow information

- **General:** Year, Station, Vessel registry no., Cruise ID, Day./month, Statist. Square, Sub-square, Tow number, Gear type no., Mesh size, Briddles length (m).
- **Start of haul:** Pos. N, Pos. W, Time (hour:min), Tow direction in degrees, Bottom depth (m), Towing depth (m), Vert. opening (m), Horizontal opening (m).
- **End of haul:** Pos. N, Pos. W, Time (hour:min), Warp length (fm), Bottom depth (m), Tow length (naut. miles), Tow time (min) , Tow speed (knots).
- **Environmental factors:** Wind direction, Air temperature °C, Wind speed, Bottom temperature °C, Sea surface, Surface temperature °C, Towing depth temperature °C, Cloud cover, Air pressure, Drift ice.

B.3.2.3. Fishing gear

Two types of the bottom survey trawl "Gulltoppur" are used for sampling: "Gulltoppur" is used in the shallow water and "Gulltoppur 66.6 m" is used in deep waters. The trawls were common among the Icelandic bottom trawl fleet in the mid-1990s and are well suited for fisheries on cod, Greenland halibut and redfish.

The bottom trawl used in the shallow water is called "Gulltoppur". The headline is 31.0 m, and the fishing line is 19.6 m. The trawl used in the deep-water area is "Gulltoppur 66.6 m" (Figures 6–9). The headline is 35.6 m and the fishing line is 22.6 m.

Towing speed and distance: The towing speed is 3.8 knots over the bottom. The trawling distance is 3.0 nautical miles calculated with GPS when the trawl touches the bottom until the hauling begins (i.e. excluding setting and hauling of the trawl).

B.3.2.4. Data processing

B.3.2.4.1. Abundance and biomass estimates at a given station

As described above the normal procedure is to measure at least 4 times the length interval of a given species. The number of fish caught of the length interval L_1 to L_2 is given by:

$$P = \frac{n_{measured}}{n_{counted} + n_{measured}}$$

$$n_{L_1-L_2} = \sum_{i=L_1}^{i=L_2} \frac{n_i}{P}$$

Where $n_{measured}$ is the number of fished measured and $n_{counted}$ is the number of fish counted.

Biomass of a given species at a given station is calculated as:

$$B_{L_1-L_2} = \sum_{i=L_1}^{i=L_2} \frac{n_i \alpha L_i^{\beta}}{P}$$

Where Li is length and alpha and beta are coefficients of the length–weight relationship.

B.3.2.4.2. Index calculation

For calculation of indices the Cochran method is used (Cochran, 1977). The survey area is split into sub-areas or strata and an index for each subarea is calculated as the mean number in a standardized tow, divided by the area covered multiplied with the size of the subarea. The total index is then a summed up estimates from the sub-areas.

A 'tow-mile' is assumed to be 0.00918 square nautical mile. That is the width of the area covered is assumed to be 17 m (17/1852=0.00918). The following equations are a mathematical representation of the procedure used to calculate the indices:

$$I_{strata} = \frac{\sum_{strata} Z_i}{N_{strata}}$$

$$\sigma^2_{strata} = \frac{\sum_{strata} (Z_i - I_{strata})^2}{N_{strata} - 1}$$

$$I_{region} = \sum_{region} I_{strata}$$

$$\sigma^2_{strata} = \sum_{region} \sigma^2_{strata}$$

$$CV_{region} = \frac{\sigma_{region}}{I_{region}}$$

Where *strata* refers to the subareas used for calculation of indices which are the smallest components used in the estimation, *I* refers to the stations in each subarea and region is an area composed of 2 or more subareas. *Zi* is the quantity of the index (abundance or biomass) in a given subarea. *I* is the index and sigma is the standard deviation of the index. CV refers to the coefficient of variation.

The subareas or strata used in the Icelandic groundfish surveys (same strata division in both surveys) are shown in Figure 3. The division into strata is based on the so-called BORMICON areas and the 100, 200, 400, 500, 600, 800 and 1000 m depth contours.

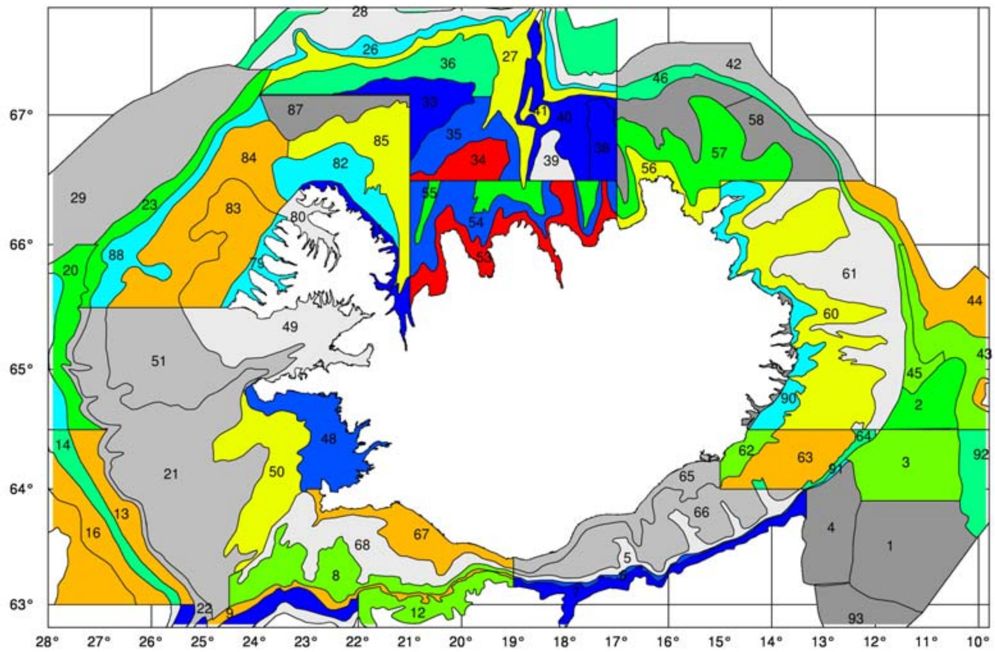


Figure 3. Subareas or strata used for calculation of survey indices in Icelandic waters.

B.3.2.4.3. Stratification for Greater Silver Smelt

The standard calculations of regional survey indices are not particularly applicable to greater silver smelt (originally designed for cod). Therefore, the processing of the Autumn Survey data is done at a slightly different regional scale. In short, the main distributional area of greater silver smelt off the southeast, south and west coast of Iceland, and in recent years also off the northwest coast. Also, fishing of greater silver smelt is banned at depths less than 220 fathoms (~400 m). To get a proxy for 'fishable' survey indices a few regions are defined for depths greater than 400 m (Table 1 and Figure 4).

Table 1. Survey regions used for calculation of various Autumn Groundfish Survey indices for greater silver smelt in Va.

Region	No. strata	Area (km2)	No. stations
Total	74	339 691	378
GSS fishing grounds	13	46 993	80
Depth >400 m	32	152 626	186
Depth <400 m	41	186 870	192
NW >400 m	2	20 081	16
W >400 m	9	31 613	60
S >400 m	6	26 715	24
SE >400 m	7	30 358	36

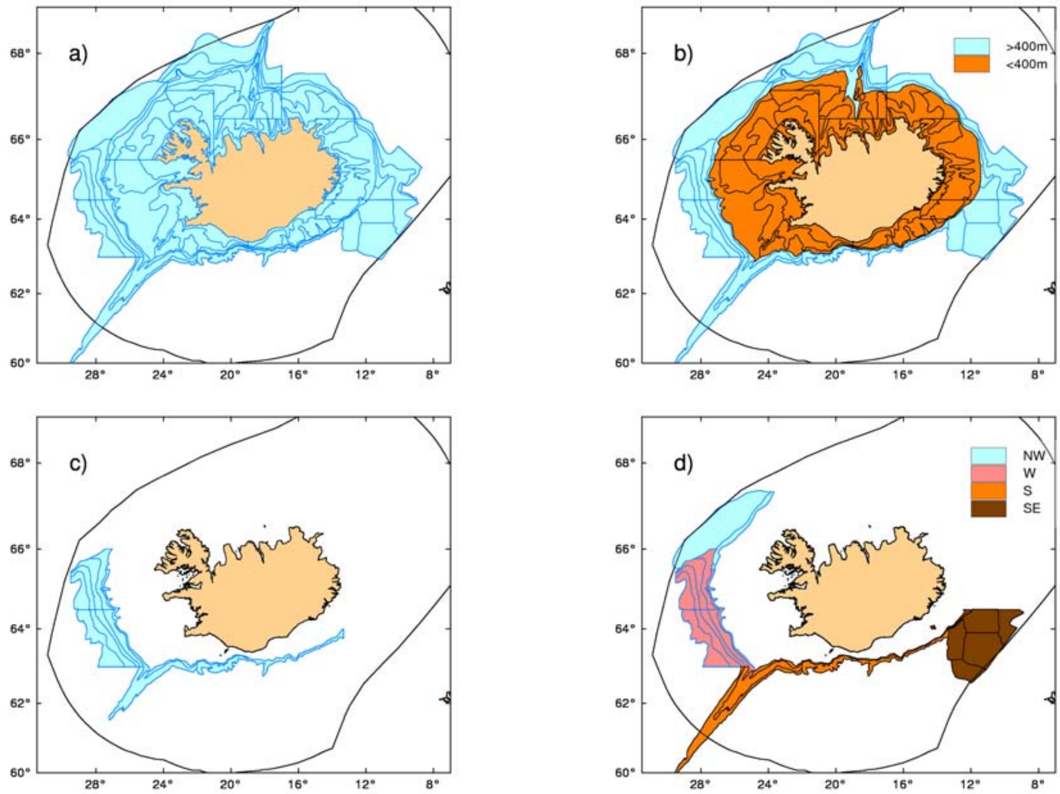


Figure 4. Divisions used in calculation of indices for greater silver smelt in Va. a) Total area. b) Division at 400 m depth contour. c) Greater silver smelt fishing area. d) Subdivisions of the main distributional area of greater silver smelt.

B.3.2.4.4. Winsorization of survey data

One of the main problems when calculating indices from tow surveys is how to treat few large hauls. In some cases, one or two hauls, that happens to be inside a large stratum, can result in very marked increase in survey estimates. This is a problem for greater silver smelt as for many other species. Not only can exceptionally large hauls increase survey estimates but also greatly affect estimated *CV* of the index in question.

Winsorization is one way to deal with outliers (Sokal and Rolf, 1995). A typical way to go when applying Winsorization is to set all outliers to a specified percentile of the data; for example, a 90% Winsorisation would set all data below the 5th percentile to the 5th percentile, and data above the 95th percentile set to the 95th percentile. Winsorised estimators are usually more robust to outliers than their un-winsorised counterparts.

This strategy is applied to the greater silver smelt data from Autumn Groundfish Survey. The number of greater silver smelt in a tow that are greater than the 95th percentile are set at the quantile. The same is done for the 5th percentile quantile, that is, numbers of greater silver smelt in a tow that are lower than 5th percentile quantile are set at the quantile. It should be noted that tow-stations that have no greater silver smelt are excluded from the Winsorization.

B.4. Commercial cpue

Catch per unit of effort (cpue) has been calculated using all data where catches of the greater silver smelt were more than 30%, 50% and 70% of the total reiterated catch in each haul. Estimates of Raw-cpue is simply the sum of all catch divided by the sum of the hours trawled. As the trawlers do not set out the trawl except when the captain is certain there is an aggregation of greater silver smelt and as the fishery is largely driven by markets and quota shares in other species (deep-water redfish and Greenland halibut) it is not certain how representative the cpue series is of stock trends.

C. Historical stock development

Greater silver smelt in Va is assessed based on trends in survey biomass indices (standard un-winsorized and winsorized) from the Icelandic Autumn survey and changes in age distributions form commercial catches and surveys. Supplementary data used includes relevant information from the fishery and surveys such as changes in spatial (geographical and depth range) and temporal distribution, length distributions and maturity ogives.

At present analytical assessments cannot be conducted because of contrasting signals in the available data and the relative shortness of the time-series available.

D. Short-term predictions

No short-term predictions are performed.

E. Medium-term predictions

No medium-term predictions are performed.

F. Long-term predictions

No long-term predictions are performed.

G. Biological reference points

No biological reference points are defined for greater silver smelt in Division Va.

H. Other issues

Stock identity of greater silver smelt in the Northeast Atlantic is unclear and further reasearch is need. Strong recommendations are given in the 2010 WKDEEP Report on this issue (Section 7.1, WKDEEP 2010 Report).

I. References

Cochran,W.G. 1977. Sampling techniques, 3rd edition. New York: Wiley & Sons.

Sokal, R. R. and Rohlf, F. J. 1995. Biometry. W. H. Freeman and Company, 3rd edition.

Stock Annex: Greater Silver Smelt (*Argentina silus*) in Subareas I, II, IV, VI, VII, VIII, IX, X, XII and XIV, and Divisions IIIa and Vb

Stock	Greater Silver Smelt (*Argentina silus*) in Subareas I, II, IV, VI, VII, VIII, IX, X, XII and XIV, and Divisions IIIa and Vb (whole ICES Area except Division Va)
Working Group	WKDEEP
Date	24 March 2010
Revised by	Elvar H. Hallfredsson and Lise Helen Ofstad

A. General

A.1. Stock definition

Stock definitions for greater silver smelt is unclear and further research is needed. Within ICES greater silver smelt in Subareas I, II, IV, VI, VII, VIII, IX, XII, XIV and Divisions IIIa and Vb is one assessment unit, while greater silver smelt in Division Va is a separate assessment unit.

A.2. Fishery

Landings since 1988 are mainly reported in Subareas I–VII (Table 1), with landings elsewhere being either minor (VIII, XII and XIV) or none. There are presently three areas where direct fisheries are conducted; around Iceland (Va), around Faroe Islands (Vb) and west of mid Norway (IIa) (Figure 1). The direct fisheries are mainly by semi-pelagic trawls. In addition, the greater silver smelt is being exploited west of Ireland (VI, VII) by the Dutch fleet (and previously by other fleets), and historically in the Skagerrak (IIIa) by Norwegian, Danish and Swedish vessels.

Table 1. Landings of greater silver smelt in all ICES areas (ICES, 2009). ***Argentina sphyraena*** **may in some cases have been included in the landing figures (particularly in Subareas III and IV).**

YEAR	I + II	III + IV	VA	VB	VI + VII	VIII	XII	XIV	TOTAL
1988	11 351	2718	206	287	10 438				25 000
1989	8390	3786	8	227	25 559				37 970
1990	9120	2321	112	2888	7294			6	21 741
1991	7741	2554	247	60	5197				15 799
1992	8234	5319	657	1443	5906				21 559
1993	7913	3269	1255	1063	1577		6		15 083
1994	6807	1508	613	960	5707				15 595
1995	6775	1082	492	12 286	6242				26 877
1996	6604	3300	808	9498	5863		1		26 074
1997	4463	2598	3367	8433	7300				26 161
1998	8261	3982	13387	17 570	5555				48 755
1999	7163	4320	6704	8214	8856		2		35 259
2000	6293	2471	5657	5209	13 866			217	33 713
2001	14 369	2925	3043	10 081	19 050			66	49 534
2002	7407	1811	4960	7471	15 985	191			37 825
2003	8917	1188	2683	6549	2451	37			21 825
2004	16 162	1157	3645	6451	5133	23	4		32 575
2005	17093	791	4481	7009	3808	202	322		33 706
2006	21685	4016	4775	12559	1115	0	0		44 150
2007	13273	3343	4227	14093	4122				39 059
2008*	11876	1629	8778	14595	4035				40 913

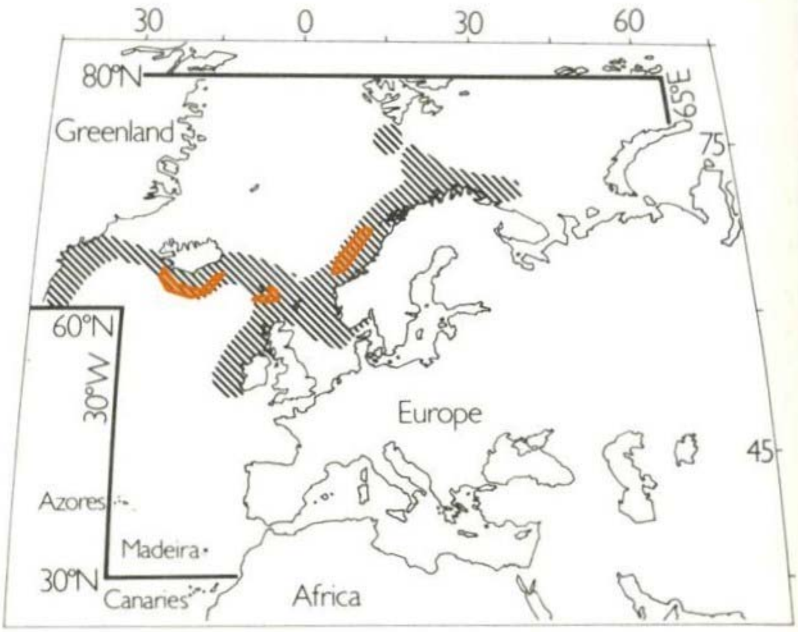


Figure 1. Distribution of greater silver smelt in the ICES area (Cohen, 1984). The locations of current direct fisheries are indicated in orange.

No analytical assessment is provided for the assessment unit by ICES. The Advice for 2009 is biennial and valid for 2009 and 2010: As a consequence of its low productivity greater silver smelt can only sustain low rates of exploitation. Fisheries on such species should always be accompanied by programmes to collect data on both target and bycatch fish. The fishery should not be allowed to expand unless it can be demonstrated that it is sustainable.

Norwegian fisheries and management: Only selected trawlers are licensed to conduct aimed trawling for smelt in IIa, and area and season restrictions also apply in this area. For a period after 1983 a precautionary unilateral annual TAC applied, but the landings never exceeded the quota and this regulation was abandoned in 1992. Annual landings from this fishery were stable around 10000 t for a long period. However, in the 2004–2005 there was a sharp increase in the landings. The fleet expressed concern about declining catch rates and reduced abundance of large individuals in the catches, and the Norwegian authorities again implemented a precautionary TACs based on Norwegian scientific advice. The advice from IMR was to limit the landings to a level that had proven sustainable for the past 1–2 decades. For 2010 the TAC is 12 000 tonnes. Landings by Norway in Subareas III and IV varied between 1000 and almost 4500 t. The Danish quota (part of EU TAC) for 2003 onwards was 1388 t, and the annual landings are below this level. As a consequence of the introduction of the sorting grid to the shrimp fishery the bycatch of fish is very low in the Danish, Norwegian and Swedish fishery for *Pandalus borealis*. The Norwegian bycatch in the industrial fishery for Norway pout and blue whiting is very variable. Bycatch is now regulated in the Norwegian EEZ not to exceed 10% in total catches and in individual catches.

Faroese fisheries and management: There is no species-specific management of greater silver smelt in Vb, only minimum landing size (28 cm) and a licensing system. At present licenses are issued to three pairs of pairtrawlers. The landings of *A. silus* in Division Vb increased considerably from 1994–1998 as a direct fishery for this species.

After 1998 when 18 000 tonnes were landed, the landings were 6500 tonnes on average in 1999–2005. In 2006, 2007 and 2008 the landings have increased to 12 500, 14 100 and 14 600 tonnes respectively. The variations in the catches are largely as a consequence of market demands, and that a third pair of trawlers got licensed in 2007. Greater silver smelt is also taken as bycatch in the blue whiting fishery and in the deep-water fishery for e.g. red fish and blue ling. These bycatches are not recorded in the landings.

EU fisheries and management: The EU introduced TAC management in 2003, and for each year quotas were set for greater silver smelt. EU TACs as valid for community vessels fishing in community waters and waters not under the sovereignty or jurisdiction of third countries. There has been a considerable decline in the landings of *A. silus* from Subareas VI and VII from a peak in the late 1980s to the mid 1990s, with the exception of the years 2000–2002, when the landings were between 14 000 and 19 000 tonnes. A main fleet producing catches of greater silver smelt is Dutch freezer trawlers operating in Vb, VI and VII, west and northwest of the Hebrides, and west of Ireland (Porcupine Bank) where smelt is a minor bycatch in the fishery directed at blue whiting. The Dutch fleet apparently also operated in IIa in 2004. In 2004 the landings significantly exceeded the TAC for the Netherlands for V and VI. Irish landings were very high in the late 1980s when an exploratory fishery was developed by large pelagic trawlers. However by the early 1990s landings had declined to a few hundred tonnes and directed fishing had ceased by 1993. There was some directed fishing for the species in subsequent years. In 2000 larger Irish pelagic trawlers began to direct effort at this species on the shelf edge of Division VIa. Landings reached over 4700 t in 2000 and were estimated at around 7500 t in 2001 and 2002. Figures for 2003 showed a very low landing of only 95 t. Because of a restrictive quota there was no Irish directed fishery for greater silver smelt. The landings by Scottish vessels also increased in 2000–2002 and between 65% and 75% of these landings were outside the UK. The Scottish landings also dropped abruptly to a very low level in 2003. In some of the years where landings are very high, there is possibly some misreporting but no documentation of quantities is available.

The Russian bycatch statistic of greater silver smelt in the commercial blue whiting fishery in Division Vb demonstrates considerable catch decline during recent years.

A 2. Ecosystem aspects

No information is available on impacts on the ecosystem of fishing for greater silver smelt.

B. Data

B.1. Commercial catches

Logbook catch and corresponding effort data for the Danish fleet in Division IIIa are available for the period 1992–2006 as demonstrated in the WGDEEP Report 2008. The Danish fisheries are reduced and insignificant in 2007 and 2008. Data from logbooks do not represent the entire landings (ICES, 2008, WGDEEP).

Logbooks from three pairs of pairtrawlers (>1000 HP) fishing greater silver smelt in Faroese waters (Area Vb) are available (Ofstad and í Homrum, 2009, WGDEEP 2009 WD14). The longest of these series is from 1995 to 2003. Logbook data reveals that greater silver smelt is fished mostly in the area west of the Faroes and on the continental slope north and north-west of the Faroe Bank, at depths around 300–700 meters. To some extent, there is also being trawled on the Bill Bailey Bank and Lousy Bank and north of the Faroes.

Landings are available from other areas.

B.2. Biological

Analysis on growth as well as age and length-at-maturity were presented at the WKDEEP 2010.

Table 2 summarizes the von Bertalanffy growth parameters estimated by sex and for combined sexes. Greater silver smelt older than 19 year old where not include in the analysis. Table 3 summarizes the estimated maturity ogive parameters from Norway and Faroese data.

Although there was considerable variability in individual fish length-at-age, the resultant curves for the areas showed marked differences (Table 2). No age calibration exercises have been performed to check the agreement between age readers of the different institutes. Ageing of greater silver smelt is considered relatively easy at least up to age 20 and this might relax the importance of the lack of calibration, even though conducting such calibration is encouraged.

Table 2. Parameters estimated in von Bertalanffy growth curve for combined sexes, females, and males for age 0–19.

	Both sexes		Females		Males	
	Estimate	Std.	Estimate	Std.	Estimate	Std.
NORWAY						
Linf	39.5	0.273	41.7	0.388	36.9	0.29
K	0.19	0.007	0.19	0.008	0.22	0.01
t0	-2.13	0.136	-1.85	0.169	-2.02	0.173
FAROE ISLANDS						
Linf	42.4	0.231	43.9	0.311	40.3	0.288
K	0.22	0.004	0.22	0.005	0.24	0.007
t0	-1.12	0.043	-1.08	0.050	-1.11	0.067

Maturity ogives also showed strong differences between the two areas (Table 3). Trends in these parameters vary between areas, but also between sexes. It was noted there was some uncertainty in the direct equivalence of some of the gonad-staging between areas.

Table 3. Summary of maturity ogive parameters for greater silver smelt by area.

Parameter	Faroe Islands		Norway	
	Female	Male	Female	Male
a	-6.78	-7.30	-3.35	-2.26
b	1.16	0.96	0.79	0.44
A50	5.8	7.6	4.2	5.1

B.3. Surveys

Survey indices for greater silver smelt in Faroese area are available from an annual spring- (since 1994) and a summer- (since 1996) groundfish survey for cod, haddock and saithe. The survey covers the Faroe Plateau (depths less than 500 m) and the spring survey in February cover 100 stations while the summer survey in August has 200 stations. Although the greater silver smelt is not a target species in these surveys the 2010 WKDEEP regarded them as a useful indicator of trends in relative abundance in this area.

Spanish research bottom-trawl surveys have been carried out in Subarea VII (Porcupine) since 2001. Blue whiting is the most abundant species in the survey area.

It should be noticed that these greater silver smelt shows an aggregation behaviour and catch trends and cpue in different areas are unlikely to reflect the level of abundance of this benthopelagic species (WGDEEP Report 2008).

Norwegian research vessel investigations 1980–1994 and 2007–2009, including acoustic survey estimates of biomass for the years 1989–1992 and 2009 (Hallfredsson, 2010 ICES WKDEEP-GSS-09). However lack of information on methodical standardisation for the earlier surveys compared to the 2009 survey prohibits any direct comparison of biomass estimates.

C. Historical stock development

For Division Vb, trends in biomass were derived from the Faroese summer survey and mean length for the mature and immature greater silver smelt from the spring- and summer surveys for cod, haddock and saithe. For Subarea VII, biomass indices and length frequencies were derived for the greater silver smelt from the Spanish Porcupine survey.

Acoustic abundance estimates for greater silver smelt from Norwegian surveys in 1989–1992, 2007 and 2009 are available. The results might indicate that the abundance in IIa is not less in 2009 than in the earlier findings. However this should not be considered as time-series until further evaluation of the earlier acoustic estimations.

D. Short-term predictions

No short-term predictions are performed.

E. Medium-term predictions

No medium-term predictions are performed.

F. Long-term predictions

No long-term predictions are performed.

G. Biological reference points

No biological reference points are defined for Greater Silver Smelt in Subareas I, II, IV, VI, VII, VIII, IX, X, XII and XIV, and Divisions IIIa and Vb.

H. Other issues

WKDEEP 2010 strongly recommends the building of acoustical time-series for the purpose of assessment for greater silver smelt.

Emphasis should be placed on following closely any further changes in the age distribution of greater silver smelt, both from surveys and commercial catches.

Stock definitions for greater silver smelt are unclear and further research is needed. Strong recommendations are given in the 2010 WKDEEP Report on this issue.

I. References

Cohen D M, 1984. Argentinidae. p. 386–391. in Whitehead P J P, Bauchot M L, Hureau J C, Nielsen J and Tortonese E (Eds.). Fishes of the North-eastern Atlantic and the Mediterranean, Vol I. UNESCO, Paris, 510pp.

Hallfredsson, E. H. 2010. Greater silver smelt assessment units in the northeast Atlantic. ICES WD WKDEEP-2010--GSS-09.

ICES. 2008. Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP), 3–10 March 2008, ICES Headquarters, Copenhagen. ICES CM 2008/ACOM:14. 531 pp.

ICES, 2009. Report of the Working Group on the Biology and Assessment of Deep Sea Fisheries Resources (WGDEEP), 9–16 March 2009, Copenhagen, Denmark. ICES CM 2009/ACOM:14. 511 pp.

9 Orange Roughy (*Hoplostethus Atlanticus*) in the Northeast Atlantic

9.1 Stock description and management units

Orange roughy are typically associated with seamounts or other topographical features e.g. pinnacles or slopes. Because these features tend to be sequentially depleted by fisheries, there is potential for the fishery to expand out of Subareas VI and VII as fisheries decline. Exploratory fisheries is known to take place in Subareas VIII–XII.

Orange Roughy is an aggregating species and the spatial scale of current management units would not prevent sequential depletion of local aggregations. ICES recommended that where the small-scale distribution is known, this be used to define smaller and more meaningful management units.

The current practice is to assume three assessment units;-

- Subarea VI;
- Subarea VII;
- Orange roughy in all other areas.

Given the scarcity of spatial fisheries data and genetics data etc, WGDEEP in 2008 saw no reason to change this.

Figure 9.1.1 shows the accumulated catch of orange roughy in the NEA in the different ICES areas for catches from 1991 to 2009. Catches data for orange roughy in 2008 and 2009 aggregated at the level of statistical rectangle were provided to the Working Group by France and Ireland. These are shown in Figures 9.1.2 and 9.1.3.

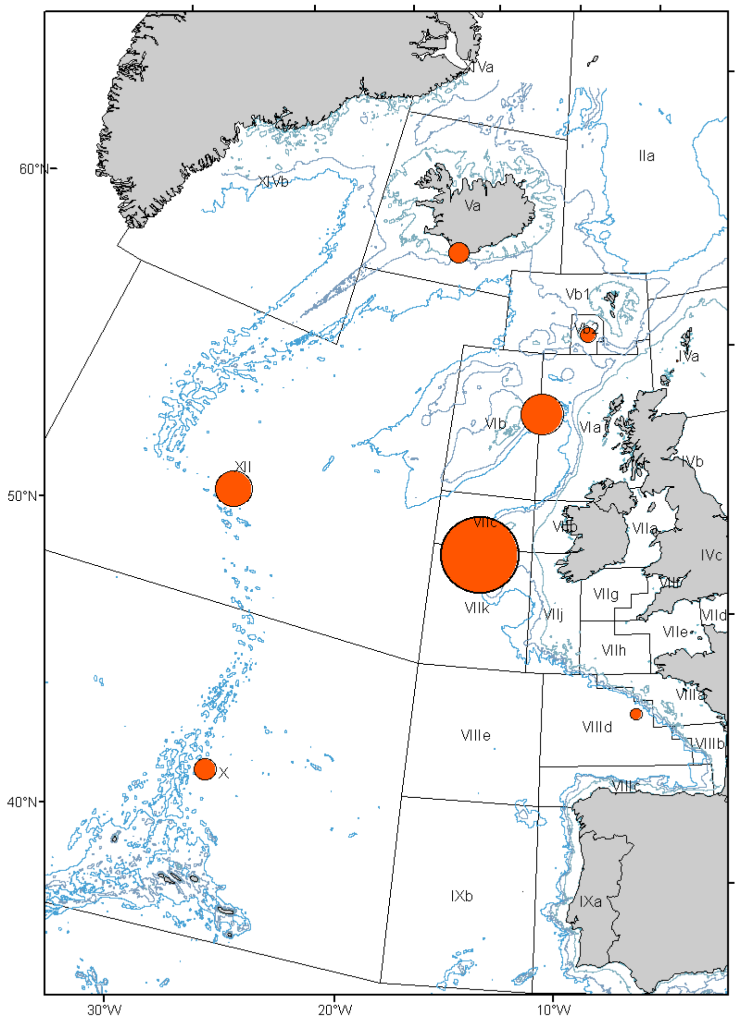


Figure 9.1.1. Fisheries for orange roughy by ICES areas in North East Atlantic. Size of circles reflects historic accumulated catch 1991–2009).

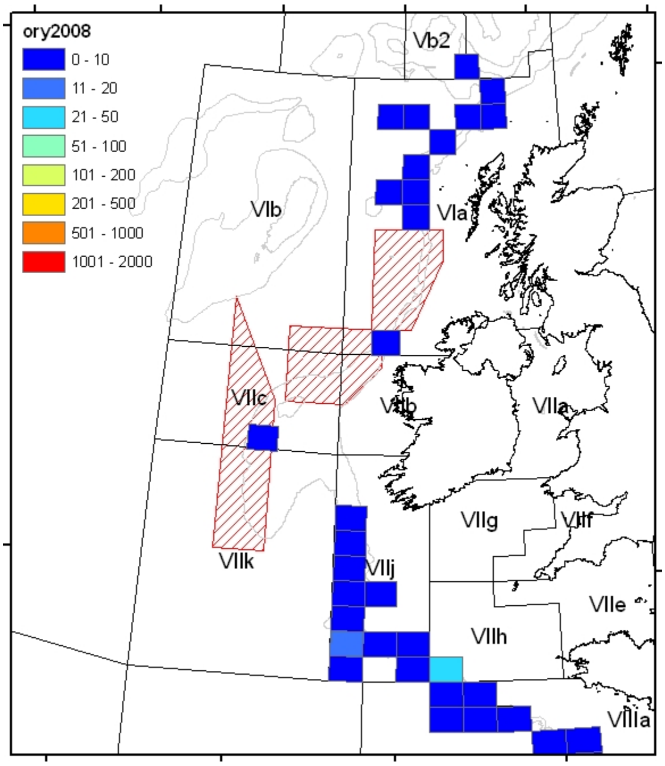


Figure 9.1.2. Catches of Orange roughy by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2008.

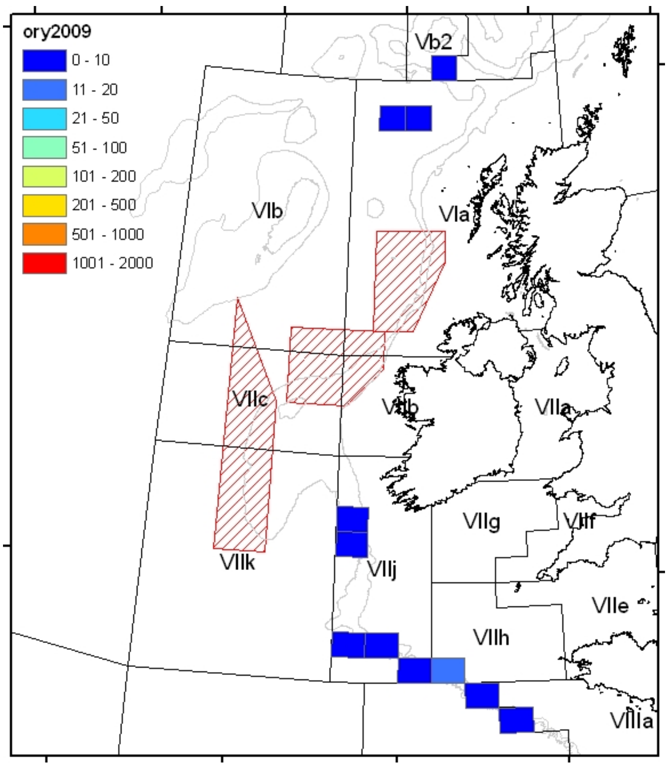


Figure 9.1.3. Catches of Orange roughy by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2009.

9.2 Orange Roughy (*Hoplostethus Atlanticus*) in Subarea VI

9.2.1 The fishery

There was a French target fishery, centred on spawning aggregations around the Hebrides Terrace Seamount. Irish vessels fished there for two years starting in 2001, but they have now effectively abandoned it.

9.2.1.1 Landings trends

Table 9.2.0 and Figure 9.2.1 show the landings data for orange roughy for the ICES area as reported to ICES or as reported to the Working Group.

The fishery began in 1989 with landings peaking at 3500 t in 1991, and 5300 t removed from the stock by the end of 1993. The cumulative catch in Area VI in 2009 was 7185 tons (9.2.2). It is not clear if over-reporting was a feature of the fishery in this area in the years preceding the introduction of TACs. Reported landings since 2003 are decreasing and are consistently below the TAC. Reported landings of orange roughy in VI in 2009 were 2 tons.

9.2.1.2 ICES Advice

ICES Advice in 2008 was:

Due to its very low productivity, orange roughy can only sustain very low rates of exploitation. Currently, it is not possible to manage a sustainable fishery for this species. ICES recommends no directed fisheries for this species. Bycatches in mixed fisheries should be as low as possible.

9.2.1.3 Management

In 2003 a TAC was introduced for orange roughy in VI, this TAC remained at 88 tons until 2006. Landings in relation to TAC are displayed in the Table below. The Table illustrates that since the introduction of the TAC, the reported landings were substantially lower than the set TAC.

		Landing (t)	
Year	TAC (t)	EC vessels	Total
2003	88	81	81
2004	88	56	56
2005	88	45	45
2006	88	33	33
2007	51	12	12
2008	34	5	5
2009	17	2	2
2010	0		

In order to align the TAC with landings, the TAC for EC vessels in Area VI was reduced annually and is set for 0 in 2010.

In addition to a TAC, a number of orange roughy protection areas have been introduced in 2005, from which EU vessels have no permission to land or retain any catches of orange roughy. These areas are shown in Figures 9.1.2 and 9.1.3.

9.2.2 Data available

9.2.2.1 Landings and discards

Landings are in Table 9.2.0. Landings data were provided by France and Ireland at the level of ICES statistical rectangles to display the geographic distribution of the fishery in Figures 9.1.1 and 9.1.2. New information of French observer data is available. It is combined with data from VII and presented in Section 9.3.

9.2.2.2 Length compositions

Length distributions are available from historical observer programmes and current deep-water surveys. Available information is combined with data from Subarea VII and is presented in Section 9.3.

9.2.2.3 Age compositions

No new information. Available information is combined with data for Subarea VII and is presented in Section 9.3.

9.2.2.4 Weight-at-age

No information.

9.2.2.5 Maturity and natural mortality

No new information. Available information is combined with data for Subarea VII and is presented in Section 9.3.

9.2.2.6 Catch, effort and research vessel data

French cpue series is shown in Figure 9.2.3. The data shows that there is a strong declining trend in the cpue from the early nineties onwards. There is no update to this time-series from 2007 onwards as the fishery has virtually ceased.

9.2.3 Data analyses

No assessment was carried out for this stock in 2010. Preliminary productivity–susceptibility analysis for orange roughy in the mixed deep-water fishery was carried out and is presented in Section 3.1. The analysis needs to be further improved and adapted before it can be used for the provision of management advice.

9.2.3.1 Comments on the assessment

No assessment has been performed for this stock in 2010.

Bason *et al*. (2002) used available data up to 1998 to describe the trends in the fishery and the stock in the North east Atlantic. For the assessment he used French commercial cpue series and international survey data. The main data set is the commercial cpue. Shaefer production model and Delury depletion models have been used. Assessments have been tried in Subareas VI and VII. The results in Subarea VI were promising, the data fitted well to the models and the results were considered reliable. Both methods gave K (carrying capacity) of 6000 tons (95% confidence limits; 5500–7300 tons). Population biomass in 1998 was estimated to be about 1800 tons, 30% of carrying capacity. MSY was estimated to be about 300 t (95 % confidence limits; 100–480 t) and around 5% of carrying capacity.

9.2.4 Management considerations

No msy proxy has been evaluated.

Due to stringent management restrictions, the fishery for Orange Roughy in VI has practically ceased. A zero TAC without the allowance of a bycatch can potentially lead to discarding, if existing fisheries overlap with the distribution of Orange Roughy. A preliminary examination of French observer data does not suggest that bycatch and discarding of Orange Roughy is currently significant. In order to protect the species, careful monitoring of the spatial overlap of existing fisheries with the distribution of Orange Roughy, coupled with the collection of fisheries dependant and independent data (observer programme and surveys) is required. Management measures should be developed to ensure that there is no bycatch of this species. Length frequency data and cpues of the Scottish and Irish deep-water surveys give evidence of the occurrence of juvenile Orange Roughy along the flat grounds of the continental slope in VI and VII. There are no discard data to indicate whether these are taken in current fisheries.

Table 9.2.0. Orange roughy catch in Subarea VI.

Year	Faroes	France	E & W	Scotland	Ireland	Spain	Total
1988	-	-	-	-	-	-	0
1989	-	5	-	-	-	-	5
1990	-	15	-	-	-	-	15
1991	-	3,502	-	-	-	-	3502
1992	-	1,422	-	-	-	-	1422
1993	-	429	-	-	-	-	429
1994	-	179	-	-	-	-	179
1995	40	74	-	2	-	-	116
1996	0	116	-	0	-	-	116
1997	29	116	1	-	-	-	146
1998	-	100	-	-	-	2	102
1999	-	175	-	-	0	1	176
2000	-	136	-	-	2	-	138
2001	-	159	-	11	110	-	280
2002	n/a	152	-	41	130	-	323
2003	-	79	-	-	2	-	81
2004	-	54	-	-	2	-	56
2005	-	41	-	-	6	-	47
2006		32			1		33
2007		12					12
2008		5					5
2009*		2					2

*** Preliminary.**

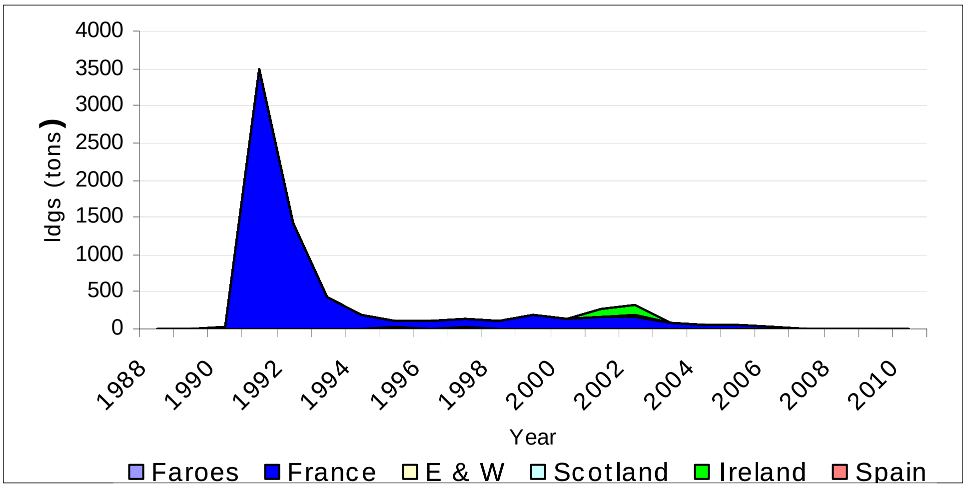


Figure 9.2.1. Time-series of Orange Roughy landings by country in ICES Area VI.

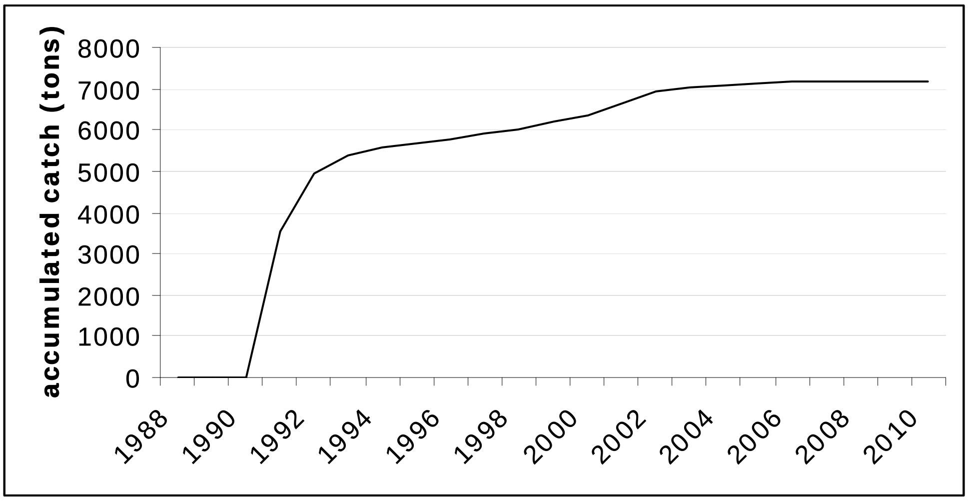


Figure 9.2.2. Accumulated catches of Orange Roughy in ICES Area VI.

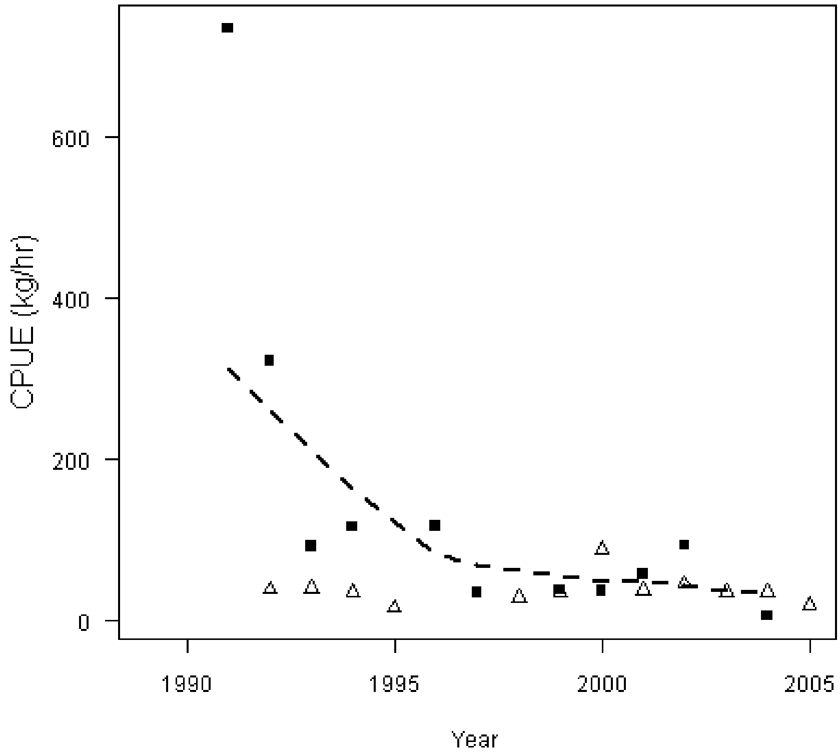


Figure 9.2.3. French 2006 cpue series (VIa) for 400–600 kw power vessels (open triangles) and for 1400–1600 kw vessels (solid squares). The line is a smooth curve through the latter series.

9.3 Orange Roughy (*Hoplostethus Atlanticus*) in Subarea VII

9.3.1 The fishery

After the collapse of the VI fishery, the main fishery for orange roughy in the northern hemisphere moved to this Subarea. French vessels used to prosecute this fishery alone, but in 2001, new Irish vessels became heavily involved in this fishery for a short number of years. Orange roughy aggregations are mainly associated with seamounts, but they are also found close to other features and on the flat grounds of the continental slope. Initially, trawlers targeted orange roughy at the base of seamounts, but since 2000 there has been a shift to fishing down the slopes of seamounts. Before the fishery closure, new features were found to replace them, as catch rates declined. Large (~50 m) high-sea French trawlers targeted orange roughy in Subarea VII up to 2001. These large trawlers have reduced their activity in VII. In recent years some targeted fishing from a few or even one single artisanal trawlers was carried out until 2008, however now catches of orange roughy are a bycatch of some remaining deepwater fishing by large trawlers.

9.3.1.1 Landings trends

Table 9.3.1 and Figure 9.3.1 show the landings data for orange roughy as reported to ICES or as reported to the Working Group. The preliminary landings for 2009 are 15 t, which are the lowest in the time-series. Over-reporting is likely to have been a feature of this fishery prior to the introduction of TACs. The restrictive quotas that have been introduced from 2003 onwards may have resulted in underreporting and misreporting at other areas and species.

A French fishery developed in 1991, and landings peaked at over 3000 t in 1992. By the end of 2000 the French fleet had removed over 13 500 t of orange roughy from this Subarea. An Irish fishery commenced in 2001, and since then the combined Irish and French accumulated landings have amounted to a further 10 800 t. There are two fisheries for Orange Roughy in the area. A single targeted peak fishery that has been occurring on distinct topographical features and a mixed trawl flat fishery that occurs along the continental slope and has Orange Roughy as a bycatch.

Historical landings data suggest several pulses in landings (Figures 9.3.1 and 9.3.2). The first occurred in 1992 when over 3000 t were landed. Landings declined until 1995, but then increased again to the highest in the series in 2002. The total accumulated catch in Area VII is 24 581 tons. A restrictive quota was introduced in 2003 and resulted in a decrease in declared landings since then.

9.3.1.2 ICES Advice

The ICES Advice statement from 2008 was:

Due to its very low productivity, orange roughy can only sustain very low rates of exploitation. Currently, it is not possible to manage a sustainable fishery for this species. ICES recommends no directed fisheries for this species. Bycatches in mixed fisheries should be as low as possible.

9.3.1.3 Management

A TAC for orange roughy in Area VII was first introduced in 2003. Landings in relation to TAC are displayed in the Table below:

		Landing (t)	
Year	TAC (t)	EC vessels	Total
2003	1349	541	541
2004	1349	467	467
2005	1149	255	255
2006	1149	489	489
2007	193	172	172
2008	130	118	118
2009	65	15	15
2010	0		

The TAC for orange roughy in VII was set to 65 t in 2009 and to 0 t in 2010, respectively. Further to a TAC, a number of orange roughy protection areas have been introduced in 2005, from which EU vessels have no permission to land or retain any catches of orange roughy. These areas are shown in Figures 9.1.1 and 9.1.2.

9.3.2 Data available

Landings data are available for all fleets. A French cpue series is available until 2006. Historic Irish catch data has been analysed from the Irish deep-water fleet. New information is available from the French deep-water fleet observer programme and the Irish and Scottish deep-water surveys.

9.3.2.1 Landings and discards

Landings are shown are in Table 9.3.0. Distribution maps of the landings by statistical rectangle per quarter for 2008 and 2009 are shown 9.1.1 and 9.1.2. Irish discard information is available from three observer discard trips carried out in 2003 and 2004, covering targeted fishery on peaks and in canyons for orange roughy and fishing on flat grounds for a mixture of roundnose grenadier, black scabbard, blue ling, siki sharks and orange roughy. Discarding of Orange roughy was zero in the peak fishery and <1% on the flat fishery.

From the on-board observations of the French deep-water fishery in Area Va, VI and VII, it appears that the bycatch of orange roughy might be minor on most fishing grounds. The total catch (landings and discards) observed during the observations program from 2004 to 2009 amounts to around 2000 tonnes (Table 9.3.2). The contribution of orange roughy in this weight caught, was minor, 118 kg only (Table 9.3.3). This is in line with logbook data, where French landings of orange roughy have decreased over time, and the catch in recent year was reported from a small number of logbook records only (Table 9.3.4). Note that landings data from 2009 are preliminary and might represent less than half the actual total 2009 catch (Logbook records corresponds to one day in one ICES rectangle).

9.3.2.2 Length compositions

New survey length frequency information is available from the Irish and Scottish deep-water trawl surveys (Figure 9.3.3) which sampled the flat grounds along the continental slope in VI and VII from 2006 to 2009. Survey data show that the length frequency on gentle slopes has several peaks between 7 and 23 cm with a further peak between 45 and 65 cm suggesting the presence of several juvenile cohorts. Length frequencies from most of the commercial catches show a distribution between 45 and 65 cm (WGDEEP, 2008).

9.3.2.3 Age compositions

No new age information is available. Most recent age data was available from sampling at sea on commercial trawlers operating on the Porcupine Bank during September 2003 to April 2004 and February 2005 (Sheppard and Rogan, 2006). The von Bertalanffy growth model was fitted to the data (R^2=0.92). Estimated growth parameters were: L_∞=47.6 cm, k=0.039 yr-1 and t0=2.61 years. (Standard length). Orange roughy in the area west of Ireland appear to reach the greatest age of any populations so far examined.

9.3.2.4 Weight-at-age

No data.

9.3.2.5 Maturity and natural mortality

Recently estimated maturity L50 was 34 cm SL for Orange Roughy collected from the flats fishery and 37 cm SL from hill aggregations on the Porcupine Bank (Sheppard and Rogan, 2006). This is similar to the estimate from the west of Ireland of 36 cm SL (Minto and Nolan, 2003). These are higher than that estimated for orange roughy in New Zealand and Australia.

9.3.2.6 Catch, effort and research vessel data

Historical French cpue series is shown in Figure 9.3.6. The data shows that there is a strong declining trend in the cpue from the nineties onwards. No new data is available for this cpue from 2006 onwards, as the fishery has virtually ceased. Standardised cpues for Irish deep-water trawlers targeting Orange Roughy are shown in Figure 9.3.7. These are based on personal logbooks and are calculated using the mean catch weight per haul per month for the period of January 2001 to December 2003, i.e. the main period when the Irish trawlers were participating in the fishery. In the peak fishery for Orange Roughy, the trawl is often fast on the bottom or sometimes lifted over coral and rocks. Effective fishing time can be as short as 20 minutes. Trawling time therefore does not give any good indication of effort and consequently, only catch per haul is used for the analysis. The data shows a strong increasing trend towards spring of 2002, when the highest catches were taken. It subsequently declined in 2003. The cpue from fishery on flat ground was also worked up but the data was scarcer as it only developed as a regular fishery since the second half of 2002.

Mean catch rates (number/hours) for Orange Roughy from the Irish deep-water trawl survey are shown in Figure 9.3.8 for individuals >23 cm (a.) and < 23 cm (b.) caught in the 1000 m to 1500 m depth band between 2006–2009. Data is very variable, but do indicate the entry of juveniles into the population.

9.3.3 Data analyses

No assessment was carried out for this stock in 2010. Preliminary productivity–susceptibility analysis for orange roughy in the mixed deep-water fishery was carried out and is presented in Section 3.1. The analysis needs to be further improved and adapted before it can be used for the provision of management advice.

9.3.4 Comments on the assessment

NA.

9.3.5 Management considerations

Due to stringent management restrictions, the fishery for Orange Roughy fishery in VII has practically ceased. A zero TAC without the allowance of a bycatch can potentially lead to discarding if existing fisheries overlap with the distribution of Orange roughy. A preliminary examination of French observer data does not suggest that bycatch and discarding of Orange Roughy is currently significant. In order to protect the species, careful monitoring of the spatial overlap of existing fisheries with the distribution of Orange Roughy, coupled with the collection of fisheries dependant and independent data (observer programme and surveys) is required. If signals indicate an overlap and a likely impact of fisheries on Orange Roughy, then the potential for a sustainable bycatch quota for Orange Roughy should be evaluated.

Table 9.3.1. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, by nation in Subarea VII.

Year	France	Spain	E & W	Ireland	Scotland	Faroes	Total
1988	-	-	-	-	-	-	0
1989	3	-	-	-	-	-	3
1990	2	-	-	-	-	-	2
1991	1406	-	-	-	-	-	1406
1992	3101	-	-	-	-	-	3101
1993	1668	-	-	-	-	-	1668
1994	1722	-	-	-	-	-	1722
1995	831	-	-	-	-	-	831
1996	879	-	-	-	-	-	879
1997	893	-	-	-	-	-	893
1998	963	6	-	-	-	-	969
1999	1157	4	-	-	-	-	1161
2000	1019	-	-	1		-	1020
2001	1022	-	1	2367	22	-	3412
2002	300		14	5114	33	4	5465
2003	369			172			541
2004	279			188			467
2005	165			90			255
2006	451			37			489
2007	145			28			164
2008	118						118
2009*	15						15

***Preliminary.**

Table 9.3.2. Total discards and landings from during on-board observations of the French deep-water fishery, 2004–2009 (no sampling in 2007).

Year	2004	2005	2006	2008	2009
Discards (tonnes)	258 783	128 602	86 498	60 970	180 591
Landings (tones)	401 263	213 061	93 247	202 628	538 039

Table 9.3.3. Discards and landings of orange roughy from during on-board observations of the French deep-water fishery, 2004–2009 (no sampling in 2007).

Year	2004	2005	2006	2008	2009
Discards (kg)	8	1	3	15	8
Landings (kg)	35	6	16	0	24

Table 9.3.4. French landings of orange roughy (tones) 1992–2009, all areas combined, and number of logbook records were the species was reported.

Year	Orange Roughy landings	Number of Logbook records with Orange Roughy
1992	3 995 989	1906
1993	1 686 433	1914
1994	1 621 093	1590
1995	992 776	1006
1996	1 043 569	884
1997	1 017 335	1109
1998	291 011	1083
1999	1 411 436	1134
2000	1 183 031	1948
2001	1 250 808	1997
2002	484 692	1762
2003	547 320	1810
2004	511 598	1686
2005	280 116	801
2006	537 224	870
2007	172 161	295
2008	116 358	283
2009	21 875	35

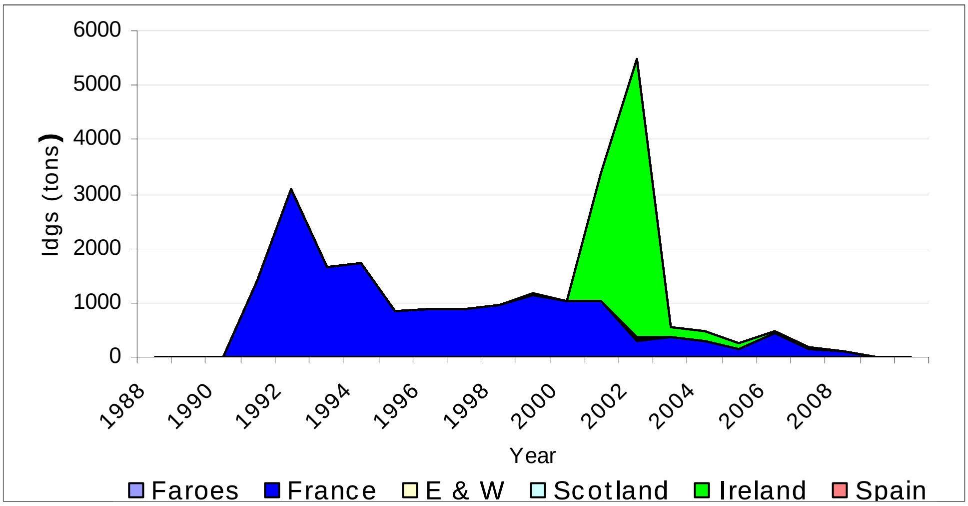


Figure 9.3.1. Time-series of Orange Roughy landings by country in ICES Subarea VII.

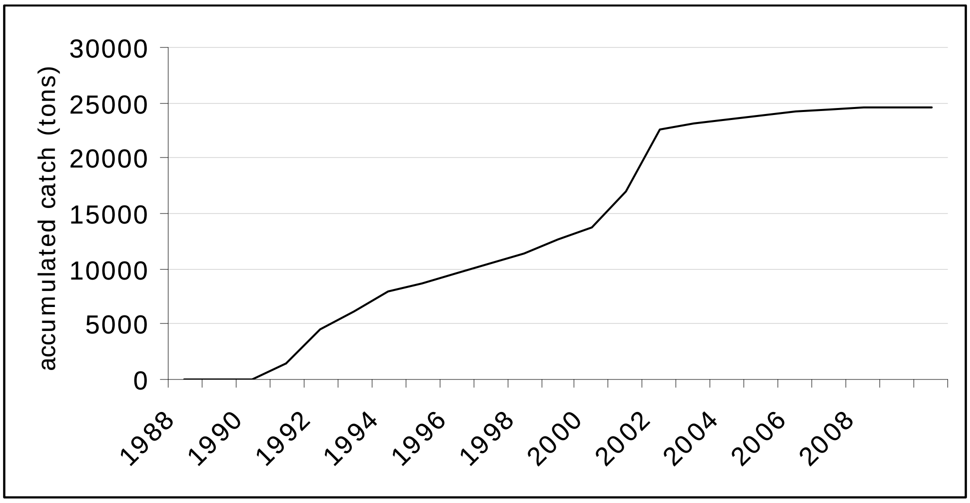


Figure 9.3.2. Accumulated catches of Orange Roughy in ICES Area VII (total in 2009 is 24 581 tons).

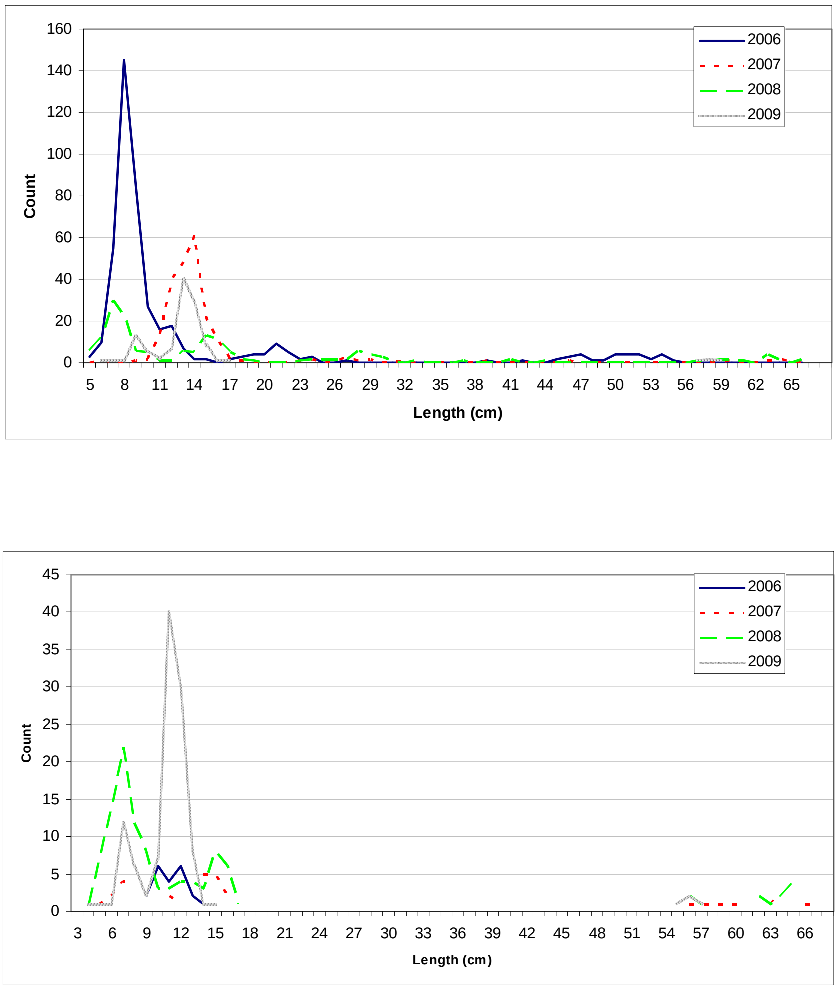


Figure 9.3.3. Length frequency of Orange Roughy caught at the Irish (upper panel) and Scottish (lower panel) deep-water survey 2006–2009.

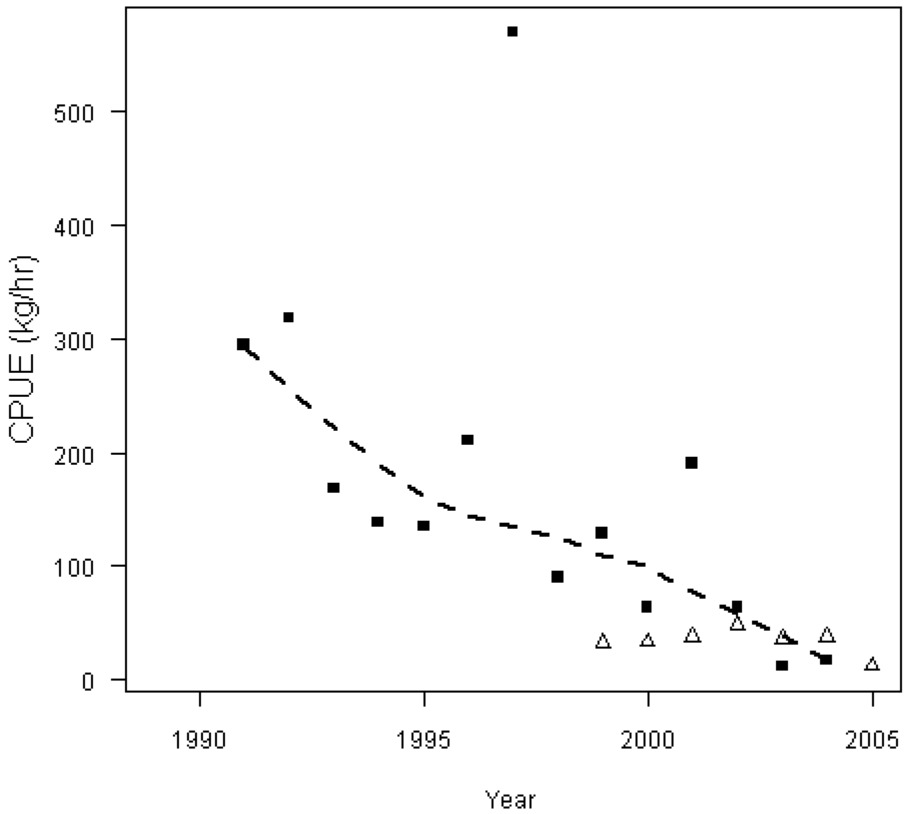


Figure 9.3.4. 2006 cpue series for 400–600 kw power vessels (open triangles) and for 1400–1600 kw vessels (solid squares). The line is a smooth curve through the latter series excluding the high 1997 point.

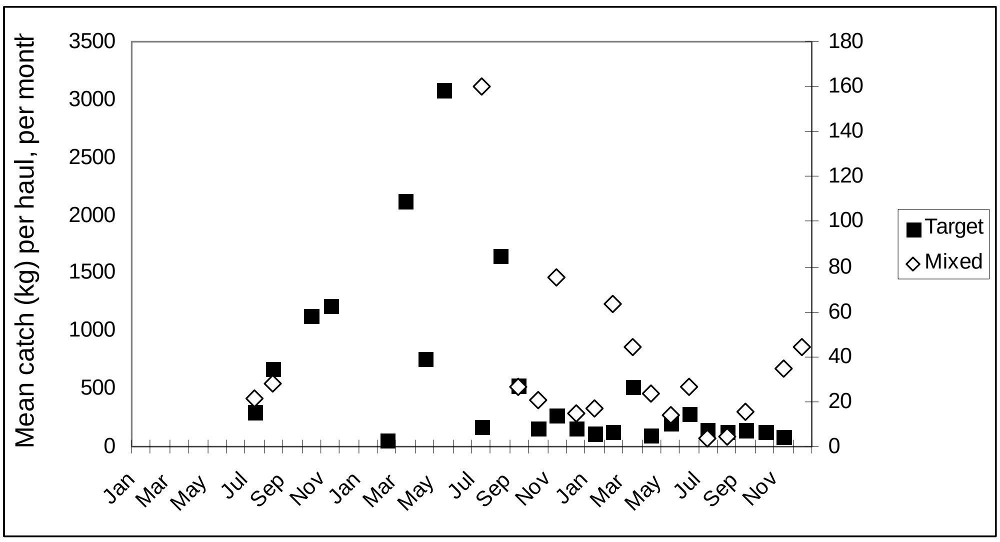
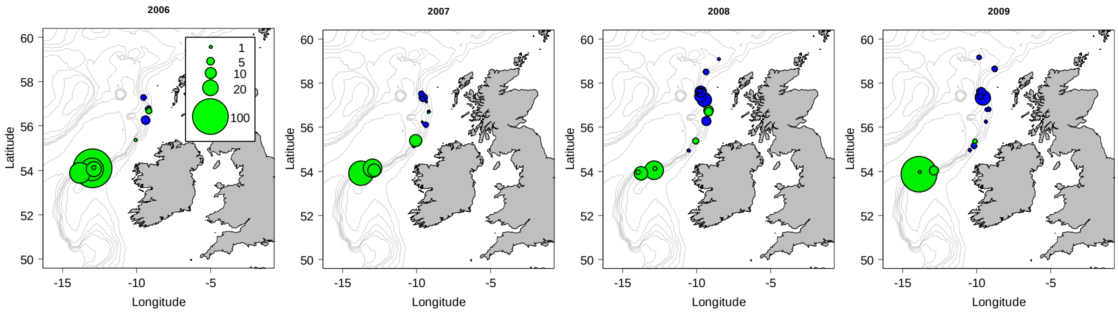


Figure 9.3.5. Cpue series for Irish deep-water trawlers targeting Orange Roughy with mean catch weight by haul per month between January 2001 and December 2003 for targeted (closed squares) and mixed fisheries hauls (open diamonds). Secondary axis corresponds to mixed fishery.

a.)



b.)

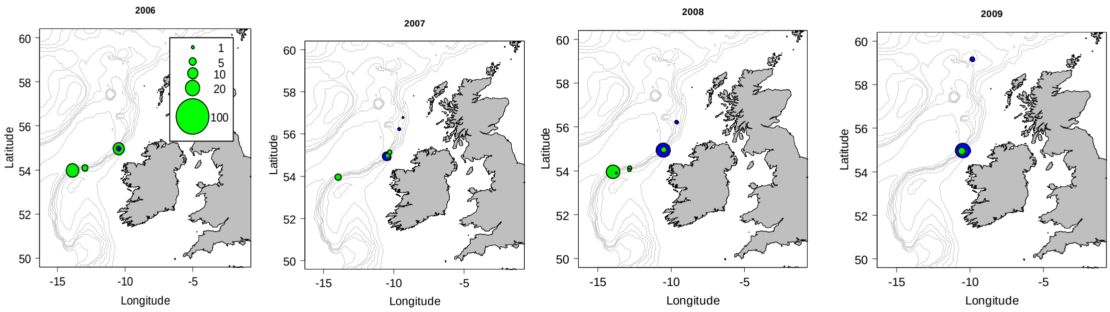
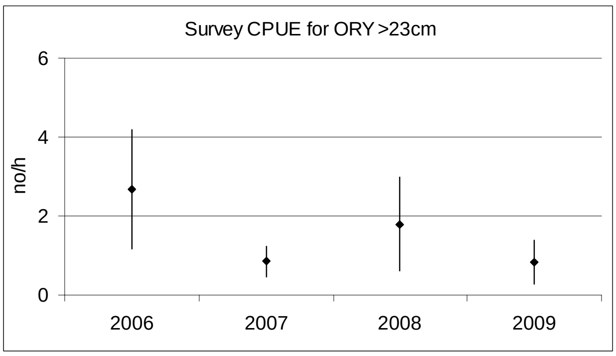


Figure 9.3.4. Cpue of a.) Orange Roughy (≤23 cm) and cpue of b.) Orange Roughy (>23 cm), 2006–2009. Combined Irish (green) and Scottish (blue) Deep-water survey data.



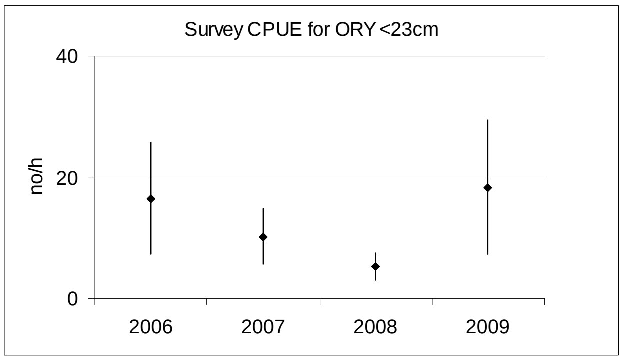


Figure 9.3.4 Mean catch rates (number/hours) for Orange Roughy >23 cm (a.) and < 23 cm (b.) caught at the Irish deep-water survey 2006–2009 in the 1000 m to 1500 m depth band (±1SE).

9.4 Orange Roughy (*Hoplostethus atlanticus*) IN I, II, IIIa, IV, V, VIII, IX, X, XII, XIV

9.4.1 The fishery

Small fisheries have existed in Subareas Va, Vb, VIII, and X, and a relatively modestly sized one in XII. Most started in the early 1990s, the exception being Subarea X which started in 1996. There has been no real fishery in IX, just a few tonnes caught over a few years.

9.4.1.1 Landing trends

Table 9.4.0 demonstrates the landings data for orange roughy for the ICES area as reported to ICES or as reported to the Working Group. Figures 9.1.1 and 9.1.2 show the landings by statistical rectangle for 2008 and 2009.

In Division Va, the fishery peaked with landings of over 700 t in 1993, and landings have declined to very low levels by 2002. In Division Vb, landings were highest in 1995, at 420 t, but since 1997 they have been small in recent years except for in 2000.

In Subarea VIII, there have been small landings by France since the early 1990s. In Subareas VIII and IX, Spain has recorded small landings in some years.

In Subarea X, there are fluctuating Faroese landings, and in 2000, there was an experimental fishery by the Azores (Portugal). This fishery has not been continued.

In Subarea XII, the Faroes dominated the fishery throughout the 1990s, with small landings by France. In one year each, New Zealand and Ireland have targeted orange roughy in this area. There are many areas of the Mid-Atlantic Ridge where aggregations of this species occur, but the terrain is very difficult for trawlers.

A Faroese exploratory trawl fishery took place in 2008 in the Mid-Atlantic Ridge area. This fishery was mainly targeting at orange roughy and black scabbard fish, and was undertaken in the period 13 February to 9 March 2008 in ICES Areas X and XII according to a resolution adopted at the 26th Annual Meeting of NEAFC on management measures for orange roughy. The fishery was performed with one trawler (M/S Ran TG0752) with many years participation in the Faroese orange roughy fishery. The gear was a traditional bottom trawl, but in the fishing operations the trawl doors did not touch the bottom. All information for the fishery was registered in accordance with NEAFC Recommendation X: 2007 concerning submission of scientific information on deep-sea fisheries. The Faroese Fisheries Laboratory provided instructions for how to keep logbook such that all the information mentioned in NEAFC recommendation was properly recorded (Reinert, 2010 WD).

9.4.1.2 ICES Advice

The ICES Advice statement from 2008 was:

Due to its very low productivity, orange roughy can only sustain very low rates of exploitation. Currently, it is not possible to manage a sustainable fishery for this species. ICES recommends no directed fisheries for this species. Bycatches in mixed fisheries should be as low as possible.

9.4.1.3 Management measures

For 2005 and 2006, an overall TAC of 102 t was set for EC vessels that covered the zones: I, II, III, IV, V, VIII, IX, X, XII, XIV. This TAC has been reduced every year since then and is 15 t in 2009 and 0 t in 2010. The TAC applies to Community waters and international waters. Landings in relation to TAC were as follows, Add sentence on NEACF recommendation about impact assessment for new bottom fishing habitats.

		Landing (t)	
Year	TAC (t)	EC vessels	Total
2005	102	71	278
2006	102	58	149
2007	44	16	36
2008	30	8	112
2009	15	5	62
2010	0		

9.4.2 Data available

9.4.2.1 Landings and discards

Landings are in Table 9.4.0.

9.4.2.2 Length composition

No new information.

9.4.2.3 Age composition

No data.

9.4.2.4 Weight-at-age

No data.

9.4.2.5 Maturity and natural mortality

No specific data for this Subarea.

9.4.2.6 Catch, effort and research vessel data

No new information supplied to the Working Group.

9.4.3 Data analysis

No assessment has been carried out during WGDEEP 2010.

9.4.4 Management considerations

Due to its very low productivity, orange roughy can only sustain very low rates of exploitation. Currently, it is not possible to manage a sustainable fishery for this species. ICES recommends no directed fisheries for this species. Bycatches in mixed fisheries should be as low as possible. Impact assessment of any newly developing deepwater fisheries (whatever the target species) should be carried out to evaluate the risk to this species.

Table 9.4.0a. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Division Va.

Year	Iceland	Total
1988	-	0
1989	-	0
1990	-	0
1991	65	65
1992	382	382
1993	717	717
1994	158	158
1995	64	64
1996	40	40
1997	79	79
1998	28	28
1999	14	14
2000	68	68
2001	19	19
2002	10	10
2003	0	0
2004	28	28
2005	9	9
2006	2	2
2007	0	0
2008	4	4
2009	<1	<1

Table 9.4.0b. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Division Vb.

Year	Faroes	France	Total
1988	-	-	0
1989	-	-	0
1990	-	22	22
1991	-	48	48
1992	1	12	13
1993	36	1	37
1994	170	+	170
1995	419	1	420
1996	77	2	79
1997	17	1	18
1998	-	3	3
1999	4	1	5
2000	155	0	155
2001	1	4	5
2002	1	0	1
2003	2	3	5
2004		7	7
2005	3	10	13
2006	0	0	0
2007	0	1	1
2008	0	<1	<1
2009	<1	2	2

Table 9.4.0c. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea VIII.

Year	France	Spain VIII and IX	E & W	Total
1988	-	-	-	0
1989	0	-	-	0
1990	0	-	-	0
1991	0	-	-	0
1992	83	-	-	83
1993	68	-	-	68
1994	31	-	-	31
1995	7	-	-	7
1996	22	-	-	22
1997	1	22	-	23
1998	4	10	-	14
1999	33	6	-	39
2000	47	-	5	52
2001	20	-	-	20
2002	20	-	-	20
2003	31			31
2004	43			43
2005	29			29
2006	43			43
2007	1			1
2008	8			8
2009	3			3

Table 9.4.0d. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea IX.

Year	Spain	Total
1990	-	0
1991	-	0
1992	-	0
1993	-	0
1994	-	0
1995	-	0
1996	-	0
1997	1	1
1998	1	1
1999	1	1
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009*		

Table 9.4.0e. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea X.

Year	Faroes	France	Norway	E & W	Portugal	Ireland	Total
1989	-	-	-	-	-		0
1990	-	-	-	-	-		0
1991	-	-	-	-	-		0
1992	-	-	-	-	-		0
1993	-	-	1	-	-		1
1994	-	-	-	-	-		0
1995	-	-	-	-	-		0
1996	470	1	-	-	-		471
1997	6	-	-	-	-		6
1998	177	-	-	-	-		177
1999	-	10	-	-	-		10
2000	-	3	-	28	157		188
2001	84	-	-	28	343		455
2002	30	-	-	-	-		30
2003		1					1
2004	384					19	403
2005	128	2					130
2006	8						8
2007	0						0
2008	37						37
2009*	26						26

Table 9.4.0f. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea XII.

Year	Faroes	France	Iceland	Spain	E & W	Ireland	New Zealand	Russia	Total
1989	-	0	-	-	-			-	0
1990	-	0	-	-	-			-	0
1991	-	0	-	-	-			-	0
1992	-	8	-	-	-			-	8
1993	24	8	-	-	-			-	32
1994	89	4	-	-	-			-	93
1995	580	96	-	-	-			-	676
1996	779	36	3	-	-			-	818
1997	802	6	-	-	-			-	808
1998	570	59	-	-	-			-	629
1999	345	43	-	43	-			-	431
2000	224	21	-	-	2			12	259
2001	345	14	-	-	2		450	-	811
2002	+	6	-	-	-		0	-	6
2003		64				136	0	-	200
2004	176	131					0		307
2005	158	36					0		193
2006	81	15							96
2007	20								20
2008	71								71
2009	34*								34

Table 9.4.0g. Orange roughy total international landings in the ICES Area, excluding VI and VII.

Year	IV	Va	Vb	VIII	IX	X	XII	All areas
1988		0	0	0	0	0	0	0
1989		0	0	0	0	0	0	0
1990		0	22	0	0	0	0	22
1991		65	48	0	0	0	0	113
1992		382	13	83	0	0	8	486
1993		717	37	68	0	1	32	855
1994		158	170	31	0	0	93	452
1995		64	420	7	0	0	676	1167
1996		40	79	22	0	471	818	1430
1997		79	18	23	1	6	808	935
1998		28	3	14	1	177	629	852
1999		14	5	39	1	10	431	500
2000		68	155	52	0	188	259	722
2001		19	5	20	0	455	811	1310
2002		10	1	20	0	30	6	67
2003		+	5	31	0	1	200	237
2004		28	7	43	0	403	307	788
2005		9	13	29	0	83	193	327
2006		2	0	43	0	8	96	149
2007	14		1	1	0	0	20	36
2008	7	4	<1	8	0	37	71	127
2009*	0	1	2	3	0	26	34	66
Total	14	1688	1004	537	3	1896	5492	10598

***Preliminary.**

10 Roundnose grenadier (*Coryphaenoides rupestris*)

10.1 Stock description and management units

ICES WGDEEP has in the past proposed four assessment units of roundnose grenadier in the NE Atlantic

- Skagerrak (IIIa);
- The Faroe-Hatton area and Celtic sea (Divisions Vb and XIIb, Subareas VI, VII);
- the Mid-Atlantic Ridge 'MAR' (Divisions Xb, XIIc, Subdivisions Va1, XIIa1, XIVb1);
- All other areas (Subareas I, II, IV, VIII, IX, Division XIVa, Subdivisions Va2, XIVb2).

The current perception is based on what is believed to be natural restrictions to the dispersal of all life stages. The Wyville-Thomson Sill may separate populations further south on the banks and slopes off the British Isles and Europe from those distributed to the north along Norway and in the Skagerrak. Considering the general water circulation in the North Atlantic, populations from the Icelandic slope may be separated from those distributed to the west of the British Isles. It has been postulated that a single population occurs in all the areas south of the Faroese slopes, including also the slopes around the Rockall Trough and the Rockall and Hatton Banks but the biological basis for this remains hypothetical.

In 2007, WGDEEP examined the available evidence of stock discrimination in this species but, on the available evidence, was not able to make further progress in discriminating stocks. On this basis WGDEEP concluded there was no basis on which to change current practice.

Catches data for roundnose grenadier in 2008 and 2009 aggregated at the level of statistical rectangle were provided to the Working Group by France, Ireland, Spain, the UK (England and Wales and Scotland) and Iceland. These are shown in Figures 10.1.1 and 10.1.2.

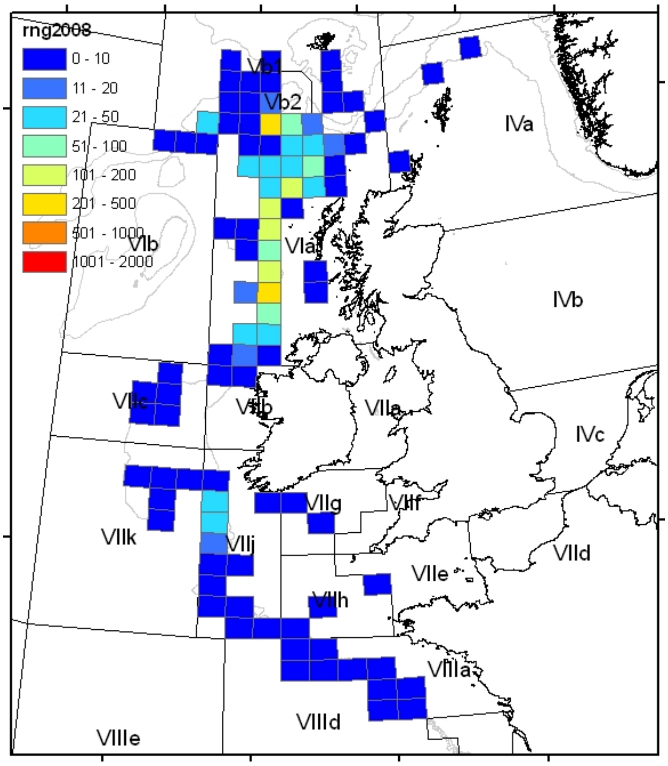


Figure 10.1.1. Catches of roundnose grenadier by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2008.

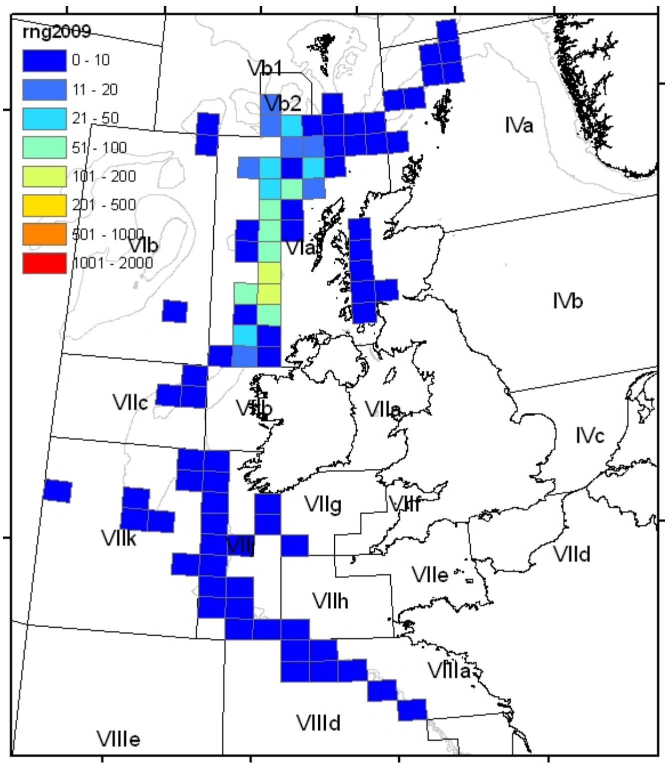


Figure 10.1.2. Catches of roundnose grenadier by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2009.

10.2 Roundnose Grenadier (*Coryphaenoides rupestris*) in Division Vb and XIIb, Subareas VI and VII

10.2.1 The fishery

The majority of landings of roundnose grenadier from this area are taken by bottom trawlers. To the west of the British Isles, in Divisions Vb, VIa, VIb2 and Subareas VII, French trawlers catch roundnose grenadier in a multispecies deep-water fishery. The Spanish trawling fleet operates further offshore along the western slope of the Hatton Bank in ICES Divisions VIb1 and XIIb.

10.2.1.1 Landings trends

This year, revisions of the landing datasets back to 2002 have been provided by Spain for Subarea VI and Division XIIb. Substantial mismatches in both regions have been noticed between observer and official data of landings. This raises some concerns about possible misreporting between the different species of grenadiers (*Coryphaenoides rupestris, Macrourus berglax* and *Trachyrincus scabrus*). Further investigation should be encouraged to assess the magnitude of potential misreporting.

French landings data for 2009 are very preliminary due to some changes in the processing of the fishing data by the administration.

Over the past two decades, in Division Vb, the landings have reached more than 3800 t in 1991 and more than 2000 t in 2001. Between these two periods, the landings were low in the mid-1990s (less than 700 t in 1994). After 2001, it decreased to about 1000 t in 2002 but increase further to about 1750 t in 2005–2007, 1100 t in 2008 and 370 t in 2009. These landings are almost exclusively from French and Faroese trawlers (Table 10.2.0a–f).

In Subarea VI, the highest landings were observed in 2001 (close to 15 000 t) and has decreased to around 2000 t in 2008 and 1800 t in 2009. Most of these landings are caught by French trawlers.

In Subarea VII landings close to 2000 t were recorded in 1993–1994; recent annual landings are much lower (from 200 to 400 t/year in 2005–2007, 30 t in 2008). In 2009, provisional landings are 30 t.

In ICES Division XIIb, the fishery is almost exclusively nowadays from Spanish trawlers. The Spanish data since 2002 have been strongly revised during this meeting. After a peak to more than 27 000 t in 2004, the reported landings have decreased to about 9000 t in 2005 and have been around 4000 t since then. There was significant Faroese landings in the mid-1990s, but this fishery disappeared in the 2000s, French landings has varied over time with a maximum of 1700 t in 2004 and has strongly decreased since that year to 85 t in 2006. There were no French landings in Division XIIb for 2007–2009.

The landings data are considered uncertain in Division XIIb, because unreported landings may occur in international waters. In addition to this, all national landings data were not reported by new ICES divisions and some landings were allocated to divisions according to knowledge of the fisheries from the Working Group.

10.2.1.2 ICES Advice

In 2009 ICES advised: *Due to its low productivity, roundnose grenadier can only sustain low rates of exploitation. Cpue in the areas has been at a reduced level. ICES recommends that catches should be constrained to 6000 t (50% of the level before the expansion of the fishery, 1990–1996). The fishery should not be allowed to expand unless it can be shown that it is sus-*

tainable.

10.2.1.3 Management

TACs for EU vessels for deep-water species have been set since year 2003. These TACs are revised every second year. The EU TAC and national quotas from member countries apply to all vessels in EU EEZ and to EU vessels in international waters.

For Division Vb and Subareas VI and VII, a TAC was set at 3910 t in 2009 and 3324 t in 2010.

In Subareas VIII, IX, X, XII and XIV the TAC was set at 5197 t in 2009 and 2010. This TAC covers areas with minor roundnose grenadier catches (VIII, IX and X), part of the assessment area (Division XIIb, the western slope of the Hatton bank) and the Mid-Atlantic Ridge (Divisions XIIa, c and Subarea XIV). The main countries having quotas allocations under this TAC are Spain and Poland. Therefore these quota allocations are based upon historical landings in XIIb for Spain and in XIIa, c (Mid-Atlantic Ridge) for Poland.

The Table below summarizes the TACs in the two management areas and landings in the assessment area.

	Vb, VI, VII		VIII, IX, X, XII, XIV		Total international landings Vb, VI, VII, XIIb
	EU TAC	EU Landings	EU TAC	EU Landings XIIb	
2005	5253	5777	7190	8782	14 558
2006	5253	4676	7190	4361	9037
2007	4600	3778	6114	4258	8036
2008	4600	3090	6114	2432	5522
2009	3910	2167*	5197	3860*	6028*
2010	3324		5197		

*** Provisional.**

After the introduction of TACs in 2003 and 2005, the reported landings have decreased. However, the reported decrease may not be real as significant misreporting is likely to have occurred.

In addition to TACs, further management measures applicable to EU fleets are a licensing system, fishing effort limits, the obligation to land the fish in designated harbours and a regulation for on-board observations according to Council Regulation (EC) No 2347/2002 of 16 December 2002. In the Faroes waters, the catch of roundnose grenadier is subject to a minimum size of 40 cm total length, other regulations that may apply to roundnose grenadier are detailed in the Overview Section.

10.2.2 Data available

10.2.2.1 Landings and discards

Landings time-series data per ICES areas are presented in Table 10.2.0

Landings data by new ICES areas were available from France, Norway and UK (England and Wales and Scotland) from 2005. No other country provided data by new ICES area. Catch in Subarea XII were allocated to Division XIIb (western Hatton Bank) or XIIa,c (Mid-Atlantic Ridge) according to knowledge of the fisheries from WG members.

Landings per ICES rectangle were available from France, UK (England and Wales and Scotland), Spain and Ireland and were plotted to display the geographical distribution of the fishery (Figures 10.2.0a–f).

Catch and discards by haul were available from observer programmes from France and Spain.

- *French observer program:* From the French observer programme, total catch, landings and discards and catch, landings and discards of roundnose grenadier were available on a haul by haul basis for 2004–2006. Discard data (quantities and length distribution) were also available from the on-board observation of the French fishery, 2004–2006, from French on-board observations on French vessels in 1997–1998 and from Scottish observers on board of French vessels, 1997–2001. New discards data are available from France in 2008 and 2009. The length distributions of discards from all these observations seem quite consistent and stable in recent years.
- Based on French observer programme 2004–2009, about 30% by weight and 50% by number of the catch of roundnose grenadier is discarded, because of small size. This figure is higher than in previous sampling where the discarding rate in the French fisheries was estimated slightly above 20% from sampling in 1997-1998 (Allain *et al.*, 2003). The change may come from a combination of changes in the depth distribution of the fishing effort and a decrease in the abundance of larger fish as visible in the landings.
- *Spanish Observer program (Hatton Bank)*: The only available discard data are from the Spanish Observer Programme. For the period 2002–2009, observers have covered on average 18±9% (range 8–27%) of the fleet fishing days in Division VIb, and 10±8% (range 3–28%) in Division XIIb. Although occasionally the discards reached 19% of the total weight catch, they are negligible in most sampled months. Annual average discards range from 2 to 15% in weight in Division VIb and from 0 to 12% by weight in Division XIIb. Average discarding for the whole period is 5% by weight in both areas. These discards, however, correspond to undersized individuals.

Official data show that on average, landings represent in Division VIb the 38% and 43% of live weight estimates and catch respectively, and the 37% in Division XII for both live weight and catch. Roundnose grenadier is processed in six different ways and the conversion factors range from 2 to 6, which probably translates into a significant loss of live weight. The question remains if this loss can account for as much as 60% of the catch, as the official data suggest.

10.2.2.2 Length composition of the landings and discards

Length composition of landings and discards were available from France (Figures 10.2.1–10.2.5) and Spain (Figures 10.2.6–10.2.7) covering different periods and areas.

For France, the modal discarded length has remained constant (Figures 10.2.1–10.2.4) at around 12 cm while the average pre-anal length of the individuals in the landings has decreased from 20.8 cm in 1990 to 16.0 in 2009 (Figure 10.2.8).

Size frequency data provided by Spain for the period 2002–2009 in VI and XIIb shows the modal length (PAFL) of landings to be closely similar between divisions with female being larger than male by around 2 cm (Figure 10.2.9). The modal length of discards is around 9.5 cm. Over the period 2002–2009, there is no apparent trend for a change of size of discards. However for landed individuals, both the average size for male and female has lost 1cm (from 15.5 cm to 14 cm for females and 13.5 to 12.2 cm for males).

The difference of modes of the length distributions of landed catch between the Spanish fleet in Divisions VIb and XIIb and France is probably because of different sorting habits in relation to different markets. It is therefore important that length distribution of the landings and discards are provided to the Working Group by all fleets exploiting the stock.

10.2.2.3 Age composition

No new data.

10.2.2.4 Weight-at-age

No new data.

10.2.2.5 Maturity and natural mortality

No new data on maturity and natural mortality was collected in recent years. Natural mortality was previously estimated from catch curves and an estimated M=0.1 was used by the Working Group since 2002. It should be kept in mind than this estimate is based on limited data.

10.2.2.6 Research vessel survey and cpue

Research Vessel survey

No new data.

Lpues from the French trawl fishery to the west of the British Isles.

Data from French tallybooks were updated for 2008 and 2009. Lpues for roundnose grenadier were calculated based on those data.

10.2.3 Data analyses

Benchmark assessments

Trends from lpues

Abundance indices (2000–2009) were calculated based upon the French tallybook data (see Stock Annex). The grenadier abundance was predicted for the mean length of all tows carried out in every rectangle of the five small areas and averaged across rectangles (Figure 10.2.10–12). Trends in each box are relatively the same: after a period of decline from 2000 to 2003, indices have been stable since then.

Multi-Year Catch curve analysis

The Multi year catch curve (MYCC) model developed as part of the EU-Deepfishman project with which first trials were prepared for WKDEEP (see Stock Annex) was used to assess trend in Z per year with the same four datasets as used in the Bayesian Surplus Production Model i.e. four time-series of landings (no discards included). The model converged for two out of the four datasets. It should be noted that the development of this model is still on-going.

Some model parameters need to be fixed, fixed parameters where as follow:

- natural mortality (M=0.1);

- Coefficient of variations of the recruitement (CVrec= 0.1);
- Coefficient of variations of the landings or catch (CVo=0.05 : CV of observations).

The model was run on age 25–46+ (fully recruited stock).

The results indicated that since the beginning of the time-series, Z increased and peaked in 2003–2005(Figure 10.2.13). Afterwards, Z declined close to those from 1990.

Bayesian surplus production model

A Bayesian surplus production model is used for this stock and results are used as indicators of trends (see stock annex). The following datasets were used for the reference assessment ('Ref'):

- landings in Vb, VI, VII (1988–2009);
- Abundances indices from the French tallybooks (2000–2009).

The abundances indices used for the assessment have been compiled using the same method than during the WKDEEP benchmark: abundances indices are derived from five small areas (Section 10.2.3.1) and are combined together with relative weights corresponding to the intensity of catches in the respective areas. Those indices slightly differ from those of Section 10.2.3.1 without affecting the trends and conclusions of the analysis of lpues.

Exploratory assessments

The benchmarked assessment methodology uses data only from Vb, VI and VII. In order to evaluate the effects of including data from XIIb, additional exploratory assessments were run:

- lpue indices from Section 10.2.3.1 instead of those from the benchmark ('PredAll' run);
- Vb, VI, VII and XIIb reported landings and effort; landings and abundances indices in XIIb ('+XIIb' run) were combined to the reference run using landings in XIIb and Spanish effort data. Abundances indices from lpues for 2002–2009 were combined with a weighting corresponding to the relative importance of the landings in XIIb and Vb, VI, VII.
- As above including misreporting: Spanish landings data in VI ('Infl6SP' run) and XIIb ('+XIIbSP' run) were inflated with landings data of *Macrourus berglax* and *Trachyrincus scabrous* for those regions.
- Vb, VI and VII reported and misreported landing

The various times-series used for those runs are listed in Table 10.2.2.

10.2.3.1 Comments on the assessments

The benchmark assessment is considered as indicative of trends only. Diagnostic plots of the reference assessment are presented in Figure 10.2.16.

Uncertainties on exploitable biomass estimates and harvest rate estimates are high (Figure 10.2.17–10.2.20). All simulations present a decline of around 50% in median exploitable biomass from 1988 to 2003. Then biomass is relatively stable. Median estimated harvest rate, expressed as the ratio of landings over biomass exhibits an increase up to 2006 with increasing uncertainties followed by a decrease to the 2002–2003 levels. Harvest rates in 2006 were more or less the double of those in 1988.

The use of updated abundance indices (Figure 10.2.18) in Section 10.2.3.1 did not substantially affected biomass estimates but increased the standard deviations for each year.

In the exploratory assessments, the inclusion of XIIb (Figure 10.2.19) data resulted of an increase of around 85% of the biomass estimates in 1988 and by 110% in 2009 in comparison to the reference assessment. This highlights the need of accurate landings and effort data in XIIb.

Considering all Spanish landings of grenadier species in VI as *those of Coryphaenoides rupestris* has led to an increase of landings ranging year by year ranging from 40 to 130%. The simulation has reflected this by an increase of 16% of the biomass in 2009 (Figure 10.2.20). For the assessment on the entire stock, total landings were inflated by 15 to 30%. This resulted in a decreased of the 2009 biomass by 16% (Figure 10.2.19). Those changes in biomass appear quite unpredictable and small in comparison of the amplitude of uncertainties in the biomass estimates therefore the effect of misreporting does not seem to be substantial for the assessment.

All exploratory simulations present a decline of around 50% in median exploitable biomass from 1988 to 2003.

10.2.4 Management considerations

In previous years, the ICES Advice has been precautionary considering there are some evidences that biomass depletion has occurred for Vb, VI, VII and XIIb since the beginning of the fishery in the early 1990s.

Analysis of biomass trends using the benchmark method shows that a decline occured from 1998 to 2003 and has since been relatively stable at a low level.

In the management Area Vb, VI and VII, TACs have not been caught from 2006 onwards. In 2008, about ²/₃ of the TAC was landed. Similar patterns occurred in the management Area VIII IX, X XII and XIV.

Management options for this stock are either to maintain a status quo catch of 6000 t or to reduce the catch to take account of the fact that stock continues to remain at a low level.

Roundnose grenadier is taken as one of the target species in a mixed-species fishery, along with other deep-water species (black scabbard and deep-water sharks in Division Vb, Subareas VI and VII) or as a bycatch in fisheries for other species (*Pandalus borealis* in the deeper parts of Division III). Any measures taken to manage the stocks of grenadier should take account of the advice given for all the species taken in the same deep-water mixed fishery.

Table 10.2.0a. Working Group estimates of landings of roundnose grenadier from Division Vb.

Year	Faroes	France	Norway	Germany	Russia/USSR	UK (E+W)	UK (Scot)	TOTAL
1988				1				1
1989	20	181		5	52			258
1990	75	1470		4				1549
1991	22	2281	7	1				2311
1992	551	3259	1	6				3817
1993	339	1328		14				1681
1994	286	381		1				668
1995	405	818						1223
1996	93	983		2				1078
1997	53	1059						1112
1998	50	1617						1667
1999	104	1861	2			29		1996
2000	48	1699		1		43		1791
2001	84	1932						2016
2002	176	774				81		1031
2003	490	1032				10		1532
2004	508	985	0	0	6	0	76	1575
2005	903	884	1	0	1	0	48	1837
2006	900	875	0	0	0	0	0	1775
2007	838	862	0	0	0	0	0	1700
2008	665	447	0	0	0	0	0	1112
2009*	322	44	0	0	0	0	2	368

*** Preliminary.**

Table 10.2.0b. Working Group estimates of landings of roundnose grenadier from Subarea VI.

YEAR	ESTONIA	FAROES	FRANCE	GERMANY	IRELAND	LITHUANIA	NORWAY	POLAND	RUSSIA	SPAIN	UK (E+W)	UK (SCOT)	TOTAL
1988		27		4							1		32
1989		2	2211	3								2	2218
1990		29	5484	2									5515
1991			7297	7									7304
1992		99	6422	142			5				2	112	6782
1993		263	7940	1								1	8205
1994			5898	15	14							11	5938
1995			6329	2	59							82	6472
1996			5888									156	6044
1997		15	5795		4							218	6032
1998		13	5170				21			3			5207
1999			5637	3	1					1			5642
2000			7478		41		1			1002	1	433	8956
2001	680	11	5897	6	31	137	32	58	3	6942	21	955	14 773
2002	821		7209		12	1817		932			6	741	11 538
2003	52	32	4924		11	939		452	3			185	6598
2004	26	12	4574	0	8	961	0	13	72	1991	0	72	7729
2005	80	24	2897	0	17	92	1	0	71	467	0	44	3694
2006	34	25	1931	0	5	112	0	0	0	393	0	15	2515
2007	0	10	1552	0	2	31	0	0	0	252	0	4	1851
2008	0	5.962	1433	0	0	11	0	0	16	458	0	27	1951
2009*	0	6	998	0	0	0	0	0	0	752	0	15	1771

***Preliminary.**

Table 10.2.0c. Working Group estimates of landings of roundnose grenadier from Subarea VII.

YEAR	FAROES	FRANCE	IRELAND	SPAIN	UK (SCOT)	TOTAL
1988						0
1989		222				222
1990		215				215
1991		489				489
1992		1556				1556
1993		1916				1916
1994		1922				1922
1995		1295				1295
1996		1051				1051
1997		1033		5		1038
1998		1146		11		1157
1999		892		4		896
2000		859				859
2001		938	416			1354
2002	1	449	605		3	1058
2003		373	213		1	587
2004	0	248	320	0	0	568
2005	0	191	55	0	0	246
2006		248	138	0	0	386
2007		207	20	0	0	227
2008		27				27
2009*		28				28

*** Preliminary ** French landings reported in former ICES Subarea XII allocated to XIIb.**

Table 10.2.0d. Working Group estimates of landings of roundnose grenadier from Subarea XIIb.

Year	Estonia	Faroes	France **	Germany	Iceland	Ireland	Lithuania	Spain	USSR/Russia	UK (E+W)	UK (Scotl.)	Norway	Total
1988													0
1989			0						52				52
1990			0										0
1991			14						158				172
1992			13										13
1993		263	26	39									328
1994		457	20	9									486
1995		359	285										644
1996		136	179		77			1136					1528
1997		138	111					1800					2049
1998		19	116					4262					4397
1999		29	287					8251	6				8573
2000		6	374	9				5791		9	6		6195
2001		2	159			3		5922			7	1	6094
2002			14				18	10 045		1	2		10 080
2003			539			1	31	11 663			1		12 235
2004		8	1693				120	10 880	91		4		12 796
2005	20	5	508				13	7804	81		350		8782
2006	27	1	85				6	4242					4361
2007	140	2	0				8	4108					4258
2008		0	0				3	2416	13				2432
2009*			0					3860					3860

Table 10.2.0e. Working Group estimates of landings of roundnose grenadier unallocated landings in Vb VI and VII.

Year	Unallocated
1988	
1989	
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	
2000	
2001	208
2002	504
2003	952
2004	0
2005	0
2006	0
2007	0
2008	0
2009*	0

Table 10.2.0f. Working Group estimates of landings of roundnose grenadier Vb, VI, VI and XIIb.

Year	Vb	VI	VII	XIIb	Unallocated	Vb,VI,VII	Overall total
1988	1	32	0	0	0	33	33
1989	258	2218	222	52	0	2698	2750
1990	1549	5515	215	0	0	7279	7279
1991	2311	7304	489	172	0	10 104	10 276
1992	3817	6782	1556	13	0	12 155	12 168
1993	1681	8205	1916	328	0	11 802	12 130
1994	668	5938	1922	486	0	8528	9014
1995	1223	6472	1295	644	0	8990	9634
1996	1078	6044	1051	1528	0	8173	9701
1997	1112	6032	1038	2049	0	8182	10 231
1998	1667	5207	1157	4397	0	8031	12 428
1999	1996	5642	896	8573	0	8534	17 107
2000	1791	8956	859	6195	0	11 606	17 801
2001	2016	14 773	1354	6094	208	18 143	24 237
2002	1031	11 538	1058	10 080	504	13 627	23 706
2003	1532	6598	587	12 235	952	8717	20 952
2004	1575	7729	568	26 887	0	9872	22 668
2005	1837	3694	246	8782	0	5777	14 558
2006	1775	2515	386	4361	0	4676	9037
2007	1700	1851	227	4258	0	3778	8036
2008	1112	1951	27	2432	0	3090	5522
2009*	368	1771	28	3860	0	2167	6028

***Preliminary.**

Table 10.2.2. Time-series of landings and lpues used for the reference and exploratory assessments.

	Landings data (1988–2009)				LPUE (2000–2009)		LPUE (2002–2009)
	Vb, VI, VII	Vb, VI, VII	Vb, VI, VII	Vb, VII	WKDEEP	WGDEEP 2010	Combined
		VI (all grenadiers)	XIIb	VI+XIIb (all grenadiers)	method	method	Vb, VI, VII, XIIb
Simulations	Ref	+Infl6SP	+XIIb	+XIIbSP	Ref	PredAll	+XIIb
					+Infl6SP		+XIIbSP
1988	33	33	33	33	-	-	-
1989	2698	2698	2750	2750	-	-	-
1990	7279	7279	7279	7279	-	-	-
1991	10 104	10 104	10 276	10 276	-	-	-
1992	12 155	12 155	12 168	12 168	-	-	-
1993	11 802	11 802	12 130	12 130	-	-	-
1994	8528	8528	9014	9014	-	-	-
1995	8990	8990	9634	9634	-	-	-
1996	8173	8173	9701	9701	-	-	-
1997	8182	8182	10 231	10 231	-	-	-
1998	8031	8031	12 428	12 428	-	-	-
1999	8534	8534	17 107	17 107	-	-	-
2000	11 606	11 606	17 801	17 801	1.000	1.000	-
2001	18 143	18 143	24 237	24 237	0.884	0.680	-
2002	13 627	13 627	23 706	24 843	0.989	0.649	1.000
2003	8717	8717	20 952	21 174	0.473	0.384	1.075
2004	9872	9894	36 759	37 484	0.421	0.389	1.049
2005	5777	8346	14 558	16 993	0.454	0.359	0.549
2006	4676	8695	9037	10 475	0.448	0.330	0.492
2007	3778	8804	8036	10 471	0.536	0.300	0.492
2008	3090	4274	5522	6347	0.693	0.338	0.641
2009	2167	3377	6028	7163	0.610	0.376	0.433

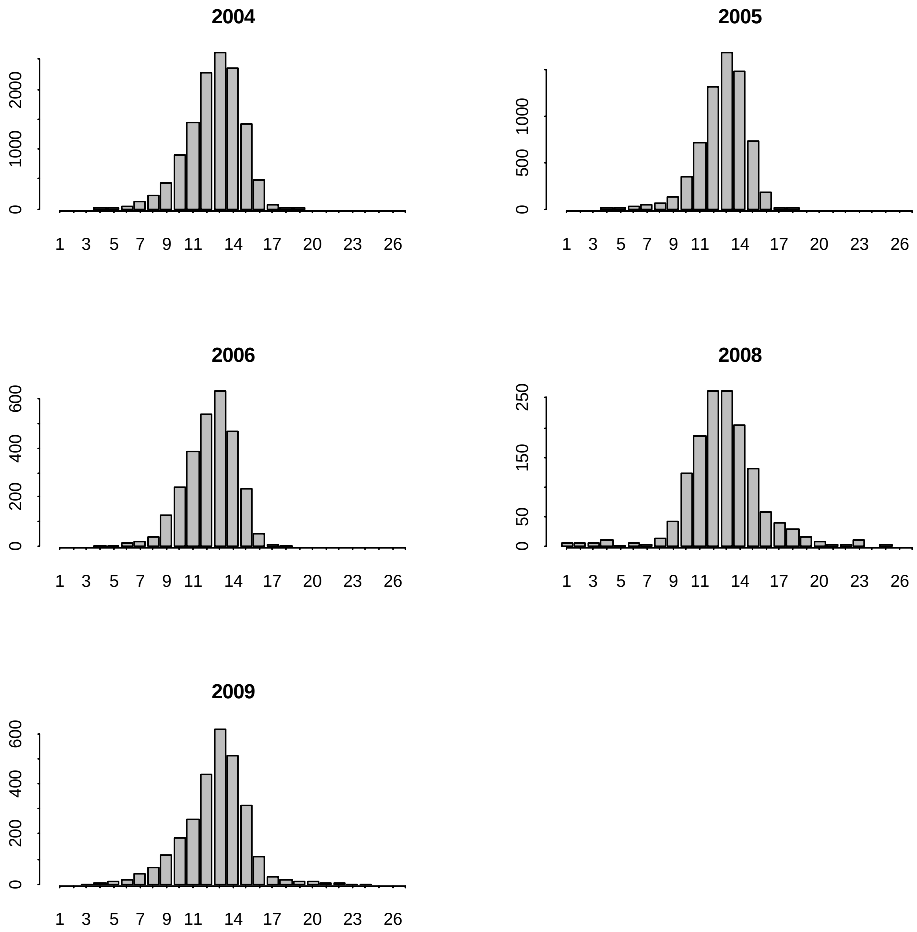


Figure 10.2.1. Sampling of the length distribution of discards (black) of roundnose grenadier from the on-board observation program 2004–2009.

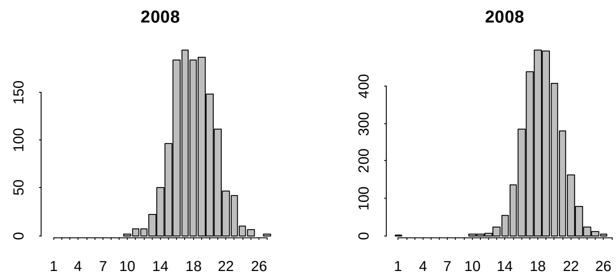


Figure 10.2.2. Sampling of the length distribution of landings (grey) and discards (black) of roundnose grenadier from the on-board observation program 2004–2009 (landings were not measured on board in 2004–2007).

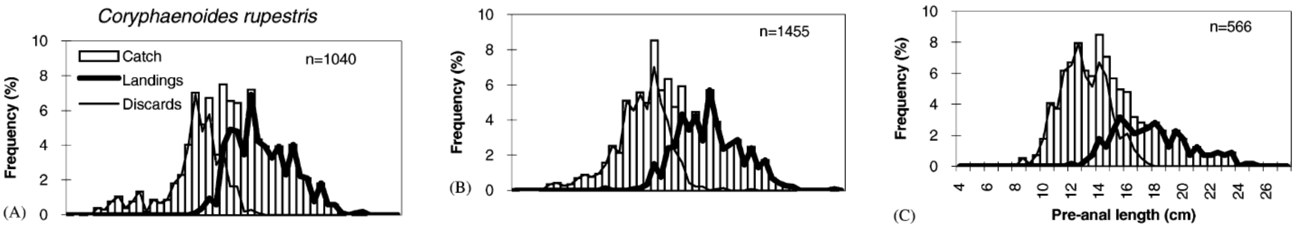


Figure 10.2.3. Length distribution of the discards and landings of roundnose grenadier in 1996–1997 by depth, left: 800–1000 m, centre: 100–1200 m, right: 1200–1400 m, sampled on board French vessels, (redrawn from Allain, 2003).

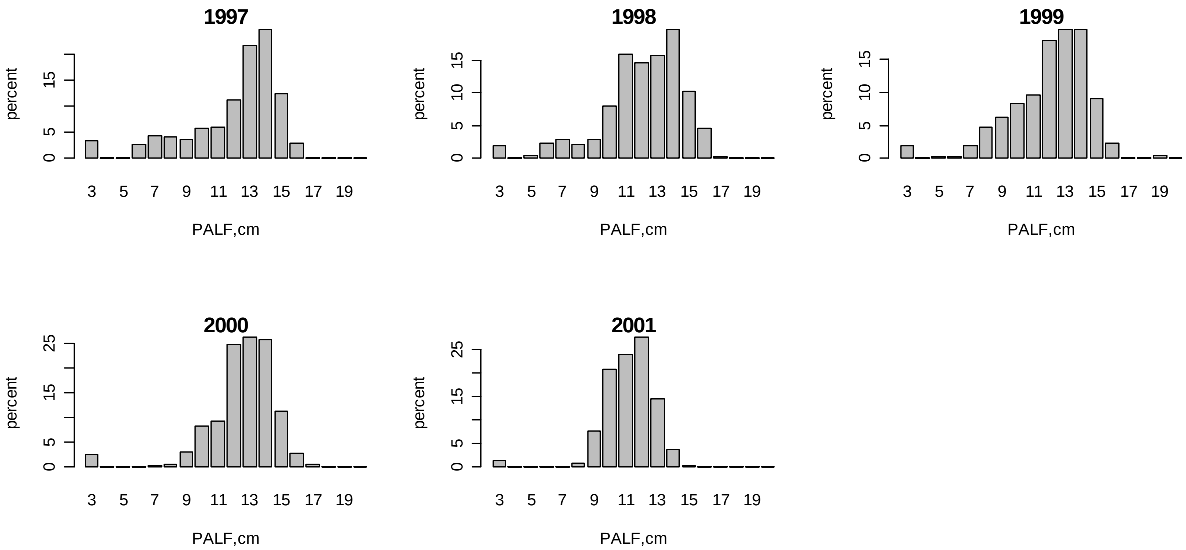


Figure 10.2.4. Length distribution of the discards of the French fleet, sampled on board French vessels by Scottish observers, 1997–2001.

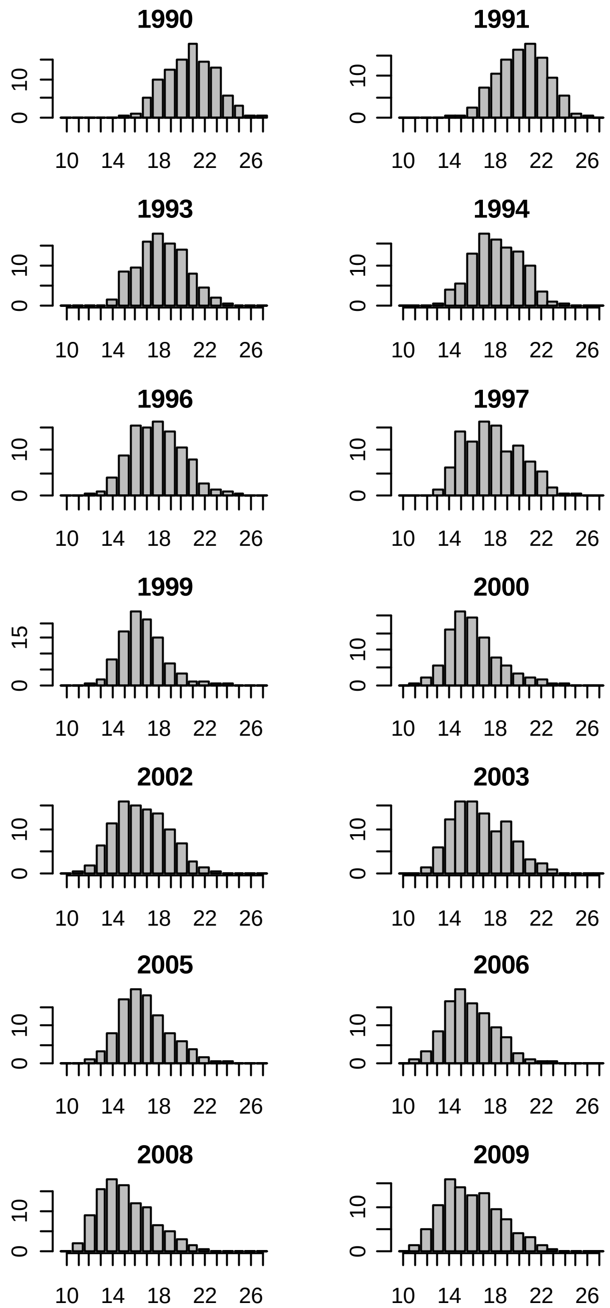


Figure 10.2.5. Length distribution (PAFL, cm) of the landings of the French fleet, sampled at fish-markets, 1997–2009.

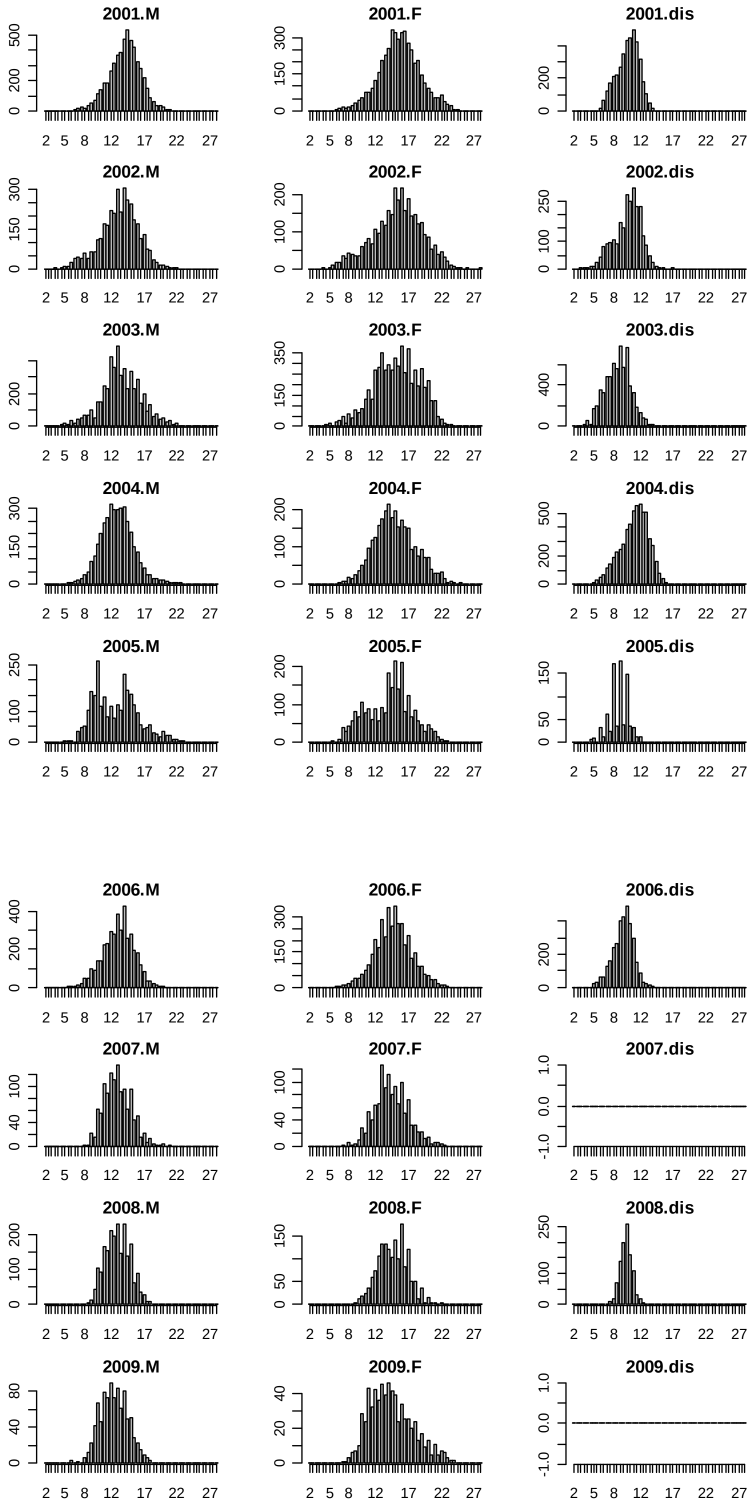


Figure 10.2.6. Length distribution of the landings by sex and discards of the Spanish fleet in Division VIb based from on-board observations.

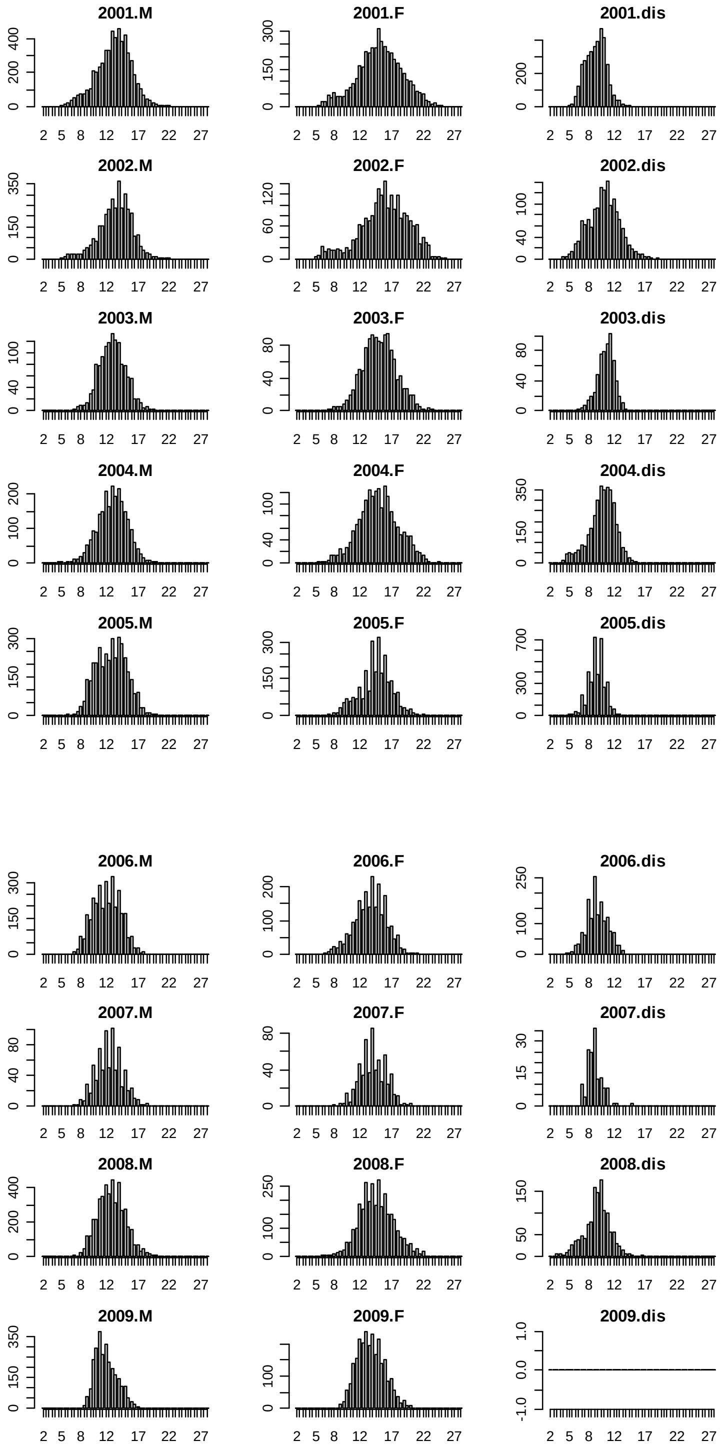


Figure 10.2.7. Length distribution of the landings by sex and discards of the Spanish fleet in Division XIIb based from on-board observations.

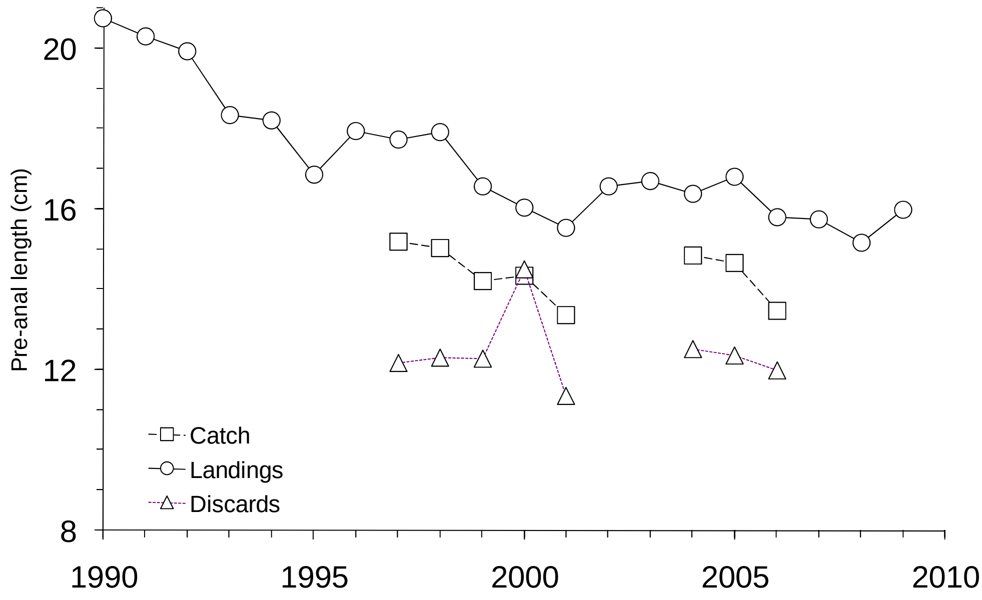


Figure 10.2.8. Evolution of the pre-anal length of Roundnose grenadier in the French landings , catch and discards, 1990–2009.

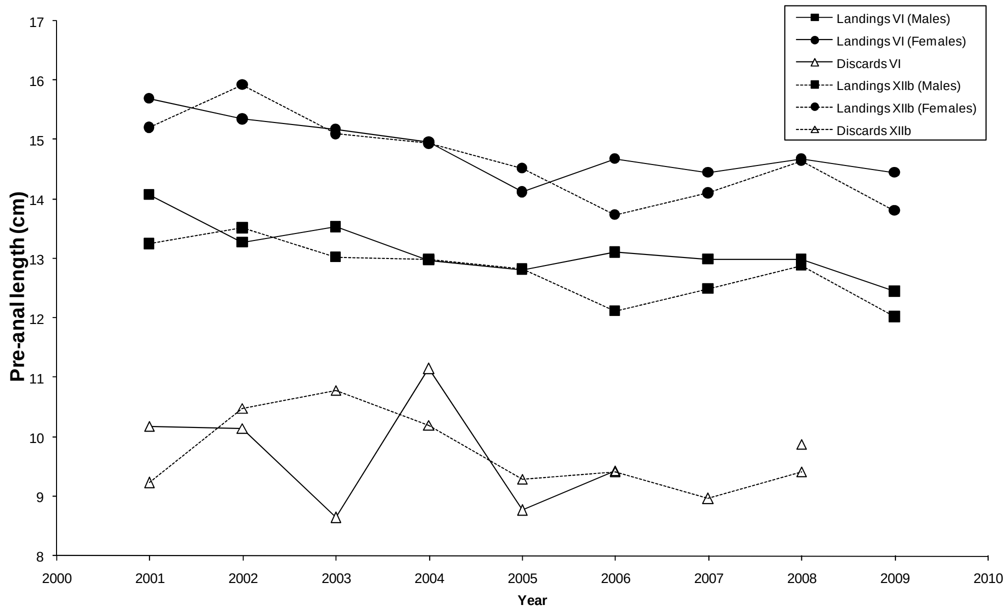


Figure 10.2.9. Evolution of the pre-anal length of Roundnose grenadier in the Spanish landings and discards in Divisions VIb and XIIb, 2001–2009.

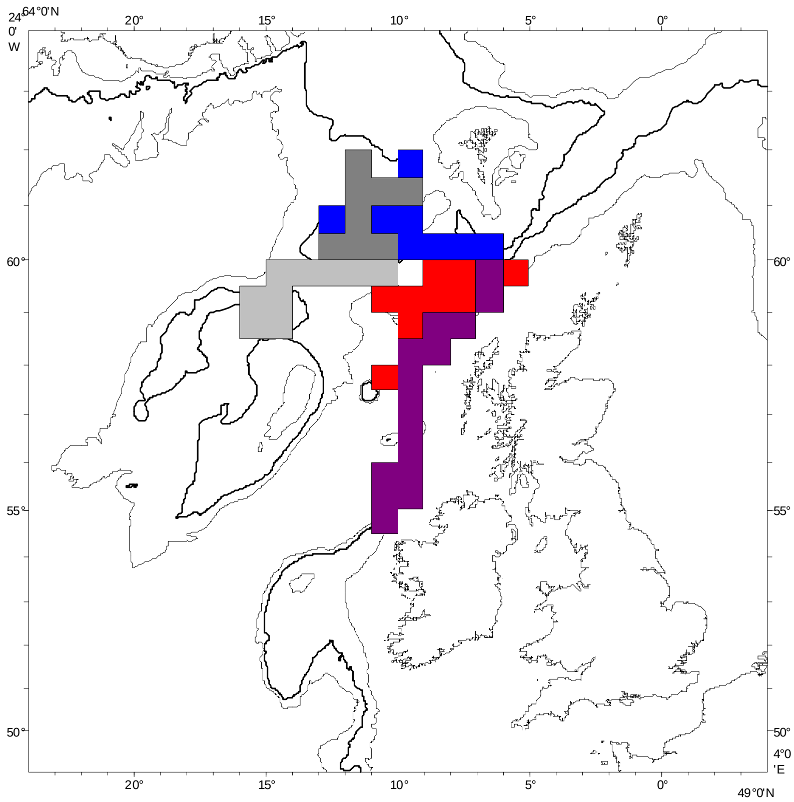


Figure 10.2.10. Reference areas (set of statistical rectangles) used to calculate French lpues (brown: New grounds in V (new5), grey new grounds in VI (new6); red: others in VI (other6); purple: edge in VI (edge6); blue: all grounds in VII (ref7). Depth contours are 200, 1000 and 2000 m.

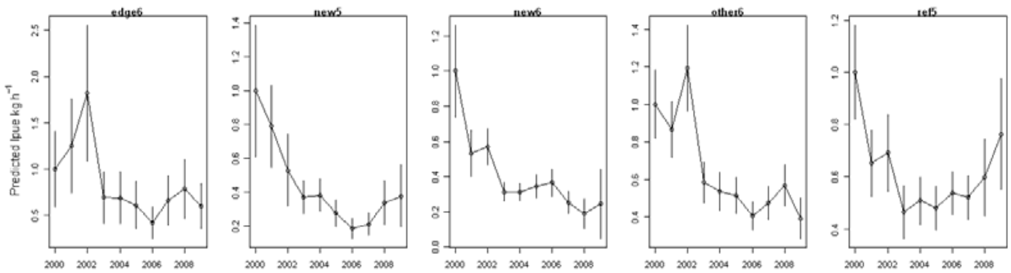


Figure 10.2.11. Lpue of French trawlers in five areas (labelled according to Biseau, 2006 WD) from tows targeting roundnose grenadier (defined as tows where the total catch include >10% of roundnose grenadier).

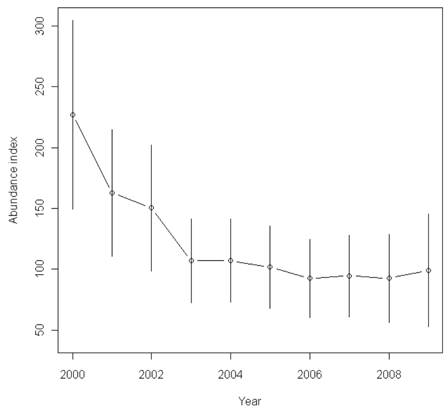


Figure 10.2.12. Time-series of abundance indices (calculated based upon the tallybook data). The grenadier abundance was predicted for the mean length of all tow carried out in every rectangle of the five small areas and averaged across rectangles.

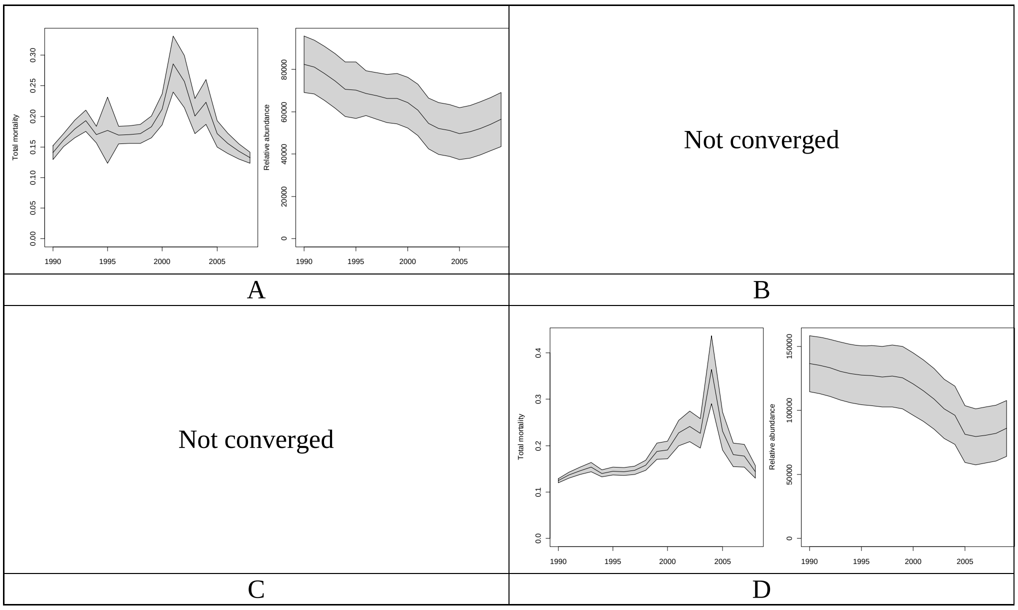


Figure 10.2.13. Time-series of Z estimated from the MYCC run on catch-at-age tables including (A) international landings reported as roundnose grenadier in Vb, VI and VII, (B) international landings reported as roundnose grenadier in Vb, VI, VII and XIIb, (C) international landings reported as roundnose grenadier and other grenadier species in Vb, VI and VII, (D) international landings reported as roundnose grenadier and other grenadier species in Vb, VI, VII and XIIb.

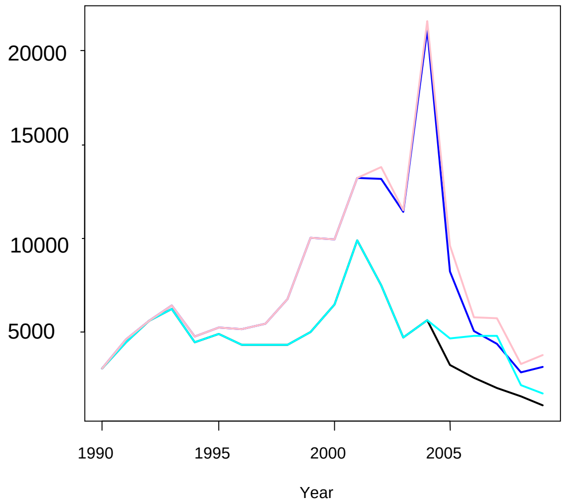


Figure 10.2.14. Total catches (tonnes) per data set used as input data for MYCC, (black) international landings reported as roundnose grenadier in Vb, VI and VII, (light blue) international landings reported as roundnose grenadier in Vb, VI, VII and XIIb, (drak blue) international landings reported as roundnose grenadier and other grenadier species in Vb, VI and VII, (D) international landings reported as roundnose grenadier and other grenadier species in Vb, VI, VII and XIIb.

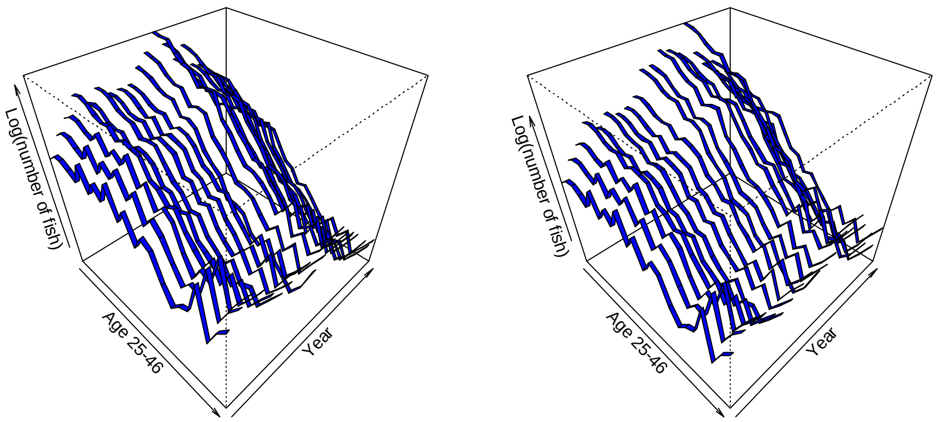


Figure 10.2.15. Numbers per age for two of the datasets.

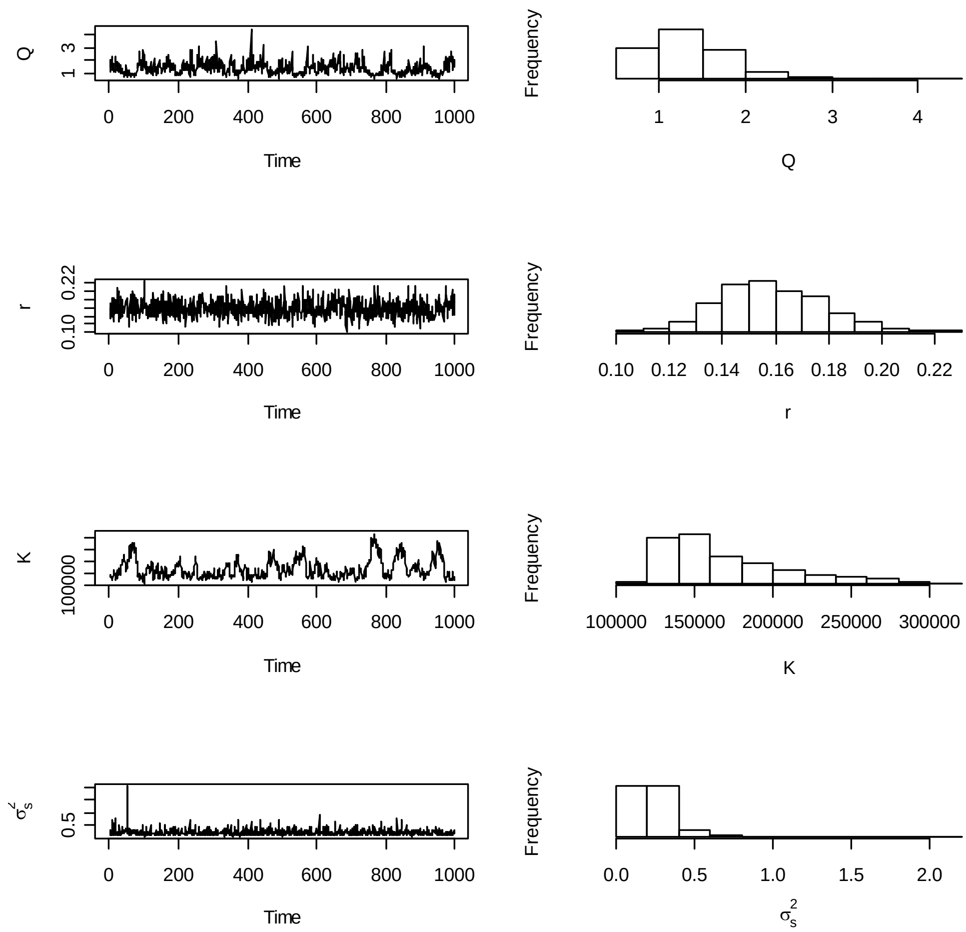


Figure 10.2.16. Diagnostic plots of the reference assessment on Roundnose grenadier in Vb, VI, VII. Time = number of iterations.

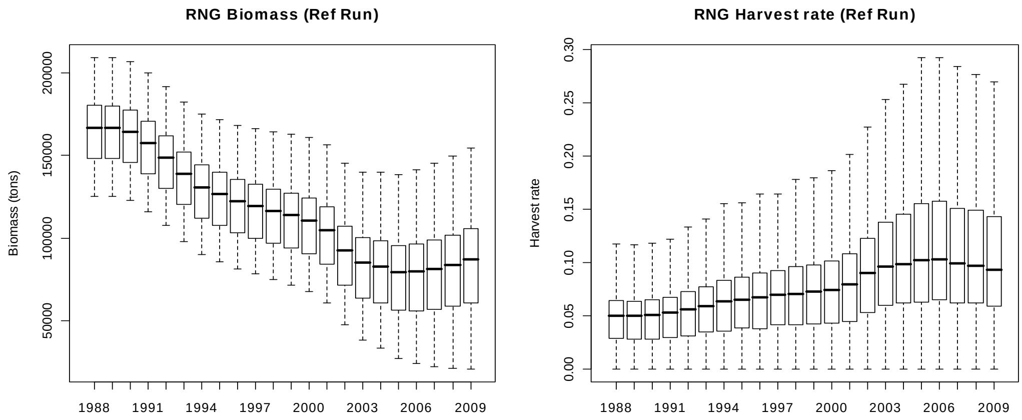


Figure 10.2.17. Estimated biomass and harvest rates from the reference simulations.

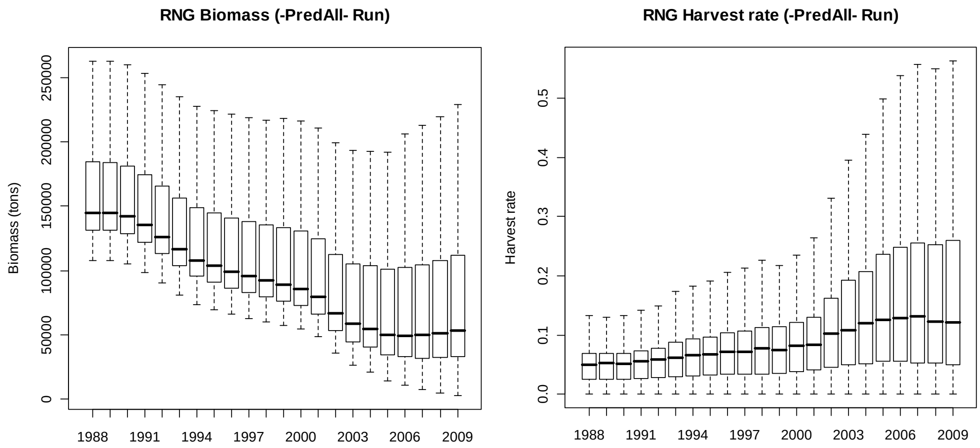


Figure 10.2.18. Estimated biomass and harvest rates using the abundance indices from Section 10.2.3.1.

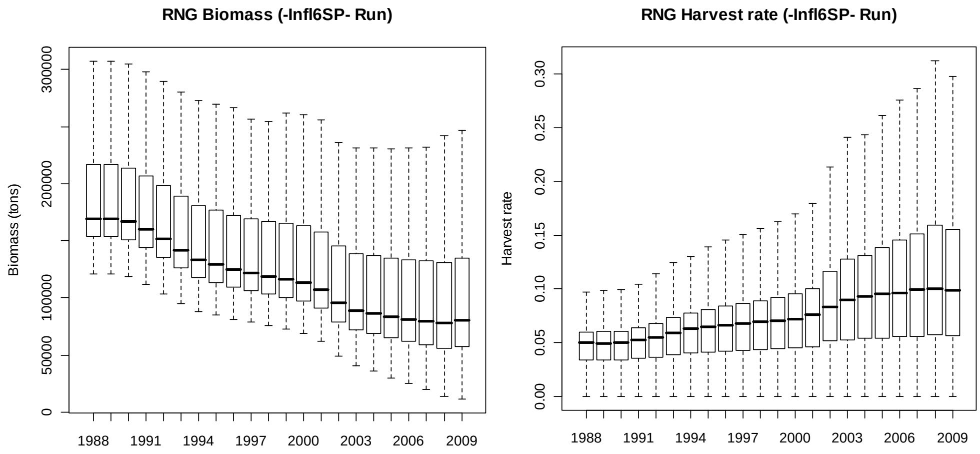


Figure 10.2.19. Estimated biomass and harvest rates using inflated Spanish landings in VIb.

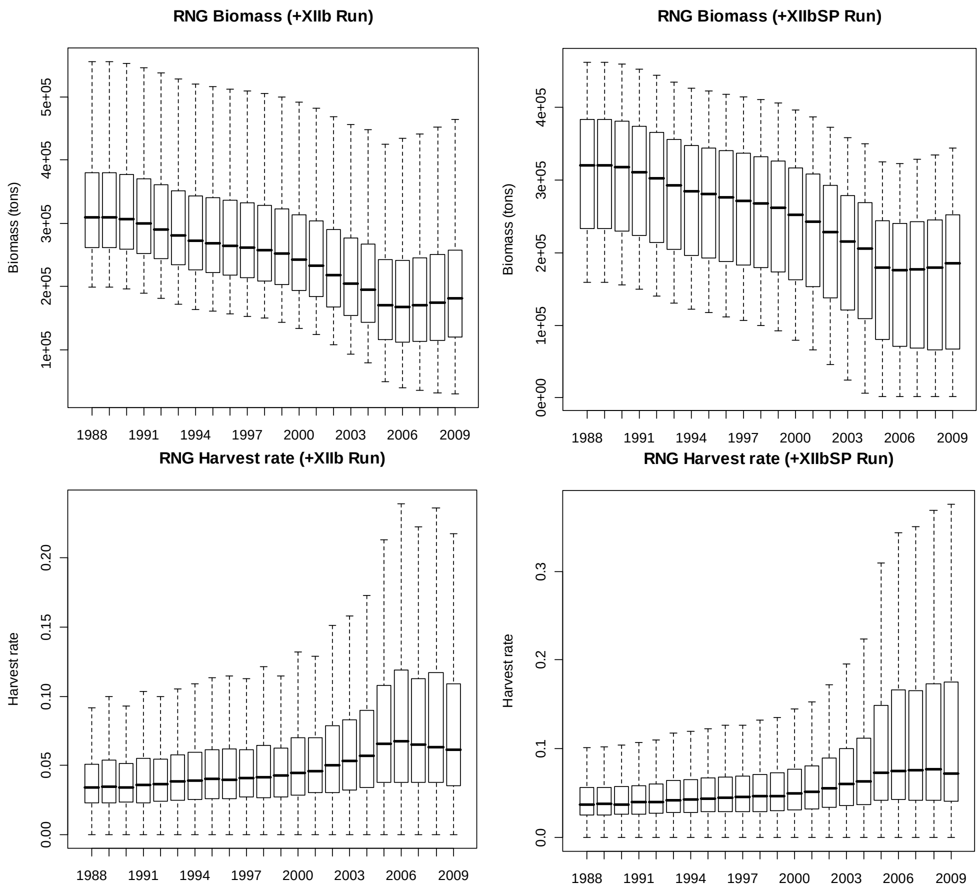


Figure 10.2.20. Estimated biomass and harvest rates for the whole stock unit Vb, VI, VII and XIIb ('+XIIb' run) and with inflated cusing the abundance indices from Section 10.2.3.1.

10.3 Roundnose Grenadier (*Coryphaenoides* rupestris) in Division IIIa

10.3.1 The fishery

The stock of roundnose grenadier found in the deep parts of Skagerrak (IIIa) was the basis for commercial exploitation by a few Danish vessels from the late 1980s until 2007, in some years mainly by a single vessel. This directed fishery began in 1987 as an exploratory fishery. Up to 2003 landings increased gradually, from around 1000 t to 4000 t with fluctuations. However, in 2004 and 2005 exceptionally high catches were reported. The catches were landed mainly for oil and meal. The geographical distribution of this fishery is shown in Figure 10.3.1 and Tables 10.3.2a–c. It is seen that a major part of the catches was taken in the Norwegian zone of Skagerrak. This directed fishery stopped in 2007 due to retirement of the single fisher conducting this metier, and until now no other fishers have taken up this fishery. Roundnose grenadier is also taken as bycatch in the fisheries for *Pandalus*, in IIIa. However, the landings of this bycatch (also for reduction) are generally insignificant.

10.3.1.1 Landings trends

WG figures for total landings, 1988–2009, by all countries are shown in Table 10.3.0. It is seen that:

- Since 2007 landings have been negligible;
- Only Denmark has contributed significantly to this fishery.

Table 10.3.1 shows the total Danish landings of this species split in landings for H.C. and for reduction. These landings figures have been estimated on basis of reported logbook records combined with samples of the landed catches for reduction. They differ slightly from the logbook recorded catches, which generally overestimate the true landings. For the period 2001–2006 peak landings within a year were recorded in March–April.

The development of this (Danish) fishery was remarkable considering the small area (Table 10.3.0 and Figure 10.3.2) From a level of around 2000 t up to 2002, taken by a mainly a single vessel, total landings increased to nearly 12000 t in 2005. In 2006 landings decreased again to 2261 tons, but this was due to special management agreements restricting the catch level in this area. In the years of peak catches, a total of only 2–3 vessels participated significantly in the fishery. Since 2007, when the directed fishery ended, only negligible amounts have been landed and only as occasional bycatch.

10.3.1.2 ICES Advice

According to the estimated biological parameters for this species and observed age composition in the stock, it can only sustain a low fishing mortality, and recovery of a depleted stock would be slow. The last assessment of this stock, based on trends in lpue and length compositions of landings (ICES, 2006; 2007), did not provide any clear picture of stock status. Because the fishery stopped in 2007 no further scientific data for assessing stock status have been available.

For roundnose grenadier in IIIa ICES 2006 recommended:

"*Based on precautionary considerations for deep-sea species ICES advises generally that expansion of fisheries should not be allowed until reliable assessments indicate that increased harvests are sustainable*",

and the Advice given for roundnose grenadier in IIIa was:

"Based on the high fishing pressure in Division IIIa in 2004 and 2005 ICES advised in 2006: For this fishery, the fishing pressure should be reduced considerably to low levels and should only be allowed to expand again very slowly if and when reliable indicators show that increased harvests are sustainable. ICES recommends a 50% reduction of effort compared to the level before the fishery expanded (1991–1999). This is interpreted as a reduction of 50% in landings and corresponds to a catch level around 1000 t in 2007". Since no new relevant information has been available since then, this Advice has been repeated since 2006.

10.3.1.3 Management

As seen above there has been no directed fishery for roundnose grenadier since 2007. However, should a new fishery begin this would be subject to management regulations agreed at the consultative meeting in Oslo 31 January 2006, the EC and Norway agreed that "fishing opportunities on this stock should be limited to a sustainable level", which in this case was set to average landings for the period 1996–2003. Following this agreement, a TAC of 2700 t for the EU in 2006 was set for IIIa including the Norwegian EEZ.

According to Article 36 of Regulation 1359/2008 a TAC of 850 t for 2009 and 2010 has been agreed for EU waters in IIIa. This TAC refers to bycatch only.

10.3.2 Data available

10.3.2.1 Length compositions

Length frequency data for roundnose grenadier in IIIa are available for 1987 from a resource surveys by the Danish research vessel and an experimental Danish fishery in that year. Samples of the Danish landings 2004–2006 have provided information of the size composition in landings, see Figure 10.3.3. A longer time-series of length frequencies is available from Norwegian shimp survey covering the period 1984–2009 and continuing, see Figure 10.3.5.

The Danish and Norwegian length–size distributions agree well for those years covered by samples from both countries (1987 and 2004–2006). Note that both in 1987 and 2004 there appear to be two clearly distinguishable components in the length compositions. In the Norwegian data several years show two modes. With the current lack of knowledge of the age structure, it is impossible to say whether the smaller one represents "recruits" to the fishery.

10.3.2.2 Age composition

No recent age composition data are available. However, the investigation by Bergstad (1990) based on data for 1987 in Skagerrak suggests very slow growth and consequently the age distributions in the catches could span over 20–30 years, both in 1987 and in 2004–2006.

10.3.2.3 Effort and cpue

Tables 10.3.2 A–C and Figure 10.3.2 show the overall trends in logbook recorded catch, effort and cpue for the Danish directed fishery on this stock for the period 1996–2006. A number of different mesh sizes were used in the fishery. Norwegian shrimp survey cpue for roundnose grenadier is shown in Figure 10.3.6. This is not considered to give a reliable indication of stock abundance for this species as the very high inter-annual variance cannot be explained in terms of the known biological parameters of the stock.

10.3.3 Data analyses

10.3.3.1 Trends in effort and cpue

The evaluation of the Danish cpue data is presented in ICES (2007) together with suggestive comments. Here it suffices to state, that these cpue figures (Tables 10.3.2 A–C) do not provide any clear indications of stock development and status for that period.

10.3.3.2 Survey indices

The abundance indices for roundnose grenadier from the Norwegian shrimp survey have not been considered sufficiently reliable to be used to assess development of this stock.

10.3.3.3 Stock situation/status

The data available for the stock (inclusive data from the ongoing Norwegian survey) have not given conclusive signals on the present stock situation. Considering the limited geographical distribution of this stock and the (likely) slow growth of the individuals in the stock on the one side and presumeably heavy exploitation of the stock from the mid-1990s to 2006 on the other, one would have expected some responding signals from the stock to the increasing fishing pressure during or after this period. A decline in the survey abundance in 2006–2009 is observed, but the levels in recent years are similar to those in the periods prior to the heavy exploitation, see Figure 10.3.6. Any long-term effects of the heavy Danish commercial exploitation of this stock during the first half of the 2000s has not yet been detected, and it is still not known, if the level of exploitation in the years 2002–2006 was sustainable.

WGDEEP therefore stress the urgent need for further biological information to elucidate the dynamics of this stock. Besides the above mentioned survey data, focus should be put on analyses of the current age composition in the stock with special reference to growth, production and exploitation.

In this connection WGDEEP points out that this stock is particular suited for such investigations, since it is geographically isolated from other stocks of roundnose grenadiers.

10.3.4 Management considerations

Until further information to clarify the status of this stock is available, a precautionary management strategy is required, and ICES has previously recommended (for the stocks of roundnose grenadier in IIIa, Vb, VI and VII) a 50% reduction of effort compared with the 2000–2002 level.

Table 10.3.0. Roundnose grenadier in Division IIIa and IVa. WG estimates of landings.

YEAR	DENMARK	NORWAY	SWEDEN	TOTAL
1988	612		5	617
1989	884		1	885
1990	785	280	2	1067
1991	1214	304	10	1528
1992	1362	211	755	2328
1993	1455	55		1510
1994	1591		42	1633
1995	2080		1	2081
1996	2213			2213
1997	1356	124	42	1522
1998	1490	329		1819
1999	3113	13		3126
2000	2400	4		2404
2001	3067	35		3102
2002	4196	24		4220
2003	4302			4302
2004	9874	16		9890
2005	11 922			11 922
2006	2261	4		2265
2007	+	1		1
2008	+	+		+
2009*	2	+	+	2

*** Preliminary data.**

Table 10.3.1. Danish landings, 1996–2006 of roundnose grenadier split into H.C. landings and landings for reduction.

	LANDINGS OF ROUNDNOSE GRENADIER (KG)		TOTAL LANDINGS
year	H. C.	Reduction	(tons)
1996	6493	2 207 000	2213
1997		1 356 280	1356
1998	635	1 489 000	1490
1999		3 113 000	3113
2000	315	2 400 000	2400
2001	6401	3 061 000	3067
2002	4	4 195 738	4196
2003	7	4 301 661	4302
2004	3129	9 870 664	9874
2005	17 056	1 904 545	11922
2006	2448	2 259 000	2261

Table 10.3.2 A–C. The Danish fishery for roundnose grenadier in IIIa. Trends in catch, effort and cpue by major ICES rectangle, see text.

Total catch (tons) by ICES rectangle						
year	44F8	44F9	45F8	45F9	46F9	total
1996	80	40	25	709	98	951
1997	28	0	115	1088	163	1393
1998	238	235	180	1483	1112	3248
1999	0	25	61	704	1353	2143
2000	0	0	40	893	854	1787
2001	105	11	65	862	956	1999
2002	165	79	0	928	1531	2702
2003	0	120	545	1223	1769	3657
2004	1104	5786	215	1704	1721	10 529
2005	518	4073	682	4739	2823	12 834
2006	26	517	40	1067	487	2136
Total effort (days) by ICES rectangle						
year	44F8	44F9	45F8	45F9	46F9	total
1996	5	23	2	59	6	95
1997	3		7	67	5	82
1998	7	9	4	54	32	106
1999		2	4	43	65	114
2000		2	4	57	48	111
2001	5	8	3	49	65	130
2002	11	7		42	70	130
2003		5	17	70	96	188
2004	99	391	9	74	65	638
2005	47	178	9	107	77	418
2006	2	19	2	24	20	67
Total CPUE (tons/day) by ICES rectangle						
year	44F8	44F9	45F8	45F9	46F9	Average
1996	16.0	1.7	12.5	12.0	16.3	10.0
1997	9.2		16.4	16.2	32.5	17.0
1998	34.0	26.1	45.0	27.5	34.8	30.6
1999		12.5	15.3	16.4	20.8	18.8
2000		0.0	10.0	15.7	17.8	16.1
2001	21.0	1.4	21.7	17.6	14.7	15.4
2002	15.0	11.3		22.1	21.9	20.8
2003		24.0	32.1	17.5	18.4	19.5
2004	11.2	14.8	23.9	23.0	26.5	16.5
2005	11.0	22.9	75.7	44.3	36.7	30.7
2006	12.8	27.2	20.0	44.5	24.3	31.9

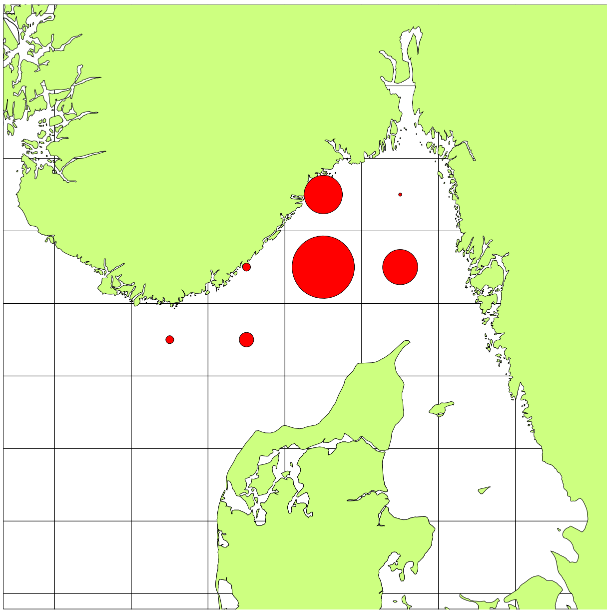


Figure 10.3.1. Geographical distribution of the fishery for roundnose grenadier in IIIa in 2006.

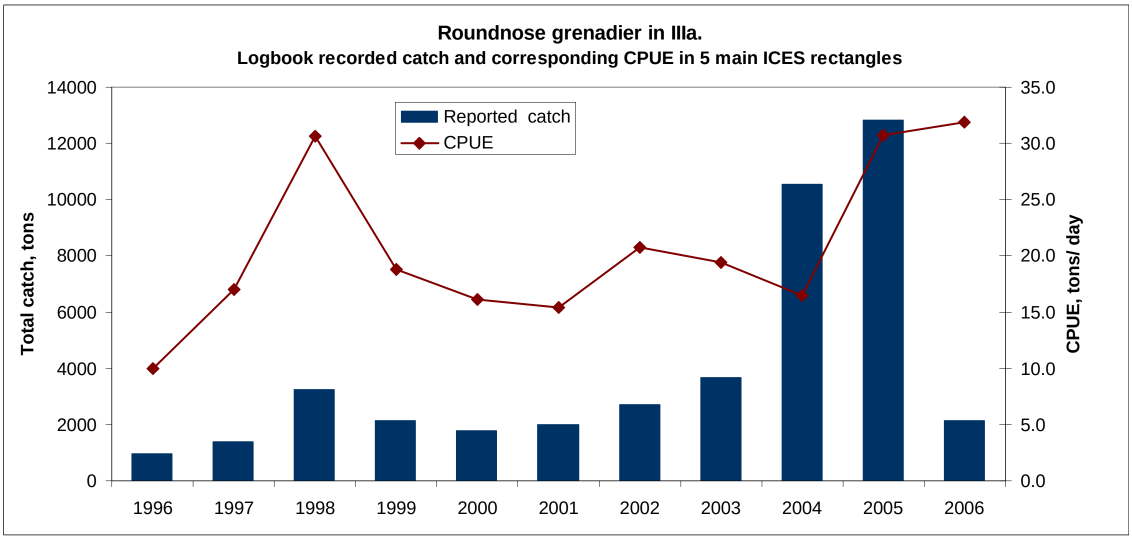
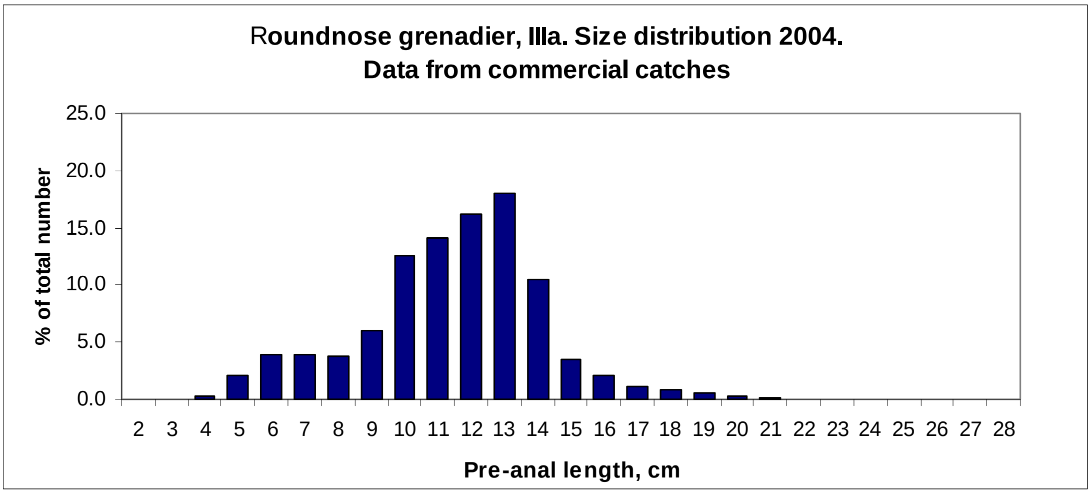
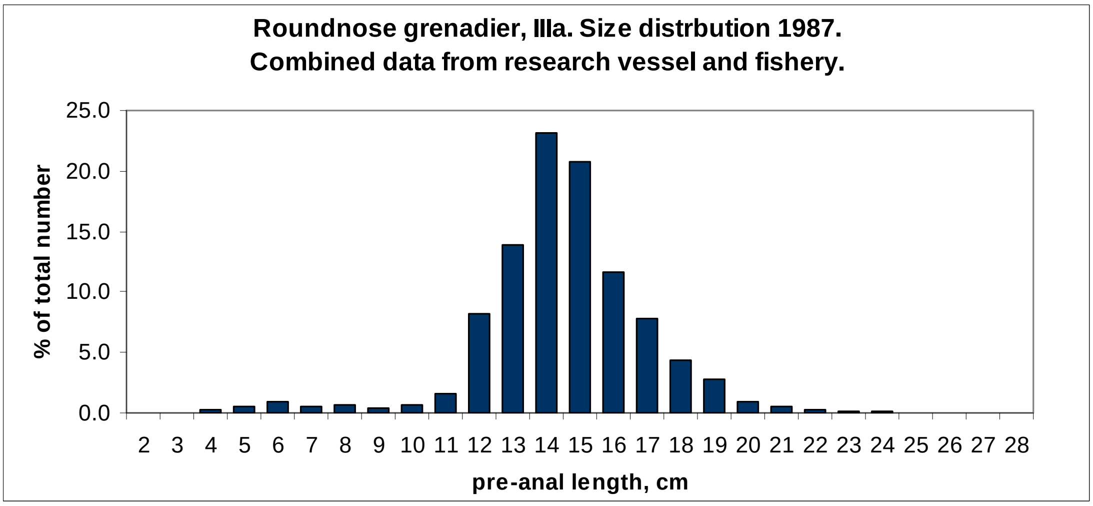


Figure 10.3.2. Danish catches and cpue by main ICES rectangle. Based on logbook records.





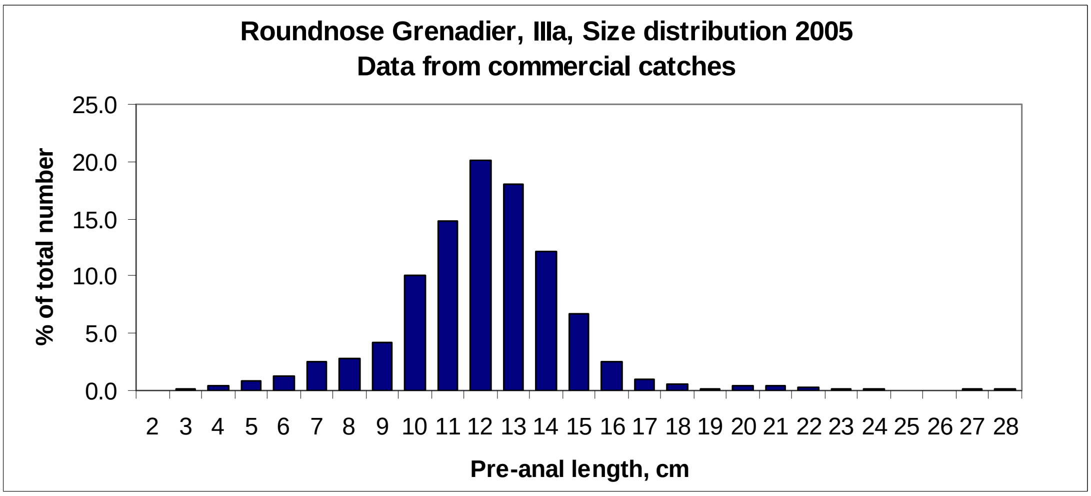


Figure 10.3.3 A–C. Length distribution Danish catches of roundnose grenadier.

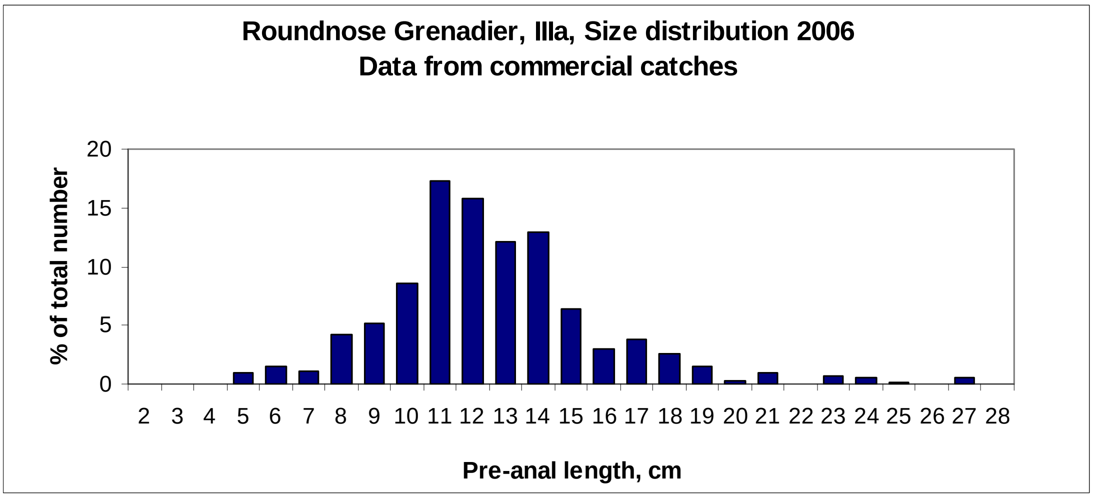


Figure 10.3.3 D. Length distribution Danish catches of roundnose grenadier.

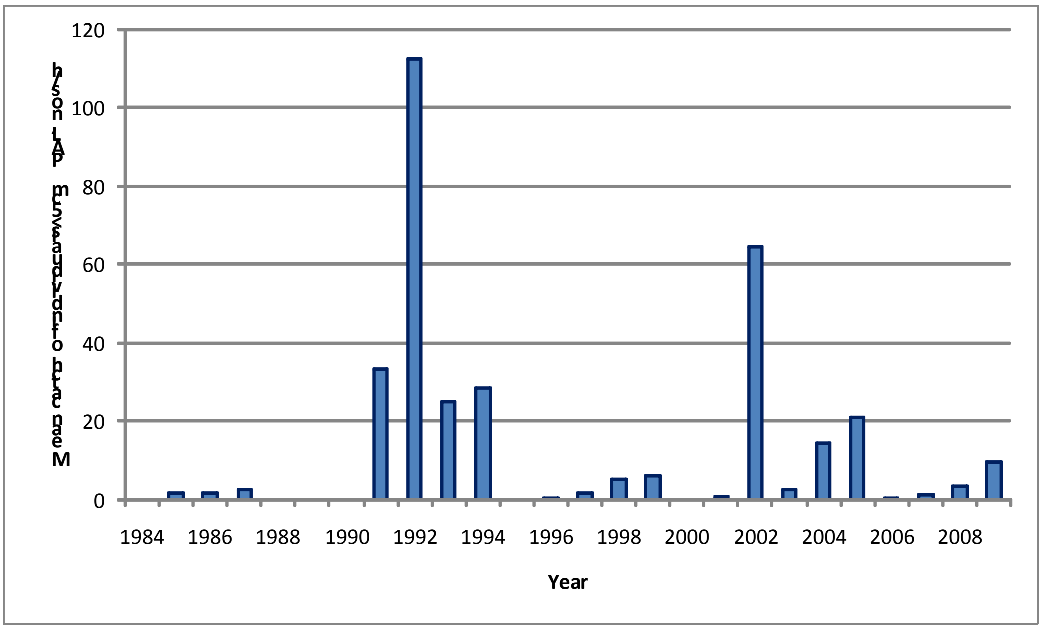
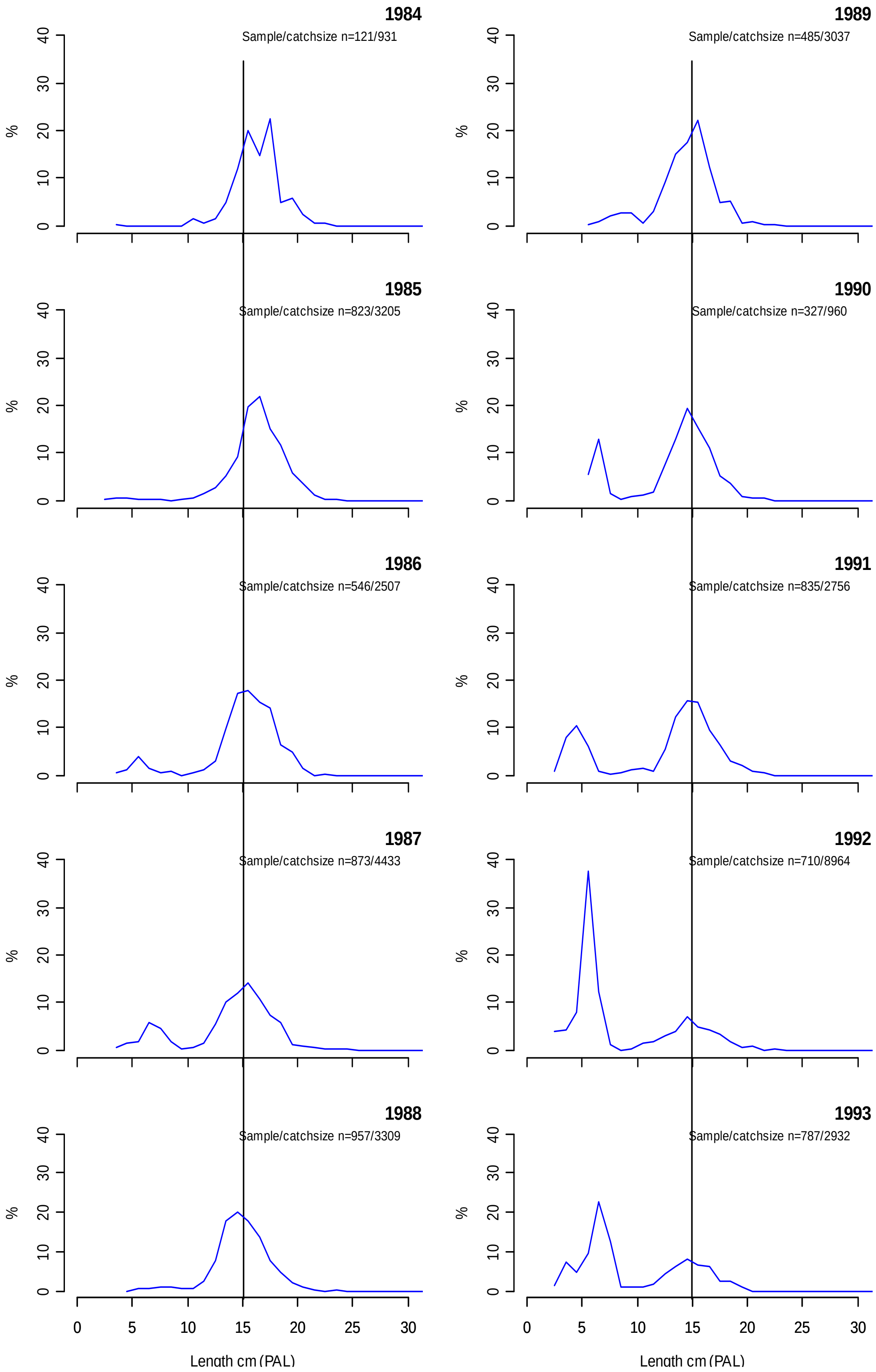
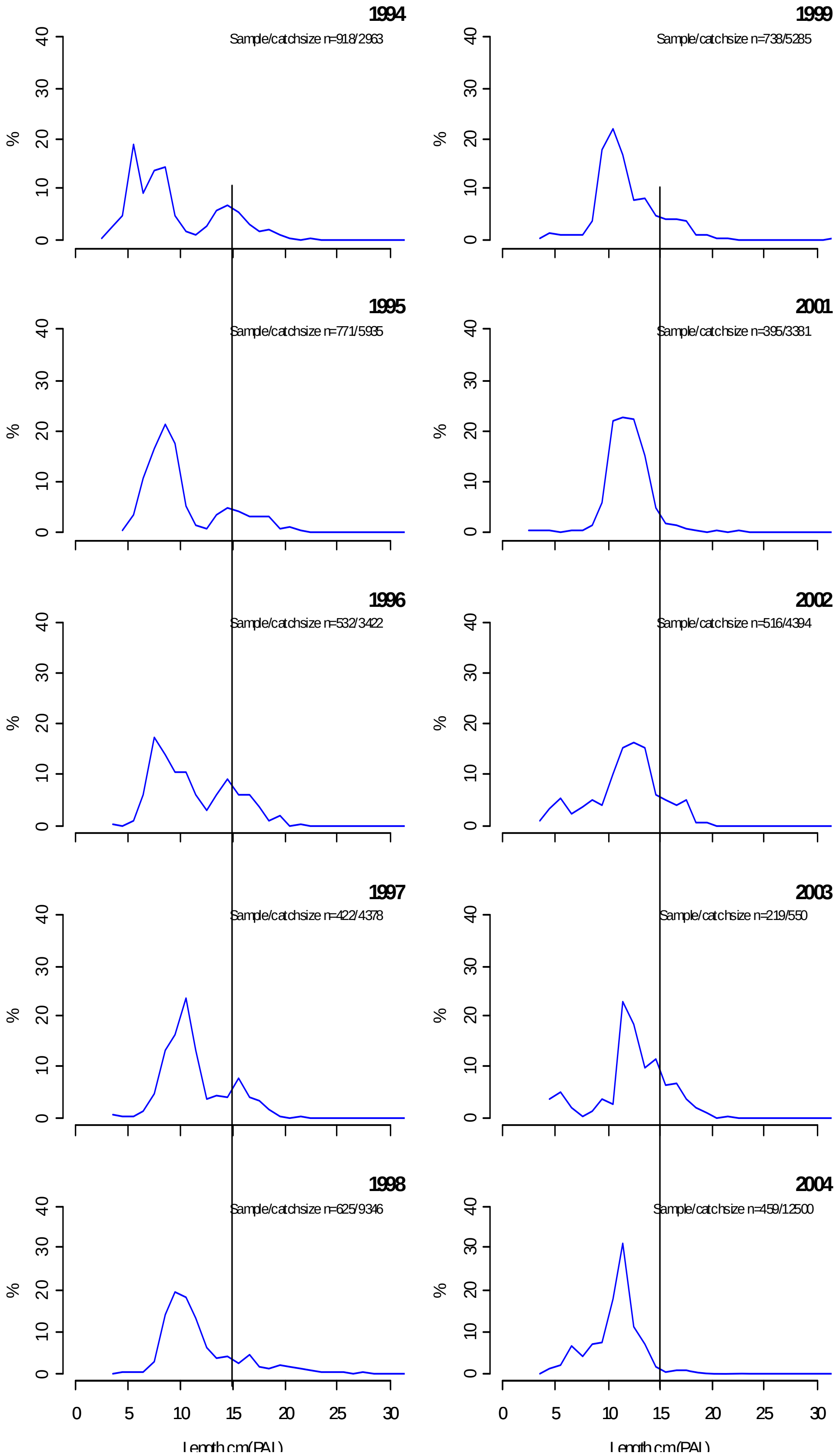


Figure 10.3.4. Mean catch of roundnose grenadier <5 cm PAL, 2005–2009. Data from shrimp survey, trawls deeper than 300 m. Note: in 1984, 2003, 2006, and 2007 only a single or no trawls were made deeper than 400 m and data from these years are unreliable.


1984
Sample/catchsize n=121/931
1985
Sample/catchsize n=823/3205
1986
Sample/catchsize n=546/2507
1987
Sample/catchsize n=873/4433
1988
Sample/catchsize n=957/3309
1989
Sample/catchsize n=485/3037
1990
Sample/catchsize n=327/960
1991
Sample/catchsize n=835/2756
1992
Sample/catchsize n=710/8964
1993
Sample/catchsize n=787/2932
%
Length cm (PAL)


1994
Sample/catchsize n=918/2963
1999
Sample/catchsize n=738/5285
1995
Sample/catchsize n=771/5935
2001
Sample/catchsize n=395/3381
1996
Sample/catchsize n=532/3422
2002
Sample/catchsize n=516/4394
1997
Sample/catchsize n=422/4378
2003
Sample/catchsize n=219/550
1998
Sample/catchsize n=625/9346
2004
Sample/catchsize n=459/12500
%
Length cm(PAL)

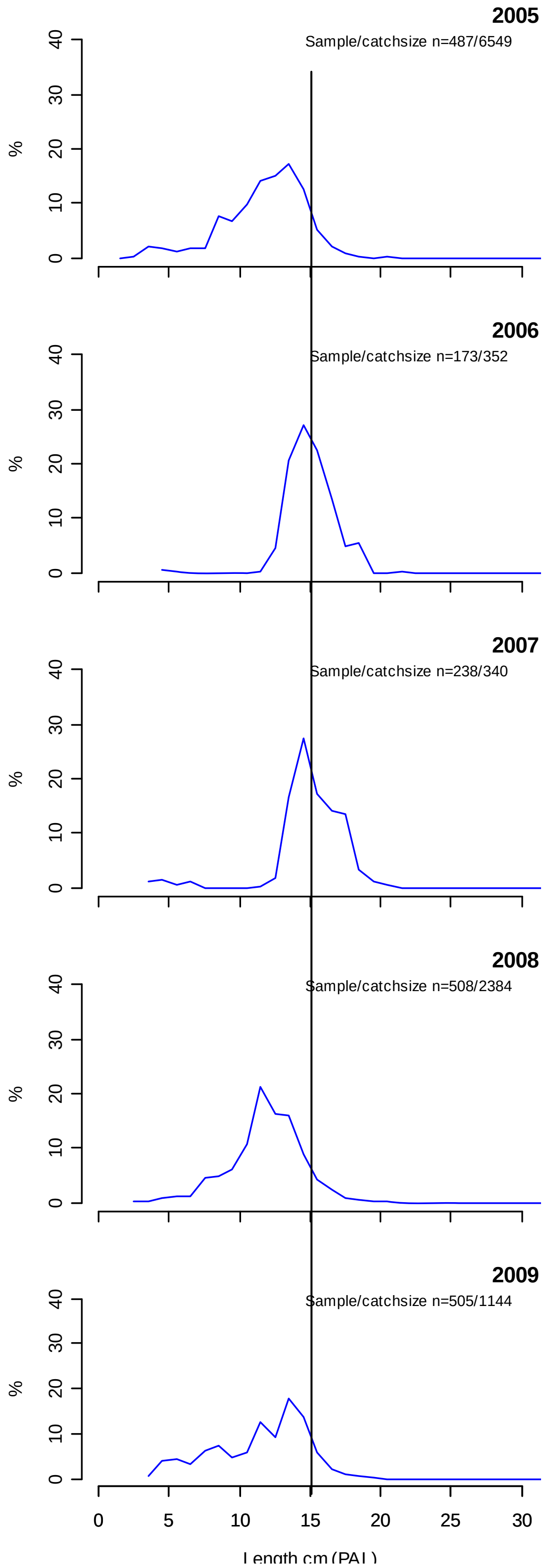


Figure 10.3.5. Length frequency distributions for roundnose grenadier, 1984–2009. Data from shrimp survey, all catches deeper than 300 m.

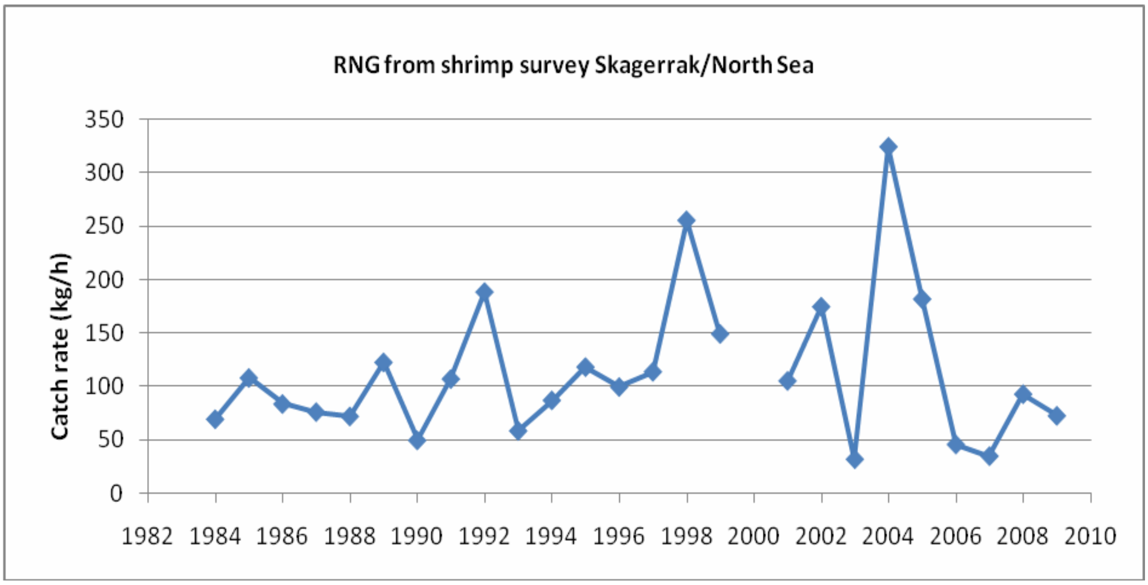


Figure 10.3.6. Mean standardised catch of roundnose grenadier in terms of numbers (upper) and weight (lower) in the 1984–2009 shrimp survey in ICES Division IIIa. For each year, the average catch was calculated for all trawls deeper than 300 m, including 0-catches. Note: in 1984, 2003, 2006, and 2007 only a single or no trawls were made deeper than 400 m and data from these years are unreliable.

10.4 Roundnose Grenadier (*Coryphaenoides rupestris*) in divisions Xb, XIIc and Subareas Va1, XIIa1, XIVb1

10.4.1 The fishery

The fishery on the Northern Mid-Atlantic Ridge (MAR) started in 1973, when dense concentrations of roundnose grenadier were discovered by USSR exploratory trawlers. Roundnose grenadier aggregations may have occurred on 70 seamount peaks between 46–62°N but only 30 of them were commercially important and subsequently exploited. The fishery is mainly conducted using pelagic trawls although on some seamounts it is possible to use bottom gear.

10.4.1.1 Landings trends

The greatest annual catch (almost 30 000 t) in that area was taken by the Soviet Union in 1975 (Tables 10.4.1–10.4.4, Figure 10.4.1) and in subsequent years the Soviet catch varied from 2800 to 22 800 t. The fishery for grenadier declined after the dissolution of the Soviet Union in 1992. In the last 15 years, there has been a sporadic fishery by vessels from Russia (annual catch estimated at 200–3200 t), Poland (500–6700 t), Latvia (700–4300 t) and Lithuania (data on catch are not available). Grenadier has also been taken as bycatch in the Faroese orange roughy fishery and Spanish blue ling fishery.

There is no information about target fishery of roundnose grenadier on the MAR in 2006 and 2007. In 2008 and 2009 Russian trawlers made attempts at fishing with pelagic and bottom-trawls in the southern part of the Division XIIc. Total catches were 29.5 t and 12.4 t respectively including 12.8 t and 5.3 t of roundnose grenadier.

10.4.1.2 ICES Advice

ICES Advice in 2008: "*Due to its low productivity, roundnose grenadier can only sustain low rates of exploitation. Fisheries on such species should always be accompanied by programs to collect data on both target and bycatch fisheries. The fishery should not be allowed to expand from the current low level unless it can be shown that it is sustainable*".

10.4.1.3 Management

There is TAC-based species-specific management of the roundnose grenadier fisheries in Subareas VIII, IX, X, XII, XIV for European Community vessels (Table 10.4.6). In the international waters there are NEAFC regulation of efforts in the fisheries for deep-water species.

10.4.2 Data available

10.4.2.1 Landings and discards

Data on catches are given in Tables 10.4.1–10.4.4. There were no discards of roundnose grenadier on Russian trawlers where smallest fish and waste were used for fish meal processing. There is no information on discards by other countries vessels.

10.4.2.2 Length compositions

No new data on length compositions were available.

10.4.2.3 Age compositions

No new data on age compositions were presented.

10.4.2.4 Weight-at-age

No new weight-at-age data are available.

10.4.2.5 Maturity and natural mortality

New data on maturity and natural mortality are unavailable.

10.4.2.6 Catch, effort and research vessel data

Catch and cpue data are given in Tables 10.4.1–10.4.4 and Figure 10.4.1. The data for 2000–2005 are demonstrated together with the data for the period 1973–1999. There are gaps in the cpue time-series due to lack of catch statistics for 1973 and 1982 and absence of target fishery in 1994–1995 and 2006–2009. Effort data separated by Subareas are available for Russian fleet in 2003–2005 only (Tables 10.4.1–10.4.4). There were no research vessel data presented for 2009.

10.4.3 Data analyses

The only source of information on abundance trends was the cpue series from the Soviet/Russian official data (Figure 10.4.1). The cpue varied strongly, but generally declined in the 1978, then the level appears to have remained comparatively stable till to 1990. Further declining took place in 1991–1993 and 1998–2000. There is some increasing of cpue in 2004–2005 but it remained at a low level, almost half that observed in the early 1970s when a virgin stock was exploited. These data must be treated with caution because the fishery on MAR is very difficult and its effectiveness depends on many factors (distribution of pelagic concentrations, experience of vessel crew, environmental conditions, etc.) that could not be taken in account during current analysis of cpue dynamics.

According to Soviet trawl acoustic survey data and analytical assessments in the 1970–1980s a stock size was estimated as 400 000–800 000 t, and the possible annual catches were estimated to be 30 000–200 000 t (Baidalinov, 1979; Pavlov *et al.*, 1991; Shibanov, 1998). In the 1990s no research surveys were conducted.

The most recent trawl acoustic survey was carried out by Russia in 2003 in the area between 47° and 58°N. According to results of this survey the biomass of the pelagic component of the grenadier only amounted to about 130 000 t (Gerber *et al.*, 2004). It was concluded that the distribution and structure of grenadier aggregations on MAR have changed considerably as compared to 1970–1980s. The depths of aggregations and the number of small immature fish may have increased.

10.4.4 Comments on the assessment

No analytical assessments were carried out.

10.4.5 Management considerations

The state of the stock is uncertain. Soviet data suggest a high stock biomass (400 000–700 000 t) in 1970–1980s but a decreasing trend of the cpue indicate that the abundance of roundnose grenadier was educed to a low level in last decade. Moreover, Russian trawl acoustic survey in 2003 showed relatively low biomass of the pelagic component of stock, an increasing depth of the aggregations, and a higher number of small immature fish. As the fishery on the MAR has been limited in recent two decades, these changes may have natural causes. According to the Soviet estimates the annual possible catch of roundnose grenadier on MAR was estimated to 30 000–200 000 t in 1970–1980s. The only more recent estimate was a single trawl acoustic survey in 2003. It is currently impossible to provide an advice for roundnose grenadier fishery on MAR owing to lack of information. Consistent with a precautionary approach the expansion of fisheries should not be allowed until reliable assessments indicate that increased harvests are sustainable.

Table 10.4.1. Working Group estimates of catch of roundnose genadier from Subdivision Va1.

YEAR	USSR/RUSSIA	TOTAL
1973	820	820
1974	12561	12561

Table 10.4.2. Working Group estimates of catch of roundnose genadier from Subarea Xb.

YEAR	USSR/RUSSIA	FAROES[1]	TOTAL
1976	170		170
1993		249	249
1994			
1995			
1996		3	3
1997		1	1
1998		1	1
1999		3	3
2000			
2001			
2002			
2003			
2004		1	1
2005	799		799
2006			
2007			
2008			
2009[2]			

[1]–official ICES data [2]– preliminary data

Table 10.4.3. Working Group estimates of catch of roundnose genadier from Subareas XIIa1 and XIIc.

Year	USSR/Russia	Poland[2]	Latvia[2]	Faroes[2]	Spain[2]	Total
1973	226					226
1974	5874					5874
1975	29 894					29 894
1976	4545					4545
1977	9347					9347
1978	12 310					12 310
1979	6145					6145
1980	17 419					17 419
1981	2954					2954
1982	12 472					12 472
1983	10 300					10 300
1984	6637					6637
1985	5793					5793
1986	22 842					22 842
1987	10 893					10 893
1988	10 606					10 606
1989	9495					9495
1990	2838					2838
1991	3214[1]		4296			7510[1]
1992	295		1684			1979
1993	473		2176	263		2912
1994			675	457		1132
1995				359		359
1996	208			136		344
1997	705	5867		138		6710
1998	812	6769		19		7600
1999	576	546		29		1151
2000	2325					2325
2001	1714			2		1716
2002	737					737
2003	510					510
2004	436			8		444
2005	600					600
2006				1		1
2007				2		2
2008	13					13
2009[3]	5					5

[1]– revised catch data [2]– official ICES data [3]– preliminary data.

Table 10.4.4. Working Group estimates of catch of roundnose genadier from Subdivision XIVb1.

Year	USSR/Russia	Spain[2]	Total
1976	11		11
1982	153		153
1997	336[1]		336[1]
1998			
1999			
2000	5		5
2001	69		69
2002	4	235	239
2003		272	272
2004	201		20[1]
2005			
2006			
2007			
2008			
2009[3]			

[1]– revised catch data [2]– official ICES data [3]– preliminary data.

Table 10.4.5. Soviet/Russian efforts and cpue on roundnose grenadier fishery by the MAR area.

Year	ICES Subarea and Division	Number of fishing days	Catch per fishing day, t
1974	XIIa1+XIIc, Va1		35.2
1975	XIIa1+XIIc		36.6
1976	XIIa1+XIIc, XIVb1, Xb		24.0
1977	XIIa1+XIIc		17.3
1978	XIIa1+XIIc		17.0
1979	XIIa1+XIIc		19.6
1980	XIIa1+XIIc		17.3
1981	XIIa1+XIIc		18.4
1982	XIIa1+XIIc, XIVb1		
1983	XIIa1+XIIc		17.3
1984	XIIa1+XIIc		18
1985	XIIa1+XIIc		18.5
1986	XIIa1+XIIc		21
1987	XIIa1+XIIc		17.3
1988	XIIa1+XIIc		21.8
1989	XIIa1+XIIc		15.6
1990	XIIa1+XIIc		18.4
1991	XIIa1+XIIc		14.5
1992	XIIa1+XIIc		12.9
1993	XIIa1+XIIc, Xb		10.7
1994	XIIa1+XIIc		
1995	XIIa1+XIIc		
1996	XIIa1+XIIc, Xb		22.2
1997	XIIa1+XIIc, XIVb1, Xb		20.3
1998	XIIa1+XIIc, Xb		6.8
1999	XIIa1+XIIc, Xb		8.8
2000	XIIa1+XIIc, XIVb1		9.1
2001	XIIa1+XIIc		15.8
	XIVb1		
2002	XIIa1+XIIc		13.2
	XIVb1		
2003	XIIa1+XIIc	51	10.1
2004	XIIa1+XIIc	25	16.1
2005	XIIa1+XIIc	42	17.7
	Xb	37	
2006	XIIc		
2007	XIIc		
2008[3]	XIIc		
2009	XIIc		

Table 10.4.6. Fishing opportunities applicable for European Community vessels for roundnose grenadier fisheries by countries and by areas in 2009–20010 (EC and international waters).

Country	TAC, t
Areas VIII, IX, X, XII, XIV	
Germany	34
Spain	3734
France	172
Ireland	7
United Kingdom	15
Latvia	60
Lithuania	7
Poland	1168
Total for EC vessels	5197

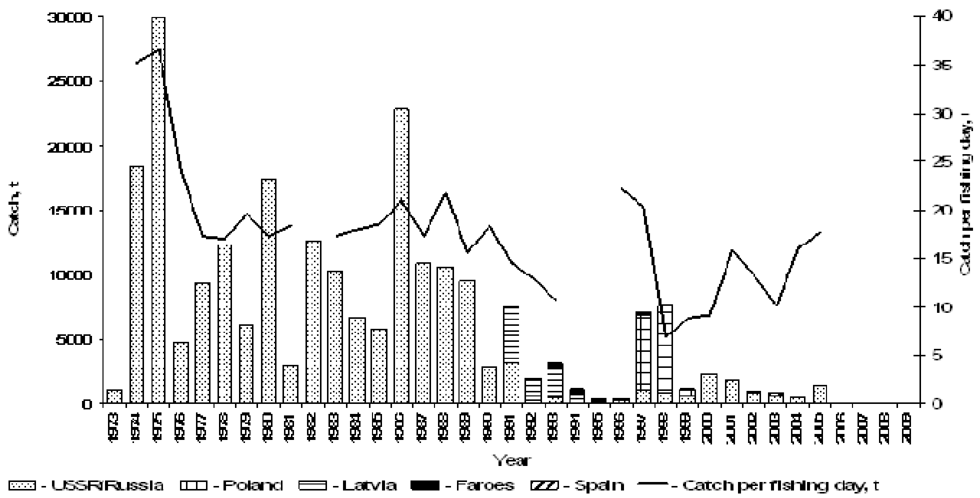


Figure 10.4.1. Roundnose grenadier in Mid-Atlantic ridge. International catch and Soviet/Russian cpue of roundnose grenadier on the Mid-Atlantic ridge in 1973–2009.

10.5 Roundnose grenadier (*Coryphaenoides rupestris*) in other Areas (I, II, IV, Va2, VIII, IX, XIVa, XIVb2)

10.5.1 The fishery

Outside of the main fisheries dealt upon in other sections catches of roundnose grenadier were insignificant.

10.5.1.1 Landings trends

Landing statistics by nations in the period 1988–2009 are presented in Tables 10.5.1–10.5.5.

In the Subareas I and II, the catch of roundnose grenadier in 2009 amounted to 9 t and was taken as bycatch by Norwegian fleet. During 1988–2009 catches varied from 0 to 106 t (Figure 10.5.1). France substantially contributed to the total catch in 1990–1992, when roundnose grenadier was taken as bycatch in the fisheries for saithe *Pollachius virens* and other gadoids. In 1997–1998, when total catch exceeded 100 t, the major contribution was made by Norway. Roundnose grenadier was partly taken in mixed deep-water fisheries; directed local fisheries in Norwegian fjords for this species also exist.

In Subarea IV, the catch of roundnose grenadier in 2009 comprised 6 t which was taken by the French fleet. During 1988–2009 total catches in this area varied between 1 and 525 t (Figure 10.5.2). The main contribution to the total catch in 1989–1994 (167–521 t) was made by the French fleet that conducted directed fishery in Division IVa off Shetland Islands. Roundnose grenadier is caught as incidental bycatch in this area by Scottish vessels in insignificant amount as well. In this area, reported catch may include a high proportion of misreported roughhead grenadier.

In 2004, the major part of the total catch (370 of 377 t) was taken by Danish fleet in the northeastern corner of IVb Division during directed trawl fishery. The WG notes that catches coming from this location in IV probably are taken from the same stock as the one in IIIa.

The catch data for roundnose grenadier in Division Va in 2009 is absent. During 1988–2009, the catches within Icelandic waters varied 2 to 398 t and were made by Iceland (Figure 10.5.3). Maximum catches were registered in 1992–1997 when 198–398 t were caught annually as bycatch in mixed deep-water fisheries. In recent years, roundnose grenadier is taken in Icelandic waters as bycatch in trawl fisheries for Greenland halibut and redfish.

Roundnose grenadier catches in Subareas VIII and IX during 1988–2009 were minor and amounted 0 to 28 t annually (Figure 10.5.4). The main contribution to the total catch was made by France.

Total catch in Greenland waters (Subdivision XIVb2) in 1998–2009 amounted to 2–126 t (Figure 10.5.5). There is no directed fishery for roundnose grenadier in these areas. The majority of catches is taken as bycatch by Greenland and Norway during Greenland halibut bottom-trawl fisheries. Recently (prior to 2005), Germany also contributed to roundnose grenadier bycatch, especially in 1998 and 1999, when 116 and 105 t were caught respectively.

10.5.1.2 ICES Advice

ICES Advice applicable to 2009 was: "*Due to its low productivity, roundnose grenadier can only sustain low rates of exploitation. Fisheries on such species should always be accom-*

panied by programs to collect data on both target and bycatch fisheries. The fishery should not be allowed to expand unless it can be shown that it is sustainable".

10.5.1.3 Management

There is a TAC management of the roundnose grenadier fisheries in Subareas I, II, IV, VIII, IX, Division Va and Subdivision XIVb1 for European Community vessels (Table 10.4.1). In international waters there are NEAFC regulation of efforts in the fisheries for deep-water species.

10.5.2 Data available

10.5.2.1 Landings and discards

Landings are given in Table 10.5.1–10.5.5. No discard data are available.

10.5.2.2 Length compositions

No data.

10.5.2.3 Age compositions

No data.

10.5.2.4 Weight-at-age

No data.

10.5.2.5 Maturity and natural mortality

No data.

10.5.2.6 Catch, effort and research vessel data

No data.

10.5.3 Data analyses

There are no suitable to assess this assessment unit.

10.5.4 Comments on the assessment

No assessment was carried out.

10.5.5 Management considerations

There are currently no significant fisheries for this species in these areas. Due to its low productivity, roundnose grenadier can only sustain low rates of exploitation. Fisheries on such species should always be accompanied by programs to collect data on both target and bycatch fisheries. Fisheries should not be allowed to expand unless it can be shown that they are sustainable

Table 10.5.1. Working Group estimates of landings of roundnose genadier from Subareas I and II.

Year	Faroes	Denmark	France	Germany	Norway	Russia/USSR	Germany	UK (E+W)	UK (Scot)	TOTAL
1989			1	2		16	3			22
1990			32	2		12	3			49
1991			41	3	28					72
1992		1	22		29					52
1993			13		2					15
1994			3	12						15
1995			7							7
1996			2							2
1997	1		5		100					106
1998					87	13				100
1999					44	2				46
2000										0
2001								2		2
2002					11	1				12
2003					4					4
2004					27					27
2005			1		12					13
2006					6	2				8
2007					11	1				12
2008					10					10
2009*					9					

*** Preliminary data.**

Table 10.5.2. Working Group estimates of landings of roundnose genadier from Subarea IV.

Year	France	Germany	Norway	UK (Scot)	Denmark	TOTAL
1989	167	1		2		170
1990	370	2				372
1991	521	4				525
1992	421			4	1	426
1993	279	4				283
1994	185	2			25	212
1995	68	1		15		84
1996	59			5	7	71
1997	1			10		11
1998	35					35
1999	56		5			61
2000	2					2
2001	2				17	19
2002	11		1	26		38
2003	5		1	11		17
2004	5			1	371	377
2005	18		2			20
2006	7		4			11
2007	25		1			25
2008	1					1
2009*	6					

*** Preliminary data.**

Table 10.5.3. Working Group estimates of landings of roundnose genadier from Division Va.

YEAR	FAROES	ICELAND**	NORWAY	RUSSIA	UK (E+W)	TOTAL
1989	2	2				4
1990		7				7
1991		48				48
1992		210				210
1993		276				276
1994		210				210
1995		398				398
1996	1	139				140
1997		198				198
1998		120				120
1999		129				129
2000		54				54
2001		40				40
2002		60				60
2003		572				57
2004		181				181
2005		76				76
2006		62				62
2007	1	13	2			16
2008		29				29
2009*						

*** Preliminary data, ** includes other grenadiers from 1988 to 1996.**

Table 10.5.4. Working Group estimates of landings of roundnose genadier from Subareas VIII and IX.

YEAR	FRANCE	SPAIN	TOTAL
1989			0
1990	5		5
1991	1		1
1992	12		12
1993	18		18
1994	5		5
1995			0
1996	1		1
1997			0
1998	1	19	20
1999	9	7	16
2000	5		5
2001	7		7
2002	3		3
2003	2		2
2004	2		2
2005	7		7
2006*	27	1	28
2007	10		10
2008	5		5
2009*	11		11

*** Preliminary data.**

Table 10.5.5. Working Group estimates of landings of roundnose genadier from Division XIVb2.

YEAR	FAROES	GERMANY	GREENLAND	ICELAND	NORWAY	UK (E+ W)	UK (SCOT)	RUSSIA	TOTAL
1989	3	42							45
1990		45	1			1			47
1991		23	4			2			29
1992		19	1	4	6		1		31
1993		4	18	4					26
1994		10	5						15
1995		13	14						27
1996		6	19						25
1997	6	34	12		7				59
1998	1	116	3		6				126
1999		105	0		19				124
2000		41	11		5				57
2001		11	5		7	2	72		97
2002		25	5		15	1	1		47
2003			15		5	1			21
2004		27	3						30
2005			7		6	1			14
2006*		35	0		17				53
2007	1				1				2
2008								12	12
2009*					1	1			

*** Preliminary data.**

Table 10.5.6. Working Group estimates of landings of roundnose grenadier from I, II, IV, Va2, VIII, IX, XIVb2.

Year	I+II	IV	Va	VIII+IX	XIVb2	Unallocated	Total
1989	22	170	4	0	45	0	241
1990	49	372	7	5	47	0	480
1991	72	525	48	1	29	0	675
1992	52	426	210	12	31	0	731
1993	15	283	276	18	26	0	618
1994	15	212	210	5	15	0	457
1995	7	84	398	0	27	0	516
1996	2	71	140	1	25	0	242
1997	106	11	198	0	57	0	373
1998	100	35	120	20	126	0	402
1999	46	61	129	16	124	0	382
2000	0	2	54	5	57	0	118
2001	2	19	40	7	97	208	373
2002	12	38	60	3	47	504	664
2003	4	17	57	2	21	952	1 054
2004	27	377	181	2	30	0	618
2005	13	20	76	7	14	0	130
2006	8	7	62	0	53	0	130
2007	12	25	16	10	2	0	65
2008	10	1	29	5	12		57
2009*	2	6		11	9		28

*** Preliminary data.**

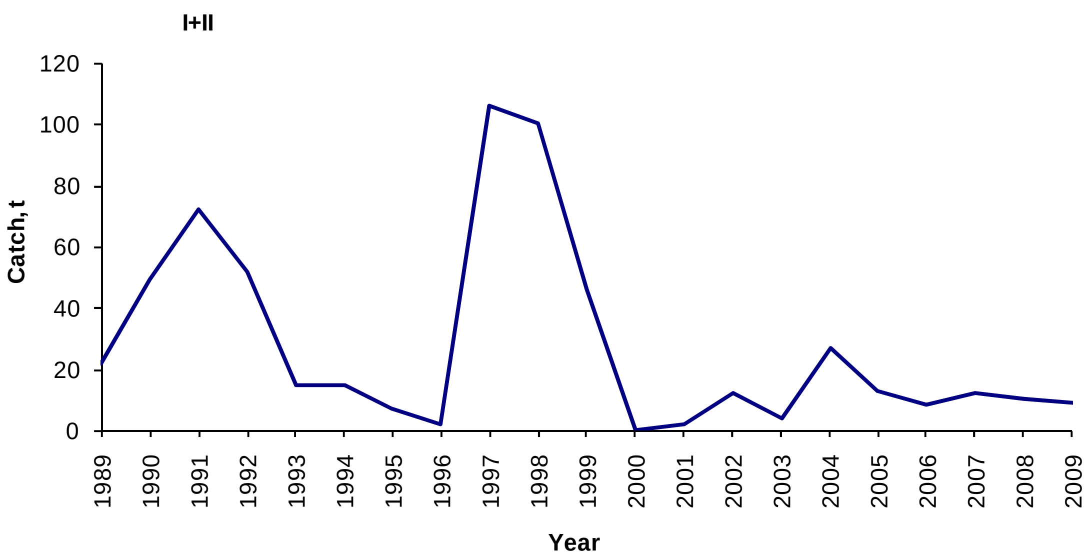


Figure 10.5.1. Roundnose grenadier catches in Subareas I and II, 1989–2009 (data for 2009 is preliminary).

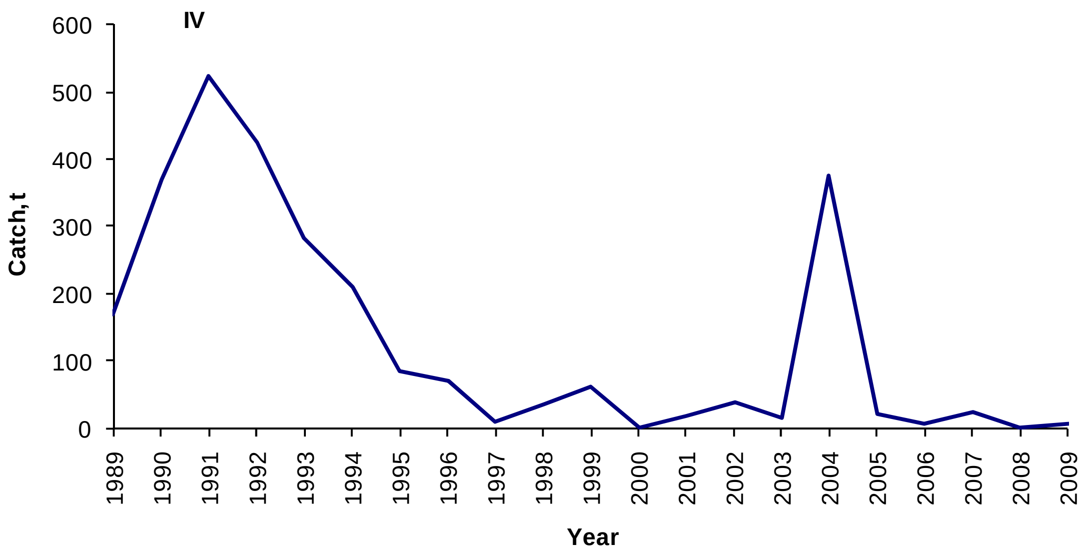


Figure 10.5.2. Roundnose grenadier catches in Subareas IV, 1989–2009 (data for 2009 is preliminary).

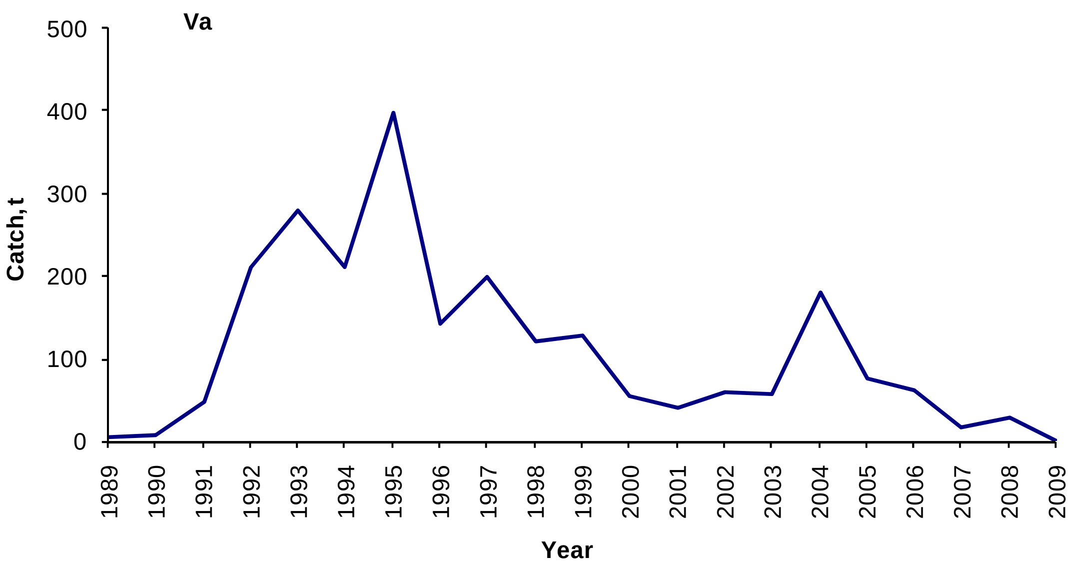


Figure 10.5.3. Roundnose grenadier catches in Division Va, 1989–2009 (data for 2009 is preliminary).

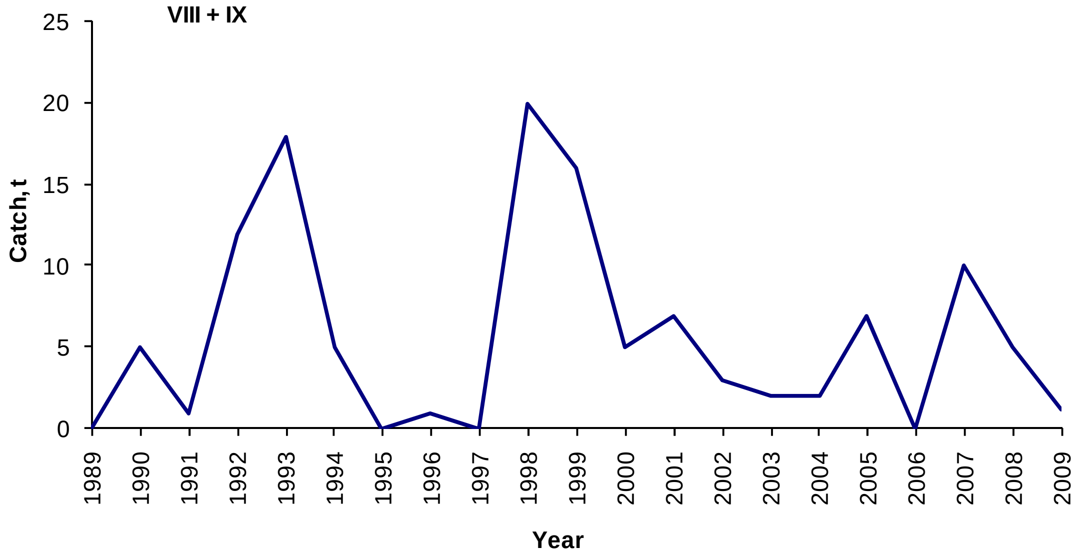


Figure 10.5.4. Roundnose grenadier catches in Subareas VIII–IX, 1989–2009 (data for 2009 is preliminary).

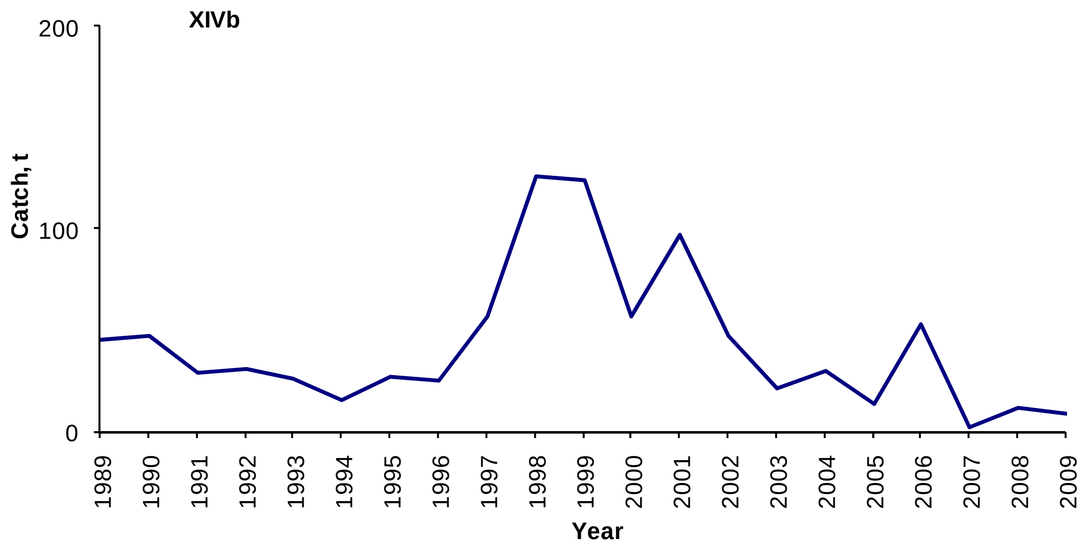


Figure 10.5.5. Roundnose grenadier catches in Subarea XIVb2, 1989–2009 (data for 2009 is preliminary).

Stock Annex: Roundnose grenadier in Vb, VI, VII and XIIb

Stock	Roundnose grenadier (*Coryphaenoides rupestris*) in Division Vb and Subareas VI, VII and Division XIIb
Working Group	WKDEEP
Date	11th March 2010
Revised by	Lionel Pawlowski and Pascal Lorance

A. General

A.1. Stock definition

ICES WGDEEP has in the past proposed four assessment units of roundnose grenadier in the NE Atlantic (Figure A.1):

- Skagerrak (IIIa)The Faroe-Hatton area;
- Celtic sea (Divisions Vb and XIIb, Subareas VI, VII);
- the Mid-Atlantic Ridge 'MAR' (Divisions Xb, XIIc, Subdivisions Va1, XIIa1, XIVb1);
- All other areas (Subareas I, II, IV, VIII, IX, Division XIVa, Subdivisions Va2, XIVb2).

Roundnose grenadier is widely distributed in the North Atlantic. Its area stretches from Norway to northwest Africa in the east to the Canadian-Greenland coasts and the Gulf of Mexico in the west, and from Iceland in the north to the areas south of the Azores in the south (Parr, 1946; Andriyashev, 1954; Leim and Scott, 1966; Zilanov *et al*., 1970; Geistdoerfer, 1977; Gordon, 1978; Parin *et al*., 1985; Pshenichny *et al*., 1986; Sauskan, 1988; Eliassen, 1983). Aggregations of this species are found on the continental slope of Europe and Canada, on the MAR seamounts, in the Faroe-Hatton area (banks Hatton, Rockall, Louzy, Bill Baileys, etc.) and in the Skagerrak and Norwegian fjords.

Some studies have allowed observing fish in all maturity stages in all the distribution area (Allain, 2001; Kelly *et al*., 1996, 1997; Shibanov, 1997; Vinnichenko *et al*., 2004), therefore allowing for several populations to exist.

No genetic results are available to validate the hypothetical stock structure presented above. Several authors also consider that roundnose grenadier is a poor swimmer and is therefore unlikely to make extended migrations. No pattern in seasonal density variation has been observed from surveys or from fisheries. However, there are no data available to indicate whether or not individuals move around during their life span.

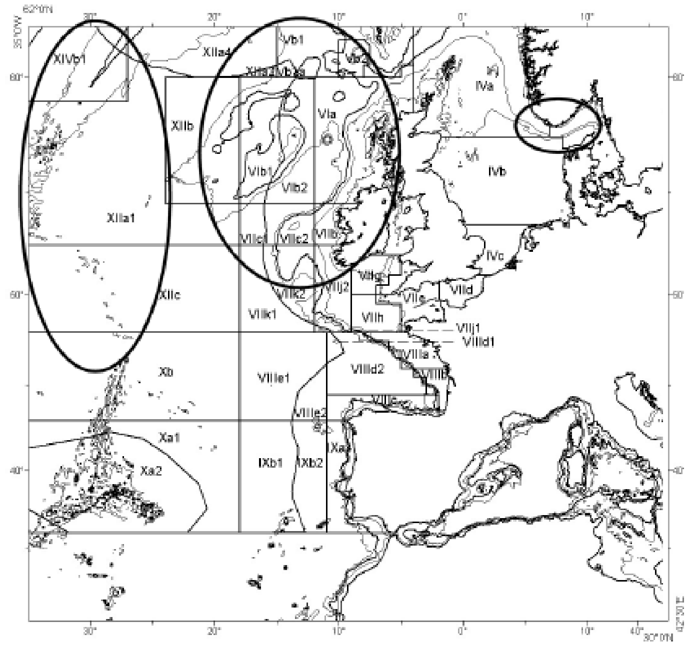


Figure A.1. Areas of the main fisheries for roundnose grenadier, Skagerrak, west of the British Isles and mid-Atlantic Ridge. The isobaths displayed are 100, 200, 1000 and 2000 m (from Lorance *et al.*, 2008).

The current perception is based on what is believed to be natural restrictions to the dispersal of all life stages. The Wyville Thomson Sill may separate populations further south on the banks and slopes off the British Isles and Europe from those distributed to the north along Norway and in the Skagerrak. Considering the general water circulation in the North Atlantic, populations from the Icelandic slope may be separated from those distributed to the west of the British Isles.

It has been postulated that a single population occurs in all the areas south of the Faroese slopes, including also the slopes around the Rockall Trough and the Rockall and Hatton Banks but the biological basis for this remains hypothetical.

Published results on length (11.5–12.5 cm pre-anal fin length, PAFL) and age (9–14 years) at first maturity of females to the West of British Isles and in the Skaggerak (Allain, 2001; Bergstad, 1990; Kelly *et al*., 1996; 1997) do not seem to clearly discriminate these two groups, although they are most likely to be demographically different unit.

Some studies have detected genetic differentiation in at least parts of the species range and indicating the presence of distinct populations within the species (Logvinenko *et al*., 1983; Duschenko, 1989).

In 2007, WGDEEP examined the available evidence for stock discrimination in this species based on length distribution, commercial catch, cpue, age, maturity, reproduction. Length distribution, catch and cpue data were considered too aggregated or too dependant on external factors (e.g. fleet dynamics, depth) to be usable to discriminate stocks. Analyses on age data on longevity were unable to conclude if the differences of longevity from one region to another were local changes or the effect of exploitation.

New genetic studies are likely to become available in the forthcoming months. Preliminary results were presented in the ICES symposium "Issues confronting the Deep Oceans" (Horta, Azores, 27–30 April 2009). Microsatellite DNA was used to characterize the large-scale population structure from samples spanning over the entire North Atlantic. Samples of *ca.* 800 individuals were analysed for eight microsatellite loci. Roundnose grenadier was found to display a trend of increasing genetic differentiation with distance among samples. In absolute terms the amount of genetic differentiation among roundnose grenadier samples was considerably higher than in other deep-sea fish species, such as Greenland halibut (Knutsen *et al.*, 2007) and tusk (Knutsen *et al.*, submitted) over comparable distances. The gene flow appeared restricted also among relatively closely situated localities (less than 500 km) (Knutsen *et al.*, 2009). If these preliminary results are confirmed, the current stock structure used for assessment and primarily based upon bathymetry and hydrology will need revision towards a structuring at smaller spatial scale.

A.2. Fishery

The majority of landings of roundnose grenadier from this area are taken by bottom-trawlers. To the west of the British Isles, in Divisions Vb, VIa, VIb2 and Subareas VII, French trawlers catch roundnose grenadier in a multispecies deep-water fishery. The Spanish trawl fleet operates further offshore along the western slope of the Hatton Bank in ICES Divisions VIb1 and XIIb.

French trawlers began to land increasing amounts of roundnose grenadier, from the west of Scotland in 1987 (Charuau *et al.*, 1995). Landings of these species have been reported separately in French landings statistics since 1989 (Lorance *et al.*, 2001). The quantities landed in 1987 and 1988 are not known with accuracy but they are believed to be less compared with landings in the 1990s.

The activity of the Spanish fishery in international waters is poorly known. New information on landings data in Division VIb and Subarea XII from the Spanish fisheries for the years 2005, 2007 and 2008 have been made available. These newly obtained data are from the freezer fleet operating mostly in those regions. Data from 2006 are incomplete and of no use for stock assessment. The main problem associated to Spanish official landing data for roundnose grenadier is the uncertainty regarding their accuracy. The disagreement between observer catch data and official landings data suggests that catches of this species might be reported as corresponding to several species. Roughhead grenadier is mostly absent from observer data despite recorded annual catches above 1000 tonnes in 2005 and 2007. Similarly, roughsnout grenadier is absent from observer data although apparently between 1300 and 4800 tonnes where landed in the years 2005, 2007 and 2008. Gunther´s grenadier was recorded by the observers but not in the logbooks. The distribution of the catch and effort are poorly known. Effort directed at deep-water species increased from 1989 to 1996 (Lorance and Dupouy, 2001). In 1995 an effort regulation was introduced but was not a constraint to this fleet. TACs and a new effort regulation was introduced in 2003 (Council Regulation (EC) No 2347/2002 of 16 December 2002) and the fishery has reduced. Part of the fishing time of the licensed fleet is expended on the shelf mainly in the Celtic Sea.

A.3. Ecosystem aspects

Roundnose grenadier is a slow-moving species, which prefers grounds with slow currents. Vertical diurnal migrations are also observed, the pattern of which depends on feeding (Savvatimsky, 1969) and water circulation and meteorological processes (Shibanov and Vinnichenko, 2007).

There is no direct evidence of long distance migrations made by adult fish. The distribution and dispersal of the eggs and larval stages is poorly known, except in the Skagerrak (Bergstad and Gordon, 1994). Juveniles grenadier of 2–8 cm pre-anal length were caught in the mid-water by 120–840 m over bottoms of 1200–3200 m along Greenland slope, on the Mid-Atlantic Ridge, Hatton bank, in the Irminger and Labrador seas suggesting that some passive migrations of juveniles in the open ocean occurs (Vinnichenko and Khlivnoy, 2007).

In the Skagerrak (ICES Division IIIa), available information indicates that roundnose grenadier spawn in the late autumn (Bergstad, 1990a). Eggs (diameter 2.4–2.6 mm), postlarvae and pelagic juveniles have been caught with plankton net from 150 to 550 m. The newly hatched larvae appear very primitive and the pelagic phase is extensive. The mean size of larvae, assumed to belong to the same cohort sampled repeatedly in the same year, increased from February to October, when they attained a demersal stage of life cycle (Bergstad and Gordon, 1994). To the west of the British Isles, females with maturing ovaries have been observed from February to December, but they were more abundant from May to October and spawning appears to extend at least from May to November (Kelly *et al.*, 1996; Allain, 2001). Studies in Icelandic waters indicate year-round spawning, with no obvious peaks (Magnússon *et al.*, 2000). There appear thus to be differences in the timing of spawning between areas, perhaps reflecting varying environmental conditions. Roundnose grenadier is a batch spawner with a fecundity of 4000–70 000 oocytes per batch (Allain, 2001).

There is a lack of knowledge of the distribution and dispersal of the eggs and larval stages, except in the Skagerrak (Bergstad and Gordon, 1994), and so the biological basis for the current hypothetical population structure must await the results from future studies of genetics and otolith microchemistry. To date, only a single study of whole otolith microchemistry of roundnose grenadier from a wide area of the Atlantic (Mid-Atlantic Ridge, Reykjanes Ridge, Hatton Bank, Porcupine Seabight, Rockall Trough, Skagerrak and two Norwegian fjords) has been carried out using solution-based, inductively-coupled, plasma mass spectrometry (SO-ICPMS) (Gordon *et al.*, 2001). Discriminant analysis of eight elements separated samples from the Norwegian fjords and the Skagerrak from those from the NE Atlantic areas. Differences between samples from six areas of the Atlantic (Hatton Bank, Rockall Trough, Porcupine Seabight, Mid-Atlantic Ridge, and Reykjanes Ridge) were small, and elemental concentrations overlapped. Therefore, this study supports the view that populations in the NE Atlantic are separate from the Norwegian fjords and the Skagerrak, but does not show any difference in populations between the Mid-Atlantic Ridge and the remainder of the NE Atlantic.

B. Data

B.1. Commercial catch

Landings time-series data per ICES areas are available.

Landings data by ICES statistical rectangle are available from France, Norway and UK (England and Wales and Scotland). No other country provided data by rectangle. Landings by ICES division are available from other countries.

Catch in Subarea XII are allocated to Division XIIb (western Hatton Bank) or XIIa, c (Mid-Atlantic Ridge) according to knowledge of the fisheries from WG members. For each country, the time-series of landings are checked and revised if needed according to Statland data. Statland reports landings in Subarea XII consistently with what this Working Group did in the past.

Catch and discards by haul are available from observer programmes. From the French observer programme, total catch, landings and discards and catch, landings and discards of roundnose grenadier are available on a haul by haul basis for 2004–2006.

Discard data (quantities and length distribution) are also available from the on-board observation of the French fishery, 2004–ongoing, from French on-board observations on French vessels in 1997–1998 and from Scottish observers on board of French vessels, 1997–2001. The length distributions of discards from all these observations seem quite consistent.

Based on EU observer programme 2004–2005, about 30% by weight and 50% by number of the catch of roundnose grenadier is discarded, because of small size. This figure is higher than in previous sampling where the discarding rate in the French fisheries was estimated slightly above 20% from sampling in 1997-1998 (Allain *et al*., 2003). The change may come from a combination of changes in the depth distribution of the fishing effort and a decrease in the abundance of larger fish as visible in the landings. The modal discarded length has remained constant.

The mode of the length distribution of the discards from the Spanish fleet in Divisions VIb and XIIb is slightly smaller, probably because of different sorting habits in relation to different markets. It is therefore important that length distribution of the landings and discards are provided to the working group by all fleets exploiting the stock. Larger variations in discards levels have been reported between species and between observers and vessels.

Misreporting or underreporting are not known to have been a problem in the French trawling fleet. Concerns have been repeatedly expressed that misreporting could occur in international waters (NEAFC regulatory area). There are also been regular complains from the French Industry that IUU fish was landed in France and was pulling the prices down. This seems to have disappeared in recent years. Misreporting is not an issue that scientists have the power to inquire and this should stay in hand on management and regulation authorities to monitor misreporting. No quantitative data on misreporting is available.

The landings data were however considered uncertain in Division XIIb, because unreported landings may occur in international waters. In addition to this, all national landings data were not reported by new ICES divisions and some landings were allocated to divisions according to knowledge of the fisheries from the Working Group. Lastly significant unallocated landings occurred in 2005. This has led the Working Group to remove in 2008, XIIb from the exploratory assessments although the stock definition consider the Faroe-Hatton area, Celtic sea catches (Divisions Vb and XIIb, Subareas VI, VII) belonging to the same stock.

B.2. Biological data

Size frequency data (and corresponding weight data) for roundnose grenadier are available for French catches for every year since 1990.

Age estimates were available from France. This dataset may be heterogeneous, because three different readers estimated the age over these different years and also because measuring the fish on board may lead to different age–length relationship than measuring the landed fish that may have lost water for some days in ice. Large discrepancies between readers were observed in a recent otolith reading exchange and workshop (ICES, 2007a).

Age composition of the French landings has been routinely estimated since 2001. Formerly age–length keys (ALK) were derived from a cruise in 1999 and from sampling on board of commercial trawler in 1996–1997 (Lorance *et al.*, 2001; 2003). Preliminary analysis of the length-at-age data demonstrated that ALK is very stable over years. ALK for years 1999 and 2001–2004 were very similar, the ALK for 2005 appeared different and the change was ascribed to a change of the reader.

These data are based upon ALK from age estimates in 1996, 1999 and 2002–2005. Otoliths from 1996 and 1999 were collected respectively on board of commercial trawlers and during a scientific cruise; otoliths for 2002–2005 were routinely sampled from the landings.

No new data on maturity and natural mortality has been collected in recent years. Natural mortality was previously estimated from catch curves and an estimated M=0.1 was used by the Working Group since 2002. It should be kept in mind than this estimate is based on limited data.

B.3. Surveys

Only one cruise relevant to roundnose grenadier is currently carried out on a yearly basis by FRS (Scotland). Stock indicators were derived from this survey (Neat and Burns, in press) but have not yet been formally integrated into stock assessment.

Another cruise has been carried out since 2006 on the R/V Celtic explorer every year during the autumn. The surveys aim to collect biological data on the main deep-water fish species and invertebrates along the continental slope in Subareas VI and VII north. Fishing tows were carried out at four depths, 500 m, 1000 m, 1500 m and 1800 m in three distinct areas. The effective fishing time, from when the net touched the bottom, was set at two hours. Tows were carried out along the depth contour. At each station the entire catch was sorted to species level and weighed. Full biological sampling, i.e. length, weight, sex, maturity, and age, was carried out on specific commercial species. Additional biological sampling, without age, was carried out on an *ad-hoc* basis on other species.

B.4. Commercial cpue

Time-series of French fishing effort are available based upon logbook data (1987–2009). Following their requirement under the Data Collection Regulation (DCF), VMS data (starting back from 2003) are made available from 2010. Lpues data based upon French tallybooks are available from 2000 based upon a voluntary participation of fishermen. These data are used in the Working Group as indicators of trends and also in the assessment.

Time-series of fishing effort of past years can be improved from tallybooks. In EU logbooks, fishing operations (individual tows and lines and net setting) carried out in the same day and rectangle are cumulated. For the French trawling fleet, tallybooks of haul by haul data were provided by the industry and allowed for better account of all factors in lpues (Lorance *et al.*, 2009). Applied to all fleets such data would allow effort to be properly handled. Electronic logbooks are under development on French vessels and data will be reported haul by haul including depth. It should be noted that this improvement is particular to deep-water fisheries where depth may vary a lot in a single statistical rectangle. Therefore haul by haul data and fishing depth are much more crucial in deep water fisheries than in shelf fisheries were most of the depth information is conveyed by the statistical rectangle.

VMS data also allows for improvement of effort data as is allows for some particular uses such as estimating the fishery footprint and fine scale changes in effort distribution. Nevertheless, data such as tallybooks provided to Ifremer by the industry includes all the effort information (tow duration, depth, location) coupled with catch, while using VMS requires assumptions to identify fishing and steaming activities and coupling catch to VMS data is an unresolved issue.

Overall the knowledge of the fleet activity at sea is reliable in Division Vb and Subareas VI and VII, the situation is poorer in Divisions VIb and XIIb. Distribution of catch and effort at the resolution of ICES rectangle has been available, from France, Ireland and UK (ICES, 2006; ICES, 2007b).

The French fleet is known based upon the licensing scheme since 2003. Before this time, catch composition was used to identify which vessels were fishing in the deep water. Therefore, composition of the fleet, number of vessels can be considered available since the early 1980s.

B.5. Other relevant data

No other source of data is used in the assessment.

C. Historical stock development

Past assessments

Based upon what is believed to be natural restrictions to the dispersal of all life stages, the area of this stock is considered to include Division Vb and XIIb and Subareas VI and VII. Due to uncertainties in the catch in Division XIIb, assessment has been restrained to Vb, VI, VII. Therefore only a portion of the regions of this stock has been assessed in 2008 and 2009.

Given the lack of data, assessments have only been exploratory until 2009. Exploratory assessments focused on integrating discard data into the assessment (WGDEEP, 2008) and rebuilding catch at the beginning of the fishery (WGDEEP, 2009; Pawlowski and Lorance, 2009). The assessment model used was the Separable VPA. The main criticisms against the use of this model were the short time-series of available data and the uncertainties around the age- and length-based approach for this species.

The *Bayesian Surplus Production model*, *Multi-Year Catch Curve model* and other *indicators* of trends are currently used for assessment until the next Benchmark Workshop.

Bayesian surplus production model

In 2010, WKDEEP considered the Bayesian Surplus Production Model as the most parsimonious short-term approach. Such an approach can be informative on relative trends such as changes in exploitation biomass and depletion. However, interpreting absolute levels are inappropriate with the current data.

Multi-year catch curve model

A Multi year catch curve (MYCC) model developed as part of the EU-DEEPFISHMAN project, returns realistic trends in total mortality Z per year. Absolute level may have to interpret with caution. Nevertheless, this model should be used further, to derive an indicator of total mortality and to explore the stock dynamic. Input data are age distribution of the landings or of the catch (landings and discards) per year. The model was run on age 25–46+ (fully recruited stock). The model requires some parameter to be fixed.

- M=0.1 (depending on model setting)
- Coefficient of variations of the recruitement (CVrec= 0.1)

- Coefficient of variations of the landings or catch (CVo=0.1 : CV of observations

Other indicators of trends

Biological indicators such as trends in mean length, ratio of mature/immature provide valuable insights of the state of stocks. Information from length distribution of landings and discards in addition to information on fishing depths are useful indicators of trends in the fishery and in the population structures.

Lpues data based upon French tallybooks are used as indicators of trends and also in the assessment. Catch rates from surveys are used to check the consistency of the analysis on the commercial cpues.

Stock assessment parameters

Assessment Model used: Surplus Production Model (based on Pella Tomlinson biomass dynamic model)

Software used: FLBayes package version 1.4, FLCore 1.99-91, R 2.9.2 (URL: http://code.google.com/p/wgdeep-rng/)

Model Options chosen:

Initial parameters

- Age-at-maturity: 11 (variance 0.1)
- Longevity: 50 (variance 0.1)
- Priors for Q (logQ.mean = 0, loqQ.var = 100)
- Priors for K (K.mean = log(100000) , K.var = 1)
- Priors for r (r.mean = mean(log(r.mc)), r.var = mean(var(r.mc)))
- sigma.shape = 2
- sigma.rate = 1

Input data types and characteristics:

- Landings data are used from 1988 in Vb, VI, VII and XIIb when available.
- Lpues from French tallybooks from 2000 (past lpues may be included when data will be available). Lpues are provided by region and are combined. The weight of each region is the proportion between the local and the total landings.

D. Short-term projection

No projections are performed.

E. Medium-term projections

No projections are performed.

F. Long-term projections

No projections are performed.

Biological reference points

The current data are inappropriate to provide MSY absolute estimates from the Bayesian Surplus Production model.

H. Other issues

Landings and effort data in Division XIIb should be included into the assessment if they become reliable. A separate assessment for Division XIIb should be carried out separately from the one for Division Vb, and Subareas VI, VII.

As the performance of this model is dependant on the length of the times-series, separate exploratory runs may be performed to evaluate the effects of new datasets or data points.

Because discarding is no longer allowed for this species (ref), all catch should be landed in the forthcoming years and will be integrated into the assessment.

New stock identity results are likely to become available in the next few years and should be considered to evaluate the assessment area.

I. References

Allain V. 2001. Reproductive strategies of three deepwater benthopelagic fishes from the northeast Atlantic Ocean. Fisheries Research 51: 165–176.

Allain V, Biseau A, Kergoat B. 2003. Preliminary estimates of French deepwater fishery discards in the Northeast Atlantic ocean. Fisheries Research 60: 185–192.

Allain V, Lorance P. 2000. Age estimation and growth of some deepsea fish from the Northeast Atlantic ocean. Cybium 24: 7–16.

Andriyashev A. P. 1954. The North seas fish. Moscow. AN USSR:568 (in Russian).

Bergstad OA. 1990. Distribution, population structure, growth and reproduction of the roundnose grenadier *Coryphaenoides rupestris* (Pisces: Macrouridae) in the deep waters of the Skagerrak. Marine Biology 107: 25–39.

Bergstad OA, Gordon JDM. 1994. Deep-water ichthyoplankton of the Skagerrak with special reference to *Coryphaenoides rupestris* Gunnerus, 1765 (Pisces, Macrouridae) and Argentina silus (Ascanius, 1775) (Pisces, Argentinidae). Sarsia 79: 33–43.

Charuau A., Dupouy H., Lorance P. 1995, French exploitation of the deep-water fisheries of the North Atlantic. In: Hopper A.G. (Ed.) Deep-water fisheries of the North Atlantic oceanic slope, Series E: Applied Sciences, Kluwer Academic Publishers, Dordrecht/Boston/London, 337–356.

Dushchenko V. V. 1989. On intraspecific structure of roundnose grenadier (*Coryphaenoides rupestris* G.) from the North Atlantic. Abstract of Biology science kandidat dissertation. M:22. (in Russian).

Eliassen J.E. 1983. Distribution and abundance of roundnose grenadier (*Coryphaenoides rupestris*, Gadiformes, Macrouridae) in northern and mid Norway//ICES CM1983/G:43:24.

Geistdoerfer P. 1977. Contribution a la biologie de *Coryphaenoides rupestris*. Repartition et reproduction dans l'Atlantique nord-est// ICES C.M. 1977/F:45:6.

Gordon JDM. 1978. Some notes of the biology of the Roundnose Grenadier *Coryphaenoides rupestris* to the west of Scotland// ICES C.M. 1978/G:40:13.

Gordon, JDM, Swan SC, Geffen AJ,Morales-Nin B. 2001. Otolith microchemistry as a means of identifying stocks of deep-water demersal fishes (OTOMIC). Northwest Atlantic Fisheries Organization (NAFO) Scientific Council Meeting, Varadero (Cuba), NAFO Scientific Council Research Document 01/100 Serial No. N4488.

ICES. 2006. Report of the Working Group on the Biology and Assessment of Deep-sea Fisheries Resources. ICES CM2006/Assess:28.

ICES. 2007a. Report of the Workshop on Age Reading of Roundnose Grenadier (WKARRG), 4–7 September 2007, Boulogne-sur-mer, France. ICES CM 2007/ACFM:36. 50 pp.

ICES. 2007b, Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP), 8–15 May 2007. International Council for the Exploration of the Sea. ICES CM 2008/ACOM 14. 471p.

ICES. 2008, Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP), 3–10 March 2008. International Council for the Exploration of the Sea. ICES CM 2008/ACOM 14. 486p.

ICES. 2009, Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP), 9–16 March 2009. International Council for the Exploration of the Sea. ICES CM 2008/ACOM 14. 504p.

Kelly CJ, Connolly PL, Bracken JJ. 1996. Maturity, oocyte dynamics and fecundity of the roundnose grenadier from the Rockall Trough. Journal of Fish Biology 49: 5–17.

Kelly CJ, Connolly PL, Bracken JJ. 1997. Age estimation, growth, maturity and distribution of the roundnose grenadier from the Rockall Trough. Journal of Fish Biology 50: 1–17.

Knutsen, H., Jorde, P. E., Albert, O. T., Hoelzel, A. R., Stenseth, N. C. 2007. Population genetic structure in the North Atlantic Greenland halibut (*Reinhardtius hippoglossoides*): influenced by oceanic current systems? Canadian Journal of Fisheries and Aquatic Sciences 64(6), 857–866.

Knutsen, H., Jorde, P. E., Sannaes, H., Hoelzel, A. R., Bergstad, O. A., Stefanni, S., Johansen, T., Stenseth, N. C. 2009*. Bathymetric barriers promoting genetic structure in the deepwater demersal fish tusk (Brosme* brosme). Molecular Ecology 18(15), 3151–3162.

Knutsen H., Jorde P.E., Skogen M., Stenseth N.C. 2009. Large-scale population structure in roundnose grenadier. ICES International Symposium, Issues confronting the deep oceans, Horta, Azores, 27–30 April 2009.

Leim AH, Scott WB. 1966. Fishes of the Atlantic coast of Canada. Ottawa: 220–221.

Logvinenko BM, Nefedov GN, Massal'skaya LM., Polyanskaya IB. 1983. A population analysis of rock grenadier based on the genetic polymorphism of non-specific esterases and myogenes. Can Trans Fish Aquat Sci No. 5406: 16pp.

Lorance P., Dupouy H., Allain V. 2001, Assessment of the roundnose grenadier (*Coryphaenoides rupestris*) stock in the Rockall Trough and neighbouring areas (ICES Subareas V–VII). Fisheries Research 51, 151–163.

Lorance P., Garren F., Vigneau J. 2003. Age estimation of roundnose grenadier (*Coryphaenoides rupestris*), effects of uncertainties on ages. Journal of Northwest Atlantic Fishery Science 31:387–399.

Lorance P., Large P.A., Bergstad O.A., Gordon J.D.M. 2008. Grenadiers of the Northeast Atlantic – Distribution, biology, fisheries, and their impacts, and developments in stock assessment and management. In: Grenadiers of the world oceans: biology, stock assessment and fisheries, Bethesda, MS, USA, American Fisheries Society Symposium 63, 365–397.

Lorance P., Pawlowski L., Trenkel V. 2009. Standardizing blue ling LPUE from industry haul by haul data using generalised additive models, Journal of Marine Science. *Submitted.*

Magnússon J, Magnússon JV, Jakobsdottir KB. 2000. Deep-sea fishes. Icelandic contributions to the deep-water research project, EC FAIR Project CT 95-0655, 1996–1999.

Neat F., Burns F. in press. Stable abundance, but changing size structure in grenadier fishes (*Macrouridae*) over a decade (1998–2008) in which deepwater fisheries became regulated. Deep Sea Research I.

Parin, NV, Neyma VG, Rudyakov YA. 1985. To the problem of waters biological productivity in the High Sea areas of underwater elevations. In: Biological grounds of the fishery development of the High Sea areas. Selected papers. Nauka. Moscow: 192–203 (in Russian).

Parr AE. 1946. The Macrouridae of the Western North Atlantic and Central American seas//Bull. of the Bingham Oceanogr. Collect. Yale Univers., - v. X, art. 1. p. 1–101.

Pawlowski L., Lorance P. 2009. Effect of discards on roundnose grenadier stock assessment in the Northeast Atlantic. *Aquat. Living Resour.* 22 (2009). DOI: 10.1051/alr/2009040.

Pshenichny, BP., Kotlyar AN, Glukhov AA, 1986. Fish resources of thalassobathyal Atlantic Ocean. In: Biological resources of the Atlantic Ocean. Moscow, Nauka:230–252 (in Russian).

Savvatimsky, PI. 1969. Roundnose grenadier of the North Atlantic. PINRO, Murmansk, 72 (in Russian).

Sauskan VI. 1988. Commercial fish of the Atlantic ocean. Agropromizdat, Moscow: 165–166 (in Russian).

Shibanov VN. 1997. Biological foundation of roundnose grenadier (*Coryphaenoides rupestris* Gunnerus, 1765) fishery in the North Atlantic. Candidate Dissertation in Biological Sciences. Murmansk, PINRO:156 (in Russian).

Shibanov VN, Vinnichenko VI. 2007. Biology and fishery of roundnose grenadier (*Coryphaenoides rupestris* Gunnerus 1765) in the North Atlantic/ *In press.*

Vinnichenko VI, Khlivnoy BN, Orlov AM. 2004. Biology and distribution of the deepwater fish on the Northeast Atlantic underwater elevations. Fishery economy. Water biological resources, their condition and use: Obzornaya informacjiya/ VNIERH. Moscow. 1:46 (in Russian).

Vinnichenko VI, Khlivnoy BN. 2007. New data on distribution of young roundnose grenadier (*Coryphaenoides rupestris*) in the North Atlantic. In press.WALTERS, C. 2003. Folly and fantasy in the analysis of spatial catch rate data. Canadian Journal of Fisheries and Aquatic Sciences, 60, 1433–1436.

Zilanov VK, Troyanovsky FM, Shepel LI. 1970. Some biology features, search and fishery characteristics of the roundnose grenadier in the North Atlantic. In: Materials of the Northern Basin. Murmansk. 16:3–21 (in Russian).

11 Black scabbard fish (*Aphanopus carbo*) in the Northeast Atlantic

11.1 Stock description and management units

The species is distributed on both sides of the North Atlantic and on seamounts and ridges south to about 30ºN. It occurs only sporadically north of the Scotland-Iceland-Greenland ridges. Juveniles are mesopelagic and adults are benthopelagic. It is admitted that the species life cycle is not completed in just one area and also that either small or large scale migrations occur seasonally. It has been postulated that fish caught to the west of the British Isles are pre-adults that migrate further south (possibly down to Madeira) as they reach maturity.

The stock structure is uncertain. Three management units are considered:

i) Northern (Divisions Vb and XIIb and Subareas VI and VII);

ii) Southern (Subareas VIII and IX);

iii) Other areas (Divisions IIIa and Va Subareas I, II, IV, X, and XIV).

The Northern component comprises fish exploited mainly by trawl fisheries while the southern component by a longline fishery in Subarea IXa. In other areas the species is exploited by both longliners and trawlers, but the overall landings are much lower than at the other two management units.

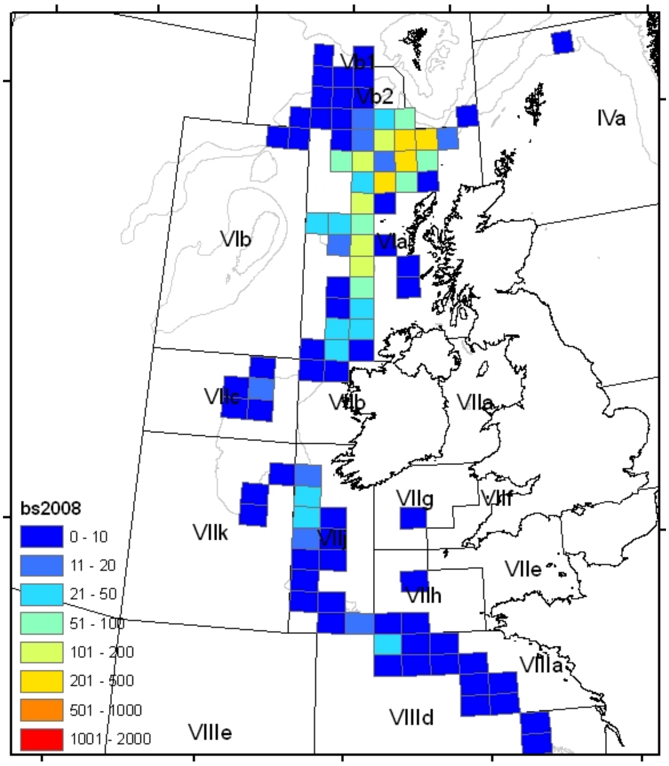


Figure 11.1.2. Catches of black scabbard fish by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2008.

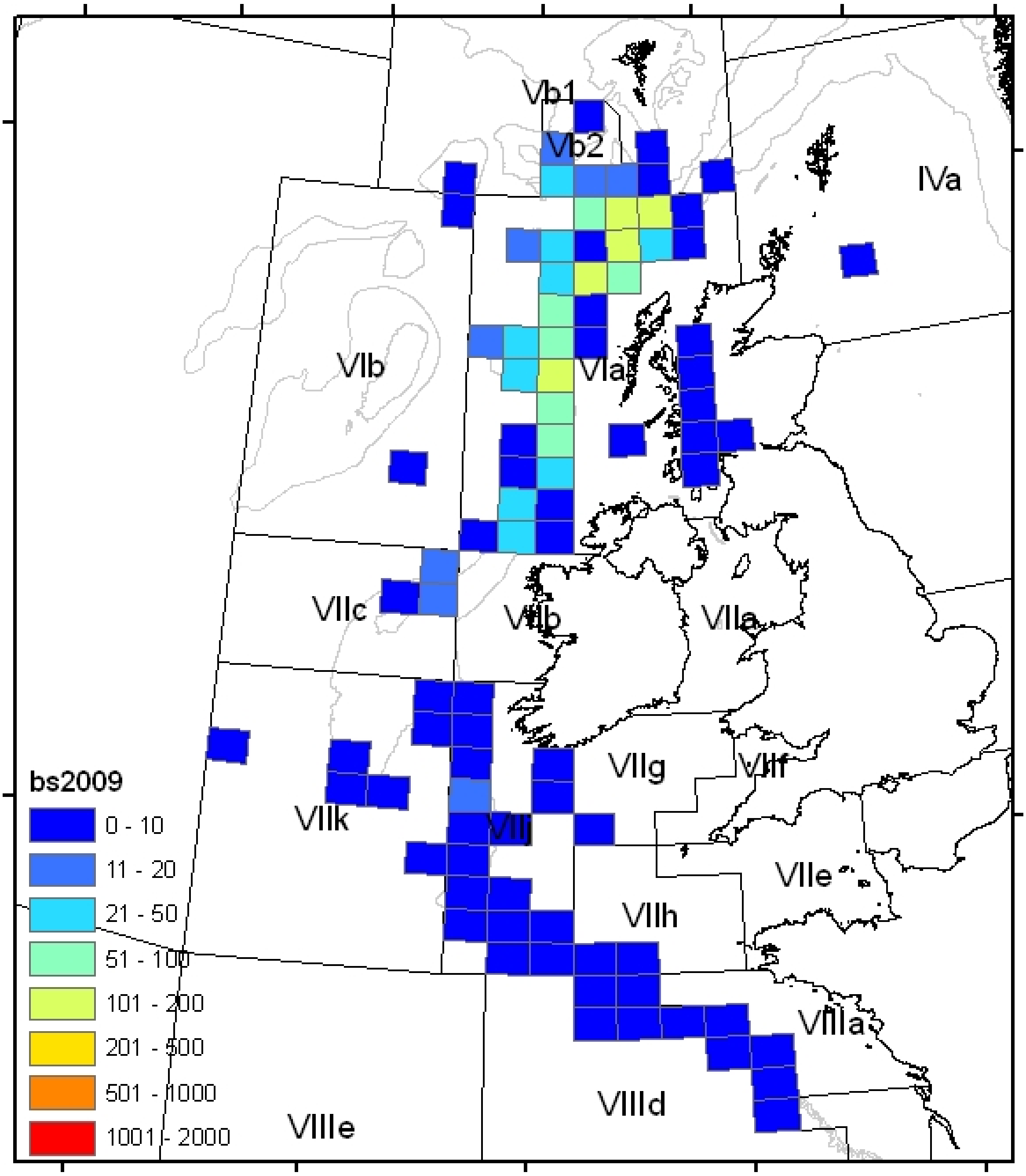


Figure 11.1.2. Catches of black scabbard fish by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2009.

11.2 Black scabbard fish in Subareas Vb and XIIb and Divisions VI and VII

11.2.1 The fishery

The Faroese fisheries take mostly place in Subarea Vb with a minor activity in Subarea VI. The Faroese deep-sea trawl fishery started in the late 1970s as a mixed redfish, blue ling, grenadier and black scabbardfish fishery; a more directed black scabbard fishery began in the late 1980s (1988) as a result of improvements of the gear and handling of the fish. And from 1993 onwards some of the otter board trawlers have targeted black scabbardfish either seasonally or throughout the year. The main fishing grounds for the species are located n the bank area southwest of the Faroe

Islands. The fleet of otter board trawlers (the so called deep-sea trawlers) consist of 13 vessels >1000 HP, but only 1–3 trawlers > 2000 HP are targeting black scabbardfish.

In ICES Subarea VI a Scottish mixed deep-water trawl fishery included some catches of black scabbard fish between the 1999–2005. This fishery has decreased since the introduction of TACs in 2003 and in recent years, 2004–2009, the volume of landings are around 57 t in VIa and inexistent in VIb.

Following the decline of target orange roughy Irish trawl fishery, landings of black scabbardfish derived from ICES Suabreas VI and VII reached about 1000 t in 2002. In the two most recent years (2008 and 2009) Irish landings have been null.

The French deep-water fishery operates mainly in Subareas VI and VII targeting roundnose grenadier, black scabbardfish, blue ling and deepwater sharks. Over recent years, the landings of black scabbardfish have declined but landings of other deep-water species (roundnose grenadier, orange roughy, deep-water sharks) have declined in a larger proportion.

The Spanish fishery in Hatton Bank started in 1996, triggered by the decline in catches in traditional fishing grounds. Durán Muñoz and Román Marcote (2001) described the beginning of this fishery and the fleet operating in Hatton. A total of 48 vessels have logged in fishing days at Hatton for the period 2002–2009, but the maximum number of vessels in the fishing grounds in any given month is 16. Most often, and on average, vessels stayed in Division VIb less than two weeks per month, but stayed in Division XII between three and four weeks.

11.2.1.1 Landings trends

Total landings from the ICES Subareas Vb and Divisions VI, VII and XII show a markedly increasing trend from 1999 to 2002 followed by a decreasing trend till 2005. There is a peak in 2006 and then there was a decrease mainly due to decreases of landings from ICES Divisions VI and VII (Figure 11.2.1).

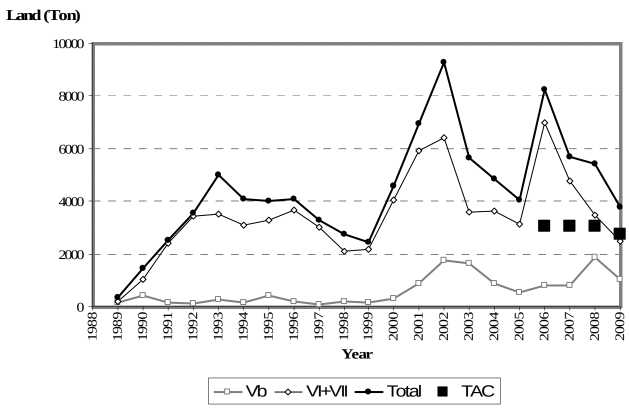


Figure11.2.1. Annual landings for Northern Component (NC) and Subarea Vb and Divisions VI and VII, as well as, the TAC.

In earlier years French landings represent more than 75% of the Northern Component total landings however at recent years both Faroese and Spanish landings greatly increase their relative contribution (Figure 11.2.2).

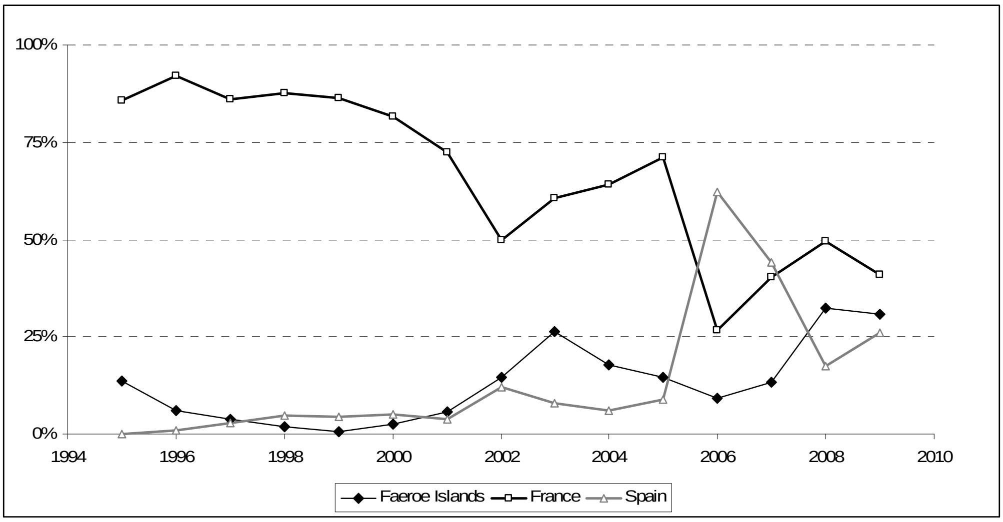


Figure 11.2.2. French, Spanish and Faroes relation contribution to the annual landings for Northern Component (NC).

11.2.1.2 ICES Advice

The most recent ICES Advice, in 2008, was: "*Despite the lower landings in recent years, cpue in areas Vb, VI, VII and XII has declined to about 20% of its initial level. ICES recommends that catches should be constrained to 2000 t (50% of the level before the expansion of the fishery, 1993–1997). The fishery should not be allowed to expand unless it can be shown that it is sustainable*."

11.2.1.3 Management

Since 2003, management of black scabbardfish by EU vessels fishing in EU and international waters includes a combination of TAC and licensing system. The TACs for 2007–2008; 2009–2010 and the total landings in Subareas V, VI, VII and XII in 2006, 2007, 2008 and 2009 are presented in the Table below. The overall TAC have been significantly overshoot from 2006 to 2008 (however 2009 landing estimates are still preliminary).

YEAR	EU TAC 2008 V, VI, VII & XII	EU LANDINDS VB, VI, VII AND XII
2006	3042	7495
2007	3042	4936
2008	3042	3666
2009*	2738	2624
2010	2547	

*** 2009 landing estimates are preliminary.**

11.2.2 Data available

11.2.2.1 Landings and discards

The time-series of the Spanish trawling fleet operating on the Northern and Western Hatton Bank (Divisions VIb1 and XIIb has been update with new data.)

New data on discards were made available for the Spanish fleet. These data are derived from a Spanish observer programme and have not yet been standardised. They should therefore be treated with caution.

11.2.2.2 Length compositions

New French length distributions of back scabbardfish by depth have been provided (Figure 11.2.3). Data were derived from on-board observations of French trawlers.

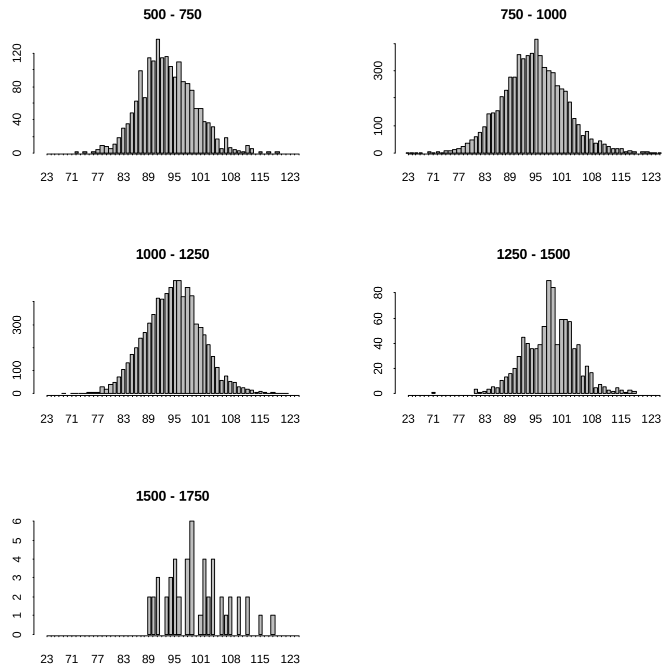


Figure 11.2.3. Black scabbard fish Length distribution by depth from on-board observations of French trawlers. Number are raised to total numbers in haul where black scabbardfish was measured.

Length frequency distributions for the period 1996–2001 (Figure 11.2.4.) have been provided from observers on board Spanish trawling fleet operating on the Northern and Western Hatton Bank (Divisions VIb1 and XIIb).

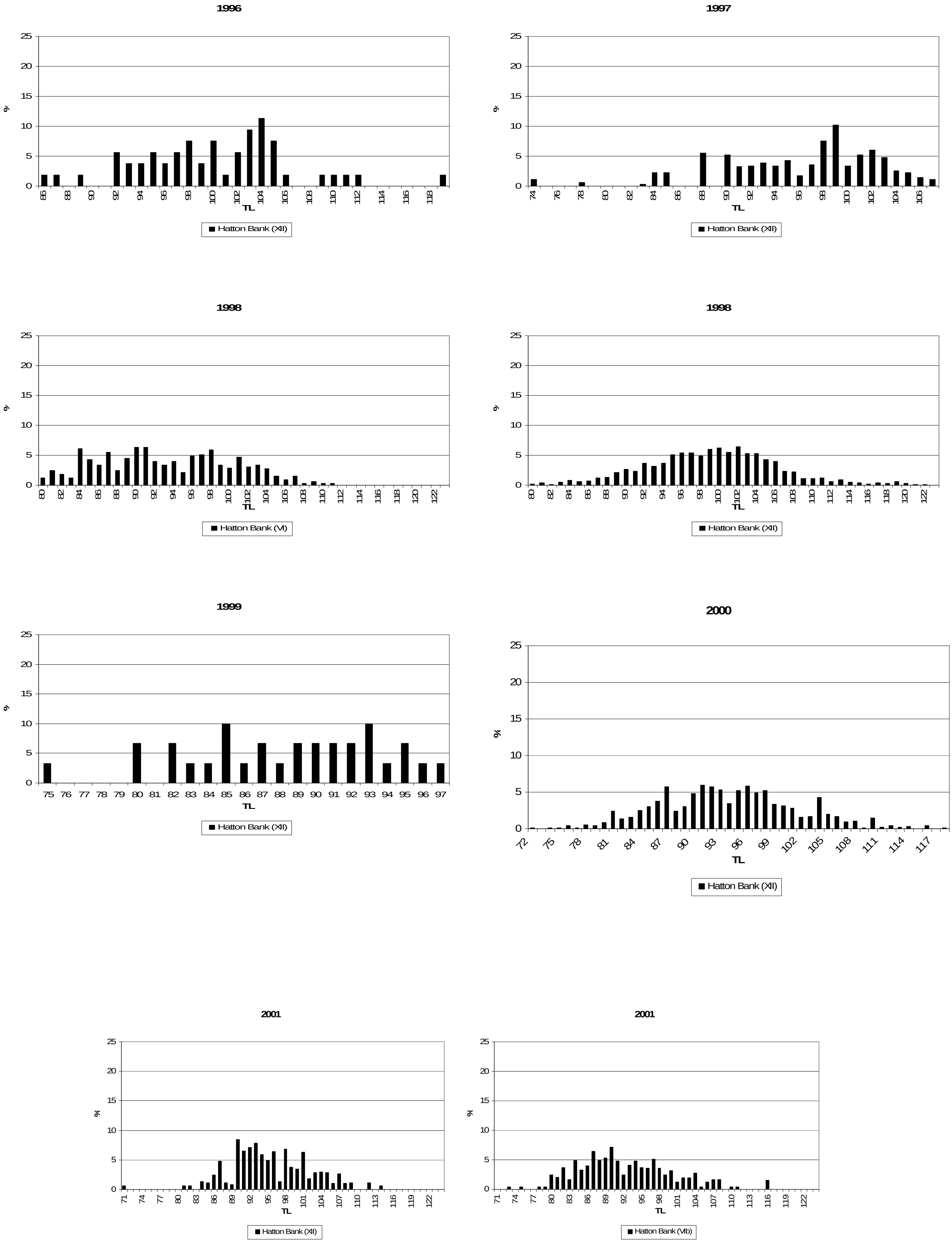


Figure 11.2.4. Black scabbard fish length frequency distribution by year from on-board observations of Spanish trawlers.

Mean length per depth stratum data from Scottish and Irish deepwater surveys (Figure 11.2.5) indicates that smaller length classes are preferentially distributed at depths shallower than 1000 m deep. These results support the hypothesis of species dynamics.

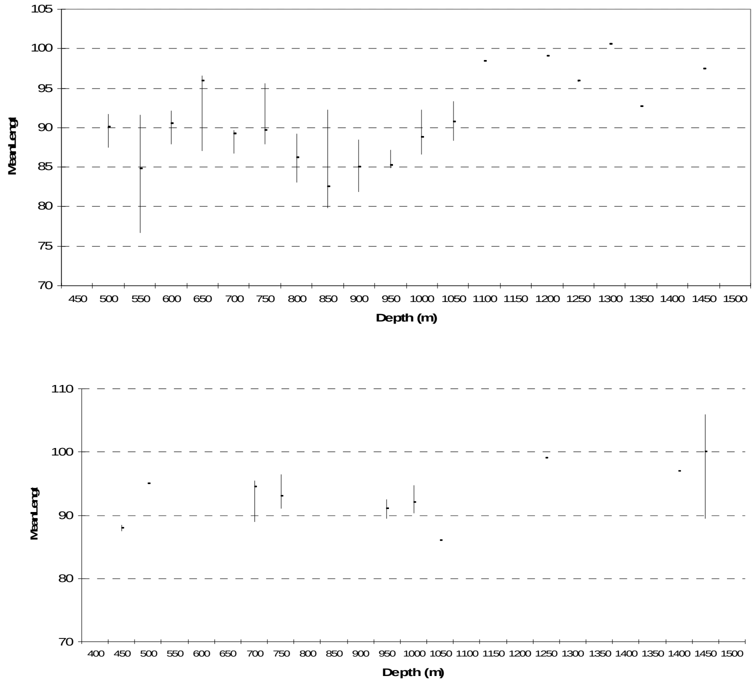


Figure 11.2.5. Black scabbard fish mean length per depth stratum from Scottish (upper) and Irish(lower) deep-water surveys.

Length on data from Soviet exploratory fishing surveys at late 1970s at Lauzy Bank, Anthon-Dorn Bank and Anthon-Dorn Bank and the Hatton-Rockall Plateau showed that the size range of the species (70–130 cm with higher frequencies at lengths varying between 96–110 cm) do not greatly differ among areas (Vinnichenko *et al.*, 2003).

11.2.2.3 Age compositions

No new data on age composition was presented.

11.2.2.4 Weight-at-age

No new data were available.

11.2.2.5 Maturity and natural mortality

It is important to stress that so far the information available for ICES Subareas Vb, VI, VII and XII consistently points out to the predominance of small and absence of mature specimens.

11.2.2.6 Catch, effort and research vessel data

A new lpues series for black scabbardfish have been presented based upon the French tallybooks (Pawlowski *et al.*, WD 2009). The tally book (from skipper own logbooks) database provided by the French industry (PROMA/PMA a producers organization and EURONOR a ship owner), has the advantage in relation to logbook of having the records on a haul by haul resolution and on having fishing depth available (Pawlowski *et al.*, WD 2009).

Lpues estimated for areas to west of the British Isles as defined by Biseau, 2006WD and for the all ICES rectangles are presented in Figures 11.2.6 and 11.2.7. Estimates show rather wide confidence intervals with no clear trends during the 2000s.

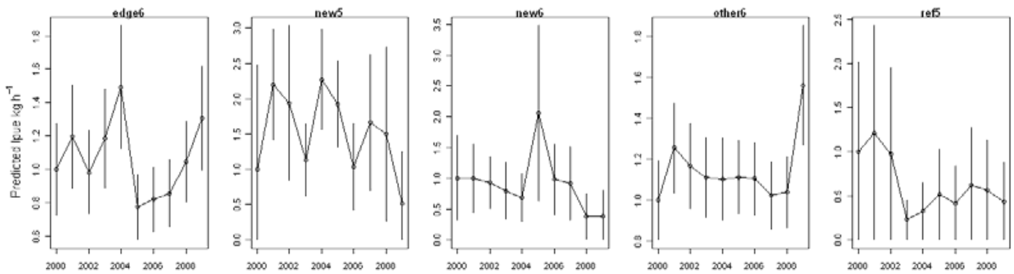


Figure 11.2.6. Lpue of French trawlers in 5 areas (labeled according to Biseau, 2006 WD) from tows targeting black scabbardfish (defined as tows where the total catch include >10% of black scabbardfish). Absolute levels should not be compared over areas as the predictions were carried out for one particular rectangle.

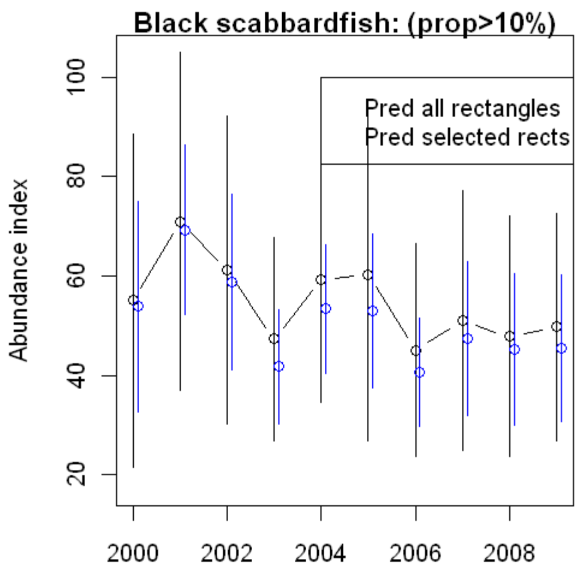


Figure 11.2.7. Lpue of French trawlers for the overall rectangles.

A new cpue series for black scabbardfish from the Faroese otterboard trawlers from 1991 to 2008 is presented in Figure 11.2.7. Catch and fishing effort data were derived from logbooks from 5–8 otterboard trawlers (HP>1000). The data are stored at a database in the Faroese Marine Research Institute.

The cpue estimates were based on fishing hauls with trawling depth >350 m and the area are west of the Faroe Islands. The fishing effort unit is giving in fishing (trawling) hours. Catch data are in kilogram and were reported by the Fisheries authorities (Lise, 2010 WD).

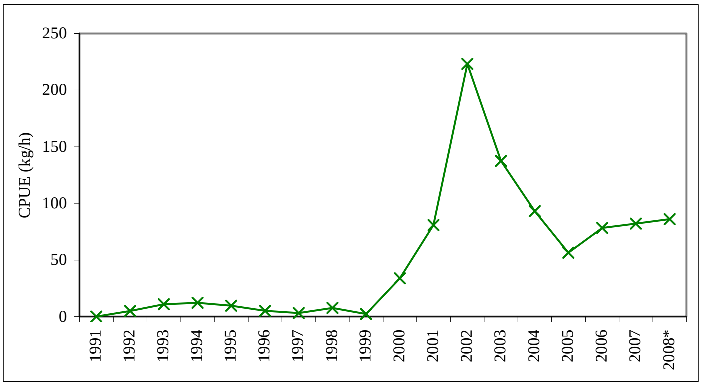


Figure 11.2.8. Black scabbard fish in Vb (Faroes). Cpue (kg/h) from Faroese otterboard trawlers >1000 HP in the bank area west of the Faroes (DB-DG, 9–14).

New cpue series were estimated for the Spanish trawlers operating Hatton Bank using the available data on annual catch and number fishing days. Cpupe were estimated for Subdivisions VIb1 and XIIb separately as well as for the two combined (Figure 11.2.9).

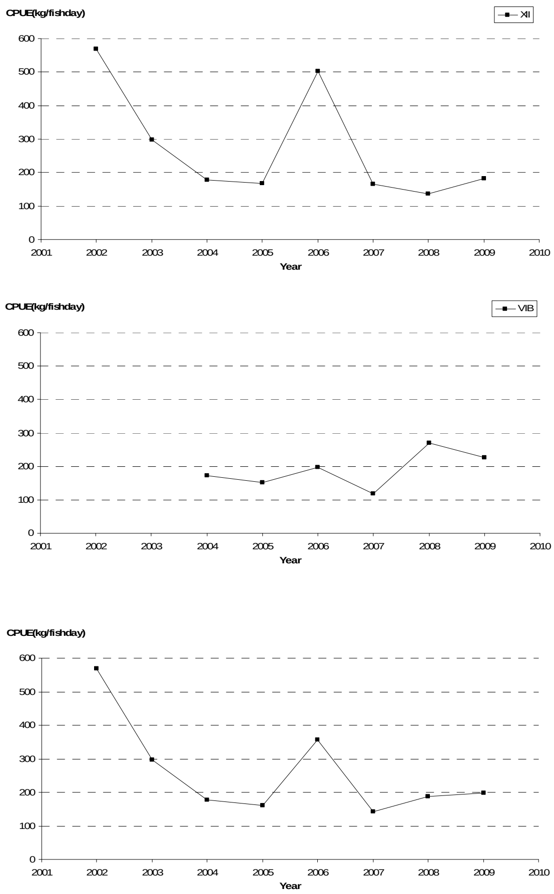


Figure 11.2.9. Black scabbard fish cpue (kg/fishing days) in VIb (upper left). XIb (upper right) and the two Subareas combined (center) from Spanish trawlers.

The average catch rate (kg/h) along year for depths shallower than 1000 m based on Scottish survey data is presented in Figure 11.21.10.

Marine Scotland - Science [formerly Fisheries Research Services, (FRS)] has surveyed the fish community of the continental shelf slope to the northwest of Scotland since 1996 with strictly comparable data available between 1998 and 2008. This has focussed on a core area between 55–59°N, with trawling undertaken at depths ranging from 300 to 1900 m with most of the hauls being conducted at fixed stations, at depths of around 500 m, 1000 m, 1500 m and 1800 m. Further hauls have been made on seamounts in the area, and on the slope around Rockall Bank, but these are exploratory, irregular and not included in the survey dataset.

The Irish deep-water trawl survey sampled the fish community of the continental shelf slope to west and northwest of Ireland since 2006. Methodology and trawl gear is standardised in accordance with the Scottish deep-water survey with trawling at fixed stations around 500 m, 1000 m, 1500 m and 1800 m.

The analysis of Figure 11.2.10 suggests the existence of pulses of entrance of smaller specimens. This aspect should be further explored using appropriate statistical tools that enter into consideration the spatial correlation aspects.

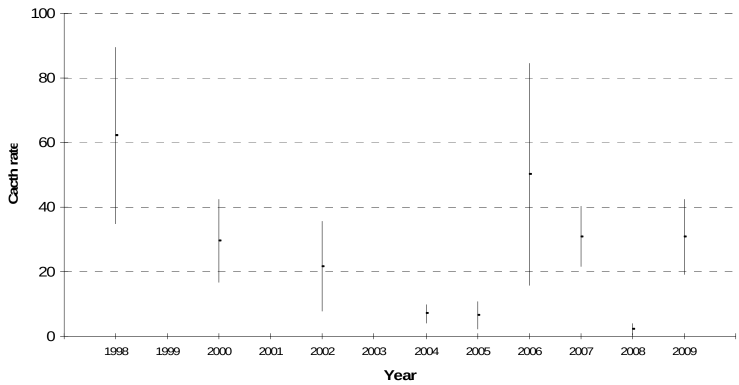


Figure 11.2.10. Black scabbard fish average catch rates +/- standard error along years based on Scottish survey data for fishing held at depth shallower than 1000 m.

11.2.3 Data analyses

France, Spanish and Faroese cpue dataseries were available for analysis stock status.

Lpues for black scabbardfish were estimated for the period 2000–2009 based upon French tallybooks (Pawlowski *et al.*, WD, 2009). The lpue estimates based on tallybooks demonstrate rather wide confidence intervals and do not indicate significant trends during the 2000s (Figure 11.2.6).

Both the Spanish and the Faroese cpue series were not standardized and both covered a small time range of years. The Spanish cpue series shows an initial decline followed by a more stable period from 2003. It is uncertain whether this series reflects trends in stock abundance.

The increasing trend on cpue the Faroese cpue series which mainly derived from fishing grounds at bank area west of the Faroes (ICES Subarea Vb) may not reflect the stock trend in this area since the fishing regime of the Faroese fleet has been changed in most recent years, the species has become a target species.

The analysis mean length of survey data is consistent with the hypothesis about the species spatial dynamics in NE Atlantic, particularly, the fact that younger individuals live at shallower depths (<1000 m). The mean catch rates for fishing hauls shallower than 1000 m further suggest the existence of pulses of younger individuals entering the Northern component.

11.2.4 Comments on the assessment

The French tallybooks database is considered to give more accurate lpues estimates than EU logbooks, especially because they provide information on haul by haul basis and include data on fishing depth, which is considered an important auxiliary source of information to identify deep-water hauls. Several factors, such as seasonal, fishing depth and species directivity are known to greatly affect commercial cpues and consequently their interpretation.

Data from the French fishing industry only allow lpues estimates from 2000 onwards, while cpues from French logbook data begin at 1989. Index abundance from French logbook data for directed fisheries (reference fleet in a reference area) indicated a fairly strong overall declining trend in abundance from 1991. However, most of the vessels formerly used as the reference fleet and used to derive abundance indices have been recently decommissioned or moved to other fisheries. As a consequence the lpue estimates from logbooks after 2008 onwards are considered not reliable as it includes only a few fishing days and will not be available in future.

11.2.5 Management considerations

For this species, it is unclear whether the start of the fishery in the late 1980s corresponds to the start of exploitation as earlier catches of this species may have been taken and discarded. However, since recent observations of targeted blue ling fisheries show low bycatch of black scabbard fish, this may not have been the case.

Indicators show a consistent decline in abundance during the 1990s. After 2000 there is some inconsistencies between the series but the tallybook index, which is considered to be more reliable, shows a gradual decline until 2006 and stability thereafter.

For ICES Division VIb and XIIa included in Northern Component landing data (Tables 11.2.0a–d) indicate that fishing restrictions established since 2003 have not been enforced and the management measures adopted did not resulted on a reduction of the fishing pressure over the stock.

Table 11.2.0a. Landings of black scabbard fish from Division Vb. Working Group estimates.

Year	Faeroe Islands			France	Germany*		Scotland	E&W&NI	Total
	Vb 1	Vb 2	Vb		Vb1	Vb			
1988					.	.	-	-	**0**
1989	-	-		170	.	.	-	-	**170**
1990	2	10		415	.	.	-	-	**427**
1991	-	1		134	-	-	-	-	**135**
1992	1	3		101	-	-	-	-	**105**
1993	202	-		75	9	-	-	-	**286**
1994	114	-		45	-	1	-	-	**160**
1995	164	85		175	-	-	-	-	**424**
1996	56	1		129	-	-	-	-	**186**
1997	15	3		50	-	-	-	-	**68**
1998	36	-		144	-	-	-	-	**180**
1999	13	-		135	-	-	6	-	**154**
2000			116	186	-	-	9	-	**311**
2001	122	281		457	-	-	20	0	**880**
2002	222	1138		304	-	-	80		**1744**
2003	222	1230		172	-	-	11		**1635**
2004	80	625		94	-	-	70		**869**
2005	65	363		106	-	-	20		**553**
2006	54	637		93	-	-			**784**
2007	78	596		116	-	-	0		**790**
2008	94	787	828	159	.	.	0		**1868**
2009	117	852	0	70			1	0	**1042**
*STATLAND data									

Table 11.2.0b. Landings of black scabbard fish from Division XII. Working Group estimates.

Year	France (XIIa)	Spain	Scotland	Russia(XIIc)**	Poland*	Netherlands*	Total
1988				.	-	-	**0**
1989	0			.	-	-	**0**
1990	0			.	-	-	**0**
1991	2			.	-	-	**2**
1992	7			.	-	-	**7**
1993	24			.	-	-	**24**
1994	9			.	-	-	**9**
1995	8			.	-	-	**8**
1996	7	41		.	-	-	**48**
1997	1	98		.	-	-	**99**
1998	324	134		.	-	-	**458**
1999	1	109	0	.	-	-	**109**
2000	5	237		.	-	-	**242**
2001	3	115		.	-	-	**118**
2002	0	1117	1	.	-	-	**1119**
2003	7	444		.	1	1	**453**
2004	10	230	1	.	-	-	**242**
2005	14	239		.	-	-	**253**
2006	0	492		.	-	-	**492**
2007		134	0	.	-	-	**134**
2008		70	0	4	.	.	**74**
2009		107		0			**107**
* STATLAND data							
*STATLAND data from 1988 to 2007			104				

Table 11.2.0c. Landings of black scabbard fish from Division VI. Working Group estimates.

Year	France		Faroes		Germany*		Ireland	Scotland	Scotland	Netherlands *		Lituania*	Estonia *	Poland*	Russia**	Spain	**Total**
	V Ia	VIb	V Ia	VIb	VIa	VI b	VIa	VIa	VIb	VIa	Vib	Via	VIb	VIb	VIb		
1988					.	.				-	-	.	.		.		
1989	138	0	46		.	.		-	-	-	-	.	.	-	.		**184**
1990	971	53			.	.		-	-	-	-	.	.	-	.		**1023**
1991	2244	62			-	-		-	-	-	-	.	-	-	-		**2307**
1992	2998	113	3		-	-		-	-	-	-	-	-	-	-		**3113**
1993	2857	87		62	48	-		-	-	-	-	-	-	-	-		**3054**
1994	2331	55			30	15		2	-	-	-	-	-	-	-		**2433**
1995	2598	15			-	3		14	4	-	-	-	-	-	-		**2634**
1996	2980	1			-	2		36	<0.5	-	-	-	-	-	-		**3019**
1997	2278	16		3	-	-		147	88	-	-	-	-	-	-	0	**2533**
1998	1553	7			-	-		142	6	-	-	-	-	-	-	1	**1709**
1999	1610	8			-	-		133	58	11	-	-	-	-	-	0	**1820**
2000	2971	27			-	-		333	41	7	-	-	-	-	-	1	**3380**
2001	3791	29		3	-	-		486	145	-	-	3	225	-	226	150	**5058**
2002	3833	156	2		-	-		603	300	21	2	9	-	2	-		**4928**
2003	2934	67	45		-	-		78	9	-	2	12	7	2	7		**3162**
2004	2637	99	59		-	-		100	24	-	-	85	5	1	5	62	**3076**
2005	2533	59	38		-	-		18	62	-	-	5	11	-	11	126	**2864**
2006	1713	36	59		-	-	1	63	0	-	-	1	3	-	3	4647	**6526**
2007	1991	4	44	37	-	-	0	53	0	-	-	-	-	-	-	2374	**4503**
2008	2348	0	37	0	.	.	0	26	0	14	.	.	.	-	1	870	**3296**
2009	1397	1	39	0			0	80							0	880	**2397**

*STATLAND data

*STATLAND data from 1988 to 2007

Table 11.2.0d. Landings of black scabbard fish from Division VII. Working Group estimates.

Year	France												Ireland			Scotland	E&W&NI
	VII	VIIa	VIIb	VIIc	VIId	VIId-h	VIIe	VIIf	VIIg	VIIh	VIIj	VIIk	VIIb,j	VIIc	VIIk	VIIb,c,j,k	VIIj,k
1988																	
1989		0	0	0		0					0	0				0	
1990		0	2	8		0					0	0				0	
1991		0	14	17		7					7	49				0	
1992		0	9	69		11					49	183				0	
1993		0	24	149		16					170	109				0	
1994		0	32	165		8					120	336				0	
1995		0	52	121		9					74	385				0	
1996		0	104	130		2					60	360				0	
1997		0	24	200		1					33	202				0	
1998		0	15	104		6					52	211				0	
1999			7	97			0			2	70	177				0	
2000			25	173	0		0		0	4	100	253				3	
2001			40	237				0	0	3	180	267				41	
2002		0	33	105	0			0	1	7	138	49				53	
2003			15	29	1		0			3	159	36				1	
2004			31	28	2		6			9	115	63				0	
2005	0	5	6	11	1				0	17	105	23					
2006			3	10			1		0	24	315	20	1	32	37	0	2
2007			2	7			0			4	168	7	0	52	17	0	0
2008			2	19			0	0	0	6	148	4	0	0	0	0	0
2009				29	1		0		0	2	52	4	0	0	0	0	0

Table 11.2.0d. Landings of black scabbard fish from Division VI and VII. Working Group estimates.

Year	Ireland	E&W&NI	Total
1988			
1989			**0**
1990			**0**
1991			**0**
1992			**0**
1993	8		**8**
1994	3		**3**
1995			**0**
1996		1	**1**
1997	0	2	**2**
1998	0	1	**1**
1999	1	1	**2**
2000	59	40	**99**
2001	68	37	**105**
2002	1050	43	**1093**
2003	159	5	**164**
2004	293	2	**295**
2005	79	0	**79**
2006			**0**
2007			**0**
2008			**0**
2009			**0**

11.3 Black scabbard fish in Subareas VIII, IX

11.3.1 The fishery

The main fishery taking place in these Subareas is derived from the Portuguese longliners. This fishery was described in 2007 report (Bordalo_Machado and Figueiredo, 2007 WD). The French bottom-trawlers operating in Subareas mainly VI and VII have a small marginal activity in Subarea VIII.

11.3.1.1 Landings trends

Landings in Subareas VIII and IX are almost all from the Portuguese longline fishery that takes place in Subarea IXa (more than 99% of the total landings) (Figure 11.3.1).

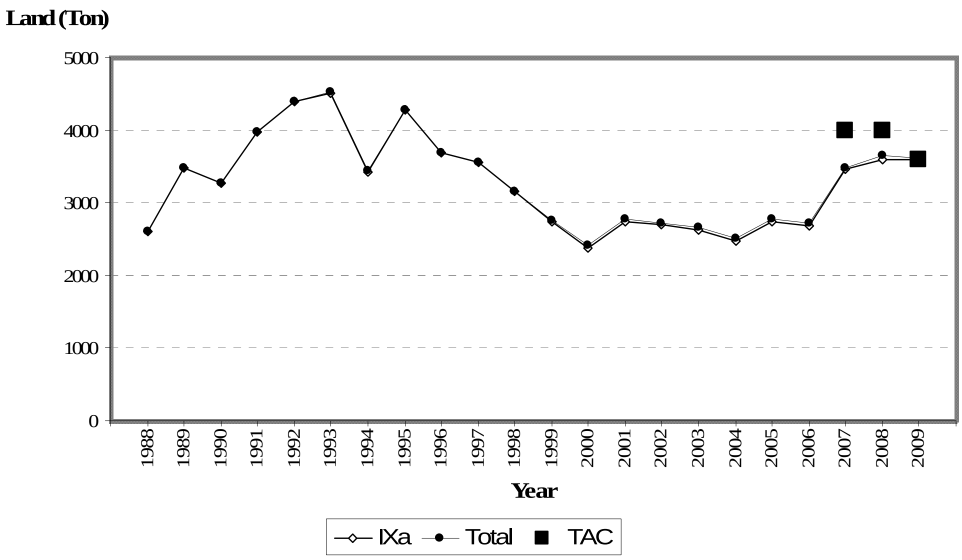


Figure 11.3.1. Annual landings for Southern Component (SC) and Subarea IXa, as well as, the TAC.

11.3.1.2 ICES Advice

The most recent ICES Advice, in 2008, was: "*CPUE in Subareas VIII and IX does not indicate any clear trends but no information is available before 1996. Recent levels of catches do not appear to have had a negative impact. ICES recommends that catches should be constrained to 2800 t. (average 2003–2007) and to collect information that can be used to evaluate a long-term sustainable level of exploitation*."

11.3.1.3 Management

Since 2003, management of black scabbardfish by EU vessels fishing in EU and international waters includes a combination of TAC and licensing system. The TAC adopted from 2006 till 2010, as well as, the total landings in Subareas VIII, IX and X are next presented.

YEAR	EU TAC 2008 VIII, IX AND X	EU LANDINDS
2006	3042	2791
2007	4000	3556
2008	4000	3719
2009*	3600	3601
2010	3348	

*** 2009 landing estimates are preliminary.**

11.3.2 Data available

11.3.2.1 Landings and discards

The artisanal segment of the commercial fishing fleet of mainland Portugal is responsible for the largest landings' quantities of deep-water species. The onboard discard sampling for longline Portuguese commercial fleet started in mid 2005 and is integrated in the Portuguese Discard Sampling programme, included in the EU DCR/NP. Onboard sampling in longline commercial vessels is carried out in a monthly basis to get discards and trip information.

Recent discard data from the Portuguese the black scabbardfish fishery shows very low percentages of discards and that the target species constitute nearly 84% of catch in weight. The 2008 results don't differ much from the ones obtained for 2005–2007 period (Fernandes *et al*., 2009WD).

11.3.2.2 Length compositions

In the scope of the National Minimum Landings Sampling Program, length frequency and biological samples from Portuguese landing port at Sesimbra were collected on a monthly basis during 2009. 2009 length frequency distribution is presented in Figure 11.3.2.

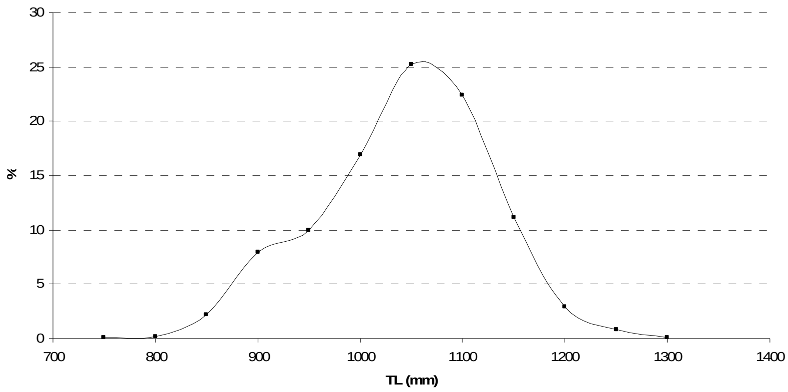


Figure 11.3.2. Length frequency distribution derived from National Minimum Landing Sampling Program for the deep-water longline fishery in IXa.

11.3.2.3 Age compositions

The main results from a Portuguese Project showed that sectioned otoliths were shown to be more appropriate for age assignment because growth increments are more evident and ageing of larger specimens is easier than in whole otoliths. In addition although vertebrae are not the most appropriate structure for age assignment, this structure may be useful in the absence of otoliths. Figure 11.3.3 presents the growth parameter estimates of the von Bertalanffy model for Portugal Mainland (ICES Subarea IXa) and Madeira, as well as, for sex separated (Vieira *et al.*, 2009).

Area	Sex	L_∞ (mm)	k (year^{-1})	T_0 (year)	r
Mainland	females	1354 (42.68)	0.170 (0.022)	−2.040 (0.378)	0.952
	males	1240 (28.99)	0.208 (0.021)	−1.654 (0.284)	0.941
Madeira	females	1586 (41.37)	0.119 (0.009)	−2.282 (0.224)	0.971
	males	1461 (12.78)	0.146 (0.004)	−1.441 (0.065)	0.965

Figure 11.3.3. Von Bertalanffy growth model for Aphanopus carbo caught off mainland Portugal and Madeira. Standard deviation in parenthesis (Vieira *et al.*, 2009).

It was also observed that females, particularly those from Madeiran waters, presented a lower growth rate than those from Mainland (ICES Subarea IXa). This reduction in the growth rate seems to be related to the reproductive effort. The differential growth pattern between the females from mainland Portugal (non-reproductive females) and Madeira (reproductive females) may reflect the optimisation of the energetic balances (Vieira *et al.*, 2009).

11.3.2.4 Weight-at-age

The weight (total weight W) length (Total length TL) relationship for the species (Morales-Nin and Carvalho, 1996) estimated for the species has the following expression:

males W= 0.000154 TL 3.4519, r^2 = 0.95

females W= 0.000201 TL 3.3906, r^2 = 0.95

11.3.2.5 Maturity and natural mortality

In ICES Subarea IXa only immature and early developing specimens have been observed (Figueiredo, 2009 WD).

Mature individuals only occurred in Madeira (Figueiredo *et al*., 2003) and, in Canary Islands (Pajuelo *et al*., 2008) and the northwest coast of Africa although it is possible that two species may occur in these areas.

The new results on the reproduction of the species have been obtained from a recent Portuguese Project, which included mainland Madeira and Azores. It was observed that black scabbardfish has a determinate fecundity strategy the relative fecundity estimates ranged from 73 to 373 oocytes/female weight(g). Skipped spawning was also considered to occur in this species; the percentages of non-reproductive females between 21% and 37% (Vieira *et al*., 2009).

11.3.2.6 Catch, effort and research vessel data

Monthly standardized black scabbardfish lpue from the longline fleet operating in Subarea IXa were estimated for the period 1995–2009 (Figueiredo and Farias, 2010 WD). The monthly lpue estimates and the corresponding confidence intervals are shown in Figure 11.3.4.

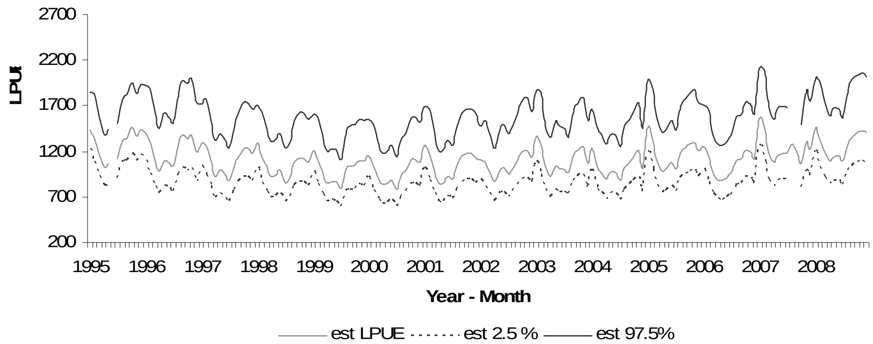


Figure 11.3.4. Monthly lpue estimates for ICES Subarea IXa with 95% confidence intervals from the adjusted GLM model (Figueiredo and Farias, WD 2010).

The monthly lpue estimates did not show any marked long-term trend and seem to follow a seasonal pattern along the period in analysis.

Figure 11.3.5 shows the variation of the estimated Year effects for the selected model during the period 1995–2009.

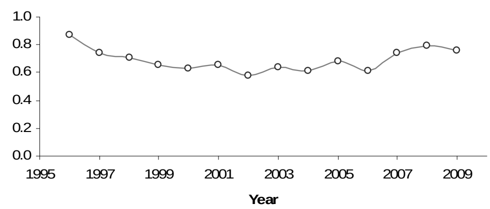


Figure 11.3.5. ICES Subarea IXa Year effects for the selected model during the period 1996–2009 (Figueiredo and Farias, WD 2010).

11.3.3 Data analyses

Standardized black scabbardfish lpue from the longline fleet operating in Subarea IXa were estimated for the period 1995–2009 (Figueiredo and Farias, WD 2010). GLM models were adjusted and YEAR, MONTH and VESSEL were considered as factor. A Gamma distribution was admitted and logarithmic function as used as link function. The quality of model adjustment was evaluated by quantile residuals analysis.

The monthly lpue estimates and the corresponding 95% confidence intervals are shown in Figure 11.3.4. Lpue did not show any marked trend and seem to follow a seasonal pattern along the period in analysis.

Figure 11.3. 5 shows the variation of the estimated Year effects for the selected model during the period 1995–2009.

11.3.4 Comments on the assessment

The cpue estimate, as well as, other information on the species for the southern component and other components will be analysed under DEEPFISHMAN Project aiming to the development of new approaches that take into consideration spatial stock dynamics.

11.3.5 Management considerations

The ongoing stability of the cpue series appears to indicate that current levels of fishing are not having a detrimental effect on the stock.

Table 11.3.0a. Black scabbard fish from Subarea IX; Working Group estimates of landings.

Year	Portugal	Spain	**Total**
1988	2602		**2602**
1989	3473		**3473**
1990	3274		**3274**
1991	3978		**3978**
1992	4389		**4389**
1993	4513		**4513**
1994	3429		**3429**
1995	4272		**4272**
1996	3686		**3686**
1997	3553	0	**3553**
1998	3147	0	**3147**
1999	2741	0	**2741**
2000	2371	0	**2371**
2001	2744	0	**2744**
2002	2692		**2692**
2003	2630		**2630**
2004	2463		**2463**
2005	2746		**2746**
2006	2674		**2674**
2007	3453		**3453**
2008	3602		**3602**
2009	3601		**3601**

Table 11.3.0b. Black scabbard fish from Subarea VIII; Working Group estimates of landings.

Year	France				Spain	
	VIIIa	VIIIb	VIIIc	VIIId		**Total**
1988						**0**
1989	0	0		0		**0**
1990	0	0		0		**0**
1991	1	0		0		**1**
1992	4	0		4		**9**
1993	5	0		7		**11**
1994	3	0		2		**5**
1995	0	0		0		**0**
1996	0	0		0	3	**3**
1997	1	0		0	1	**2**
1998	2	0		0	3	**6**
1999	7			4	0	**12**
2000	15	0		20	1	**35**
2001	16	0		12	1	**29**
2002	17	2		16	1	**36**
2003	25			8	1	**34**
2004	25	0		14	1	**40**
2005	19	0		6	1	**26**
2006	30	2	0	19	0	**52**
2007	14	1		13	1	**29**
2008	10	0		35	1	**45**
2009	5	1	0	2	1	**9**

11.4 Black scabbard fish other Areas (I, II, IIIa, IV, X, Va, XIV)

11.4.1 The fishery

The significant fisheries in the other areas have been taken place in different ICES subareas along years.

A Faroese exploratory trawl fishery took place in 2008 in the Mid-Atlantic Ridge area. This fishery was mainly targeting at orange roughy and black scabbard fish, and was undertaken in the period 13 February to 9 March 2008 in ICES Areas X and XII according to a resolution adopted at the 26th Annual Meeting of NEAFC on management measures for orange roughy. The fishery was performed with one trawler (M/S Ran TG0752) with many years participation in the Faroese orange roughy fishery. The gear was a traditional bottom trawl, but in the fishing operations the trawl doors did not touch the bottom. All information for the fishery was registered in accordance with NEAFC Recommendation X: 2007 concerning submission of scientific information on deep-sea fisheries. The Faroese Fisheries Laboratory provided instructions for how to keep logbook such that all the information mentioned in NEAFC recommendation was properly recorded (Reinert, 2010 WD).

11.4.1.1 Landings trends

Total landings in "other areas" were quite variable along the years under analysis (Figure 11.4.1.), that reflects the ICES subarea where fisheries took place. Landings from 1989 to 1992 were mainly derived from French trawlers operating at ICES Subarea IV (this may be misreported). Landings from 1998 to 2000 were mainly derived from Portuguese longliners operating in ICES Subarea X. Landings from 2004 onwards were mainly derived from both Portuguese longliners and Faroese trawlers both operating in ICES Subarea X.

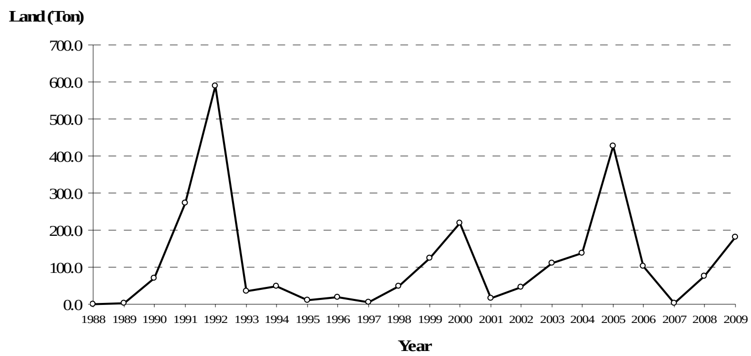


Figure 11.4.1. Black scabbard fish landings in other areas.

11.4.1.2 ICES Advice

The most recent ICES Advice, in 2008, was: "*The fishery in other areas should not be allowed to expand unless it can be shown that it is sustainable.*"

11.4.1.3 Management

Since 2003, management of black scabbardfish by EU vessels fishing in EU and international waters includes a combination of TAC and licensing system. The TAC adopted from 2007 to 2010 by subareas are next presented.

YEAR	EU TAC 2008 VIII, IX AND X	EU LANDINGS
2007	15	1
2008	15	0
2009*	12	9
2010	12	

*** 2009 landing estimates are preliminary.**

11.4.2 Data available

11.4.2.1 Landings and discards

Landings are given in Tables 11.4.0a–e.

11.4.2.2 Length compositions

Length frequency distribution based on data collected at 2008 Faroese exploratory survey for the all hauls pooled is shown in Figure 11.4.2. This distribution mainly reflects the length composition of the species from western seamounts of ICES Subarea Xb. Recent studies have shown that two species may occur in this area.

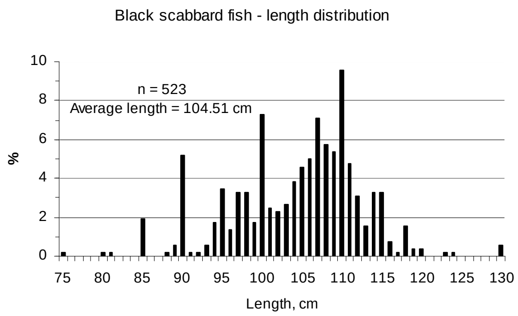


Figure 11.4.2. Faroese exploratory survey Black scabbardfish. Total length distribution in all hauls.

11.4.2.3 Age compositions

No new data were available.

11.4.2.4 Weight-at-age

No new data were available.

11.4.2.5 Maturity and natural mortality

In Azorean waters females in spawning condition (GSI > 3 up to 9) with total lengths between 108 and 137 cm occurred predominantly in October and in November (J. Pereira, pers comm.). The length 108 cm corresponds to the estimate of first maturity determined for Madeira specimens. Spawners were observed around the Azores from November to April (Vinnichenko, 2002).

11.4.2.6 Catch, effort and research vessel data

Data on total catches of black scabbardfish from 2008 Faroese exploratory trawl fishery on the Middle Atlantic Ridge held in ICES Divisions X and XII were made available (Reinert, 2010 WD). Figure 11.4.3.shows the geographical location of the positive hauls, i.e., with catches of black scabbardfish. The species occurred mostly at western seamounts of Subarea Xb.

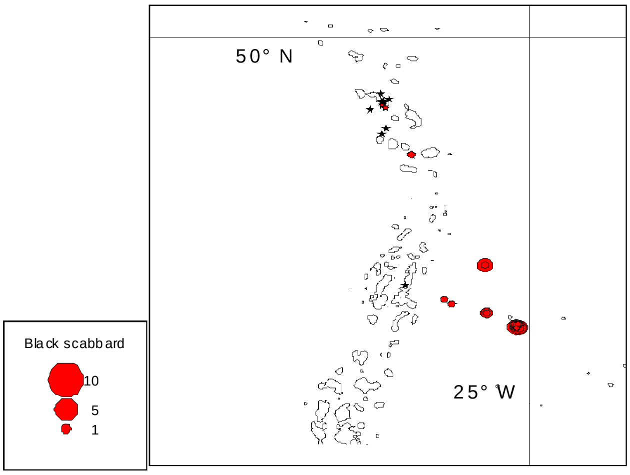


Figure 11.4.3. Faroese exploratory survey total catches of black scabbardfish (tonnes).

11.4.3 Data analyses

Apart from the data presented for Faroese exploratory survey, the data available only refer to landings.

The overall landings were quite variable along years. However apart from the landings from ICES Subarea Va, which have been quite stable along years (aprox. 10 ton), landings from other areas have varied.

11.4.4 Comments on the assessment

Despite the variability on the overall landings data along years, the landing data available for different ICES subareas give evidence that the areas of major concentration of the species is at ICES Division X. This spatial aspect is consistent with the actual hypothesis on the spatial dynamics of the species at NE Atlantic.

11.4.5 Management considerations

There was no relevant data available to alter perception of the stock status in these areas so the 2006 advice; *Fisheries on black scabbard should be accompanied by programmes to collect data on both target and bycatch fish. The fishery should not be allowed to expand unless it can be shown that it is sustainable* should be maintained.

Table 11.4.0a. Black scabbard fish other Areas II. Working Group estimates of landings.

Year	France	Faroes	**Total**
		II a	
1988			**0**
1989	0		**0**
1990	1		**1**
1991	0		**0**
1992	0		**0**
1993	0		**0**
1994	0		**0**
1995	1		**1**
1996	0		**0**
1997	0		**0**
1998	0		**0**
1999			**0**
2000			**0**
2001			**0**
2002			**0**
2003			**0**
2004			**0**
2005	0	27	**27**
2006		0	**0**
2007		0	**0**
2008		0	**0**
2009		0	**0**

Table 11.4.0b. Black scabbard fish other Areas IV. Working Group estimates of landings.

Year	France	France	France	Scotland			Germany *	E&W&NI	**Total**
		IVa	IVb	IVa	IVb	IVc	IVa	IVa	
1988				-			.	-	**0**
1989	3			-			.	-	**3**
1990	70			-			.	-	**70**
1991	107			-			-	-	**107**
1992	219			-			-	-	**219**
1993	34			-			-	-	**34**
1994	45			-			3	-	**48**
1995	6			2			-	-	**8**
1996	6			1			-	-	**7**
1997	0			2			-	-	**2**
1998	2			9			-	-	**11**
1999		4		3			-	-	**7**
2000		2		3			-	-	**5**
2001		1		10			-	1	**12**
2002		0		24			-		**24**
2003		0		4			-		**4**
2004		4	1	0			-		**5**
2005		1	1	0			-		**2**
2006		13		0	0	0	-		**13**
2007		1	0	0			-		**1**
2008		0		0			.		**0**
2009		4	0	0	0	0		0	**4**

Table 11.4.0c. Black scabbard fish other Areas Va. Working Group estimates of landings.

Year	Iceland	**Total**
1988	-	**0**
1989	-	**0**
1990	-	**0**
1991	-	**0**
1992	-	**0**
1993	0	**0**
1994	1	**1**
1995	+	**0**
1996	0	**0**
1997	1	**1**
1998	0	**0**
1999	6	**6**
2000	10	**10**
2001	5	**5**
2002	13	**13**
2003	14	**14**
2004	19	**19**
2005	19	**19**
2006	23	**23**
2007	1	**1**
2008	0	**0**
2009	15	**15**

Table 11.4.0d. Black scabbard fish other Areas X. Working Group estimates of landings.

Year	Faroes	Portugal	France	Ireland	**Total**
1988	-	-			**0**
1989	-	-	0		**0**
1990	-	-	0		**0**
1991	-	166	0		**166**
1992	370	-	0		**370**
1993	-	2	0		**2**
1994	-	-	0		**0**
1995	-	3	0		**3**
1996	11	0	0		**11**
1997	3	0	0		**3**
1998	31	5	0		**36**
1999	-	46	66		**112**
2000	-	112	1		**113**
2001	-	+	0		**0**
2002	2	+	0		**2**
2003		91	0		**91**
2004	111	2	0		**113**
2005	56	323	0	0	**379**
2006	10	55	0		**65**
2007	0	0	0	0	**0**
2008	75	0	0	0	**75**
2009	157	5	0	0	**162**

Table 11.4.0e. Black scabbard fish other Areas XIV. Working Group estimates of landings.

Year	Faroes	Spain	**Total**
	XIVb		
1988	-	-	**0**
1989	-	-	**0**
1990	-	-	**0**
1991	-	-	**0**
1992	-	-	**0**
1993	-	-	**0**
1994	-	-	**0**
1995	-	-	**0**
1996	-	-	**0**
1997	-		**0**
1998	2		**2**
1999	-		**0**
2000	-	90	**90**
2001	-	0	**0**
2002		8	**8**
2003		2	**2**
2004			**0**
2005	0		**0**
2006	-		**0**
2007	0		**0**
2008	0		**0**
2009	0		**0**

11.5 References

Vieira, A.R.Farias, I. Figueiredo, I., Neves, A. Morarales-Nnin, B., Sequeirara, V., Martins, R. ang Gordo, L.S. 2009. Age and growth of black scabbardfish (*Aphanopus carb*o Lowe, 1839) in the southern NE Atlantic Scientia Marina 73Ss.

Bordalo-Machado, P. and Figueiredo. 2009. Fishery for black scabbardfish (*Aphanopus carbo* Lowe, 1839) in the Portuguese continental slope. Rev. Fish Biol. Fish., 19: 49–67.

Neves, A., Vieira, A.R. Farias, I., Figueiredo, I., Sequeira, V. and Gordo, L.S. 2009 Reproductive strategies in black scabbardfish (*Aphanopus carbo* Lowe, 1839) from the NE Atlantic Scientia Marina 73Ss2.

Vinnichenko V.I., Khlivnoy V.N., Orlov A.M. Specific features of deep-sea species distribution and biology in the north east Atlantic (Lousy Bank, Hatton-Rockall Plateau, Faroe Islands area). Working Document for the Study Group on the Biology and Assessment of Deep-sea Fisheries Resources, ICES, 2003, 35 p.

Morales-Nin, B. and Sena-Carvalho, D. 1996. Age and growth of black scabbard fish (*Aphanopus carbo*) off Madeira. Fisheries Research, 25: 239–251.

12 Greater Forkbeard (*Phycis Blennoides*) in all eco-regions

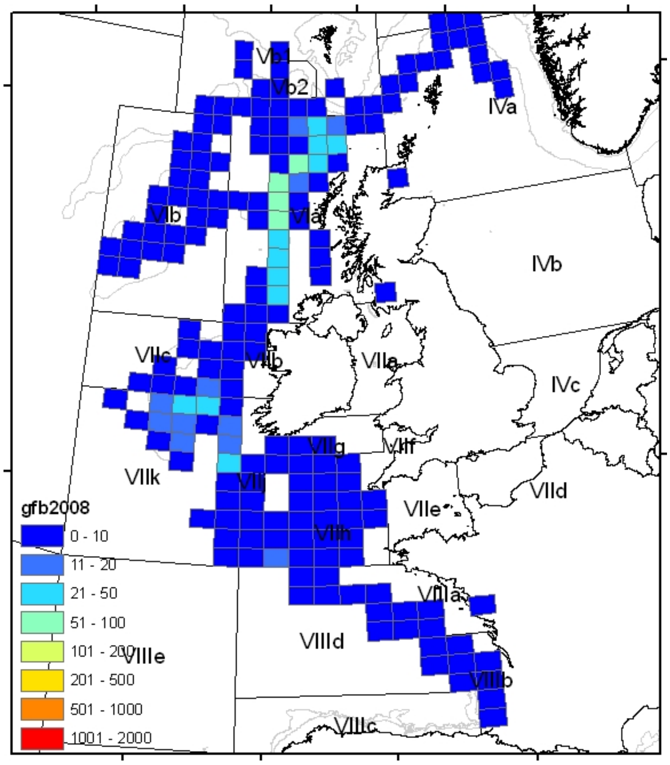


Figure 12.1.1. Catches of Greater forkbeard by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2008.

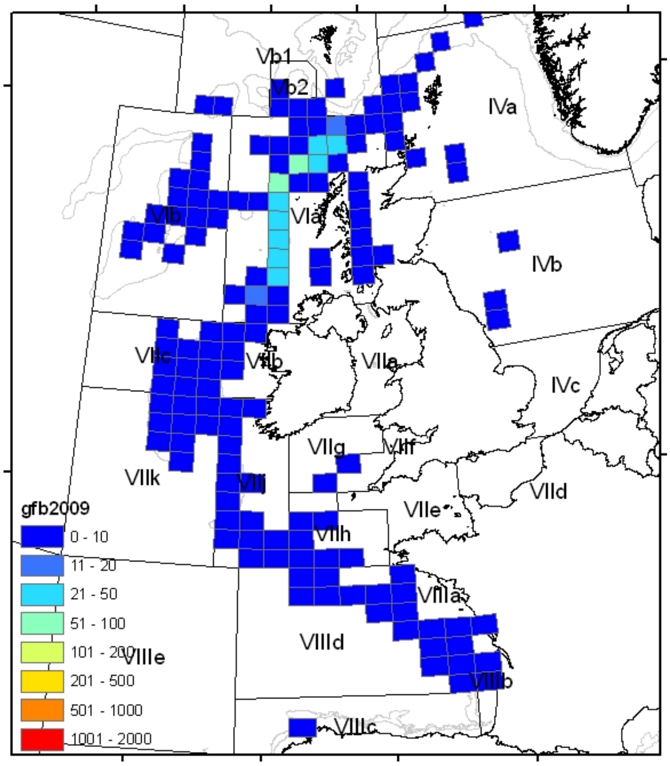


Figure 12.1.2. Catches of Greater forkbeard by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2009.

12.1 The fishery

Greater forkbeard may be considered as a bycatch species in the traditional demersal trawl and longline mixed fisheries targeting species such as hake, megrim, monkfish, ling, blue ling.

Since 1988, around 80% of landings came from the Subareas VI and VII. Spanish, French and UK trawlers and longliners are the main fleets involved in this fishery. But also the Irish deep-water fishery around Porcupine Bank is based on the flat grounds and targets orange roughy, black scabbard, roundnose grenadier and deep-water siki sharks has landed historically important quantities of this species. The Russian fishery in the North-East Atlantic targeting roundnose grenadier, tusk and ling fish small quantities of greater forkbeard as bycatch of the trawler fleet in Hatton and Rockall Banks.

The rest of landings in that period (12%), come from Subareas VIII and IX (mainly from VIII) by the trawler and longliner Spanish and French fleet. In Subarea IX since 2001 small amounts of Phycis spp (probably *P. phycis*) are landed in ports of Strait of Gibraltar by the longliner fleet targeting scabbardfish in Algeciras, Barbate and Conil.

Minor quantities of *P. blennoides* from X Subdivision and Vb Subarea are landed by Portuguese and Norwegian vessels respectively. The Azores deep-water fishery is a multispecies and multigear fishery dominated by the main target species *Pagellus bogaraveo*. Target species can change seasonally according to abundance and market prices, but landings of *Phycis blennoides* representing less than 1% of total deep-water landings in last three years, and can be considered as bycatch.

Catches data for greater forkbeard in 2008 and 2009 aggregated at the level of statistical rectangle were provided to the Working Group by France, Ireland, UK (England and Wales and Scotland) and Iceland (Figure 12.1) and for 2009 by the Basque Country (Spain) (Figure 12.5).

12.1.1 Landing trends

Tables 12.0a–h shows the landings of greater forkbeard (*P. blennoides.* by subarea and country. Notice that landings in Subareas VIII, IX and X may contain some landings of *Phycis spp* and further north, landings may include *Mora moro.*

In Subarea s I, II, III, IV and V only Norwegian landings are significant especially since 2002. The Norwegian longliners which fish in these areas catch *P. blennoides* as a bycatch in the ling fishery. The quantity of this bycatch depends on market price. After eight years without *P. blennoides* records, in 2002 the Norwegian fleet in Subareas I and II reported 315 t, but since this year the landings of this country have been reduced until 2007. However in 2008 and 2009 landings increased again (112 and 75 t respectively).

In Subareas III and IV a strong decrease in landings is observed from 1992 to 2001, but like in Subareas I and II landings since 2002 show an important increase. Although the landings in Subarea Vb are lower than Subareas III and IV the historical trends are similar.

The trend in VI and VII Subdivision shows an important increase in landings from 1994 to 2000. In this year the total landings reported reached a peak of 4967 t. Since 2001 a continuous and notable decrease is observed and in 2009 only 654 t are recorded, that is the lower value of the whole historical series (Table 12.0d and Figure 12.2).

From 1998 to 2007, Subareas VIII and IX landed on average 467 t but in 2008 and 2009 only 176 t and 2003 t have been reported respectively, mainly due to the decrease of the Spanish landings.

In the Subarea X landings of greater forkbeard show ups and downs because is not a target species of the Portuguese demersal fleet. Two peaks can observed in 1994 and 2000, but in 2009 the lower value of the historical series is recorded (13 t).

Landings by subarea and gear of Spanish fleet from 2003 to 2009 are shown in Table 12.2. In this period the landings of *Phycis spp* of Spain comes from bottom-trawler and longline fleet (63% and 32% respectively) operating mainly in Subareas VII and VIII.

12.1.2 ICES Advice

The only new information available for these species is landings information and it is not sufficient to change the Advice from 2006. The Advice for 2009 and 2010 is therefore the same as the advice given in 2006: F*isheries on greater forkbeard should be accompanied by programmes to collect data. The fishery should not be allowed to expand unless it can be shown that it is sustainable.*

12.1.3 Management

The TAC for 2009 and 2010 only reduce slightly the catches in Subareas I, II, III, IV and in Subareas X and XII. In the next table a summary of *P. blennoides* international TAC by subarea and also landings in 2008 to 2009 are shown. Due to in some cases international landings are not available by species, these summary tables could include significant landings of *Phycis spp*. The landings in 2008 and 2009 are below the TAC. Note that landings in Subareas I and II include Norwegian landings while only EU TACs are shown.

Phycis blennoides	TAC	TAC	Landings	
Subarea	2007–2008	2009–2010	2008	2009
I, II, III, IV	36	31	362	227
V, VI, VII	2028	2028	1463	672
VIII, IX	267	267	178	203
X, XII	63	54	35	57
Total	2394	2380	2038	1160

12.2 Stock identity

The Greater forkbeard is a gadoid fish which is widely distributed in the North-Eastern Atlantic from Norway and Iceland to Cape Blanc in West Africa and the Mediterranean (Svetovidov, 1986; Cohen *et al*., 1990). It is distributed along the continental shelf and slope in depths ranging between 60 and 800 meters but recent observations on board of commercial longliners and research surveys extend the depth range to below 1000 m (Stefanescu *et al*., 1992). Unfortunately very little is known about stock structure of the species.

Since the beginning of the SGDEEP the information has been split into four different components according to the importance of the catches and their geographical distribution. However, this separation does not pre-suppose that there are four different stocks of Greater forkbeard and only offers a way of recording the available information in the ICES area.

- Greater forkbeard in Subareas I, II, III, IV and V;
- Greater forkbeard in Subareas VI, VII and XII (Hatton Bank);

- Greater forkbeard in Subareas VIII and IX;
- Greater forkbeard in Subarea X (Azorean region).

12.3 Data available

12.3.1 Landings and discards

Landings are presented in Table 12.0a–h. An estimation of discards of Basque Country (Spain) trawler fleet by subdivision since 2003 is presented in this WG (Table 12.3). The estimation was made taking on board a subsample of the total discard of each haul and then extrapolated to the whole discard of the trip and to the total fleet for each year. Estimated discards from French fisheries in Subareas VII and VIII are presented in Table 12.4.

12.3.2 Length compositions

The Figure 12.7 presents the comparison between length frequency distributions from 2001–2009 Spanish bottom-trawl surveys in Porcupine. According to the results of this survey since 2003 the number of greater forkbeard of all sizes have decreased strongly; in 2008 individuals smaller than 20 cm were not found at all, but they can be found again in a low proportion in 2009.

No data on age composition are available.

12.3.3 Weight-at-age

No weight-at-age data are available.

12.3.4 Maturity and natural mortality

No data on maturity and natural mortality are available.

12.3.5 Catch, effort and research vessel data

Data of abundance of Greater forkbeard are provided from 2001 to 2009 for Spanish bottom-trawl surveys in Porcupine. The results of these surveys show a peak in abundance in 2003 and inbiomass in 2005 followed by a return to previous levels (Figure 12.8).

A geographic representation of *Phycis blennoides* catches (kg/30 min haul) in Porcupine bank is shown in Figure 12.9 The geographical distribution of catches abundance show continues decreasing trend in the last years although a slight increase is observed in 2009 in the southern part of area. The notable abundance in 2003 in all geographic area covered by the survey coincides with an important increase of sizes from 22 to 32 cm in this year.

A historical dataseries of Effort (days at sea) and lpues of *Phycis spp*. of commercial Baka trawler of Basque Country in VI, VII and VIII Subareas is shown in Table 12.5. This is a bycatch fishery and abundance indices should be treated with caution.

Data on length frequencies and abundance from Spanish survey in Cantabrian Sea (VIIIc), French western IBTS, Scottish IBTS and Irish survey have been provided to the WG. Plot of the result of this data are shown in Figures 12.10a–f.

12.4 Data analyses

The stock was assessed according to the procedure set out in the Stock Annex. French surveys showed no trend in the Cantabrian Sea or Celtic Sea. Scottish surveys showed no trend in Subarea VI.

12.4.1 Exploratory assessment

At WKDEEP an exploratory Stock Depletion Model for Greater forkbeard stock developed by Roa-Ureta and based on the model described by Roa-Ureta and Arkhipkin (2007) was presented but is still considered to be exploratory.

12.4.2 Modeling

The exploratory stock assessment model follows the daily catch and effort dynamics. It is a generalisation of the depletion model described in Roa-Ureta and Niklitschek (2007); so many technical details are not repeated here. In this data-poor situation there is no biological sampling of the catch and the catch is reported in biomass, so the model had to be transformed from a model predicting catch in numbers to a model predicting catch in biomass. Secondly, there have been three Spanish fleets using different gears catching greater forkbeard as a bycatch. Thus the model was adapted to deal simultaneously with the information coming from multiple fleets. With these considerations the model is:

$$\chi_t = e^{-M/2} g(K)_{t,\tilde{a}-1/2} \sum_{i=1}^{f} \left(B_0 e^{-Mt} g(K)_{t,\tilde{a}} - e^{-M/2} g(K)_{t,\tilde{a}-1/2} \sum_{j<t} \chi_{f,j} e^{-(t-j-1)M} g(K)_{t,\tilde{a}-j-1} \right)^{\beta_f} q_f E_{f,t}^{\alpha_f} + \varepsilon_t,$$

$$\varepsilon_t = \sum_{i=1}^{f} \varepsilon_{i,t} \sim \text{Normal}\left(0, \sigma_C^2 = \sum_{i=1}^{f} \sigma_i^2\right)$$

$$g(K)_{t,\tilde{a}} = \left(\frac{1-e^{-K(t+\tilde{a})}}{1-e^{-K(t+\tilde{a}-1)}} \right)^3, \quad g(K)_{t,\tilde{a}-1/2} = \left(\frac{1-e^{-K(t+\tilde{a}-1/2)}}{1-e^{-K(t+\tilde{a}-1)}} \right)^3, \quad g(K)_{t,\tilde{a}-j-1} = \left(\frac{1-e^{-K(t+\tilde{a}-j-1)}}{1-e^{-K(t+\tilde{a}-j-2)}} \right)^3$$

where t is a daily time step, χ is the observed catch as a random variable, $e^{-M/2}$ is the daily natural change due to daily natural mortality rate M, $g(K)$ is the daily natural change in biomas due to individual growth, f is the number of fleets, B_0 is the biomass at the start of the year, β is an abundance hyper-response parameter (accounting for nonlinearities in the relation between catch and abundance), q is a scaling parameter (catchability), E is the observed effort, α is an effort hyper-response parameter (accounting for nonlinearities in the relation between catch and effort), ε is a normal random variable composed of independent normal random deviates from each fleet, with pooled variance σ^2_C. The transformation to catch in biomass involved the inclusion of a model of biomass growth by individual fish to account for natural change in biomass due to individual growth. As it can be seen from the equations for $g(K)$, we assumed a von Bertalanffy individual growth model. There was no firm knowledge about the value of K so we used the relation of K with M, namely $K=(2/3)M$ (Jensen, 1996). M in turn was assumed as coming from the empirical relation between M and longevity of Hewitt and Hoenig (2005). M=0.003693956 day^{-1}. The transformation to catch in biomass also involved some assumption about the mean age of fish at the start of each year. We assumed that they had the geometric mean age ($\tilde{a}$) as computed using a maximum age of 20 years old (Cohen *et al.*, 1990) plus five years for improbable observation of extreme values, and four years as the age of recruitment to the fishery.

The model was programmed in R (R Development Core Team, 2009) as a function to be called by setting up initial parameter values by exploratory analysis. The fit was done maximising the profile likelihood function by recourse to the optimal function and the Nelder-Mead algorithm.

The database covered three years (2003 to 2005) of daily activity by the trawling, gill-net and longline Spanish fleets operating in Portuguese waters, Bay of Biscay, Porcupine Bank and the Irish Sea, north of Azores Islands, and Rockall and the West Scotland sea (Subareas III, VI, VII, VIII, IX, X and XII).

12.4.3 Results

For the three years of available data of daily catch and effort the model follows well the daily catch dynamics (Figure 12.2 to 12.4). There are clusters of large positive residuals caused by catches too high to be explained by the generalised depletion model, which implies that these clustered residuals originates from periods of recruitment, which the model as it stands now cannot account for.

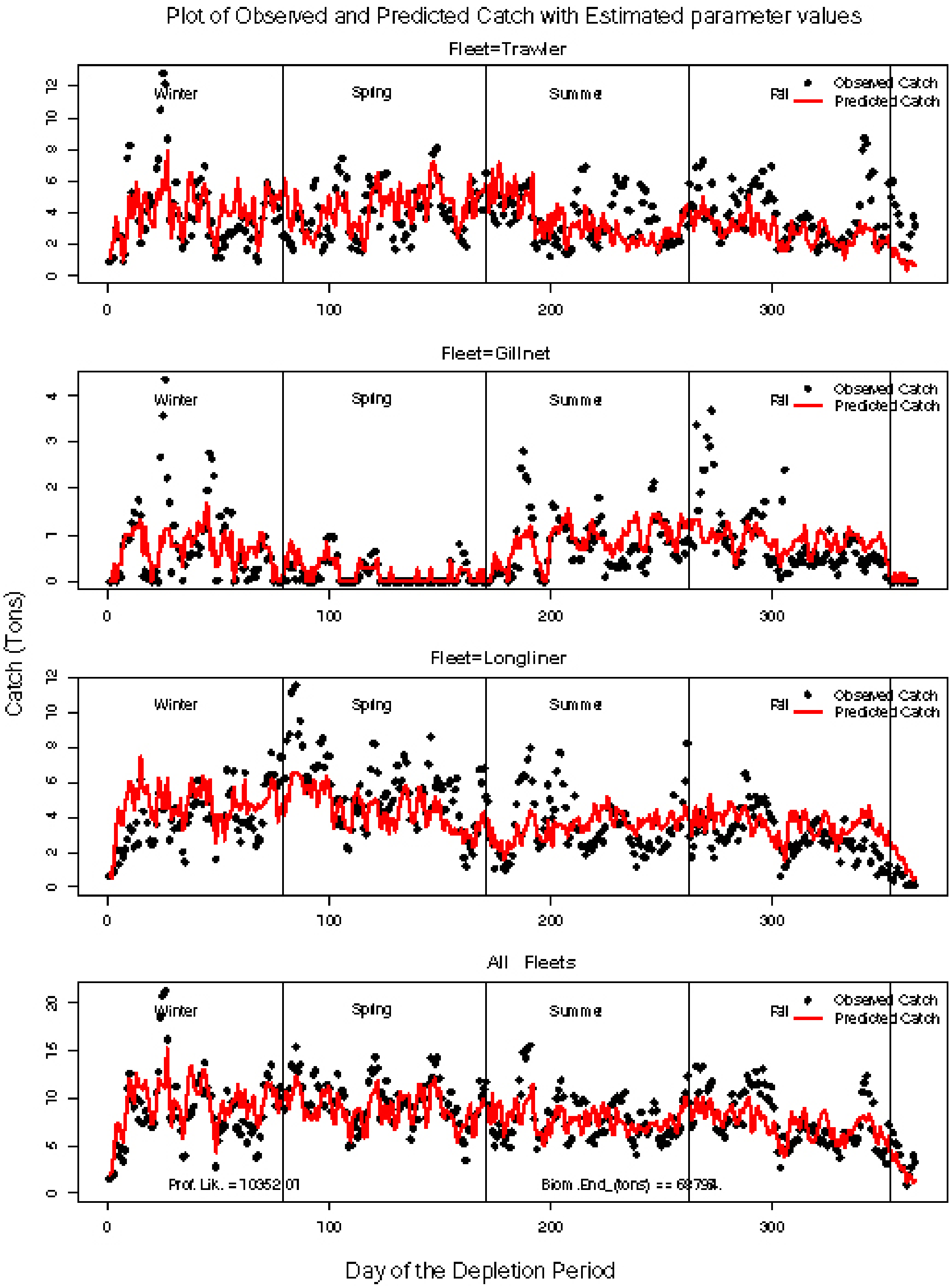


Figure 12.2. Observed catch and predicted catch by the daily catch dynamics (generalised depletion) model in 2003.

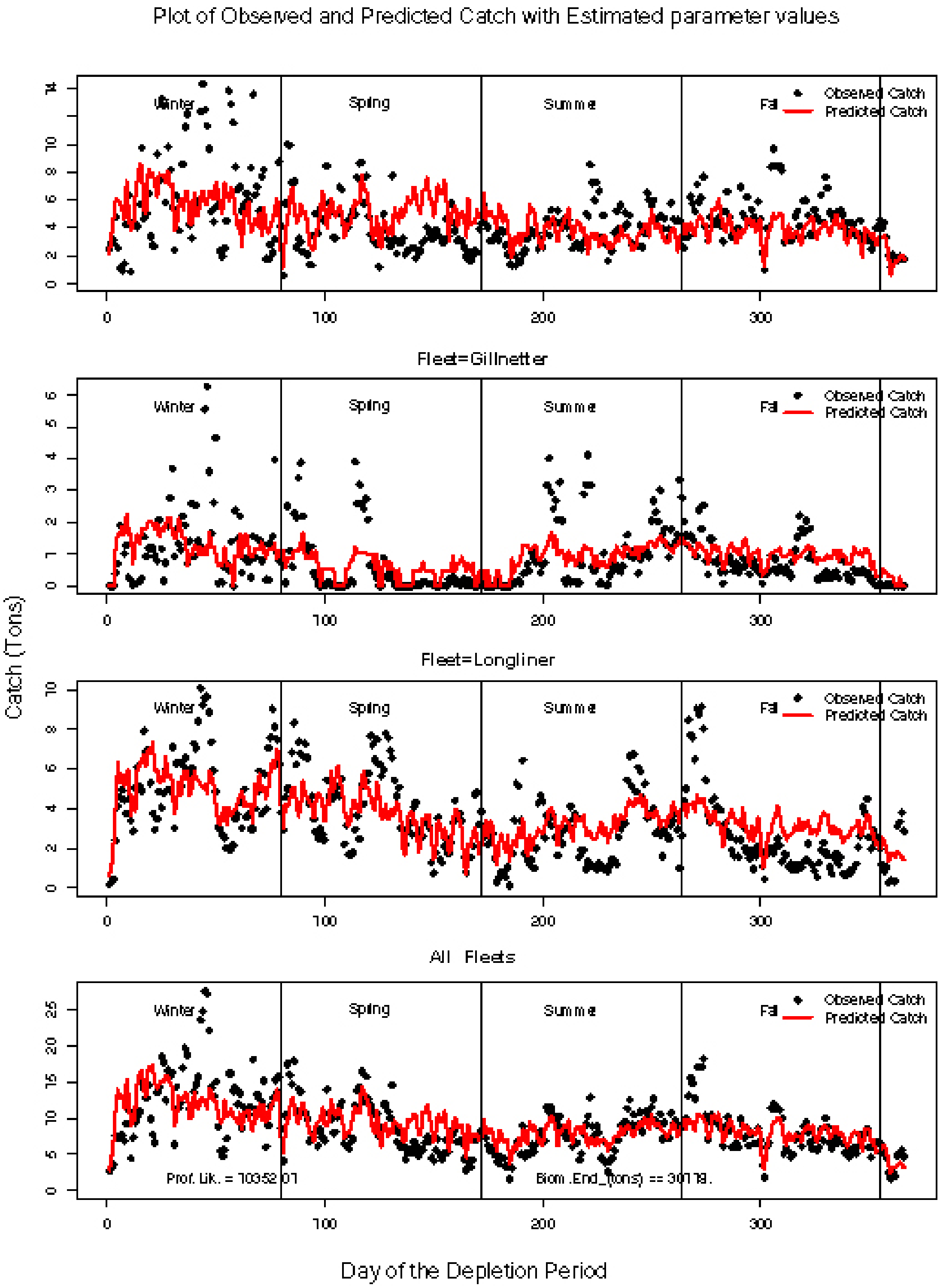


Figure 12.3. Observed catch and predicted catch by the daily catch dynamics (generalised depletion) model in 2004.

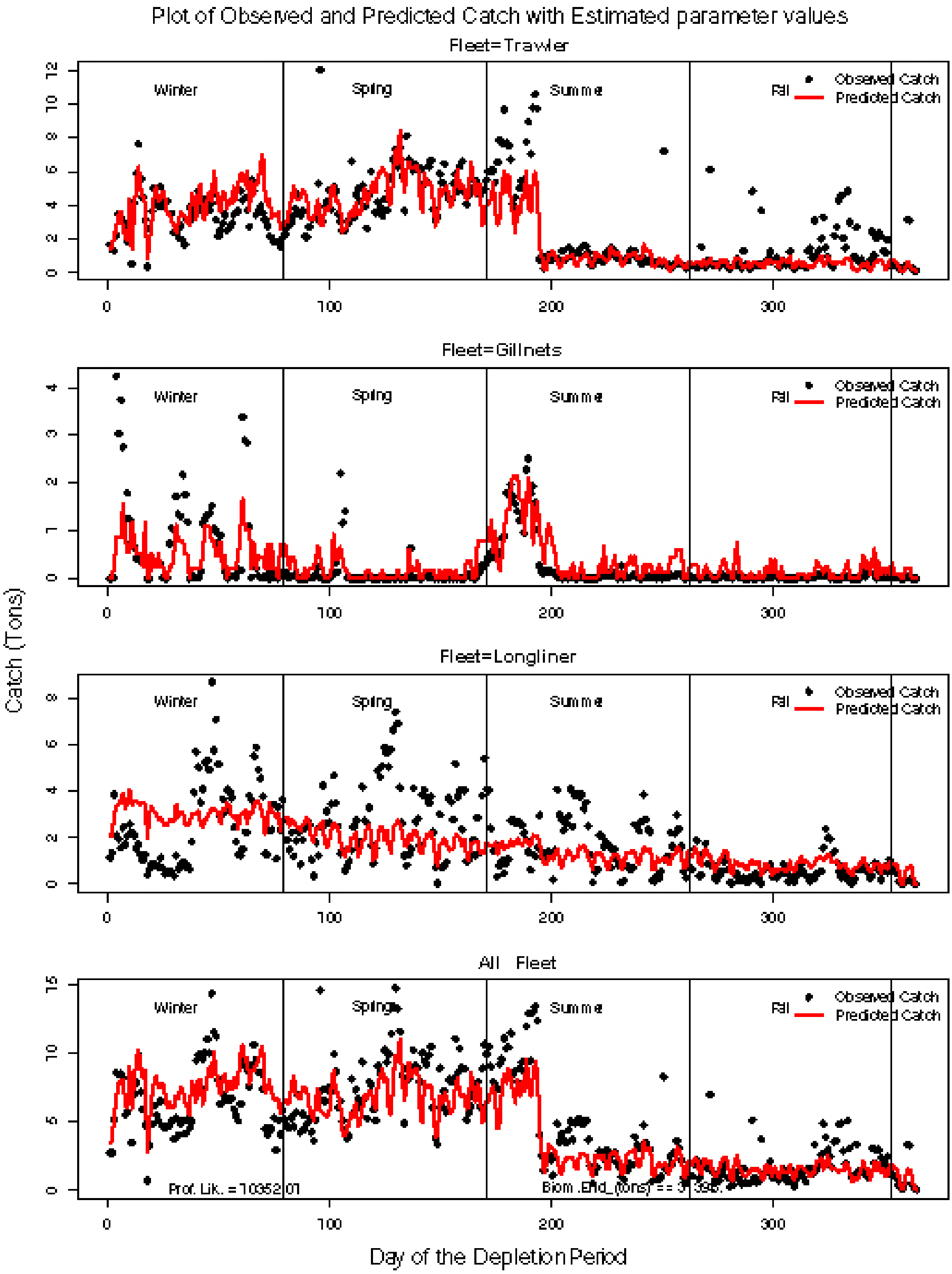


Figure 12.4. Observed catch and predicted catch by the daily catch dynamics (generalised depletion) model in 2005.

Table 12.1. Parameter estimates (standard errors not shown) of greater forkbeard stock and fishery from the exploratory catch dynamics (generalised depletion) stock assessment model.

	OBSERVED/PREDICTED/ESTIMATED VALUES		
Parameter/Quantity	2003	2004	2005
Predicted Trawlers Catch (ton)	1288.8	1642.3	945.2
Observed Trawlers Catch (ton)	1390.5	1675.3	1026.9
Predicted Gillnetters Catch (ton)	232.8	334.3	118.8
Observed Gillnetters Catch (ton)	222.8	316.8	101.5
Predicted Longliners Catch (ton)	1442.0	1338.4	629.8
Observed Longliners Catch (ton)	1428.8	1280.6	674.2
Trawlers Effort (Vessel-Days)	9967	10664	8560
Gillnetters Effort (Vessel-Days)	1502	1461	621
Longliners Effort (Vessel-Days)	8125	8013	4470
Profile Support	-10 143.5	-10 930.3	-9534.8
Initial Biomass (ton)	267 655.2	119 746.1	122 664.7
Catchability Coefficient Trawlers (1/Vessel-Days)	0.00000961	0.00003413	0.00003014
Catchability Coefficient Gillnetters (1/Vessel-Days)	0.00080123	0.00021670	0.00004866
Catchability Coefficient Longliners (1/Vessel-Days)	0.00074782	0.00090835	0.00031228
Effort Hyper-response Trawlers	1.54	1.14	1.42
Effort Hyper-response Gillnetters	0.75	0.60	1.16
Effort Hyper-response Longliners	0.79	0.68	0.45
Abundance Hyper-response Trawlers	0.65	0.72	0.60
Abundance Hyper-response Gillnetters	0.49	0.69	0.73
Abundance Hyper-response longliners	0.52	0.56	0.67

Parameter estimation was consistent over the years (Table 1). The trawling fleet has the lowest catchability and is effort-synergistic, the gillnet fleet switched from effort-saturated in the first two years to effort-synergistic in the last year, the longline fleet had the highest catchability and it was effort-saturated, and all fleets were abundance hyper-stable. Biomass decreased from the first year to the second and then remained stable at ca. 120 thousand tonnes.

The model and its results remain exploratory and should be developed further by accounting for recruitment, the single major process affecting catch not accounted for by the model.

12.5 Comments on the assessment

The assessment was presented but not accepted as basis for advice.

12.6 Management considerations

The landings of greater forkbeard are mainly bycatch from traditional demersal trawl and longline fisheries targeting species such as hake, megrim, monkfish, ling, blue ling, etc. Fluctuations in landings are probably the result of changing effort on different target species and/or market prices and are not necessary linked with changes in the resource abundance. The species should not be managed in a singles species context and any advice should take into account advice on other species/fisheries.

Table 12.0a. Greater forkbeard (*Phycis blennoides*) in Subareas I and II. Working Group estimates of landings.

Year	Norway	France	Russia	UK (Scot)	Germany	UK (E +W)	Faroe Islands	TOTAL
1988	0							0
1989	0							0
1990	23							23
1991	39							39
1992	33							33
1993	1							1
1994	0							0
1995	0							0
1996	0							0
1997	0							0
1998	0							0
1999	0	0						0
2000	0	0						0
2001	0	1	7					8
2002	315	0		1		2		318
2003	153	0				2		155
2004	72	0	3	0				75
2005	51	0						51
2006	46	0	3					49
2007	41	0	5	1	0			47
2008	112	0	4	1			0	117
2009	75	0	6					81

Table 12.0b. Greater forkbeard *(Phycis blennoides)* in Subareas III and IV. Working Group estimates of landings.

Year	France	Norway	UK (EWNI)	UK (Scot)[1]	Germany	TOTAL
1988	12	0	3	0		15
1989	12	0	0	0		12
1990	18	92	5	0		115
1991	20	161	0	0		181
1992	13	130	0	2		145
1993	6	28	0	0		34
1994	11			1		12
1995	2			1		3
1996	2	10		6		18
1997	2			5		7
1998	1		0	11		12
1999	3		5	23		31
2000	4		0	7		11
2001	6		1	19	2	27
2002	2	561	1	21	0	585
2003	1	225	0	7		233
2004	2	138		3		143
2005	2	81	0	1		83
2006	1	134	3			139
2007	1	236	0	2		239
2008	0	244		1		245
2009	4	142				146

Table 12.0c. Greater forkbeard (*Phycis blennoides*) in Division Vb. Working Group estimates of landings.

Year	France	Norway	UK (Scot)[1]	UK (EWNI)	Faroe Islands	Russia	TOTAL
1988	2	0					2
1989	1	0					1
1990	10	28					38
1991	9	44					53
1992	16	33					49
1993	5	22					27
1994	4						4
1995	9						9
1996	7						7
1997	7	0					7
1998	4	4					8
1999	6	28	0				34
2000	4	26	1	0			32
2001	9	92	1	0			102
2002	10	133	5	0			149
2003	11	55	7	0			73
2004	9	37	2	2			50
2005	7	39		0,3			46
2006	8	26			6		39
2007	11	34	0	0	9	2	56
2008	10	20	0		4	11	45
2009	0	13			3	2	18

(1) Includes Moridae, in 2005 only data from January to June.

Table 12.0d. Greater forkbeard (*Phycis blennoides*) in Subareas VI and VII. Working Group estimates of landings.

Year	France	Ireland	Norway	Spain[(1)]	UK (EWNI)	UK (Scot)[(2)]	Germany	Russia	Faroe Islands	TOTAL
1988	252	0	0	1584	62	0				1898
1989	342	14	0	1446	13	0				1815
1990	454	0	88	1372	6	1				1921
1991	476	1	126	953	13	5				1574
1992	646	4	244	745	0	1				1640
1993	582	0	53	824	0	3				1462
1994	451	111		1002	0	7				1571
1995	430	163		722	808	15				2138
1996	519	154		1428	1434	55				3590
1997	512	131	5	46	1460	181				2335
1998	357	530	162	530	1364	97				3040
1999	314	686	183	824	929	518	1			3455
2000	671	743	380	1613	731	820	8	2		4967
2001	683	663	536	1332	538	640	10	4		4405
2002	613	481	300	1049	421	545	9	0		3417
2003	469	319	492	1100	245	661	1	1		3287
2004	441	183	165	1131	288	397		1		2606
2005	598	237	128	979	179	164		5		2290
2006	625	68	162	1075	148			2	0	2081
2007	578	56	188	875	117	179		2	0	1995
2008	711	43	174	236	31	196		27	0	1418
2009	304	7	222	48	31	41		1		654

(1) *Phycis* spp.

(2) Includes Moridae, in 2005 only data from January to June.

Table 12.0e. Greater forkbeard (*Phycis blennoides*) in Subareas VIII and IX. Working Group estimates of landings.

YEAR	FRANCE	PORTUGAL	SPAIN[1]	UK (EWNI)	TOTAL
1988	7	0	74		81
1989	7	0	138		145
1990	16	0	218		234
1991	18	4	108		130
1992	9	8	162		179
1993	0	8	387		395
1994		0	320		320
1995	54	0	330		384
1996	25	2	429		456
1997	4	1	356		361
1998	3	6	656		665
1999	8	10	361		379
2000	36	6	375		417
2001	36	8	453		497
2002	67	8	418		493
2003	28	11	387		427
2004	44	10	446		500
2005	58	14	312	0	384
2006	54	10	257		321
2007	32	44	510	0	586
2008	41	13	123		178
2009	8	13	183	0	203

(1) ***Phycis* spp.**

Table 12.0f. Greater forkbeard (*phycis blennoides*) in Subarea X. Working Group estimates of landings.

Year	Portugal[1]	TOTAL
1988	29	29
1989	42	42
1990	50	50
1991	68	68
1992	91	91
1993	115	115
1994	136	136
1995	71	71
1996	45	45
1997	30	30
1998	38	38
1999	41	41
2000	91	91
2001	83	83
2002	57	57
2003	45	45
2004	37	37
2005	22	22
2006	15	15
2007	17	17
2008	18	18
2009	13	13

(1) from 1988 to 2005 *Phycis* spp.

Table 12.0g. Greater forkbeard ***(phycis blennoides)*** **in SubXII. Working Group estimates of landings.**

Year	France	UK (Scot)[1]	Norway	UK (EWNI)	Spain[2]	Russia	TOTAL
1988							0
1989							0
1990							0
1991							0
1992	1						1
1993	1						1
1994	3						3
1995	4						4
1996	2						2
1997	2						2
1998	1						1
1999	0	0					0
2000	2	4					6
2001	0	1	6	1			8
2002	0		2	4	73		79
2003	3		8	0	141		153
2004	3		6		34		43
2005	1	0	0		60		61
2006							0
2007							0
2008	0				17		17
2009	1		0		37	6	44

(1) Includes Moridae, in 2005 only data from January to June.

(2) ***Phycis*** **spp.**

Table 12.0h. Greater forkbeard (*phycis blennoides*) in the northeast Atlantic. Working Group estimates of landings.

YEAR	I+II	III+IV	VB	VI+VII	VIII+IX	X	XII	TOTAL
1988	0	15	2	1898	81	29	0	2025
1989	0	12	1	1815	145	42	0	2015
1990	23	115	38	1921	234	50	0	2381
1991	39	181	53	1574	130	68	0	2045
1992	33	145	49	1640	179	91	1	2138
1993	1	34	27	1462	395	115	1	2035
1994	0	12	4	1571	320	136	3	2046
1995	0	3	9	2138	384	71	4	2609
1996	0	18	7	3590	456	45	2	4118
1997	0	7	7	2335	361	30	2	2742
1998	0	12	8	3040	665	38	1	3764
1999	0	31	34	3455	379	41	0	3940
2000	0	11	32	4967	417	91	6	5524
2001	8	27	102	4405	497	83	8	5131
2002	318	585	149	3417	493	57	81	5099
2003	155	233	73	3287	427	45	82	4302
2004	75	143	50	2606	500	37	54	3464
2005	51	83	46	2290	384	22	77	2952
2006	49	139	39	2081	321	15	42	2686
2007	47	239	56	1995	586	17	37	2978
2008	117	245	45	1418	178	18	17	2038
2009	81	146	18	654	203	13	44	1160

Table 12.2. ***Phycis*** **spp Spanish landings (t) by Subarea and gear in the period 2003–2009.**

PHYCIS SPP												
	2003						2004					
Gear	VI	VII	VIII	IX	XII	XIV	VI	VII	VIII	IX	XII	XIV
Longliners	64	359	103	5	0	0	1	157	242	0	0	0
Gillnets	0	43	37	1	0	0	0	26	28	0	0	0
Bottom trawl	66	541	167	34	71	0	57	891	112	32	34	0
Others	0	27	10	31	0	0	0	0	0	30	0	0
	2005						2006					
Gear	VI	VII	VIII	IX	XII	XIV	VI	VII	VIII	IX	XII	XIV
Longliners	1	180	148	0	0	0	0	376	80	1	0	0
Gillnets	0	10	8	0	0	0	0	9	21	1	0	0
Bottom-trawl	146	699	97	39	3	0	37	653	84	28	0	0
Others	0	0	0	18	0	0	0	0	0	42	0	0
	2007						2008*					
Gear	VI	VII	VIII	IX	XII	XIV	VI	VII	VIII	IX	XII	XIV
Longliners	0	325	294	3	0	0	0	75	20	14	0	0
Gillnets	0	2	41	4	0	0	0	0	3	29	0	0
Bottom-trawl	37	512	113	55	0	0	28	133	56	0	0	0
Others	0	0	0	0	0	0	0	0	0	0	0	0
	2009											
Gear	VI	VII	VIII	IX	XII	XIV						
Longliners	0	0	20	5	0	0						
Gillnets	0	0	1	4	0	0						
Bottom-trawl	9	0	58	53	37	0						
Others	0	0	0	0	0	0						

Table 12.3. Landings and estimate of discards (ton) of Greater forkbeard by the Basque Country (Spain) OTB fleet.

PHYCIS BLENNOIDES				
	Subarea	VI	VII	VIII
	Disc.	0	0	
2003	Land.	65	13	12
	Disc.			
2004	Land.	53	17	10
	Disc.			
2005	Land.	50	27	9
	Disc.	7		
2006	Land.	37	4	13
	Disc.			0
2007	Land.	37	5	8
	Disc.	372		0
2008	Land.	27	0	20
	Disc.	13		
2009	Land.	37	0	6

Table 12.4. Landings and discards by French métiers in Subareas VI, VII and VIII combined in the period 2003–2008.

Subarea VI

DCF MÉTIER	OTB_DEF	OTB_DWS	OTT_DEF	OTT_DWS
Métier names	Otter trawl, demersal fish	Otter trawl, deep-water fish	Midwater trawl, demersal fish	Twin trawl for deep-water fish
GFB landings (kg) (1)	8196	13 899	2645	62
GFB discards (kg) (1)	1516	3617	57	0
GFB landings (t) (2)	142	128	0	
GFB raised discards (t) (3)	24	27	4	0

Subarea VII

DCF MÉTIER	GTR_DEF	OTB_CRU	OTB_DEF	OTT_CRU	OTT_DEF
Métier names	Trammelnet for demersal species	Otter trawl, *nephrops*	Otter trawl demersal fish	Twin trawl, *nephrops*	Twin trawl, demersal fish
GFB landings(kg) (1)	0	59	62	4975	2332
GFB discards (kg) (1)	0	271	120	4265	1385
GFB landings (t) (2)	0	2	11	4	7
GFB raised discards (t) (3)	0	7	4	74	16

Subarea VIII

DCF MÉTIER	GNS-DEF	GTR_DEF	OTB_DEF	OTT_CRU	OTT_DEF
Métier names	Gillnet, demersal fish	Trammelnet, demersal fish	Otter trawl, demersal fish	Twin trawl, *nephrops*	Twin trawl for demersal fish
GFB landings(kg) (1)	0	0	6	160	332
GFB discards (kg) (1)	0	0	82	739	552
GFB landings (t) (2)	0	0	8	6	9
GFB raised discards (t) (3)	0	0	13	45	25

(1) From on-board observations; (2) From landings statistics; (3) Observed discards raised to total landings.

Table 12.5. ***Phycis*** **spp landings (t), effective effort (fishing days = trips*(days/trip)) and lpue (landings in kg/day) of different fleets landing in the Basque Country (Spain) ports in the period 1996–2009.**

(A)	OTB-VIII			OTB-VII			OTB-VI		
Year	Landings (t)	Effort (days)	lpue (kg/days)	Landings (t)	Effort (days)	lpue (kg/days)	Landings (t)	Effort (days)	lpue (kg/days)
1996	5	4378	1.2	63	1170	54.0	46	695	65.7
1997	7	4286	1.6	15	540	28.6	36	710	51.0
1998	1	3002	0.3	52	1196	43.9	54	750	72.2
1999	1	2337	0.6	42	1384	30.5	141	855	164.7
2000	7	2227	3.3	60	1850	32.2	191	763	250.0
2001	4	2707	1.5	59	1531	38.3	184	1171	156.9
2002	11	3617	3.1	24	1055	22.4	164	1592	103.1
2003	12	3363	3.5	13	1060	12.7	65	827	78.8
2004	10	4232	2.4	17	1074	15.8	53	510	103.5
2005	9	3697	2.3	27	663	40.3	50	484	103.1
2006	13	2979	4.4	4	501	7.9	37	449	82.7
2007	8	2780	3.0	5	476	9.5	37	369	99.6
2008	20	2967	6.6	0	107	0.6	27	349	77.6
2009	6	2274	2.5	0	0	0.0	37	380	98.5

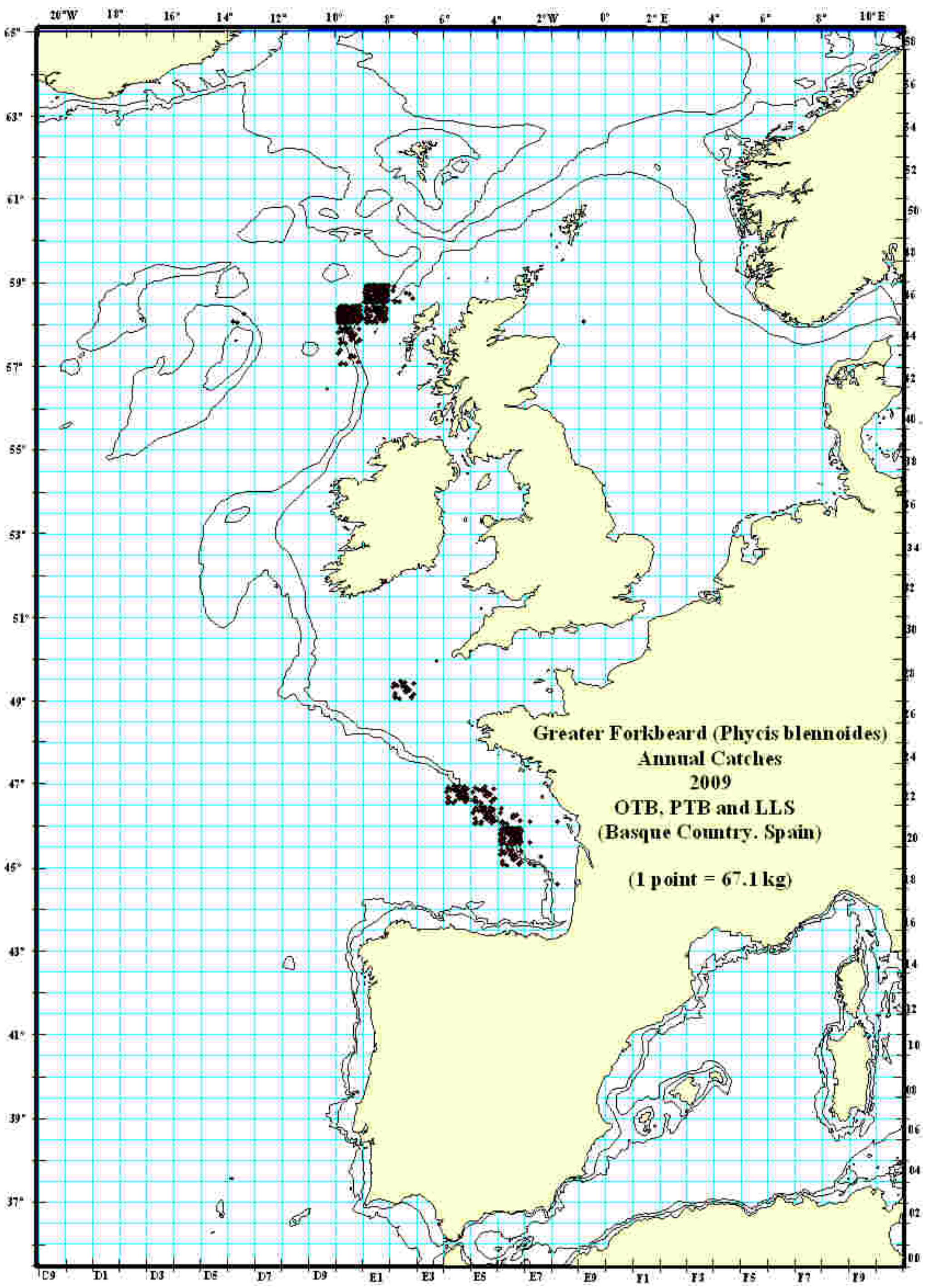


Figure 12.5. Catches by statistical rectangle of greater forkbeard by Basque Country (Spain) in 2009.

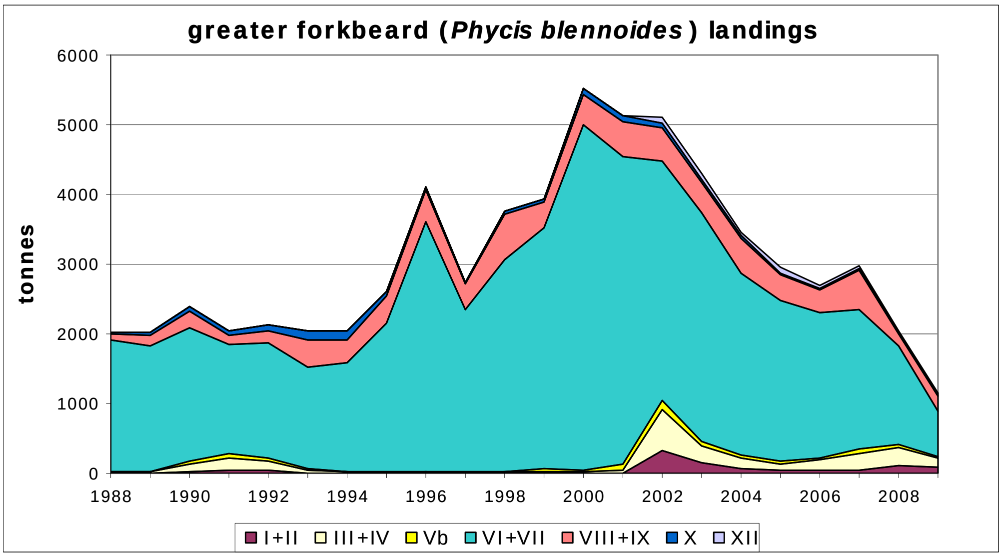


Figure 12.6. Greater forkbeard landing trends in all ICES Subareas since 1988.

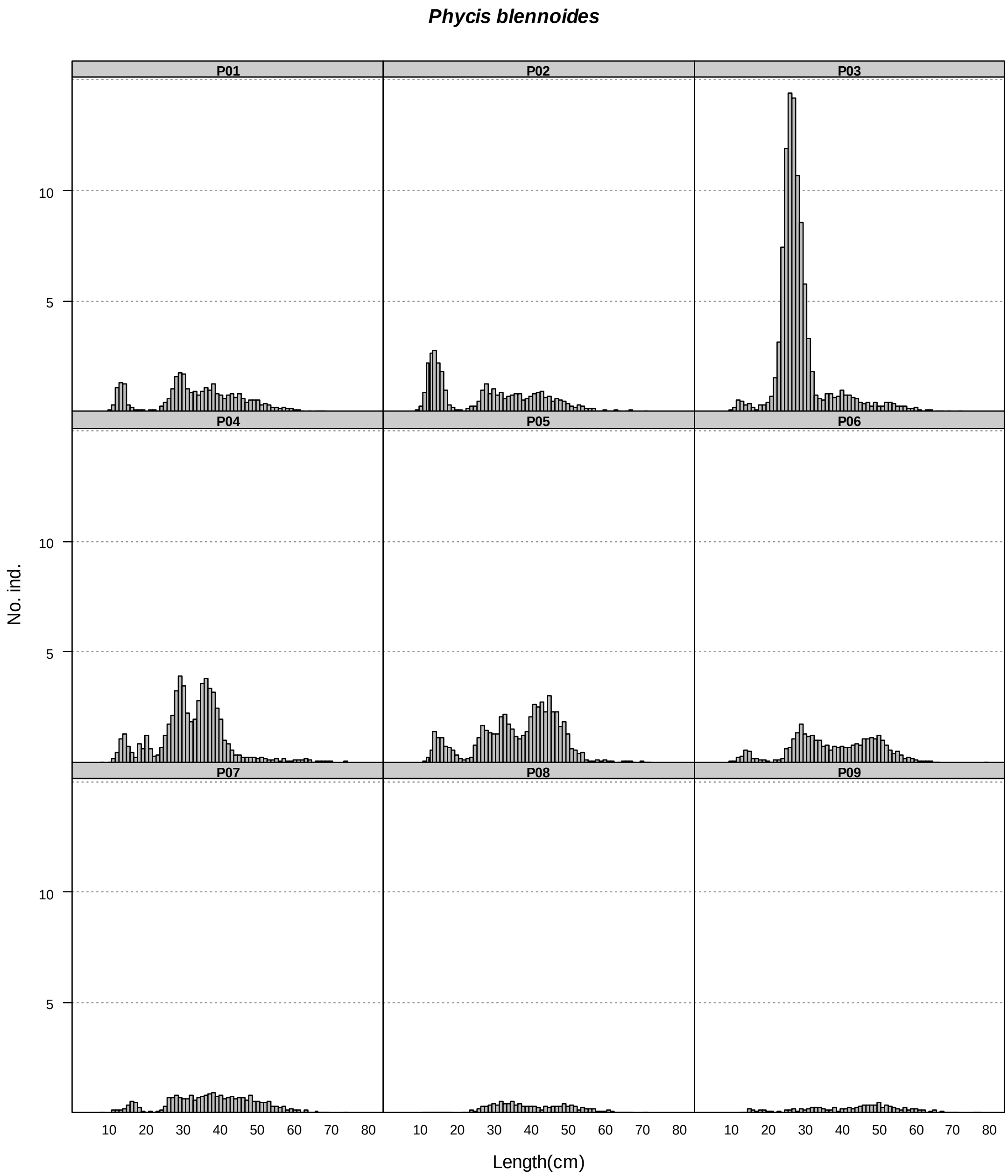


Figure 12.7. Mean stratified length distributions of *Phycis blennoides* in Porcupine surveys (2001–2009).

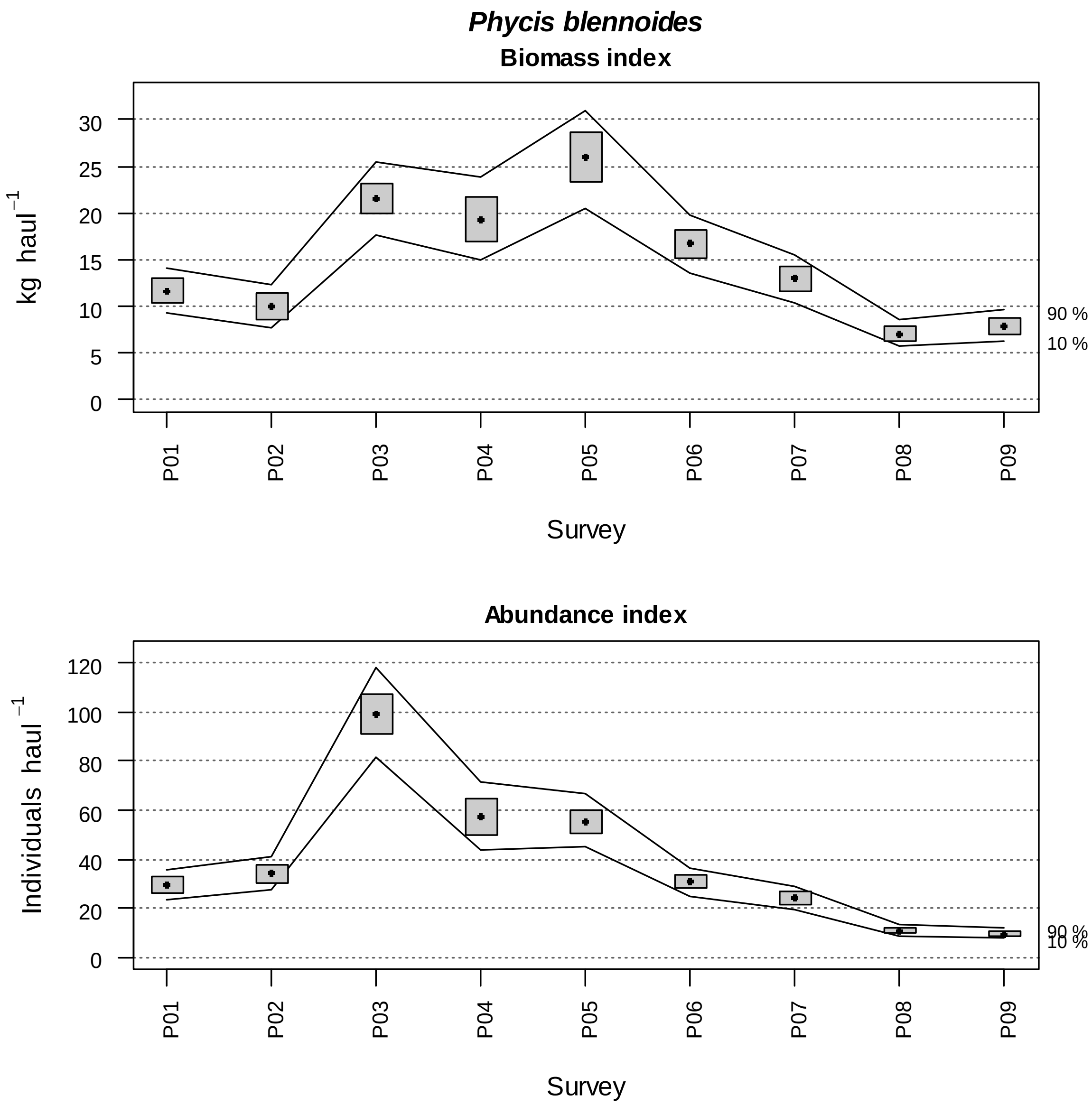


Figure 12.8. Changes in *Phycis blennoides* biomass and abundance indices during Porcupine Survey time-series (2001–2009). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

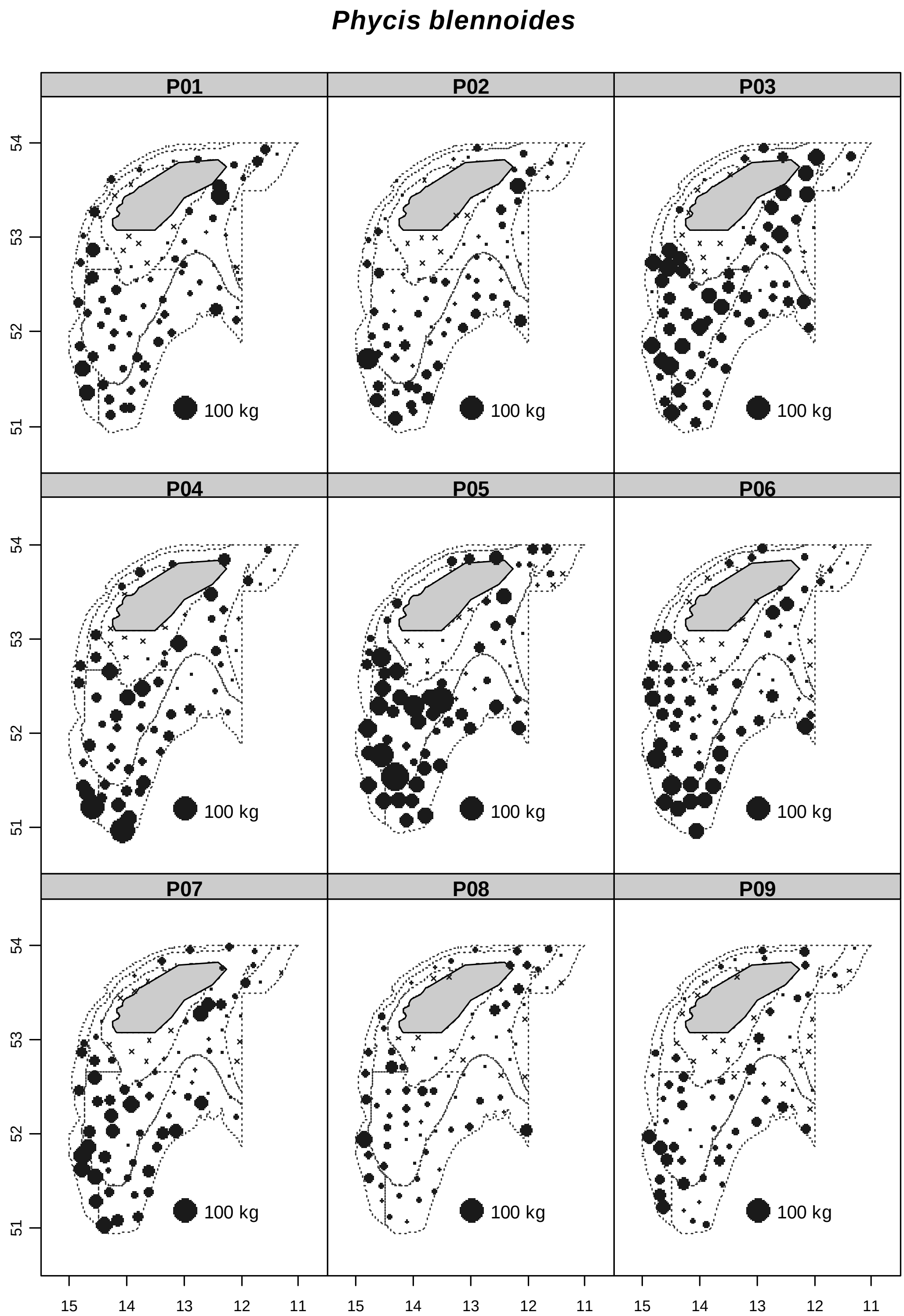


Figure 12.9. Geographic distribution of *Phycis blennoides* catches (kg/30 min haul) in Porcupine surveys between 2001 and 2009.

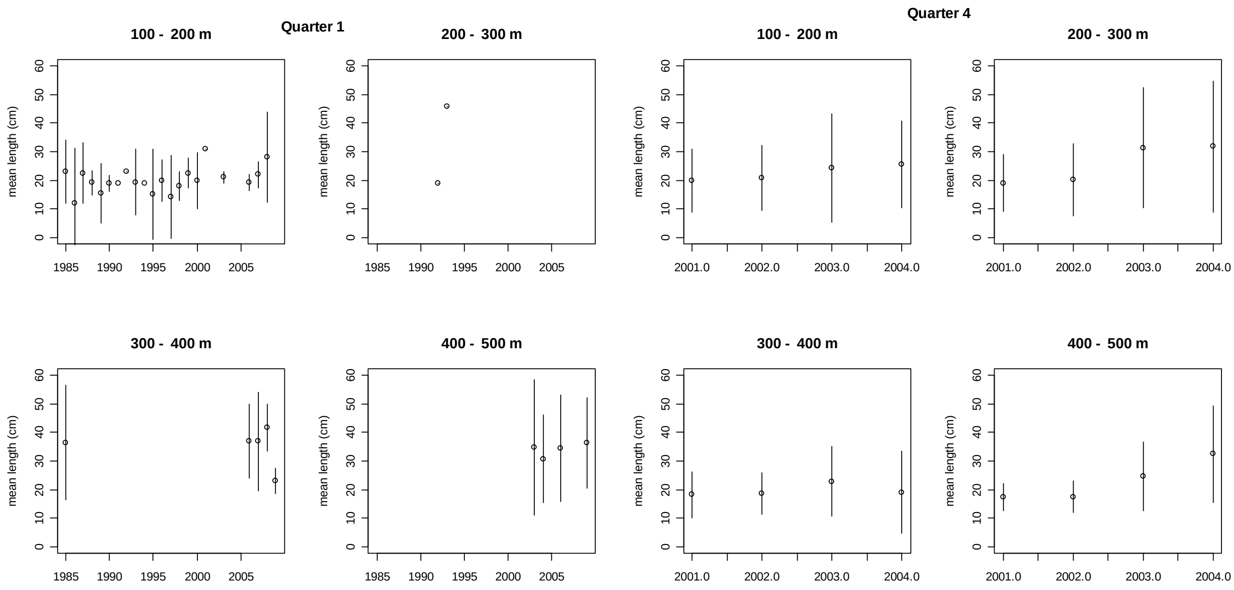


Figure 12.10a. Greater forkbeard (*Phycis blennoides*). Mean length per depth strata in the Cantabrian Sea (Bay of Biscay, Division VIIIc, Spanish survey), quarter 1 (left) and 4 right).

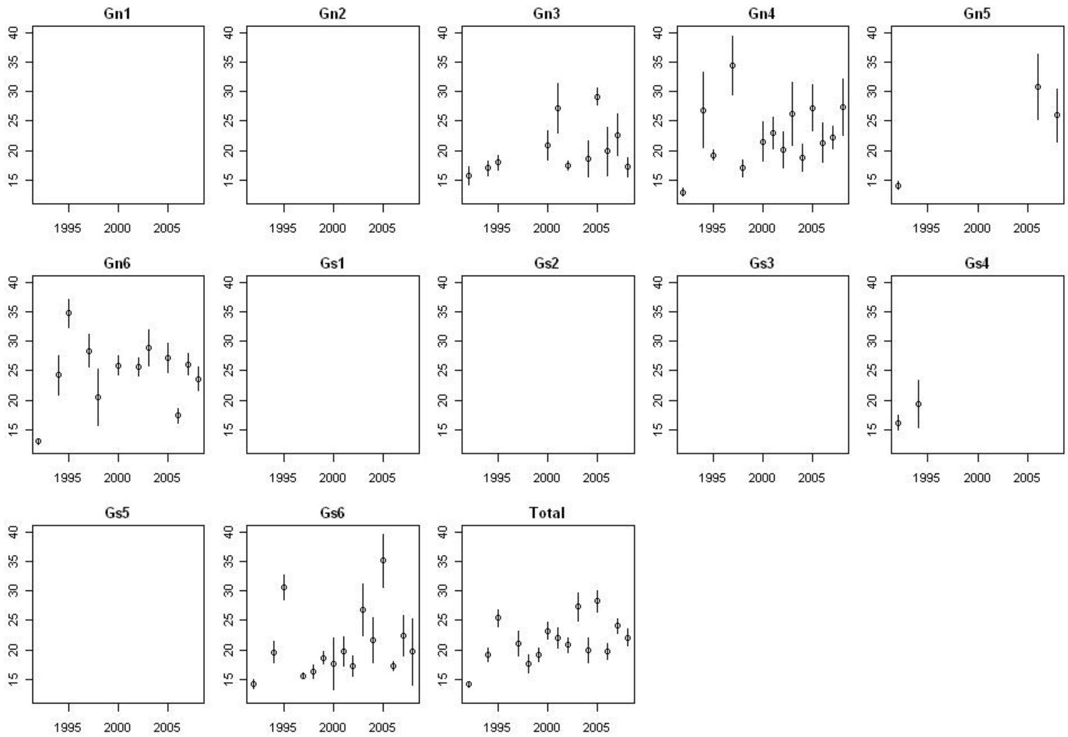


Figure 12.10b. Greater forkbeard (*Phycis blennoides*). Mean length per strata in the Bay of Biscay (Division VIIIa,b) from the French western IBTS (see Figure 5 for strata code).

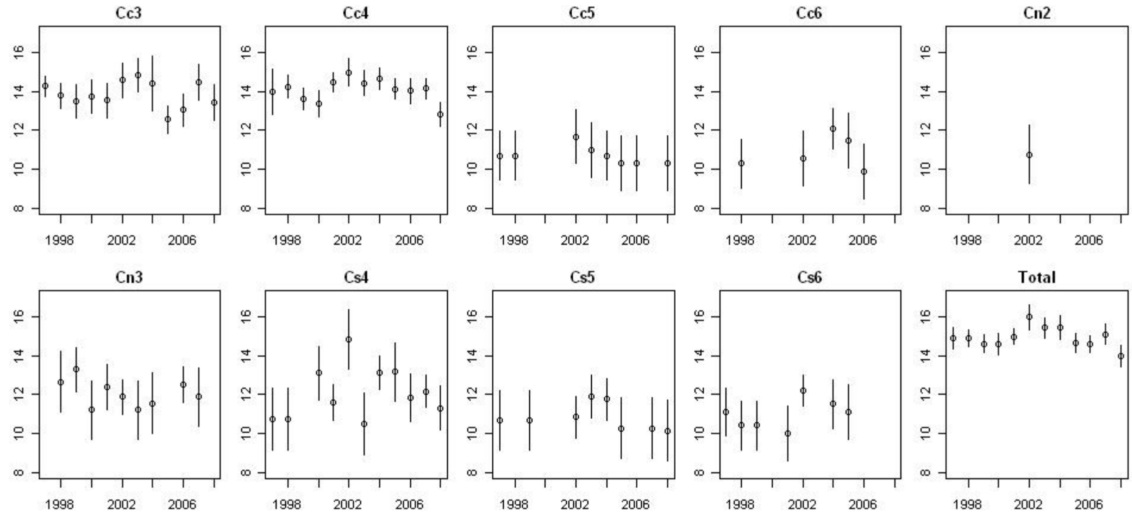


Figure 12.10c. Greater forkbeard (*Phycis blennoides*). Raised abundance (swept area method, Log scale) per strata in the Celtic Sea (Log scale) from the French western IBTS (see Figure 5 for strata code).

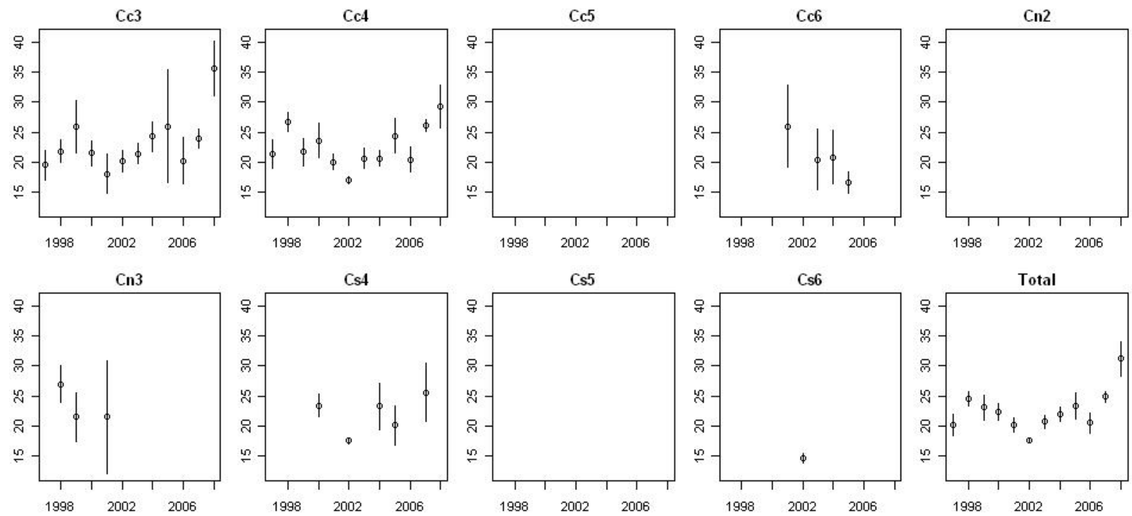


Figure 12.10d. Greater forkbeard (*Phycis blennoides*). Mean length per strata in the Celtic Sea (Subarea VII) from the French western IBTS (see Figure 5 for strata code).

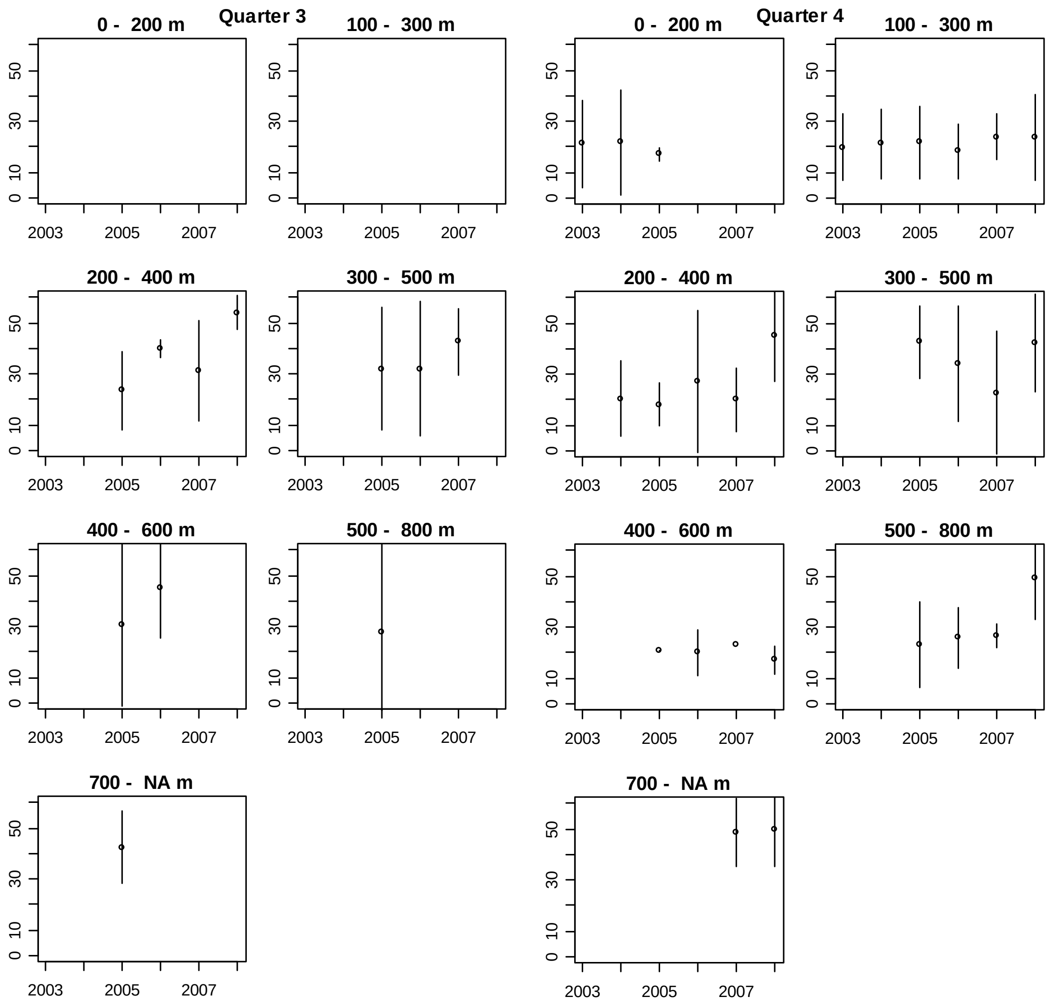


Figure 12.10e. Greater forkbeard (*Phycis blennoides*). Mean length per depth strata in the ICES Subarea VII, Irish survey quarter 3(left) and 4 (right).

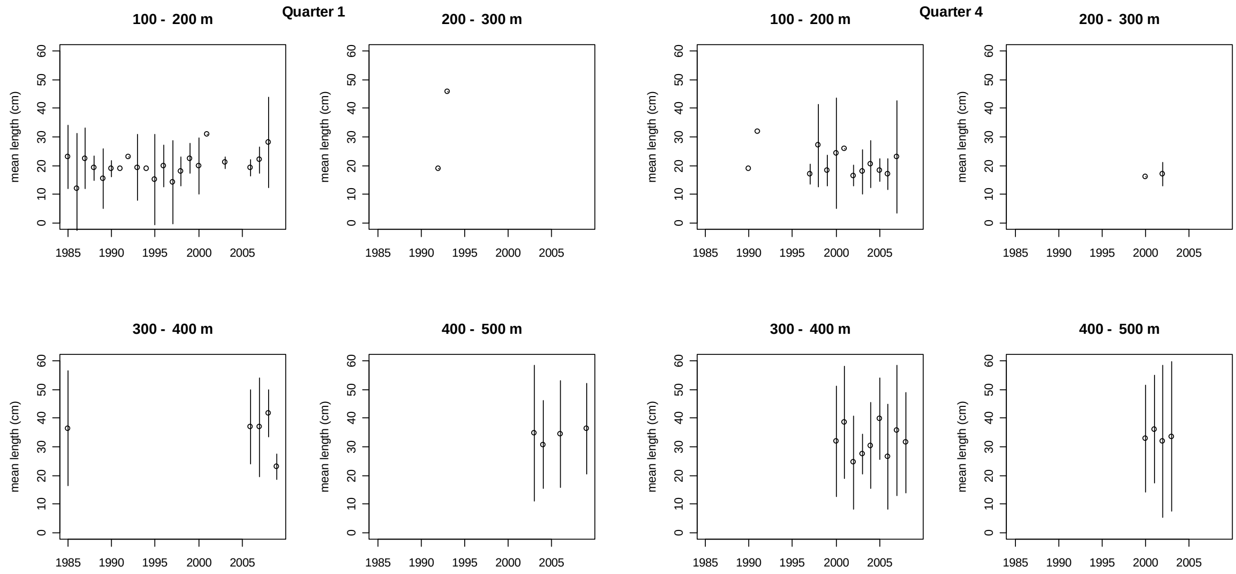


Figure 12.10f. Greater forkbeard (*Phycis blennoides*). Mean length per depth strata in the ICES Subarea VI, Scottish IBTS, quarter 1 (left) and quarter 4 (right).

Stock Annex: Greater forkbeard in the Northeast Atlantic

Stock	Greater forkbeard in the Northeast Atlantic
Working Group	WKDEEP
Date	February 2010 (WKDEEP)
Revised by	Guzman Diez (gdiez@azti.es), Ruben Roa (rroa@azti.es) and Pascal Lorance (Pascal.Lorance@ifremer.fr)

A. General

A.1. Stock definition

The Greater forkbeard is a gadoid fish which is widely distributed in the North- Eastern Atlantic from Norway and Iceland to Cape Blanc in West Africa and the Mediterranean (Svetovidov, 1986; Cohen *et al*., 1990). It is distributed along the continental shelf and slope in depths ranging between 60 and 800 meters but recent observations on board of commercial longliners and research surveys extend the depth range to below 1000 m (Stefanescu *et al*., 1992).

Unfortunately very little is known about stock structure of the species. Currently ICES considered greater forkbeard as a single stock for all the ICES area – greater forkbeard in the Northeast Atlantic. Probabli the stocks structure is more complex, but further studies needs to be implemented to allow a scientific basis for the stock structure.

A.2. Fishery

Greater forkbeard may be considered as a bycatch species in the traditional demersal trawl and longline mixed fisheries targeting species such as hake, megrim, monkfish, ling, and blue ling. Since 1988, around 80% of landings came from the Subareas VI and VII. Spanish, French and UK trawlers and longliners are the main fleets involved in this fishery. But also the Irish deep-water fishery around Porcupine Bank is based on the flat grounds and targets orange roughy, black scabbard, roundnose grenadier and deep-water siki sharks has landed historically important quantities of this species. The Russian fishery in the North-East Atlantic targeting roundnose grenadier, tusk and ling fish small quantities of greater forkbeard as bycatch of the trawler fleet in Hatton and Rockall Banks. The rest of landings in that period (11%), come from Subareas VIII and IX (mainly from VIII) by the trawler and longliner Spanish and French fleet. In Subarea IX since 2001 small amounts of *Phycis* spp (probably *P. phycis*) are landed in ports of Strait of Gibraltar by the longliner fleet targeting scabbardfish in Algeciras, Barbate and Conil.

Minor quantities of *P. blennoides* from X Subdivision and Vb Subarea are landed by Portuguese and Norwegian vessels respectively. The Azores deep-water fishery is a multispecies and multigear fishery dominated by the main target species Pagellus bogaraveo. Target species can change seasonally according to abundance and market prices, but landings of Phycis blennoides representing less than 0.6% of total deep-water landings in last two years, and can be considered as bycatch.

Catches data for greater forkbeard in 2006 and 2007 aggregated at the level of statistical rectangle were provided to the Working Group by Basque Country (Spain) France, Ireland, the UK (England and Wales and Scotland) and Iceland.

A.3. Ecosystem aspects

For greater forkbeard can be applied the same ecosystem considerations of other deep-water fisheries in the areas defined for the stocks. Fishing is a major disturbance factor of the continental shelf communities of the regions. As the fishery of Greater forkbeard is mainly a bycatch of trawler fishery in all ecoregions the main affections on the ecosystem is the impact on the sediment compound.

B. Data

B.1. Commercial catch

Commercial landings are available from the Basque Country trawler fleet (OTB and PTB) operating in Subareas VI, VII and VIII from 2001 to 2008. . Owing to the bycatch status of the species, they may be unreliable and significant discards occur in some fisheries, in particular on the shelf where juvenile greater forkbeard occur.

B.2. Biological

The biology of the species is poorly known. In general most of biological data are not reliable or not available (e.g. age composition, maturity, growth, natural mortality…). In Tables 3and 4 a compilation of biological available data are shown. (WGDEEP 2001 (ICES C.M. 2001/ACFM: 23; Lorance 2010)). The spawning areas and seasonality are also not well (or at all) identified. Only historical series of length frequencies from surveys were available.

Table 3. Life-history characteristics of Greater forkbeard (from WGDEEP 2001 (ICES C.M. 2001/ACFM: 23; Lorance, 2010).

LHC	Sex	Estimate	Area (month)	Reference
Maximum observed length (TL, cm)	Combined	50	VIIIc and IXa	Sanchez *et al.*, 1995
	Female	84	VIIIc and IXa	Casas and Piñeiro, 2000
	male	44	VIIIc and IXa	Casas and Piñeiro, 2000
Maximum observed age (year)	Female	14	VIIIc and IXa	Casas and Piñeiro, 2000
	male	6	VIIIc and IXa	Casas and Piñeiro, 2000
	combined	20	Atlantic	Cohen *et al.*, 1990
	Female	9	NE Atlantic	Kelly, 1997
	male	7		
	combined	15	NE Atlantic	EC FAIR, 1999, Sub-t. 5.12, Doc.55
Length at 50% maturity (PAFL, cm)	Female	33 cm	NE Atlantic and Med.	Cohen *et al.*, 1990(1,2)
	Male	18 cm		Cohen *et al.*, 1990(1,2)
	Female	32 cm	NE Atlantic and Med.	Kelly, 1997
	Male	31 cm	NE Atlantic	
Age at 50% maturity (year)	Combined	3-4 yrs	Mediterranean sea	Muus and Nielsen, 1999
Length of smallest individuals caught (TL)	Combined	6 cm	VIIIc and IXa	Casas and Piñeiro, 2000
		8cm	VIIIa,b,d (Oct.–Nov.)	Data from French western IBTS
		8 cm	VIIg-k (Oct.–Nov.)	Data from French western IBTS
Age of youngest individuals caught (year)	Combined	< 1yr	VIIIc and IXa	Casas and Piñeiro, 2000
Length of the first mode of the length distribution	Combined	13.9 cm	VIIIc, IXa (Apr.)	Casas and Piñeiro, 2000
		16.9 cm	VIIIc, IXa (Sept.)	Casas and Piñeiro, 2000
		17.4 cm	VIIIc, IXa (Oct.)	Casas and Piñeiro, 2000
		16 cm	VIIIa,b,d (Oct.–Nov.)	Data from French western IBTS
		16 cm	VIIg-k(Oct.–Nov.)	Data from French western IBTS

Unclear whether it is mean length at first maturity or length of smallest mature individual.

Table 4. Growth parameters of greater forkbeard. (from WGDEEP 2001 (ICES C.M. 2001/ACFM: 23; Lorance, 2010)).

Sex	L∞	K	T0	Area	Reference
Male	41.7	0.208	N/A	Gulf of Lions (Med.)	Nony, 1983 (from Fishbase)
Female	51.2	0.258	N/A	Gulf of Lions (Med.)	Nony, 1983 (from Fishbase)
Combined	57.7	0.168	-0.66	Aegean sea (Med.)	Papaconstantinou *et al.*, 1993
Male	54.9	0.217	-0.663	VIIIc and IXa	Casas and Piñeiro, 2000
Female	113.3	0.0886	-0.556	VIIIc and IXa	Casas and Piñeiro, 2000

B.3. Surveys

Data of abundance, length frequencies of *P. blennoides* and area covered by hauls from the of Spanish survey in Porcupine and data of length frequencies from Spanish Cantabrian sea and French western and Scottish IBTS and Irish surveys has been used in the assessment.

Data from surveys are available in the DATRAS database and at national level. Most survey do not cover the deeper part of the depth distribution of the species.

B.4. Commercial effort

Commercial effort (number of total trips) is available from the Basque Country trawler fleet (OTB and PTB) operating in Subareas VI, VII and VIII from 2001 to 2008.

C. Historical stock development

Survey based population indicators of greater forkbeard should be calculated from all relevant survey and provided to WGDEEP. The recommended indicators are: abundance, log abundance, mean length, quantiles of mean length, biomass, per strata and for the whole survey. Interpretation of trends by survey and strata should be used to define the overall trend of greater forkbeard in areas where it is caught.

D. Short-term projection

No short-term forecasts were performed for greater forkbeard in the Northeast Atlantic.

E. Medium-term projections

No medium-term forecasts were performed for greater forkbeard in the Northeast Atlantic.

F. Long-term projections

No long-term forecasts were performed for greater forkbeard in the Northeast Atlantic.

G. Biological reference points

No reference points have been set for stocks of greater forkbeard in the Northeast Atlantic.

H. Other issues

Landings and effort data in XIIb should be included into the assessment if they become reliable. Landings and discards from all areas and fisheries were greater forkbeard occur should be compiled. Because greater forkbeard is a bycatch in shelf and slope fisheries and is subject to discards data on total catch are essential to assess the stock (s).

Greater forkbeard is caught in a number of surveys that are likely to provide reliable trends in either total abundance, recruitment of both. It is recommended that survey data are used to assess stocks trends.

Stock identity knowledge is lacking for greater forkbeard in the Northeast Atlantic.

I. References

Cohen, D.M., T. Inada, T. Iwamoto and N. Scialabba. 1990. FAO species catalogue. Vol. 10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. FAO Fish. Synop. 10 (125). 442 p.

13 Alfonsinos/Golden eye perch (*Beryx* Spp.) in all eco-regions

13.1 The fishery

Alfonsinos, *Beryx splendens* and *Beryx decadactylus*, are generally considered as by-catch species in the demersal trawl and longline mixed fisheries targeting deep-water species. For most of the fisheries, the catches of alfonsinos are reported under a single category, as *Beryx spp*.

The proportions of each species in the catches are not well known. Detailed landings data by species are available only for the Portuguese (Azores) longline fishery in Division Xa, where the landings of *B. decadactylus* averaged 18% of the catches of both species in the last 10 years, and for the Russian trawl fishery that targeted *B. splendens*.

Portuguese, Spanish and French trawlers and longliners are the main fleets involved in this fishery.

From 1988 to 1993 almost only the Azores (Division Xa) was involved on the fishery (representing 94% of the landings). Russian trawlers were responsible for high catches in Area Xb (a seamount fishery on Mid Atlantic Ridge) during 1994 to 2000. Other areas with important catches are VI and VII, with an average contribution of around 15% of the total catch from 1996 onwards and Areas VIII and IX, which catches averaged around 31% of the total from 1996 onward. In all the Areas the catches present a high interannual variability, with a general decreasing trend. The Azores deep-water fishery is a multispecies (up to 20 or more) and multigear fishery dominated by the main target species *Pagellus bogaraveo*. Target species can change seasonally according to abundance and market prices, and landings of *Beryx* represent 5 to 10% of the total deep-water species caught in the region. In the last two years almost the Azores is involved in the fishery.

13.1.1 Landings trends

The available landings data for Alfonsinos, (*Beryx spp*), by ICES Subareas/Divisions as officially reported to ICES or to the Working Group, are presented in Tables 13.1(a–g), 13.2 and 13.3 and Figures 13.1, 13.2 and 13.3. Data presented here are Working Group estimates and may differ from official landings for some countries. In most cases the statistics refer to both species combined (*B. splendens* and *B. decadactylus*). In general, it is not known if the annual variations in landings are as a result of changes in fish abundance, changes in the targeting of the fisheries or to more accurate reporting or monitoring of the landings. Alfonsinos are often a bycatch of demersal fisheries targeting other species. The general trend of the total landings follows the Azorean trend (increase until 1996 and decrease thereafter). Landings increase from 225 t in 1988 to 729 t in 1993 mainly because of the contribution of the Azores. From 1994 to 2000 the total landings fluctuate considerably because of the catches of the Russian trawlers fishery from the Division Xb, with a peak in 1994 (837 t) and 1996 (960 t). In 2001 the total landings become at the same level of 1993 but with a decrease trend from 607 t in 2001 to 370 t in 2009.

Landings reported from Subareas IV–V are very small and most were taken by French and Spanish vessels.

The reported landings from Subareas VI–VII were small and variable until 1995, ranging from 1 to 12 t. In 1996, landings increased to 178 t, taken mainly by longline fisheries in Subarea VII, but decreased in the following years. The higher catch was observed in 2001 (180 t), but decreased in the following years.

In Subareas VIII–IX, the reported landings were very small (1–2 t) and scattered until 1994, but they have increased continuously until 1998 and maintained thereafter around 200 t, mainly because of the Spanish landings, with a drop from 2004 (287 t) to 2009 (60 t). Most of these landings can be regarded as bycatches of the Spanish and Portuguese demersal fisheries in these Subareas. Overall, most of the *Beryx spp*. landings are taken in Subarea X. They are mainly from longliners fishing within the Azorean EEZ and by trawlers fishing north of that area. Landings from the Azores increased steadily from 225 t in 1988 to 644 t in 1994, the highest value in the catch series, then decreased to 175 t in 1999. In the following years they fluctuate around 200 t. Landings of *B. splendens* by Russian trawlers were estimated to be around 3028 t during 1994–2000. From 2000 no catches were reported by Russia for the Subarea X.

Detailed information by species is available only for Divisions Xa and Xb. Both species, *B. splendens* and *B. decadactylus*, present a decreasing trend in Azores landings, which is partly explained by a change in target species in the fishery. The landings series in the period 1988–2009 for both species separately is presented in Table 13.3 and in Figure 13.4. Russian catches consisted of *B. splendens* (100%) during whole fishing period.

13.1.2 ICES Advice

ICES Advice in 2008 was the same as the Advice given in 2006: *As a consequence of their spatial distribution associated with seamounts, their life-history and their aggregation behaviour, alfonsinos are easily overexploited by trawl fishing; they can only sustain low rates of exploitation. Fisheries on such species should not be allowed to expand above current levels unless it can be demonstrated that such expansion is sustainable. To prevent wiping out entire subpopulations that have not yet been mapped and assessed the exploitation of new seamounts should not be allowed*.

13.1.3 Management

Fishing with trawl gears was forbidden in the Azores region (EC. Reg. 1568/2005). A box of 100 miles limiting the deep-water fishing to vessels registered in the Azores was created in 2003 under the management of fishing effort of the common fishery policy for deep-water species (EC. Reg. 1954/2003). An EU TAC of 328 t for EC vessels is in force for 2009–2010 (EC. Reg. 1359/2008).

Technical measures have been introduced on the Azores since 1998. During 2009 new measures were introduced, particularly to control the effort of longliners through restrictions on fishing area, minimum length, gear and effort. A seamount (Condor) was closed to the fishery for two year (2010–2011).

There are NEAFC regulations of efforts in the fisheries for deep-water species and closed areas to protect vulnerable habitats.

13.2 Stock identity

The alfonsinos *Beryx spp*. are deep-water species that occur throughout the world's tropical and temperate waters, in depths from 25 to 1300 meters. The 2004 WGDEEP Report made reference to preliminary genetic results for *B. splendens* suggesting that significant genetic differentiation may occur between populations of the species within the North Atlantic, which may have some implications for future management of the fisheries. No further information is available. Because very little is known about stock structure of these species, the WG has assumed single-stocks of both *B. splendens* and *B. decadactylus* in the North Atlantic. This is contradictory conclusion with above information.

13.3 Data available

13.3.1 Landings and discards

Tables 13.1a–g describe the alfonsinos landings by subarea and country. New information about discards of *Beryx* species was available during the WGDEEP meeting for the Azores longliners (WD Pereira, 2010). About 17 t was discarded annually by this longline fishery during 2008 and 2009.

13.3.2 Length compositions

New length composition in number and weight by year and species was presented to the Group (WD Pereira, 2010). Length compositions are shown in Figures 13.5 and 13.6. No trends are observed in these distributions.

13.3.3 Age compositions

No information about age compositions of *Beryx* species was available during the WGDEEP meeting.

13.3.4 Weight-at-age

No information about weight-at-age of *Beryx* species was available during the WGDEEP meeting.

13.3.5 Maturity, sex-ratio, length–weight and natural mortality

New biological data by species from the Azores, collected under the DCR framework was presented to the Group (WD Pereira, 2010).

Maturity

Monthly macroscopic maturity stages by sex for *Beryx decadactylus* is shown in Figure 13.7. It is observed that for the case of females, individuals in spawning condition (stage IV) were not observed in the sampling and only few individuals were observed in ripe or post spawning conditions. In case of the males also few individuals were observed in spawning or post spawning conditions. This result is also supported by the monthly gonadosomatic index (GSI) (Figure 13.8).

Monthly macroscopic maturity stages by sex for *Beryx splendens* is shown in Figure 13.9.

Individuals in ripe (stage III) and spawning (stage IV) were observed from January to June and also in November, with a peak in February and March. The same was observed for males. The evidence of a reproductive period is also confirmed by the monthly evolution of the gonadosomatic index, where high GSI values was observed from January to May with a peak in February and March (Figure 13.10).

The females maturity ogive was estimated considering as sexually mature the individuals on stages III, IV and V (Figure 1311). From the fitted logistic curve a length of first maturity of 35 cm was estimated.

Sex-ratio

For *Beryx decadactylus* 1766 individuals were sampled, from which 858 were males (48.6%) and 908 where females (51.4%). The overall ratio of males to females (1:1.06) was not significantly different from the 1:1 ratio. However, the sex ratio by size classes shows an increasing proportion of females for sizes over 44 cm. This could indicate a differential in growth or in the natural mortality between sexes, since even for the smaller sizes, signs of hermaphroditism were not observed. The observed proportions by sex of the golden eye perch, by size classes, are presented in Figure 13.12.

For *Beryx splendens* 1698 individuals were sampled, from which 693 were males (41%) and 1005 were females (59%). The overall ratio of males to females (1:1.44) was significantly different from the 1:1 ratio. Sex-ratio by length shows an increasing proportion of females for sizes over 31 cm and few males were observed for sizes over 40 cm of fork length. This could indicate a differential in growth or in the natural mortality between sexes, since even for the smaller sizes, signs of hermaphroditism have not been observed. The sex ratio *Beryx splendens*, by size classes, is presented in Figure 13.13.

Length–weight

Length–weight relationship by sex and species was estimated (Table 13.4 and Figures 13.14 and 13.15).

13.3.6 Catch, effort and research vessel data

New data on nominal cpue for *Beryx splendens* and *Beryx decadactylus* species from commercial longline fisheries in the Azores was presented to the Group (WD Pereira and Pinho, 2010) (Figures 13.16a and b). Trends in this time-series shows interanual variability for *Beryx splendens* around a mean value of 10 kg per thousand hooks. For *Beryx decadactylus* cpue increase until 1996 and decrease suddenly in 1997 maintaining thereafter at low levels. Cautions should be taken on the interpretation of these trends since the nominal cpue may not be an accurate proxy of the abundance due to the targeting effects, among others, under the multispecies context of the fishery.

Survey data was not updated because there was no survey. However, abundance indices from the Azorean longline survey, until 2008, are presented for the golden eye perch (*Beryx decadactylus*) (Figure 13.17) and the alfonsinos (*Beryx splendens*) (Figure 13.18).

Survey abundance indices for the *Beryx splendens* shows a decrease pattern, similar to the one observed on the landings (Figure 13.18). However for *Beryx decadactylus* very high annual variability is observed. Again, caution in the interpretation of these indices is important since the survey is not design for these species which distribution is significantly broader than the survey area and so they may not be representative of abundance.

13.4 Data analyses

13.4.1 *Beryx decadactylus*

No data analyses were carried out this year.

13.4.2 *Beryx splendens*

No data analyses were carried out this year.

13.5 Comments on the assessment

No assessment was carried out this year.

13.6 Management considerations

As a consequence of their spatial distribution associated with seamounts, their life-history and their aggregation behaviour, alfonsinos are easily overexploited by trawl fishing; they can only sustain low rates of exploitation. Fisheries on such species should not be allowed to expand above current levels unless it can be demonstrated that such expansion is sustainable. To prevent wiping out entire subpopulations that have not yet been mapped and assessed the exploitation of new seamounts should not be allowed.

Table 13.1a. Landings (tonnes) of *Beryx* spp. IV.

YEAR	FRANCE	TOTAL
1988	0	0
1989	0	0
1990	1	1
1991	0	0
1992	2	2
1993	0	0
1994	0	0
1995	0	0
1996	0	0
1997	0	0
1998	0	0
1999	0	0
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009*	0	0

***Preliminary.**

Table 13.1.b. Alfonsinos (*Beryx* spp.) Vb.

Year	Faroes	France	TOTAL
1988			0
1989			0
1990		5	5
1991		0	0
1992		4	4
1993		0	0
1994		0	0
1995	1	0	1
1996	0	0	0
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	0	0
2001	0	0	0
2002	0	0	0
2003	0	0	0
2004	0	0	0
2005	0	0	0
2006	0	0	0
2007	0	0	0
2008	0	0	0
2009*	0	0	0

***Preliminary.**

Table 13.1.c. Alfonsinos (*Beryx* spp.) VI and VII.

	FRANCE	E & W	SPAIN	IRELAND	SCOTLAND	TOTAL
1988						0
1989	12					12
1990	8					8
1991						0
1992	3					3
1993	0		1			1
1994	0		5			5
1995	0		3			3
1996	0		178			178
1997	17	4	5			26
1998	10	0	71			81
1999	55	0	20			75
2000	31	2	100			133
2001	51	13	116			180
2002	35	15	45			95
2003	20	5	55	4		84
2004	15	3	46			64
2005	15	0	55	0		70
2006	27	0	51	0		78
2007	17	1	47	0		65
2008	18	0	32	0		22
2009*	0	0	0	0	1	1

***Preliminary.**

Table 13.1.d. Alfonsinos (*Beryx* spp.) VIII and IX.

Year	France	Portugal	Spain	E & W	TOTAL
1988					0
1989					0
1990	1				1
1991					0
1992	1				1
1993	0				0
1994	0		2		2
1995	0	75	7		82
1996	0	43	45		88
1997	69	35	31		135
1998	1	9	258		268
1999	11	29	161		201
2000	7	40	117	4	168
2001	6	43	179	0	228
2002	13	60	151	14	238
2003	10	0	95	0	110
2004	21	53	209	0	287
2005	9	45	141	0	196
2006	9	20	64	3	97
2007	8	45	67	0	120
2008	5	42	54	0	58
2009*	0	42	18	0	60

*** Preliminary.**

Table 13.1.e. Alfonsinos (*Beryx* spp.) X.

	XA	XB				
YEAR	PORTUGAL	FAROES	NORWAY	RUSSIA**	E & W	TOTAL
1988	225					225
1989	260					260
1990	338					338
1991	371					371
1992	450					450
1993	533		195			728
1994	644		0	837		1481
1995	529	0	0	200		729
1996	550	0	0	960		1510
1997	379	5	0			384
1998	229	0	0			229
1999	175	0	0	550		725
2000	203	0	0	266	15	484
2001	199	0	0		0	199
2002	243	0	0		0	243
2003	172	0	0		0	172
2004	139	0	0		0	139
2005	157	0	0		0	157
2006	192	0	0		0	192
2007	211	0	0		0	211
2008*	250	2	0	0	0	252
2009*	311	1	0	0	0	31

*** Preliminary.**

**** Not official data from ICES Area Xb.**

Table 13.1.f. Alfonsinos (*Beryx* spp.) XII.

YEAR	FAROES	TOTAL
1988		
1989		
1990		
1991		
1992		
1993		
1994		
1995	2	2
1996	0	0
1997	0	0
1998	0	0
1999	0	0
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009*	0	0

*** Preliminary.**

Table 13.1.g. Alfonsinos (*Beryx* spp.) in Madeira (Portugal).

Year	Portugal	TOTAL
1988		0
1989		0
1990		0
1991		0
1992		0
1993		0
1994		0
1995	1	1
1996	11	11
1997	4	4
1998	3	3
1999	2	2
2000		
2001		
2002		
2003		
2004		
2005		
2006		
2007		
2008		
2009*		

*** Preliminary.**

Table 13.2. Reported landings for the Alfonsinos, (*Beryx* spp), by ICES Subareas/Divisions.

Year	IV	Vb	VI+VII	VIII+IX	Xa	Xb	XII	TOTAL
1988			0	0	225	0		225
1989			12	0	260	0		272
1990	1	5	8	1	338	0		353
1991			0	0	371	0		371
1992	2	4	3	1	450	0		460
1993			1	0	533	195		729
1994			5	2	644	837		1488
1995		1	3	82	529	200	2	817
1996			178	88	550	960		1776
1997			26	135	379	5		544
1998			81	268	229	0		579
1999			75	201	175	550		1001
2000			133	168	203	281		784
2001			180	228	199	0		614
2002			95	238	243	0		574
2003			84	110	172	0		363
2004			64	287	139	0		481
2005			70	196	157	0		418
2006			78	97	192	0		402
2007			65	120	211	0		317
2008	0	0	22	58	250	2		332
2009*			1	60	311	1		373

***Preliminary.**

Table 13.3. Reported landings of *Beryx splendens* and *B. decadactylus* in Azores (ICES Division Xa).

YEAR	B. SPLENDENS	B. DECADACTYLUS	TOTAL
1988	122	103	225
1989	113	147	260
1990	137	201	338
1991	203	168	371
1992	274	176	450
1993	316	217	533
1994	410	234	644
1995	335	194	529
1996	379	171	550
1997	268	111	379
1998	161	68	229
1999	119	56	175
2000	168	35	203
2001	182	17	199
2002	223	20	243
2003	150	22	172
2004	110	29	139
2005	134	23	157
2006	152	40	192
2007	165	46	211
2008	187	63	250
2009	243	68	311

Table 13.4. Parameters of the length–weight relationship for *Beryx splendens* and *Beryx decadactylus* from the Azores (ICES, Xa2).

BERYX SPLENDENS			
	All sexes	Males	Females
n	1778	697	1009
a	0.01751	0.01699	0.01749
b	3.07989	3.08976	3.0794
r2	0.985	0.982	0.986
FL range	14.5–47.5 cm	14.5–47.5 cm	16.5–45.0 cm

BERYX DECADACTYLUS			
	All sexes	Males	Females
n	1711	823	873
a	0.02174	0.0217	0.02152
b	3.0788	3.03842	3.04073
r2	0.994	0.993	0.994
FL range	20.0–55.0 cm	20.0–55.0 cm	21.0–54.0 cm

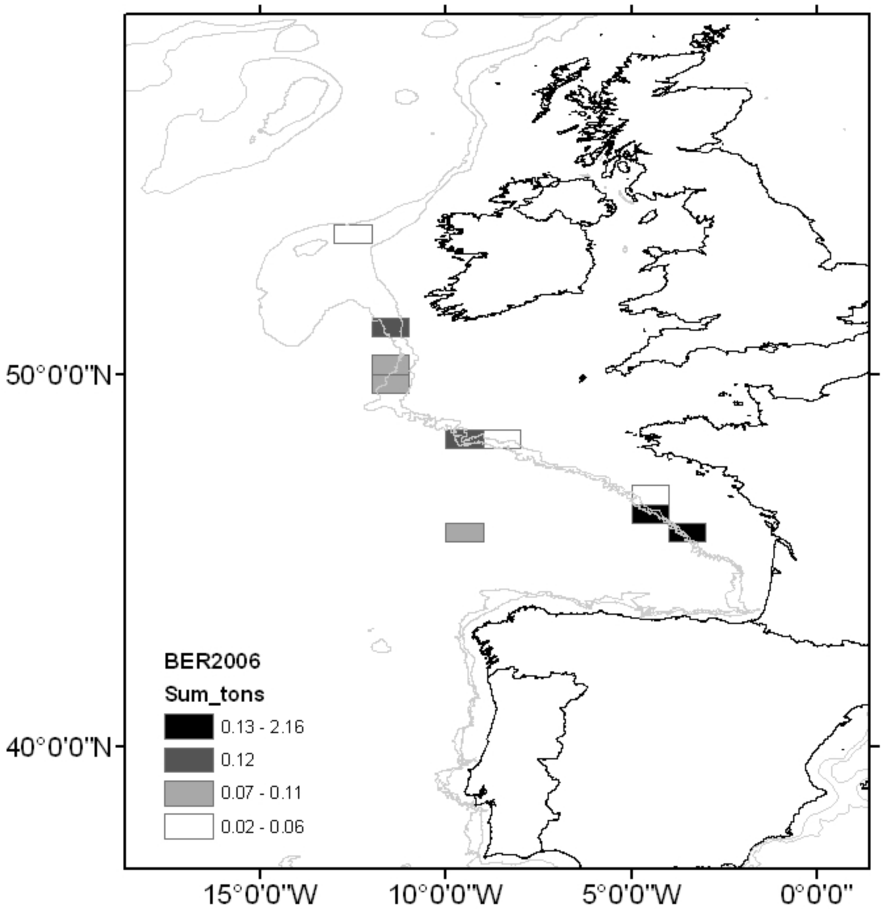


Figure 13.1. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2006.

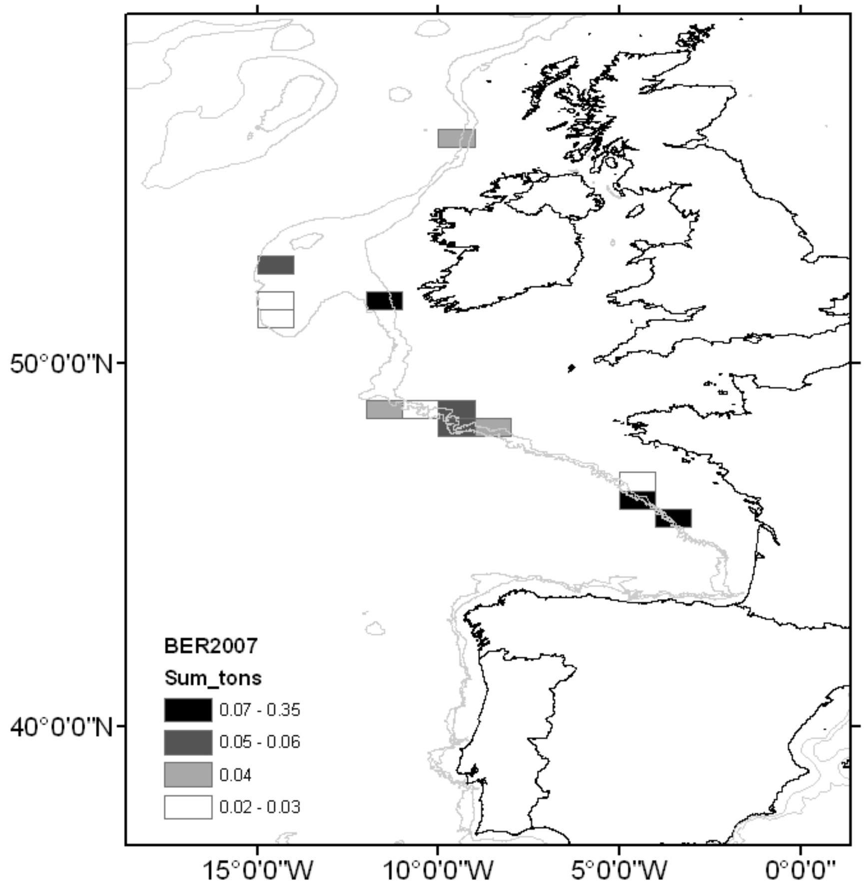


Figure 13.2. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2007.

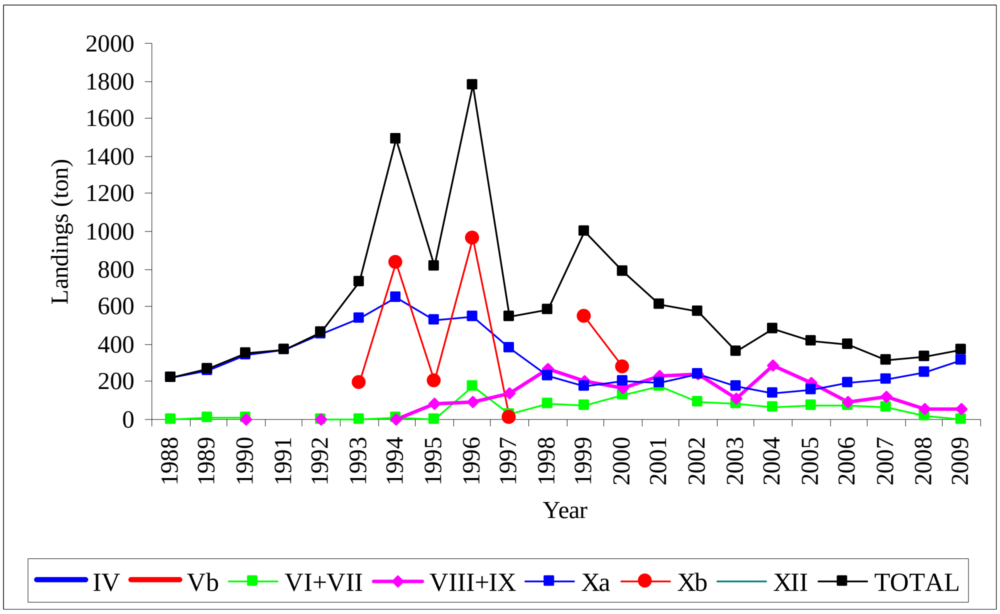


Figure 13.3. Reported landings for the alfonsinos, (*Beryx* spp), by ICES Subareas/Divisions.

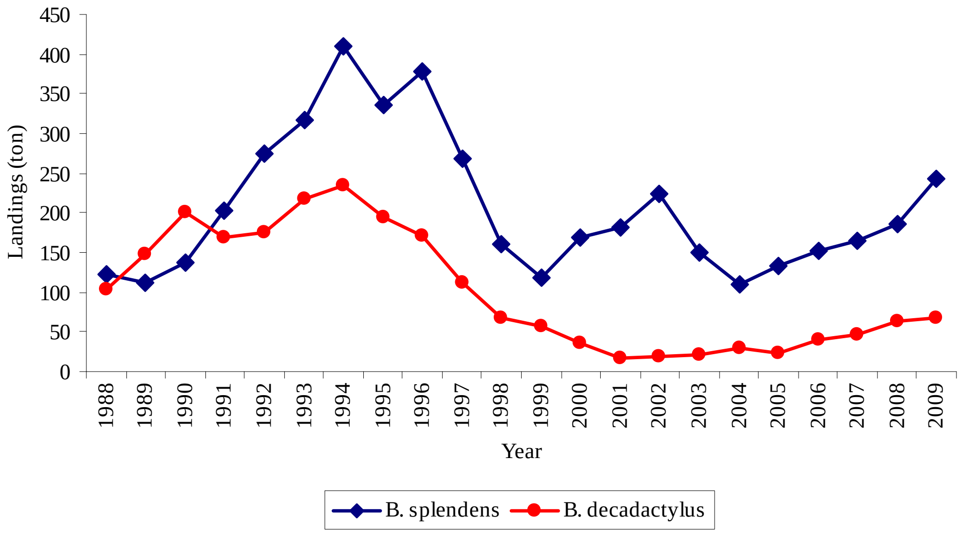


Figure 13.4. Landings of *Beryx splendens* and *B. decadactylus* in Azores (ICES Subarea X).

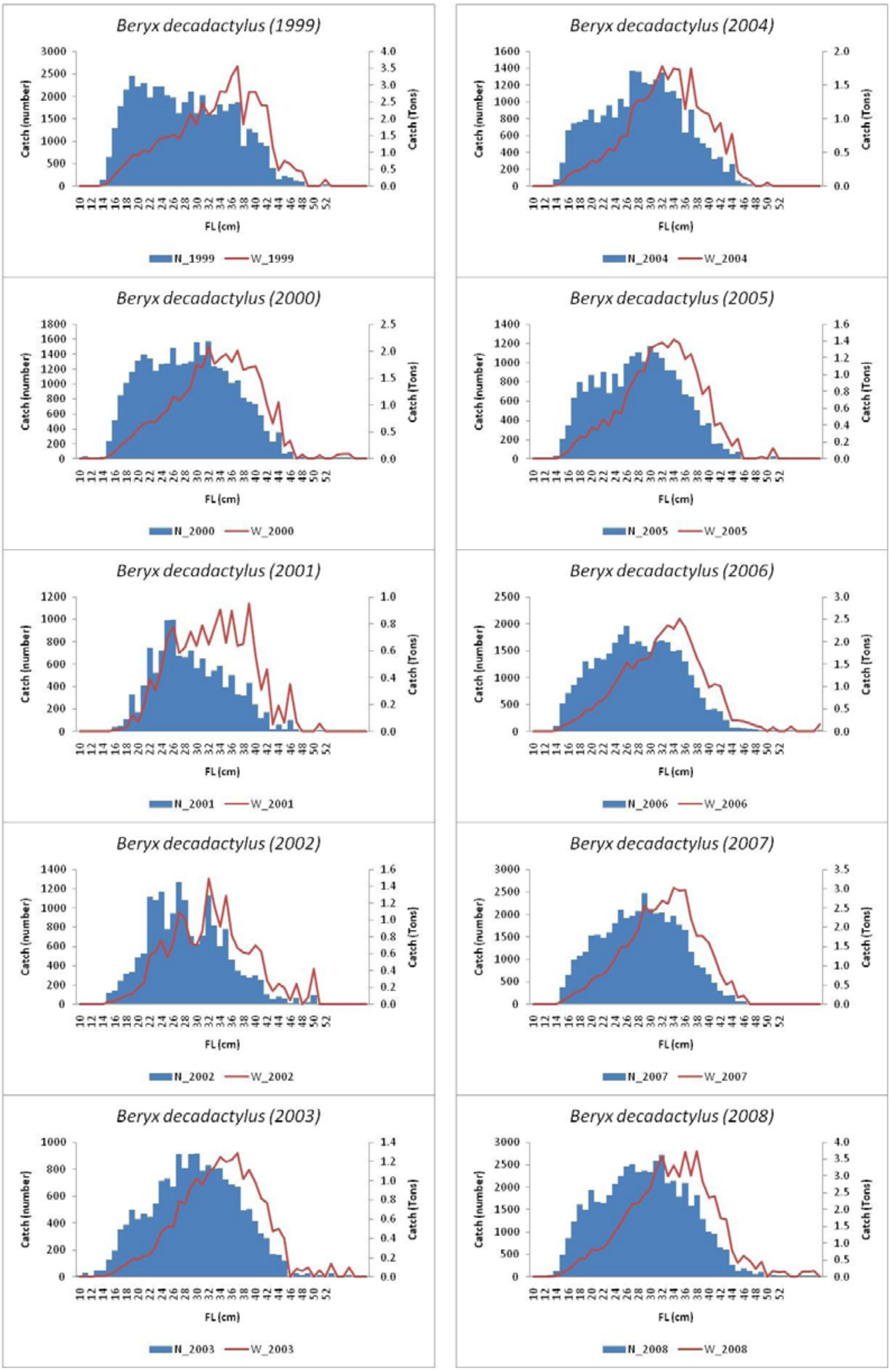


Figure 13.5. *Beryx decadactylus* fishery length compositions, in number and weight, by year from the Azorean fishery in the ICES Xa2.

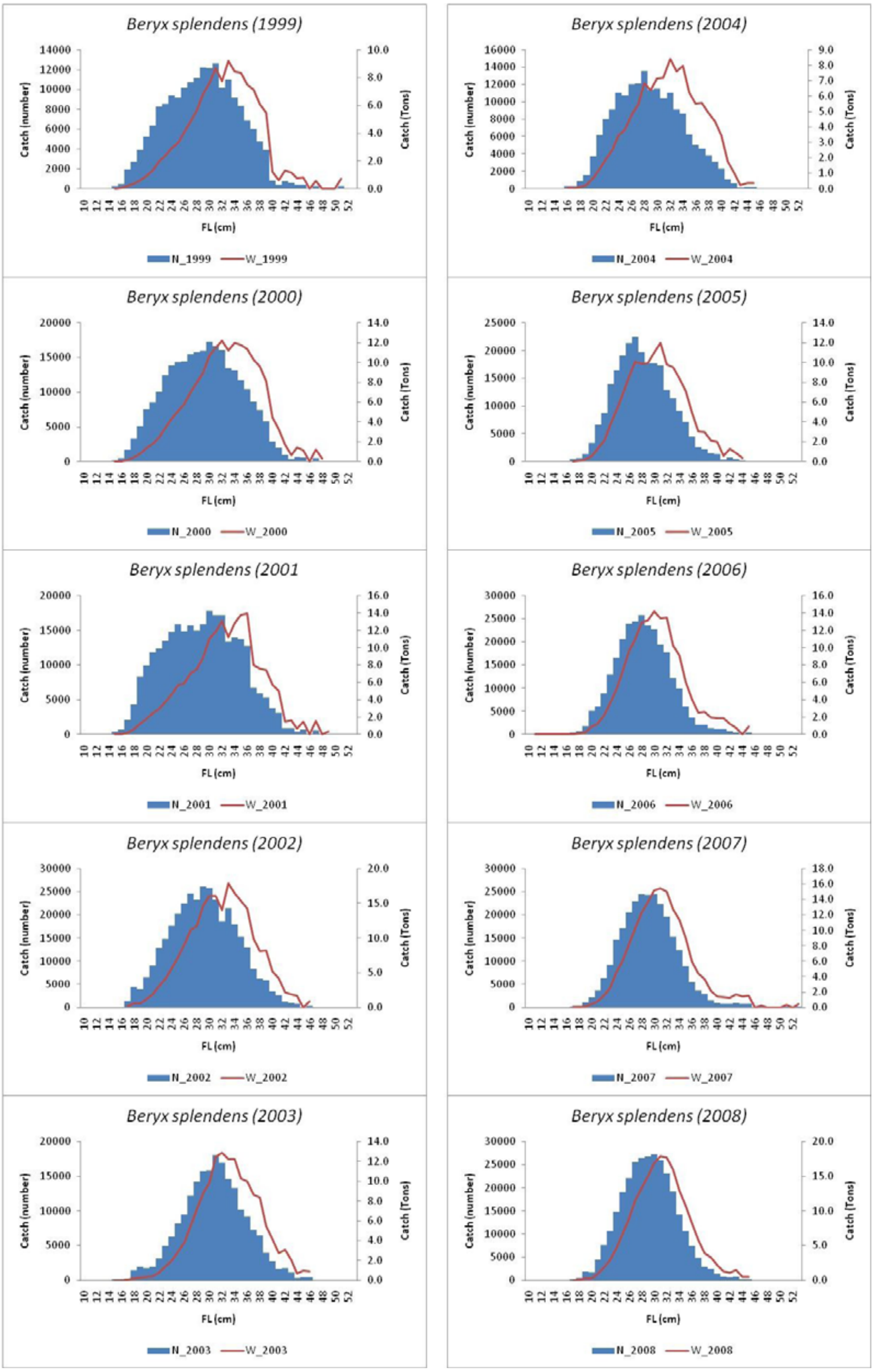


Figure 13.6. ***Beryx splendens*** **fishery length compositions, in number and weight, by year from the Azorean fishery in the ICES Xa2.**

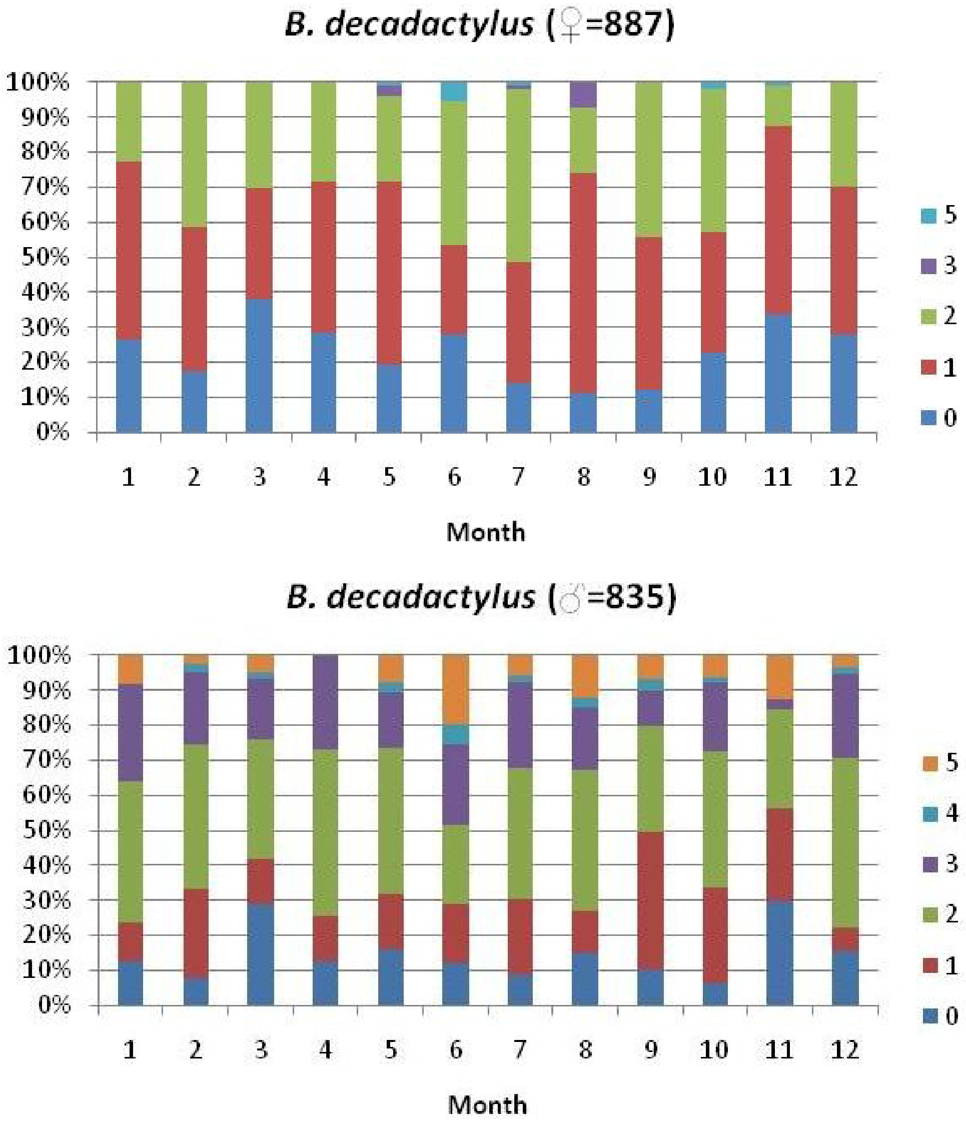


Figure 13.7. Monthly changes in the frequency of occurrence of the various maturity stages of the gonads of male and female of golden eye perch (*Beryx decadactylus*) in Azores (ICES Xa2).

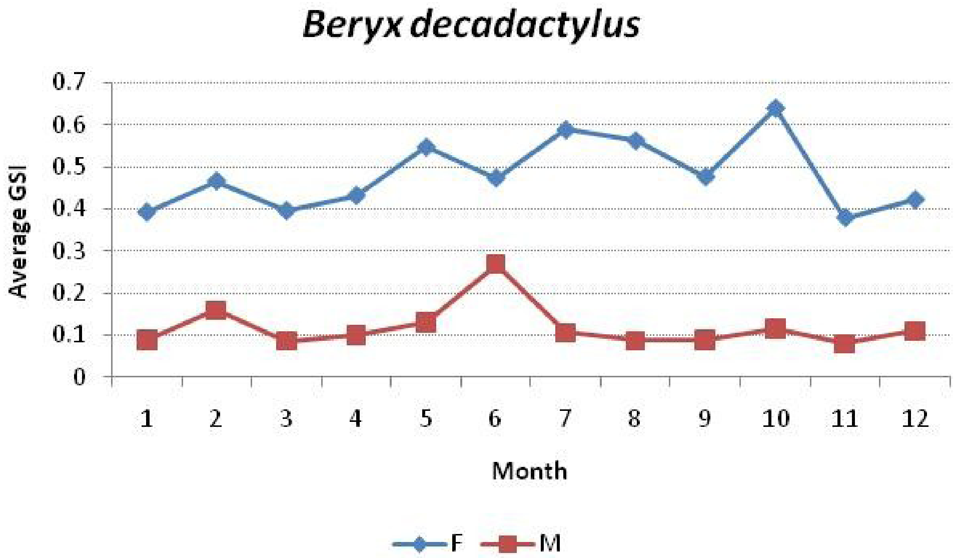
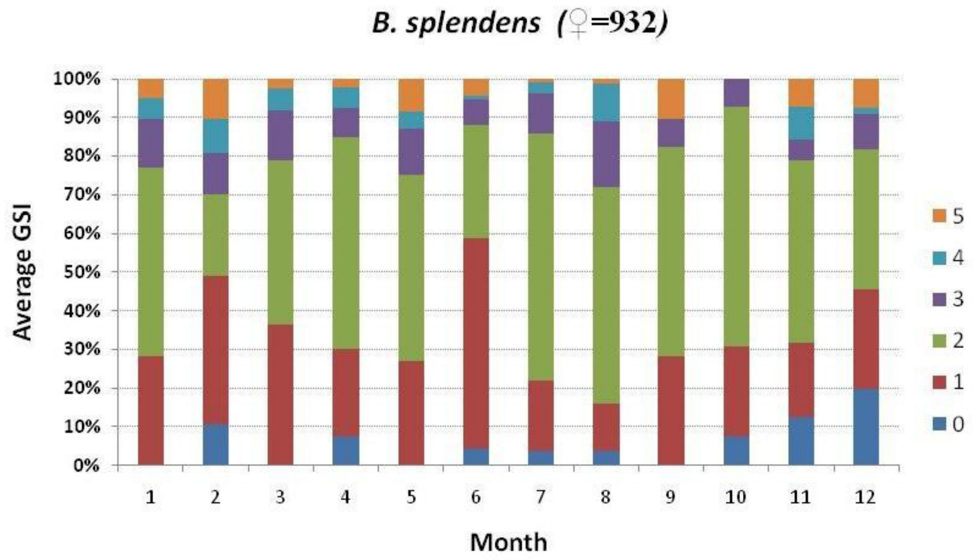


Figure 13.8. Monthly evolution by sex of the average gonadosomatic index (GSI) for Golden eye perch (*Beryx decadactylus*) from the Azores (ICES, Xa2).



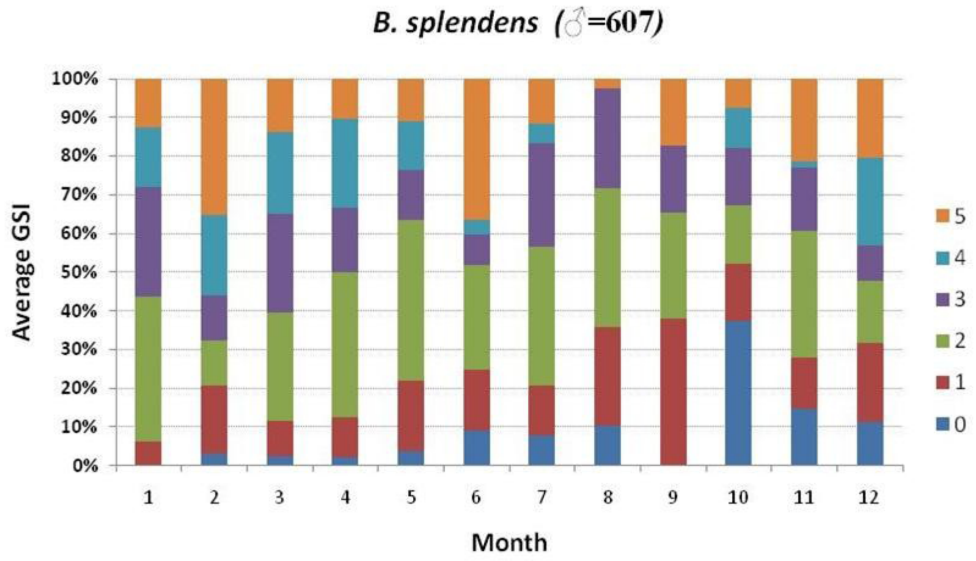


Figure 13.9. Monthly changes in the frequency of occurrence of the various maturity stages of the gonads of male and female of golden eye perch (*Beryx splendens*) in Azores (ICES Xa2).

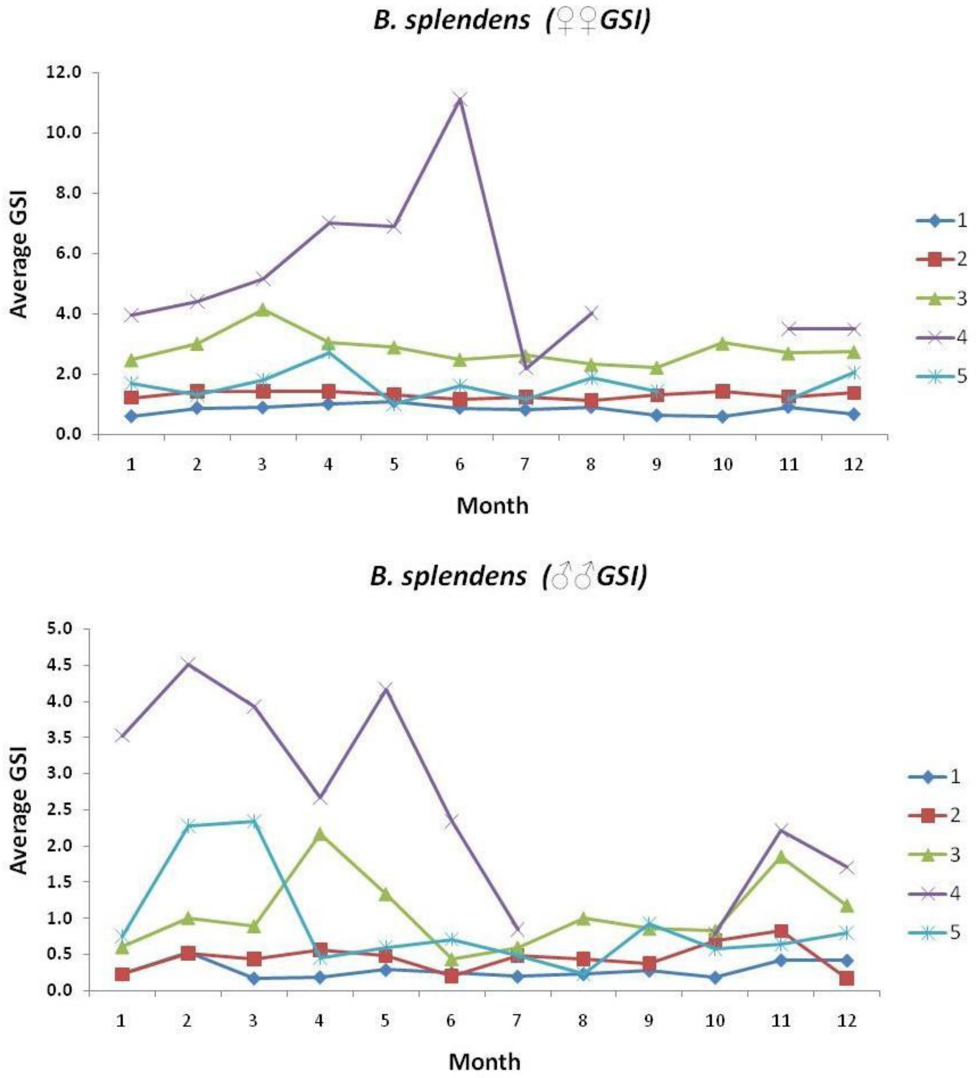


Figure 13.10. Monthly evolution by sex of the mean gonadosomatic index (GSI) for the Alfonsino (*Beryx splendens*) from the Azores.

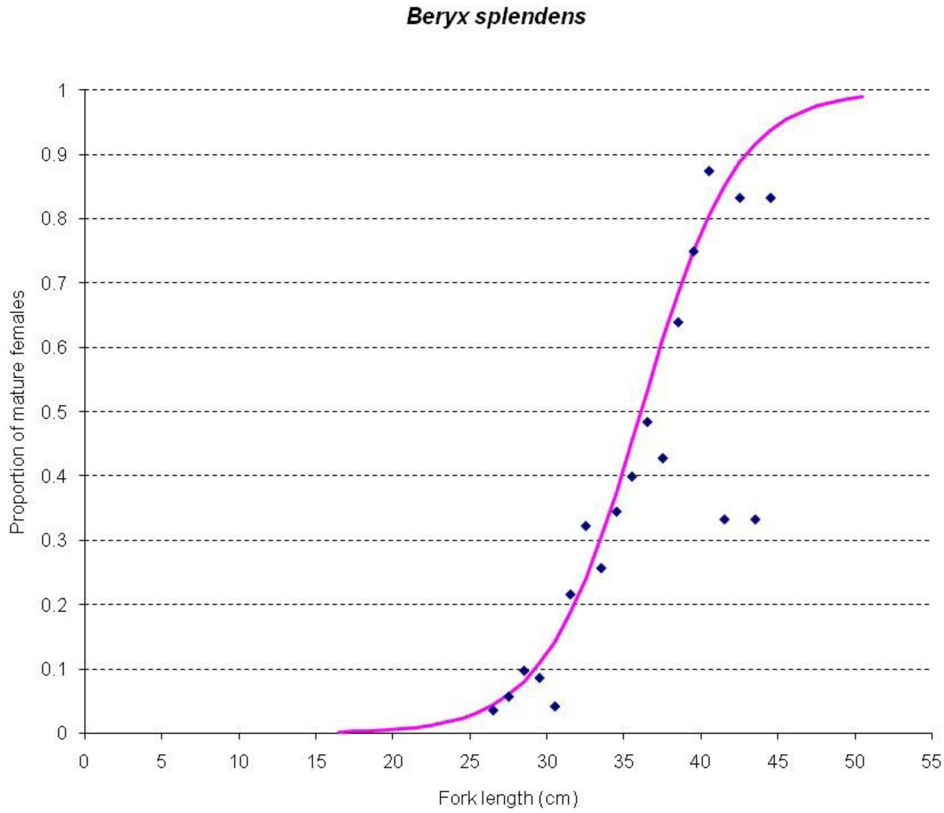


Figure 13.11. Maturity ogive for Beryx splendens from the Azores (ICES, Xa2).

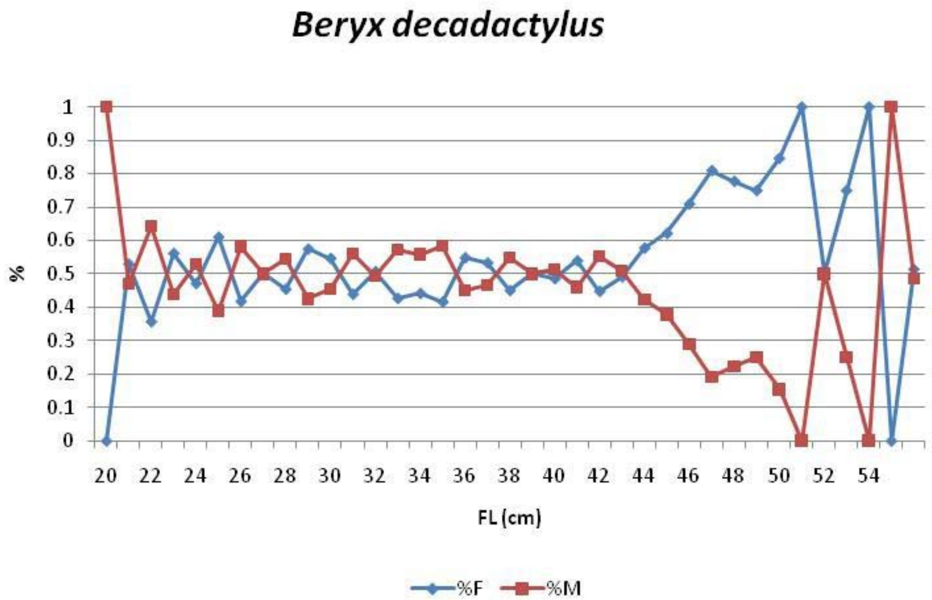


Figure 13.12. Sex ratio of the Golden eye perch (*Beryx decadactylus*) from the Azores (ICES, Xa2).

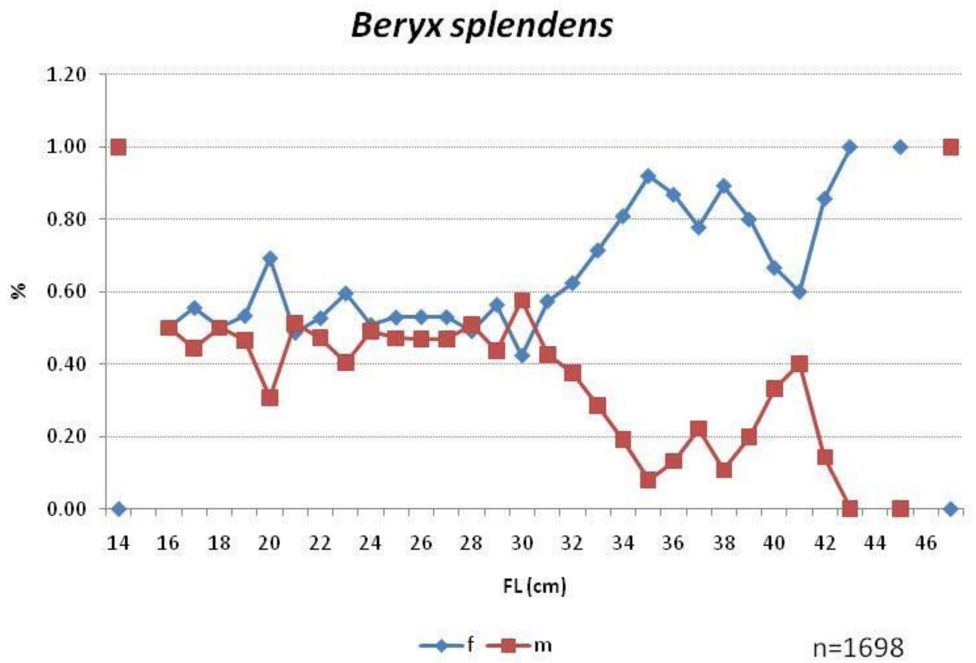


Figure 13.13. Sex ratio of *Beryx splendens* in the Azores (ICES Xa2).

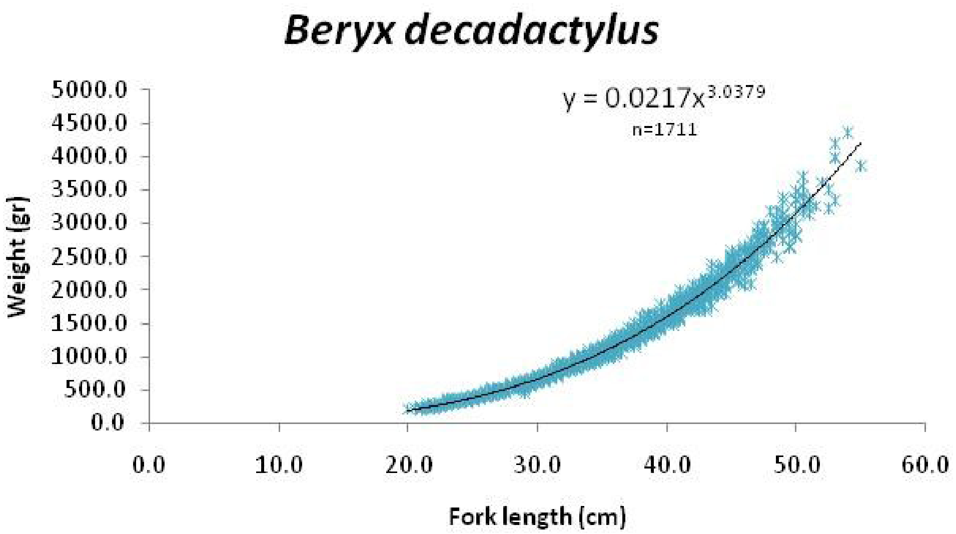


Figure 13.14. Length–weight relationship for the Golden eye perch (*Beryx decadactylus*) from the Azores (Xa2).

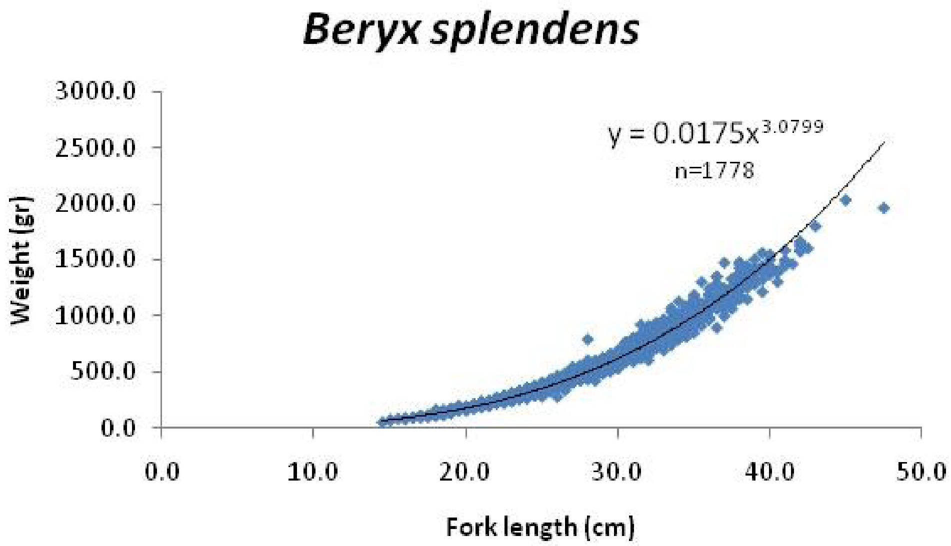


Figure 13.15. Length–weight relationship for the Alfonsino *(Beryx splendens*), sexes combined, from the Azores (Xa2).

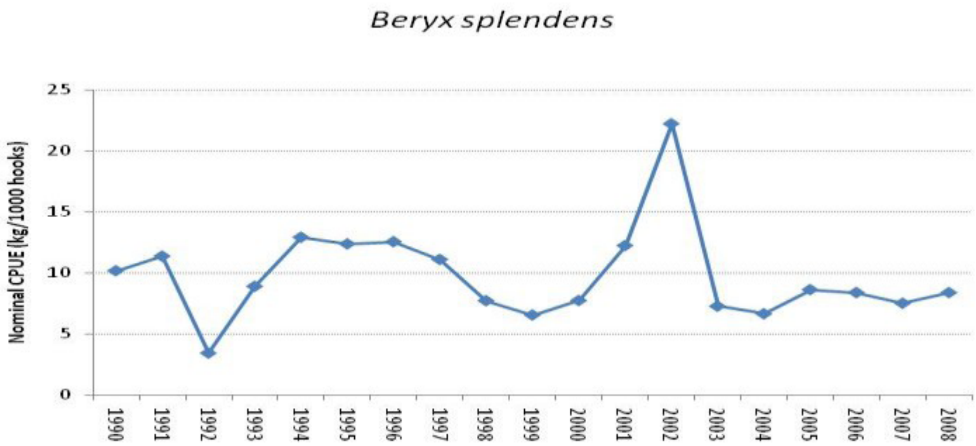


Figure 13.16a. Nominal cpue for *Beryx splendens* from the Azores longline fishery (ICES, Xa2).

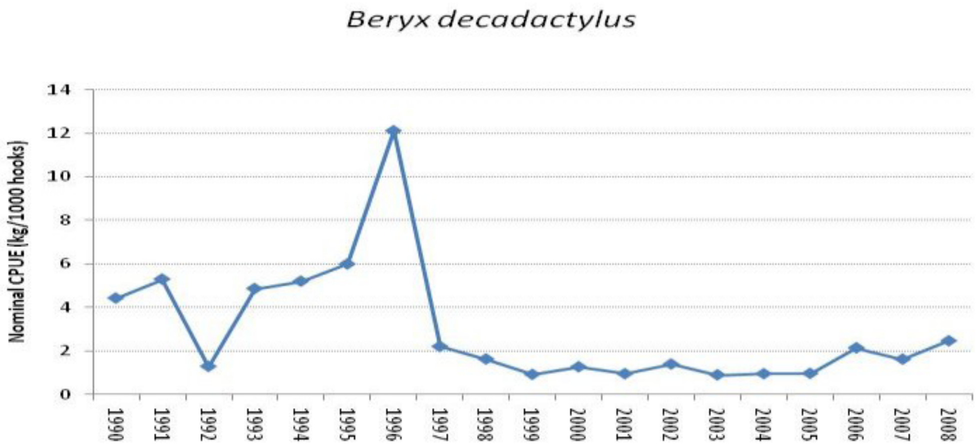


Figure 13.16b. Nominal cpue for *Beryx decadactylus* from the Azores longline fishery (ICES, Xa2).

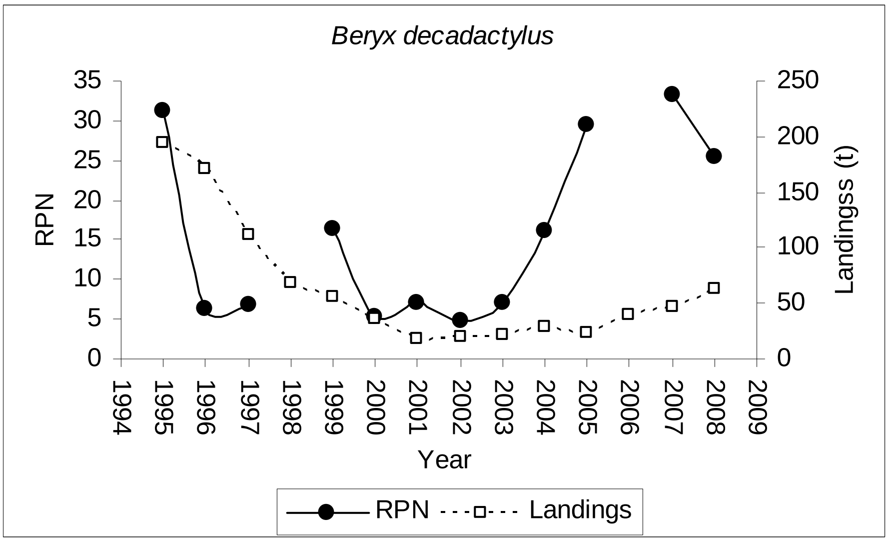


Figure 13.17. Annual bottom longline survey abundance index in number "Relative Population Number" (RPN) available for the golden eye perch (*B. decadactylus*) from the Azorean deep-water species surveys (ICES Subarea X). Annual landing are also presented in the graph for trend illustration.

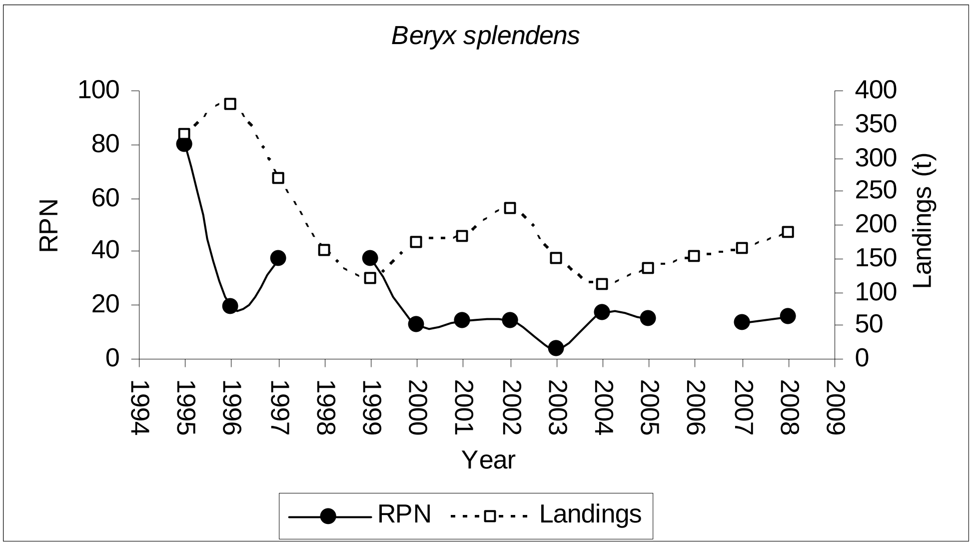


Figure 13.18. Annual bottom longline survey abundance index in number "Relative Population Number" (RPN) available for the Alfonsinos (*Beryx splendens*) from the Azorean deep-water species surveys (ICES Subarea X). Annual landing are also presented in the graph for trend illustration.

14 Red (black spot) seabream (*Pagellus bogaraveo*)

14.1 Current ICES stock structure

ICES considered three different components for this species: a) Areas VI, VII, and VIII; b) Area IX, and c) Area X (Azores region), (ICES, 1996; 1998a). This separation does not pre-suppose that there are three different stocks of red (blackspot) seabream, but it offers a better way of recording the available information.

The inter-relationships of the (blackspot) seabream from Areas VI, VII, and VIII, and the northern part of Area IXa, and their migratory movements within these areas have been observed by tagging methods (Gueguen, 1974). However, there is no evidence of movement to the southern part of IXa where the main fishery currently occurs.

Recent studies show that there are no genetic differences between populations from different ecosystems within the Azores region (East, Central and West group of Islands, and Princesa Alice bank) but there are genetic differences between Azores (ICES Area Xa2) and mainland Portugal (ICES Area IXa) (Stockley *et al*., 2005). These results, combined with the known distribution of the species by depth, suggest that Area X component of this stock can effectively be considered as a separate assessment unit.

Available information, particularly genetics and tagging, seems to support the current assumption of three assessment units (VI–VIII, IX and X).

Catches data for red sea bream since 2004 aggregated at the level of statistical rectangle were provided to the Working Group by Basque Country (Spain). This is shown in Figure 14.1.1.

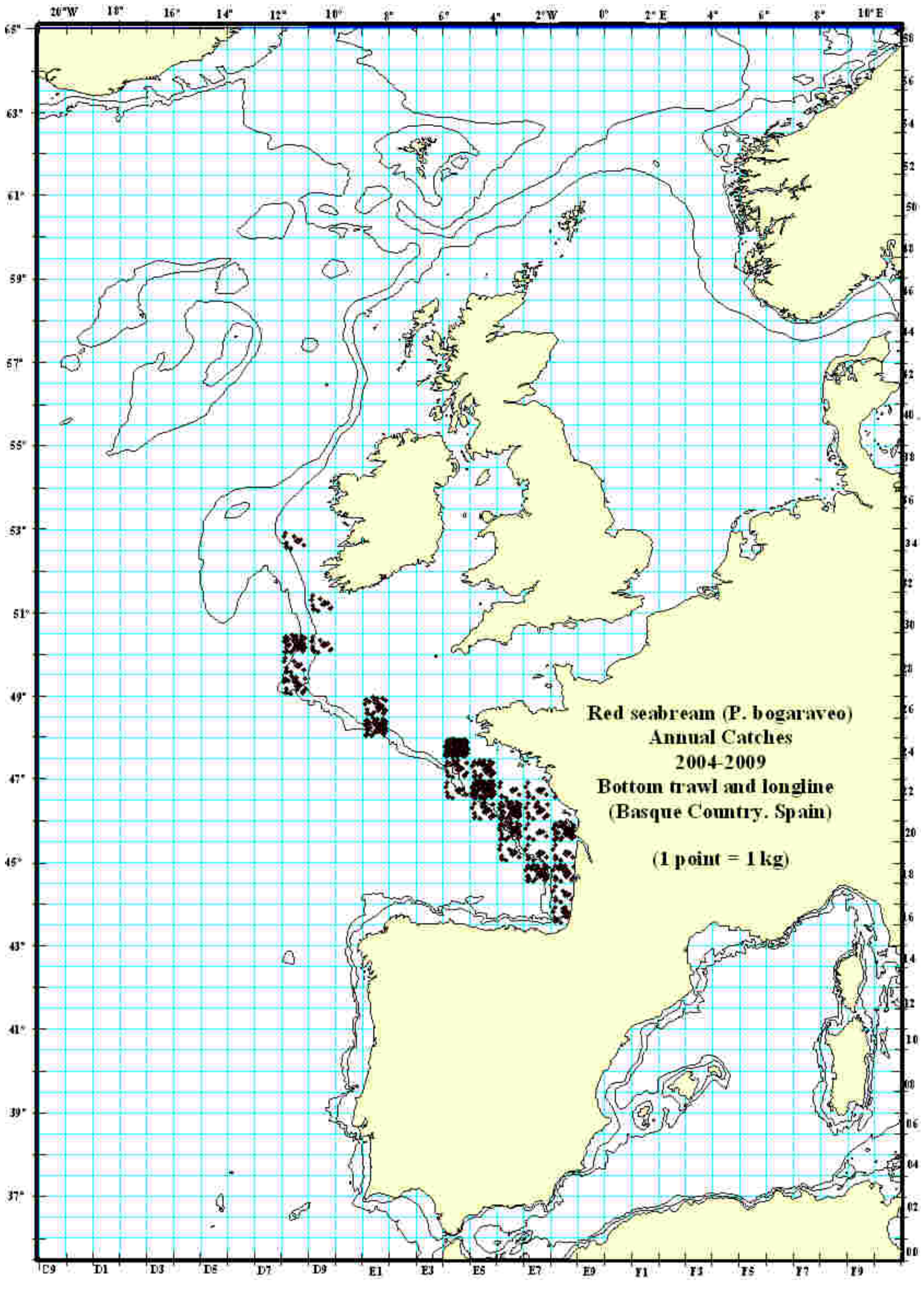


Figure 14.1.1. Catches by statistical rectangle of Red seabream by Basque Country (Spain) in the period from 2004 to 2009.

14.2 Red Seabream (*Pagellus Bogaraveo*) in Subareas VI, VII & VIII

14.2.1 The fishery

This Section includes a description of the *Pagellus bogaraveo* in Subareas VI, VII, VIII by the Spanish, French, and UK fleets.

They are no important changes in this fishery since last report of WGDEEP. The fishery in Subareas VI, VII and VIII strongly declined in the mid-1970s, and the stock is seriously depleted. Since 1988 the landings from Subarea VIII represents the 62% and

VI and VII the 28% of total accumulated landings. At present the Spanish red seabream catches in this area, are almost all bycatches of longliner fleet and trawlers but there is also some landings from "other" unidentified fleets.

14.2.1.1 Landings trends

Landings data for red (blackspot) seabream, *Pagellus bogaraveo*, by ICES Subareas/Divisions as reported to ICES or to the Working Group are shown in Table 14.2.1. For this three subareas combined landings fell from more than 461 t in 1989 to 52 t in 1996, then they increased until 2000 (237 t), and from 2001 to 2009 a continous decrease is observed except in 2007 in which the highest value since 1990 is reached (322 t). In the period considered (1988–2009), most of the estimated landings from the Subareas VI, VII and VIII were taken by Spain (65%), followed by France (17%), UK (15%) and Ireland (2%).

A Spanish, French and UK extended landing series in North East Atlantic have been improved from two sources, one of this from a table performed for P. Lucio in WGDEEP 2004 (S1) and the other from a compilation of statistic bulletins (S2). Some of the high historical catches could be included other species of *Pagellus* and/or other *Sparidae*, i.e. "seabream", as some landings could be also misreported. Figure 14.2.1 tries to shows by means of these two sources the differences in the historical interpretation of the landings of red sea bream in Subareas VI, VII and VIII. Although the landings estimated by both sources since sixties onwards are very different, .the trend of both sources coincides in that period, giving a clear perspective of the important decline of this fishery in North East Atlantic in last 30 years.

In relation to this they are no information about French landings in most of the years between 1950 and 1975, and the great peaks observed in 1950, 1960, 1965, 1970 and 1975 just coincide with the only French reports in this period.

In any case, and taking into account the constraints of data collected (especially in the first decade) it's very clear the important and fast decline of the fishery since 1977 onwards. Looking at in last 30 years no landings higher than 1000 t are recorded after 1986 and in last 10 years the annual catches have been almost always below of 300 t.

14.2.1.2 ICES Advice

In 2008, ICES advised; *Red seabream can only sustain low rates of exploitation. Fisheries on such species should be permitted only when they are accompanied by programmes to collect data and should expand very slowly until reliable assessments indicate that increased harvests are sustainable*.

14.2.1.3 Management

The TAC for the Subareas VI, VII and VIII was reduced from 253 t in 2009 to 215 t in 2010. In the following Table a summary of red sea bream international TACs for the period 2009–2010 and the landings for 2008–2009 is shown. These landings are bycatches becasuse no directed fishing is allowed. There is a minimum landing size of 35 cm (total length).

PAGELLUS BOGARAVEO	LANDINGS		TAC	TAC
Subarea	2008	2009	2009	2010
VI, VII, VIII	159	74	253	215

14.2.2 Data available

14.2.2.1 Landings and discards

Historical series of landings data available to the Working Group have been described in text and tables of Section 14.2.1. The information of observers in the Basque country fleet in Subareas VI, VII and VIII indicates that there was no discard for this species in the period 2003–2009.

14.2.2.2 Length compositions

No length data were available to the Working Group.

14.2.2.3 Age compositions

No age data were available to the Working Group.

14.2.2.4 Weight-at-age

No weight-at-age data were available to the Working Group.

14.2.2.5 Maturity and natural mortality

No maturity and natural mortality-at-age data were available to the Working Group.

14.2.2.6 Catch, effort and research vessel data

No catch, effort and research vessel data were available to the Working Group. It is known that catches in two French surveys in 1973 and 1976, conducted with the same protocols as the current western IBTS survey in the Bay of Biscay, red sea bream was caught in significant numbers. In the current Western IBTS time-series, only a few individuals (zero in some years) are caught which reflects that the stock remains at very low levels compared to historical abundance.

14.2.3 Data analyses

No data analysis was carried out by the Working Group.

14.2.4 Management considerations

Its peculiar reproductive biology makes red seabream especially vulnerable by a fishery concentrated in the spawning season and focused on the bigger fish that are mainly females.

The stock declined in the 1970s but no management was introduced until 2003.

Even though in the early 2000s a small directed fishery to *P. bogaraveo* has been developed in France most of the catches in Subareas VI, VII and VIII must be considered as occasional bycatches of the fleets, mainly longliners, targeting other demersal species. The data reported to the Group indicate that since the middle of 1980s the landings have been reduced dramatically. The TAC proposed for 2009 and 2010 in the Subareas VI, VII, VIII, was reduced to 253 t and 215 t respectively. In relation to that it's noticeable that the landings exceeded the TAC in 2007, but not in 2008.

In agreement with the ICES Advice saying that Red seabream in these Subareas appears to be severely depleted based on historical catches, fisheries on such species should be permitted only when they are accompanied by programmes to collect data, the WG considers that studies focused to define juvenile aggregation areas must be carried out. In the 1920s and 1930s, it was reported that juveniles were widely distributed on the coasts of Brittany and in the Western Chanel French and UK coasts.

The definition of such areas is a necessary step to establish in the future red seabream juvenile protection areas in Northeast Atlantic waters.

Table 14.2.1a. Red seabream in Subareas VI and VII; WG estimates of landings by country.

YEAR	FRANCE*	IRELAND	SPAIN	UK (E & W)	CH. ISLANDS	TOTAL
1988	52	0	47	153	0	252
1989	44	0	69	76	0	189
1990	22	3	73	36	0	134
1991	13	10	30	56	14	123
1992	6	16	18	0	0	40
1993	5	7	10	0	0	22
1994	0	0	9	0	1	10
1995	0	6	5	0	0	11
1996	0	4	24	1	0	29
1997	0	20	0	36		56
1998	0	4	7	6		17
1999	2	8	0	15		25
2000	4	n.a.	3	13		20
2001	2	11	2	37		52
2002	4	0	9	13		25
2003	13	0	7	20		40
2004	33		4	18		55
2005	29		4	7		41
2006	36	0	8	19		63
2007	46	0	27	57		130
2008	39	0	2	22		63
2009	6	1	0	10		17

Table 14.2.1b. Red seabream in Subarea VIII; WG estimates of landings by country.

YEAR	FRANCE*	SPAIN	ENGLAND [(1)]	TOTAL
1988	37	91	9	137
1989	31	234	7	272
1990	15	280	17	312
1991	10	124	0	134
1992	5	119	0	124
1993	3	172	0	175
1994	0	131	0	131
1995	0	110	0	110
1996	0	23	0	23
1997	18	7	0	25
1998	18	86	0	104
1999	13	84	0	97
2000	11	189	0	200
2001	8	168	0	176
2002	10	111	0	121
2003	6	83	0	89
2004	37	82	8	128
2005	28	90	0	118
2006	20	57	0	77
2007	44	149	1	193
2008	55	40	0	95
2009	28	28	0	56

[(1)] In 2005 England and Wales.

Table 14.2.1c. Red seabream in Subareas VI, VII and VIII; WG estimates of landings by subarea.

YEAR	VI AND VII*	VIII*	TOTAL
1988	252	137	389
1989	189	272	461
1990	134	312	446
1991	123	134	257
1992	40	124	164
1993	22	175	197
1994	10	131	141
1995	11	110	121
1996	29	23	52
1997	56	25	81
1998	17	104	121
1999	25	97	122
2000	20	200	220
2001	52	176	227
2002	25	121	147
2003	40	89	129
2004	55	128	183
2005	41	118	158
2006	63	77	139
2007	130	193	324
2008	63	95	159
2009	17	56	74

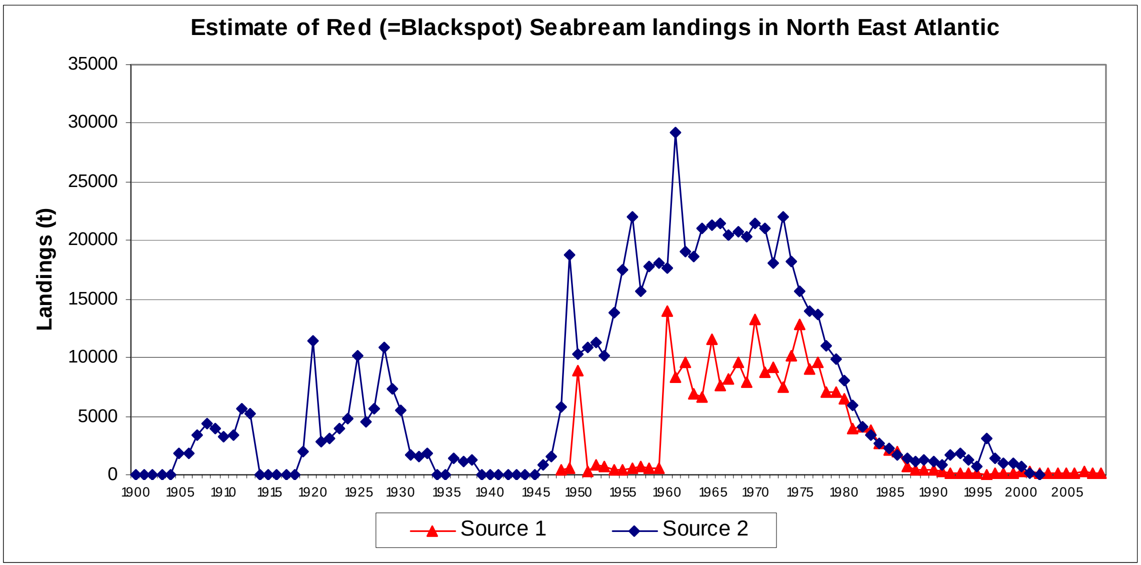


Figure 14.2.1. Historical series of Red Seabream landings since 1900 in North East Atlantic (Subareas VI, VII and VIII).

Source 1

- 1948–1978: Data extracted from Table 16.3 ICES WGDEEP 2004 (French landings in VI, VII and VIII Subareas, Spanish landings in Northeast Atlantic, E & W landings in VI, VII and VIII Subareas);
- 1979–1985: Data extracted from Table 14.2.1. ICES SGDEEP 1996;
- 1986–1987: Data extracted from Table 16.3. ICES WGDEEP 2004;
- 1988–2009: ICES WGDEEP 2010 International landings of French, Spanish, E & W in VI, VII and VIII Subareas.

Source 2

- Compilation of several statistic bulletins.

14.3 Red Seabream (*Pagellus bogaraveo*) in Subarea IX

14.3.1 The fishery

Although *Pagellus bogaraveo* is caught by Spanish and Portuguese fleets in Subarea IX, only a more complete description of one of the fisheries has been provided to the Working Group, the corresponding to the Spanish fishery in the southern part of Subarea IX, close to the Strait of Gibraltar.

The majority of landings on deep-water species at mainland Portugal are conducted by the artisanal fleet, mainly longline fisheries. These operated in the Portuguese continental slope and located in ports as Peniche, Sesimbra and Sagres. Red seabream landings reflect a seasonal activity probably related with a larger availability of the species or market demands that lead fishermen to spend some time targeting this species (I. Figueiredo, *pers. com*.).

In relation to the Spanish fishery in the southern ICES Subarea IXa, an updated description of it has been presented to the Working Group by Gil *et al*. (WD, 2010), that complete the information offered in the previous WGs (Gil *et al*., 2000; 2003; 2005; 2006; 2007; 2008; 2009; Gil and Sobrino, 2001; 2002; 2004). This artisanal longline fishery targeted red seabream has been developed along the Strait of Gibraltar area. Actually this fishery covers more than the 70% of the landings for the species in the Subarea IX. The "voracera", a particular mechanised hook and line baited with sardine, is the gear used by the fleet. The base and landing ports are two: Algeciras and mainly Tarifa (Cádiz, SW Spain). Fishing is carried out taking advantage of the turnover of the tides in depths from 200 to 400 fathoms. Usually landings are distributed in categories due to the wide range of sizes and to market reasons. These categories have varied in time.

In the beginning of the 1980s, there were 25 small boats engaged in this fishery. Thereafter the fleet has increased to more than a hundred since the 1990s. The mean technical characteristics of this fleet by port are 8.95 and 6.52 meters length and 5.84 and 4.0 tons G.T.R. for Tarifa and Algeciras, respectively (from Gil *et al*., 2000).

From 2002 onwards artisanal boats from other port, Conil, have began to direct its fishing activity to *P. bogaraveo* in different fishing grounds than the boats of Tarifa and Algeciras.

14.3.1.1 Landing trends

In Subarea IX, catches -most of them taken by lines- correspond to Spain (72%) and Portugal (28%). Spanish landings data from this area are available from 1983 and Portuguese from 1988 onwards. The maximum catch in this period was obtained in

1993–1994 and 1997 (about 1000 t) and the minimum in 2002 (359 t). Catches in 2009 amount to 718 t.

Almost all Spanish catches in this area are taken in waters close to the Gibraltar Strait. Until 2002 they were restricted to two ports (Tarifa and Algeciras), but from 2002 significant catches were obtained also by artisanal Spanish boats of a third port (Conil) in different fishing grounds of the same area. After reaching a minimum value in 2002 an increasing trend in landings was observed which continues until the present.

In the Portuguese landings no clear tendency is observed. The maximum values took place in 1988 (370 t) and in 1998 (357 t) and the minimum one in 2000 (83 t).

14.3.1.2 ICES Advice

ICES recommends *that catches in Areas IXa and Xa should be constrained to recent average catches (2003–2007) of 500 t in Area IXa and 1050 t in Area Xa and to collect information that can be used to evaluate a long-term sustainable level of exploitation.*

14.3.1.3 Management

Since 2003, a regime of TAC and Quotas has been applied also to the *P. bogaraveo* fishery in Subarea IX. The following Table shows a summary of *P. bogaraveo* TAC which is by far never reached in all these years. However, the last year landings are close to the next year adopted TAC because while landings are increasing TACs are decreasing. There is a minimum landing size of 35 cm.

P. bogaraveo	2003-2004	2005-2006	2007-2008	2009 -2010
ICES Subarea	TAC/Landings	TAC/Landings	TAC/Landings	TAC/Landings
IX	1271/471–480	1080/494–544	1080/592–602	918–780/718*–

*** Preliminary.**

Moreover, some technical measures have been set up by the Spanish Central Government, in 1998, and by the Regional Government of Andalucía since 1999, in order to regulate the fishing activity and to conserve the resource. Recently a Regional Recovery Plan of *P. bogaraveo* related to this Spanish fishery in the Strait of Gibraltar area has been implemented by the Regional Government of Andalucía for 2003–2008 Among the technical measures adopted by this Plan there are: closure of the fishing season during two and half months (15th January–31st March), minimum size of fish retained or landed (33 cm total length), authorised vessels list, hook size, maximum hooks per line (100), maximum number of lines per boat (30), and maximum number of automatic machines for hauling per boat (3), restricted ports for landing the red seabream catches (only Tarifa and Algeciras).

14.3.1.4 Stock identity

See head of the chapter.

14.3.2 Data available

14.3.2.1 Landings and discards

Historical series of landings data available to the Working Group have been described in text and tables of Section 14.3.1. No discard data were available to the Working Group, but for this species this could be considered minor. The landings data used in the assessment exercise of red seabream in IX included Spanish and Portuguese landings from 1990 onwards. The full time-series are presented in Table 14.3.1.

14.3.2.2 Length composition

Landing length frequencies data are only available for Spanish Red seabream fishery in the Strait of Gibraltar (1983–2009) and it's raised to the total landings of the Subarea IX for the assessment exercise (1990–2009). Figure 14.3.1 reflects the updated information regards the mean length of landings from the Strait of Gibraltar fishery (WD, 2010). The fishery resource suffers a decrease of the landed mean length mainly from 1995 to 1998. It is necessary to point out that species probably does not have a homogeneous geographic and bathymetric distribution related to their length. This fact could explain the different landed mean length between different ports (Tarifa and Algeciras). The mean length of the landings gets progressively increasing from 1999 onwards, but along the last years the trend varies increasing again from 2006 on in both ports. However the median value from these years remains under the mean in every case and more close to the minimum landing size in Algeciras.

14.3.2.3 Age compositions

A combined ALK was obtained by 1497 three agreed readings from otoliths collected from 2003 to 2008 presented by Gil *et al.* in 2009. It covers lengths from 24 to 54 cm. and comprises ages between 3 and 10. Younger ages are well sampled while the older groups are susceptible to poorer estimates. Results are preliminary and are not validated yet. There is greater confidence for ages less than six years (partially validated by comparison with growth rates in captivity) while the aging of older fish may be unreliable and possible underestimated.

From ICES Subareas VI, VII and VIII, Gueguen (1969) reported a maximum age of 20 years. In the Azores, ICES Subarea X, a maximum age of 15 years was observed in a 56 cm length fish (Krug, 1994). While, from the available information the maximum years observed is ten in Subarea IX. However, the ages of older fish may be underestimated and it is possible that this species may be slower growing and longer-lived than current studies indicate. In fact, from tagging experiences one recaptured sample was notified after more than ten years at sea (J. Gil, *pers. com.*).

Annual age frequencies (catch-at-age) were derived by the application of the combined ALK to the landings length distributions. Figure 14.3.2 shows the landings age distribution for the period considered. Age 4 individuals are the most represented in the landings, even in the early years.

14.3.2.4 Weight-at-age

Weight-at-age were assumed to be the same in both the catch and the stock. These were estimated according to the ALK and the length–weight relationship presented by Gil *et al.* in 2009. As a result of the application of a unique ALK to all the series, the weights-at-age do not present a lot of variation along the years because differences are only related to the landings length distribution variability. For all the assessment exercise, mean weight-at-age in the stock was considered equal to the mean weight-at-age in the catch.

14.3.2.5 Maturity and natural mortality

An annual reproductive cycle is defined for the species in this area by Gil in 2006: The spawning season seems to take place during the first quarter of the year. The smallest specimens are mainly males, maturing at a L50=30.15 cm. Around 32.5 cm total length an important part of individuals change it sex and became females. Females maturing at L50=35.73 cm. Thus, from age 5 all individuals could be considered mature ones.

The natural mortality of *Pagellus bogaraveo* is uncertain because there is no data available to estimate M directly. A mortality rate of 0.2 year-1 has been adopted by several authors in several studies from other areas (Silva, 1987; Silva *et al*., 1994; Krug, 1994; Pinho *et al*., 1999; Pinho, 2003) and also by Gil in 2006 for the Strait of Gibraltar.

14.3.2.6 Catch, effort and research vesssel data

Figure 14.3.3 updated the catch and effort data available only for the Strait of Gibraltar fishery (WD, 2010). It is important to emphasize also that the effort unit chosen (number of sales) may be inappropriate as it fails to consider the missing effort when vessels have not caught enough fish to go to the market. Thus, in the recent years this missing effort increases substantially (fishing vessels with no catches and no sale sheet to be recorded) and recent lpue values may be over-estimated.

No research vessel data were available for the species in this subarea.

14.3.3 Data analyses

As in 2006 and 2008, for the separable analysis, reference age=4 (which is the most represented in the landings) and weighting default values (six recent years). Also the selection pattern adopted from S=0.4 seems to be reliable related to a hook fishery and F=0.3 was selected. The assessment exercise was run considering age 10 as a plus group (10+) and as a real age.

The results from the separable were used to carry out a traditional VPA analysis. The results are very sensitive to the inclusion of a + group (Figure 14.3.4) and therefore WGDEEP consider them unreliable.

14.3.4 Comments on the assessment

The assessment exercise shown here is an update from the 2006 and 2008 attempts and has been carried out under some uncertainties.

ALKs computed from one year must not be applied to samples taken in a different year, because they could give biased results (Westrheim and Ricker, 1978).

As in previous years, SSB differences dues to the use, or not, of a plus group do not so important in the recent years. In both cases the SSB decreasing trend is clear enough. Current SSB remains at the lowest value in the time-series.

For these reasons the assessment attempt should be considered as an exercise and due to its related uncertainty its results should be examined only in qualitative terms.

14.3.5 Management considerations

For 2009 and 2010 a regime of TAC (918 and 780 t) was established for whole Subarea IX. This stills higher than the recent total landings of the Subarea and does not seem to constrain catches. Landings continue to increase but have not yet reached the TAC level. Based on the assessments attempts, the recent increasing trend of landings in the fishery may be considered unsustainable. Thus, despite the uncertainty of the assessment exercise, fishing mortality rates should be reduced until reliable assessments prove the fishery sustainability. WGDEEP reiterates the 2008 advice to maintain catches at the mean level of 2003–2007, corresponding to 500 t, and to collect information that can be used to evaluate a long-term sustainable level of exploitation.

Table 14.3.1. Red seabream (*Pagellus bogaraveo*) in Subarea IX: Working Group estimates of landings (tonnes).

YEAR	PORTUGAL	SPAIN	TOTAL
1988	370	319	689
1989	260	416	676
1990	166	428	594
1991	109	423	532
1992	166	631	797
1993	235	765	1000
1994	150	854	1004
1995	204	625	829
1996	209	769	978
1997	203	808	1011
1998	357	520	877
1999	265	278	543
2000	83	338	421
2001	97	277	374
2002	111	248	359
2003	142	329	471
2004	183	297	480
2005	129	365	494
2006	104	440	544
2007	185	407	592
2008	158	444	602
2009*	124	594	718

***provisional.**

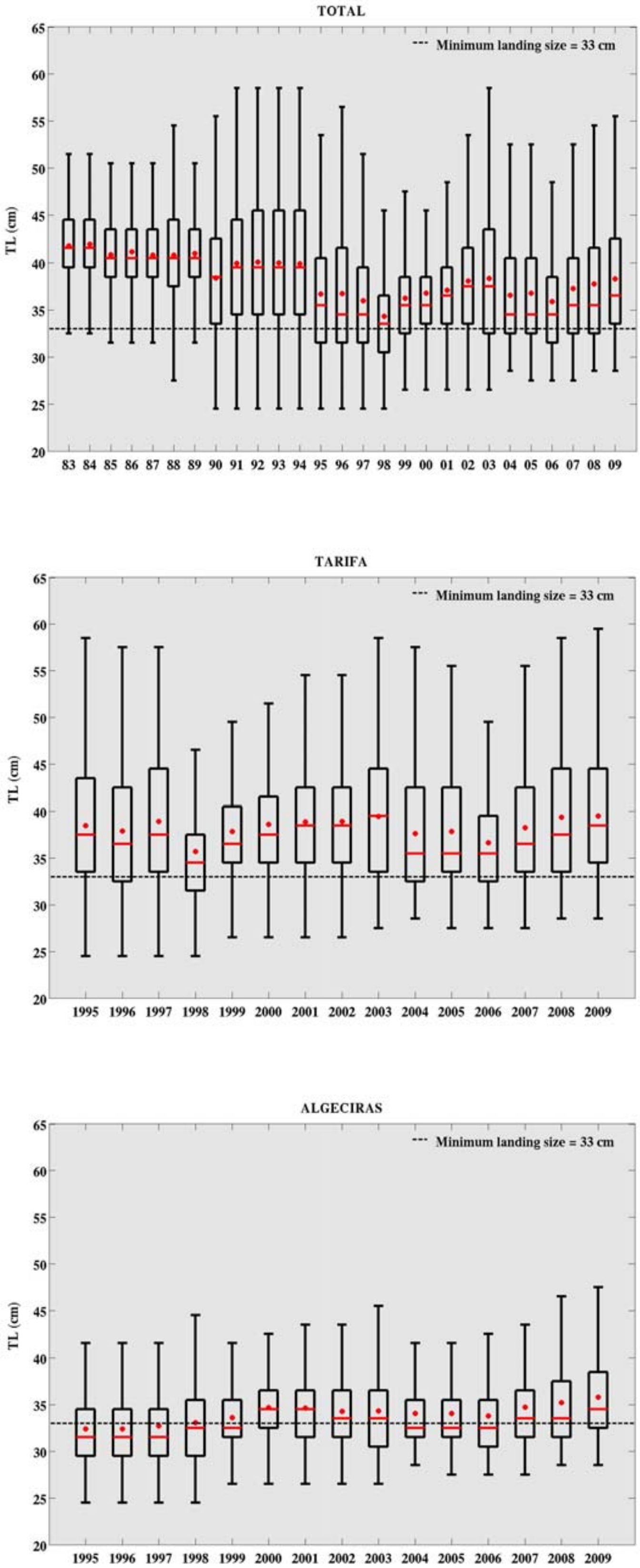


Figure 14.3.1. Red seabream fishery of the Strait of Gibraltar (ICES Subarea IX): 1983–2009 landings mean length distribution (from Gil *et al.*, WD, 2010).

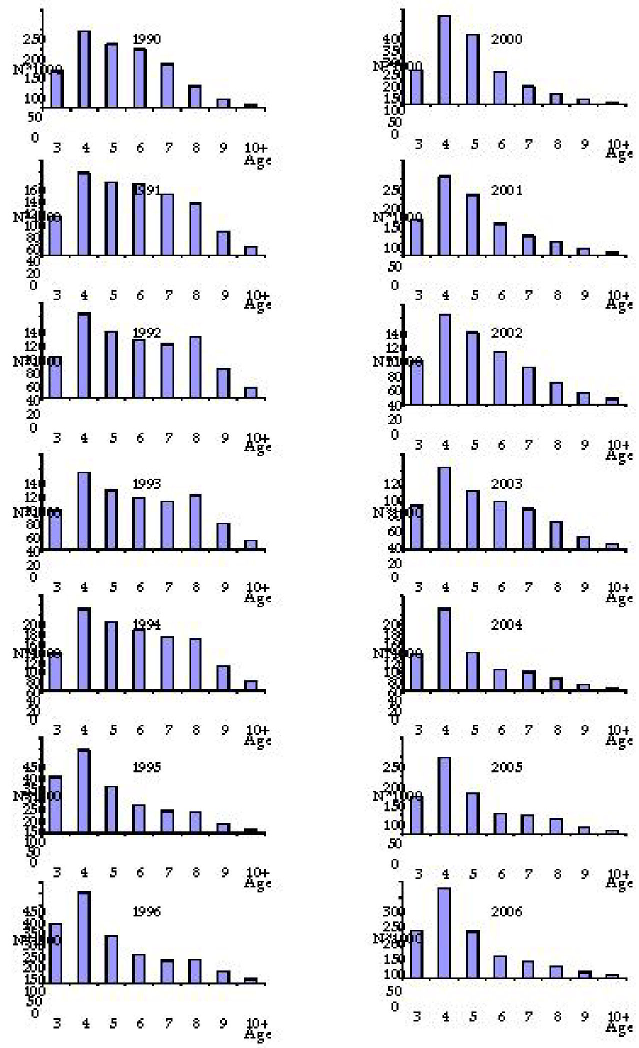


Figure 14.3.2. Red seabream (ICES Subarea IX): 1990–2009 landings age distribution (raised from the Strait of Gibraltar fishery).

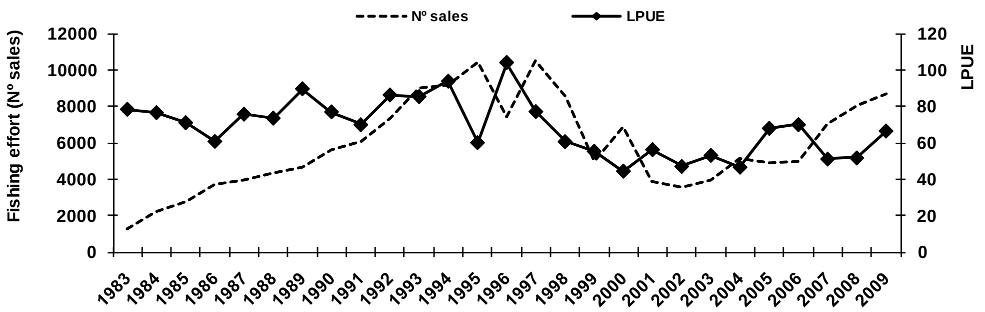


Figure 14.3.3. Red seabream fishery of the Strait of Gibraltar (ICES Subarea IX): Evolution of effort and lpue in the period 1983–2009 (from Gil *et al.*, WD, 2010).

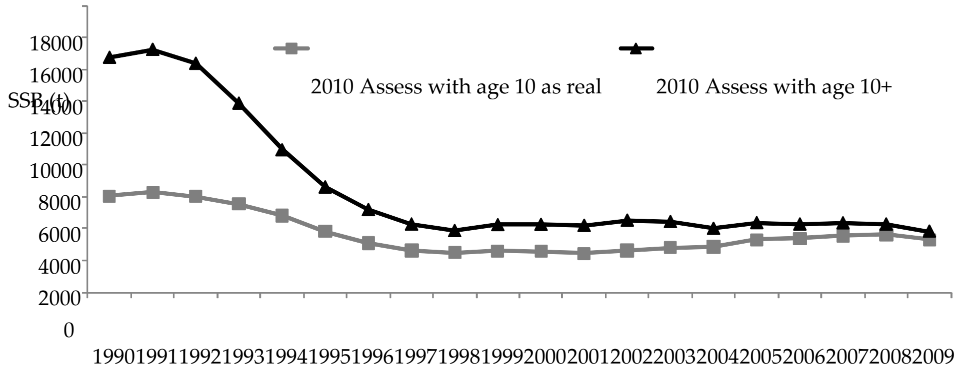


Figure 14.3.4. Red seabream (ICES Subarea IX): SSB estimates from traditional VPA (separable analysis with reference age:4, S=0.4, F=0.3, default weighting values and considering, or not, age 10 as a plus group).

14.4 Red Seabream (*Pagellus Bogaraveo*) in Division Xa

14.4.1 The fishery

Blackspot seabream has been exploited in the Azores (Area Xa2), at least, since the XVI century, as part of the demersal fishery, and is actually one of the most important northeast Atlantic fisheries. The directed fishery is a hook-and-line fishery where two components of the fleet can be defined: the artisanal (hand lines) and the longliners (Pinho *et al.*, 1999; Pinho, 2003). The artisanal fleet is composed of small open deck boats (<12 m) that operate on local areas near the coast of the islands using several types of handlines. Longliners are closed deck boats (>12 m) that operate in all areas, including banks and seamounts. The tuna fishery caught, until the end of the nineties, juveniles (age 0) of blackspot seabream as live bait, but in a seasonal and irregular way because these catches are dependent on tuna abundance and on the occurrence of other preferred bait species like *Trachurus picturactus* (Pinho *et al.*, 1995).

The Azorean demersal fishery is a multispecies and multigear fishery where *P. bogaraveo* is considered the target species. The effect of these characteristics on the dynamics of the target fishery is not well understood.

14.4.1.1 Landings trends

Historically the landings increased from 400 t at the start of the eighties to approximately 1000 t at the start of the nineties (Figure 14.4.1), due to the development of new markets, increased fish value, entry of new and modern boats, better professional education of the fisherman, and introduction of bottom longline gear, permitting the expansion of the exploitable area to deeper waters, banks, and seamounts as well as, the expansion of the fishing season (ICES, 2006). During the last 17 years the landings fluctuated around the 1050 t.

14.4.1.2 ICES Advice

IICES advised in 2008; *ICES recommends that catches in Divisions IXa and Xa should be constrained to recent average catches (2003–2007) of 500 t in Division IXa and 1050 t in Division Xa and to collect information that can be used to evaluate a long-term sustainable level of exploitation*.

14.4.1.3 Management

Under the European Union Common Fisheries policy an analytical TAC of 1116 mt was introduced in 2003 (EC. Reg. 2340/2002) and maintained in 2004 (EC. Reg. 2270/2004), 2006 (EC. Reg. 2015/2006) and 2008 (EC. Reg. 1359/2008).

P. BOGARAVEO	2003		2004		2005		2006	
ICES Subarea	TAC	Landing	TAC	Landing	TAC	Landing	TAC	Landing
Xa2	1136	1068	1136	1075	1136	1113	1136	958

P. BOGARAVEO	2007		2008		2009	
ICES Subarea	TAC	Landing	TAC	Landing	TAC	Landing
Xa2	1136	1070	1136	1089	1136	1042

For the 2006 the Regional Government introduced a quota system by Island and vessel. A specific access requirements and conditions applicable to fishing for deep-water stocks was established (EC. Reg 2347/2002). Fishing with trawl gears was forbidden in the Azores region. A box of 100 miles limiting the deep-water fishing to vessels registered in the Azores was created in 2003 under the management of fishing effort of the common fishery policy for deep-water species (EC. Reg. 1954/2003).

For 2009 the Regional Government introduce new technical measures, including the minimum landing size (30 cm total length), area restrictions by vessel size and gear, and gear restrictions (hook size and maximum number of hooks on the longline gear). A seamount (Condor) was also closed to fisheries for a two year period (2010–2011) with a multidisciplinary research (ecological, oceanography and geological) for characterization of its dynamic.

14.4.2 Data available

14.4.2.1 Landings and discards

Total landings are available since 1980. However, detailed and precise landing data are available for the assessment since 1990 (ICES, 2006). Landings from Area Xa2 are presented in the Table 14.4.1 and Figure 14.4.1. New information on discards from the year 2007 and 2008 was presented to the Group (WD Pereira and Pinho, 2010). Important discards values, 16.4% and 30% of the total landings in 2007 and 2008 respectively was reported. This discards may be a consequence of the technical measures (tac/quota system by vessel and minimum length) introduced.

14.4.2.2 Length compositions

Fishery length composition in number and weight for the period 1990 to 1998 was presented to the group (WD Pereira and Pinho, 2010) (Figure 14.4.2). Length composition is similar to the survey with a mode around 25 cm. Large quantity of adult individuals, greater than 40 cm, are observed on the fishery composition for the years 1998–2000 and in 2005. This increase may probably relate to the catchability factors or due to an expansion of the fishery to offshore areas and deeper depth strata.

Survey data is not available for 2009 because there was no survey during that year. Length composition from the survey for the period 1990–2008 is presented in Figure 14.4.3. No trends are observed in these data.

14.4.2.3 Age compositions

No new information was presented to the Working Group.

14.4.2.4 Weight-at-age

No new information was presented to the Group.

14.4.2.5 Maturity, sex-ratio and natural mortality

No new information was presented to the Working Group.

14.4.2.6 Catch, effort and research vessel data

Standardized fishery cpue was presented to the Group (WD Pereira *et al.*, 2010). Catch rates for the period 1990–2008 were estimated using a Generalized Linear Mixed modelling approach assuming a delta-lognormal error distribution. The explanatory variables considered for standardization include the geographical area, season, vessel category and port of fishing operation.

Abundance indices from surveys are available since 1995. For 2009 there is no survey data.

14.4.3 Data analyses

This stock follows the protocol in the Stock Annex.

The fishery catch rate show a relatively stable trend, with a decrease pattern from 1997 to 2000 and an increased pattern from 2000 to 2005 and decreasing thereafter (Figure 14.4.4). The last trend is similar to the one observed on the survey (Figure 14.4.5).

Survey indices from 1990 to 2008 presented an increase trend with a high value every three years (Figure 14.4.5). These high values may be related with some sort of catchability variability (fish is more available to the gear in some years) as a function of the feeding behaviour (benthopelagic) and reproduction (protandric forming spawning aggregations) of the species.

Survey abundance indices of mature and immature follows the same trend of the total abundance estimates (Figure 14.4.6).

Annual mean length from the fishery and from the survey follow similar trend (Figure 14.4.7). An increase on the mean length by year, with interanual variability, is observed.

Mean length of mature stock is around 37 cm (Figure 14.4.8) and immature (Figure 14.4.9) about 25 cm. Variance of the estimates is high but the trends along time are stable.

14.4.3.1 Comments on the assessment

The assessment followed the procedure described in the Stock Annex. This is considered to be appropriate to assess this stock.

14.4.4 Management considerations

The status of Red blackspot seabream is uncertain but there are signs of increases in indices of abundance from surveys and relatively stable cpue from the fishery. The catches of red black spot seabream have been increased until the actual TAC plateau level.

Considering the uncertainty of the assessment fishing mortality should not be increased beyond the current level until validated assessments indicate that any harvest increase are sustainable.

It is possible that sequential depletion of local populations may be occurring and this may be contributing to the stability of observed commercial cpue series.

Table 14.4.1. Historical landings of *Pagellus bogaraveo* from the Azores (ICES Area Xa2).

Year	Azores (Xa2)	Total
1980	415	415
1981	407	407
1982	369	369
1983	520	520
1984	700	700
1985	672	672
1986	730	730
1987	631	631
1988	637	637
1989	924	924
1990	889	889
1991	874	874
1992	1090	1090
1993	830	830
1994	989	989
1995	1115	1115
1996	1052	1052
1997	1012	1012
1998	1119	1119
1999	1222	1222
2000	947	924
2001	1034	1034
2002	1193	1193
2003	1068	1068
2004	1075	1075
2005	1113	1113
2006	958	958
2007	1063	1070
2008	1089	1089
2009	1042	1042

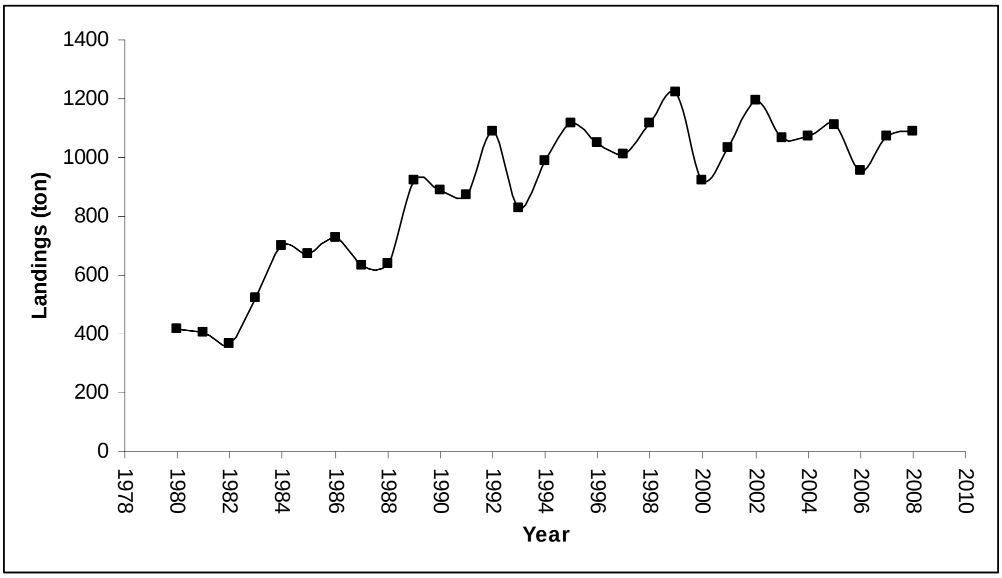


Figure 14.4.1. Historical landings of *Pagellus bogaraveo* from the Azores (ICES Area Xa2).

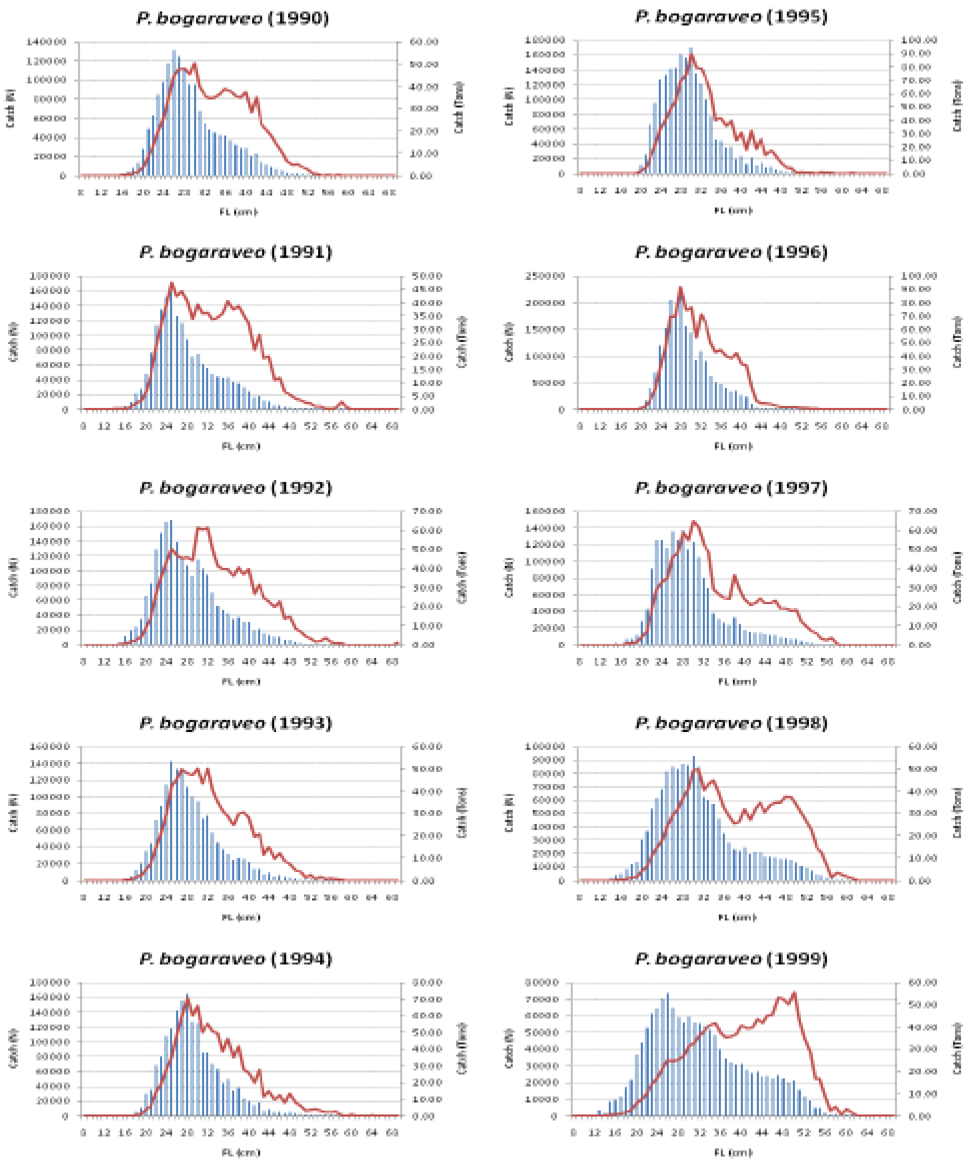


Figure 14.4.2. Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1990–1999 (ICES Area Xa2).

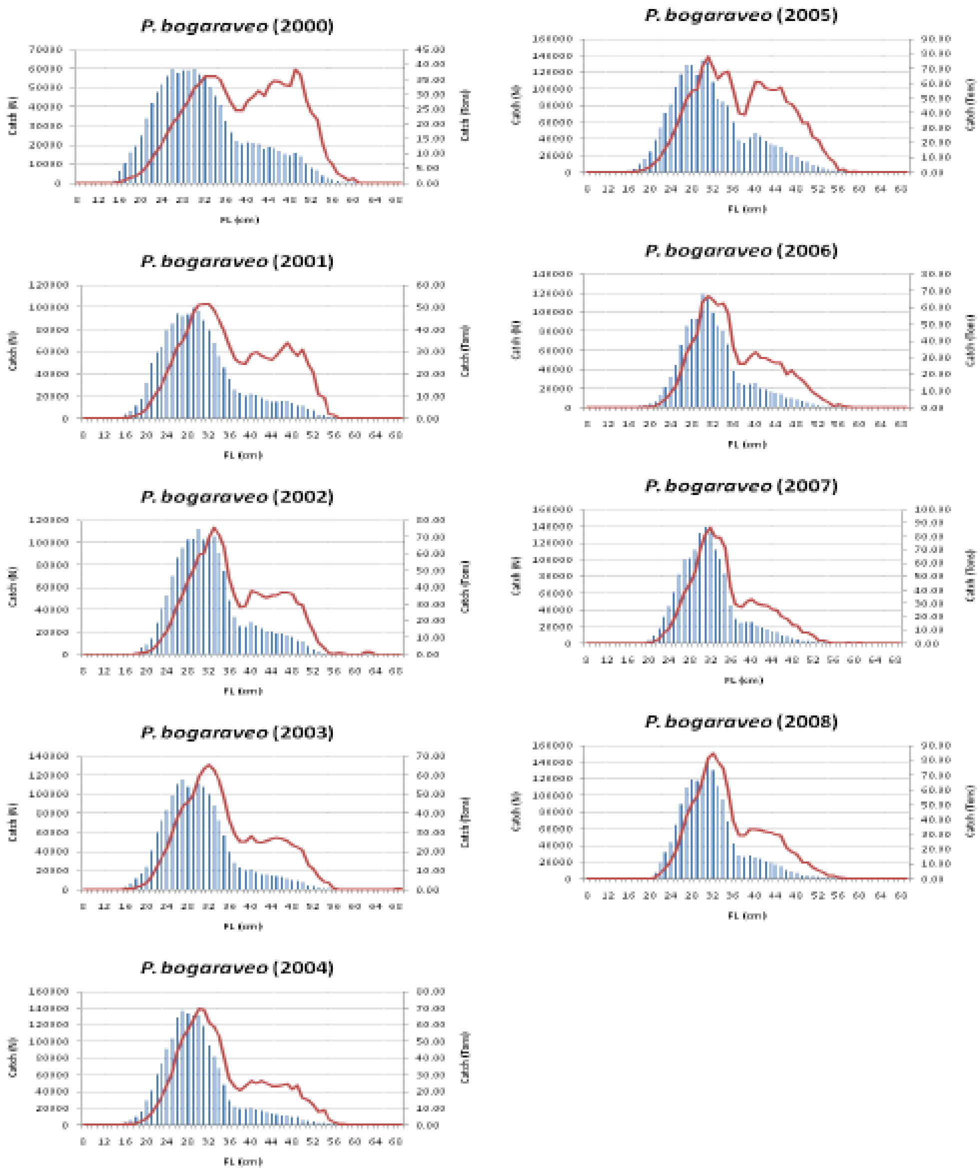


Figure 14.4.2. cont. Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1999–2008 (ICES Area Xa2).

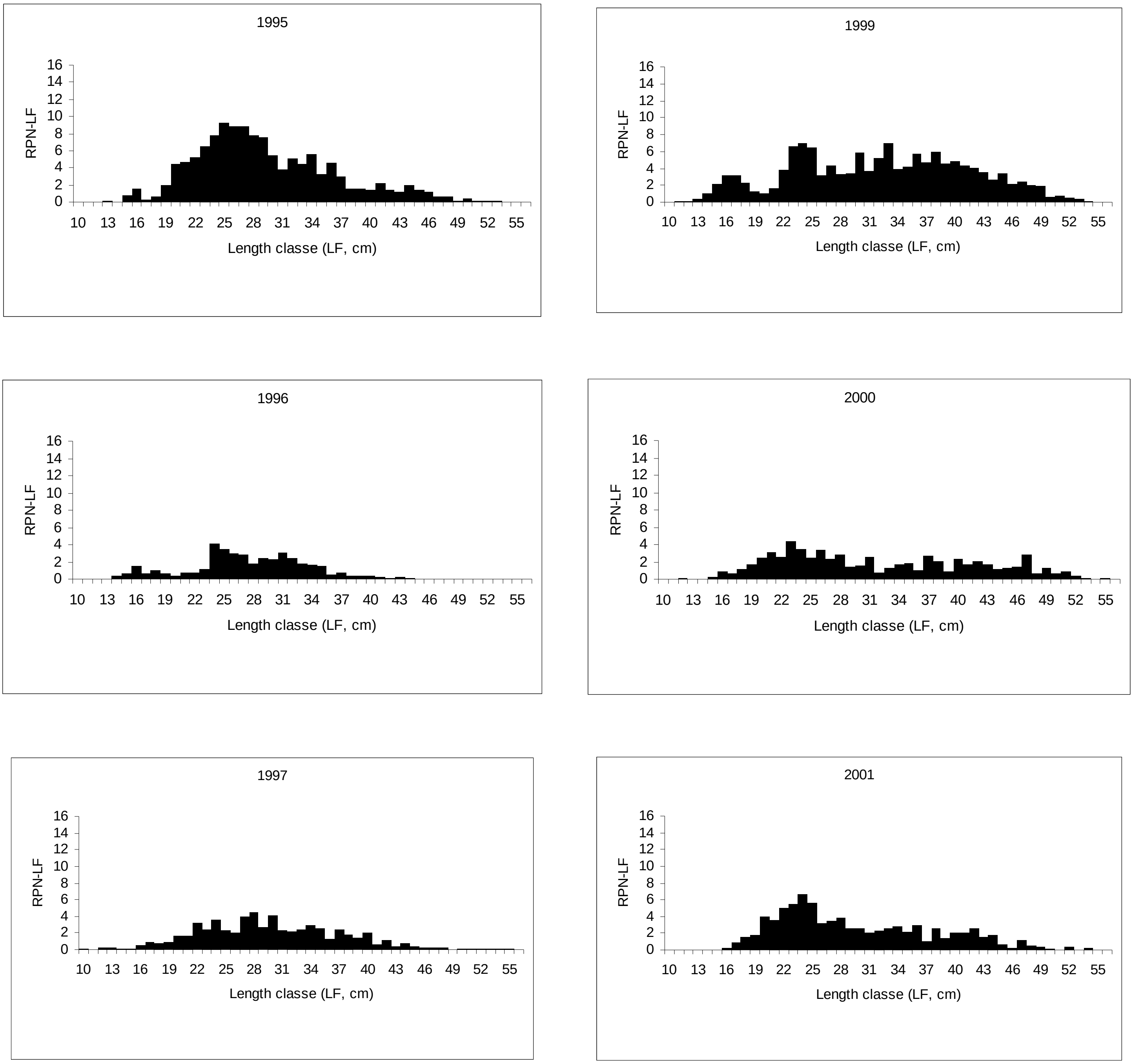


Figure 14.4.3. Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 1995–2001 (ICES Area Xa2).

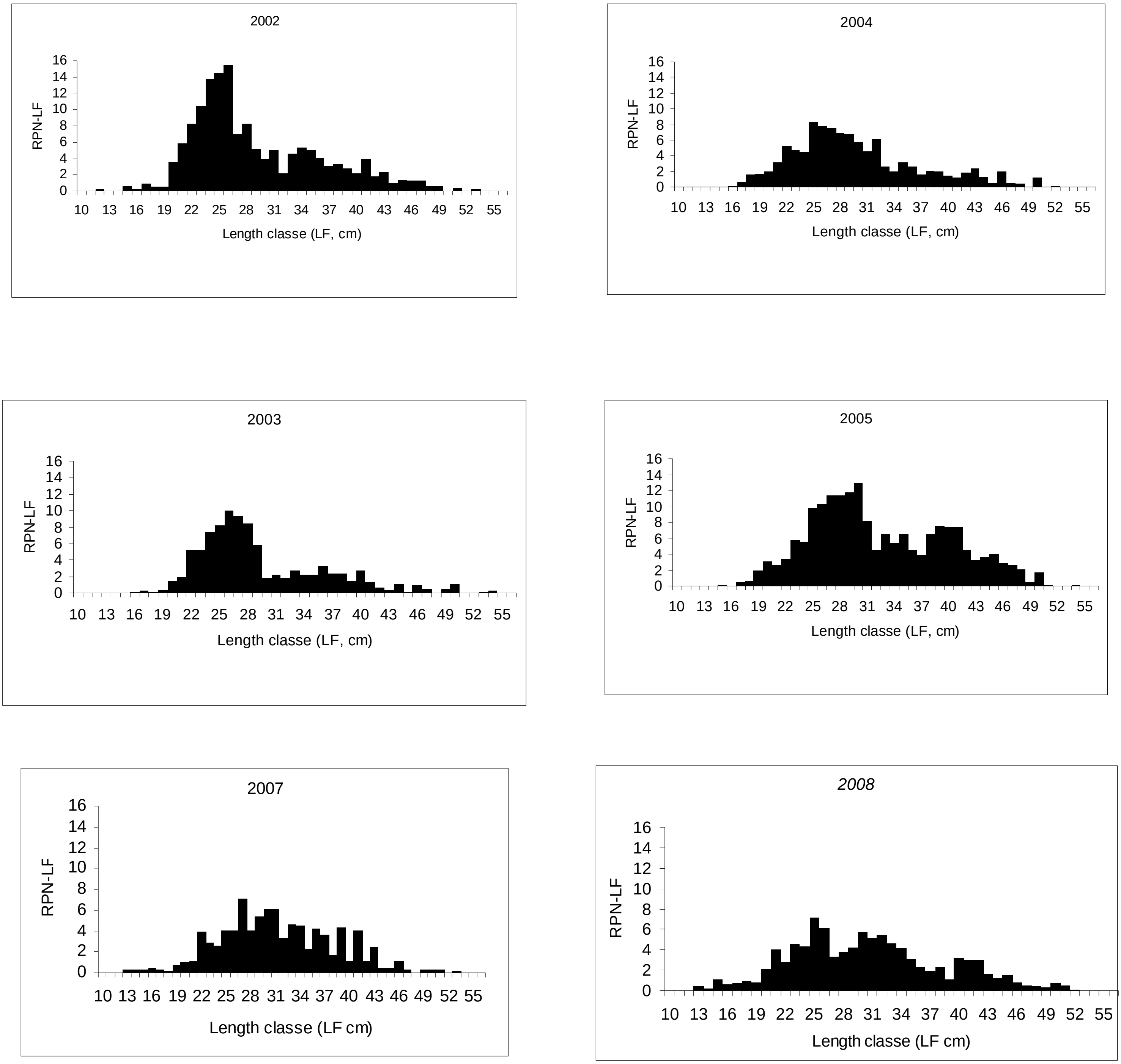


Figure 14.4.3. cont. Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 2002–2008 (ICES Area Xa2).

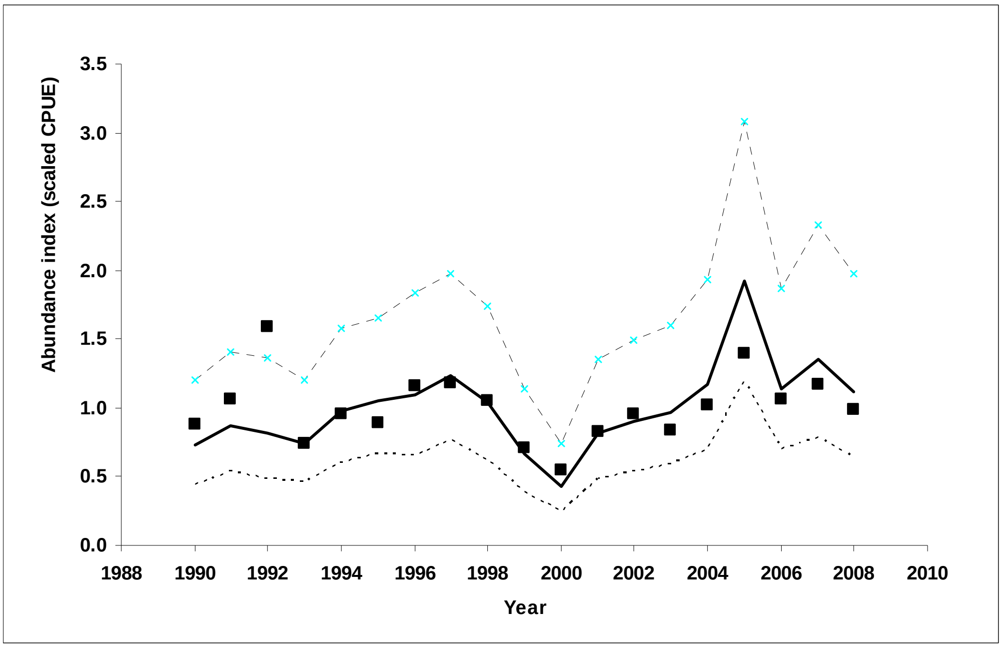


Figure 14.4.4. Standardized fishery catch rates of *Pagellus bogaraveo* from the ICES Area Xa2.

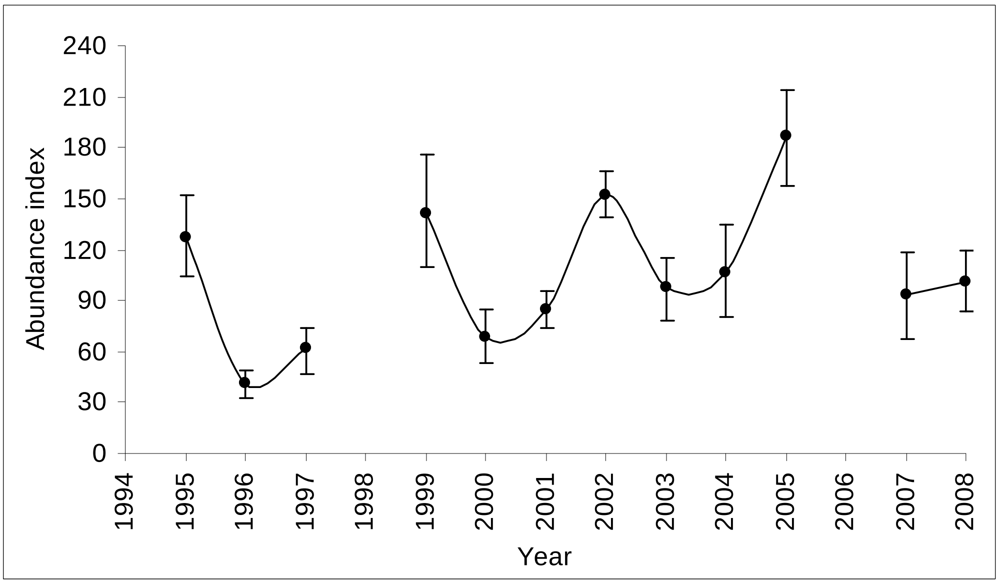


Figure 14.4.5. Annual abundance in number (Relative Population Number) and in weight (Relative Population Weight) of *Pagellus bogaraveo* from surveys for the ICES Area Xa2.

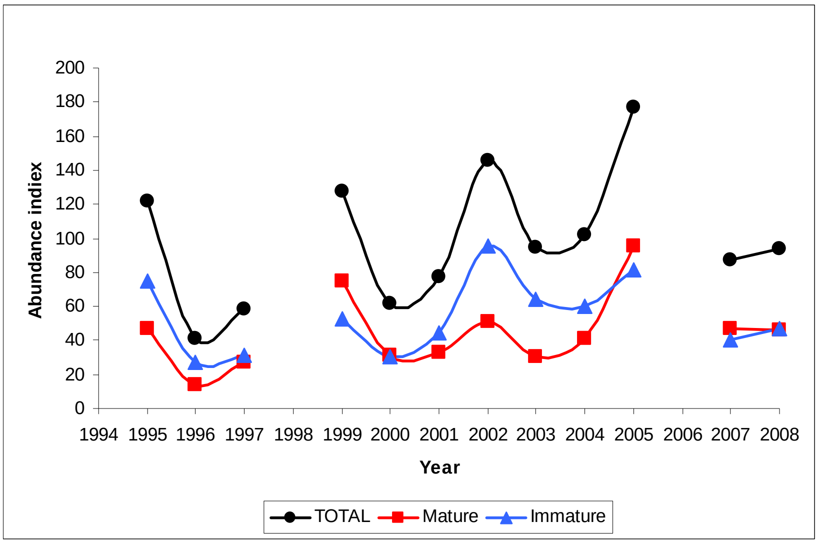


Figure 14.4.6. Survey abundance indice for mature and immature stock.

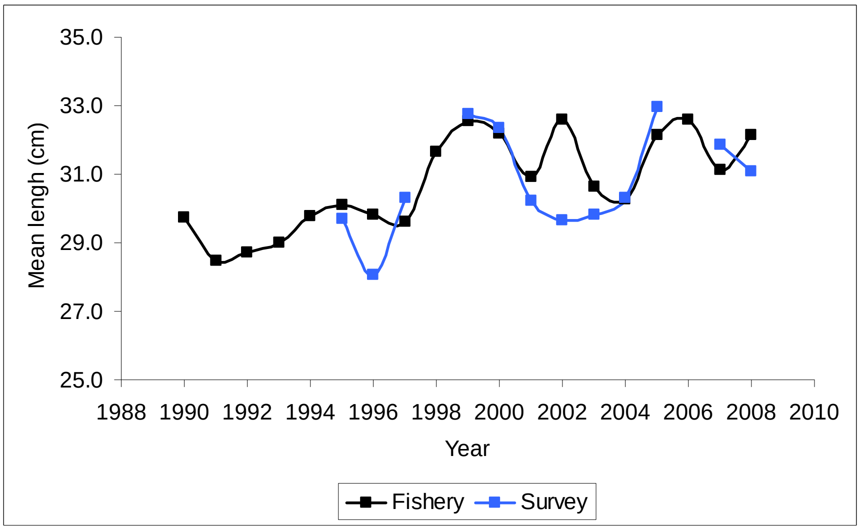


Figure 14.4.7. Annual mean length from the fishery (1990–2008) and survey length compositions (1995–2008).

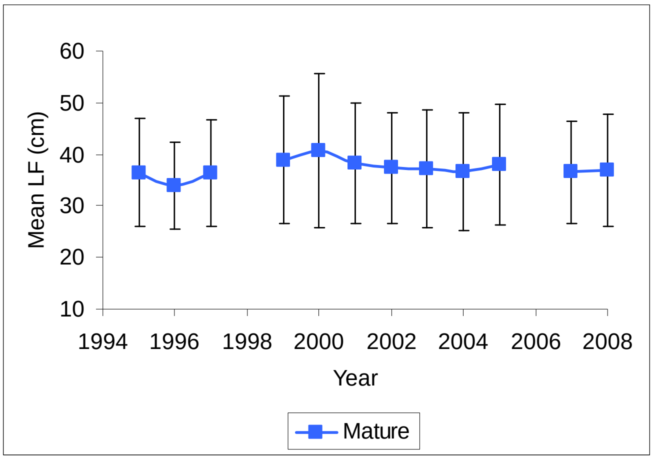


Figure 14.4.8. Annual mean length of mature individuals from the Azorean longline survey.

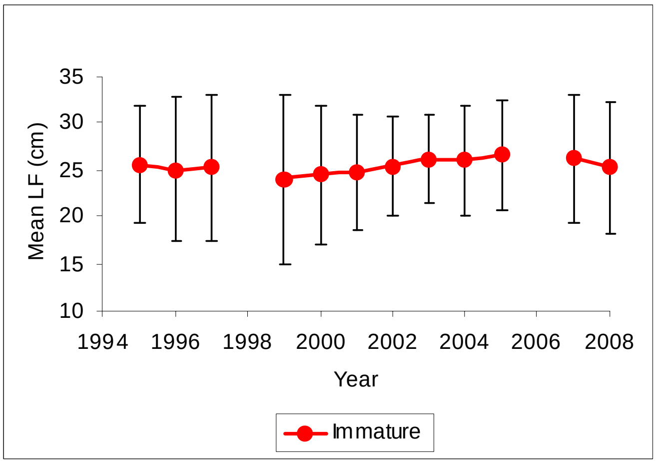


Figure 14.4.9. Annual mean length of mature individuals from the Azorean longline survey.

Stock Annex: Red (Blackspot) seabream (*Pagellus bogaraveo*) in Subarea X

Stock	Red (Blackspot) seabream (*Pagellus bogaraveo*) in Subarea X
Working Group	WKDEEP
Date	February, 2010 WKDEEP 2010
Revised by	Mario Pinho

A. General

A.1. Stock definition

"Stock limits are generally determined not only by biological considerations but also by agreed boundaries and coordinates. ICES considered three different components for this species: a) Areas VI, VII, and VIII; b) Area IX, and c) Area X (Azores region). This separation does not pre-suppose that there are three different stocks of red (blackspot) seabream, but it offers a better way of recording the available information" (ICES, 2007).

In fact, the inter-relationships of the red (blackspot) seabream (*Pagellus bogaraveo*) from Subareas VI, VII, and VIII, and the northern part of DivisionIXa, and their migratory movements within these sea areas have been confirmed by tagging results (Gueguen, 1974). Possible links between red (blackspot) seabream from the Azores region (Subarea X) with the others areas are not yet fully studied. However, recent studies show that there are no genetic differences between populations from different ecosystems within the Azores region (East, Central and West group of Islands, and Princesa Alice bank) but there are genetic differences between Azores (ICES Subarea X) and mainland Portugal (ICES Division IXa) (Stockley *et al*., 2005). These results, combined with the known distribution of the species by depth and tagging information, suggest that Subarea X component of this stock can be considered as a separate management unit.

A.2. Fishery

Blackspot sea bream has been exploited in the Azores (Subdivision Xa2), at least, since the XVI century, as part of the demersal fishery (Silva and Pinho, 2007).

The Azorean fishery is a multispecies (Figure 1) and multigear/fleet one (demersal mixed hook and lines) (Figure 2). About 104 species belonging to 49 families were caught and identified during the spring demersal longline surveys from 1995–2006 (Menezes *et al.*, 2006). This demersal community is structured by assemblages according depth (Pinho and Menezes, 2005; Menezes *et al.*, 2006). Three main assemblages can be defined according depth: Shallow (<200 m), Intermediate (200–700 m) and Deep (>700 m). The key species of this fishery is black spot seabream (*Pagellus bogaraveo*) and bluemouth (*Helicolenus dactylopterus*), distributing from shallow (<50 m) to deep depth strata (1000 m). The fishery is also considered as small-scale because the highest proportion (about 80%) of small vessels (<12 m).

The directed fishery is a mixed hook and line fishery where two components of the fleet can be defined: the artisanal (handlines) and the longliners. The artisanal fleet is composed of small open (sometimes closed) deck boats (<12 m) that operate on local areas near the coast of the islands using several types of handlines and covering depth until 800 m. Longliners are closed deck boats (>12 m) that operate in all areas (except on the 3 miles of island coasts), including banks and seamounts (Pinho and

Menezes, 2005; Silva and Pinho, 2007; Pinho and Menezes, 2009) (Figure 3). In the past, the tuna fishery has also caught juveniles (age 0) of blackspot sea bream for use as live bait, in a seasonal and irregular way, depending on tuna abundance and on the occurrence of other preferred bait species, like *Trachurus picturactus* (Pinho *et al.*, 1995). This practice has been reduced significantly during the last decade, particularly since the introduction of the TACs.

The operational regime of each vessel type varies considerably. Small open-deck vessels usually operate in areas near the coast, using mainly handlines. They make daily trips and target mainly shallow (<200 m) and intermediate (200–700 m) depth species (see Pinho and Menezes, 2005). On average this component make between 70 to 150 fishing days per year, depending on the based island of the vessel. Some open-deck vessels (9–12 m) based in St Miguel Island operates in a larger area including banks near the coast (to 50 nm). These vessels make about 200 fishing days per year. Small closed-deck vessels (<14 m) are considered the main component of the fleet targeting deep-water species and cover almost all areas and depth strata. They use mainly deep longlines and handlines, operating in coastal areas of the islands and in the main banks and seamounts. These vessels operate in all strata but preferentially target species from 200–800 m strata, making on average between three and seven fishing days per trip, with one set a day, though occasionally more, using from six to ten thousands hooks by set. On average they make about 200 fishing days per year. Industrial vessels operate mainly on banks and seamounts, inside or outside the EEZ, including the ICES and CECAF areas, using deep longlines. They usually fish in the intermediate (200–700 m) and deepwater strata (>700 m). These vessels make trips, on average of seven days, with one (or more) sets a day of about 14 000 hooks a set. They make on average 250 fishing days per year. However, the fleet presents a very high level of absenteeism (many vessels operate on a non regular basis and with many interruptions on landings along time), particularly on the small vessel size component, probably related with the subsistence characteristic of this component where the fishers are also farmers.

Although the predominant gears are the demersal longline and handlines, the fleet, particularly the local open (or close) deck component, is very plastic and can operate opportunistically and on seasonal way to other species like crustaceans (using traps) or small pelagic (using nets), squids or tunas (live and bait) in function of the abundance and price (Pinho and Menezes, 2009). Each vessel has usually permits to use different gears.

A.3. Ecosystem aspects

The red blackspot seabream is found in the northeast Atlantic, from south of Norway to Cape Blanc, in the Mediterranean Sea, and in the Azores, Madeira, and Canary Archipelagos (Desbrosses, 1938; Pinho and Menezes, 2005**)**. Hareide (2002) reported also occasional occurrence of this species along the Mid-Atlantic Ridge (north and south of the Azores). The Azores region (Subdivision Xa2) is considered a management unit based on genetic studies and tagging data (ICES, 2007).

Blackspot seabream is a benthopelagic species that inhabits various types of bottom (rock, sand, and mud) down to a depth of 900 m. The vertical distribution of this species varies according to individual size, and season of the year. In the Azores, this species is found in all habitats (coastal areas of islands, banks, and seamounts) down to 900 m depth (Figure 4). Local distribution is directly correlated with depth with juveniles inhabiting littoral and shallow waters (0–30 m), young immature individuals inhabiting depths less than 300 m, and large adults inhabiting areas between 300–700 m depth (Menezes *et al.*, 2005).

Blackspot seabream undertakes a vertical spawning migration, with the adults moving from deeper to shallower waters during the spawning season (December–March) and forming aggregations (Krug, 1990; 1998). The dynamic of the spatial distribution in the Azores region is not yet very well understood. Data from the survey shows that juveniles (age 0–1 years) are almost absent from the main seamounts, but are found in the coastal areas throughout the year, suggesting areas interactions (Pinho, 2003).

The Azores is an oceanic region where deep-water ecosystem is predominant. The major topography feature is the mid-Atlantic Ridge (MAR) that follows a sinuous course southwards from Iceland to the Azores. Islands and seamounts are other prominent topographic features, which are characterized by very specific circulation patterns and play an important role in ocean biological system (Bashmachnikov *et al.*, 2005; 2009a; 2009b; Silva and Pinho, 2007, Morato *et al.*, 2008). This ecosystem is poorly known and important dynamics of the *Pagellus bogaraveo* population are dependent of environmental dynamics at different scales.

The essential fishing habitat of *Pagellus bogaraveo* comprises littoral and deep-water areas. The distribution of this habitat around the Azores is much discontinued.

B. Data

For this species data is available from commercial fisheries and from surveys reported to ICES (Table 1). Data from commercial fisheries include landings (auction data) and biological port sampling. There are also inquires and logbooks and observers (from large longliners) available to compute fishing effort.

Annual landings are computed from the diary sales of fresh fish on the auctions. Landing information does not include discards. Biological sampling is made on the most important fisheries ports, which usually incorporate an inquiry to the captain. From these data are computed the annual fishery length composition and the fishing effort. Standardized catch rates, exploring several explanatory variables (year, port, season and vessel type), have been estimated since 2006.

Biological fishery data, including aging and maturity, is available and is collected annually since 2002, under the EU data collection regulation, and since 2009, under the EU data collection framework.

Demersal longline survey data is available since 1995 (Pinho, 2003; Menezes *et al.*, 2006). Annual abundance index and biological data (length composition, sex, age and maturity) from the survey is available and the time-series have been presented to the ICES WGDEEP.

Data is supplied from databases maintained by Department of Oceanography and Fisheries (DOP/UAç). An informatics routine to compute these basic output data specific for the WGDEEP is under development.

The data used in the assessments are considered as the best available data at the Working Group time of the year.

B.1. Commercial catch

Landings data (in weight and value) from the Azores have been reported to ICES. Landings are collected directly from the first sale of fresh fish on the auctions. Information on discards has been collect in recent years, but it is not relevant for Red (Blackspot) seabream because the species almost is not rejected.

Complete official landings are available since 1982; however detailed landing by vessel is only available since 1990. An incomplete time series from 1948 is available to be used for illustrative development of the fishery (Figure 5).

Landing data disaggregated by gear type, area and depth is lacking or is incomplete.

B.2. Biological

The information available for *Pagellus bogaraveo*, Azores ICES Subdivision Xa2, is resumed in Table 1.

Annual length composition from the fishery (1990–2008) and survey (1995–2008) are available. In general length composition covers amplitude of lengths from 10 to 57 cm with a mode around 30 cm.

Pagellus bogaraveo is a protandric hermaphrodite species changing from males to females (Figure 6). Sexing and staging this species may be sometimes problematic because macroscopic scales are not validated with microscopic observations.

Spawning in SubdivisionXa2 occurs from December to March, with a mode on Janury/March (Figure 7).

Maturity information is only available for some periods (1982-1986, 1991 and 2002–2008).

Red (blackspot) seabream is considered a slow growing species. Gueguen (1969) reported a maximum age of 20 years, Ramos and Cendero (1967) and Coupé (1954) reported 12 years, Sanchez (1983) reported 10 years, Ana *et al* (2006) reported 9 years and Gil and Sobrino (2002) reported 8 years. In the Azores a maximum age of 15 years was observed in a 56 cm length fish (Krug, 1994). However, no age validation was obtained by examining structures from known age fish (e.g. from mark-recapture studies with conventional tags or tetracycline method).

Aging data is available from the fishery and from the surveys. Annual ALK are available for the survey (1996–2008) and fishery (2002–2008). Growth parameters have been estimated for sex combined (Pinho *et al.*, 2006).

B.3. Surveys

Survey data available from the Azores for *Pagellus bogaraveo* is resumed in Table 1.

The Azorean longline survey was conducted annually each spring (usually from April to June) from 1995 to 2008, with exception of the years 1998 and 2009. The survey followed a stratified design (6 statistical areas and 12 depth strata) and covered the Azores archipelago around the islands, banks, and major seamounts (Figure 8). The survey is design for abundance estimation of red (blackspot) seabream, covering the depth strata from 50 to 600 m. Depth coverage was extending to 800 m since 2004. Additionally depth from 800 to 1200 m is covered in one transept by statistical area for ecological studies. Details of the survey design can be found in Pinho (2003) and Menezes *et al.* (2006).

The catch per hook value (cpue) was calculated for each species, area, and station stratum, and an index of relative abundance in number (RPN) (or weight-RPW) was obtained by multiplying each of these cpue values by the corresponding area size. The average RPN value for each area and stratum was then calculated. The abundance values for each area and for the Azores were computed by summing the abundance index values across strata and across areas, respectively.

Length data were collected for all survey years, following a random stratified design. Length samples were stratified by station, statistical area and depth strata, and then weighted by the area-stratum size. The resultant length distributions were averaged within each area-stratum and summed across strata and areas to estimate total length frequency.

B.4. Commercial cpue

Nominal commercial catch rates are estimated by trip from the fishery landing enquiries data, collected by interviews to the fishermen during the landings. So, the catch data for each trip correspond to the landings information collect by the auction market. The effort data is recorded by shore based samplers that inquire the fishing masters collecting detailed information on fishing operations, including the number of hooks per set, number of sets per trip, gear characteristics, etc. Each record also includes information on date, geographical area of the catch and catch in weight for each species landed. The total fishing effort per trip is usually estimated as the product of the mean number of hooks per set times the number of sets per trip. Nominal catch rates were estimated as the kg of blackspot seabream caught per 1000 hooks.

This catch rates are affected by the abundance but also by other factors, like season, gear configuration, boat type and fishing target species. The effects of the different factors in the catch rates have been estimated, using GLM-generalized linear models, since 2006 (Pereira, 2006). This standardized cpue covered the considered "fully exploited phase" of the fishery (since 1990) and presented a relatively stable trend. There is no information available for the ancient times of the fishery.

B.5. Other relevant data

C. Historical stock development

The first attempted to assess the resource was performed during 1996 SGDEEP meeting using the SVPA and Laurec-Shepherd on the matrix of catch-at-age from the period 1982–1993 and the Azorean effort fleet. Concerns related to the annual age compositions, maturity ogives and lack of convergence were expressed and the assessment was not validated (ICES, 1996). A new attempted was made during the 2006 WGDEEP meeting using SeparableVPA, Ad hoc VPA tuning and XSA) (ICES, 2006). The results from the exploratory assessment performed in 2006 were considered unreliable.

Agreed data and assessment at the Benchmark (WKDEEP, 2010).

Annual landing data from 1990 and onwards and standardized cpue from 1990 and onwards. Standardized fishery cpue derived by applying the GLM delta lognormal model distribution to inquiry data (landing and effort data by trip and vessel).

Azorean longline survey abundance indices from 1995–onwards.

Annual survey length compositions abundance by area from 1995–onwards.

This assessment unit is assessed based on i) trends in the mean length of mature and immature from longline survey using the entire survey area and individual survey statistical areas; ii) trend in abundance in survey and standardize commercial cpue series.

For the survey data indices of abundance (cpue weighted by the area size) by length classes were computed. These annual data was then disaggregated by sexes assuming a sex change dynamic proposed by Krug (1990; 1998). The sexes include: Females, males, hermaphrodites and undifferentiated.

To split the annual length composition by sex the following equations were used to describe the sex-ratio of each sex:

$$P = \frac{1}{1 + e^{(6.56 - 0.1816 * LF)}} \quad \text{Females}$$

$$P = \frac{1}{1 + e^{(-5.180 + 0.227 * LF)}} \quad \text{Males}$$

$$P = 0.388 * (-23.688 + LF) e^{[-0.225 * (-23.688 + LF)]} \quad \text{Hermaphrodites}$$

$$P = e^{(16.68 - 0.71 * LF)} \quad \text{Undifferentiated}$$

Where P is the proportion of each sex category and LF is the fork length.

To split these annual length compositions by mature and immature length compositions the following maturity ogives for males and females were adopted:

$$P = \frac{1}{1 + e^{(-21.43 + 0.66 * LF)}} \quad \text{Females}$$

$$P = \frac{1}{1 + e^{(-13.46 + 0.476 * LF)}} \quad \text{Males}$$

Where P is the proportion of mature of each sex and LF fork length.

L50% derived from ogives given above were 28 cm for males and 32 cm for females. A mid-point between these two values was assumed for hermaphrodites. A knife edge was adopted to separate mature from immature fish by sex type see Table below).

Sex	Mature	Immature
Males	> 28 cm	< 28 cm
Females	> 32 cm	< 32 cm
Hermaphrodites	> 30 cm	< 30 cm
Undifferentiated	-	All

This analysis should be carried out for the entire survey area and survey statistical areas.

D. Short-term projection

No short-term projection is conducted for this stock.

E. Medium-term projection

No medium-term projection is conducted for this stock.

F. Long-term projection

No long-term projection is conducted for this stock.

G. Biological reference points

No reference points were defined for this stock.

H. Other issues

I. References

Anna C., G. Petrakis and Tsamis evaggelos. 2006. Aspects of the biology of blackspot seabream (*Paqgellus bogaraveo*) in the Ionian Sea, Greece. Fisheries Research, 77:84–91.

Coupé, R. 1954. Cinquème note sur les Sparidés de la côte marocain, *Pagellus centrodontus*, (Val. 1836). Journal du Conseil Permanent International pour L`Exploration de la Mer, 11 pp.

Desbrosses, P. 1938. La dorade commune (*Pagellus centrodontus*) et sa pêche. Revue du Travail de l`Office des Pêches maritime, 5 (2): 167–222.

Bashmachnikov, I., Lafon, V., and Martins, A. 2005. Sea Surface Temperature Variability in the Subtropical North-East Atlantic. 31st International Symposium on Remote Sensing of Environment (ISRSE). 20–24 June.2005, StPetersburg. WWW site

Bashmachnikov, I., Mohn ,C., Pelegri, J.L., Martins, A., Machin, F., Jose, F., and White, M. 2009a. Interaction of Mediterranean water eddies with Sedlo and Seine seamounts, Subtropical Northeast Atlantic. Deep-Sea Research II, Vol. 56:25, 2593–2605.

Bashmachnikov, I., Martins, A., and Mendonça, A. 2009b. In-situ and remote sensing signature of three meddies east of the Mid-Atlantic ridge. Journal of Geophysical Research (2008JC005032: accepted).

Gil, J. and Sobrino, I. 2002. Update of the information about the red seabream (*Pagellus bogaraveo*) from the strait of Gilbraltar (ICES Ixa south). ICES WGDEEP 2002 Working Doc.

Gueguen, J. 1969. Croissance de la dorade, *Pagellus centrodontus* Delaroche. Revue du Travail de l´ Institut des Pêches Maritimes, 33 (3): 251–254.

Hareide NR and Garnes G. 2001. The distribution and catch rates for deep-water fish along the Mid-Atlantic Ridge from 43 to 61°N. Fish Res 51:297–310.

ICES. 2007. Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources. ICES CM 2004/ACFM:20.

ICES. 1996. Report of the Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources. ICES CM 1996/Assess:8.

Krug, H. 1990. The Azorean blackspot seabream, *Pagellus bogaraveo* (Brunnich, 1768) (*Teleotei, Sparidae*). Reproductive cycle, hermaphroditism, maturity and fecundity. Cybium, 14:2: 151–159.

Krug, H. 1998. Variation in reproductive cycle of the blackspot seabream, *Pagellus bogaraveo* (Brunnich, 1768) in the Azores. Arquipélago. Life and Marine Sciences. 16A:37–47.

Meneses, G. M., M. F. Sigler, H. M. Silva, and M. R. Pinho. 2006. Structure and zonation of demersal and deep-water fish assemblages off the Azores Archipelago (mid-Atlantic). Marine Ecology Progress Series, 324:241–260.

Morato, T., M. Machete, A. Kitchingman, F. Tempera, S. Lai, G. Menezes, R.S. Santos and T.J. Pitcher. 2008. Abundance and distribution of seamounts in the Azores. *Marine Ecology Progress Series*, 357: 17–21. doi:10.3354/meps07268.

Pereira *et al*., 2006. Standardized catch rates in number and weight for the Blackspot seabream (*Pagellus bogaraveo*) from the Azores longline fishery. WGDEEP working document, WD15b, Vigo, 2006.

Pinho, M. R., J. Pereira and I. Rosa. 1995. Caracterização da pesca do isco da frota atuneira Açoreana. *Arquivos do DOP, Série: Estudos*, nº 2/95, 29p.

Pinho, M. R. 2003. Abundance estimation and management of Azorean demersal species. PhD thesis. Department of Oceanography and Fisheries, University of the Azores, Horta, Portugal, 163 pp.

Pinho, M.R. and Menezes, G. 2005. Azorean Deepwater Fishery: Ecosystem, Species, Fisheries and Management Approach Aspects. *Deep Sea 2003: Conference on the Governance and Management of Deep-sea Fisheries*, Conference Poster and Dunedin Workshop Papers. FAO Fish. Proc. 3/2.

Pinho, M. R., Krug, H. and Pereira, J. G. 2006. Data evaluation for the assessment of red black spot seabream (*Pagellus bogaraveo*) from ICES Area X (Azores). ICES W.D.15-H, WGDEEP, Vigo 2006.

Pinho, M. R. and Menezes, G. 2009. Pescaria de demersais dos Açores. Boletim do Núcleo Cultural da Horta 2009:85-102. ISSN 1646–0022.

Ramos, F. and O. Cendero. 1967. Notes on the age and growth of *Pagellus cantabricus* (Asso) of Northern Spain. ICES CM 1967/G: 3. 8 pp.

Rosa, A. (*in prep*). Demersal fish assemblages off the Azores: spatio temporal patterns and trends.

Sanchez, F. 1983. Biology and fishery of red sea-bream (*Pagellus bogaraveo*) in VI, VII and VIII Subareas of ICES. ICES CM 1983/G:38. 15 pp.

Silva, H. M. and Pinho, M. R. 2007. Small Scale Fisheries in Seamounts (Chapter 16), 335–360. In: Pitcher, T.J., Morato, T., Hart, P.J.B., Clark, M.R., Haggan, N. and Santos, R.S. (eds.) Seamounts: Ecology, Conservation and Management. Fish and Aquatic Resources Series, Blackwell, Oxford, UK, p. 533.

Stocey, B., Menezes, G., Pinho, M. R., Rogers, A. D. 2005. Genetic population structure in the black-spot sea bream (Pagellus bogaraveo Brunnich, 1788) from NE Atlantic. Marine Biology, 146: 793–804.

Table 1. Time-series from fishery and survey available for the assessment of *Pagellus bogaraveo*, ICES, Area X. Data in brackets refers to a period.

DATA	FIHERY	SURVEY
Length composition (sex combined)	1990–2008	1995–2008
ALK (otholits)	(2002–2008)	1995–2008
Maturity ogives	(1982–1986); 1991; (2002–2008)	-
Sex-ratio	Same as maturity ogives	1995–2008
Abundance index	1990–2008	1995–2008
Landings (weight)	1980–2008	-

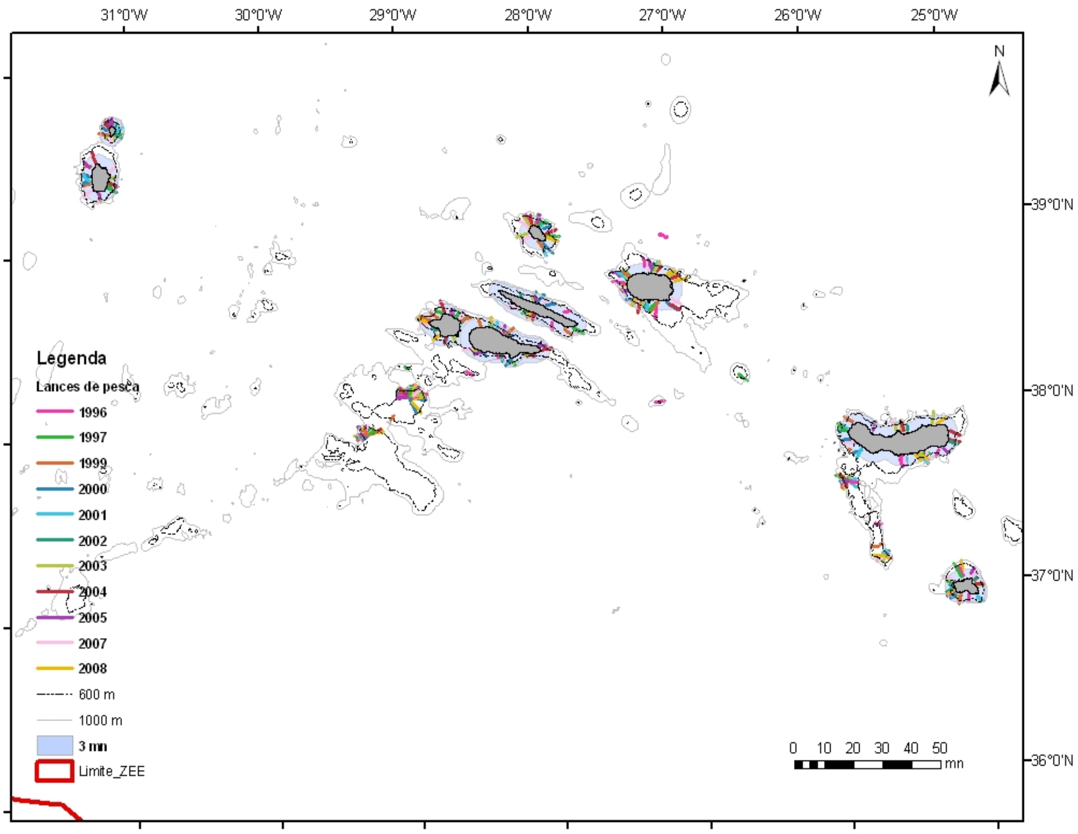


Figure 8. Statistical areas covered by the Azorean Spring Demersal Longline Survey. Annual transepts are represented on the graph for illustration. The 3 miles (shadow) island coast box area and the 600 m and 1000 m contour are also shown. Adapted from Rosa (1999).

15 Recommendations

WGDEEP 2010 recommends the following:

15.1 Benchmark Assessment meeting on deep-water stocks proposed for 2011 and 2012

WGDEEP agrees with the ACOM suggestion to holds a deep-water stock assessment benchmark meeting in 2012. To allow sufficient time to incorporate results into assessments, this meeting should be held in January 2012 at latest. Suggested deep-water stocks to cover in this meeting are;

- Blue ling in Vb, VI and VII;
- Orange roughy VI and VII;
- Black Scabbard fish all ICES subareas;
- Red sea bream in Division IXa and Subarea X;
- Greater forkbeard in all ICES subareas.

Stock identity will not be addressed by this group as it will have been addressed in a workshop before the meeting (see 15.2).

WGDEEP considers that the proposal to hold a benchmark workshop on deep-water ecosystems in the Celtic Seas ecoregion in 2011 will not represent the best timing. The Deepfishman project has a work package on this which will be delivered in early 2012. In order that this information can be fully considered by the Benchmark Workshop, it would be preferable to hold the meeting in 2012. This could be incorporated into the deep-water stock assessment workshop proposed above if sufficient time is allocated (around 10 days) and appropriate experts invited.

15.2 Workshop on stock identity

Current stock assessment units used by WGDEEP are based on the best currently available information, however, in many cases this information is insufficient to identify biological stocks with any confidence. WGDEEP is aware that new information on genetics and other studies relevant to the identification of biological stocks is expected to become available in the near future (DEECON project results to be released later 2010). We propose that a workshop on stock identity in deep-water species should be held in early 2011 to evaluate data relevant to WGDEEP stocks and make suggestions for new assessment units.

15.3 WGDEEP work programme

WGDEEP 2010 was held in April; somewhat later than has been the practice in recent years. This was highly beneficial for stock assessment as it allowed the use of complete catch and effort data that would not have been available had the meeting been held earlier, eg. French stakeholder tallybook data, Norwegialn longline cpues, Icelandic Spring survey indices and Spanish catch data.

We propose that the practice of meeting in April should be maintained in advice years but in other years, if it is necessary to co-locate with WGDEC, it may be more appropriate to hold the meeting in March.

In advice years, at least eight days will be required to complete the work of assessing stocks and drafting advice sheets.

We propose that a two day workshop on Intercatch should be held prior to the next WGDEEP meeting.

15.4 Working group chairs

WGDEEP recommend that the Group should have two co-chairs. These will be Tom Blasdale and Phil Large.

15.5 Improvement of data availability

The Working Group is aware that, under NEAFC regulations, all fisheries occurring in new areas in the NEAFC Regulatory Area must be accompanied by Impact Assessments and a programme for biological sampling. The availability of this data would greatly assist WGDEEP in evaluating the impacts of deep-water fishing on stocks and the wider marine environment.

Reports of the data collected by observer under the EU deep-water licensing regulations should be made available to WGDEEP and WGDEC on a regular basis. These data, from 2009 onwards, should include information on the maturity composition of blue ling catches. Data should be stored and made available to ICES in the same way as data collected under the DCF.

National sampling plans submitted to the EU under the deep-water licensing regulations should be submitted to ICES for scientific evaluation.

Catch and fisheries data (including VMS data) from all countries should be made available to ICES at the highest possible resolution for spatial analysis.

15.6 Terms of Reference for 2011

Evaluate methodologies for developing MSY targets for data poor and deep-water stocks and propose targets for the stocks assessed by WGDEEP.

Complete the development of Stock Annexes for all the stocks assessed by WGDEEP.

Continue work on exploratory assessments for deep-water species.

Annex 1: List of participants

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Annex 2: Technical minutes from the Deep Sea Stocks Review Group

- RGDEEP
- By correspondence 16 April–12 May 2010
- Participants: Ciarán Kelly (Chair), Arni Magnusson (Iceland), Paul Marchal (France), Francis Neat (UK)
- Working Group: WGDEEP

This review document is a feedback document to WGDEEP; as well as providing a technical quality check for ADGDEEP who have the responsibility of producing the ICES Advice, for the stocks covered by WGDEEP.

The review document is based on a draft version of the WGDEEP report. Subsequently, many errors that the Reviewers identified were corrected and issues in the RGDEEP Technical Minutes were addressed in the final version of the WGDEEP Report.

General comments

The 2010 WGDEEP Report is a very comprehensive volume of information. On the basis of the detail and of the extent of the information the WG are to be commended. The Report also represents an improvement over previous years, and the analyses now include assessment benchmark efforts for several stocks. That said however the Report does not represent a useful synthesis of the information. All of the reviewers have invariably made reference to overly long texts with unclear conclusions. There are several sections which are well written and laid out, these make a sharp contrast with others which are poorly laid out or difficult to follow. The reviewers understand that the WG have gone to some lengths to keep the Report as brief as possible, however brevity is not merely a mater of leaving information out of the Report, it should be achieved by synthesising the information.

In the technical minutes of the last review in 2008 a number of issues were highlighted, thankfully some of these have been addressed, however the issues below remain problematic in the 2010 report;

- If information is untrustworthy and/or does not materially affect the analyses or conclusion, do not waste time or space dealing with it. Simply ignore it, or deal with the problem intersessionally.
- If a particular analysis forms the basis for the conclusions (whether or not this analysis was presented previously), **ALL** the necessary supporting information must be presented in the Report.
- The EG report is the primary the knowledge base for the advice. If its conclusions are equivocal then this makes for a weak basis for advice.

The issue of commercial cpue series is still problematic for WGDEEP. The reviewers recognise the standardisation efforts made by the WG (detailed in Section 3) and the importance of these efforts to the interpretation of the data. However unstandardised cpue indices still appear in the report. The reviewers recommend that for ALL commercial cpue series there should be an explicit treatment of time-series which may represent changes in technology (i.e. do not put two series on the same plot and then say that they are not comparable). Cpue plots should only be presented with uncertainty bounds on the point estimates, and some effort to deal with "efficiency creep" needs to be made in the standardisation. The use of cpue from attracting fishing methods (such as longlines) needs some justification as to how the index deals with inter (size based) and intra-species competition at the hooks (e.g. the decrease in abundance of a large predator may result in an increased cpue for a smaller fish on the lines even if their abundance is not changing). Even depending on hook size longlines can be extremely selective.

Where useful survey information is available, it does not seem to have been used for all stocks. This is an unfortunate oversight. A singular robust survey index, is often far more useful than several incomplete or partial time-series.

In relation to the Report layout: The standard subsection "x.y.2.6 Catch, effort and research vessel data" should explain in some detail how the cpue data were standardized. Which GLM family and predictors were used, etc. This section could make reference to the general cpue chapter which should detail the standardisation approaches.

Catch data is very useful and should be presented as line or stacked bar plots, and where possible as spatial plots by rectangle. The historical perspective on many fisheries is very important and this should always be included in these plots. This should be addressed explicitly in subsection "x.y.2 Landings trends" for every stock, and a standard sentence describing what is known about the fishing history before the first year in the landings table should be included.

It is somewhat confusing whether trends in the data (change over time in length distributions, age distributions, and biomass indices) should be described inside the "Data available" section or the "Data analyses" section. Some authors describe the trends inside the "Data available" section, along with the data sources and dimensions (number of years, number of gears, etc.), and leave "Data analyses" for modelling results. Other authors use the "Data available" for material and "Data analyses" for results. It may be helpful to divide the material accordingly: (1) material, (2) results with descriptive statistics, and (3) analysis. It seems practical to combine 1+2 (reasonably objective) and keep 3 (always subjective) separate.

Some standardization makes the Report easier to read. Currently, there seem to be no guidelines for WG authors regarding what should be in each section. It might be worthwhile creating such guidelines.

The benchmark process appears not to have delivered very practically for WGDEEP. The benchmark process is designed to handle developments to established assessments such that there is not year to year “fiddling” with the settings. In a number of instances assessments which were looked at in the benchmark process (WKDEEP) were agreed as indicative of trends only; however the reviewers understand that the people running these assessments were not at the benchmark meeting. These individual(s) then continued to develop the assessment, benchmarked as trends only, within the WG (after WKDEEP) and put them forward as a basis for quantitative advice. Given the lack of stock annexes, and the incomplete Benchmark Report, the reviewers are not sure, if the benchmark process is suitable, in its current setup, for WGDEEP.

Almost all report sections (stocks) continue to recommend (for some years now) collecting information that can be used to evaluate a long-term sustainable level of exploitation, and yet in many cases this analysis is not done. The reviewers note that where ageing is possible or at least length frequencies and growth information is available, a crude production function (e.g. YPR) could be explored; by comparison with an exploitation proxy, this could give an indication whether the stock was under or overexploited with respect to long-term sustainable yield. If data problems which preclude even this kind of crude analysis persist, WGDEEP should come up with a short-term and longer-term strategy to address the issues. This way one would expect to see some progress year on year.

These recommendations are not intended to push more workload onto an already highly loaded WG. It is envisaged that many efficiencies could be created by ensuring data transmission before the meeting starts. If this is effected, then previously benchmarked assessments can be updated "offline" before the meeting starts. There may be several process approaches that the WG can look at to streamline the written sections, either by tasking subgroups to "oversee" a standardised approach, or by making sure that human resources are efficiently deployed during the meeting, to "help out" on sections which may be lagging behind.

Although the data may not lend themselves to traditional stock assessment approaches, the direction taken by the WG to use alternative methods with these data is positive, and it is hoped that it can be extended to look at simple production functions in future. A concentration on the objectives of elucidating the exploitation level of the fishery(ies) on the stock, and analyses of the productivity of the stock given the fishery pattern, could yield some very practical and useful management advice. In addition a development of the productivity susceptibility approach (outlined in the introduction) would be very useful as an additional piece of information for mixed deep-water fisheries.

Detailed technical review

Ling in Vb (Report Section 5.2)

Reviewer 1 General comments

It may be appropriate to schedule a stock assessment next year, preferably using a modern statistical catch-at-age model. Only minor changes required now, to give a better overview, clarify, and correct errors.

Reviewer 2 General comments

Informative section with plenty of data. Some of the conclusions are not well substantiated on the basis of the data presented.

Reviewer 1 Technical comments

5.2.2 Landings trends

Landings data (Tables 5.2.0a–c and Figure 5.2.1) should be presented back to the early 1970s, to shed light on the possible stock decline from the early 1970s to mid 1980s, indicated by the Norwegian longliner cpue data; this is highly relevant to the status of the stock.

Figure 5.2.1 x-axis labels are not readable.

5.2.5.2 Length compositions

Point out what is the most common length caught by each gear.

5.2.5.3 Catch-at-age

Why are there so few otolith readings from 2007 and 2008, as indicated in Table 5.2.1?

Figure 5.2.3 y axes should show relative frequency (%) or let the axis limits vary between panels.

Point out what is the most common age caught by each gear.

Point out that recruitment variability seems low, with no gigantic or almost missing year classes.

5.2.5.6 Catch, effort and research vessel data

The longest cpue series (Norwegian longliners) shows a long-term decline, from around 150 (1973 to mid-1980s) down to around 80 in recent years; this is worth mentioning before talking about the "increasing trend in the last 3 years."

Were no otoliths sampled in the groundfish surveys, or have they not been read yet?

Modern statistical catch-at-age models can incorporate the highly valuable survey biomass indices, even though no age data are available.

5.2.6.1 Cpue trends

Did the Norwegian longliners switch to gear that is likely to catch less g/hook (thus explaining the declining trend) or more?

"stable stock size up to about 2000" should be "stable stock size from the mid-1980s up to about 2000", but probably declining stock size before the mid-1980s.

5.2.8 Management consideration

Specify exactly which data are needed.

Reviewer 2 Technical comments

Section 5.2.2 There is a statement that landings have been very stable since the 1950s; however it is a pity that there is no tabular or graphical evidence to support this. The data which is presented shows that landings have been stable in recent years (although there are currently (2007–2009) approximately twice the volume landed at the start of the presented time-series (1988)). These data mask what could be an important change in the fishery with decreased landings by Norway and Faroes in Vb2 and an increase in effort and landing from the Faroes in Vb1.

Section 5.2.4 There is a reference to a minimum landing size of 60 cm, however Figure 5.2.2 shows size frequency of commercial landings with a considerable proportion of landings below this size, particularly form longliners. One would have to ask the question if the management measures are being enforced, and if they were whether the assumption of no discarding would hold?

Section 5.2.5.3 The second sentence says that no new catch data were available for 2008–2009. However Figure 5.2.3 shows landings-at-age for longliners >110 grt for all years up to 2009 m and for trawlers>1000 hp for all years except 2007 and 2008. So the sentence is technically incorrect. The text goes on to explain that the samples were not raised, but why not? Surely this is the basic function of the WG.

Section 5.2.4 Says no new data for weights at age are presented for 2008–2009, however Table 5.2.1 shows that there was sampling for weights in these years.

Section 5.2.5.5 There is a statement that natural mortality is assumed 0.15 for all ages. This may be fine, but given the large size of adults and their ecological niche (top predators), would they not likely have a lower m than juveniles of this species? Just a thought.

Section 5.2.5.6 There is a statement that all the commercial cpues show a small increasing trend over the last three years. Without any detail on the standardization of these indices and any analyses of the precision of the annual point estimates, I would say this statement is weakly supported. In the second last paragraph for this section, there is a reference to the fishery independent cpue indices not being used for tuning as no age structure is available; I would make two points. First you could use the index without an age structure, and second if you have a length structure you could "borrow" an ALK from adjacent years or even from commercial series to give an age structure; presuming that the survey catches are at least measured.

Section 5.2.6.1 There is a statement that the lower cpue from the Norwegian longline series in the more recent years may be explained by changes in fishing gear. I would comment that it is not often that fishing gear is changed to make it less effective at capture, therefore I would conclude without further supporting information that this statement is counter intuitive.

Reviewer 1 Conclusions

Relatively stable fishery since the mid 1980s and WG recommends same number of fishing days. The stock was probably larger in the 1970s and early 1980s, but the WG chooses to compare the current stock status to the mid-1980s. There seem to be enough data for a stock assessment, and a modern statistical catch-at-age model could both incorporate the survey data biomass index (which was not done with XSA in WGDEEP 2007) and quantitatively express the uncertainty that the WG discusses in qualitative terms.

Reviewer 2 Conclusions

This section concludes with the "take home message" that taken together the commercial cpue series indicate over time a stable, increasing and stable stock abundance. I would consider this conclusion poorly supported by the data analyses and presentation. There is no description of the standardization of the indices, and no presentation of the uncertainty bounds on each years point estimate, from which conclusions on a trend are being deduced. Given their unknown standardization and precision, an alternative interpretation of these series is a gradually increasing cpue over 15 years reflecting the efficiency creep of the fleets over this time. While the data do not indicate a drastic change in the abundance of the resource, without a more thorough presentation of the analyses of the dataseries, I would be reluctant to draw any more conclusions.

Apparently an assessment was attempted three years ago, and while I understand the EG is taxed with a lot of work, I would wonder why no update on such analyses has been attempted. At the very least a YPR could have been conducted from which a sensitivity to selection and biological parameters could have been explored. This coupled with a range of rough estimators on current exploitation rates, could give a gross indication of the state of the resource relative to high long-term yield.

Ling in I–II (Report Section 5.3)

Reviewer 1 General comments

This year's recommendation needs to be clarified. Other than that, only minor changes required, to give a better overview, clarify, and correct errors.

Reviewer 2 General comments

Informative section with plenty of data. Some of the conclusions are not well substantiated on the basis of the data presented. Please include plots of any data you are drawing conclusions on. Please do not include abundance-series and expect to draw conclusions on trends, without some estimate of the uncertainty on the point estimates. It becomes difficult to say anything conclusively about a trend without an appreciation for the “noise” in the dataseries you are looking at.

Reviewer 1 Technical comments

5.3.2 Landings trends

Provide barplot with landings, perhaps stacked by area or gear.

"Preliminary landings for 2009 show a decrease to 8086 tonnes" should be "Preliminary landings for 2009 show a decrease to 8406 tonnes."

5.3.4 Management

Do the two sentences "The quota for the EU in Areas I and II in the Norwegian zone for bycatch species such as ling and tusk is in 2010 set to 5000 tons." and "The quota for the EU in Areas I and II in the Norwegian zone (Norwegian exclusive stocks) for bycatch species such as ling and tusk is in 2010 set to 350 tonnes." contradict each other?

5.3.6 Data analyses

"from 72 to 34" should be "from 72 to 42", according to Table 5.3.1.

"during the period 1995–2008" should be "during the period 1995–2009" in Table 5.3.1 caption.

"fishing days per vessel have remained relatively stable during the last years. (Table 5.3.2)" should be "fishing days per vessel have increased at the same time (Table 5.3.2)."

"In Figure 7.3.1. the data"should be "In Figure 5.3.2 the data."

5.3.7 Comments on the assessment

Heading should be numbered 5.3.7.

"these estimates cannot be compared because" should be "these estimates cannot be compared with earlier years because."

The text does not explain how the cpue series in Figure 5.3.3 "show that ling to a very large degree is a bycatch species in Area IIa (Figure 5.3.3.)"

5.3.8 Management considerations

"by 2009 there were only 34 vessels" should be "by 2009 there were only 42 vessels", according to Table 5.3.1.

"52% reduction since 2000" should be "42% reduction since 2000", according to Table 5.3.1.

Mention that even though longline effort has decreased from 2000–2009, landings have increased substantially at the same time.

The new interpretation of the cpue data seems to lead to a view of the stock status than the 2008 Advice was based on (see Section 5.3.3); this needs to be said explicitly.

Provide a summary statement about the status of the stock and recommended management actions.

Reviewer 2 Technical comments

Section 5.3.2 the text says the catches in 2000–2005 (which should be 5–7 kt not 6–7 kt) are about the same as in the previous decade, whereas they are slightly lower than the previous decade 5.5–9kt.

Section 5.3.4 The detail on the TAC by area is interesting but the overall TAC should be listed somewhere. I am confused by the text which says that the quota for the EU for bycatch species such as ling and tusk for 2010 is 5000 t and then says lower down that it is 350 t. I still don't know what the overall TAC is?

Section 5.3.5.1 I am sure I have seen several references in this report to the statement that "discards are assumed to be minor because they are prohibited." I would question this assumption, as if the logic followed one would assume that black landings are minor in all fisheries managed areas because they are prohibited, and of course we know that this is not always the case.

Section 5.3.2 There is a conclusion drawn on length frequency data which is not presented in the Report. It is not possible to ascertain the veracity of this conclusion without a presentation of the analysis in the Report.

Section 5.3.5.6 Reference to Figure 7.3.2 presumes it is 5.3.2 which is illegible. Y axes on Figures 5.3.3 and 5.3.4 are illegible. Why is data presented for other areas here??

Section 5.3.6 There is a statement under "comments on the assessment" that the historical data show no historical trend. It is not possible to ascertain the veracity of this comment/conclusion without reference to which data and which period. If I were to guess, that the Report is referring to the cpue data then I would not agree. The "old" cpue series shows a declining trend over time and the new series appears to show an increasing cpue.

Reviewer 1 Conclusions

The WG seems to withdraw the 2008 Advice (constraining catches to 6000 t), since new interpretation of the longline cpue data, separating autolines (2000–onwards) from earlier technology, leads to a more optimistic view of the stock status. It is not clear what the the current WG recommendation is.

Reviewer 2 Conclusions

There is a general conclusion that because the number of vessels has decreased (due to legislation regulating the cod fishery) and the season has been reduced that effort on the species has been significantly reduced. However since 2001 the catches (in the main Area IIa) have not decreased but did dramatically increase in 2007, along with a dramatic increase in the number of hooks used over the previous year. This would lead me to conclude that the number of vessels or duration of fishing is less of an indicator of effective effort than hook numbers. In this regard effective effort has not decreased significantly over the period. However the catch per 1000 hooks seems to have increased by about 40% since 2006; so the question is, is this because of increased targeting, increased efficiency, or increased fish abundance? If it is due to increased abundance and not targeting, does the increase reflect the stock or is it due to a change in fishing area or season? Without information to answer these questions it is difficult to draw any definitive conclusion from the data presented.

Ling in Va (Report Section 5.4)

Reviewer 1 General comments

This year's recommendation needs to be clarified. Other than that, only minor changes required, to give a better overview, clarify, and correct errors. Gadget assessment sounds promising.

Reviewer 2 General comments

A well written and informative section. Logical analyses are clearly presented and easy to follow, thank you!

Reviewer 1 Technical comments

5.4.1 The fishery

In Figure 5.4.1 caption, "where it was 50% or more" should probably be "where it was 50% or less"; otherwise, the caption leads to the erroneous statement that in 2005 around 90% of the annual catch of cod were caught where it was 90% or more of the catch in each set (which cannot be true if 20% of the catch comes from sets which consist of 50% or more cod).

5.4.2 Landings trends

Provide a barplot showing landings, possibly stacked by country.

The last table is an extra Table 5.4.1 and should probably be deleted, since Table 5.4.3 contains the newest landings data.

5.4.4 Management

Add a sentence in the 2nd paragraph, quantifying the problem: landings exceeded TAC by 50% in 2003/04, 2006/07, and probably again in 2008/2009.

Can Table 5.4.5 be extended back to 1997, like Figure 5.4.4?

5.4.6 Data analyses

Cpue shifting from 0.8 to 1.4 in 2001–2009 (or 1991–2009 for that matter) is better described as an increase rather than "relatively stable over the time period."

"in both in the" should be "in both the."

The statement "the total biomass index ... in the March survey declined by half from the late 1980s to 1989" seems wrong, as the total biomass (and fishable biomass) was around 4 thousand t throughout this period.

Perhaps what was meant is that the total and fishable biomass declined by half from the late 1980s to 1995, simple deleting the "1989, but gradually decreased until."

"All so there is" should be "Also there is" or "There is also."

"The relative changes relative fishing" should be "The changes in the relative fishing."

In Figure 5.4.12 caption, "Ling in Va. Ling in Va." should be "Ling in Va."

"may have declined from 2001 to 2002" should probably be "2001 to 2004" or "2003 to 2004", according to Figure 5.4.12.

Reviewer 2 Technical comments

Section 5.4.1 The Figure 5.4.1 does not show clearly that the ling fishery is now a mixed fishery. To some extent the classification between a bycatch and a mixed fishery is subjective anyway. The Figure does show that ling has become a greater proportion of the catch. The Table 5.4.1 on page 127 is a repeat from last year and should be removed.

Section 5.4.4 It would be useful to see exactly what the TAC was, then one could deduce the magnitude of the overshoot.

Section 5.3.2 There is a conclusion drawn on length frequency data which is not presented in the Report. It is not possible to ascertain the veracity of this conclusion without a presentation of the analysis in the Report.

Section 5.4.5.2 Mean length decreased from 2000–2008. It is just stated that the mean length increased in 2008, given the magnitude of the increase in one year relative to the annual decrease previously some comment should be made on putative causes for this, e.g. a change in the fishery area/depth, etc.

Section 5.4.5.6 There is a comment that the cpue are not used due to changes in fishing technology. This is an important observation, as increased efficiency coupled with increased effort (Figure 5.4.6) indicates significantly increased fishing pressure. The spring surveys do not show a lag between the increased abundance of fish <40 cm and those >90 cm, the increase in abundance for all size groups occurs in the same years. A comparison between Figures 5.4.3 and 5.4.10 shows a fishery concentrated (its greatest proportion spatially) in the area where the survey is detecting a proportional decrease in biomass.

Section 5.4.6 It has already been stated that the commercial cpue is not a useful indicator of abundance trends, so it should not be mentioned in the second paragraph.

Reviewer 1 Conclusions

It is not clear whether the WG is reiterating the 2008 Advice (constraining catches to 7500 t), since the WG does not provide other recommendations.

Surveys and cpue show stock size increasing over 100% from 2000 to 2010, and good recruitment. Effort and landings have increased rapidly at the same time, and Fproxy is close to the maximum since 1985. Landings have repeatedly exceeded TAC by around 50% due to quota carryover and conversion. The high fishing mortality rate may be considered above precautionary levels.

Reviewer 2 Conclusions

There has been a significant increase in landings and effort on ling since 2005; and the TAC is being exceeded. Over this period the survey is interpreted as indicating an increasing abundance. However it is worrying that the increase in abundance and biomass occurs simultaneously for all size groups; this may indicate a change in catchability on the survey, rather than a change in abundance. The increase in mean length in the commercial catches is interpreted as an increase in growth (presumably through strong recruiting yearclasses). However the increase in mean length over the years 2008–2009 (6.9 cm), seems too large (relative to a 1–3 cm decrease annually since 2000) to be explained by this source alone. I would postulate that this effect may be more to do with the development of new fishing grounds or a change in the fish distribution relative to the fishery. These observations coupled with the increasing Fproxy since 2006 (which is now almost at its highest level), would suggest a cautions advice for limiting exploitation on this stock.

Ling in IIIa, IV, VI, VII, VIII, IX, X, XII, XIV (Report Section 5.5)

Reviewer 1 General comments

This year's recommendation needs to be clarified. Contradicting cpue trends (recent Norwegian=increase, Danish=flat, Basque=decrease) should be addressed in the text. WG conclusion makes unclear reference to effort in 1998, which needs to be clarified. Other than that, only minor changes required, to give a better overview, clarify, and correct errors.

Reviewer 2 General comments

Well written and comprehensive section. Some important information used to draw conclusions left out of the Report and only referred to in other documents.

Reviewer 1 Technical comments

5.5.1 The fishery

Start with an overview map showing total (or average) landings in each area, see Figure 9.1.1 (orange roughy) for example.

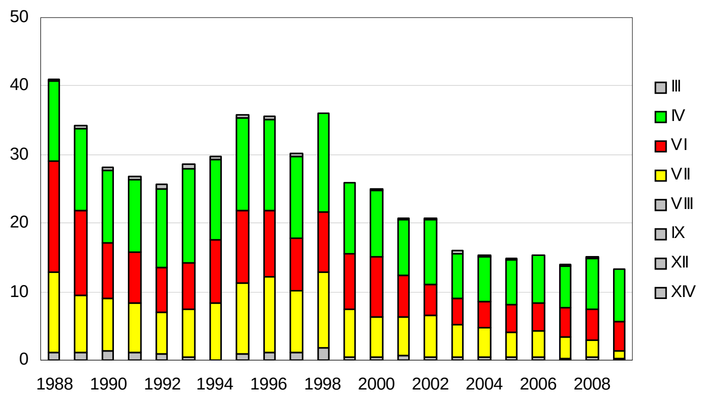
Before the area-specific fishery descriptions, there should be a paragraph decribing the overall picture: when Areas III–IV and VI–XIV are pooled over 1988–2009, 40% of the landings have been in Area IV, 29% in Area VI, and 26% in Area VII.

Spawning sites are of relevance for stock identity; the text mentions VIb1 (Rockall), but are there other places where spawning fish have been caught?

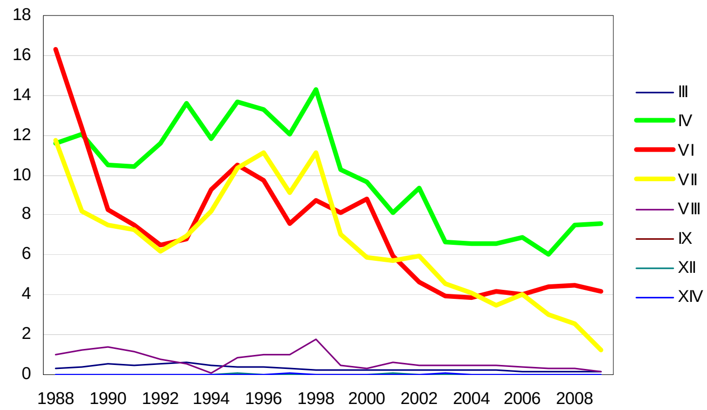
5.5.1.1 Landings trends

Make the total landings Table the first table (now the sixteenth table, with the caption "Ling. Total landings by Subarea or Division.")

Provide one barplot showing the annual landings, stacked by area:



Provide one line plot showing the annual landings:



Before the area-specific landings trends, there should be a paragraph describing the overall picture: when Areas III–IV and VI–XIV are pooled, the total landings averaged 32 thousand t in 1988–1998 and then declined to an average of 15 thousand t in 2003–2009.

This first paragraph should also mention that the decline has been simultaneous in the main Areas IV, VI, and VII (see line plot), but Area VII has seen greater reduction in landings than Areas IV and VI.

A short second paragraph should explain the declining landings with the 2000 cod fishery regulations, and finally a third paragraph should begin the area-specific trends.

5.5.2.5 Maturity and natural mortality

What was the length at 50% maturity?

5.5.2.6 Catch, effort and research vessel data

Figure 5.5.6 is hard to read, but the Basque trawler cpue data seem to indicate around 25% population decline between 1996–2009 in Area VI (40–>30), 90% decline in Area VII (60–>6), and Area VIII is not readable at all. The short description "varies with no apparent trend since 2001" does not convey this information very well.

5.5.3 Data analyses

It needs to be emphasized that even though the number of longliners has declined, the effort has increased slightly, when measured in fishing days and hooks per year.

In Table 5.5.1 caption, "2000–2007" should be "2000–2009."

In Table 5.5.2 caption, "2000–2007" should be "2000–2009."

In Table 5.5.3 caption, "2000–2007" should be "2000–2009."

"Areas IVa, Vb and VIa" should be "Areas IVa, VIa, and VIb."

The sentence "There was an overall increase in cpue in Areas IVa, [VIa and VIb]" is somewhat misleading, given the declining Basque trawl cpue in VI (and VII).

Many of the older Norwegian cpue series show a declining trend: 1986–1993 in IVa, 1971–1976 in VIa, 1986–1993 in VIa, and 1978–1985 in VIb (trends could be indicated with linear regression lines where simple linear regression is significant).

5.5.4 Comments on the assessment

The Norwegian cpue series can be compared within each area-baiting series (see comment above).

"The Danish series ... (Figure 5.5.4)" should be "The Danish series ... (Figure 5.5.5)."

Figure 5.5.6 is hard to read, but the Basque trawler cpue data seem to indicate declines (see comment above); the data should perhaps be tabulated as well, so that Area VIII values can be read.

5.5.5 Management considerations

"number of vessels (52% reduction since 2000)" should be "number of vessels (42% reduction since 2000)", according to Table 5.3.1.

It is not clear how "the total number of weeks fished" has decreased by "41% since 2001–2001", e.g. Table 5.5.1 shows a long-term increase in the number of days.

Why is the current effort compared with 1998? None of the effort data presented include that year, but since the landings were high in 1998 the effort was probably also relatively high.

Reviewer 2 Technical comments

Section 5.5.2.1 There is a reference to discarding previously reported, but no comment on what this showed, is discarding insignificant? If so then say so.

Section 5.5.2.2 There is a reference to mean length varying around 88 cm; however there is no evidence for this presented.

Section 5.5.2.5 The text says males were most abundant at 58%, I would suggest given the sample size that, this is just about what you would expect for a 50:50 ratio, so I would hardly draw the conclusion stated. There is a reference to the maturity stages observed, however there is no reference to the period of sampling, this would be useful.

Section 5.2.6 There is no reference to Figure 5.5.4. Implicit in this figure is cpue over time which is measured from various fishing technology bases. Granted the cpue may not be directly comparable between the series, but given the advances in technology, one would expect the catching power to become more efficient with time. Why should handbaited lines have such a high cpue compared to autolines? If there is no logical answer to this then would one not conclude a decrease in abundance between the 1970 and the contemporary period? To conclude otherwise is to imply that handbaited longlining is more efficient than autoliners. There is a reference to analyses carried out in Helle and Pennington WD 2010; is there any conclusion to this? Why is nothing further stated here? The conclusion on the lpues from the Basque OTB fleet I find poorly founded. There appears to be a decreasing trend in VI and VII and the magnitude of the lpue is so small for VIII, that nothing can be concluded, presumably it is a small bycatch in this fishery.

Section 5.5.5 Presumably the legislation in 2000 is referring to Norway? There is a statement that the total number of hooks has decreased by 22% since 2002, however Table 5.5.3 shows the number of hooks in 2009 to be between 7 and 43% *higher* than the number of hooks deployed per year over the period 2003–2008, and to be only 8% lower than the number of hooks deployed in 2002.

Reviewer 1 Conclusions

It is not clear whether the WG is reiterating the 2008 Advice (constraining catches to 10 thousand t), since the WG does not provide other recommendations. Landings have declined sharply due to cod fishery regulations, limiting the number of longliners that can catch ling. Contradicting cpue trends: recent Norwegian=increase, Danish=flat, Basque=decrease.

Reviewer 2 Conclusions

The major conclusions in this chapter seem to be based on a stable or increasing cpue over a period of stable or decreasing catches implying no detrimental effect of the fishery on the stock. This is then qualified with reference to restrictive legislation for cod effecting a reduction in number of vessels and thus effort in the major nation involved in the fishery. I would make the following comments; this is purportedly a slow growing species, so you might expected a slow turnover rate, and consequently slow changes in abundance if the stock is not overfished. The changes in the cpue in the most recent series are not qualified with any precision making it difficult to comment on any trend. In addition whereas efficiency would have been expected to increase over time, the cpue is now much lower than in the 1970s and this is not explained by a fishing down of a virgin biomass; as the fishery has persisted for much longer than the dataseries. The conclusion on the decrease in effort is not as obvious as the text implies. In fact the total number of hooks in 2009 was similar to 2002 and quite a bit above that of the recent period 2005–2008, so even if the number of vessels and the fishing period did decrease, the fishery appears to be more concentrated. That said it is not apparent that there has been any major decline in the abundance either.

Blue ling (Report Section 6)

Reviewer 1 Comments on stock description and management units

This section would benefit from extra discussion of spawning areas and reference to the Large *et al*., 2010 paper on this. An overall species distribution map with current stock areas would be useful. Also the Report should point out that there has been confusion between *Molva dipterygia* and *M. macropthalma* in the southern stock. Clearly a major constraint in understanding and managing this stock is the lack of good data on stock structure. Research (genetics and other stock id techniques are clearly needed to be applied to this species).

I fail to see why maps 6.1.1 and 6.1.2 are presented here rather than in Section 6.3. The southerly extent of this map suggests there is still confusion between the two species.

Blue ling Areas V and XIV

Reviewer 1 Comments

It is stated that ‘This increase is likely to be the result of increased availability of blue ling in the northwestern area, rather than being the result of an increase in effort or reporting’. It is not at all clear what the data and reasons behind this statement are.

6.2.6 I disagree with the statement that the length sampling has been inadequate-a minimum of 400 fish per year and over 2000 in some years-the LF distributions appear representative.

The map of spawning grounds is very poor and has already appeared in the WGDEEP Report of 2007. It is not necessary.

I agree that the use of data from the spring survey is not suitable for cpue estimates since this survey does not cover the core depth range of the species. It nevertheless may provide information on recruitment of blue ling.

Figure 6.2.1b is difficult to interpret.

The cpue time-series suggest the stock is relatively stable. Overall the state of knowledge of in Area Va is pretty good with the exception of a reliable aging protocol. Renewed effort into age reading should be encouraged so that formal assessments can be undertaken. This is particularly important given the recent resurgence in landings for this species in Area Va.

Reviewer 2 Comments

- No TAC regulation, no constraint on effort development. Should we recommend catch limits as for other DW spp?
- Spring survey (<500 m) and commercial cpue of limited use. It should be better stressed that the autumn survey is the source of advice. Then see whether the other indicators (trawl cpue, spring survey) fit. In fact the spring and the autumn surveys provide conflicting signals in some years.
- Separating small (~recruits) and large (~post-recruits) individuals in the survey results is useful, thanks.
- p. 5: "In most years the length distribution in the autumn survey peaks between 70–80 cm, close to what is observed in the commercial trawl catches (Figure 6.2.4)": so the survey and commercial vessels have the same selectivity?
- Recent increase of effort targeted at blue ling, confirmed by increase in estimated F. Is this due to catches not being capped by a TAC?
- The increase in F (and in yield) should result in management advice on setting catch (or effort) limits in addition to the protected area on spawns (as for other dw stocks).

Blue ling Areas Vb, Subarea VI and VII

Reviewer 1 Comments

The new time-series data from the research surveys are a welcome addition here, however, more could perhaps be made of these in particular;

Table 6.3.3 Needs a column of hours fished as well as number of hauls.

Table 6.3.4 States 'Note: nos fish are not standardised for tow duration which changed from 2 hrs to 1hr in 2009' this is not a big calculation to make and should have been done.

Figure 6.3.2 Is partially a repeat of Figure 6.1.1 and the plot for 2007 adds no new information.

LF plots should be formatted in the same way so that direct comparisons can be made.

The analyses presented are preliminary and there is promise of a more formal assessment for 2012. The time-series of cpue and lpue suggest a possible upturn in numbers in the last 3 years, but it's hardly dramatic. Data quality and quantity is good for this species in these areas. Aging protocols are problematic and this should be considered a priority for the future.

Reviewer 2 Comments

- About the relatively low landings in 2009, what is the extent of data completion, especially on the French side?
- p. 20: "However, the French industry has reported low levels of discarding towards the end of 2009 when quotas were exhausted." Considering the previous point, does this mean that only France exceeded its catch allowance? Or does this confirm that the 2009 landings data are notoriously incomplete?
- p. 21 on RV data. What is the depth range of the Faroese survey. If <500 m, same lack of coverage as for the Icelandic spring survey.
- Scottish/Irish survey. It could be interesting to know the catch ratio between the area covered by the survey and the total catch, to evaluate its coverage. Also, the survey results could be shown for two length groups (recruit and post-recruits), similar to what was done for blue ling in Va. This would provide some idea of recruitment variations over time.
- The preliminary analytical analyses support a reduced F in recent years. Interesting but how sensitive is it to assumptions around growth?

Blue ling Areas I, II, IIIa, IV, VIII, IX, X, XII

Reviewer 1 Comments

These areas are clearly much less well understood. There is some interesting new information on the amount of blue ling landed from Hatton Bank (Area XII). Very little effort has been made to consolidate the information in this section.

Reviewer 2 Comments

- Why is XIIb not included in the Vb, VI and VII stock;
- Difficult to link catches with stock level, when no other information is available. Why would the low TAC not be responsible for the low catches in recent years?
- The lack of TAC in XII is worrying though, maybe add some recommendation there? Protected areas may not be a sufficient tool to manage that stock.

Tusk (Report Section 7)

Reviewer 1 Comments

An incredibly long section: 87 pages on a single species! How much is new and how much is necessary? It desperately needs to be summarised and streamlined.

Figures 7.1.1 and 7.1.2 are missing; since they are apparently from 2006 and 2007, I fail to see what is new about them.

Tusk Areas Va and XIV Section 7.2

Reviewer 1 Comments

Table 7.2.5 Information on otolith sampling by gear type-in what context is this important-how is this going to be used in assessing the stock or understanding its biology and current state?

It is stated that 'At the benchmark meeting for deepsea species in 2010 (WKDEEP) the Group concluded that the results of Gadget model for tusk in Va were indicative of trends'. Is that all? This must be the minimal hope for an assessment model. It is difficult to understand what the gadget model does as details are not provided, but the outputs looks reasonable.

Figure 7.2.1 Is obscure and difficult to figure out (as it was with blue ling). I can't see the point of the comparison with cod.

Figure 7.2.3 It's not clear that there are changes in spatial distribution of catches of tusk around Iceland; there is variation, but significant change; it's not obvious and it's not been statistically tested for in any way.

Figure 7.2.4 These data could better summed up by a quick analysis and sentence to the effect of whether there has been any significant change in LF of the species over the past ten years.

Figure 7.2.5 Again no analysis is presented. It does not look like a change in age; but, it needs to have statistical test of this.

Figures 7.2.13 I can't make out what these plots are and whether they provide anything useful; what can be drawn from them? How do they help us interpret the model output?

Reviewer 2 Comments

TAC however not restrictive in Iceland, and does not apply to foreign vessels which are unregulated. Should we not put some recommendation there?

- There is a lack of a statement to qualify the relative strength of the different surveys as reflectors of stock abundance, and also which one should be used in priority and why. The Icelandic spring survey seems to be used in subsequent analyses, why not the autumn survey? Also both surveys show conflicting signals in recent years, which should be commented.
- Separating small (~recruits) and large (~post-recruits) individuals in the survey results is useful, thanks.
- Why don't we have the length distribution from the autumn survey?
- Thanks for providing some diagnostics of the Gadget assessment. It would be good to summarise the different Gadget assessment outputs (F, SSB, TSB, landings) in a tabular form (similar to the XSA Table 16). I have some concerns about the outcomes of the model, and these are expressed below;
- Why do we have SSB and B increase in recent years while the spring survey indicates a decrease? There is a lack of fit (N vs. survey) for some of the plots in the older age in Figure 7.2.17 (50–59, 60–69, 80+ cm), which also suggests a conflict between survey data and catch data;
- Also the recruitment increase in Figure 7.2.19 seems to conflict with the decrease of fish <30 cm for the spring survey in Figure 7.2.8;
- Also trends in F (increase and then decrease) not consistent with those in the F-proxy (steady increase since 2005), although the discrepancy is less obvious;

Tusk Areas I and II

Reviewer 1 Comments

None.

Reviewer 2 Comments

- Comments on the assessment: The correct series is that of 2000–2009. Cannot be compared with the previous one (change from handline to autoline). All vessels equipped in 1985. So why can we not compare the increase >2004 with 2000–2004?
- It would be useful to have the confidence intervals around cpue to see whether the fluctuations reveal some regime shift or just a noise (especially in the years where few vessels participated in the reference fleet).

Tusk Areas VIb

Reviewer 2 Comments

- Same comments for the Norwegian cpue series as for I,II.

Tusk areas MAR

No review comments.

Tusk other areas

Reviewer 1 Comments

Do we really need all these tables on numbers of hooks deployed and days which tusk were caught? This information is peripheral to the aims of the EG. This type of information is why the Report is so exceedingly lengthy.

Section 7.6.2.5 This data tells us nothing other than tusk do not spawn in the third quarter of the year; and since this is already established, it is hardly new and important information.

Reviewer 2 Comments

- Same comments for the Norwegian cpue series as for I,II
- Not easy to compare the trends of the different series (Norwegian cpue series, Faroese survey in Vb and Danish cpue in IVa). Large recent increase in all indices seems corroborated across all time-series available. It might be useful to have the different series on the same graph.
- Could the Faroese survey outcomes be shown for two age groups (recruits/post-recruits), similar to the Icelandic survey in Va?

Greater silver smelt Report Section 8

Greater silver smelt in Va

Reviewer 1 General comments

This is a well written, well laid out and informative section.

Reviewer 1 Technical comments

Section 8.1.1 Line 18 WGDEEP in 2010 not 2009.

Section 8.2.1.3.2 Line 33 figure reference is 8.2.2 not 8.2.1.

Section 8.2.2 Top of following page line 2 to almost 8500 t not 9000 t, in 2008 not 2009 and then to over 10 000 t in 2010 not to 10 829 t in 2009.

Reviewer 2 Technical comments

- Changes in length or age frequency could also be due to spatial change in the fishery?
- Difficult to compare the fishery-derived indices (cpue, length–age frequencies) with those from the autumn survey (which is the reference here), given exploitation shifts and the lack of inter-calibration/standardisation to account for it;
- The trends in recruitment are different depending on whether the series is winsorised or not. Can we qualify which series should be considered or not?
- It would be useful to have the mean or the median of the length distribution derived from the autumn survey in Figure 8.2.8. Eye-balling the figure gives me the impression of a slight increase in (or at least relatively stable) mean length, but that would need to be confirmed.

Should the F-proxy increase not be the basis for recommending this stock to be managed under some TAC (or input-based) regime? It is not extremely important though.

Reviewer 1 Conclusions

The Benchmark attempt at an assessment was unsuccessful, and the rationale presented as two contradicting pieces of information. On the one hand the biological parameters of the stock suggest increasing exploitation levels, while on the other the survey suggests greater abundance. Of course both of these occurrences are possible, but should be reflected in a commensurate increase in the catches. The basis for the increase in the abundance comes from the survey; however this has not covered the entire area of distribution of the fish as evidenced by the SW fishery in the late 1990s. It may be possible that there has been some movement of fish from outside the survey area to inside, which is reflected as an increase in abundance by the survey, but which may not necessarily be the case. If there has been no fishing depth effect, the decrease in proportions of the catch over 16 years since 1997 and the decrease in mean length in the catch is indicative of a stock exposed to greater mortality over this time. The conclusion of the section is reasonably founded. However the final line of 8.2.8 should refer to the low productivity of the species (fecundity) as its growth rate is similar to horse mackerel (*trachurus trachurus*) which one would not class as especially vulnerable to exploitation.

Greater silver smelt in other areas

Reviewer 1 General comments

There is a lot of information in this section; however some important pieces on which conclusions have been based are not presented in the Report. There are some numbering problems with figures and tables (i.e. why do all the figures and tables have a four point numbering system beginning with 8.1 when this is Section 8.3?).

Reviewer 1 Technical comments

Section 8.3.2 Figure 8.1.2.1 missing.

Section 8.3.4 Text table, what does the asterisk denote for Subarea V VI and VII in 2003/2004?

Section 8.3.5.2 There is a statement that length distributions have not changed over time, but there is no plot presented to show this (Figure 8.1.5.2.1 shows only a few samples from 2009).

Section 8.3.5.6 Figures 8.1.6.1 and 8.1.6.2 have the plots mixed up.

Section 8.3.6 Figure 8.1.6.1 should have CI's drawn on all points. Given the reported low turn over rate (high turnover time) in this stock you would not expect to see large changes in abundance by year, this implies that the large changes in year values in the Faroese survey may be noise related. This makes it difficult to interpret any reliable stock abundance information from this plot. There is a statement below this which states that a decline in the Spanish index has continued despite a reduction in catches, again I would ask what would be expected given the low turnover rate in the stock?

There is a statement that surveys for IIa do not indicate a decline in abundance, however there is no plot presented in the report to justify this conclusion.

Section 8.3.7 Presumably the EG means that there was no analytical assessment and that the evidence for the trends in the development of the stock was from surveys.

Section 8.3.8 Beginning on the second line there is a statement that in area 6 the age range had been truncated, which suggested high levels of exploitation. Besides the point that there is no data presented on which to base this statement, the exact same effect (truncation in the size distribution) is explained as a natural reaction as a consequence of a new fishery, for the Faroese zone. Whereas the Faroese fishery was not "new" over that period (1994–2000).

Reviewer 2 Technical comments

- The rapid expansion of the fishery in Vb in recent years (yielding about half of landings in recent years) is worrying indeed, also it seems the only area not be regulated by a TAC. Add a recommendation there?
- "Length distributions for two Faroese surveys in Vb (1994 onwards) showed no obvious trend". Does this survey really really cover the GSS distribution area appropriately, given it is designed to evaluate shallower-water species (cod, haddock, saithe)? This should be commented, also in the light of the previous point.

Reviewer 1 Conclusions

The only basis of the effect of the fishery on the stock is from survey abundance indices. This is a species with apparently a slow turnover rate (low productivity) so you do not expect to see large yearly fluctuations in abundance. Management considerations are presented for three areas. For VI the survey shows a convincing downward trend in abundance and catches have declined by about 80% from the peak about ten years ago. The TAC seems to be limiting the exploitation, and one would expect the abundance to take several years to respond if the F has been reduced. For Area V the presentation of the survey is not convincing, it is not presented with any precision, making it difficult to say anything about the development over time. Other information shows that the mean size has decreased over time and the landings have increased rapidly over the past few years. This is a management area without a TAC and I would conclude that the licensing scheme used as a management instrument is not limiting the exploitation of the species in this area. In Area I and II there is no survey trend shown in the 2010 Report, but there is a reference to a previous report which apparently shows that there is no decline in abundance. There are regulations in force for this area which appear to be limiting the exploitation, however without evidence of the development of the stock over time, the putative effect of the fishery on the species in this area is not verifiable.

Orange roughy (Report Section 9)

Stock description and management units

A recent genetic study demonstrates that there is no genetic structure across the NE Atlantic. A lack of genetic structure does not necessarily mean the stock should be considered as a single management unit. It does however suggest there is potential for recolonisation of areas that were fished out. Given the slow growth and longevity of the species, it will many years before this actually happens.

Orange roughy in VI 9.2

Reviewer 1 Comments

Some new information on this species derives from the Irish and Scottish research surveys which show some interesting patterns with respect to juvenile numbers of the slope areas. The data suggest there is recruitment and that the cohorts are surviving year on year.

Data on monthly cpue from the Irish fishery is potentially interesting as it may indicate when the aggregations form. However it could simply indicate the development of the fishery and the sudden depletion of the aggregations. This data is perhaps worthy of more detailed study.

The phasing out of the fishery has inevitably meant less and less information about the state of the stock. The zero TAC this year effectively puts an end to any fisheries dependent data. This places greater emphasis on the need for data from research vessel surveys if any recovery is.

Reviewer 2 General comments

Well written and clear. The nature of the protected areas and their effect on fleet behavior need clarifying, though.

Reviewer 2 Technical comments

9.2.1.1 Landings trends

Figure 9.2.1 Should be stacked barplot instead of stacked area plot.

9.2.1.3 Management

Where is Hebrides Terrace on Figures 9.1.2 and 9.1.3?

9.2.2.6 Catch, effort and research vessel data

Any ideas why low-power vessels showed no long-term cpue trend from 1992 to 2005?

9.2.4 Management considerations

The management option to fully protect some seamounts should be commented on. The description of the current "protected areas" implies that EU vessels will simply discard orange roughy bycatch in those areas.

Reviewer 2 Conclusions

Fishery is collapsed. Management goal is to set up effective protected areas and minimize orange roughy bycatch.

Orange roughy in VII Section 9.3

Reviewer 1 Comments

Mistake in Table 9.3.4 Should be tonnes not kg.

Reviewer 2 General comments

Minor changes required, to give a better overview, clarify, and correct errors.

Reviewer 2 Technical comments

9.3.1.1 Landings trends

Figure 9.3.1 Should be stacked barplot instead of stacked area plot.

9.3.1.3 Management

Heading should be numbered 9.3.1.3.

9.3.2.1 Landings and discards

"[Irish d]iscarding of Orange roughy was ... <1%" of what? Of the orange roughy catch? In numbers or weight? The dynamics of discarding is such a relevant topic that the absolute numbers should be presented, not just the proportion.

"118 kg only" should be "118 kg only, of which 35 kg were discarded."

9.3.2.6 Catch, effort and research vessel data

"French cpue ... Figure 9.3.6 "Should be "French cpue ... Figure 9.3.4."

In Figure 9.3.4 caption "2006 cpue" should be "French cpue."

Any ideas why low-power vessels showed no long-term cpue trend from 1999 to 2005?

"Cpues for Irish ... are shown in Figure 9.3.7." should be "Cpues for Irish ... are shown in Figure 9.3.5."

"Irish deep-water trawl survey is shown in Figure 9.3.8" should be "Irish deep-water trawl survey are shown in Figures 9.3.6 and 9.3.7."

Maps showing Irish-Scottish survey should be numbered 9.3.6, not 9.3.4.

Plots showing Irish-Scottish survey trends should be numbered 9.3.7, not 9.3.4.

9.3.5 Management considerations

The management option to fully protect some seamounts should be commented on. The description of the current "protected areas" implies that EU vessels will simply discard orange roughy bycatch in those areas.

Reviewer 2 Conclusions

Fishery is collapsed. Management goal is to set up effective protected areas and minimize orange roughy bycatch.

Orange roughy in I, II, IIIa, IV, V, VIII, IX, X, XII, XIV (Report Section 9.4)

Short description of the assessment

Reviewer 2 General comments

Not fully written. Several improvements are required to make a convincing case to introduce more effective management measures. Orange roughy have become a textbook example of poorly managed fisheries, and the subareas in this section are lagging behind in halting the (Faroese) fishery and protecting orange roughy topographical features.

Reviewer 2 Technical comments

9.4.1 The fishery

"relatively modestly sized" should be "slightly larger"; as it stands X can be interpreted as the smallest of those mentioned.

9.4.1.1 Landings trends

Make the total landings table (currently 9.4.0 g) the first table.

"Figures 9.1.1 and 9.1.2" should be "Figures 9.1.2 and 9.1.3."

Add a sentence specifying the accumulated landings in each subarea, starting with the largest fishery.

Mention that X and XII are the only subareas where orange roughy are still caught in considerable quantity, in both cases by the Faroes.

The sentence "Add similar text to black scabbard fishery?" should be deleted.

9.4.1.3 Management measures

What is going on with the Faroese management of the orange roughy fishery? While all other countries have stopped catching orange roughy, they continue to land considerable quantities. If they are not cooperating in the necessary protection of extremely depleted and vulnerable orange roughy stocks, then this should be said explicitly.

The sentence "Add sentence on NEACF ... habitats" should be deleted.

Discuss plans to protect orange roughy topographical features, since Va, Vb, X, and XII seem to be lagging behind VI and VII in this respect.

9.4.2.2 Length compositions

If "no new information" means that older information does exist, then those data should at least be briefly mentioned.

9.4.2.6 Catch, effort and research vessel data

If "no new information" means that older information does exist, then those data should at least be briefly mentioned.

9.4.4 Management considerations

Mention what is going on with the Faroese management of the orange roughy fishery (see comment above).

Mention plans to protect orange roughy topographical features (see comment above).

Reviewer 2 Conclusions

Fishery is collapsed. Management goal is to set up effective protected areas and minimize orange roughy bycatch. Subareas Va, Vb, X, and XII are lagging behind VI and VII in terms of halting the fishery and protecting orange roughy topographical features.

Roundnose grenadier (Report Section 10)

Grenadier in Vb, VI, VII, XIIb

Reviewer 1 Comments

It should be noted that stock structure in the species is currently being resolved using genetics; a recent paper (White *et al.*, 2009) suggested weak structuring, notably between the Mid-Atlantic Ridge and the continental shelf slope.

Figure 1.1 should be moved to next section (p. 320).

The bullet points have the Hatton-Faroe stock together with the Skagerrak stock.

It's important to note that at last the Spanish are forthcoming with data about the fishery for this species at Hatton Bank (Area XII). The Spanish landings if they are as high as they say, must be taken seriously as they are far higher (27 000 tons in 2004) than any recent landings for this species.

Research vessel data; It is stated that no new data is available. This is not so, both the Scottish and Irish surveys have good data on this species (similar data is presented in chapters on blue ling and orange roughy). Why was it not presented, analysed or referred to? In addition there is a recent paper published by Neat and Burns (2010) in deep-sea research which reports trends in research vessel cpue over the past decade.

It is stated that 'the benchmark assessment is considered as indicative of trends only.' While I think the establishment of a benchmark assessment for this species is necessary, what use is it if it can only be considered 'as indicative of trends only.' These trends were already evident in the simple time-series. I guess at least they are broadly comparable.

Reviewer 2 Comments

- p. 6: "The difference of modes of the length distributions of landed catch between the Spanish fleet in Divisions VIb and XIIb and France is probably because of different sorting habits in relation to different markets." This could be an issue in terms of interpreting subsequent results. Could this not be due to different areas being visited by the two fleets corresponding to different life stages? Most of Spanish landings are from XIIb (where no French fleets are present), while the French fleets, but not the Spanish ones, fish in Vb. Maybe this should be elaborated a bit further.
- RV survey. No data from the Scottish/Irish surveys?
- Am I right to understand that the French tallybook data from which the lpue series is derived are those from the observers' programme (it seems so as the series starts in 2000)? If it is so, why are discards not included, so we have a cpue and not a lpue series? Clarify please;
- It is encouraging that all assessments are broadly convergent, whether they build on catch curve or stock reduction analyses. I guess the most recent trends could be further commented. The increase in harvest rate until the mid-2000 may correspond to a period where the fishery was unregulated

by TAC and where fishers tried to increase their catch records in views of the 2003 TAC setting process. The fact that harvest rates remained high until 2005–2006 could indicate that the initial TACs set for RNG were poorly restrictive at the time. The decrease of harvest rate after 2005–2006 could be linked to more restrictive TACs in most recent years;

- The exploratory analysis is useful, given the uncertainties on catch data. Thanks.
- Providing the ratio between B(2009) and the unfished biomass (K or B_0) could be useful, as well as having the median values +/- std in a tabular form. From the reference assessment, it seems that B(2009) ~50%B_0, which does not seem too alarming (in NZ and Australia, B_{MSY} usually ranges between 30% and 40% of unfished biomass for deepwater species such as orange roughy, oreos, etc.), while in Australia the even more conservative B_{MEY} is 48–50% of B_0. To evaluate overfishing, it could be appropriate to compare current harvest rate with that corresponding to MSY. Currently, the harvest rate (which could be considered as a F-proxy) is of the same order of magnitude than M (~0.1).

Grenadier in Area III

Reviewer 1 Comments

The roundnose grenadier in the skaggerak is relatively small and likely to be a separate stock from the other NE Atlantic stocks. The fishery in the Skaggerak is now very minimal, but is should be pointed out that landings were close to 10 000 T just five years ago which is likely to have had a big impact on the small, localised stock.

First it is stated that ‘The abundance indices for roundnose grenadier from the Norwegian shrimp survey have not been considered sufficiently reliable to be used to assess development of this stock’… then it goes on to state that ‘A decline in the survey abundance in 2006–2009 is observed, but the levels in recent years are similar to those in the periods prior to the heavy exploitation, see Figure 10.3.6.’ Why is the data now being considered is previously is was considered unreliable? Bad information can be worse than no information. Some justification is needed here for inclusion of this data.

Other areas; It is very difficult to gauge much about the state of the stock on Mid-Atlantic ridge. Clearly at one point it was very large and landings from this area have been very high in the past. Whether is still is or not is impossible to say given the paucity of data.

Overall there is good information for this species in many areas and the efforts of the EG to assess the stock should be encouraged in the future.

Black scabbard (Report Section 11)

Section 11.2 Black scabbardfish in Vb VI VII and XII

Reviewer 1 Comments

Once again Figures 11.1.1and 11.1.2 seem to be out of place and should be in the next section corresponding to the area in question. The figures in this section are badly organised and just pasted in like a scrap book.

There is further repetition about the fisheries; this section is about black scabbard and has no need to mention other species, such as orange roughy and deep-water sharks.

There is some useful new data on cpue and lpue from French, Faroese and Spanish sources. It is reassuring that most of these time-series appear to showing a similar pattern of relative stability, although only the Faroese time-series is long enough to be considered with any certainty.

It is useful to see the new data from the Scottish and Irish surveys; I would have liked to see more of this. Discussion is weak, however, for example the Report goes on to state 'Mean length per depth stratum data from Scottish and Irish deep-water surveys (Figure 11.2.5) indicates that smaller length classes are preferentially distributed at depths shallower than 1000 m deep. These results support the hypothesis of species dynamics.' What are the hypotheses of species dynamics? Such vague discussion is meaningless.

Reviewer 2 Comments

- It is understandable why the Spanish and Faroese unstandardised cpue series could not be used a stock indicator. So, there remains the French cpue series, but also the survey. Any reason why the surveys were not used extensively to reflect on stock status? Although the French cpue and the survey do not seem to match particularly well, none of them indicate a noticeable trend since 2000.
- The harvest rate should be shown as an F-proxy
- Why not having pursued similar analyses (at least stock reduction) as for roundnose grenadier?

Section 11.3 Black scabbardfish in Subareas VIII, IX

Reviewer 1 Comments

The recent studies from Madeira and Portugal on the reproductive biology of this species are interesting and a welcome addition.

Reviewer 2 Comments

- There seems to be an ageing procedure agreed by WGDEEP this year. Ageing BSF was subject to controversial debates in the past, so is this procedure confirmed? If so, could it be used (next time) to age-structure catches and attempt some catch-curve analysis? How about using this ageing procedure for the Northern stock?

Section 11.4 Black scabbard in Areas (I, II, IIIa, IV, X, Va, XIV)

Reviewer 1 Comments

Section 11.4 'The gear was a traditional bottom trawl, but in the fishing operations the trawl doors did not touch the bottom.' This does not sound like a traditional bottom trawl to me, rather a semi pelagic trawl. More detail is needed.

Overall, it seems that following an initial downturn in abundance this species has stabilised at a lower level.

Greater forkbeard (Report Section 12)

Short description of the assessment

Reviewer 1 General comments

Considerable changes required, addressing whether it is likely that the stock is being severely overfished. Also reorder tables and figures, etc.

Reviewer 2 General comments

There are some nice features to this chapter (plots of catch by rectangle and an exploratory assessment) with regard to exploration and presentation of the data, but the conclusions are not very helpful for the formation of advice.

Reviewer 1 Technical comments

12.1 The fishery

Provide one overview map showing total (or average) landings in each area, see Figure 9.1.1 (orange roughy) for example.

"The rest of landings in that period (12%), come" should be "In that period, 12% come."

The Figures and Table need to be reordered, in the same order as they are referred to in the text.

12.1.1 Landing trends

Make the total landings table (now 12.0h) the first table.

Start by describing the total landings trends, then area by area.

Figure 12.6 is never referred to in the text.

Explain why the total landings have decreased by a factor of 5 from 2000 to 2009, in VI–VII and elsewhere. It doesn't seem to be due to TAC reductions, so is it overfishing or something else?

"that is the lower value" should be "that is the lowest value."

"176 t and 2003 t" should be "176 t and 203 t."

12.2 Stock identity

Spawning sites are of relevance for stock identity; what are the places where spawning fish have been caught?

12.3.1 Landings and discards

Describe the discard estimates in the text; there seem to be years when most of the catch was discarded.

12.3.2 Length compositions

Figure 12.7 needs to be redrawn with relative frequency (%) on the y axis, or allowing the axis limits to very between panels.

12.3.3 Age compositions

This heading (and number) is missing.

12.3.5 Catch, effort and research vessel data

Describe the location of the Porcupine Bank, in relation to greater forkbeard historical catches.

12.4 Data analyses

Before the exploratory assessment, describe in the text what the Basque cpue data indicate about the status of the stock.

Before the exploratory assessment, describe in the text what the survey length frequencies indicate about the status of the stock.

The sentence "French surveys showed ... Subarea VI" should be moved to Section 12.3.5.

Is the model predicting catch from effort? Do the results tell us anything about the status of the stock?

12.6 Management considerations

Doesn't the rapid decline in landings between 2000 and 2009, together with the Porcupine survey results indicate that the stock may be severely overfished?

The information provided in this report suggest that more drastic management considerations should be laid out.

Reviewer 2 Technical comments

Section 12.3.5 Figures 12.10a,b,d,e,f are not particularly informative without any spatial or other relevant context to the strata. On the contrary Figure 12.10.c is very useful as an abundance index, my question would be why this couldn't be produced for the other areas?

12.4 The assessment assumes k=2/3*M, with M derived from an empirical relationship; whereas a quick search of fishbase will yield an estimate of K from a French study at about 0.3. Given the model formulation, I would assume that the whole analysis is rather sensitive to the value of K used. I would suggest that the results should at least be checked for robustness to the assumed K. Some legend describing the notation in the model formulation would help.

12.5 Even if the assessment is not used as the basis for advice, is there nothing WGDEEP could even comment on the utility of this approach, or any value in the trends of the results? For example the trend of abundance from the assessment (2003–2005) maps very nicely to the abundance trend (over the same years) from an independent survey in the centre of the fishery area.

Reviewer 1 Conclusions

The information provided by the WG (rapid decline in landings and survey indices) indicate that the stock may be severely overfished, but this is not reflected in the WG management considerations.

Reviewer 2 Conclusions

Despite going to some lengths to explore a depletion model, the only management advice provided by the WGDEEP is to manage the species as part of a mixed fishery consideration. However for this to be useful one would need to know in what fisheries Forkbeard is caught and how much of a bycatch it is in these fisheries, Alas this information is not presented.

Alfonsinos/Golden eye perch (Report Section 13)

Short description of the assessment

Reviewer 1 General comments

Minor changes required, to give a better overview, clarify, and correct errors.

Reviewer 2 General comments

Much information presented, which is very interesting, but not presented in a way which it makes it easy to base advice. Some of the conclusions on management considerations appear poorly founded.

In Section 13.4, no analyses are presented, however using the growth data already published and the length frequencies, catch curves could have been constructed. There is plenty of data to make an expert judgment on the range of natural mortality, and thus crude estimates of exploitation level could have been made. There is enough data to construct a YPR, and sensitivity analyses on this could have been done to look at likely candidates for F_{msy}. With these two pieces of information advice could have been framed in relation to whether the current exploitation rates were compatible long-term sustainable yield.

Reviewer 1 Technical comments

13.1 The fishery

"Areas VIII and IX, which catches" should be "Areas VIII and IX, whose catches."

The sentence "In all the Areas the catches present a high interannual variability, with a general decreasing trend." should be moved to Section 13.1.1.

13.1.1 Landings trends

Provide one overview map showing total (or average) landings in each area, see Figure 9.1.1 (orange roughy) for example.

The caption in Figures 13.1 and 13.2 mentions Icelandic vessels, which are not mentioned in the text or tables.

Since the first sentence refers to Table 13.3, it should also refer to Figure 13.4.

The total column in Table 13.1.e for the year 2009 should be 312, not 31.

The sentence "Alfonsinos are often a bycatch of demersal fisheries targeting other species." can be deleted, since this was already explained in Section 13.1.

The summarized landings (Table 13.2) should be before the details (Tables 13.1a–g).

The columns in Table 13.2 don't always add up to the total: in 2006 the sum of columns = 367, but total column says 402, and in 2007 the sum of columns = 396, but total column says 317.

Rewrite the sentence "From 1994 to 2000 the total landings fluctuate ... with a peak in 1994 (837 t) and 1996 (960 t)", to make it clear that those are Russian landings from Xb, not the total landings.

"a decrease trend" should be "a decreasing trend."

"The higher catch" should be "The highest catch."

13.3.5 Maturity, sex ratio, length-weight and natural mortality

"length of first maturity" should be "length at 50% maturity."

13.3.6 Catch, effort and research vessel data

The text wrongly refers to Figures 13.15 and 13.16 as cpue.

There are two Figures 13.16, with separate captions.

13.6 Management considerations

State explicitly whether the two species seem equally likely to be overfished or vulnerable to overfishing, or if one is slightly more likely, based on the data presented.

Reviewer 2 Technical comments

Page 401 Section 13.1.2 lines 28–29, this is an incorrect statement of what ICES advised in 2008. Page 401 line 40–41 a reference to the NEAFC regulations and closed areas would be useful.

Section 13.2 Page 402 line 1 what implications for management may the studies have? Lines 4–5 Why would the EG assume something if it considers it contradictory to the information it presents, this is not logical.

Section 13.3.1 Page 402 Figure 13a describes landings, while Figures 13b–g do not specify if the data are landings or catch. There is a reference to discards in the text (line 10–11), but these do not appear in the tables anywhere. Table 13.1c there is an error in the 2008 total. Table 13.1e 2008 does not appear to be preliminary any more (it has been updated), and there is an error in the 2009 total. Table 13.1g should refers to CECAF Area 34.1.2, it should be labeled as such.

Sections 13.3.3 and 13.3.4 growth information is available for the Azores area from Krug *et al*. (ICES CM 1998 O:84) and length frequencies and length–weight are available, so some information on age compositions and weight-at-age could have been determined.

Section 13.3.5 The fact that females in spawinig condition were not observed is an important observation, this implies that *Beryx decadactylus* is spawning outside the area of the fishery and the survey. Line 38 Ripe and spawning fish January to July (not June) peak for females looks like August not February and March.

Figure 13.9 The y axes are labeled incorrectly.

Section 13.4 Nothing presented; see general comments.

Section 13.6 There is a statement that Alfonsinos are easily overexploited by trawl and that they can only sustain low rates of exploitation. These conclusions are not backed up by the data presented. Cpue data are noted as possibly not being a proxy for abundance, but if they were they indicate a decline in abundance in relation to exploitation by longline (Figure 13.16), *Beryx splendens* matures at about 35 cm, this is the same size as given for other studies, which also give the age-at-maturity at 2–6. No information is presented on productivity, and there is some evidence that spawning occurs outside the fishery area (Section 13.3.5). The combination of these facts would lead to the conclusion that a) the stocks may not necessarily be vulnerable to overexploitation, and b) if they were it would not be just to trawling. The conclusion in Lines 13–15 is not substantiated by information presented in the Report.

Reviewer 1 Conclusions

Poor data lead to precautionary advice, seems reasonable.

Reviewer 2 Conclusions

There is a conclusion that Alfonsinos are easily overexploited by trawl and that they can only sustain low rates of exploitation. These conclusions are not backed up by the data presented. Cpue data are noted as possibly not being a proxy for abundance, but if they were they indicate a decline in abundance in relation to exploitation by longline (Figure 13.16), *Beryx splendens* matures at about 35 cm, this is the same size as given for other studies, which also give the age-at-maturity at 2–6. No information is presented on productivity, and there is some evidence that spawning occurs outside the fishery area (Section 13.3.5). The combination of these facts would lead to the conclusion that a) the stocks may not necessarily be vulnerable to overexploitation, and b) if they were, it would not be just to trawling. The final consideration of preventing the exploitation of new seamounts is not substantiated by information presented in the Report.

Red seabream in VI–VIII (Report Section 14.2)

Reviewer 1 General comments

Minor changes required, to give a better overview, clarify, and correct errors.

Reviewer 2 General comments

Simple and straight forward presentation of limited data. There is a reference to the vulnerability of the species due to spawning aggregations, however there is no useful spatial identification of putative spawning areas or spawning seasons which could be protected.

Reviewer 1 Technical comments

14.1 Current ICES stock structure

Provide one overview map showing total (or average) landings in each area, see Figure 9.1.1 (orange roughy) for example.

The paragraph about Figure 14.1.1 should be moved to Section 14.2.

14.2.1 The fishery

"VIII represents the 62% and VI and VII the 28%" should be "VIII represents 67% and VI and VII 33%", according to Table 14.2.1c.

14.2.1.1 Landings trends

Table 14.2.1 needs a caption.

Start the second paragraph with a sentence saying that seabream landings in Areas VI–VIII were on the order of 10–20 thousand t annually during 1960–1975.

14.2.1.3 Management

The sentence "These landings are bycatches ... allowed." should be moved to Section 14.2.1.

14.2.2.6 Catch, effort and research vessel data

These are important data and should be presented quantitatively, despite their shortcomings.

14.2.4 Management considerations

The sentence "Even though in the early 2000s a small ... targetting other demersal species" should be moved to Section 14.2.1.

The sentence "The TAC propose for 2009 and 2010 ... but not in 2008" should be moved to Section 14.2.1.3.

Reviewer 2 Technical comments

Figure 14.1.1 Why are there no catch by rectangle data from France or UK, these should be available.

Figure 14.2.1 The source of data for series 2 would be a useful addition to the legend, otherwise it's a bit cryptic as to where these data have come from. This Figure 14.2.1 does not follow the trends in landings since 1988 presented in Table 14.2.1c, why is this the case?

Reviewer 1 Conclusions

The fishery in Areas VI–VIII is less than 10% of what it was in 1960–1975, and spotty survey data also indicate serious depletion.

Reviewer 2 Conclusions

Given the large decrease in landings it is assumed that the stock was overexploited over the period 1950s–1970s. The low abundance on surveys during contemporary times is presented as evidence of lack of "recovery" and the aggregation nature of spawning as a rationale for the vulnerability of the species to fisheries. Could the changes in catches by the fisheries be related to a distributional change in the species over time? If the EG's conclusions are correct and the species needs to be afforded protection, there is no identification of putative spawning areas or periods nor juvenile distribution areas. If the EG considers these as useful management instruments then they would be well occupied to try and determine the spatial and temporal extents of such putative closures. Without this information the current management strategy of decrementing TAC would seem to be reasonable.

Red seabream in IX (Report Section 14.3)

Short description of the assessment

Reviewer 1 General comments

Unresolved modelling issues could be tackled with a modern statistical catch-at-age model, rather than VPA. That approach would be better suited to make explicit modelling assumptions and portray the uncertainty in probabilistic terms.

Also minor changes required, to give a better overview, clarify, and correct errors.

Reviewer 2 General comments

Lots of information is available on this stock, and the basis for the assessment is benchmarked. However the Stock Annex is rather incomplete with regard to figures and tables. Although the commercial cpue series has been standardized for area gear season and vessel factors, it still assumes a correspondence between abundance and catch rate for a fishing technique which is primarily an attracting method, the survey is subject to the same shortcomings.

Reviewer 1 Technical comments

14.3.1.1 Landing trends

Provide a stacked barplot showing annual landings by country.

14.3.1.2 ICES Advice

The Advice in Area Xa is not relevant in this section.

14.3.2.3 Age compositions

Point out that in 1990–1994, ages 5–8 are relatively common, but in 1995–onwards they are considerably less common.

Point out that the catch-at-age data indicate relatively stable recruitment.

14.3.2.6 Catch, effort and research vessel data

Are there any data supporting the claim that "in the recent years this missing effort increases substantially"?

14.3.3 Data analyses

What kind of results from a separable model was used to carry out a traditional VPA?

The y axis in Figure 14.3.4 starts at 2000, but should start at 0.

14.3.4 Comments on the assessment

The sentence "Current SSB remains at the lowest value in the time-series." should be "Current SSB remains close to the lowest value in the time-series." (Figure 14.3.4 shows the lowest value in 2001).

Point out that the plus group model implies an SSB decline of ca. 10 thousand t between 1991 and 1996, while only 5 thousand t were removed during those years, and that the catch-at-age data do not indicate a major drop in the number of individuals age 10+.

Point out that it would be better to use a modern statistical catch-at-age model rather than VPA, which would make it easier to see how each model fits the catch-at-age data and compare the goodness of fit in likelihood terms.

Reviewer 2 Technical comments

Section 14.3.2 There is a reference to no discard data being available and an assumption that discarding is minor. However Section 14.3.1.3 indicates a minimum size regulation of 33 cm and Figure 14.3.1 shows many fish below 33 cm in the landings, so presumably the regulations are not enforced. If the size limit is not adhered to is the TAC?

Section 14.3.2.3 There is a reference to a tagged fish recaptured after 10 years, this fish would be a useful check for individual growth rates.

Section 14.3.2.4 There is an assumption that the catch weights equal the stock weights. However spawning is in the first quarter, is the fishery also limited to this period? If not then the assumption may not be correct.

Section 14.3.2.6 There is a presentation of commercial cpue data followed by a statement that it may be inappropriate. This is not useful, an expert judgment should be made on the dataseries, and only data which is useful for analyses should be presented in the Report.

Section 14.3.3 This section needs far more detail than is presented. Even an exploratory assessment requires a presentation of the input data, a settings log file, a few diagnostics to rationalize the settings and some plots of stock development wrt F and R and SSB.

Section 14.3.4 While the conclusion drawn from Westerheim and Ricker may be technically correct, it may be a sacrifice one has to make given limited data. On the other hand if recruitment and growth are not highly variable then it would make less of an effect.

Section 14.3.5 The assessment is presented but then qualified as being unreliable. Then a conclusion is drawn referring to the F in the assessment which is not even presented. Although the general conclusion is fine, it is poorly qualified by these statements, and I would add that the information required to crudely evaluate if current exploitation is above that which is sustainable in the long term, is already available.

Reviewer 1 Conclusions

Landings have increased in recent years, the WG recommends lowering the TAC a bit.

Reviewer 2 Conclusions

A commercial cpue index is presented and then qualified as being inappropriate, an exploratory assessment is attempted but insufficient detail is presented to evaluate its usefulness, this assessment is then qualified as being unreliable. Then a conclusion is drawn, referring to the assessment F trend which is not even presented. Although the general conclusion is fine it is poorly qualified by these statements, and I would add that the information required to crudely evaluate if current exploitation is above that which is sustainable in the long term, is already available.

Red seabream in Xa (Report Section 14.4)

Reviewer 1 General comments

Minor changes required, to give a better overview, clarify, and correct errors.

Reviewer 2 General comments

Lots of information is available on this stock, however there is a need for a fishery independent abundance index. The assessment approach may be too elaborate given the lack of fishery independent data. A presentation data followed by a statement that it may be inappropriate is not helpful. The EG should make an expert judgment on the suitability of data and then either present it or not as the basis for analyses or interpretation. There should be plenty of scope here to look at simple catch curves and a YPR, to get some rough proxies for changes in exploitation levels, and an idea of long-term sustainable F.

Reviewer 1 Technical comments

14.4.1.2 ICES Advice

The Advice in Area IX is not relevant in this section.

14.4.2.2 Length compositions

"for the period 1990 to 1998" should be "for the period 1990 to 2008."

14.4.2.6 Catch, effort and research vessel data

Figure 14.4.4 caption should say what the points and lines show.

14.4.3 Data analyses

The sentence "This stock follows ... stock annex." can probably be deleted.

Point out that the mode of the length distribution has shifted gradually from 26 cm (1990) to 30 cm (2008). Section 14.4.3 should simply say "No data analyses were carried out this year."

14.4.4 Comments on the assessment

The two sentences can be deleted. The heading "Comments on the assessment" should be numbered 14.4.4 and simply say "No assessment was carried out this year."

14.4.5 Management considerations

The heading should be numbered 14.4.5 "uncertainty of the assessment fishing mortality" should be "uncertainty about the stock status, catches."

Reviewer 2 Technical comments

Section 14.4.1 I would respectfully suggest that there may be other equally important fisheries in the North Atlantic, notwithstanding the fact that this fishery may be very important to the Azores. The description of the fishery as multigear is not obvious unless one is drawing the distinction between different kinds of longlines.

Figure 14.4.1 The discard figures should be shown alongside the landings data to evaluate the outtake by the fisheries.

Section 14.4.3.1 TAC is 1136 t not 1116 t.

Section 14.4.2.1 The change in the technical regulations is implied as a cause for discarding, however the minimum size was apparently introduced in 2009 and discarding is present in 2007.

Section 14.4.2.2 The survey shows no trends but there do appear to be some year effects. Given the variability of the index in the way it is presented a simpler index such as a kg/hr (standardized) with CV's would be useful just to look in terms of abundance trends over time.

Reviewer 1 Conclusions

Flat cpue and survey abundance indices, the WG recommends maintaining current catch levels.

Reviewer 2 Conclusions

The conclusion from this section says that there are signs of increases in abundance from surveys and a relatively stable cpue from the fishery. I would caution that with an attracting fish capture method and increases in technology as well as the possibility to expand to new grounds, the commercial cpue series could well be insensitive to decreases in overall stock abundance. While the survey is more standardized with respect to the technology advances and the change in grounds, it is still primarily a fish attracting capture method. This means that there is competition at the hooks which is influenced by both intra species size effects, and interspecies competition, which in turn would be affected by the abundance of other larger predators in the "lure zone" from the lines. That said the conclusion is reasonably sound.