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Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources

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International Council for the Exploration of the Sea

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1 PARTICIPANTS AND TERMS OF REFERENCE

1.1 Participants

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1.2 Terms of Reference

The terms of reference of the Working Group adopted at the 2003 Annual Science Conference (91th Statutory Meeting) were as follows (C. Res. 2003/ACFM:2ACFM02):

2ACFM02 The **Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources** [WGDEEP] (Chair: O. A. Bergstad, Norway) will meet at ICES Headquarters from 18–24 February 2004 to:

a) compile the available data on landings of deep-water species, including blue ling, ling, and tusk, by ICES Subarea or Division;

b) update descriptions of deep-water fisheries in waters inside and beyond coastal state jurisdiction, for species such as grenadiers, scabbard fishes, orange roughy, forkbeards, ling, blue ling, and tusk, especially catch statistics by species, fleets and gear – and if possible the biological status of these stocks;

c) update the data on length/age at maturity, growth and fecundity and document other relevant biological information on deep-water species;

d) update information on quantities of discards by gear type for the stocks and fisheries considered by this group and make an inventory of deep-water fish community data;

e) compile geo-referenced data on documented historical or present spawning/aggregation areas of species such as blue ling and orange roughy;

f) discuss and propose sampling and reporting schemes in relation to the need for improved data for assessments;

g) provide specific information on possible deficiencies in the 2004 assessments including, at least, any major inadequacies in the data on catches, effort or discards; any major inadequacies in research vessel surveys data, and any major difficulties in model formulation, including inadequacies in available software. The consequences of these deficiencies for the assessment of the status of the stocks and for the projection should be clarified.

WGDEEP will report by 2 March 2004 for the attention of ACFM and the Living Resources Committee.

Appendix 1 is a list of the 2004 attendees of WGDEEP and their contact details.

2 BACKGROUND

2.1 History

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 summarised the current status of knowledge on 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) seabream (*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 assessemnts 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 data series 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 approach. 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, at least in some areas. As in previous years, it was recognised 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 showed 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 2000b, 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, fisheries 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 (see ICES 2001b, 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.

In 2003 the Group worked by correspondence and updated landings and other data sets, and furthermore considered special requests from NEAFC regarding baseline levels of effort underlying the 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.

2.2 Data availability

At the end of the 1998 meeting of the Study Group species co-ordinators were appointed to collate available data prior to the meeting and forward them to an assessment co-ordinator. This arrangement facilitated the assessment work at that meeting and has thus been retained.

It continues to be a major problem for the assessment of stock status that data, particularly on fishing effort, are limited or of relatively poor quality. The quality of landings data has improved over the years for most major species, at least from areas within national jurisdiction. Most landings data for 2002 and 2003 were provided by working group members because official statistics available to ICES were incomplete. A specific problem concerns the non-target species for which landings may be relatively small and scattered. The reporting for such species depends to a large extent on the efforts of individual members of the group, and changes of membership appears to affect this reporting. This may result in inconsistency, and lack of reporting makes compilation of data on such species very difficult.

For some of the major species such as ling and tusk, effort data from major fisheries (i.e. Norwegian) could not be updated because of lack of reporting. This prevents the Group from carrying out assessments for these species in most areas. Faroese data were updated at the 2004 meeting, and work is in progress to computerize, compile, and analyse Norwegian longliner's logbooks for recent years. The situation thus seems to improve somewhat.

For a range of species exploited by trawl in the areas west of Scotland, Ireland and France, assessments in 2000 were largely based on the catch per unit of effort data series from French trawlers, i.e. the fleet landing a major proportion of deep-sea fish in these areas. It had been agreed by the Group at its previous meeting that it was especially important to utilise directed effort data where possible to create reasonably reliable CPUE data series for each species. Due to changes in formatting of the French commercial database, directed effort data could not be extracted for 1999 and 2001, and thus many assessments could not be conducted in the 2002 meeting. The only updated effort series available from France in 2002 was the total effort directed at all deep-sea species.

In 2004 several CPUE series were updated or new were calculated. The assessment attempts continue to rely very heavily on CPUE data and analyses, especially from commercial fleets, and this is not satisfactory (Ch 2.3). Few extensive survey series are available, but if they are continued, several series may become useful in the future, at least for some species.

2.3 Quality of available CPUE series from fisheries

In the absence of better data, the evaluation of abundance trends of the deepwater species relies to a high degree on CPUE data from commercial fisheries. Few relevant survey series are available. Questions are often raised concerning the quality of the commercial CPUE series, and there is frequently doubt as to whether trends in CPUE reflect abundance. Also, several key series have changed or been interrupted because it has been impossible to update the estimates in a consistent manner.

The latter has been the case for the particularly important French CPUE series previously used by the Working Group in attempts to evaluate abundance of a number of species fished in areas Vb, VI, VII, and VII. The problem of inconsistency was especially severe in 2002, and for this meeting a completely new approach was adopted to derive a full time- series for French vessels.

A full description of the French fishery, and the analysis underlying the derivation of the CPUE series used at this meeting is given in **Ch. 4.1.2.**

2.4 Ongoing or recently completed research projects/programmes, and activities of non-ICES advisory groups

2.4.1 DGXIV Study Contract 99/55 Development of elasmobranch assessment (DELASS)

This project was funded by the European Commission, in support of the Common Fisheries policy. The DELASS project involved 15 European research institutes and 2 sub-contractors. The duration of the project was three years (2000-2002) and the main objective was the improvement of the scientific basis for the management in Europe of fisheries taking elasmobranchs. The study contract provided for a work programme for assessing the stock status of 9 elasmobranch species, comprising pelagic sharks, skates, coastal dogfish and deepwater sharks.

The deepwater sharks being considered by the project were *Centroscymnus coelolepis* and *Centrophorus squamosus* in all ICES areas combined, *Galeus melastomus* in Division IX a and *Dalatias licha* in Subarea X. The four main tasks of the project are 1) species identification and sampling, 2) stock discrimination, 3) data compilation and 4) stock assessment. The DELASS project aimed to support the work of ICES, and preliminary stock assessment exercises were performed for the 4 case study deepwater sharks at the ICES Study Group on Elasmobranch Fisheries, in May 2002.

A report by Heessen (2002) is available.

2.4.2 EU project TECTAC

TECTAC (TEChnological developments and TACtical adaptation of important EU fleets) is a project, which has been earmarked for funding by the EU. The overall objective of this project is to evaluate and predict the impact of various management scenarios on fleet dynamics and fish resource. One case study that will be investigated during this project is the French deep-water fisheries in subareas VI and VII. The working group will be kept updated of the findings of this project, which started in September 2002.

2.4.3 PROMA collaboration

Strong collaboration with fishermen started in June 2001 within a collaboration between PROMA and IFREMER. PROMA is a fishermen's organisation that developed a research activity in order to provide data that is usually not available for assessment. These data are expected to provide useful additional information to catch and effort statistics and also landings samplings. Description of the data, methods and preliminary results were given in a WD (Girard and Biseau 2004).

2.4.4 Spanish observer programme on the Hatton Bank (Subareas VI and XII, international waters) and agreement for the sudy of the red seabream fishery of the Strait of Gibraltar (ICES IXa south)

In the year 1996, at the start of the Spanish deep-sea fishery at Hatton Bank, an intensive scientific observer programme was established by agreement between the Spanish Fisheries Administration and the Shipowners' Associations. Detailed description of this programme is given in Durán Muñoz *et al*. (2001 and 2002) and also in a WD to this meeting (Durán Muñoz *et al*. 2004). The objective is to collect the information required for monitoring the fishery. The Spanish Institute of Oceanography (IEO) in Vigo is responsible of the scientific tasks, while funding is provided by the Institute, Administration and the Shipowners' Associations. The independent scientific observers provide data on effort, catches and discards by species, depth and position, haul by haul. In addition, length distributions by sex and biological samples are also recorded. This programme provided samples and data for several deep-sea fisheries studies. During the period 1996-2001 an average about 23% of the total fishing days were sampled.

On other hand following the recommendations of the STEFC the IEO and Andalusian Goverment signed a collaboration agreement to study and monitoring the red seabream fishery of the Strait of Gibraltar. This will be carry out along the 2003-2008 period. Study includes fishery and biological aspects of the target species.

2.4.5 EC EVK3/2001/00152- Oceanic Seamounts: an integrated study (OASIS)

This project, funded by the European Commission began in the summer of 2002 and will last until 2005. The project is coordinated by the University of Hamburg (Germany). The project aims at describing the functional characteristics of seamounts ecosystems, integrating hydrographical, biochemical and biological information.

2.4.6 MAR-ECO, a Census of Marine Life project in the northern mid-Atlantic

The Mid-Atlantic Ridge and adjacent areas is the target of an international ecosystem study (www.mar-eco.no) under the Census of Marine Life programme. This project gathers new knowledge on biodiversity, distribution patterns, and ecological processes, and the overriding aim is "to describe and understand the patterns of distribution, abundance and trophic relationships of the organisms inhabiting the mid-oceanic North Atlantic, and identify and model ecological processes that cause variability in these patterns". The project will focus on pelagic, benthopelagic and epibenthic macrofauna, and analyse distribution and abundance patterns in relation to the abiotic and biotic environment, as well as trophic relationships and life history strategies. Fish, crustaceans, cephalopods and gelatinous plankton and nekton have the highest priority in the study.

A central aim is thus to utilise modern remote sensing technology (acoustics, optics) using advanced instrument carriers (e.g., towed vehicles, ROVs, landers).

The project is carried out as a multi-ship operation in 2003-2005. The project works on the mid-Atlantic Ridge and in adjacent waters from the Azores to Iceland, both by surveying large areas by acoustics and mid-water trawling, and by focusing on selected subareas for intensive sampling and observation by traditional and novel methods and technology. Overlapping with the field seasons, the period 2004-2008 will be an analytical phase.

An already initiated component project of MAR-ECO is an analysis of population genetics of several of the fish species considered by WGDEEP, and the collection of reference tissue samples has already begun in many slope areas exploited by deep-sea fisheries. Studies of life history strategies of several species are also underway, and these and especially methodological elements of the project, will be very relevant for the future work of the Working Group.

2.4.7 PESCPROF- Deep-water resources of the Macaronesian (Azores Madeira and Canaries)

PESCPROF project is funded by the European Commission under the Interreg program and focus on the Atlantic insular regions, Azores, Madeira and Canaries. The project PESCPROF, Deep-water resources of the Macaronesian (Azores Madeira and Canaries) were developed to address exploratory fishing for deep-water resources, including fish and crustaceans. The overall objective of the project is to survey unexplored depth strata areas and improve fishing technology for non-explored species.

2.4.8 Assessment of orange roughy (*Hoplostethus atlanticus*) stocks in the deep waters off the west coast of Ireland using acoustic survey techniques

Irish Marine RTDI Programme 2002 ST/02/04

This project started in 2003 and continues to 2005. The aim is to achieve stock assessments of the orange roughy populations west of Ireland. Acoustic techniques are a key component of the project. The project is funded by the Marine Institute and involved University College Cork, National Institute of Water and Atmospheric Research, New Zealand, Irish Sea Fisheries Board (BIM) and Fisheries Resources Surveys, South Africa. The project aims to assess the stock size of aggregations of this species and to produce stock assessments. Biological data such as lengthy, weight, age and maturity is also being collected. In addition, the Irish National Seabed Survey will provide bathymetric data to aid in the classification of suitable habitat and aggregation of this species. The first sea trips as part of this project began in February 2004.

Irish Observer Scheme (Marine Institue) 2003

Under the terms of EU Council Regulation 2347/2002 member states were obliged to establish observer schemes in deepwater fisheries in 2003. The Irish Marine Institute implemented such a scheme, starting in June 2003. Four observer trips were carried out on trawlers. In addition 5 port sampling trips were carried out for trawl and one for longline catches. In total, 3,828 length measurements were obtained, in addition to age, maturity and stomach data. The discard data will be analysed and the results presented to WGDEEP in 2005. A detailed description of the methodology is presented by Borges et al. (2003). This programme will continue in 2004.

2.4.9 BIM Deepwater Programme 2001and 2002

The Fisheries Development Division of the Irish Sea Fisheries Board (BIM) carried out a scientific and technical observer programme during deepwater fishing trials in 2001. New vessels entering the fishery were required to carry observers (BIM, 2002a). Catch and effort, spatial and bathymetric distributions and length frequency data were collected for commercial (BIM, 2002b) and discard species (BIM, 2002c) during the programme. This programme was the most extensive of its kind ever carried out for a deepwater fishery. Catch rates by depth interval were also collected. In addition otoliths from a range of species were collected and age estimates were produced by the Central Ageing Facility (CAF), Marine and Freshwater Resources Institute, Queenscliff, Australia. Age estimates and length-at-age were presented for orange roughy, black scabbard, roundnose grenadier, deepwater redfish, blue ling, wreckfish, bluemouth, conger eel, mora, greater forkbeard, deepwater cardinal, greater argentine, blue antimora, and Baird's smoothhead (Talman *et al*., 2002). The reports detailing the programme (BIM, 2002abc; Talman *et al*. 2002) were submitted to WGDEEP 2002 but arrived too late to be considered and were then submitted directly to ACFM in May 2002. Detailed catch, effort and size-frequency information were provided to WGDEEP in 2004.

2.4.10 National fishery-independent surveys

In the 2001 report of WGDEEP a document discussing the applicability of various surveys for obtaining relevant data for assessments of deep-water fishes was provided. Information was also given on surveys being conducted by different countries. The following is a shortened version of the description of national surveys. Accounts on a Scottish continental slope survey has been added.

Spain

The Instituto Español de Oceanografía (IEO) organises three bottom trawl surveys by year (2 in NAFO Regulatory Area and 1 in ICES IIb). Of these, the Spanish spring bottom trawl survey in NAFO (Paz *et al.* 2000) is a multispecies survey that samples depths from 50 to 1400 m.

Annual bottom trawls surveys are carried out in the Cantabrian and Galicia sea (ICES VII and IX) and in the Gulf of Cádiz (ICES IXa south), from 1983 and 1992 on, respectively.

More recently, in 2001, an annual stratified random bottom trawl survey has been conducted in ICES VII (Porcupine Bank). It is a multispecies survey that samples depths from 190 to 800 meters in two geographic sectors and three depth strata (<200, 200-400 and 400-800 in the first two surveys and <301, 301-450 and 451-800 m in the 2003 one). The most abundant species are Blue whiting (*Micromesistius poutassou*) and Argentines (*Argentina silus*). Information regarding these surveys are available in the ICES IBTS Working Group Reports and WDs.

Greenland

Greenland has conducted stratified random bottom trawl surveys in ICES XIVB since 1998 (except 2001) covering depths between 400 and 1500 m, and estimates of biomass and abundance and length frequencies on roundnose and roughhead grenadier were provided for 2003. Further, information on sex, length and weight on the very few tusk, ling, smoothheads, argentines and different species of elasmobranchs that were recorded during the survey. The utility of this survey for assessment purposes cannot yet be evaluated. Another survey will be conducted in 2004.

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 taken 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 deepwater 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.

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/UAç), 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 sea bed, and mark recapture studies are ineffective for some of the species because they die when brought to surface).

Portugal (mainland)

Portugal carries out bottom trawl surveys more or less regularly in Division IXa waters shallower than 900 m. Most of the catches are composed of species which have yet relatively low or no commercial value. The survey does not provide data for assessment of e.g. black scabbardfish.

Ireland

The Marine Institute began a deepwater research survey programme to the west of Ireland in 1993. To date ten surveys have been carried out, five each by trawl and longline. The survey programme was initiated to obtain samples of deepwater fish for biological analysis. The surveys have also produced catch per unit effort (CPUE) and discarding information.

One year after the ICES triennial mackerel and horse mackerel egg survey, a further egg survey was carried out to assess whether significant spawning occurs outside the ICES standard area. 173 ICES rectangles were sampled on the Porcupine, Rockall and Hatton Banks, the Rockall Trough and the Faeroes waters using standard methodology for the collection of mackerel and horse mackerel eggs. This survey was organised to assess if the current standard grid was covering the distribution area of mackerel. The survey also provided extensive information on deepwater fish eggs and larvae from Rockall and Hatton Banks, including ling, tusk, greater argentine and greater forkbeard (Dransfeld *et al.* in press).

Scotland

Since 1998 The Marine Laboratory, Aberdeen has implemented a program of research fishing on the continental slope west of the UK. Fishing is stratified by depth and ranges between 500 and 1300 m. The survey area extends from the Wyville-Thomson Ridge in the north to south of the Hebridean Terrace. Survey methodology followed standard Marlab sampling procedures. Data collected in the form of length frequencies for all species, weight of each species, length/weight data and biological sampling as required for current projects. Surveys took place in 1998, 2000, 2002 and a further survey is planned for 2004. It is expected that surveys will continue on a biannual basis.

Russian Federation

In May – July 2003 the complex survey of roundnose grenadier stock in the mid-Atlantic Ridge area was carried out by R/V *Atlantida*. Estimation of grenadier biomass was fulfilled with the acoustic method on 26 seamounts between 47–58ºN in the depth range 900 -1400 m. A mesoscale hydrological survey was conducted and also micro-surveys at individual seamounts, total number of stations 59. Data on distribution and behaviour of grenadier were collected. For biological sampling 42 control hauls with the pelagic trawl were made. The results of the survey are represented in the WD (Gerber *et al.,* 2004). As the subject of estimation was only pelagic aggregations of grenadier, it should be considered that minimal value of grenadier biomass in this area has obtained.

Data on biology and distribution of young roundnose grenadier were collected in May-July 2003 during the redfish trawl-acoustic survey of R/V "Smolensk" in the Irminger Sea, as well as during works on the national program of investigations of redfishes in the areas of the West Iceland and East Greenland. Results of the observations show that juvenile roundnose grenadier are occurred not only on the shelf, continental slope and seamounts, but in the pelagic waters of the open ocean as well. The main results of this investigation are represented in WD by Vinnichenko, Khlivnoy (2004b).

3 OVERVIEW OF LANDINGS BY AREA AND NATION

The estimated landings of deep-water species by ICES Subarea and division for the period 1988 to 2003 (preliminary data) are given in Table 3.1. The data in this table are derived from a variety of sources. Working Group members have provided information that has filled some of the gaps in the STATLANT database but an inspection of the more detailed information presented for each species in the following sections of this report will reveal that the data are still somewhat incomplete. For this reason, some of the apparent trends and fluctuations during the time-series should be treated with caution. Some new data not available to previous meetings of the Working Group have been used to refine and correct landings data.

In ICES Subarea I+II there are directed longline and gillnet fisheries for ling (*Molva molva*) and tusk (*Brosme brosme*). There is also a directed bottom and pelagic trawl fishery for *Argentina silus* and a minor fjord fishery for roundnose grenadier (*Coryphaenoides rupestris*). Roughhead grenadier (*Macrourus berglax*) is taken as by-catch in the trawl, gillnet and longline fisheries for Greenland halibut and redfish.

In ICES Subarea III there is a targeted trawl fishery for roundnose grenadier and *Argentina silus*. These species are also a by-catch of the *Pandalus* and *Nephrops* fisheries with trawls, and probably only a minor part of this by-catch is landed.

In ICES Subarea IV there is a by-catch of *Argentina silus* from the industrial trawl fishery. There is a longline fishery for tusk and ling with forkbeard (*Phycis blennoides*) and some roughhead grenadier as a by-catch. There is a by-catch of some deep-water species in the trawl fisheries targeting *Lophius* spp. and Greenland halibut.

In ICES Subarea V there are trawl fisheries which target blue ling (*Molva dypterygia*), redfish, argentine (*Argentina silus*) and occasionally orange roughy (*Hoplostethus atlanticus*). By-catch species are typically roundnose grenadier, roughhead grenadier, black scabbard fish (*Aphanopus carbo*), anglerfish (*Lophius piscatorius*), bluemouth (*Helicolenus dactylopterus*), mora (*Mora moro*), greater forkbeard (*Phycis blennoides*), argentine (*Argentina silus*), deep-water cardinal fish (*Epigonus telescopus*) and rabbit fish (*Chimaera monstrosa*). There are traditional longline fisheries for ling and tusk and these species are also by-catches in trawl and gillnet fisheries. There are also targeted trawl and gillnet fisheries for Greenland halibut and *Lophius* spp which have deep-water by-catch of for example deep-water red crab (*Chaceon affinis*). There have also been trap fisheries for the deep-water red crab (*Chaceon* (formerly *Geryon*) *affinis*).

In ICES Subareas VI and VII there are directed trawl fisheries for blue ling, roundnose grenadier, orange roughy (*Hoplostethus atlanticus*), black scabbard fish and the deepwater sharks *Centroscymnus coelolepis* and *Centrophorus squamosus*. The *Argentina silus* and blue ling landings from directed fisheries increased until 2002, but then declined in 2003. By-catch species in these areas include bluemouth (*Helicolenus dactylopterus*), mora (*Mora moro*), greater forkbeard (*Phycis blennoides*), argentine (*Argentina silus*), deep-water cardinal fish (*Epigonus telescopus*) and chimaerids of which *Chimaera monstrosa* is the most important. There are directed longline fisheries for ling and tusk and also for hake. Deep-water sharks are a by-catch of the longline fisheries but there are also targeted fisheries for sharks in Subareas VI and VII. There is gillnet fishery in Subarea VII for ling.

In ICES Subarea VIII there is a longline fishery that mainly targets greater forkbeard (*Phycis blennoides*). There are also some trawl fisheries targeting species such as hake, megrim, anglerfish and *Nephrops* that have a by-catch of deep-water species. These include *Molva* spp., *Phycis phycis, Phycis blennoides, Pagellus bogaraveo, Conger conger, Helicolenus dactylopterus, Polyprion americanus* and *Beryx* spp.

In ICES Subarea IX some deep-water species are a by-catch of the trawl fisheries for crustaceans. Typical species 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 is a directed longline fishery for black scabbard fish (*Aphanopus carbo*) with a by-catch of the *Centroscymnus coelolepis*. There is also a longline (Voracera) fishery for *Pagellus bogaraveo*.

In ICES Subarea X the main fisheries are by handline and longline near the Azores, and the main species landed are red (=blackspot) seabream (*Pagellus bogaraveo*), wreckfish (*Polyprion americanus*), conger eel (*Conger conger*), bluemouth (*Helicolenus dactylopterus*), golden eye perch (*Beryx splendens*) and alfonsino (*Beryx decadactylus*). At present the catches of kitefin shark (*Dalatias licha*) are made by the longline and handline deep-water vessels and can be considered as accidental. There are no vessels at present catching this species using gillnets. Outside the Azorean EEZ there are trawl fisheries for golden eye perch (*Beryx splendens*), orange roughy (*Hoplostethus atlanticus*), cardinal fish (*Epigonus telescopus*), black scabbard fish (*Aphanopus carbo*), and wreckfish (*Polyprion americanus*).

In ICES Subarea XII there are trawl fisheries on the mid-Atlantic Ridge for orange roughy, roundnose grenadier, and black scabbard fish. There is a multispecies trawl and longline fishery on Hatton Bank, and some of this occurs in this subarea, some in Subarea VI. There is considerable fishing on the slopes of the Hatton Bank, and effort may be increasing. Smoothheads seem now to a greater extent to feature in the landings statistics but was previously usually discarded.

In ICES Subarea XIV there are trawl and longline fisheries for Greenland halibut and redfish that have by-catches of roundnose grenadier, roughhead grenadier and tusk.

Table 3.1 Estimated landings (tonnes) of deep-water species by ICES Subareas and Divisions, 1988-2003. Data for 2002 and 2003 are preliminary. Note: data for deepwater sharks has been discontinued after 2002.

I+ II	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	ALFONSINOS (Beryx spp.)																
	ARGENTINES (Argentina silus)	11351	8390	9120	7741	8234	7913	6807	6775	6604	4463	8261	7163	6293	14363	7407	8908
	BLUE LING (Molva dypterigia)	3537	2058	1412	1479	1039	1020	422	364	267	292	279	292	252	200	148	117
	BLACK SCABBARDFISH (Aphanopus carbo)																
	BLUEMOUTH (Helicolenus dactylopterus)																
	GREATER FORKBEARD (Phycis blennoides)			23	39	33	1								8	315	153
	LING (Molva molva)	6126	7368	7628	7793	6521	7093	6322	5954	6346	5409	9200	7651	5964	4951	7131	6144
	MORIDAE																
	ORANGE ROUGHY (Hoplostethus atlanticus)																
	RABBITFISHES (Chimaerids)												1	6	5	15	15
	ROUGHHEAD GRENADIER (Macrourus berglax)			589	829	424	136				17	55		48	94	29	77
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)		22	49	72	52	15	15	7	2	106	100	46		2	12	4
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)																
	SHARKS, VARIOUS	37	15											1			
	SILVER SCABBARDFISH (Lepidopus caudatus)																
	SMOOTHHEADS (Alepocephalidae)																
	TUSK (Brosme brosme)	14403	19350	18628	18306	15974	17585	12566	11617	12795	9426	15353	17183	14008	12050	12191	7876
	WRECKFISH (Polyprion americanus)																

III +IV	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	ALFONSINOS (Beryx spp.)			1		2											
	ARGENTINES (Argentina silus)	2718	3786	2321	2554	5319	3269	1508	1082	3300	2598	3982	4319	2471	2925	1811	1166
	BLUE LING (Molva dypterigia)	385	482	522	648	592	438	442	503	202	291	292	271	144	276	385	108
	BLACK SCABBARDFISH (Aphanopus carbo)	2		57				16	2	4	2	9	6	5	12	24	4
	BLUEMOUTH (Helicolenus dactylopterus)												5				
	GREATER FORKBEARD (Phycis blennoides)	15	12	115	181	145	34	12	3	18	7	12	31	11	26	585	231
	LING (Molva molva)	11933	12486	11025	10943	12154	14249	12288	14112	14531	12325	14472	10472	9858	8397	9618	6857
	MORIDAE																
	ORANGE ROUGHY (Hoplostethus atlanticus)																
	RABBITFISHES (Chimaerids)					122	8	167		14	38	56	45	33	20	24	19
	ROUGHHEAD GRENADIER (Macrourus berglax)					7					36			4	11	3	2
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	618	1055	1439	2053	2754	1441	771	85	2284	177	1854	3187	2406	3121	4258	4315
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)																
	SHARKS, VARIOUS				3	133	78	86	20	14	32	359	201	36	62		
	SILVER SCABBARDFISH (Lepidopus caudatus)					27											
	SMOOTHHEADS (Alepocephalidae)																
	TUSK (Brosme brosme)	4490	6515	4319	4623	5029	5234	3433	3405	3576	2341	3474	2498	3411	3196	3082	2024
	WRECKFISH (Polyprion americanus)																

Table 3.1 (Continued)

Va	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	ALFONSINOS (Beryx spp.)																
	ARGENTINES (Argentina silus)	206	8	112	247	657	1255	613	492	808	3367	13387	5518	4593	3043	4960	2683
	BLUE LING (Molva dypterigia)	2171	2533	3021	1824	2906	2233	1632	1635	1323	1344	1154	1877	1711	915	1349	1143
	BLACK SCABBARDFISH (Aphanopus carbo)							1			1		9	18	8	13	0
	BLUEMOUTH (Helicolenus dactylopterus)																
	GREATER FORKBEARD (Phycis blennoides)																
	LING (Molva molva)	5861	5612	5598	5805	5116	4854	4604	4192	4060	3933	4302	4647	3743	3343	3315	4123
	MORIDAE																
	ORANGE ROUGHY (Hoplostethus atlanticus)				65	382	717	158	64	40	79	28	14	68	19	10	
	RABBITFISHES (Chimaerids)				499	106	3	60	106	21	15	29	2	5			
	ROUGHHEAD GRENADIER (Macrourus berglax)									15	4	1		5	3	11	
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	2	4	7	48	210	276	210	398	140	198	120	129	67	57	60	0
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)																
	SHARKS, VARIOUS		31	54	58	70	39	42	45	65	70	87	45	45	57		
	SILVER SCABBARDFISH (Lepidopus caudatus)																
	SMOOTHHEADS (Alepocephalidae)					10	3	1	1								
	TUSK (Brosme brosme)	6855	7061	7291	8732	8009	6075	5824	6225	6102	5394	5171	7264	6391	4831	5651	5404
	WRECKFISH (Polyprion americanus)																

Vb	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	ALFONSINOS (Beryx spp.)			5		4			1								
	ARGENTINES (Argentina silus)	287	227	2888	60	1443	1063	960	12286	9498	8433	17570	8214	8343	10461	8195	6321
	BLUE LING (Molva dypterigia)	9526	5264	4799	2962	4702	2836	1644	2440	1602	2798	2584	2932	2524	2532	2091	3098
	BLACK SCABBARDFISH (Aphanopus carbo)		166	419	152	33	287	160	424	186	68	180	172	311	800	1756	1465
	BLUEMOUTH (Helicolenus dactylopterus)												58	16			
	DEEP WATER CARDINAL FISH (Epigonus telescopus)												8	2	7		
	GREATER FORKBEARD (Phycis blennoides)	2	1	38	53	49	27	4	9	7	7	8	34	32	100	148	69
	LING (Molva molva)	4488	4652	3857	4512	3614	2856	3622	4070	4896	5657	5359	5238	3719	4588	4524	5374
	MORIDAE				5								1		100	19	2
	ORANGE ROUGHY (Hoplostethus atlanticus)			22	48	13	37	170	420	79	18	3	5	155	5		3
	RABBITFISHES (Chimaerids)								1				3	54	84	64	3
	ROUGHHEAD GRENADIER (Macrourus berglax)											9	58	1	4		
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	1	258	1549	2311	3817	1681	668	1223	1078	1112	1667	1996	1791	2017	1027	1181
	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)																
	TUSK (Brosme brosme)	5665	5122	6181	6266	5391	3439	4316	3978	3310	3319	2710	3964	2974	3887	2839	3157
	WRECKFISH (Polyprion americanus)																

Table 3.1 (Continued)

VI+VII	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	ALFONSINOS (Beryx spp.)		12	8		3	1	5	3	178	25	81	75	133	186	118	18
	ARGENTINES (Argentina silus)	10438	25559	7294	5197	5906	1577	5707	7546	5863	7301	5555	8856	13866	19050	15985	2280
	BLUE LING (Molva dypterigia)	9285	9434	6396	7319	6697	5471	4309	4892	6928	7361	8004	9471	8525	9296	6215	3343
	BLACK SCABBARDFISH (Aphanopus carbo)		154	1060	2759	3436	3529	3101	3278	3689	2995	1967	2166	3712	4623	6325	2651
	BLUEMOUTH (Helicolenus dactylopterus)												403	342	189	182	151
	DEEP WATER CARDINAL FISH (Epigonus telescopus)												279	241	349	976	986
	GREATER FORKBEARD (Phycis blennoides)	1898	1815	1921	1574	1640	1462	1571	2138	3590	2335	3040	3430	4919	4349	3343	2486
	LING (Molva molva)	28092	20545	15766	14684	12671	13763	17439	20856	20838	16668	19863	15087	14593	11528	10435	7968
	MORIDAE				1	25							20	146	190	158	265
	ORANGE ROUGHY (Hoplostethus atlanticus)		8	17	4908	4523	2097	1901	947	995	1039	1071	1337	1887	3692	5765	559
	RABBITFISHES (Chimaerids)							2					236	355	641	550	47
	ROUGHHEAD GRENADIER (Macrourus berglax)						18	5	2				34	9	44	12	2
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	32	2440	5730	7793	8338	10121	7860	7767	7095	7070	6364	6538	9790	15262	9028	5029
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)	252	189	134	123	40	22	10	11	29	56	17	25	20	51	25	32
	SHARKS, VARIOUS	85	40	43	254	639	1392	1864	2099	2176	3240	3023	1791	8			
	SILVER SCABBARDFISH (Lepidopus caudatus)						2						18	15		1	
	SMOOTHHEADS (Alepocephalidae)										7			978	4844	260	8
	TUSK (Brosme brosme)	3002	4086	3216	2719	2817	2378	3233	3085	2417	1832	2240	1654	4498	2687	1794	1700
	WRECKFISH (Polyprion americanus)	7		2	10	15				83		12	14	14	17	9	1
VIII+IX	Species	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	ALFONSINOS (Beryx spp.)			1		1		2	82	88	135	269	201	167	229	124	9
	ARGENTINES (Argentina silus)															191	37
	BLUE LING (Molva dypterigia)										14	33	4	4	6	29	7
	BLACK SCABBARDFISH (Aphanopus carbo)	2602	3473	3274	3979	4389	4513	3429	4272	3815	3556	3152	2752	2404	2767	2725	2658
	BLUEMOUTH (Helicolenus dactylopterus)												31	36	34	16	
	DEEP WATER CARDINAL FISH (Epigonus telescopus)												3	5	4	8	3
	GREATER FORKBEARD (Phycis blennoides)	81	145	234	130	179	395	320	384	456	361	665	378	411	494	489	135
	LING (Molva molva)	1028	1221	1372	1139	802	510	85	845	1041	1034	1799	451	331	577	439	357
	MORIDAE								83	52	88			26	20	11	10
	ORANGE ROUGHY (Hoplostethus atlanticus)					83	68	31	7	22	23	14	39	52	20	21	21
	RABBITFISHES (Chimaerids)												2	2	7	6	
	ROUGHHEAD GRENADIER (Macrourus berglax)																
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)			5	1	12	18	5		1		20	16	4	7	3	1
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)	826	948	906	666	921	1175	1135	939	1001	1036	981	647	691	552	489	500
	SHARKS, VARIOUS	3545	1789	1789	2850	6590	3740	4	43	64	1104	2890	2287	704	549		
	SILVER SCABBARDFISH (Lepidopuscaudatus)	2666	1385	584	808	1374	2397	1054	5672	1237	1725	966	3069	16	308	484	741
	SMOOTHHEADS (Alepocephalidae)										7						
	TUSK (Brosme brosme)	1										1					
	WRECKFISH (Polyprion americanus)	198	284	163	194	269	338	409	393	294	214	227	151	121	167	156	224

Table 3.1 (Continued)

X	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	ALFONSINOS (Beryx spp.)	225	260	338	371	450	728	1500	623	536	983	228	175	229	199	242	172
	ARGENTINES (Argentina silus)																
	BLUE LING (Molva dypterigia)	18	17	23	69	31	33	42	29	26	21	13	10	13			
	BLACK SCABBARDFISH (Aphanopus carbo)				166	370	2		3	11	3	99	112	113	0	0	0
	BLUEMOUTH (Helicolenus dactylopterus)												320	452	301		
	DEEP WATER CARDINAL FISH (Epigonus telescopus)													3		14	
	GREATER FORKBEARD (Phycis blennoides)	29	42	50	68	81	115	135	71	45	30	38	41	94	83	57	45
	LING (Molva molva)																
	MORIDAE	18	17	23	36	31	33	42							1	267	316
	ORANGE ROUGHY (Hoplostethus atlanticus)						1			471	6	177	10	188	28	22	0
	RABBITFISHES (Chimaerids)																
	ROUGHHEAD GRENADIER (Macrourus berglax)												3				
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)									3	1	1	6	74	0	2	0
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)	637	924	889	874	1110	829	983	1096	1036	1012	1114	1222	947	1034	1193	1068
	SHARKS, VARIOUS	1098	2703	1204	3864	4241	1183	309	1246	1117	859	995					
	SILVER SCABBARDFISH (Lepidopus caudatus)	70	91	120	166	2160	1722	373	789	815	1115	1186	86	28	44	10	25
	SMOOTHHEADS (Alepocephalidae)																
	TUSK (Brosme brosme)																
	WRECKFISH (Polyprion americanus)	191	235	224	170	237	311	428	240	240	177	139	133	268	229	283	270

XII	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	ALFONSINOS (Beryx spp.)								2								
	ARGENTINES (Argentina silus)						6			1			2				
	BLUE LING (Molva dypterigia)	263	70	5	1147	971	3335	752	573	788	417	438	1353	594	1166	146	96
	BLACK SCABBARDFISH (Aphanopus carbo)					512	1144	824	301	444	200	154	112	244	121	1	5
	BLUEMOUTH (Helicolenus dactylopterus)																
	GREATER FORKBEARD (Phycis blennoides)					1	1	3	4	2	2	1		6	8	6	9
	LING (Molva molva)			3	10			5	50	2	9	2	2	7	59	8	19
	MORIDAE													1	87	13	15
	ORANGE ROUGHY (Hoplostethus atlanticus)					8	32	93	676	818	808	629	431	259	814	6	175
	RABBITFISHES (Chimaerids)										32	42	115	48	63	9	12
	ROUGHHEAD GRENADIER (Macrourus berglax)												39	7	10	7	2
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	10600	9500	2800	7510	1997	2741	1161	644	1728	8676	11978	9660	8528	7815	7251	9432
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)							75									
	SHARKS, VARIOUS				1	2	6	8	139	147	32	56	50	1069	1208		
	SILVER SCABBARDFISH (Lepidopus caudatus)		102	20			19										
	SMOOTHHEADS (Alepocephalidae)									230	3692	4643	6549	4146	3592	n.a.	n.a.
	TUSK (Brosme brosme)	1	1		1	1	12	1	18	158	30	1	1	5	52	27	83
	WRECKFISH (Polyprion americanus)																

Table 3.1 (Continued)

XIV	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	ALFONSINOS (Beryx spp.)																
	ARGENTINES (Argentina silus)			6										217	66		
	BLUE LING (Molva dypterigia)	242	71	79	155	110	3725	384	141	14	4	55	8	532	97	1	40
	BLACK SCABBARDFISH (Aphanopus carbo)											2		90	0	0	0
	BLUEMOUTH (Helicolenus dactylopterus)																
	GREATER FORKBEARD (Phycis blennoides)															23	
	LING (Molva molva)	3	1	9	1	17	9	6	17	0	61	6	1	26	35	20	83
	MORIDAE																
	ORANGE ROUGHY (Hoplostethus atlanticus)																
	RABBITFISHES (Chimaerids)																1
	ROUGHHEAD GRENADIER (Macrourus berglax)						52	5	2			6	14		26	4	
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	52	45	47	29	31	26	15	27	25	59	126	124	57	97	47	21
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)																
	SQUALID SHARKS	2253	2151	3871	5610	7836	7985	7474	6801	7065	6158	6318	5636	7150	9175		
	SHARKS, VARIOUS including some squalids	3630	1860	2026	4453	10429	9044	5757	5383	5974	7579	9602	7655	6764	7874		
	SILVER SCABBARDFISH (Lepidopus caudatus)																
	SMOOTHHEADS (Alepocephalidae)													12			
	TUSK (Brosme brosme)	2	23	32	135	202	80	25	87	281	118	15	9	11	69	58	87

4 OVERVIEW OF FISHERIES

4.1 Description of fisheries by nation

4.1.1 Faroe Islands

Except for the traditional long line fisheries for tusk and ling, which have been well established for many years, 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 on the fishery was gradually expanded to more distant areas and to include more and more species/stocks. In many cases these fisheries started as more or less scientific exploratory fisheries/surveys evolving to commercial fisheries. However, availability of other more profitable species/stocks (higher commercial value, not so distant waters) have always determined the extent of the Faroese deep-sea fishery. And in 2003, the only Faroese deep-sea fisheries have been in Faroese waters (several gears, several species) and Icelandic waters (longline fishery for ling, tusk and blue ling).

The main deepwater fleet consist of about 10 otterboard trawlers with engines larger han 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)*. Most fisheries have taking place inside the Faroese EEZ, but some trawlers fished also further south to the Hatton Bank, eg. targeting blue ling during the spawning season, then black scabbardfish in the summer time and later in the year roundnose grenadier became the most important species. There has been no fishery on Hatton Bank in the most recent years. In stead a few of these trawlers have increased their effort on black scabbardfish, roundnose grenadier and blue ling in Vb with a corresponding increase in the landings of these species. Following a special exploratory trawl fishing programme initiated in 1992 with several vessels aimed at orange roughy (*Hoplostethus atlanticus*), one trawler was regularly fishing on the Mid-Atlantic Ridge. The fishery was directed towards orange roughy most of the time, but sometimes other deep-sea species as black scabbardfish, roundnose grenadier and deep-water sharks are taken. In 2002 and 2003 no such fishing took place.

The traditional longline fleet fishing ling, tusk and blueling consist of 19 longliners larger than 100 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 deepwater sharks (*Centroscymnus coelolepis* and *Centrophorus squamosus*) was initiated; however, there has been no such fishery in 2002 and 2003.

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

A trawl fishery for greater silver smelt *(Argentina silus)* has been expanding rapidly in recent years. 3 pairtrawlers, which otherwise mainly target saithe have got licences to perform this fishery which mainly takes place in late spring and summer.

4.1.2 France

4.1.2.1 Overview

The French deep sea fishery is studied through the activity of a list of 50 vessels (most of them being present in the entire period studied 1989-2003).

Information from the 50 selected vessels

Area	(Tous)

	Year														
Données	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Somme Hoursfihed	155780	163075	164380	174740	173272	162947	165688	174000	170037	161430	194656	188545	183932	157118	119184
Somme Grenadier	1318	5108	7141	6527	6704	6878	7752	6892	7088	4989	7928	9700	8701	8337	4384
Somme Saithe	11962	9218	7360	5041	8214	8058	5624	5054	4556	4033	2964	4805	4160	2315	1898
Somme Tusk	465	536	364	392	315	284	318	345	347	317	193	233	184	125	90
Somme Ling	2444	1991	1515	1119	1388	1585	1787	1856	1687	1752	890	734	773	378	340
Somme BlueLing	6650	4757	4518	2995	2970	2339	3158	3225	4092	3329	5137	4939	3297	2788	2485
Somme Phycis	159	271	327	483	461	369	348	452	462	310	187	344	342	290	254
Somme Beryx	11	9	2972	3	1	2	0	1	1	10	43	21	52	18	8
Somme OrangeRoughy	3	4	264	3629	1524	1551	896	995	1008	275	1274	1127	1213	431	297
Somme BlackScabbard	308	1334	2001	2865	2817	2770	3318	3667	2677	1235	1924	3251	4369	4149	2286
Somme TontSik	0	0	0	0	0	975	2447	2946	2668	1768	2328	2830	2868	1254	529
Somme TontAig	0	0	0	0	0	0	0	0	0	0	0	247	245	36	24
Somme TontSch	0	0	0	0	0	0	0	0	0	0	0	0	0	33	22
Somme TontPai	0	0	0	0	0	0	0	0	0	0	0	0	0	347	249
Somme TontSqa	4	379	1134	2264	2675	1972	603	140	164	146	15	68	5	0	0
Somme SqualidSharks	4	379	1134	2264	2675	2947	3050	3087	2832	1914	2343	3146	3119	1671	825

Since the activity of those vessels could take place on the shelf or on the slope, within a single statistical square, one can only handle the fishing effort directed to deep sea species by looking at the results of the catch (assuming that a directed activity allow to catch the desired species).

Recently, information from each line of the log-books is computed. This can be considered (since no information trawl by trawl is available) as the lowest scale information which can be analysed. This lowest scale is called 'fishing sequence'.

In the past, a fishing sequence could represent more than one day since all the information of a trip from the same rectangles with the same gear were cumulated.

All the fishing sequences in Subareas V, VI and VII, using trawls, are examined for the 50 vessels of the list.

4.1.2.2 Relations between species

In 1989, at the start of the French deep Sea fishery, most of the fishing sequences catching Saithe did not catch (land) much Grenadier. On the opposite, in recent years, most of the fishing sequences catching Grenadier did not catch (land) much Saithe. In the middle, within each fishing sequence, Saithe and Grenadier can be found together (possibly because of the way the log-books were computed, summing all the information within a single rectangle in the same trip). In recent years (since 2000), the annual landings (catches) of grenadier, black scabbard and squalid sharks appear to be correlated.

2002 Correlation between species in each fishing sequence

	Grenadier	Saithe	Ling	Blue Ling	Black Scabbard	Squalid Sharks
Grenadier	1.00					
Saithe	-0.12	1.00				
Ling	-0.13	0.06	1.00			
Blue Ling	-0.03	-0.07	-0.04	1.00		
Black Scabbard	-0.01	-0.09	-0.08	0.04	1.00	
Squalid Sharks	0.24	-0.09	-0.08	0.05	0.13	1.00

2001 Correlation between species in each fishing sequence

	Grenadier	Saithe	Ling	Blue Ling	Black Scabbard	Squalid Sharks
Grenadier	1.00					
Saithe	-0.10	1.00				
Ling	-0.18	0.06	1.00			
Blue Ling	0.12	-0.06	-0.08	1.00		
Black Scabbard	0.12	-0.07	-0.08	0.10	1.00	
Squalid Sharks	0.41	-0.07	-0.11	0.14	0.18	1.00

1995 Correlation between species in each fishing sequence (file grenadier95)

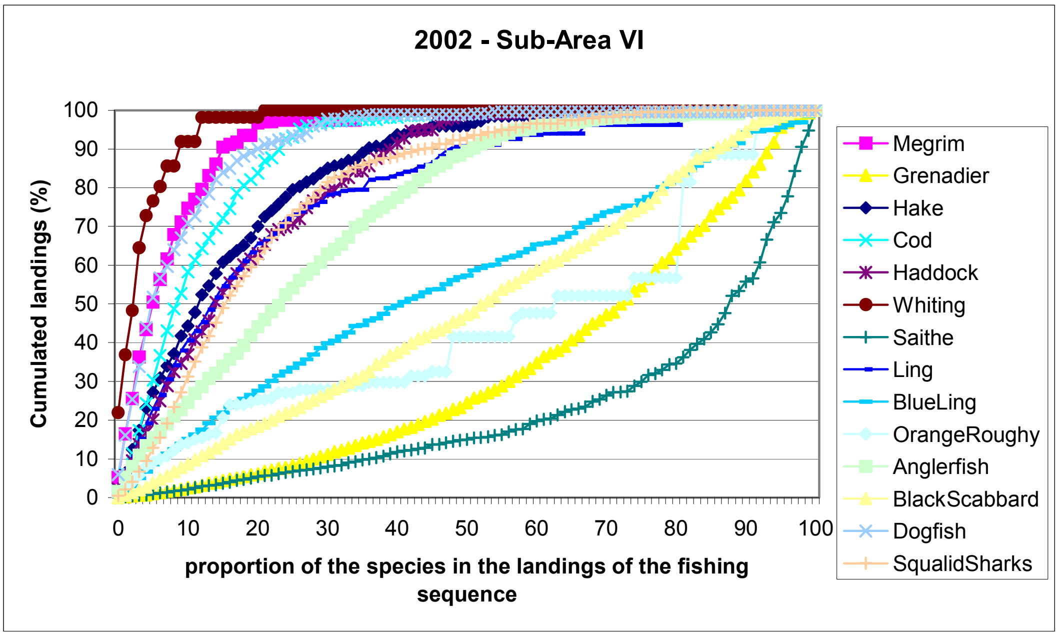
	Grenadier	Saithe	Ling	Blue Ling	Black Scabbard	Squalid Sharks
Grenadier	1.00					
Saithe	-0.08	1.00				
Ling	-0.06	0.17	1.00			
Blue Ling	0.18	-0.04	0.00	1.00		
Black Scabbard	0.45	-0.04	-0.03	0.24	1.00	
Squalid Sharks	0.69	-0.03	-0.05	0.20	0.47	1.00

[Note that a fishing sequence in 1995 could represent more than one day in the same area. The apparent stronger correlation may be a consequence of this lack of precision in the definition of a fishing sequence, increasing the probability of a mixture of different depths in a same fishing sequence, leading to greater correlation between species].

Conclusion: At a fishing sequence level, there is no relationship between the species in the landings (as reported in the log books), with the exception of Black Scabbard and Squalid Sharks. [Note the very strong separation between Saithe and Grenadier].

4.1.2.3 Definition of the metiers

- identification of the target species (see Biseau, 1998) : the cumulative plots of relative landings of each species, fishing sequence by fishing sequence, can give indication of the target 'mass' species (Grenadier and Saithe), or target (BlackScabbard, BlueLing, and Anglerfish in 2002). These kind of profiles can allow to follow the evolution of the fishery (change in the target species…).



- Single-species approach : each fishing sequence can be characterised by the proportion of a species in its landings. Thresholds could be found in order to allow a certain level of explanation of the total landings of the species in the selected fishing sequences. For instance, in 2002, 90% of the landings of Grenadier came from fishing sequences with more than 28% (threshold EQL) of this species in its landings.

  These thresholds are computed species by species and can vary from one year to the other.

- Metier approach : Compromise between the EQL on a single-species basis and the combination of thresholds applied on various species, one fishing sequence being categorised by 3 percentages for three species (or group of species). The compromise consists on maximising the discrimination species by species, minimising the amount of 'unclassified' fishing sequence (metier 'Other') and minimising the amount of mixed fishing sequences (mixed because more than one thresholds is reached). The use of the 90%EQL could be considered as a good compromise.

Métiers defined with thresholds = 90% EQL

French fishery (50 vessels) in Sub-Area VI

		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Grenadier	Landings	1085	3936	5555	4483	4892	4919	6004	5367	5555	4168	5218	7156	5855	7169	3609
	90% EQL	6	11	12	12	11	12	14	14	17	15	21	22	21	28	27
Black Scabbard	Landings	141	923	1791	2477	2329	2101	2508	2881	2166	1033	1442	2556	3254	3563	2003
	90% EQL	7	6	3	5	4	4	5	7	5	3	5	6	9	12	12
Saithe	Landings	9312	7326	5994	4711	7641	6153	4975	4148	3936	3464	2486	3700	3213	1891	1549
	90% EQL	26	22	20	16	22	21	16	12	18	17	28	37	32	36	39

Example: Year 2002

Identification of target species: Grenadier, Black Scabbard are obvious. Sikis could be an a priori candidate but is not really a target species (as shown in the graph above) and given the correlation with the other species. Saithe is the third target species (significant amount of landings and well separated from the other species).

A threshold of 28% allows to explain 90% of the landings of Grenadier, 12% for Black Scabbard, and 36% for Saithe.

Each fishing sequence could be classified in 8 classes:

1. Class 'Grenadier' if the proportion of Grenadier in its landing is greater than 28%, the proportion of Black Scabbard lower than 12%, and the proportion of Saithe lower than 36%
2. Class 'Black Scabbard' if the proportion of Black Scabbard in its landing is greater than 12%, the proportion of Grenadier lower than 28%, and the proportion of Saithe lower than 36%
3. Class 'Saithe' if the proportion of Saithe in its landing is greater than 36%, the proportion of Grenadier lower than 28%, and the proportion of Black Scabbard lower than 12%
4. Class 'Others' if none of the threshold is reached
5. Class mixed 'Grenadier + Black Scabbard' if the two respective thresholds are reached
6. Class mixed 'Grenadier + Saithe'
7. Class mixed 'Black Scabbard + Saithe'

Year 2002 - Sub Area VI

Target	Hours Fished	Effort (h*100kW)	Total	**Grenadier**	**Saithe**	Tusk	Ling	BlueLIng	Phycis	Anglerfish	**BLackScabbard**	SqualidSharks
1. Grenadier	24319	287781	6968	**5047**	24	17	16	480	22	24	247	543
2. Black Scabbard	20866	243416	4549	432	44	46	43	636	79	135	**2404**	369
3. Saithe	6011	60396	1960	25	**1629**	4	39	27	5	46	21	9
4. Others	21030	180238	3155	216	114	33	160	918	95	392	82	200
5. Grenadier + BlackScabbard	12008	138061	2859	**1437**	4	13	3	171	16	19	**776**	256
6. Grenadier + Saithe	77	745	12	5	6	0	0	0	0	0	0	1
7. BLackScabbard + Saithe	405	5427	126	5	67	1	2	6	1	1	30	4
8. Grenadier + BlackScabbard + Saithe	38	378	10	3	4	0	0	0	0	0	2	0
Total	84753	916443	19638	7169	1891	115	263	2239	216	617	3563	1382

8. Class mixed 'Grenadier + Black Scabbard + Saithe' if the three respective thresholds are reached

Landings of the target species from the most important classes

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	Grenadier			Black Scabbard			Squalid Squids		
	Total	1.Grenadier	5.Grenadier+BlackScabbard	Total	2. Black Scabbard	5.Grenadier+BlackScabbard	Total	1.Grenadier	2. Black Scabbard
1989	1085	513	125	141	63	62	4	1	0
1990	3936	1562	1462	923	172	651	250	51	14
1991	5555	1703	2602	1791	468	1008	844	255	100
1992	4483	1681	1734	2477	1070	1001	1395	588	87
1993	4892	1369	2403	2329	823	1125	1812	461	138
1994	4919	1357	2605	2101	642	1167	1723	338	164
1995	6004	2063	3085	2508	655	1386	2059	470	262
1996	5367	1546	2822	2881	855	1600	2203	432	303
1997	5551	2823	1826	2151	1209	685	2135	682	412
1998	4168	1612	1806	1033	436	414	1561	406	274
1999	5218	2547	2117	1442	664	623	1560	468	286
2000	7156	3976	2446	2556	1405	877	2279	778	469
2001	5855	3228	2036	3254	1842	1068	2235	836	418
2002	7169	5047	1437	3563	2404	776	1382	543	369
2003	3609	2477	777	2003	1367	428	682	294	174

4.1.2.4 CPUE calculations

CPUE could be calculated as :

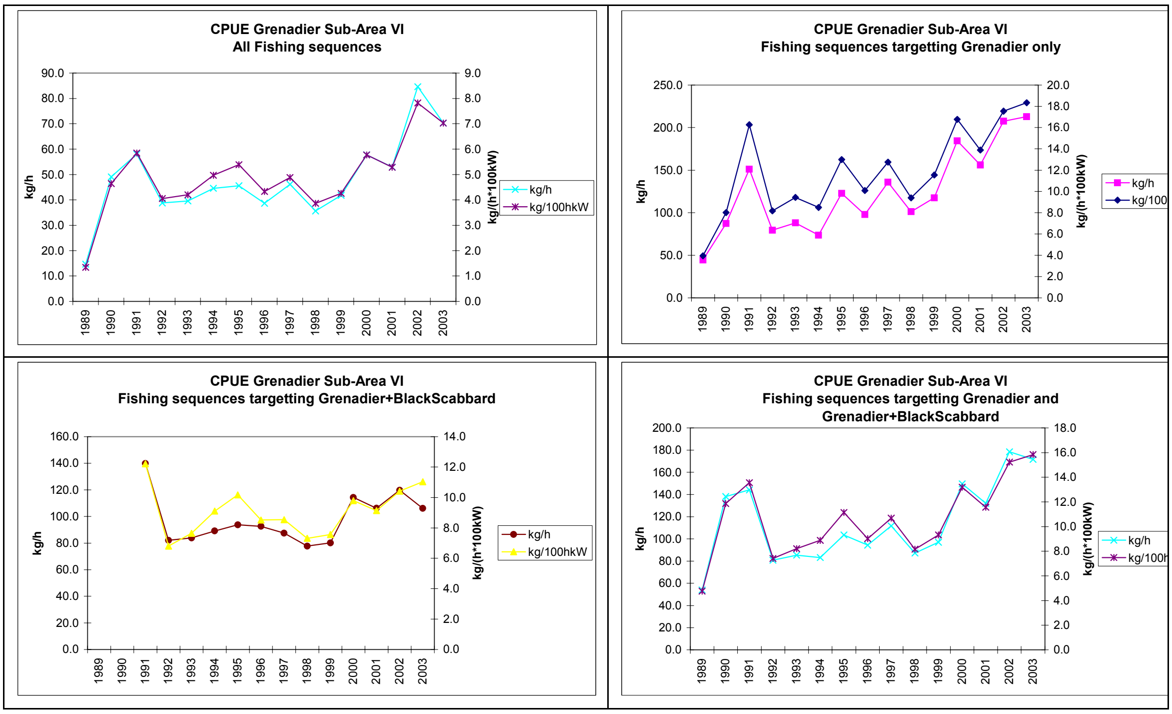
- Total landings / Total effort in the area (effort in hours or engine power corrected)
- Landings for the pure targeted fishing sequences / corresponding effort
- Landings for the mixed fishing sequences / corresponding effort
- Landings for all the targeted fishing sequences (pure + mixed) / corresponding effort

A series of tests have been made to finalise the choice of the CPUE series to be used by WGDEEP in 2004.

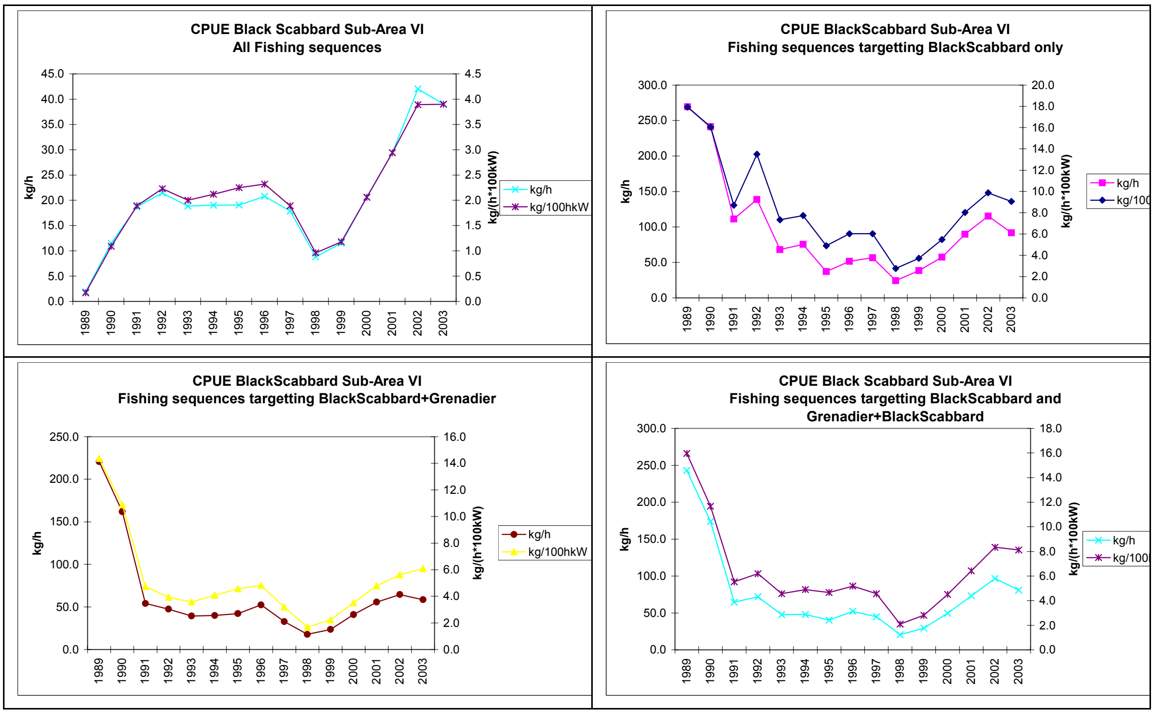
4.1.2.5 Choice of the fishing effort unit

The fishing effort used was either hours fishing, or hours fishing adjusted by engine power.

Grenadier



Black Scabbard



The fishing effort using the engine power correction does not improve significantly the quality of the cpue, in this case with the same vessels all over the period. Furthermore, this correction does not allow taking into account possible changes in the efficiency and strategy of the vessels.

4.1.2.6 Choice of the metier

CPUE were calculated with different metiers identified in **Ch 4.1.2.3.**

CPUE for Grenadier and Black Scabbard from different classes

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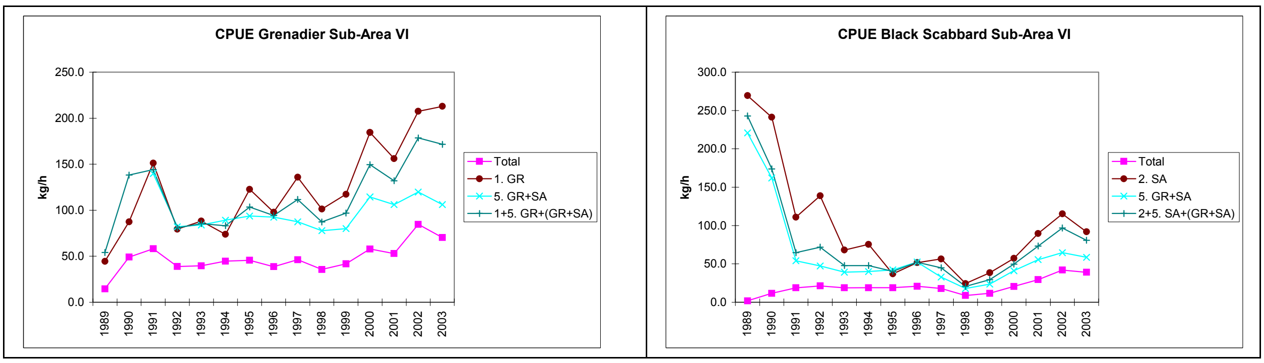
	Grenadier				BlackScabbard			
	Total kg/h	1. Grenadier kg/h	5. Grenadier + BlackScabbard kg/h	1+ 5 kg/h	Total kg/h	2. Black Scabbard kg/h	5. Grenadier + BlackScabbard kg/h	2+ 5 kg/h
1989	14.6	44.5	418.8	54.0	1.9	269.4	220.9	242.9
1990	49.1	87.5	389.2	138.2	11.5	241.3	161.9	173.9
1991	58.1	151.2	139.8	144.1	18.7	111.0	54.2	64.7
1992	38.8	79.5	82.1	80.8	21.4	138.8	47.4	71.8
1993	39.6	88.1	83.9	85.4	18.9	68.2	39.3	47.8
1994	44.6	73.7	89.1	83.2	19.0	75.4	39.9	47.9
1995	45.6	122.7	93.8	103.6	19.0	37.1	42.1	40.4
1996	38.7	97.9	92.5	94.4	20.8	51.6	52.5	52.2
1997	46.2	135.9	87.5	111.7	17.9	56.6	32.8	44.8
1998	35.6	101.2	77.7	87.3	8.8	24.3	17.8	20.7
1999	41.8	117.4	80.1	96.9	11.6	38.5	23.6	29.5
2000	57.8	184.5	114.4	149.6	20.6	57.3	41.0	49.7
2001	52.9	156.1	106.1	132.1	29.4	89.7	55.7	73.3
2002	84.6	207.5	119.7	178.5	42.0	115.2	64.6	96.7
2003	70.3	212.9	106.1	171.6	39.0	91.9	58.5	80.9

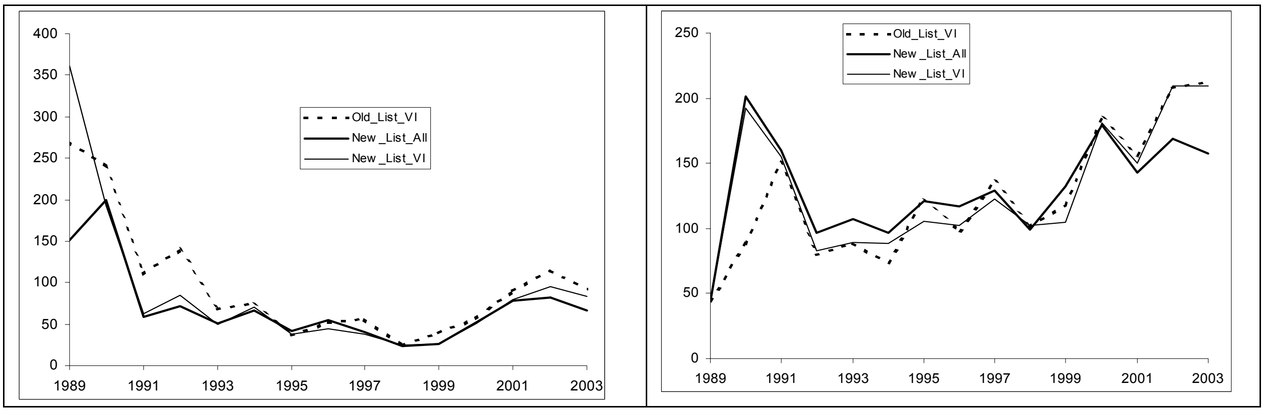
Comparison:



CPUE series computed from fishing sequences of the 'pure target class' (ie 1. For Grenadier, 2. For Black scabbard) or for the mixed class (i.e. 1+5. For Grenadier and 2+5 for Black Scabbard) could be both candidate for a proxy of the abundance indice. Given the assessments are stock-based, the CPUE directed to one single stock (i.e. 1 and 2) were selected here.

4.1.2.7 Choice of the vessel composition

Stock-directed CPUE were compared with different vessel composition and for different geographical areas visited by the fishing vessels. In the Figure below, the series "Old_list_VI" is based on the list of vessels used in Ch 4.1.2.3 and fishing in subarea VI. "New_list_VI" is based on a list of vessels provided by the French fishing industry prior to WGDEEP04 and fishing in subarea VI. "New_list_All" is based on the same list of vessels fishing in Vb, VI, VII (grenadier) and .Vb, VI, VII, X (black scabbard).



The trends are similar across the three series for the two stocks. The series chosen for the analyses was "New_List_All" for all stocks, since it encompasses the whole stock geographical distribution, and since it integrates the valuable information from the fishing industry.

4.1.2.8 The CPUE provided to WGDEEP in 2004

The final CPUE series, which were made available to WGDEEP in 2004 are shown below.

The interpretation of these series will be left to the individual stock sections. However it must be kept in mind that these CPUE are over optimistic since only the 'good' fishing sequences are kept for the calculation. This is particularly true for aggregative species (blue ling, orange roughy), which have been subject to sequential depletion. Nevertheless, in the absence of precise information (on a haul by haul basis) including the depth and the expected target species (whatever the result is), methods based on catch profiles are probably the most appropriate to identify 'the' deep-sea fishery, and to derive CPUE on this basis.

4.1.3 Germany

There appears to have been no new developments since the 1998 report.

4.1.4 Greenland

Traditionally small by-catches have been reported of roundnose grenadier from the Greenland fisheries for Greenland halibut in ICES Division XIVb.

4.1.5 Iceland

Iceland deepwater fisheries are only conducted in Icelandic waters (Va). Tusk, ling and blue ling remain the most important species (Table 4.1) and many vessels are engaged in the fishery with catches from below 100 kg. to nearly 1000 tonnes. In 2003 around 4400 tonnes of deep water species were caught in bottom trawl, whereof 2600 were greater silver smelt. There has been reduction in the catches in recent years, mostly due to decrease in the greater silver smelt fishery, but also due to reduction in the catches of tusk. By longline, nearly 6300 tonnes were caught, mostly tusk and ling, but also blue ling. Table 4.4 gives the overview of the Icelandic catches in 2003 by gear-type and by month. All catches of deep-sea species in 2001 were taken within the Icelandic EEZ. There are quota restrictions on ling (3000t) and tusk (3500 t) by Icelandic vessels in Va, but greater silver smelt and blue ling fishery are currently with no restrictions.

Discarding is prohibited on Icelandic vessels and information on prohibited discards is not available.

Orange roughy. Less than 200 Kg were caught in 2003.

Ling. Totals of 3 587 tonnes were caught, whereof 2 214 tonnes with longline, 456 tonnes with gillnets and 845 tonnes with bottom trawl. This is increase in all gears, compared with 2002 and is highest catch since 1999. Catches of ling are a by-catch fishery where the main target species are cod, tusk and others. The fishing grounds as recorded in the logbooks in 2000, 2002 and 2003 are shown in Figure 4 of the WD by Sigurdsson (2004). According to the fishermen, ling has become more abundant in Icelandic waters in most recent years, and is difficult to avoid in the catches. Total of 568 vessels reported catches in 2003.

Blue Ling. Blue ling is mostly caught as a by-catch in the bottom trawl and longline fishery. During the last decades, direct trawl fishery for blue ling took place during the spawning season. This has decreased during the last years, as the catch rates have been low while trying to fish on spawning aggregations. The total catch in 2003 was 1098 tonnes whereof 197 and 877 tonnes were taken by longeline and bottom trawl, respectively. The catches in 2003 are only 100 t less that in 2002. The fishing grounds as recorded in the logbooks are shown in Figure 4.1 for 2000, 2002 and 2003. In total 175 vessels reported catches in 2003.

Tusk. In early nineties directed effort towards tusk started and the catches increased to 6400 tonnes in 1991 and 1992. Since then, the catches have been between 4100 and 5800 tonnes until 2001. In 2001 the Icelandic catch decreased down to about 3400 t, whereof 3200 tonnes was taken by longlines but in 2002 and in 2003 the catches increased again to 4000 t. The fishing grounds as recorded in the logbooks are shown in Figure 4 of the WD by Sigurdsson (2004) for the years 2000, 2002 and 2003. Total of 568 vessels reported catches in 2003.

Greater Silver smelt. Greater silver smelt have been caught in bottom trawl for years, as a by-catch in the redfish fishery. Only small amounts was reported prior to 1996 as most of the fish was discarded. Since 1997, direct fishery for greater silver smelt have been ongoing and the catches increased significantly, from 800 tonnes in 1996 to 13 000 tonnes in 1998. In 1999 and 2000, the catches were close to 6000 tonnes, but decreased to only 3000 tonnes in 2001. The catches in 2002 increased again to almost 5000 tonnes where the dominant gear was bottom trawl and further down to 2700 tonnes in 2003. The fishing grounds as recorded in the logbooks are shown in Figure 4 of the WD by Sigurdsson (2004) for 2000, 2002 and 2003. Total of 31 vessel landed the species in 2003 and the range of the landed catch by vessel were from less than 200 Kg to 386 tonnes.

Fishery of other nations in Icelandic waters in 2003. There is information on catches of deep-sea species caught by Germany, Faroe Islands, UK and Norway in Icelandic waters in 2003. The catches were total of 1917 tonnes, divided by country and species as follows (information from the Icelandic Coast Guard):

Species	Germany	Faroe Islands	UK	Norway	Total catch
Blue ling	12	1	20	20	53
Ling	1	422	2	154	579
Tusk		969	1	315	1.285

Table 4.1 Overview of Icelandic deep-sea fishery in 2003 by month and gear type (t). Number of vessels involved in the fishery by gear is also given. It should be mentioned that the same vessels can be included in more than one category of gear type. More detailed information see Annex 1 in WD by Sigurdsson (2004).

Sum of afli			month												
Species	Number of vessles	Gear type	1	2	3	4	5	6	7	8	9	10	11	12	Total catch
Ling	244	Longline	196	109	216	166	155	125	116	155	227	256	235	257	2214
	173	Gillnet	24	29	79	108	122	20	7	5	7	21	11	23	456
	86	Jiggers	0	0	0	0	1	1	1	1	1	1	0	0	7
	55	Danish seine	4	2	5	6	6	4	4	2	7	9	7	6	63
	139	Bottom trawl	28	47	85	115	107	114	186	40	43	34	29	18	845
		Pelagic trawl				3						0			3
Ling Total			252	187	385	397	390	264	314	203	285	321	282	304	**3587**
Blue ling	48	Longline	7	1	0	0	3	23	10	18	20	63	27	25	197
	15	Gillnet	0	0	0	0	0	0				5	1	0	7
	1	Jiggers							0						0
	20	Danish seine	0	0		0	0	0	1		3	5	1	2	11
	105	Bottom trawl	53	69	56	31	26	10	69	66	92	193	123	90	877
		Pelagic trawl				1	0				3				5
Blue ling Total			60	70	56	33	29	33	79	84	118	265	152	118	**1098**
Tusk	276	Longline	284	249	348	301	336	344	290	232	401	429	385	339	3937
	139	Gillnet	6	7	7	4	2	1	0	2	1	5	3	3	41
	113	Jiggers	0	0	0	1	2	2	2	1	0	1	0	0	10
	23	Danish seine	0	0	0	0	0		0	0	0	0	0	1	1
	126	Bottom trawl	7	7	7	5	7	3	5	3	5	8	6	4	67
		Pelagic trawl										0			0
Tusk Total			298	263	362	310	347	350	297	238	407	443	394	347	**4057**
Greater silver smelt		Bottom trawl	154	240	275	281	251		155	120	47	316	351	470	2660
		Pelagic trawl				23									23
Greater silver smelt Total			154	240	275	304	251		155	120	47	316	351	470	

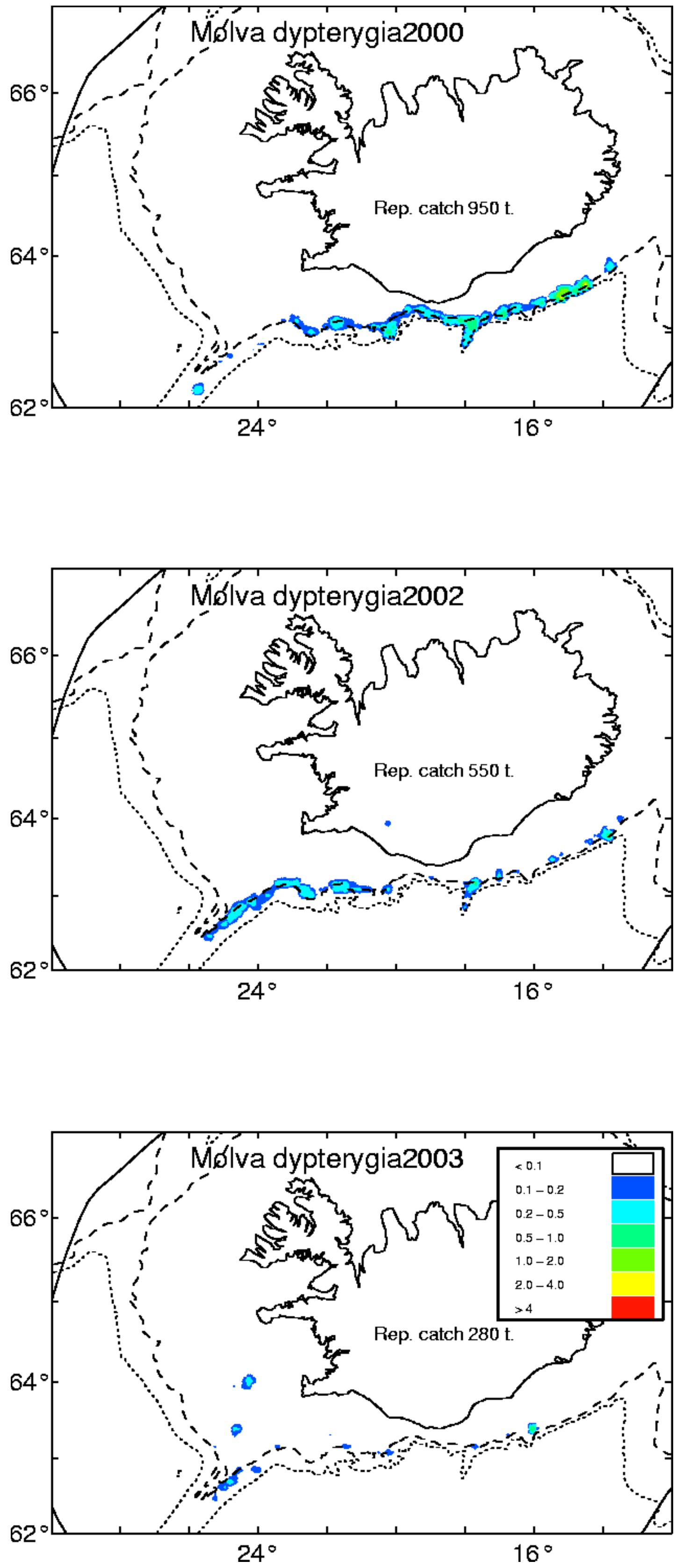


Figure 4.1 Distribution of Icelandic landings of blue ling in 2000, 2002 and 2003 as reported in the log-books. All gear types combined

4.1.6 Norway

Longline fisheries

The longline fishery for ling (*Molva molva*) and tusk (*Brosme brosme*) remains the most important aimed deep-sea fishery in Norway (e.g. Bergstad and Hareide 1996). Around 55 vessels longer than 70 feet are engaged in these fisheries which are mainly conducted in ICES Divisions and Subareas IIa, IVa, V, VI, VII, and XIV. The longliner fleet also has other often preferred target species for parts of the year, primarily northeast Arctic cod in area I and IIa. A time-series of effort data on the fisheries in the period 1974–1996, i.e., number of vessels, weeks at sea, distribution of effort by species and Norwegian Directorate of Fisheries statistical areas, were given in the 1998 report. The number of vessels declined until 1994, but the number increased again in the most recent years. Due to technological advances, effort in terms of number of hooks increased throughout the series despite the decline in number of vessels and number of weeks engaged in the fishery (Bergstad and Hareide 1996; Magnússon *et al.* 1997a).

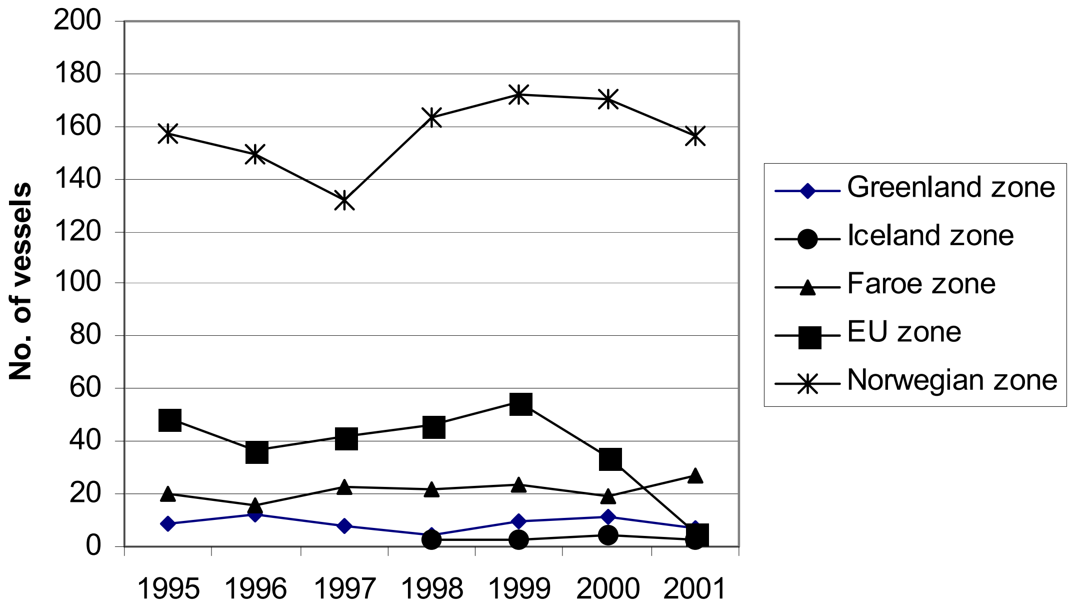


Figure 4.2 Number of Norwegian vessels fishing in different EEZs. Data provided to NEAFC in 2003 by the Norwegian Directorate of Fisheries. In the Norwegian zone, also small coastal longliners are included.

The same vessels may also temporarily target other species such as redfish (*Sebastes* sp.) and Greenland halibut (*Reinhardtius hippoglossoides)*. In recent years a longline fishery developed off southeastern Greenland at depths down to 1500 m. The target species is Greenland halibut, but probably as much as 30 % of the by-catch is roughhead grenadier (*Macrourus berglax*). The area of this fishery has expanded to eastern and western slopes of the Reykjanes Ridge south of Iceland.

In 1996-1997, a dropline (and gillnet) fishery targeting "giant redfish" (*Sebastes marinus*) developed on the Reykjanes Ridge (Subareas XII and Division XIVb). Detailed data on this fishery and estimated catches were presented in the final report of the EC FAIR project (Gordon, 1999). The activity declined to low levels in 1998 and 1999.

In 1999-2001, some exploratory longlining was carried out on the slope of the Hatton Bank and to a limited extent on the mid-Atlantic Ridge (Hareide and Garnes, 2001). This has continued as relatively limited commercial operations in subsequent years, but the effort declined significantly in 2003 (WD by Fossen, 2004).

Trawl fisheries

The relevant trawl fisheries were described in previous reports (ICES C.M. 1994/Assess:4; ICES C.M. 1996/ Assess:8). There have been no major changes in the recent years.

Argentina silus has been targeted in trawl fisheries off mid-Norway (Division IIa) and the Skagerrak (IIIa) since the late 1970s. These fisheries have continued as described in ICES C.M. 1996/ Assess:8, but the effort directed at *A. silus* varies strongly with market demand. In Division IIa landings declined from top levels at 10 000 –11 000 t in the mid 1980s to about half that level in the early 1990s. In the most recent years there has been an increase. The fishery in the Skagerrak was conducted by 1–3 trawlers and annual landings were 1 000–2 000 t/year in the late 1980s and early 1990s. Since then the activity declined and varied considerably, and landings ranged from less than 10 to 700 tonnes per year. In the Skagerrak (IIIa) and the northeastern North Sea (IVa), there are, however, trawl fisheries for Norway pout, blue whiting and deep-water shrimp (*Pandalus borealis*) that may have significant by-catches of *Argentina silus.* No landings of by-catches of *Argentina silus* in the pelagic trawl fishery for blue whiting to the west of Scotland and Ireland (Subareas VI and VII) were recorded in recent years.

Intermittently there are minor trawl fisheries in mid-Norway (IIa) targeting roundnosed grenadier *Coryphaenoides rupestris* and *Argentina silus*. Six 120-140 foot trawlers have licences. Details on this fishery were given in the report of the EC FAIR project (Gordon, 1999). The roundnosed grenadier is also a by-catch in the shrimp and *Argentina silus* fisheries in the Skagerrak (IIIa), but the by-catches not landed for human consumption have not been quantified. Interview-based estimates suggest a total catch of around 1000 t/year in the shrimp fishery alone. The recorded landings are at most a few hundred tonnes.

Exploratory trawling has been carried out on the Hatton Bank (VIa) and along the Mid-Atlantic Ridge (XII), but these were short-term experiments that did not lead to the development of lasting new fisheries.

Gillnet fisheries

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

4.1.7 Portugal

Mainland

The three main deep-water fisheries off mainland Portugal have been described in detail in the report of SGDEEP from 2000 (ICES CM 2000/ACFM:8). Some further details on the fishery targetting black scabbardfish (*Aphanopus carbo*) is given here. The commercial black scabbardfish fishery in continental Portugal started in Sesimbra, a fishing village situated to south of Lisbon. The fishing takes place on hard bottoms along the slopes of canyons off Sesimbra at depths normally ranging from 800 to 1200 m (Fig 4.3). It is important to stress the localized character of this fishery. It is restricted to a fraction of the area identified as the areas of distribution of the species based on scientific longline surveys conducted along the Portuguese continental coast. The longline gear used is designed to match the vertical distribution of the black scabbardfish and also to prevent gear loss on the hard grounds. This fishery has an artisanal character. Each fleet unit has a large number of fishermen involved. Usually associated with each fleet unit are two groups of workers; one working at sea and the other ashore, being responsible for the disentangling, baiting and coiling of the main line into the tubs. This is a time consuming and very labor intensive process, all done by hand.

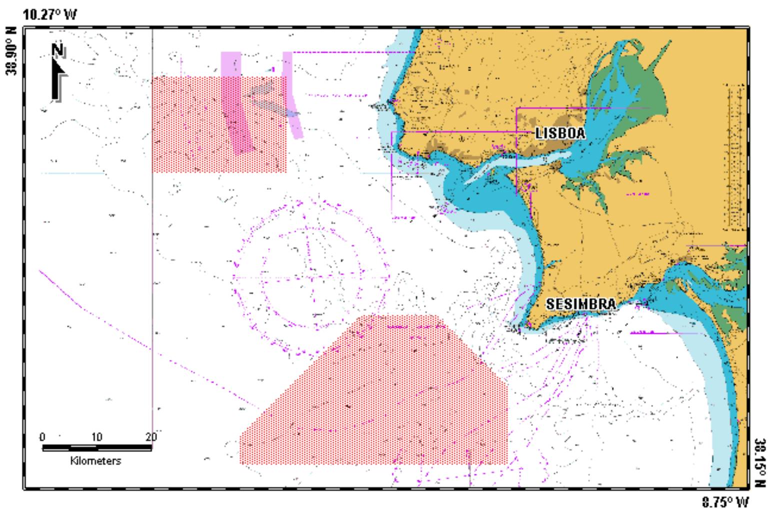


Figure 4.3 Fishing areas (shaded) of the Sesimbra fishery for black scabbardfish.

Azores

The evolution of demersal fisheries in the Azores has undergone three main phases. The first phase, before the beginning of 1980s, the fishery was traditional and conducted by small open deck boats (<12 m) operating near the coast, using mainly handline and producing small and selective catches. A second phase, started at the early 1980s, was characterised by the introduction of the bottom longline gear and new fishing vessels (12-30 m longliners). New species and new fishing areas and depths were explored, new markets were developed, and an abrupt increase in the total demersal catches and fishing effort was observed. The third and current phase is characterised by a rather stable total catch and fishing effort, and some of the stocks are considered to be intensively exploited. However, the effect of the multispecific character on the dynamics of the fishery is not yet very well understood.

This fishery can be considered as multispecific, since more than 20 species are caught by the longline fleet, that takes more than 80% of the total catches. *Pagellus bogaraveo* is considered the target species, but other species have been caught and commercialised in significant quantities, like *Helicolenus dactylopterus, Conger conger, Beryx splendens, Beryx decadactylus, Pontinus khulii, Polyprion americanus*. Small quantities of other deeper-living species are also caught occasionally, e.g. *Mora mora, Phycis blennoides, Molva macrophthalma, Epigonus telescopus*, and some elasmobranches species like *Deania calceus, Deania profundorum*. Landings of some of these species are pooled in the fishery statistics and/or are not discriminated. Catches of demersal and deep-water species by the local fleets are all sold at auctions in the Azores.

Technical measures were introduced during 1998 and 2000 to control the effort of the fishery, including the introduction of an annually minimum threshold landing in value to licence the vessels and area restrictions by gear and vessel type. In practice, with the last measure, a box of three miles was created around the island areas were only hand lines and small vessels are permitted to fishing.

At present the catches of kitefin shark (*Dalatias licha*) are made by the longline and handline deep-water fleets and can be considered as accidental. There are no vessels at present targeting this species using gillnets. Considering the observed local depletion of the kitefin stock by the gillnet fishery there are a new proposal from the Regional Govern, to be implemented during 2005, for total prohibition of gillnets for deep-water species inside the Azorean EEZ.

Experimental fishing to black scarbbard fish conducted by the industry still continues. The main constrain to the development of a target fishery seems to be the market.

Madeira

The most important deep-water fishery in Madeira (Portugal) is the longline fishery for black scabbardfish (*Aphanopus carbo*). The number of vessels is declining. In fact in 1988 there were 90 fishing vessels while in 1999 only 40 were engaged in this fishery. Despite this decline, effort in terms of number of hooks maintained throughout the series at the same level. The fishing vessels are made of wood with open deck; with an average overall length of 9m, a mean power of engine of 80 Hp and an average gross registered tonnage of 12 tonnes. There are around 500 fishermen directly involved in this fishery (Sena-Carvalho, Reis and Afonso-Dias, in preparation).

4.1.8 Russian Federation

The Russian deep-water fishery in 2002-2003 has been described by Vinnichenko *et al. (*WD 2002, 2003) and Vinnichenko and Khlivnoy (WD 2004).

Mid-Atlantic Ridge

In 2002-2003 Russian vessels operated from time to time on the seamounts of the MAR fishing for roundnose grenadier.

In March-May 2002 one trawler of 11th-tonnage class executed fishing of the roundnose grenadier on the seamounts of ridge. The vessel operated in Subarea XII. The pelagic trawl was used for fishery. The daily catch varied from 5 to 22 t. The total catch of roundnose grenadier amounted to 737 t (Table 4.1.8.1 and 2).

Late March - early June 2003, one trawler of the 9th-tonnage class executed fishing. The daily catch rate varied from 5 to 14 t. The total catch of roundnose grenadier for that period amounted to 275 t . In the second half of May, a vessel of the 10th tonnage class fished for roundnose grenadier and caught 158 t. In October, a trawler of the 10th tonnage class operated for a short time in the area. By preliminary data, the catch of roundnose grenadier on the seamounts of the MAR in 2003 constituted 585 t (Tables 4.1.8.3 and 4).

Rockall

In March-August 2002, when fishing haddock and blue whiting, ling and great silver smelt occasionally occurred in the catches by bottom trawls (Table 4.1.8.1). Besides, small amounts of blue ling, tusk and greater forkbeard were caught. In the early January, on the western slope of the bank, the longliner operated for a short period (during four days). In all, at 250-550 m depths 22.8 thousand of hooks were used. The mean catch rate per one thousand of hooks was 48 kg, the average daily catch – 360 kg. The catches contained tusk, greater forkbeard, haddock and skates. The main target species was tusk, the percentage of which made up more than a half (62.6%) of catches. Greater forkbeard was the second important species (24.5%).

In May-August 2003, deep-water fish species were caught from time to time during the fisheries for haddock and blue whiting (the depth was 200-300 m). Greater silver smelt were found in catches most often (Table 4.1.8.3); ling, tusk, greater fork-beard and various species of grenadiers were observed in less number. Besides, by-catch of greater silver smelt was recorded from time to time during fisheries for blue whiting by midwater trawls above the depth 430 - 1 300 m, the total catch of this species amounted 28 t.

In June 2003, one trawler operated by the bottom trawl during 3 days at the depth 320-560 m. The basis of catch (62 %) consisted of greater silver smelt; blue whiting (24 %), redfishes (6 %), flat fish (5 %) and other species (13 %) were registered as by-catch. Catch per fishing days constituted 9.9 t.

Hatton Bank

In March 2003, a Russian fishing vessel carried out one trawling in the area of the Hatton Plateau over depths 1 200-1 300 m. Catch constituted about 10 t of smoothhead (53.2 %), rabbitfish (8.8 %), greater silver smelt (7.0 %) with by-catch of roundnose grenadier (2.5 %), blue ling (5.7 %) and greater fork beard (3.7 %).

Faroe fishing zone

In April-May 2002, from 5 to 22 large-tonnage vessels, and in January-February, April-May, November-December 2003, from 2 to 21 Russian vessels were fishing for blue whiting by midwater trawls within the Faroe Fishing Zone. From time to time, in blue whiting catches the by-catch of great silver smelt (*Argentina* spp.) was recorded, the total catch of which was equal to 293 t in 2002 and 245 t in 2002 (Table 4.1.8.1 and 3).

Norwegian Sea

Deep-water fish species were mainly taken as by-catch during the bottom fishery north of 70°N, and the main part was taken by longline. Roughhead grenadier and tusk were caught in the largest number (Table 4.1.8.1 and 3). Other species such as greater forkbeard, roundnose grenadier, blue ling, skates and argentine were found much more seldom.

Roughhead grenadier was recorded in catches by long-liners on the continental slope almost everywhere and the greatest amount was registered to the west of the Bear Island Bank at depths 500-800 m. Grenadier occurred in small numbers in catches by the bottom trawl mainly in Div. IIb at the depth 550-750 m.

Tusk were usually caught in small number over the wide sea area, more often by long-lines on the continental slope in the depth range 200-600 m. On banks Søre and Fugløy (depths 550-750 m), tusk predominated in some catches (up to 60 %), and catch rate constituted 20-100 kg per 1 000 hooks. In catches taken by bottom trawls, tusk occurred comparatively rarely, mainly in Div. IIb on the Western and Southern slopes of the Bear Bank.

Greater silver smelt occurred in small number (tens of individuals) in catches taken by bottom trawls mainly in the south (the Faroe Islands) and in the east (the Norwegian Shallows, Nordkyn, Søre and Fugløya Banks, the Kopytov Area) of Div. IIa.

Lesser silver smelt occurred at the depth 380-750 m on the Fugløya Bank and in the Kopytov area (Div. IIa). Catches did not exceed some hundreds of individuals per trawling hour.

Barents Sea

In the western part of the area, in longline catches tusk and roughhead grenadier were taken from time to time. While trawl fishing demersal species, tusk and great silver smelt were sometimes taken as by-catches.

Table 4.1.8.1 Russian catch (t) of deep-sea species in 2002

Species	ICES Divisions							
	I	IIa	IIb	Vb	VIb	XII	XIV	Total
Roundnose grenadier	-	-	1	-	-	737	-	738
Roughhead grenadier	1	-	-	-	-	-	4	5
Tusk	7	35	-	-	-	-	-	42
Great silver smelt	-	-	-	264	29	-	-	293
Blue ling	-	-	-	-	3	-	-	3
Total	8	35	1	264	32	737	4	1081

Table 4.1.8.2 Preliminary results from the Russian fisheries for roundnose grenadier at the Mid-Atlantic Ridge in 2002 (Div. XII and XIV)

Month	Tonnage class of vessel	Catch, t	
		per fishing days	Total
March	11	13,9	309
April	11	12,1	273
May	11		155
Total			737

Table 4.1.8.3. Russian catch (t) of deep-sea species in 2003 (provisional)

Species	ICES Divisions							
	I	IIa	IIb	Vb	VIa	VIb	XII	Total
Greater silver smelt	-	7	-	245	43	120		415
Roundnose grenadier	-			-		3	585*	588*
Roughhead grenadier		8	22			-	-	30
Blue ling		<1				2	-	2
Greater forkbeard						1	-	1
Tusk	5	21				1		27
Ling						14		14
Smoothhead						6		6
Total	5	36	22	245	43	147	585	1087

*-including catch of R/V "Atlantida"

Table 4.1.8.4. Preliminary results from the Russian fisheries for roundnose grenadier at the Mid-Atlantic Ridge in 2003 (Div. XII)

Month	Tonnage class of vessel	Catch, t	
		per fishing days	Total
March	9	8.5	135.4
April	9	6.8	129.4
May	9	10.2	10.2
May	10	19.2	158.0
June	9	3.2	3.2
October	10	16.0	75.0
May - July	R/V "Atlantida"		73.9
Total:			585.1

4.1.9 Spain

A comprehensive description of the Spanish deep-water fisheries in the NE Atlantic was given in the 1998 report of the SGDEEP (ICES CM 1998/ACFM 12) and published by Piñeiro *et al*. (2001). In the present WGDEEP three WDs related to different segments of the Spanish fleet fishing deep sea species have been presented.

Multispecies deep-sea bottom trawl commercial fishery at Hatton Bank

A detailed description of this fishery (1996-2000) have been presented to the 2001 NAFO Deep-sea Fisheries Symposium (Duran Muñoz e*t al.* 2001) and updated information is given in Duran Muñoz *et al.* (2004) (WD). The fishery is carried out by freezer trawlers (35-84 m length) in international waters of the Hatton Bank, mainly in ICES Subarea XII and partially in Division VIb, using bottom trawl gear called "pedreira". The main commercial fish species are smoothheads, roundnose grenadier, blue ling and Portuguese dogfish. The presence of the majority of the vessels in this fishing ground is discontinuous, according to fishing opportunities in other North Atlantic grounds. Vessels conducted one to four fishing trips per year, of variable duration (1 week to 4 month approx.). As in the previous years, the fishing operations were conducted at depths mainly between 800-1600m. Since 1998, a gradual movement of the fishing effort towards the deeper bottoms occurred. In 2001, 28 bottom trawlers were involved in this fishery. At least one trawler operated occasionally on the Reykjanes Ridge, targeting blue ling.

The artisanal longline ("voracera") fleet in Division IXa.

A new description of the Spanish fishery in the southern part of Div. IX, in the Strait of Gibraltar, has been presented to the Working Group by Gil et al. (WD 2004), that complete the information offered in the previous working groups (Gil *et al*., 2000; Gil *et al*., 2002).

In 2001 around 100 vessels fished red seabream in a very small area close to the Gibraltar Strait. All catches are landed in only two ports, Algeciras and mainly in Tarifa. The standard vessel is a boat 6-9 m overall length, displacing around 5 GTR and with 3 to 5 crew. As the fishery has experienced an important decline of the catches in the recent years, a local Fishing Plan conducted by the Spanish Central Government and the Regional Government of Andalucia has been implemented in 1999 for the resource recuperation. 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).

Spanish new deep fishery in the Strait of Gibraltar (ICES IXa)

Since three years ago a new artisanal deep fishery targeted to the Silver scabbardfish *(Lepidopus caudatus*, in spanish "*sable*") has been developing in the Strait of Gibraltar (ICES IXa south) with bottom longlines along the whole year. It originated as an alternative to the red seabream fishery when some boats from Algeciras, Conil and Barbate (Cádiz, Spain) adapted their gears to the silver scabbardfish fishing. Catches increase from 225 tonnes in 2001 to in 719 tonnes in 2003. Actually around 60 boats are involved in this fishery which takes place in the area in depths from 150-400 meters.

The Basque Country fishery

An overview of the updated Basque deep-sea fishery has been presented to the WD by Lucio *et al.* (2004). As in the last years almost all the catches obtained by this fleet can be considered as by-catches of the bottom trawlers (mainly "baka" otter trawl) and longliners. A main feature of this fleet in the period 1994-2000 is the significant and continued reduction in the total number of the fishing boats, mainly longliners and bottom trawlers ("baka" and "bou").

Probably the only well defined Basque fishery on deepsea fish was in the past that targeting red seabream and it was restricted to a very limited season (mainly from November to March) (Lucio, 1996). At present, as before it has been indicated, most deep-sea fish catches of the Basque fleets in 2002-2003 were by-catches of the directed or mixed demersal fisheries in the Northeastern Atlantic waters by different fleets.

Two recent working documents dealing to the categorization of the Basque fleets in relation to the species composition and the concept of "fishery" have been presented.

1. The first one, more descriptive, was presented to the *STECF Subgroup on Hake Technical Measures* (Lisbon 27-31 October 2003). It was focused in the annual species composition and relative importance of hake in the landings, by sea area -ICES Subarea VI, VII and Div. VIIIabd- and fleet -trawl, longliner and gillnet-, in the period 1996-2002 (Lucio et al. 2003). In it information on the relative importance of the deep sea fish catches was also provided. Depending on the fleet and on the sea area, very high differences in the annual species composition and in the relative importance not only of the Northern hake but also deep sea fish are found.

The “Baka” otter trawl fleet –a *sensu stricto* “mixed fishery”- has a very variable species composition between areas. The sea area (ICES Subarea or the aggregation of determinate ICES Divisions (namely Div. VIIIa,b,d, *i.e.* Bay of Biscay) is considered as the factor for distinguishing three components:

“Baka” trawl in Subarea VI
“Baka” trawl in Subarea VII
“Baka” trawl in Divisions VIIIa,b,d

Deep down, they are the Spanish rights to access to a determinate sea area and to profit from a part of the Spanish quotas on a very restricted set of species or stocks (mainly Hake, Monkfish, Megrim and Nephrops), sometimes split by sea components, the reasons to go to the mentioned sea areas and not to others.

In “Baka” trawl, Hake can be considered almost as a “by-catch” (less than 10% of the landings) in all areas –mainly in Subarea VII and Div. VIIIa,b,d - in the period studied. But only in Subarea VI, the relative importance of some deeps sea fish is relevant (Blue ling, Ling and Greater Fork Beard, combined, contribute to about 25% of total landings).

On the contrary, the pair bottom trawlers with very high vertical opening nets (VHVO fleet) has hake as target (close to 80% or more of the landings) in both sea areas (Subarea VII and Div. VIIIa,b,d) and only insignificant catches of deeps sea fish are obtained. Two components of this metier could be distinguished based in the two different sea areas.

The bottom longline fleet, as the “Baka” trawl and for the same raisons, can be split also in three components each of them related a the three sea areas above indicated:

Longline in Subarea VI
Longline in Subarea VII
Longline in Divisions VIIIa,b,d

It targeted Hake until the middle of 90s of the past century in all sea areas. But since 1998, Conger and Ling are the main targets with practically null Hake catches in Subarea VII and Div. VIIIa,b,d. In Subarea VI important catches of deep sea fish (mainly Ling, Greater Fork Beard, Blue ling, Tusk, Blue-mouth rockfish and Conger, contributing all of them combined to about 50% of the landings). However the relative importance of these deep species has decreased in the more recent years at the same time that the Hake catches have increased.

The gillnet métier (implemented in 1998) has Hake as target in Subarea in VII and Div. VIIIa,b,d. Two components can be identified in it based in the two (three, if Subarea VI is included) sea areas. Very scarce catches of deep sea fish are obtained with this metier (less than 8% in Subarea VII, Greater Fork Beard and Ling) and practically null in Div. VIIIa,b,d .

2) The second one, using a more analytical approach, tried to obtain a preliminary identification of the fisheries for (only) the trawl Basque fleets fishing in the European Southern Shelf (Santurtún et al., 2004). It was presented to the recent *ICES Study Group on the development of fishery-based forecasts* (SGDFF) (Ostend, Belgium 27-30 January 2004).

For vessels with base port in the Basque Country (Ondarroa and Pasajes), the trawl fleet -“Baka” Otter trawls and Pair trawls with Very High Vertical Opening nets (VHVO)- operating in ICES Division VIIIa,b,d & Subareas VII and VI were analysed. The study year was restricted to the year 2002 for accomplishing this year 2004 SG requirement. All the fishing trips obtained from selling sheets for the fleet described above were used in the analysis. All species were included except for those contributing in less than 0.1 % to the total annual landing.

A principal component analysis (PCA) was carried out to obtain a reduced description of the large data set used and to analyse the relationships between the variables. In a second step, a cluster analysis was carried out on the principal components obtained. The grouping of homogeneous individual trips, based on the species composition of landings, resulted in the preliminary identification of five fisheries analysed in combination of the knowledge of the fishery and the characteristics of the current Sampling Program. They were:

- Baka VIIIabd Type II (mixed): "Baka" bottom trawlers fishing in the ICES Div. VIIIa,b,d targeting a great variety of species (mixed fisheries: pout, cephalopods, anglerfish, hake, horse mackerel…). In this fishery landings of deep sea fish are practically negligible.

- Baka trawl VII ANF-MEG: "Baka" bottom trawlers fishing in the ICES Subarea VII targeting Anglerfish and Megrim. This fishery has very few landings of deep sea fish.

- Baka trawl VI BLI-WIT-HKE-ANF: "Baka" bottom trawlers fishing in the ICES Subarea VI targeting a variety of species specially Blue ling, Witch and Hake but also Anglerfish and Megrim… Thus the importance of some deep sea fish is relevant.

- VHVO Pair VII trawl HKE: Pair trawlers operating with Very High Vertical Opening nets fishing in Subarea VII targeting Hake. This fishery does no catch deep sea fish in significant amounts.

- VHVO Pair trawl VIIIabd HKE: Pair trawlers operating with Very High Vertical Opening nets fishing in the ICES Div. VIIIa,b,d targeting Hake. As the previous one, this fishery does no catch deep sea fish in significant amounts.

4.1.10 Denmark

At present 4 species, classified as 'deep water species', ling, tusk, roundnose grenadier and greater silver smelt are of some importance to the Danish fisheries, mainly as by-catches. During the last 10 years a few Danish vessels have conducted fisheries targeting roundnose grenadier and greater silver smelt, in the Skagerrak (ICES Subarea IIIa) and the northern North Sea. But apart from the landings by these vessels, the Danish landings of deep-sea species are mainly taken as by-catch in various trawl fisheries carried out in ICES subareas IIIa and IVa (northern North Sea). These trawl fisheries may be grouped according to mesh size in the trawls:

- Bottom trawls, mesh size > 100 mm targeting *Nephrops,* anglerfish and various roundfish species, mainly in the eastern part of the northern North Sea. These are mixed fisheries.
- Bottom trawls, mesh size 70 - 100 mm targeting mainly *Nephrops* in IIIa and the northern North Sea.
- Bottom trawls, mesh size 35 - 45 mm targeting deep-water shrimp (*Pandalus*) both in Skagerrak and the northern North Sea.
- Bottom trawls, mesh size < 25 mm targeting fish species for reduction.

According to the Danish logbook records for ling and tusk (see Tables in Ch. 9 and 11) the majority of the by-catches of these species are taken by trawls with mesh size >100 mm in the northern North sea (Norwegian Deeps, IVa) in mixed fisheries for *Nephrops*, various roundfish species and anglerfish. In addition, small quantities of ling and tusk are taken in line fisheries.

In Skagerrak most of the catches of deep sea species are taken by trawls with mesh size 70-100 mm (mixed *Nephrops* and roundfish trawls). The catches of roundnose grenadier are taken in the deeper part of Skagerrak (IIIa), see Ch. 14. Greater silver smelt is also taken in the northern North sea. Of lesser importance are the by-catches in the shrimp fisheries (mesh size in trawl: 35 - 45 mm).

At present most of the Danish landings of roundnose grenadier are used for oil and meal, while a significant part of the landings of greater silver smelt is for human consumption.

Also small quantities of blue ling as well as rabbitfish (*Chimaera*) and lantern shark (*Etmopterus*) have been recorded in the by-catches.

4.1.11 Ireland

Ling and greater forkbeard have been the most consistently landed deepwater species by Irish vessels. These are taken in mixed trawl fisheries, on the continental shelf and slopes, but are now also been taken to some extent in deepwater longline operations, along with blue ling, deepwater sharks and mora. Greater argentine is targeted by pelagic trawlers in some years, for human consumption and fish meal.

In 2001 the Irish deep water fishery developed markedly. The largest fishery was the directed orange roughy trawl fishery, mainly based on aggregations on the continental slopes of the Porcupine Bank in Divisions VIIc and VIIk. Preliminary Irish landings in these areas of orange roughy in 2002 were 5,000 t. There was some catches of orange roughy in the Rockall Trough slopes, both continental and on the Rockall Plateau. Roundnose grenadier, black scabbardfish, blue ling and deepwater siki sharks were a small by-catch in orange roughy fisheries, but also taken in the mixed species slope fisheries in these areas. Irish pelagic RSW vessels reported landings of argentines again in 2002, with preliminary landings of 7,500 t, mainly from Subarea VIa and Division VIIc. Cardinal fish are discarded in large numbers in the orange roughy fishery, but some quantities (55 t) were landed too. As in previous years ling and forkbeard were landed in sizeable quantities, from both deepwater and shelf-based fisheries. Irish longlining took place in the slopes west of Ireland and Scotland targeting sharks, mora and forkbeards. This fishery takes place alternately with a target fishery for cod in Norwegian waters.

In 2003, Irish fisheries were subject to restrictive quotas under the terms of the new EU management regime for deepwater species. The quotas for black scabbard, orange roughy, blue ling and roundnose grenadier were all considered restrictive. The main fishery, was for orange roughy though there was less targeting of the species than in 2002. Anecdotal information suggests that catch rates have declined in this fishery. Due to the restrictive quotas in EU waters Irish vessels also fished in international waters at the Mid-Atlantic Ridge and Hatton Bank. There was very little activity in Subarea VI. The pelagic fishery for argentine that had been re-activated in recent years ceased in 2003, as the quota was allocated to demersal deepwater vessels to allow unavoidable by-catches. Longline activity was reduced, but there was still targeting of sharks, mora and forkbeard on the continental slopes, west of Ireland.

4.1.12 Netherlands

The Dutch fleet of pelagic freezer trawlers consists of 14 vessels, and another 6 vessels are sailing under different foreign flags but owned by Dutch companies. Length over all ranges from 90 - 140 m. The fleet is specialized in small pelagics such as herring (*Clupea harengus*), horse mackerel (*Trachurus trachurus*) and sardinella (*Sardinella aurita*). Fishing grounds are around the British Isles, and off Mauritania. In search of new target species, a small scale fishery for greater argentines developed to the west of the British Isles since 1989. Effort in this fishery depends on availability of different species and exhaustion of quotas. Catches are sorted on board and whole fish are frozen in packets of 22-25 kg. Total annual landings of argentines have been around 5000 t.

The main catches of greater argentine are from west and north-west of the Hebrides, from depths ranging from 600-700 m. The samples from west of Ireland (Porcupine Bank) represent minor by-catches in the fishery directed at blue whiting (*Micromesistius poutassou*). Samples from further south are very small by-catches from a fishery for horse mackerel. (Source: poster by Heessen and Rink presented at the NAFO Deep-sea fisheries Symposium 2001).

4.1.13 United Kingdom

England and Wales

There has been little change to the UK(E+W) fisheries since last described in the 2002 report of the Working Group. Long-liners and gillnetters target hake in *(Merluccius merluccius*) in VIa,b and VIj,k with deep-water sharks as a by-catch. Depending on market prices, sharks can frequently be the target species. Greater forkbeard is taken as a by-catch in demersal trawl fishers for hake, anglers and megrim. The majority of landings from these fisheries are into Spain.

Scotland

As was noted in previous reports, Scotland has no dedicated fishing fleet targeting deep-water species, but rather a number of vessels within the more general demersal fleet which are capable of fishing at greater depths when economic conditions are favourable. Vessels can move rapidly between fisheries and often target both deep-water and shelf species with the course of a single fishing trip. In addition to the Scottish-based trawl fleet, there are a number of Spanish-based longliners and gillnetters which are registered in the UK and regularly land in Scotland. These vessels principally target hake and ling along the shelf edge but a few may occasionally target deep-water sharks with other deep-water species being taken as by-catch in both the hake and shark fisheries.

Because of the opportunistic nature of the fishing fleet, it can be rather difficult to accurately quantify overall fishing effort and to track changes from year to year. Table 4.1.13.1 shows numbers of UK registered vessels landing quantities greater than 1 tonne of deep-water species in Scotland in 2002 and 2003. Numbers of trawlers landing deep-water species in Scotland decreased considerably between 2002 and 2003; this may have been partly a result of the decommissioning of vessels under the UK's fleet reduction program but is principally due to the introduction of quotas on the main deep-water. Similar trends can be observed in the total landings of these species.

Although ling and torsk are here considered as deep water species, they are regularly caught as by-catch in the long established fishery targeting cod, haddock and whiting on the continental shelf and the more recently established fishery for monkfish (*Lophius spp*) on the shelf edge and upper slope. In this case the reduction in the numbers of vessels involved and in total catch may be the result of an overall reduction in effort due to decommissioning and reduction of quota for the target species (Table 4.1.13.2.)

Table 4.1.13.1 Numbers of vessels reporting annual landings >1tonne. (UK vessels landing in Scotland & Scottish vessels landing elsewhere)

	Pelagic Trawl		Demersal Gillnets		Demersal Trawl/seine		Lines		Other gears	
Species	**2002**	**2003**	**2002**	**2003**	**2002**	**2003**	**2002**	**2003**	**2002**	**2003**
Black Scabbard	2				27	12				
Blue Ling			5	4	44	23	3			
Bluemouth				1	8	9	2	3		
Chimaera					3	4				
Greater Argentine	4	1			17	10				
Greater Forkbeard			5	7	35	23	5	5		
Ling			9	11	283	247	9	8	1	1
Orange Roughy					2					
Roundnose Grenadier					21	13				
Torsk			1		81	71	5	5		

Table 4.1.13.2 Annual landings by gear. (UK vessels landing in Scotland & Scottish vessels landing elsewhere)

	Pelagic Trawl		Demersal Gillnets		Demersal Trawl/seine		Lines		Other gears	
Species	**2002**	**2003**	**2002**	**2003**	**2002**	**2003**	**2002**	**2003**	**2002**	**2003**
Black Scabbard	20				1,405	133	1			
Blue Ling			29	10	2,992	703	10	1		
Bluemouth				3	55	53	12	11		
Chimaera					8	36				
Greater Argentine	3,865	12			638	101				
Greater Forkbeard			32	67	505	592	35	15		
Ling			281	68	5,520	3,430	1,178	568	5	3
Orange Roughy					55					
Roundnose Grenadier					851	211				
Torsk			3	1	573	357	125	31		

In 2002, as in previous years, there was a significant catch of greater argentine by Scottish pelagic vessels however, unlike previous years when all landings occurred overseas, this catch was landed into Scottish ports and processed for human consumption. In 2003, landings of this species by pelagic vessels were considerably lower and there is anecdotal evidence that this was attributed to the inability of fishermen to locate concentrations of fish.

4.2 International waters

The Working Group continues to express some concern over what appears to be incomplete reporting of deep water catches and landings from international waters, i.e. outside national EEZs. Large fractions of Subareas X, XII, VI and XIV comprising parts of the fishing areas around the Rockall bank, Hatton bank and south-west part of Lousy bank, the Mid-Atlantic Ridge north of the Azores EEZ (Subarea X), and part of the Reykjanes Ridge south of the Icelandic EEZ (Subareas XII, Division XIVb) lie outside EEZs.

The Working Group noted that the situation appeared to have improved in the most recent years, or at least received more attention by e.g. the initiative by NEAFC to convene an *ad hoc* WG on Catch and Effort Statistics in 2003. Many species dealt with by WGDEEP have wide areas of distribution that extends from slope waters into oceanic areas outside national jurisdiction. The continued lack of complete data prevents the Group from evaluating the fisheries and stock status outside the areas under national or EU jurisdiction.

The Working Group continues to encourage the collection of data and reporting of catch and effort data from international waters.

4.3 Exploratory fisheries

No information about exploratory fisheries in 2003 targeting deep water species or with a significant by-catch of deep water species was reported to WGDEEP.

4.4 Fishery-based advice

The EC has requested ICES to prepare plans for developing catch-at-age data disaggregated by fleet in order to facilitate fishery-based advice.

WGDEEP realised that it was not able to compile catch-at-age data disaggregated by fleet and fisheries during the 2004 meeting. It was, however, decided to start the process towards a fishery-based advice. And to be consistent with the ongoing approaches towards fishery-based assessments among the ICES WGs, the WGDEEP follows the operational and practical definition of fisheries suggested by the ICES Study Group for the Development of Fishery-based Forecasts (SGDFF) (ICES, 2002 & 2003).

WGDEEP suggests that fisheries data should be compiled for the following main geographical areas. The basis for this definition of areas is that they should be well defined, including continental slopes and oceanic banks/ridges at depths > 400 m.

Suggested Areas:

1. Norwegian Sea and North Sea (ICES I, II, IVa, IIIa)
2. Iceland & E-Greenland, Iceland-Faeroe Ridge, northern Reykjanes Ridge (ICES XIV, Va, Vb1)
3. Mid-Atlantic ridge (ICES X, XII)
4. European Slope (ICES Vb2,VI,VII,VII, VII, IX)

The areas are provisional and could be revised in the future.

The definition of ”fleets” and ”fishery” is according to The Study Group for the Development of Fishery-based Forecasts (SGDFF) (2003):

A “fleet” is a physical group of vessels sharing similar characteristics in terms of technical features and/or major activity.

A “fishery” is a group of vessel voyages targeting the same (assemblage of) species and/or stocks, using similar gear, during the same period of the year and within the same area.

With the information available to WGDEEP at present it has only been possible to compile the relevant data on a fleet basis. The WG decided that the first step was to let nationality and main gear type be criteria for fleet definition. This information is available for all countries and is shown in the table below.

Table 4.4 Fishery-based advice. Fleets distributed by Areas. (Aggregation of data by fisheries should be done intersessionally).

Area	Fleets	Fisheries
Norwegian Sea and North Sea		
	DEN Trawl > 100 mm	
	DEN NOR Trawl 70-100 mm	
	DEN Trawl 35-45 mm	
	DEN NOR Trawl < 32 mm	
	IRL Longline	
	NOR Longline	
	NOR Trawl mid-water	
	NOR Gillnet	
	RUS Longline	
	RUS Trawl	
	RUS Trawl mid-water	
E-Greenland, Iceland, Iceland-Faeroe Ridge		
	ICE Longline	
	NOR Longline	
	NOR, ICE, GRL, GER, FAR Trawl (135-155 mm)	
	NOR, ICE, GRL Gillnets 170-230 mm	
Mid-Atlantic Ridge		
	IRL Trawl	
	POR Handline	
	POR Longline	
	RUS Trawl	
	RUS Trawl midwater	
European Slope		
	FAR Longline	
	FAR Trawl	
	FAR Gillnet	
	FRA Trawl	
	IRL Longline	
	IRL Trawl	
	IRL Gillnet	
	NED Trawl midwater	
	NOR Longline	
	POR Longline	
	RUS Trawl	
	RUS Trawl midwater	
	SCO Trawl	
	SPN Handline	
	SPN Longline	
	SPN Trawl	
	SPN Gillnet	
	UKE/W Longline	
	UKE/W Gillnet	

Note: 'Trawl' is bottom trawl unless anything else is mentioned

As for definition of fisheries according to homogenous vessel, gear and area characteristics, the WG decided to let this task be accomplished intersessionally, since this would require more analyses of the available national data. A major problem here would be that many of the 'deep sea fisheries' are mixed and that the target species seem to change frequently. Further, a number of "deep sea" species are also caught in shallow water fisheries, e.g. ling, blue ling, tusk and argentines, and several fleets are targeting both deep and shallow water species.

5 DISCARDS AND FISH COMMUNITY DATA

5.1 Discard data

5.1.1 Current sampling

There remains an urgent need for more quantitative information on levels of discarding from deep water fisheries. A considerable number of discard studies have now been undertaken however many of these studies have been short-lived, often as a result of being driven by funding from EU projects. Moreover, due to the heterogeneous nature of many fisheries in relation to depths fished a.o. and the limited coverage that can be achieved within the budget of most studies, it has rarely been possible to achieve the level of sampling coverage that would be necessary to provide reliable estimates of discards at the level of fisheries. Consequently, most of the information that currently exists can best be regarded as qualitative or indicative of levels of discarding rather than providing reliable estimates of absolute levels of discarding.

Since the last meeting of this WG, several of the 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 programs). The UK (England, Wales and Northern Ireland), Scotland and Ireland, have each set levels of discard sampling in deep water fisheries at four trips per year. Setting up these progeams has caused some logistical problems, and in 2003, Scotland sampled no trips, England and Wales only one while only Ireland achieved their full target sampling of four trips. Portugal has planned sampling in the mainland longline fleet for black scabbard at a level of 3 trips per month; due to logistical difficulties, no sampling was achieved in 2003. Spain, as well as continuing a long standing observer program in the deep water fishery at Hatton Bank, has established an observer program in demersal fisheries to the west of the British Isles in which several deep water species are taken as a by-catch.

5.1.2 Existing data

A substantial amount of research has been carried out into deep water discarding, largely as a result of the EC FAIR project (Gordon, 1999), however much of this data remains unpublished or available only in grey literature sources. Due to the inconsistent format in which the data is presented, it has not been possible to pull it all together in a common reference collection. In order to make this work more accessible, an inventory of these existing data was presented in the 2002 report of WGDEEP.

5.1.3 New data reported in 2004

France

The French working document, WD Girard and Biseau 2004, describes preliminary results from the cooperative project with the French fishermen's organisation PROMA. This study has involved close collaboration with the industry to estimate, *inter alia,* discarding from the deep-water trawl fishery west in subareas VI and VII.

Three methods have been employed for the collection of discard information; direct estimates and recording by the fishermen of overall discard rate and species composition, analysis of randomly selected samples of mixed discarded material collected brought ashore by the fishermen and most recently, on–board sampling by observers.

Estimates of discards by the fishermen involved the skipper estimating discards by species or in a number broad categories or groups of species. The data were initially entered directly in a computerised database, however, this was discontinued due to technical difficulties in January 2003 since when more limited data has been recorded on paper forms. In some cases, due to lack of time, not all the data was recorded; Table 5.1.1 lists the data that were actually recorded by the fishermen.

Table 5.1.1 Number of the hauls retained per depth strata for the analysis

Depth strata	Global discard rate	Specific discard rate	Specific composition
500	25	4	17
600	61	45	62
700	60	131	96
800	55	188	139
900	82	182	131
1000	136	312	196
1100	228	356	245
1200	126	191	126
1300	102	133	81
1400	113	138	92
1500	-	49	-
Total	988	1729	1185

The results of this study broadly reiterate the findings of previous studies in this fishery (eg Blasdale and Newton 1998, Connolly & Kelly 1996, Dupouy *et al* 1998) in showing that the total quantity discarded and species composition of the discarded component were strongly influenced by fishing depth (Figure 5.1.1). Because the depth distribution of fishing effort may change between years, the authors did not consider it possible to make annual estimates of discarding from the French fleet from the available data.

Discards consisted of species with no commercial value as well as small individuals of commercial species. 61% of total discards were found to be of *Alepocephalus bairdii.*

The discards of commercial species mainly consisted of roundnose grenadier and rabbitfish. Over the 1729 hauls recorded by he fishermen since June 2001, discards of roundnose grenadier amounted to 19%. Both retained and discarded roundnose grenadier increased with increasing depth (Figure 5.1.2). Length frequency distribution of discarded grenadier is given in Figure 5.1.3. No discard for the blue ling, black scabbardfish, "sikis", orange roughy were recorded at any depth. A more complete account of this study program can be found in WD Girard and Biseau 2004.

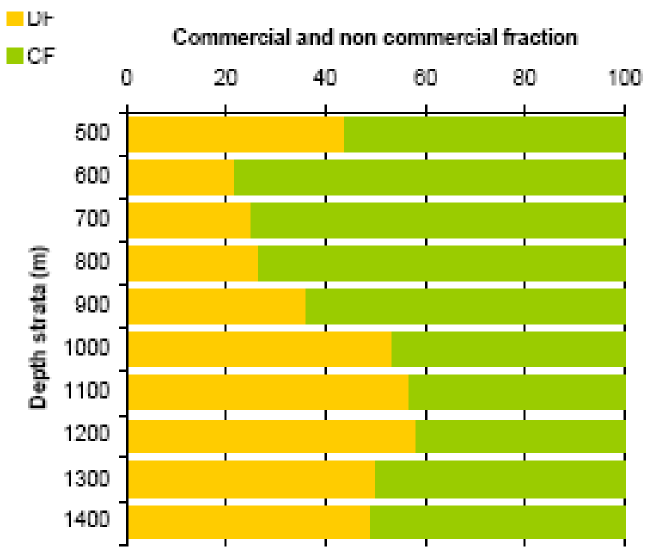


Figure 5.1.1 Overall discarding rate with depth

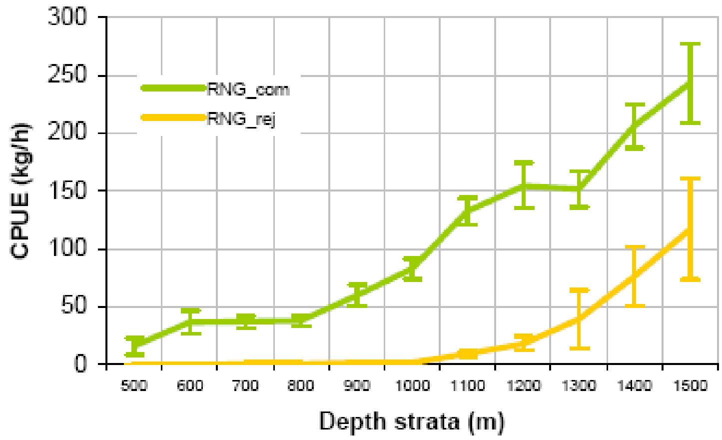


Figure 5.1.2 Variation in catch and discard of roundnose grenadier with depth

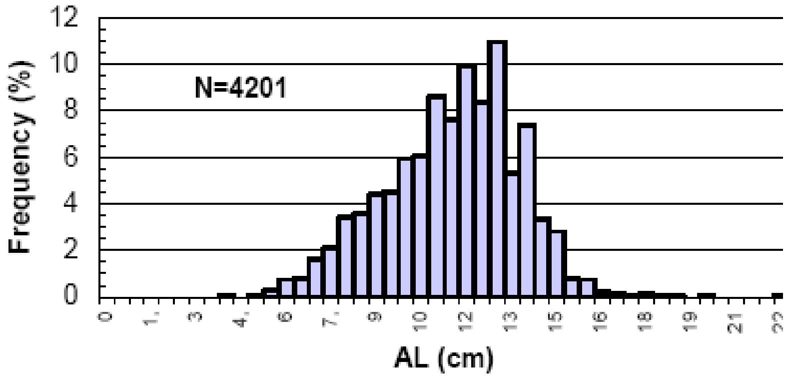


Figure 5.1.3 Length distribution of discarded roundnose grenadier in French fisheries in VIa

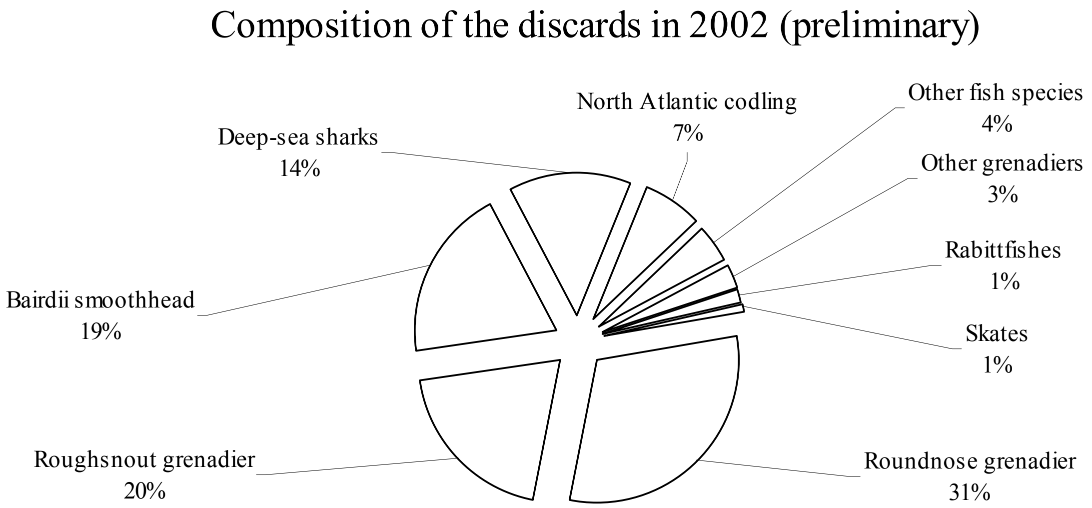
Spain

Since the start of the commercial fishery in 1996 the Spanish Institute of Oceanography (IEO) has collected haul by haul data on weight discarded by species, position and depth through it's observer program on the Spanish freezer trawler fleet operating on the Hatton Bank (sub area XII and division VIb). Data from 1996 to 1999 were presented in Durán Muñoz *et al*. 2001. New data from 2000 and 2001 were presented in the 2002 report and have been updated with new data for 2002 and 2003 in Table 5.1.2 (from Durán Muñoz WD, 2004). Of particular note is the low degree of discarding by the Spanish freezer fleet of species normally discarded by other fleets e.g. Baird's smoothhead (4% to 11% discard).

Table 5.1.2 shows the composition of the catches in terms of percentage retained and discarded (XII+VIb combined) and Figure 5.1.4 shows the species composition of discards. Length frequency of the discarded component of the catch of roundnose grenadier and Baird's smoothhead area shown in Figures 5.1.5 to 5.1.7

Table 5.1.2 Estimated retained catch and discards by specie and year. %R= percentage retained, %D = Percentage discarded. (XII+VIb combined). Preliminary table.

	2002			2003	
Species	% R	% D	Species	% R	% D
Greenland halibut	100	0	Blue ling	100	0
Blue ling	100	0	Black scabbard fish	100	0
Black scabbard fish	98	2	Greenland halibut	99	1
Cataetix laticeps	97	3	Cataetix laticeps	98	2
Bairdii smoothhead	89	11	Bairdii smoothhead	96	4
Roundnose grenadier	87	13	Roundnose grenadier	88	12
Deep-sea sharks	51	49	Rabittfishes	74	26
Mora	50	50	Deep-sea sharks	67	33
Rabittfishes	46	54	Skates	44	56
Skates	3	97	Grenadiers various	11	89
North Atlantic codling	2	98	Mora	0	100
Grenadiers various	2	98	North Atlantic codling	0	100
Roughsnout grenadier	0	100	Roughsnout grenadier	0	100



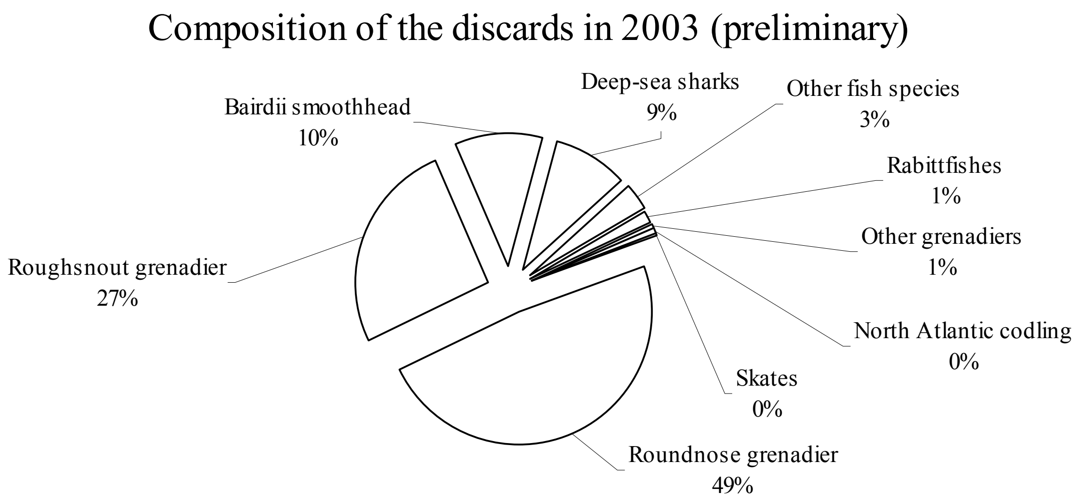


Figure 5.1.4 Composition of discards from the Spanish trawl fishery at Hatton Bank

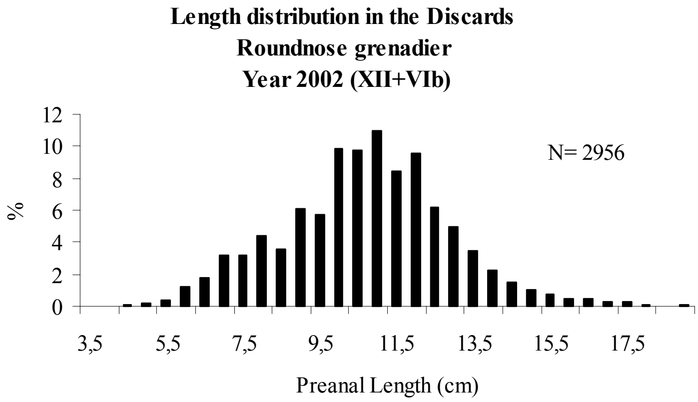


Figure 5.1.5 Length distribution of discarded roundnose grenadier from the Spanish trawl fishery at Hatton Bank 2002.

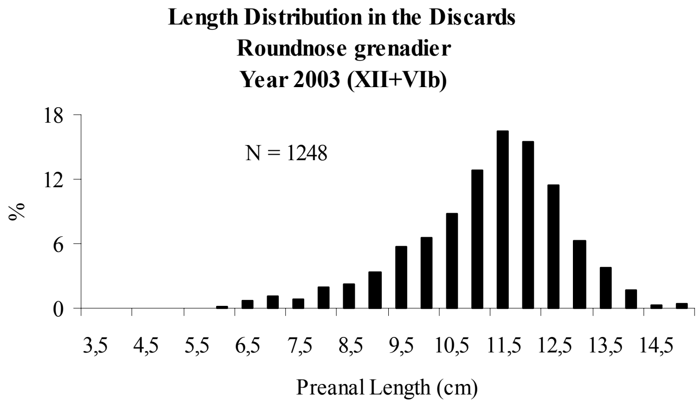


Figure 5.1.6 Length distribution of discarded roundnose grenadier from the Spanish trawl fishery at Hatton Bank 2003.

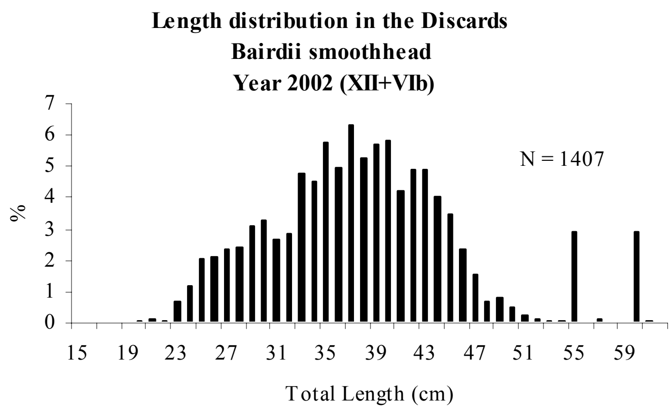


Figure 5.1.7 Length distribution of discarded roundnose grenadier from the Spanish trawl fishery at Hatton Bank 2003.

Under the minimum sampling program, Spain has deployed observers on vessels operating elsewhere in mixed demersal fisheries in northeast Atlantic waters, some of which take a by-catch of deep-water species. Information obtained by means of the Minimum National Sampling Program have not yet been processed.

The results of the 2000 survey on quarterly basis conducted by AZTI (EU DG XIV Study Contract Nº 98/095) with observers on board of Basque ships to study the catch retentions and discards by four different bottom trawl metiers working in Subarea VII and Divisions VIIIa,b,d and VIIIc, were presented in WD Lucio *et al.* 2002 . In it, although the objective was mainly demersal and pelagic species, some information on discards and retentions of some deepsea species was also obtained.

In Subarea VII, about a third of the Greater Fork Beard and Ling catches and all Silver roughy (*Hoplostethus mediterraneus*) and Argentines (*Argentina spp.*) catches by the bottom "Baka" trawl were discarded. In Div. VIIIa,b,d, a quarter of the Argentine (*Argentina spp.*) catches by the bottom "Baka" trawl, and all Argentine (*Argentina spp.*) and Greater Fork Beard catches by the bottom pair trawl with VHVO were discarded. Finally, in Div. VIIIc, all Baird´s smoothhead (*Alopocephalus bairdii*) catches, but no Argentine (*Argentina spp.*) were discarded by the bottom pair trawl with VHVO in this sea area.

These discards results must be considered with caution. The reasons for discarding are various, between them the market reasons. The same species, usually discarded by one metier or ship, is retained when the ship does a shorter trip or the catch corresponds to the last hauls. There is a great variability in the percentages of retentions and discards for each metier (and yet from each trip) sampled. The values obtained in 2000 surely cannot be extrapolated to other metiers of the same sea area nor to the same metier of different years.

Denmark

Observers have been deployed in the *Pandalus* fishery in subareas IVa and IIIa in which low levels of discarding of deep-water species occur. The results were not available for inclusion in the present report.

Ireland

Observer sampling was carried out under the BIM deep water fisheries program in 2001 (WD BIM 2002c). Discards of non-commercial species were sampled for length-frequency and weight-length data. Discards of commercial species were not sampled and so the study produced no new data on discarding rates.

The Irish Marine Institute has initiated a program of observer sampling in 2003 and four trips were successfully completed. The results have not yet been fully analysed.

5.2 Community data

An inventory of community data and a reference list was provided in the 2001 report, and some additional data reported in 2002.

New information was presented to the group on the species composition of catches in the Spanish Basque Country mixed species fisheries in the northeast Atlantic. The "Baka" trawl fishery in Subarea VI and the logline fisheries in subareas VI and VII and Divisions VIIabd catches a number of deep-water species and their catch compositions are illustrated in Figures 5.2.1 and 5.2.2.

In "Baka" trawl, hake can be considered almost as a "by-catch" (less than 10% of the landings) in all areas –mainly in Subarea VII and Div. VIIIabd - in the period studied. But only in Subarea VI, do a number of deep ware species (Blue ling, Ling and Greater Fork Beard, combined, contribute to about 25% of total landings) make a major contribution to catches (Figure 5.2.1).

The longline fishery targeted Hake until the mid 1990s in all sea areas, but since 1998, Conger and Ling are the main targets with practically null Hake catches in Subarea VII and Div. VIIIa,b,d. In Subarea VI there important catches of deep sea fish (mainly Ling, Greater Fork Beard, Blue ling, Tusk, Blue-mouth rockfish and Conger) collectively amounting to 50% of the landings). However the relative importance of these deep species has decreased in the more recent years at the same time that the Hake catches have increased (Figure 5.2.2).

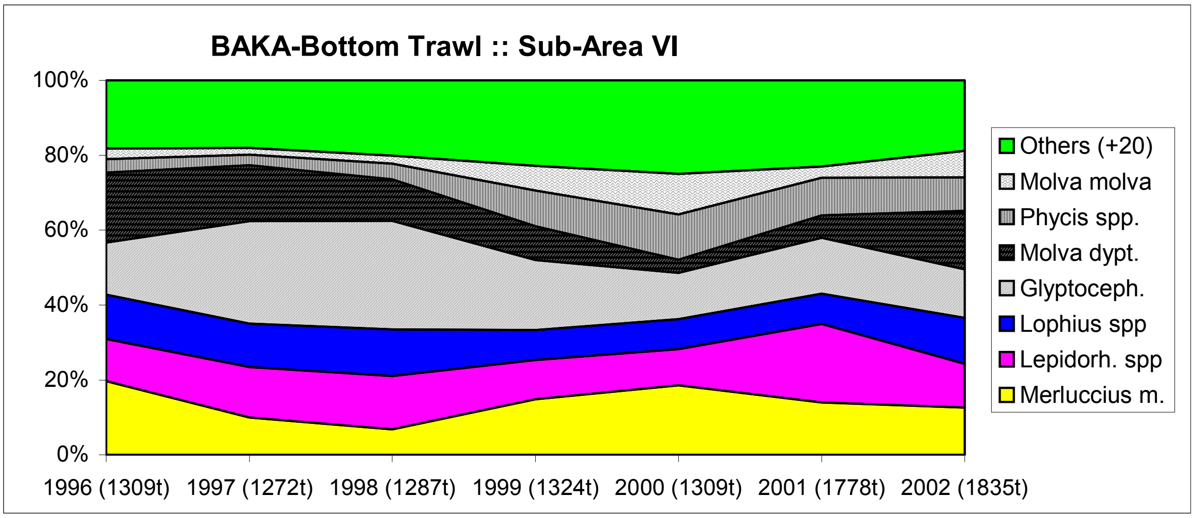
A more complete account of these fisheries can be found in Lucio *et al.* (WD 2004).

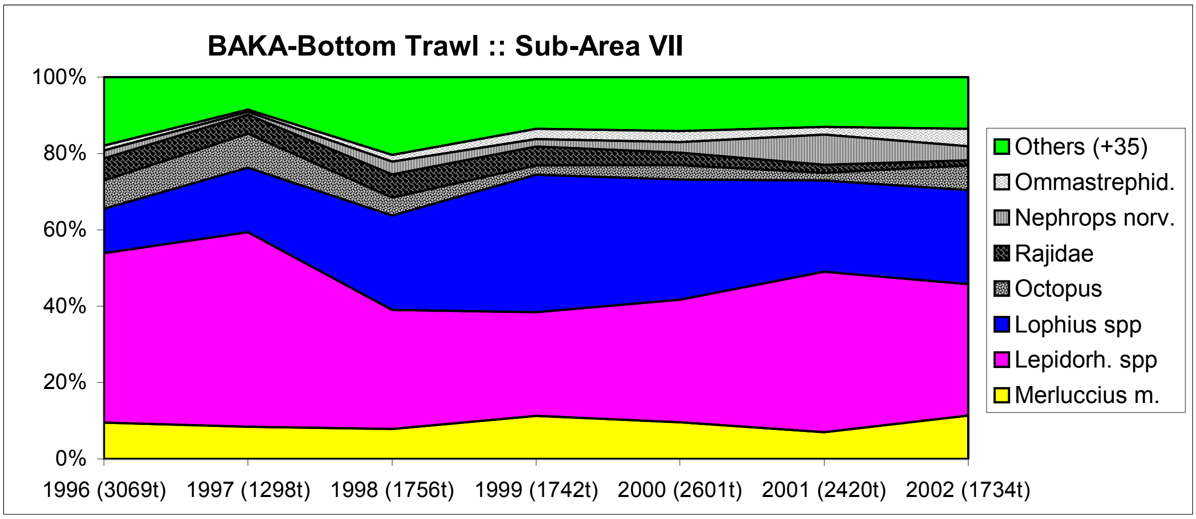
New information was also made available on the species composition of catches in the *Pagellus bogaraveo* fishery in the Strait of Gibraltar. This is almost a monospecific fishery with one clear target species. Red seabream represents the 74% of the total landed on average percentage over the period 1993-2003 (Figure 5.2.3) which constitutes a fleet component by itself (Silva *et al*., 2002).

However, Table 5.3 provides better information as the species percentages are not constant: the highest value for red seabream was 95% in the year 1995, while the lowest was 47% along the year 2000 coinciding with the maximum value for Atlantic pomfret. It must be clarified that the tuna fishery is a summer alternative for the red seabream one: obviously the gear (number and size of hooks) and the bait are quite different. Thus, the associate species to the red seabream fishery are: red seabream as target species with silver scabbardfish, Atlantic pomfret, rockfish, horse mackerel and in a minor way wreckfish and conger eel as concurrent species.

Table 5.2.3 Species landed, in percentage, by the "voracera" fleet of the Strait of Gibraltar (1993-2003).

1993	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**Species**
77	95	59	75	61	70	92	47	87	73	69	***P. bogaraveo***
0	1	35	11	26	5	5	51	2	0	0	***B. brama***
5	0	5	14	13	20	1	1	0	0	2	***T. thynnus***
0	0	0	0	0	0	0	0	7	16	21	***L. caudatus***
0	0	0	0	0	0	0	1	1	7	7	***Trachurus spp.***
0	0	0	0	0	0	1	0	1	0	0	***H. dactylopterus***
0	0	0	0	0	0	0	0	0	0	0	***P. americanus***
0	0	0	0	0	0	0	0	0	0	0	***E. guaza***
19	4	1	1	0	5	0	1	2	3	1	Other fishes





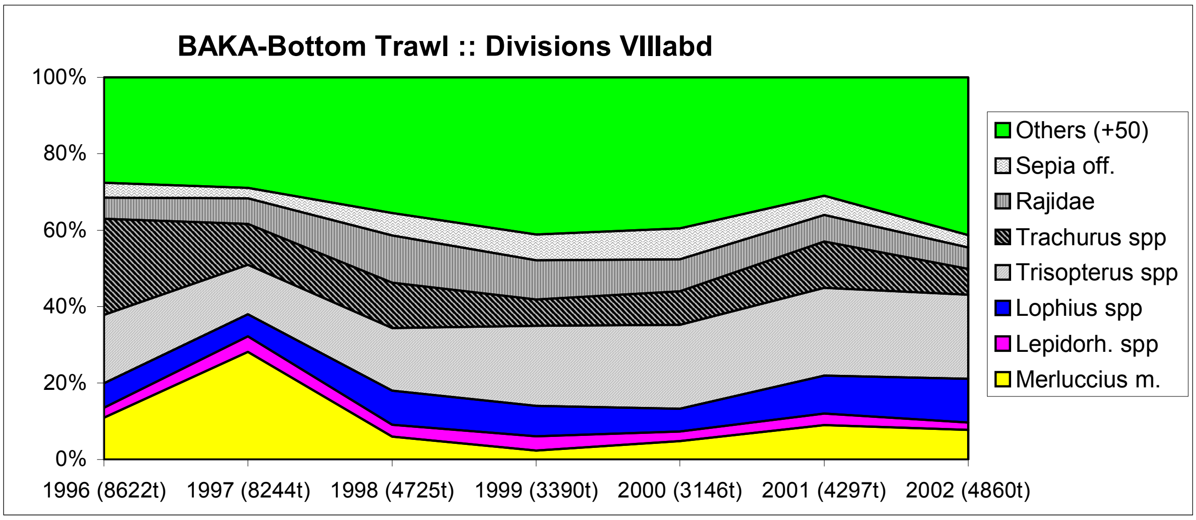


Figure 5.2.1 Catch composition of Spanish "Baka" fisheries

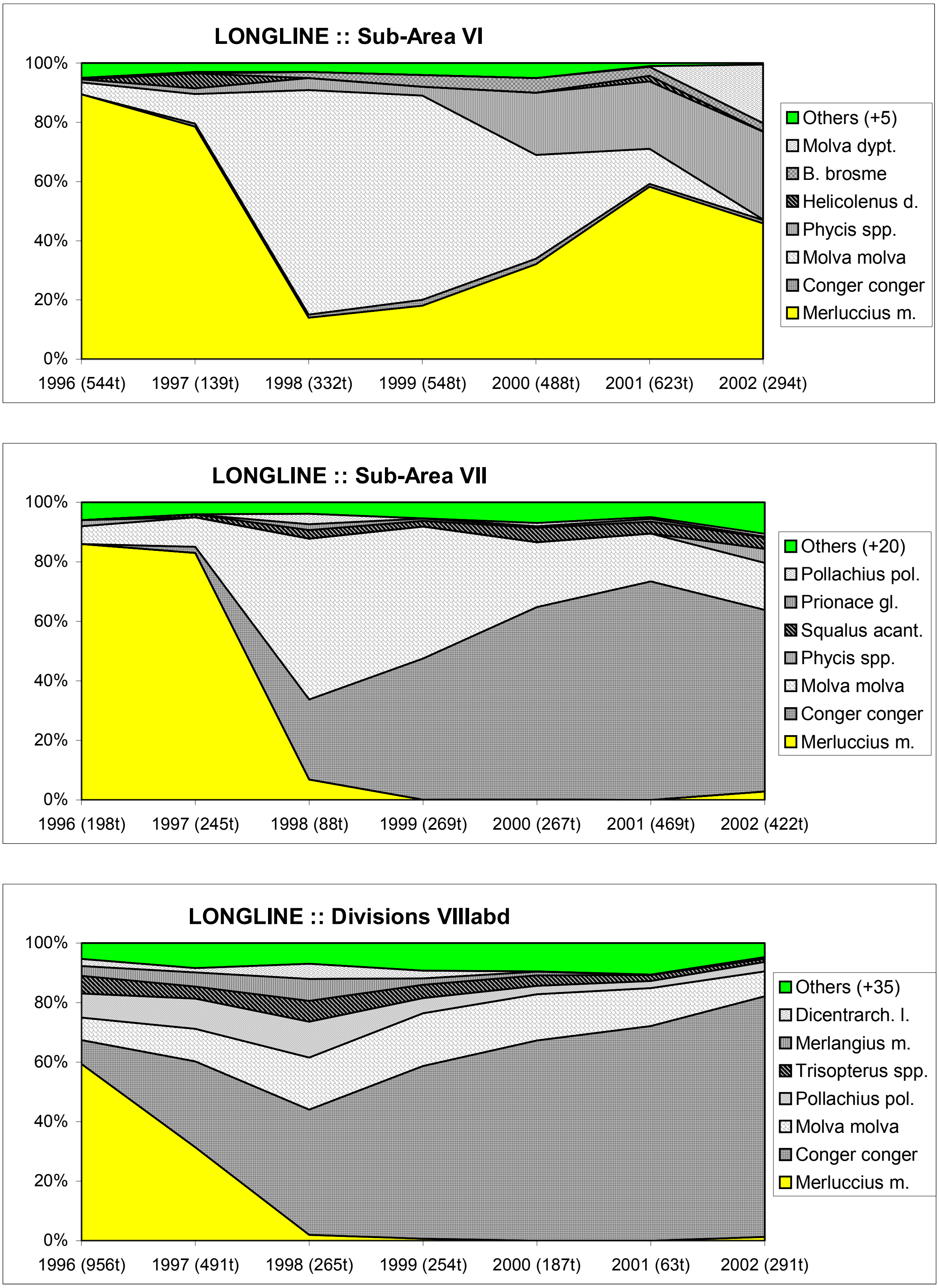


Figure 5.2.2 Composition of Basque longline fisheries

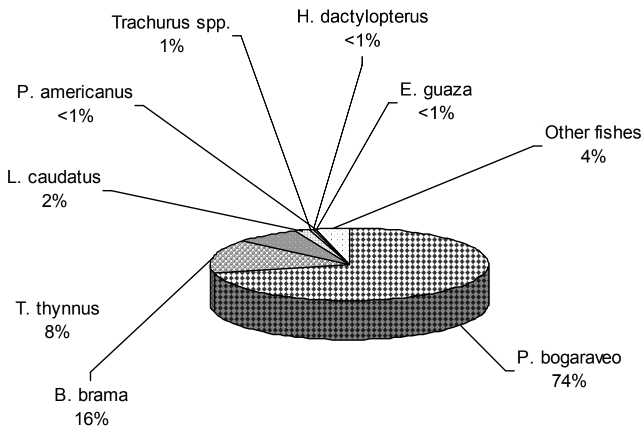


Figure 5.2.3 Strait of Gibraltar "voracera" fleet. Average percentage of the landed species in the period 1993-2003.

6 ASSESSMENT METHODOLOGY AND SOFTWARE

This section summarises the methods and software used by the Working Group.

6.1 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 Study Group recognised 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 (ie 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 time period studied. The Study Group were aware that the results from production models in these circumstances (the so called ‘one way trip’) can be unreliable.

A trial attempt to apply a Bayesian approach to a Schaefer model for black scabbardfish was carried out 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

This method has been used to carry out exploratory assessments of roundnose grenadier and ling. The Lowesoft VPA package was used, separable VPAs were trialled and extended survivors analysis (XSA) & Shepherd/Laurec were used to test for trends in catchability.

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 due to 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 and 1988).

The stock reduction model used is part of program 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 fisheries 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.

Ad hoc methods

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

6.2 Software

The main assessment software used at the Study Group was CEDA (Catch Effort data analysis, produced by MRAG Ltd, 27 Campden Street, London W8 7EP, UK.) ASPIC, PMOD (stock reduction program), the Lowestoft VPA package and Winbugs (version 1.4 http://www.mrc-bsu.cam.ac.uk/bugs/winbugs)

7 PRECAUTIONARY APPROACH

WGDEEP is aware that Study Group on Long-term Advice (SGLTA) is reviewing the ICES interpretation of the precautionary approach and reference points. Therefore WGDEEP does not consider that any revisions should be made at the present time.

Deep-water fishes continue to receive increased attention from national and international management authorities, conventions and non-governmental organisations. Increasing fishing effort on species many of which are generally considered to be long-lived, slow growing, with low reproductive potential for replacement is a potentially serious threat to deep-water fish stocks in many parts of the world. Moreover, for most stocks the effect of increased levels of fishing is difficult to determine because of a lack of scientific data. However, this is now no longer justification for not introducing management measures.

It is considered that the precautionary approach can be implemented by not allowing deepwater fisheries to expand until there are reliable data that can be used to advise on sustainable exploitation levels. Fisheries should certainly not proceed without data collection and assessments of stock status.

The urgent need to implement the precautionary approach to manage deep-water fish stocks is exacerbated by the low survival rate of discarded species and escapees. Thus, increasing fishing effort will affect deep-water fish assemblages in general and not just species of commercial importance. With regard to suitable biological reference points for deep-water stocks, given that the basic data available for these stocks are still comparatively sparse the Group, at its 2000 meeting, felt that the proposed PA limit and reference points for data-poor situations by the ICES Study Group on the Precautionary Approach to Fishery Management (ICES C.M. 1997/Assess:7) were reasonable:

$\mathbf{F}_{lim}$ = F35 %SPR

$\mathbf{F}_{pa}$ = M

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

$U_{pa} = 0.5 * U_{max}$

Where U is the index of exploitable biomass (notation used for deep-water stocks by ACFM in May 1998).

WGDEEP considers that CPUE may not always be reliable as an indicator of stock status, and as a consequence, reference points taking into account the biological characteristics of deepwater species should be considered.

8 STOCK SUMMARY

Table 8.1 Stock summary for species considered by the ICES Working Group on the Biology and Assessment o f Deep-sea Fisheries Resources. The Working Group acknowledges that stock units are not well defined for several species.

Species	**ICES Subarea/division**	**Assessment type and final year of data**	**Salient features Indicators of stock status**	**State of stock(s)**	**Concerns / comments**
Ling *(Molva molva)*	IIa,IVa,V,VI and VII	Catch curves in late 90s. Preliminary age based assessment for Vb.Trends in CPUEs. 2003	Average Z very high in late 90s. Survey indices declining in Va. Commercial CPUEs in other areas.	Survey indices suggest declining abundance in Va. Exploratory assessment for Vb suggest slight increase in stock, but probably from a low level. Stock levels believed to remain very low in other areas and is < Upa and possibly close to Ulim, as stated in 2000.	Continued limited provision of data from some major fisheries. Length and age data series still inadequate for analytical assessments.
Blue ling *(Molva dypterygia)*	I-XII and XIV	Indicative holistic assessment for V, VI & VII. CPUE data . 2003.	Strong decline in CPUE. CPUEs probably not reliable as stock indicators due to fishing on aggregations.	Assessment indicates declining stock. Considered to be below U_{lim}	Fishing on spawning concentrations implies that CPUE trend may underestimate the stock trends and should be treated with caution.
Tusk *(Brosme brosme)*	IIa,IVa,V,VI	Catch curves in late 90s and trends in CPUEs. CPUE series truncated in mid -1990s. 2003.	Historical CPUE data show strong decline over the past decade in most areas. Trends in most recent years uncertain..	Stock(s) considered to be at low levels.	Length and age data series still inadequate for analytical assessment.
Greater Silver Smelt *(Argentina silus)*	Mainly IIa,III,V,VI,VII	No recent assessment. 2003.	Available CPUEs from IIIa and Vb probably not indicative of stock development.	Uncertain. There were indications of a too high exploitation level in VI and VII, at least prior to 2003. The status in Va and Vb is unclear. In IIa and IIIa stock status is unknown, but exploitation has been at same level for many years.	Decline in landings in recent years has been observed for all ICES divisions , except Div. IIa.
Orange Roughy *(Hoplostethus atlanticus)*	Mainly VI, VII, X and XII	No assessments. CPUE data only. 2003	Strong fluctuations in CPUE. Due to the aggregational behaviour of this species CPUEs are not readily indicative of stock density .	Stock heavily depleted in VI. Situation in VII less clear, although current exploitation levels are considered to be much too high.	The fluctuations in CPUE may reflect both fluctuations in fish density on successively exploited aggregations and sequential discovery of new aggregations Recent high landings in VII are unlikely to be sustainable.

Species	ICES Subarea/division	Assessment type and final year of data	Salient features Indicators of stock status	State of stock(s)	Concerns / comments
Roundnose Grenadier *(Coryphaenoides rupestris)*	IIIa,V, VI VII and XII. Data mainly from V,VI & VII	Preliminary age based assessment for Stock in V,VI & VII indicates declining stock. Preliminary acoustic assessment for XII. 2003.	No clear trends in CPUEs for IIIa, V, VI, VII. Russian CPUEs for XII & XIV, 1975-2003, show declining trend.	Probably below Upa.	Requirement for age data. Number of large fish declining. Discard data should be collected. Full review of data for area XII and X needed. Mis-reporting suspected in XII (Hatton Bank).
Black Scabbardfish *(Aphanopus carbo)*	Mainly V,VI,VII,VIII and IX	ASPIC model. CPUE data. 2003	Consistent decline in CPUE in V, VI and VII but increase in 2002 for VI and VII. CPUE in IXa stable.	Uncertain in V VI VII and XII but probably below Upa. Situation in IX appears stable.	Stock structure unknown, and Information on reproductive tactics and dynamics is needed.
Golden Eye Perch *(Beryx splendens)*	Mainly X	No assessment, because of lack of satisfactory data. 2003		Stock definition uncertain. Status uncertain.	Concern about sequential depletion and underreporting from international waters.
Red (blackspot) Seabream *(Pagellus bogaraveo)*	Mainly in X and IX, and residual in VI, VII, VIII	No assessment attempted due to lack of data. 2003.		Uncertain in IX and X. Historical trend of landings for other areas indicates a continued depleted state.	
Greater forkbeard *(Phycis blennoides)*	All areas but mainly VI, VII, VIII and IX	No assessment	CPUE data not used because landings statistics may include landings of Morids and concerns about CPUE of by-catch species..	Unknown	Mainly by-catch

9 LING (MOLVA MOLVA)

9.1 Landings trends

Landings by Subarea or Division for the period 1988-2001 are given in Table 9.1. The 2003 data are provisional.

The major fisheries in Division IIa are the Norwegian longline and gillnet fisheries, but there are also by-catches by other gears, i.e., trawls and handline. The total landings of about 9,000 t in 1998 was the highest in the period 1988-2001. The preliminary landing for 2003 is 6050 t. Of the Norwegian landings, around 50% are taken by longline and 45% by gillnet. Landings in areas I, IIb, and III remained small and are mostly by-catches.

In Division IVa the total landings has varied between near 10,000 and 13,000 t until 1998, but declined in the subsequent years. The provisional figure for 2003 is 6,400 tonnes. The major aimed ling fishery in IVa is the Norwegian longline fishery conducted around Shetland and in the Norwegian Deep, and of the total Norwegian landings about 75% are taken by longline, 15% by gillnet, and the remainder by trawl. The bulk of the landings from other countries were taken by trawl as by-catches in other fisheries, and the landings from the United Kingdom (Scotland) are the most substantial. The comparatively low landings from the central and southern North Sea (IVb,c), are by-catches in various other fisheries.

In Division Va the landings were between 10,000 and 15,000 t from 1950s to early 1970s but have decreased since then, almost continuously, to only 3,200 t in 2001. The catches were 4,200 t in 2003. The catches in most recent years have been between 3,200 - 4,500 t. Most of the catches in recent years are by-catches in fisheries for other species. Of the Icelandic landings since 2000, about 45% were taken by longlines, and 20-30% from each of gillnet and trawls.

Landings in Subdivisions Vb1 and Vb2 increased in the late 1990s, and has in recent years varied between about 4000 and 5500 tonnes. Half of the landings are taken by Norwegian longliners, the remainder mainly by Faroese longliners (about 50%), Faroese pair trawlers (about 30%) and Faroese otterboard trawlers (15%). The proportion taken by trawlers has increased in recent years.

In Division VIa the statistics are incomplete for the period 1989-1993. In the period 1994-2003 when the data are complete, they show a declining trend. The major fisheries are the Norwegian aimed longline fisheries, and trawl fisheries by the United Kingdom (Scotland) and France which primarily take ling as by-catch. The Norwegian landings declined substantially in 2001-2003 compared with earlier years. In Division VIb landings declined to 800-1900 t in the period 1994-2000, primarily due to reduced Norwegian contributions. In the most recent three years there appears to have been an even further decrease, and the 2002 and 2003 figures were 530 and 670 tonnes, respectively.

In Subarea VII the Divisions b, c, and g-k provide most of the landings of ling. There appears to have been an increasing trend in the 1990s and landings in the period 1995-1997 were above 10 000 t. In 1998 the total landing was 11,100 t. Subsequently there has been a decline in most areas, and the figure for 2002 is only 5,800 t. Norwegian landings, and some of Irish and Spanish are from longline fisheries, whereas other landings are primarily by-catches in trawl fisheries. Data split by gear type was not available for all countries, but the bulk of the total landings (at least 60-70%) are taken by trawl in these areas.

In Subarea VIII landings appear to have declined in the most recent years, and all are by-catches in various fisheries.

9.2 Stocks

No new information on stock separation was available. Relevant data were presented and discussed in reports of previous Norwegian and Nordic projects and summarised in the 1998 report of the study group (ICES C.M. 1998/ACFM:12). 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.

9.3 Catch-effort data

The extensive Norwegian longliner CPUE data based on skipper's logbooks presented in the 1996 report were not updated after 1994. In the 1998 report (Table 6.5 of ICES C.M. 1998/ACFM:12), effort data were given for the period 1974-1996 based on official statistics, but the series has not been extended.

Norway has since 2001 made agreements with selected vessels, "the reference fleet" which is providing data for the species composition of the catch (in weight), and number of hooks used per day (Helle and Pennington, WD 2004). There are currently three longline vessels contributing data. Table 9.2 gives estimates of catch-per-unit of effort (CPUE). The measure of CPUE presented is the average weight (kg) of fish caught per 1000 hooks per day. The standard error (*se*) could only be estimated if 2 or more vessels collected samples in a particular area.

Revised commercial CPUE data for Division Vb were available from Faroese trawlers and longliners for the period 1986-2003 (Table 9.4, Fig. 9.1). Also 2 groundfish surveys CPUE series were available (Fig. 9.1).

Effort and CPUE from Icelandic longliners in the period 1994-2001 were presented in a WD (Sigurdsson 2004) and are given in Table 9.5. CPUE series from the trawler fleet was also presented and shown in Figure 9.2. A time-series for a CPUE index from the Icelandic groundfish survey is shown in Figure 9.3 for the period 1985-2003. The two commercial series are conflicting as the trawl series show a continuous increasing trend since the record low in 1999.

CPUE data for Basque trawlers fishing in Subarea VI in the years 1994–2003 were available (Fig. 9.4).

Danish CPUE data based on logbook records of catch and effort for area IV and IIIa were available for the years 1992-2003 (Table 9.6, Figure 9.5). This series stem from by-catches from various trawl fisheries, and because it does not represent a target fishery nor a substantial part of the total catch, it may not be appropriate for use in assessments. The Danish catches of ling can be considered as by-catches in bottomtrawl fisheries mainly in the Skagerrak (IIIa) and the Norwegian Deeps (IVa).

The 2 main fisheries have been:

1) 70-100 mm mesh size trawls ('*Nephrops* trawls') targeting mainly *Nephrops*, but with significant by-catches of various roundfish species including lesser amounts of ling and tusk.

2) > 100 mm mesh size trawls targeting both various roundfish species but also *Nephrops* and Anglerfish.

Note that from 2001 to 2002 there seems to be a switch from Nephrops trawl to 100 mm mesh trawls. This switch probably reflects the new Norwegian regulations for fishery in the Norwegian zone in IVa which were introduced in 2002. For ling there is no distinct trend in these CPUE figures.

9.4 Length Distribution, Age Composition, Mean Weight and Maturity-at-age

Historical data available from different countries and Divisions were indicated in Tables 6.3.1–6.3.6 of ICES C.M. 1996/Assess:8 and in ICES C.M. 1998/ACFM:12. Overviews of Norwegian samples from 1995 and earlier were given by Bergstad and Hareide (1996).

In 2000 Norway started a program to collect data and biological samples directly from selected commercial long-liners, the so-called "reference fleet." In 2000 only a limited number of fish were measured and only one vessel provided data. In 2001 two vessels participated but due to problems with the electronic measuring board, the sampling was limited. In 2002 and 2003 the sampling scheme has been adjusted to achieve the most effective sampling program (Helle *et al.*, 2003) and the sampling was conducted as planned. Three longliners participate in the reference fleet in 2004. Estimates of mean length of ling are given in Table 9.3. In column 4 are estimates of the standard error (*se*). The *se* could only be estimated if 2 or more vessels collected samples in a particular area.

Length distributions of Icelandic catches in Division Va for the period 1995-2003 are shown in Figure 9.6. Figure 9.7 shows length distributions from the Icelandic groundfish survey representing the period 1985-2003. The length distributions suggest no change in the size composition with time.

Length distributions were also available for Faroese commercial landings and two Faroese groundfish surveys in Division Vb; they are presented in a WD to the meeting (Reinert, 2004).

9.5 Biological parameters

Considerable information on biological parameters from many parts of the distribution area were presented in two relatively recent project reports, i.e., Bergstad and Hareide (1996) and Magnússon *et al.* (1997a), and Bergstad *et al.* 1998). No new data were presented to the Working Group this year. The following text table is a compilation of available data, extracted from the report of WGDEEP in 2001 (ICES C.M. 2001/ACFM: 23):

Variable	**Value**	**Source/comment**
Longevity (years)	Approx. 20	Bergstad and Hareide 1996, Magnusson *et al.* 1997
Growth rate	No data	Growth curves available in Bergstad and Hareide 1996.
Natural mortality, M	0.2-0.3	Based on review by SGDEEP 2000.
Fecundity (absolute)	millions	No exact data available.
Length at first maturity	60-75 cm	Magnusson *et al.* 1997
Age at first maturity	5-7 years	Magnusson *et al.* 1997

9.6 Assessment

9.6.1 CPUE analyses and mortality estimates

Updated and new CPUE data were presented from Iceland (Va), the Spanish fleets fishing in VI and VII, and the French and Danish trawlers, and the Faroese trawlers and longliners in Vb. Only the Va and Vb series from Iceland and the Faroes represent major fisheries for ling. The new Norwegian CPUE series is to short to be used for assessments.

In addition, few new data were available to estimate mortality despite that in previous assessments using catch curves it was estimated to have been high during the last decade. The last stock status evaluation was presented in 2000 (ICES C.M. 2000/ACFM:08).

The Icelandic CPUE series in Va from commercial longliners show no obvious trend although the index has increased by 30% from the 2002 value. The survey series indicates a strong decline in abundance. The new trawl CPUE series are conflicting with the longliner series, showing an constantly increase in CPUE since the record low in 1999. Ling in Icelandic waters is only caught in the warmest waters along the south coast and to small extent towards the west coast. During the last years temperature in Icelandic waters has increased, and this may have resulted in a more northerly distribution of ling on the fishing grounds along the shelf west of Iceland. Therefore, increase in trawlers CPUE may result from this increased temperature rather than increase in the stock abundance.

The Faroese CPUE series from trawlers and longliners show conflicting trends. The longliner series appers to fluctuate without a trend, whereas the trawler series show an increase in the latter half of the series.

Spanish CPUE data from Basque trawlers and the Danish fisheries show no clear trends.

9.6.2 Assessment in Vb

9.6.2.1 Catch-at-age

Catch-at-age data were provided for Faroese landings in Vb 1996-2003. The sampling intensity is shown in the table below.

Sampling of commercial landings of ling in Vb 1996-2003. (Quantity of weight measurements in 1996-97 not available)					
Year	Season	No of samples	No of lengths	No of weights	No of aged fish
1996	1	12	1940		210
	2	12	1850		457
	3	12	2154		280
1997	1	17	2932		548
	2	17	3320		640
	3	8	1661		341
1998	1	7	1262	120	301
	2	16	2720	180	541
	3	6	944	118	239
1999	1	9	1730	180	240
	2	11	2326	180	240
	3	0	0	0	0
2000	1	3	520	60	60
	2	8	1577	119	120
	3	6	1055	180	180
2001	1	3	536	60	60
	2	7	1284	180	180
	3	8	1817	180	180
2002	1	2	242	0	0
	2	9	1694	120	180
	3	11	2063	60	120
2003	1	10	1895	120	180
	2	11	1065	60	181
	3	10	2004	180	240

Due to the limited number of samples, samples from longliners and trawlers, respectively, were disaggregated by half year periods and then raised by the catch proportions to give the annual catch-at-age in numbers for each fleet. Catches of some minor fleets were presumed to have the same relative catch-at-age in numbers as the sum of the longliners and trawlers. No catch-at-age data were available from other nations fishing in Vb. Therefore, catches by France, Germany and UK trawlers were assumed to have the same age composition as the Faroese trawlers. The Norwegian longliners were assumed to have the same age distribution as the Faroese longliners. The resulting total catch-at-age in numbers is given in Table 9.7.

In a few years a small number of 3 year old ling have been caught; these were excluded from the analysis. By inspecting the catch-at-age matrix it was decided to treat Age 12 and older as a plus group.

No estimates of discards of ling are available. However, since for the Faroese fishery no quotas are used in the management of this stock the incitament to discard in order to high grade the catches should be low. Moreover there is a ban on discardings in Vb. The landings statistics is therefore regarded as being adequate for assessment purposes.

9.6.2.2 Weight-at-age

Mean weight-at-age data are provided for the Faroese fishery (Table 9.8). Figure 9.8 shows the mean weights-at-age in the landings for age groups 4-11 since 1996. Except for the youngest and oldest ages, they seem to be consistent showing small fluctuations throughout the period. The mean weight-at-age in the catch were also assumed for the stock.

9.6.2.3 Maturity-at-age

No annual measurements of maturity-at-age were available and a knife edge maturity for age 7 and older was assumed (Table 9.9).

9.6.2.4 Natural mortality

A natural mortality of 0.15 was assumed for all ages.

9.6.2.5 Tuning data

Commercial CPUE series. Although several commercial catch per unit effort series are updated every year (see section 9.3), only the longliner series including the logbook data from 5 selected longliners larger than 100 GRT (directed effort measured as number of hooks) were used for tuning (Figure 9.10). These vessels target mainly cod and haddock but from time to time they perform a mixed deep water fishery for ling, tusk and blue ling. Therefore, only sets where the depth is deeper than 200 m and the amount of blue ling, ling and tusk is larger than 80% were used. Reasons for not using other fleet CPUE series for tuning of ling is that ling is a by-catch in their fisheries targeting other species.

Fisheries independent CPUE series. Two annual groundfish surveys are available, one carried out in February-March since 1994 (100 stations per year down to 500m depth), and the other in August-September since 1996 (200 stations per year down to 500m depth). Biomass estimates (kg/hour) and length distributions are available for both series, but no age disaggregated data and they can consequently not be used in traditional tuning (XSA).

9.6.2.6 Analytical assessment runs

Although the assessment data series is short (7 years), it was decided to try to make an analytical assessment of the ling in Vb. In this exercise it is assumed that ling in Vb can be treated as one stock unit although such a status never has been scientifically verified.

A **Separable analysis** was first run (age 10 for unit selection 10, terminal F of 0.4 and S of 1) in order to test the catch data set for outliers (Table 9.11). Obviously the data is noisy with many high residuals on especially young and old fishes.

A **Laurec-Shepherd** *ad hoc* tuning was then carried out without shrinkage (Table 9.12) and the log catchability residuals plotted for each age (Figures 9.10-9.11) in order to screen the fleet data set. It can be seen that data are noisy with year and age effects, and standard errors are high. Year effects could probably derive from the fact that this fleet mainly targets cod and haddock when availability and market conditions for these species are favourable. If this is not the case they move into deeper waters for ling, blue ling and tusk.

Although the quality of the input data obviously can be questioned a few **XSA** runs were performed and one of these is included in the report for illustrative purposes. The diagnostics from the XSA is shown in Table 9.13. and again data are noisy with year and age effects, and standard errors are high. Results from this tentative analysis are shown in Table 9.14-9.16) showing average fishing mortalities for the whole period of 0.4, average recruitment at age 4 of 3 mll., average total biomass of 24 thousand t. and spawning stock biomasses of 14 thousand t. A plot of SBB and R in this period indicate that SSB was declining but has increased again in the three most recent years due to a slight increase in the recruitment (Figure 9.12).

To evaluate the fishing mortality estimates from the XSA the LN(catch-at-age in numbers) were calculated. The resultant LN(catch-at-age in in numbers) for selected years are plotted on Figure 9.11 indicating total mortality (Z) to be in the order of 0.6.

An exploratory **Yield-per-recruit** analysis were then made based on catch weight-at-age (Table 9.8) and the exploitation pattern from the XSA. The results are shown in Figure 9.12 indicating $\mathbf{F}_{max}$ around 0.3.

9.7 Comments on the assessment

The only analytical assessment that could be conducted was that for Vb based on Faroese data. The series with input data to the analytical assessment is very short, 7 years only. The sampling represent only approximately half of the landings and even for the sampled part the coverage could be better (see text table in section 9.6.1). Although the present assessment is highly uncertain and mainly is presented here to illustrate some of the work done on ling in Vb, it may, together with catch curve analysis, indicate recent stock development and exploitation level. It should be kept in mind, however, that the present assessment only covers a very small period in the history of this fishery, with landings figures going back to 1904 (Figure 9.13).

For other areas and fisheries it is still not possible to make analytical or CPUE-based assessments for the ling stocks due to lack of good time-series of data from the major fisheries. The Working Group is of the opinion that further improvement in the recording of effort and catch data from all fleets and areas should be encouraged, since CPUE analyses was previously used with some success to provide estimates of total mortalities, indices of abundance and as basis of production analyses.

9.8 Management considerations

This issue was considered at some length in 2000 (ICES CM 2000/ACFM:08). New assessment results are only available for Vb, and the analysis was exploratory. The overall conclusion is that the status of the ling stocks are uncertain, and except for Vb there are no signs of increases in indices of abundance. Landings are decreasing or stable in most areas.

The updated CPUE series for the Icelandic longline fishery in Va shows no trend in the period 1994-2003. The trawl series shows an increase in CPUE since the record low in 1999. It is however not known to what extend this reflects the changes in the stock status or the changes that have been occurring in the enviromental conditions in the area during the past years. The series from the groundfish survey, for the years 1985 to 2003, shows however a rather clear declining trend throughout the period since 1985. The commercial effort statistics may not fully account for changes in efficiency. The catches of ling in Va have declined almost continously since early 1970s and are now only about 30% of the catches in 1950s to early 1970s. Considered together, these series may be interpreted as showing a declining abundance of ling being compensated for by enhanced efficiency in the commercial fishery.

No new data were available for evaluating stock status in relation to reference points. There is, however, no clear evidence to suggest that the state of the ling stocks has changed since the assessments in 1998 and 2000, probably with the exception of Vb.

Table 9.1 **Ling (*Molva molva*)**. Working Group estimates of landings by ICES Subarea and Division. Figures for 2003 are preliminary.

LING I

Year	Norway	Iceland	Scotland	**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**

*Preliminary

LING IIa

Year	Faroes	France	Germany	Norway	E & W	Scotland	**Total**
1988	3	29	10	6,070	4	3	**6,119**
1989	2	19	11	7,326	10	-	**7,368**
1990	14	20	17	7,549	25	3	**7,628**
1991	17	12	5	7,755	4	+	**7,793**
1992	3	9	6	6,495	8	+	**6,521**
1993	-	9	13	7,032	39	-	**7,093**
1994	101	n/a	9	6,169	30	-	**6,309**
1995	14	6	8	5,921	3	2	**5,954**
1996	0	2	17	6,059	2	3	**6,083**
1997	0	15	7	5,343	6	2	**5,373**
1998		13	6	9,049	3	1	**9,072**
1999		11	7	7,557	2	4	**7,581**
2000		9	39	5,836	5	2	**5,891**
2001		9	34	4805	1	3	**4852**
2002		4	21	6886	1	4	**6916**
2003*		3	43	5996		8	**6050**

Table 9.1 (cont.)
LING IIb

Year	Norway	E & W	**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*	5	0	**5**

*Preliminary

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		71	32		**259**

Table 9.1 (cont.)
LING IVa

Year	Belgium	Denmark	Faroes	France	Germany	Neth.	Norway	Sweden[1)]	E&W	N.I.	Scot.	**Total**
1988	3	408	13	1,143	262	4	6,473	5	55	1	2,856	**11,223**
1989	1	578	3	751	217	16	7,239	29	136	14	2,693	**11,677**
1990	1	610	9	655	241	-	6,290	13	213	-	1,995	**10,027**
1991	4	609	6	847	223	-	5,799	24	197	+	2,260	**9,969**
1992	9	623	2	414	200	-	5,945	28	330	4	3,208	**10,763**
1993	9	630	14	395	726	-	6522	13	363	-	4,138	**12,810**
1994	20	530	25	n/a	770	-	5355	3	148	+	4,645	**11,496**
1995	17	407	51	290	425	-	6,148	5	181		5,517	**13,041**
1996	8	514	25	241	448		6,622	4	193		4,650	**12,705**
1997	3	643	6	206	320		4,715	5	242		5,175	**11,315**
1998	8	558	19	175	176		7,069	-	125		5,501	**13,631**
1999	16	596	n.a.	293	141		5,077		240		3,447	**9,810**
2000	20	538	2	146	103		4,780	7	74		3,576	**9,246**
2001		702	1	125	54		3613	6	61		3290	**7852**
2002	6	578		115			4509		59		3779	**9046**
2003*	4	779		95	62		3084	5	23		2311	**6363**

. (1) Includes IVb 1988-1993.

LING IVb,c

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		986			100	187	106	45		**1424**
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	0	3	23	62	60	6	2	**283**
2002	38	91		4	61	58	43	12	2	**309**
2003*	28	0		3	84	40	65	14	1	**235**

Table 9.1 (cont.)
LING Va

Year	Belgium	Faroes	Germany	Iceland	Norway	E & W	Scotland	**Total**
1988	134	619	-	5,098	10			**5,861**
1989	95	614	-	4,898	5			**5,612**
1990	42	399	-	5,157	-			**5,598**
1991	69	530	-	5,206	-			**5,805**
1992	34	526	-	4,556	-			**5,116**
1993	20	501	-	4,333				**4,854**
1994	3	548	+	4,053				**4,604**
1995		463	+	3,729	-			**4,192**
1996		358		3670	20	12		**4,060**
1997		299		3,634	0	-		**3,933**
1998		699		3,603	-	-		**4,302**
1999		542	+	3,980	120	4	1	**4,647**
2000		452	+	3,221	67	3	+	**3,743**
2001		359	2	2864	117	1		**3343**
2002		426	0	2844	45	0	0	**3315**
2003*		422	2	3587	108	4	0	**4123**

*Preliminary.

LING Vb1

Year	Denmark	Faroes[4]	France [2]	Germany	Norway	E&W [1]	Scotland [1]	**Total**
1988	42	1,383	53	4	884	1	5	**2,372**
1989	-	1,498	44	2	1,415	-	3	**2,962**
1990	-	1,575	36	1	1,441	+	9	**3,062**
1991	-	1,828	37	2	1,594	-	4	**3,465**
1992	-	1,218	3	+	1,153	15	11	**2,400**
1993	-	1,242	5	1	921	62	11	**2,242**
1994	-	1,541	6	13	1047	30	20	**2,657**
1995		2,789	4	13	446	2	32	**3,286**
1996		2672			1,284	12	28	**3,996**
1997		3224	7		1,428	34	40	**4,733**
1998		2,422	6		1,452	4	145	**4,029**
1999		2,446	22	3	2,034	0	71	**4,576**
2000		2008	9	1	1305	2	61	**3386**
2001		2471	17	3	1496	5	99	**4091**
2002		2174	9	2	1640	3	239	**4067**
2003*		2694	7	2	1526	3	215	**4447**

*Preliminary. [1] Includes Vb_2. [2] Includes Vb_2 and Va. [3]Reported as Vb.[4] 2000-2003 Vb1 and Vb2 combined

Table 9.1 (cont.)
LING Vb2

Year	Faroes	Norway	**Total**
1988	832	1,284	**2,116**
1989	362	1,328	**1,690**
1990	162	633	**795**
1991	492	555	**1,047**
1992	577	637	**1,214**
1993	282	332	**614**
1994	479	486	**965**
1995	281	503	**784**
1996	102	798	**900**
1997	526	398	**924**
1998	511	819	**1,330**
1999	164	498	**662**
2000		399	**399**
2001		497	**497**
2002		457	**457**
2003*		927	**927**

*Preliminary. (1) Included in Vb_1.

LING VIa

Year	Belgium	Denmark	Faroes	France (1)	Germany	Ireland	Norway	Spain(2)	E&W	IOM	N.I.	Scot.	**Total**
1988	4	+	-	5,381	6	196	3,392	3575	1,075	-	53	874	**14,556**
1989	6	1	6	3,417	11	138	3,858		307	+	6	881	**8,631**
1990	-	+	8	2,568	1	41	3,263		111	-	2	736	**6,730**
1991	3	+	3	1,777	2	57	2,029		260	-	10	654	**4,795**
1992	-	1	-	1,297	2	38	2,305		259	+	6	680	**4,588**
1993	+	+	-	1,513	92	171	1937		442	-	13	1,133	**5,301**
1994	1	1		1713	134	133	2034	1027	551	-	10	1,126	**6,730**
1995	-	2	0	1970	130	108	3,156	927	560	n/a		1994	**8,847**
1996			0	1762	370	106	2809	1064	269			2197	**8,577**
1997			0	1,631	135	113	2229	37	151			2,450	**6,746**
1998				1,531	9	72	2,910	292	154			2,394	**7,362**
1999				941	4	73	2,997	468	152			2,264	**6,899**
2000	+	+		717	3	75	2956	708	143			2287	**6889**
2001				728	3	70	1869	142	106			2179	**5097**
2002				351	1	44	973	190	65			2452	**4076**
2003*				263	1	88	1477	80	106			1257	**3272**

*Preliminary. (1) Includes VIb until 1996 (2) Includes minor landings from VIb.

Table 9.1 (cont.)
LING VIb

Year	Faroes	France [2]	Germany	Ireland	Norway	Spain [3]	E & W	N.I.	Scotland	Russia	**Total**
1988	196		-	-	1,253		93	-	223		**1,765**
1989	17		-	-	3,616		26	-	84		**3,743**
1990	3		-	26	1,315		10	+	151		**1,505**
1991	-		-	31	2,489		29	2	111		**2,662**
1992	35		+	23	1,713		28	2	90		**1,891**
1993	4		+	60	1179		43	4	232		**1,522**
1994	104		-	44	2116		52	4	220		**2,540**
1995	66		+	57	1,308		84		123		**1,638**
1996	0		124	70	679		150		101		**1,124**
1997	0		46	29	504		103		132		**814**
1998		1	10	44	944		71		324		**1,394**
1999		26	25	41	498		86		499		**1,175**
2000	+	18	31	19	1,172		157		475	7	**1,879**
2001		16	3	18	328		116		307		**788**
2002		2	2	2	289		65		173		**533**
2003*		1	3	25	485		34		111	14	**673**

*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	

Table 9.1 (cont.)

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	5	91	15			7	**118**
2003*	4	2	75	18			11	**110**

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

LING VIIb,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	**1,286**
1993	-1	97	224	145		550	9	409	**1,434**
1994	-1	98	225	306		530	2	434	**1,595**
1995	78	161	465	295		630	-2	315	**1,944**
1996	57	234	283	168		1117	-2	342	**2,201**
1997	65	252	184	418		635	-2	226	**1,780**
1998	32	1	190	89		393		329	**1,034**
1999	50	4	377	288		488		159	**1,366**
2000	117	21	401	170		327		140	**1176**
2001	80	2	413	515		94		122	**1226**
2002	123	0	315	207		151		159	**955**
2003*	88	0	270			74		52	**484**

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

Table 9.1 (cont.)
LING VIId,e

Year	Belgium	Denmark	France (1)	Ireland	E & W	Scotland	Ch. Islands	**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		**1,389**
1996	15		960		499	3		**1,477**
1997	12		1,049	1	372	1	37	**1,472**
1998	10		953		510	1	26	**1,500**
1999	7		542	-	507	1		**1057**
2000	5		452	1	372		14	**844**
2001	6		399		399			**804**
2002	7		464		386	0		**857**
2003*	5		446	1	249	0		**701**

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	90	1	111		**217**
2001	14	111	-	92		**217**
2002	16	131	3	295		**445**
2003*	15	72	1	81		**169**

*Preliminary. (1) See Ling VII.

Table 9.1 (cont.)
LING VIIg-k

Year	Belgium	Denmark	France	Germany	Ireland	Norway	Spain (2)	E&W	IOM	N.I.	Scot.	**Total**
1988	35	1	-1	-	286	-	2,652	1,439	-	-	2	**4,415**
1989	23	-	-1	-	301	163		518	-	+	7	**1,012**
1990	20	+	-1	-	356	260		434	+	-	7	**1,077**
1991	10	+	-1	-	454	-		830	-	-	100	**1,394**
1992	10	-	-1	-	323	-		1,130	-	+	130	**1,593**
1993	9	+	-1	35	374			1,551	-	1	364	**2,334**
1994	19	-	-1	10	620		184	2,143	-	1	277	**3,254**
1995	33	-	1597	40	766	-	195	3046		-3	454	**6,131**
1996	45	-	1626	169	771		583	3209			447	**6,850**
1997	37	-	1,574	156	674		33	2112			459	**5,045**
1998	18	-	1,362	88	877		1669	3,465			335	**7,814**
1999	-	-	1235	49	554		455	1619			292	**4204**
2000	17		1019	12	624		639	921			303	**3535**
2001	16		1103	4	727	24	559	591			285	**3309**
2002	16		950	2	951		568	862			102	**3451**
2003*	12		1054	5	808		274	382			38	**2573**

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

LING VIII

Year	Belgium	France	Germany	Spain	E & W	Scot.	**Total**
1988		1,018			10		**1,028**
1989		1,214			7		**1,221**
1990		1,371			1		**1,372**
1991		1,127			12		**1,139**
1992		801			1		**802**
1993		508			2		**510**
1994		n/a		77	8		**85**
1995		693		106	46		**845**
1996		825	23	170	23		**1,041**
1997	1	705	+	290	38		**1,034**
1998	5	1,220	-	543	29		**1,797**
1999	22	233	-	188	8		**451**
2000	1	219		106	5		**331**
2001		228		341	6	2	**577**
2002		288		141	10	0	**439**
2003*		239		82	36		**357**

Table 9.1 (cont.)
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**

*Preliminary

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**

*Preliminary

Table 9.1 (cont.)
LING XIV

Year	Faroes	Germany	Iceland	Norway	E & W	Scotland	**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				35			**35**
2002				20			**20**
2003*				83			**83**

*Preliminary.

Ling, total landings by Subareas or Division

Year	**I**	**IIa**	**IIb**	**III**	**IVa**	**IVb,c**	**Va**	**Vb1**	**Vb2**	**VIa**	**VIb**	**VII**	**VIIa**	**VIIb,c**	**VIId,e**	**VIIf**	**VIIg-k**	**VIII**	**IX**	**XII**	**XIV**	**All areas**
1988		6119	7	331	11223	379	5861	2372	2116	14556	1765	5057	211	865	779	444	4415	1028		0	3	**57531**
1989		7368		422	11677	387	5612	2962	1690	8631	3743	5261	311	577	700	310	1012	1221		0	1	**51885**
1990		7628		543	10027	455	5598	3062	795	6730	1505	4575	169	678	799	233	1077	1372		3	9	**45258**
1991		7793		484	9969	490	5805	3465	1047	4795	2662	3977	125	749	680	302	1394	1139		10	1	**44887**
1992		6521		549	10763	842	5116	2400	1214	4588	1891	2552	105	1286	519	137	1593	802		0	17	**40895**
1993		7093		642	12810	797	4854	2242	614	5301	1522	2294	219	1434	436	223	2334	510		0	9	**43334**
1994		6309	13	469	11496	323	4604	2657	965	6730	2540	2185	284	1595	451	400	3254	85		5	6	**44371**
1995		5954		412	13041	659	4192	3286	784	8847	1638		305	1944	1389	602	6131	845		50	17	**50096**
1996	136	6083	127	402	12705	1424	4060	3996	900	8577	1124		210	2201	1477	399	6850	1041		2	0	**51714**
1997	31	5373	5	311	11315	699	3933	4733	924	6746	814		264	1780	1472	547	5045	1034	0	9	61	**45096**
1998	123	9072	5	214	13631	627	4302	4029	1330	7362	1394		198	1034	1500	561	7814	1797	2	2	6	**55003**
1999	64	7581	6	216	9810	446	4647	4576	662	6899	1175		84	1366	1057	312	4204	451	1	2	1	**43560**
2000	69	5891	4	228	9246	384	3743	3386	399	6889	1879		73	1176	844	217	3535	331	1	7	26	**38328**
2001	66	4852	33	262	7852	283	3343	4091	497	5097	788		87	1226	804	217	3309	577	0	59	35	**33478**
2002	206	6916	9	263	9046	309	3315	4067	457	4076	533		118	955	857	445	3451	439	0	8	20	**35490**
2003*	89	6050	5	259	6363	235	4123	4447	927	3272	673		110	484	701	169	2573	357		19	83	**30939**

*Preliminary.

Table 9.2 Estimated mean CPUE ([kg/hook]x1000), standard error (*se*) and number sample days for ling. A dash denotes that only one vessel took samples in a particular area.

LING

Area	Year	CPUE ([kg/hook]x1000)	*se*(CPUE)	n
IIA	2001	9.4	-	19
IIA	2002	27.0	10.0	88
IIA	2003	33.0	9.0	134
IVA	2003	31.1	-	4
VB	2003	59.1	-	12
VIA	2003	83.3	22.8	43
VIB	2002	59.4	-	5
VIB	2003	31.1	5.4	34

Table 9.3 Estimated mean length (cm), standard error (*se*), and the number of fish measured of ling. A dash denotes that only one vessel took samples in a particular area.

LING

Area	Year	length	*se*	n
I	2003	87.8	-	161
IIA	2001	52.7	3.7	4145
IIA	2002	88.8	1.6	4794
IIA	2003	81.6	-	4622
IVA	2003	80.0	-	1702
VB	2003	79.1	-	446
VIA	2002	79.3	-	160
VIA	2003	78.5	0.7	2591
VIB	2002	102.3	-	367
VIB	2003	89.9	3.5	1393

Table 9.4 LING in Vb. Faroese commercial CPUE series for trawlers and longliners.

Fleet	Year	Catch, kg	Effort (trawl hours)	CPUE (kg/hour)
OB trawlers > 1000HP	1991	11400	21875	0,521
	1992	4900	23859	0,205
	1993	15500	22798	0,680
	1994	30948	22092	1,401
	1995	37796	20397	1,853
	1996	26190	21702	1,207
	1997	42652	18052	2,363
	1998	108806	19281	5,643
	1999	89049	24352	3,657
	2000	95498	30997	3,081
	2001	162103	31389	5,164
	2002	156885	27626	5,679
* Preliminary	2003	202852	44922	4,516

Fleet	Year	Catch, kg	Effort (trawl hours)	CPUE (kg/hour)
Pair trawlers>1000HP	1985	0	7794	0,000
	1986	990	8300	0,119
	1987	165	10827	0,015
	1988	0	9959	0,000
	1989	0	9005	0,000
	1990	4565	11046	0,413
	1991	165	10657	0,015
	1992	5240	10583	0,495
	1993	10505	10189	1,031
	1994	9686	11582	0,836
	1995	59684	13369	4,464
	1996	128827	14702	8,763
	1997	272030	18963	14,345
	1998	190992	16736	11,412
	1999	156294	18585	8,410
	2000	168005	17046	9,856
	2001	130930	17038	7,685
	2002	106702	14563	7,327
	2003	No data available		

Fleet	Year	Catch, kg	Effort (1000 hooks)	CPUE (kg/hour)
Long liners >100GRT	1986	64600	2018	32,012
	1987	115600	1981	58,354
	1988	40600	955	42,513
	1989	35800	833	42,977
	1990	62700	1882	33,316
	1991	169500	4373	38,761
	1992	171000	5869	29,136
	1993	173300	4871	35,578
	1994	298100	7012	42,513
	1995	200200	4953	40,420
	1996	2280	66	34,545
	1997	113790	1292	88,073

Table 9.4 Continued.

1998	48687	840	57,961
1999	97356	1861	52,314
2000	28215	846	33,351
2001	22200	461	48,156
2002	480	36	13,333
2003	11800	221	53,394

Table 9.5 Effort and CPUE in ling, as calculated from the Icelandic long-line logbook data.

Year	Effort - No of hooks (*10000)	CPUE (g/hook)
1994	3401	42.9
1995	4237	30.1
1996	3952	33.6
1997	3255	43.9
1998	2972	50.5
1999	5005	38.5
2000	5558	28.9
2001	4776	33.7
2002	5523	28.4
2003	4864	37.5

Table 9.6 Ling. Catch per unit effort of Danish trawlers in Subareas IV and IIIa.

DENMARK: Log-book recorded catch and effort **Species: Ling** **ICES area: IV**

Year	Mesh size in Trawl: >100 mm			70 - 100 mm			30 - 45 mm			< 25 mm			All trawls
	Kg	days	CPUE	Kg	days	CPUE	Kg	days	CPUE	Kg	days	CPUE	CPUE
1992	42495	310	137.1	199651	1780	112.2	4059	165	24.6	232918	1542	151.0	**126.2**
1993	24744	212	116.7	166759	1288	129.5	18245	512	35.6	253771	1799	141.1	**121.6**
1994	6434	87	74.0	213367	1758	121.4	6907	209	33.0	164916	1072	153.8	**125.3**
1995	3480	42	82.9	195463	1212	161.3	6195	197	31.4	119565	695	172.0	**151.3**
1996	2113	40	52.8	315231	2169	145.3	7729	177	43.7	76210	747	102.0	**128.1**
1997	81030	193	419.8	425886	2183	195.1	4310	120	35.9	47360	459	103.2	**189.0**
1998	40955	310	132.1	291986	1518	192.3	14479	161	89.9	47413	456	104.0	**161.5**
1999	79105	409	193.4	371259	2286	162.4	14553	326	44.6	22141	330	67.1	**145.3**
2000	35800	274	130.7	346237	2650	130.7	6972	224	31.1	32625	375	87.0	**119.7**
2001	139215	614	226.7	448600	3161	141.9	12685	297	42.7	117185	348	336.7	**162.4**
2002	463993	3393	136.8	15371	212	72.5	6830	173	39.5	29769	466	63.9	121.6
2003	**700963**	**4146**	**169.1**	**7164**	**113**	**63.4**	**5059**	**129**	**39.2**	**25460**	**365**	**69.8**	155.4

DENMARK: Log-book recorded catch and effort **Species: Ling** **ICES area: IIIA**

Year	Mesh size in Trawl: >100 mm			70 - 100 mm			30 - 45 mm			< 25 mm			All trawls
	Kg	days	CPUE	Kg	days	CPUE	Kg	days	CPUE	Kg	days	CPUE	CPUE
1992	4749	90	52.8	15431	363	42.5	2315	84	27.6	3335	51	65.4	**43.9**
1993	8060	166	48.6	55717	649	85.9	2228	96	23.2	8630	31	278.4	**79.2**
1994	5703	69	82.7	23369	390	59.9	915	41	22.3	2220	3	740.0	**64.0**
1995	4694	81	58.0	13406	270	49.7	672	30	22.4	260	5	52.0	**49.3**
1996	2732	55	49.7	9810	245	40.0	662	19	34.8	235	7	33.6	**41.2**
1997	1565	34	46.0	4362	157	27.8	350	10	35.0				**31.2**
1998	1325	19	69.7	3042	87	35.0	470	13	36.2	175	3	58.3	**41.1**
1999	948	28	33.9	2290	77	29.7	2709	79	34.3				**32.3**
2000	206	7	29.4	7688	211	36.4	1360	11	123.6				**40.4**
2001	2300	31	74.2	14886	304	49.0	65	2	32.5	1400	7	200.0	**54.2**
2002	2005	85	23.6	17198	399	43.1	210	9	23.3				39.4
2003	**2124**	**38**	**55.9**	**31135**	**366**	**85.1**	**795**	**27**	**29.4**	**180**	**5**	**36.0**	78.5

Table 9.7 Faroe ling. Catch-at-age in numbers (´000)

```
Run title : FAROE LING (ICES DIVISION Vb)                LIN_IND

    At 23/02/2004  20:18

       Table  1    Catch numbers-at-age                              Numbers*10**-3
       YEAR,        1996,    1997,    1998,    1999,    2000,    2001,    2002,    2003,

       AGE
         4,           90,       1,       1,      18,      45,      20,      66,      39,
         5,          232,     219,      59,      25,     123,      88,      73,      64,
         6,          329,     298,     159,       9,     110,     310,     454,     326,
         7,          324,     490,     284,     167,      57,     594,     489,     458,
         8,          213,     411,     335,     399,     113,     194,     230,     422,
         9,          106,     266,     369,     349,     177,     111,      68,     223,
        10,           61,     126,     180,     176,     107,      80,      88,      67,
        11,           28,      41,      70,      84,      57,      23,       2,      21,
       +gp,           21,      41,      62,      87,      56,      38,       6,      53,
0    TOTALNUM,      1404,    1893,    1519,    1314,     845,    1458,    1476,    1673,
     TONSLAND,      4896,    5657,    5359,    5238,    3785,    4588,    4524,    5374,
     SOPCOF %,       101,     100,      98,      98,     100,      99,      99,      99,
```

Table 9.8 Faroe ling. Catch weight-at-age

```
 Run title : FAROE LING (ICES DIVISION Vb)                LIN_IND

    At 23/02/2004  20:18

       Table  2    Catch weights-at-age (kg)
       YEAR,        1996,    1997,    1998,    1999,    2000,    2001,    2002,    2003,

       AGE
         4,       1.0530,   .6030,  1.1570,  1.0670,  1.3210,  1.0610,  1.2020,   .8060,
         5,       1.8420,  1.1470,  1.2030,  1.0880,  1.8260,  1.1220,  1.5120,  1.1900,
         6,       2.5590,  1.7820,  1.7990,  2.2160,  2.6170,  1.9210,  1.9590,  2.0880,
         7,       3.3800,  2.4040,  2.4370,  2.3660,  3.1390,  2.6040,  2.8870,  2.7240,
         8,       4.0260,  3.2210,  3.1320,  3.1180,  4.0550,  3.6380,  3.8720,  3.5020,
         9,       5.1810,  4.0580,  4.0240,  4.0830,  5.0560,  5.1680,  5.4740,  4.0440,
        10,       7.5210,  5.1560,  5.0180,  5.4800,  6.2810,  6.5870,  8.2420,  5.4820,
        11,       9.5140,  7.0620,  6.4510,  6.2270,  7.6040,  7.5210,  5.1980,  6.2190,
       +gp,      12.5520,  9.0620,  8.5550,  8.1160, 10.2740, 10.0980, 11.4340, 10.0200,
0    SOPCOFAC,    1.0085,   .9969,   .9798,   .9838,  1.0001,   .9919,   .9926,   .9871,
```

Table 9.9 Faroe ling. Proportion mature at age.

```
Run title : FAROE LING (ICES DIVISION Vb)                LIN_IND

    At 23/02/2004  20:18

       Table  5    Proportion mature at age
       YEAR,        1996,    1997,    1998,    1999,    2000,    2001,    2002,    2003,

       AGE
         4,         .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,
         5,         .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,
         6,         .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,
         7,       1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,
         8,       1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,
         9,       1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,
        10,       1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,
        11,       1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,
       +gp,       1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,  1.0000,
```

Table 9.10 Tuning fleet data.

Ling in the Faroe Ground (Fishing Area Vb)								
101								
LL_04: 5lliners>100GRT (Catch: Numbers) (Effort: 1000 hooks)								
1996 2003								
1 1 0.0 1.0								
4 11								
66	128	330	470	462	303	151	87	40
1292	85	12487	17032	27961	23442	15205	7203	2323
840	18	1897	5142	9186	10827	11941	5837	2267
1861	1328	1794	677	12216	29087	25452	12820	6095
846	1433	3931	3522	1837	3613	5657	3428	1806
461	372	1653	5838	11187	3659	2084	1501	438
36	36	40	246	265	125	37	48	1
221	417	685	3498	4915	4526	2391	721	229

Ling in the Faroe Ground (Fishing Area Vb)
101
LL_04: 5lliners>100GRT (Catch: Numbers) (Effort: 1000 hooks)
1996 2003
1 1 0.0 1.0
4 11
66 128 330 470 462 303 151 87 40
1292 85 12487 17032 27961 23442 15205 7203 2323
840 18 1897 5142 9186 10827 11941 5837 2267
1861 1328 1794 677 12216 29087 25452 12820 6095
846 1433 3931 3522 1837 3613 5657 3428 1806
461 372 1653 5838 11187 3659 2084 1501 438
36 36 40 246 265 125 37 48 1
221 417 685 3498 4915 4526 2391 721 229

Table 9.11

Title : FAROE LING (ICES DIVISION Vb) LIN_IND

At 23/02/2004 13:40

Separable analysis
from 1996 to 2003 on ages 4 to 11
with Terminal F of .400 on age 10 and Terminal S of 1.000

Initial sum of squared residuals was 100.680 and
final sum of squared residuals is 41.871 after 97 iterations

Matrix of Residuals

Years,	1996/97,	1997/98,	1998/99,	1999/**,	2000/**,	2001/**,	2002/**,	TOT,	WTS,
4/ 5,	1.014,	-2.338,	-1.471,	-.518,	1.182,	-.459,	1.268,	.000,	.159,
5/ 6,	.964,	1.369,	2.935,	-.765,	.240,	-1.483,	-.929,	.000,	.145,
6/ 7,	.870,	1.143,	1.047,	-1.067,	-.464,	-.199,	.681,	.000,	.261,
7/ 8,	.210,	.634,	-.095,	.342,	-.818,	.436,	.134,	.000,	.474,
8/ 9,	-.197,	-.092,	-.261,	.327,	.007,	.175,	-.248,	.000,	1.000,
9/10,	-.442,	-.150,	.157,	.392,	.501,	-.791,	-.259,	.000,	.484,
10/11,	-.958,	-1.142,	-1.034,	-.907,	.156,	1.503,	.283,	.000,	.227,
TOT ,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.886,	
WTS ,	.001,	.001,	1.000,	1.000,	1.000,	1.000,	1.000,		

Fishing Mortalities (F)

,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003,
F-values,	1.3004,	1.5970,	1.6658,	1.7525,	1.3037,	1.5210,	.6386,	.4000,

Selection-at-age (S)

,	4,	5,	6,	7,	8,	9,	10,	11,
S-values,	.0018,	.0113,	.0374,	.1438,	.2921,	.4968,	1.0000,	1.0000,

1

Run title : FAROE LING (ICES DIVISION Vb) LIN_IND

At 23/02/2004 13:40

Traditional vpai Terminal populations from weighted Separable populations

Fishing mortality residuals

YEAR,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003,
AGE								
4,	.0546,	-.0019,	-.0027,	-.0009,	.0008,	-.0013,	.0010,	.0000,
5,	.1020,	.1625,	.0479,	-.0119,	.0026,	-.0102,	-.0015,	-.0022,
6,	.1176,	.1443,	.1203,	-.0531,	-.0074,	-.0043,	.0191,	.0151,
7,	.0255,	.1445,	.0485,	.0278,	-.0919,	.0876,	.0120,	-.0047,
8,	-.1136,	-.0386,	-.0401,	.2682,	-.0879,	.0574,	-.0104,	-.0006,
9,	-.3062,	-.2121,	-.0193,	.2550,	.2885,	-.2657,	-.0082,	.0456,
10,	-.5522,	-.7857,	-.7059,	-.5925,	.0429,	.1267,	.2280,	.1335,
11,	-.0309,	.3519,	-.0567,	.2415,	.4057,	-.2790,	-.5061,	.0846,

Table 9.12 Lowestoft VPA Version 3.1

```
  23/02/2004  13:45

 FAROE LING (ICES DIVISION Vb)                LIN_IND

 CPUE data from file D:\Vpa\VPA2004ling\LL_04.dat

 Catch data for   8 years. 1996 to 2003. Ages  4 to  12.

      Fleet,            First, Last, First, Last
                    ,    year, year,  age ,  age
 LL_04: 5lliners>100G,   1996, 2003,   4,    11

 Disaggregated Qs
 Log transformation
 No trend in Q (mean used)

 Terminal Fs derived using    L/S    (without F shrinkage)


 Tuning converged after    9 iterations

 Regression weights
       ,  .877,  .921,  .954,  .976,  .990,  .997, 1.000, 1.000

 Oldest age F = 1.000*average of 3 younger ages.
1



 Fishing mortalities
    Age,  1996,  1997,  1998,  1999,  2000,  2001,  2002,  2003

      4,  .056,  .001,  .000,  .004,  .008,  .003,  .020,  .003
      5,  .118,  .178,  .069,  .010,  .031,  .018,  .011,  .023
      6,  .166,  .207,  .179,  .013,  .051,  .096,  .118,  .058
      7,  .205,  .374,  .294,  .273,  .099,  .394,  .204,  .159
      8,  .247,  .408,  .446,  .810,  .284,  .525,  .246,  .256
      9,  .269,  .518,  .742, 1.122, 1.026,  .467,  .331,  .376
     10,  .405,  .554,  .760,  .938, 1.331, 2.589,  .791,  .594
     11,  .307,  .494,  .649,  .957,  .880, 1.194,  .456,  .409



 Log catchability residuals


 Fleet : LL_04: 5lliners>100G

  Age  ,  1996,  1997,  1998,  1999,  2000,  2001,  2002,  2003
     4 ,  2.21,  -.73, -2.93,   .13,   .83,  -.26,   .83,   .00
     5 ,   .83,  1.95,   .86, -1.10,   .04,  -.39, -1.92,   .00
     6 ,   .25,  1.18,   .90, -1.70,  -.38,   .33,  -.46,   .00
     7 ,  -.55,   .76,   .38,   .33,  -.72,   .73,  -.92,   .00
     8 ,  -.85,   .37,   .32,   .94,  -.15,   .55, -1.21,   .00
     9 , -1.14,   .23,   .45,   .88,   .76,   .04, -1.29,   .00
    10 , -1.20,  -.17,   .01,   .24,   .56,  1.29,  -.88,   .00


1



                         SUMMARY STATISTICS FOR AGE  4
  Fleet, Pred.  ,    se     ,Partial, Raised,   Slope  ,      se   ,Intrcpt,  se
       , log q  ,  (log q)  ,   F   ,   F   ,          ,     Slope ,        ,Intrcpt
    1  , -8.93  , 1.524     , .0292 , .0027,   .277E-01,   .245E+00, -8.932,   .516

   Fbar,     Sigma(int.),   Sigma(ext.),   Sigma(overall), Variance ratio,
   .003,           1.52    ,      0.000,        1.52    ,     0.000
```

Table 9.12 (cont.)

```
                         SUMMARY STATISTICS FOR AGE  5
Fleet, Pred.  ,    se     ,Partial, Raised,   Slope  ,      se   ,Intrcpt,  se
     , log q  ,  (log q)  ,   F   ,   F   ,          ,     Slope ,       ,Intrcpt
  1  , -6.80  , 1.258     , .2466 , .0230,  -.328E+00,   .152E+00, -6.798,   .426

 Fbar,     Sigma(int.),   Sigma(ext.),   Sigma(overall), Variance ratio,
 .023,          1.26    ,      0.000,        1.26    ,     0.000


                         SUMMARY STATISTICS FOR AGE  6
Fleet, Pred.  ,    se     ,Partial, Raised,   Slope  ,      se   ,Intrcpt,  se
     , log q  ,  (log q)  ,   F   ,   F   ,          ,     Slope ,       ,Intrcpt
  1  , -5.87  ,  .933     , .6214 , .0579,  -.120E+00,   .142E+00, -5.874,   .316

 Fbar,     Sigma(int.),   Sigma(ext.),   Sigma(overall), Variance ratio,
 .058,          .933    ,      0.000,        .933    ,     0.000


                         SUMMARY STATISTICS FOR AGE  7
Fleet, Pred.  ,    se     ,Partial, Raised,   Slope  ,      se   ,Intrcpt,  se
     , log q  ,  (log q)  ,   F   ,   F   ,          ,     Slope ,       ,Intrcpt
  1  , -4.86  ,  .690     ,1.7065 , .1590,  -.584E-01,   .109E+00, -4.864,   .234

 Fbar,     Sigma(int.),   Sigma(ext.),   Sigma(overall), Variance ratio,
 .159,          .690    ,      0.000,        .690    ,     0.000


                         SUMMARY STATISTICS FOR AGE  8
Fleet, Pred.  ,    se     ,Partial, Raised,   Slope  ,      se   ,Intrcpt,  se
     , log q  ,  (log q)  ,   F   ,   F   ,          ,     Slope ,       ,Intrcpt
  1  , -4.39  ,  .752     ,2.7508 , .2565,  -.362E-01,   .120E+00, -4.386,   .255

 Fbar,     Sigma(int.),   Sigma(ext.),   Sigma(overall), Variance ratio,
 .256,          .752    ,      0.000,        .752    ,     0.000


                         SUMMARY STATISTICS FOR AGE  9
Fleet, Pred.  ,    se     ,Partial, Raised,   Slope  ,      se   ,Intrcpt,  se
     , log q  ,  (log q)  ,   F   ,   F   ,          ,     Slope ,       ,Intrcpt
  1  , -4.01  ,  .841     ,4.0266 , .3755,  -.223E-01,   .135E+00, -4.005,   .285

 Fbar,     Sigma(int.),   Sigma(ext.),   Sigma(overall), Variance ratio,
 .376,          .841    ,      0.000,        .841    ,     0.000


                         SUMMARY STATISTICS FOR AGE 10
Fleet, Pred.  ,    se     ,Partial, Raised,   Slope  ,      se   ,Intrcpt,  se
     , log q  ,  (log q)  ,   F   ,   F   ,          ,     Slope ,       ,Intrcpt
  1  , -3.54  ,  .812     ,6.3964 , .5944,   .984E-01,   .124E+00, -3.542,   .275

 Fbar,     Sigma(int.),   Sigma(ext.),   Sigma(overall), Variance ratio,
 .594,          .812    ,      0.000,        .812    ,     0.000
```

Table 9.13 Lowestoft VPA Version 3.1 23/02/2004 20:17

```
 Extended Survivors Analysis

 FAROE LING (ICES DIVISION Vb)                 LIN_IND

 CPUE data from file D:\Vpa\VPA2004ling\LL_04.dat

 Catch data for   8 years. 1996 to 2003. Ages  4 to  12.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 LL_04: 5lliners>100G,   1996, 2003,   4,    11,   .000,  1.000

Time-series weights :

     Tapered time weighting applied
     Power =    3 over  20 years

Catchability analysis :

      Catchability dependent on stock size for ages <    6

         Regression type = C
         Minimum of   5 points used for regression
         Survivor estimates shrunk to the population mean for ages <  6

     Catchability independent of age for ages >=    9

 Terminal population estimation :

      Survivor estimates shrunk towards the mean F
      of the final   5 years or the   5 oldest ages.

      S.E. of the mean to which the estimates  are shrunk =    .500

      Minimum standard error for population
      estimates derived from each fleet =    .300

      Prior weighting not applied

Tuning converged after   12 iterations

 Regression weights
       ,  .877,  .921,  .954,  .976,  .990,  .997, 1.000, 1.000

 Fishing mortalities
    Age,  1996,  1997,  1998,  1999,  2000,  2001,  2002,  2003

      4,  .057,  .001,  .000,  .006,  .012,  .005,  .028,  .012
      5,  .118,  .182,  .080,  .012,  .045,  .028,  .019,  .033
      6,  .164,  .206,  .184,  .015,  .064,  .145,  .190,  .107
      7,  .195,  .367,  .292,  .283,  .116,  .536,  .336,  .281
      8,  .224,  .382,  .435,  .809,  .297,  .668,  .385,  .512
      9,  .241,  .454,  .665, 1.078, 1.026,  .502,  .489,  .752
     10,  .365,  .473,  .600,  .742, 1.172, 2.815,  .918, 1.283
     11,  .355,  .422,  .495,  .590,  .535,  .813,  .609,  .540

 XSA population numbers (Thousands)

                              AGE
 YEAR ,      4,         5,         6,        7,         8,         9,        10,        11,

 1996 ,    1.75E+03, 2.25E+03, 2.35E+03, 1.97E+03, 1.14E+03, 5.33E+02, 2.15E+02, 1.01E+02,
 1997 ,    9.66E+02, 1.42E+03, 1.72E+03, 1.72E+03, 1.39E+03, 7.86E+02, 3.60E+02, 1.28E+02,
 1998 ,    2.61E+03, 8.31E+02, 1.02E+03, 1.21E+03, 1.02E+03, 8.18E+02, 4.30E+02, 1.93E+02,
 1999 ,    3.52E+03, 2.25E+03, 6.60E+02, 7.31E+02, 7.76E+02, 5.70E+02, 3.62E+02, 2.03E+02,
 2000 ,    3.98E+03, 3.01E+03, 1.91E+03, 5.60E+02, 4.74E+02, 2.97E+02, 1.67E+02, 1.48E+02,
 2001 ,    4.79E+03, 3.39E+03, 2.48E+03, 1.54E+03, 4.29E+02, 3.03E+02, 9.17E+01, 4.46E+01,
 2002 ,    2.54E+03, 4.11E+03, 2.83E+03, 1.85E+03, 7.76E+02, 1.89E+02, 1.58E+02, 4.73E+00,
 2003 ,    3.48E+03, 2.12E+03, 3.47E+03, 2.02E+03, 1.14E+03, 4.55E+02, 9.99E+01, 5.42E+01,

 Estimated population abundance at 1st Jan 2004

    ,     0.00E+00, 2.96E+03, 1.77E+03, 2.68E+03, 1.31E+03, 5.86E+02, 1.85E+02, 2.38E+01,

 Taper weighted geometric mean of the VPA populations:

    ,     2.72E+03, 2.21E+03, 1.84E+03, 1.32E+03, 8.22E+02, 4.39E+02, 2.01E+02, 7.21E+01,
```

Table 9.13 (cont.)

Standard error of the weighted Log(VPA populations) :

,	.5111,	.5113,	.5581,	.4877,	.4281,	.5146,	.5981,	1.2581,

Log catchability residuals.

Fleet : LL_04: 5lliners>100G

Age ,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003
4 ,	1.33,	-.36,	-2.10,	-.06,	.40,	-.28,	.50,	.61
5 ,	-1.47,	-2.79,	1.62,	2.91,	-1.49,	-.91,	1.93,	-.08
6 ,	-.01,	.93,	.68,	-1.79,	-.39,	.50,	-.23,	.37
7 ,	-.80,	.55,	.18,	.17,	-.75,	.84,	-.62,	.37
8 ,	-1.11,	.14,	.13,	.77,	-.26,	.62,	-.92,	.53
9 ,	-1.35,	.00,	.24,	.73,	.65,	.01,	-1.00,	.59
10 ,	-.94,	.04,	.14,	.36,	.78,	1.71,	-.38,	1.12
11 ,	-.96,	-.08,	-.05,	.13,	-.01,	.51,	-.87,	.28

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age ,	6,	7,	8,	9,	10,	11
Mean Log q,	-5.6331,	-4.6733,	-4.2302,	-3.9115,	-3.9115,	-3.9115,
S.E(Log q),	.8592,	.6322,	.6977,	.7664,	.9330,	.5362,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
4,	.67,	.404,	8.28,	.21,	8,	1.09,	-8.47,
5,	-2.58,	-2.199,	10.74,	.06,	8,	2.16,	-6.52,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
6,	.56,	1.390,	6.45,	.64,	8,	.45,	-5.63,
7,	.78,	.541,	5.23,	.51,	8,	.52,	-4.67,
8,	1.32,	-.363,	3.43,	.18,	8,	.99,	-4.23,
9,	.72,	.661,	4.53,	.49,	8,	.57,	-3.91,
10,	4.77,	-1.629,	-3.14,	.03,	8,	3.59,	-3.53,
11,	.86,	1.070,	4.07,	.91,	8,	.44,	-4.03,

1

Terminal year survivor and F summaries :

Age 4 Catchability dependent on age and year class strength

Year class = 1999

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
LL_04: 5lliners>100G,	5432.,	1.198,	.000,	.00,	1,	.081,	.007
P shrinkage mean ,	2212.,	.51,,,,				.449,	.016
F shrinkage mean ,	3517.,	.50,,,,				.470,	.010

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2957.,	.34,	.48,	3,	1.387,	.012

Table 9.13 (cont.)

```
 Age  5   Catchability dependent on age and year class strength

 Year class = 1998

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 LL_04: 5lliners>100G,      2592.,  1.040,       .236,    .23,   2,  .108,     .023

   P shrinkage mean  ,      1838.,    .56,,,,                        .397,     .032

   F shrinkage mean  ,      1578.,    .50,,,,                        .495,     .037

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1769.,       .35,      .24,    4,    .688,   .033


1
 Age  6   Catchability constant w.r.t. time and dependent on age

 Year class = 1997

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 LL_04: 5lliners>100G,      3473.,   .690,       .399,    .58,   3,  .318,     .083

   F shrinkage mean  ,      2378.,    .50,,,,                        .682,     .120

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      2683.,       .41,      .26,    4,    .635,   .107

Age  7   Catchability constant w.r.t. time and dependent on age

 Year class = 1996

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 LL_04: 5lliners>100G,      1562.,   .485,       .197,    .41,   4,  .425,     .241

   F shrinkage mean  ,      1152.,    .50,,,,                        .575,     .314

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1311.,       .35,      .16,    5,    .453,   .281


1
 Age  8   Catchability constant w.r.t. time and dependent on age

 Year class = 1995

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 LL_04: 5lliners>100G,       607.,   .413,       .286,    .69,   5,  .412,     .497

   F shrinkage mean  ,       572.,    .50,,,,                        .588,     .522

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       586.,       .34,      .17,    6,    .487,   .512
```

Table 9.13 (cont.)

```
 Age  9   Catchability constant w.r.t. time and dependent on age

 Year class = 1994

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 LL_04: 5lliners>100G,       189.,   .400,       .405,   1.01,   6,  .336,     .740

   F shrinkage mean  ,       183.,    .50,,,,                         .664,     .758

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       185.,       .36,      .21,    7,    .599,   .752


1
 Age 10   Catchability constant w.r.t. time and age (fixed at the value for age)  9

 Year class = 1993

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 LL_04: 5lliners>100G,        21.,   .396,       .422,   1.07,   7,  .201,    1.373

   F shrinkage mean  ,        25.,    .50,,,,                         .799,    1.261

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
        24.,       .41,      .18,    8,    .449,  1.283


 Age 11   Catchability constant w.r.t. time and age (fixed at the value for age)  9

 Year class = 1992

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 LL_04: 5lliners>100G,        32.,   .399,       .116,    .29,   8,  .404,     .472

   F shrinkage mean  ,        24.,    .50,,,,                         .596,     .590

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
        27.,       .34,      .10,    9,    .310,   .540
```

Table 9.14 Faroe ling. Fishing mortality-at-age.

Run title : FAROE LING (ICES DIVISION Vb) LIN_IND

At 23/02/2004 20:18

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	FBAR **-**
AGE									
4	.0571	.0011	.0004	.0055	.0123	.0045	.0284	.0122	.0150
5	.1177	.1816	.0796	.0121	.0450	.0284	.0193	.0330	.0269
6	.1636	.2062	.1839	.0148	.0641	.1447	.1897	.1068	.1471
7	.1953	.3675	.2925	.2829	.1162	.5363	.3360	.2808	.3844
8	.2242	.3825	.4350	.8087	.2971	.6680	.3846	.5116	.5214
9	.2413	.4536	.6655	1.0776	1.0261	.5022	.4895	.7515	.5811
10	.3654	.4730	.6001	.7421	1.1718	2.8152	.9183	1.2832	1.6723
11	.3546	.4224	.4950	.5903	.5345	.8127	.6087	.5401	.6538
+gp	.3546	.4224	.4950	.5903	.5345	.8127	.6087	.5401	
0 FBAR 6- 9	.2061	.3524	.3942	.5460	.3759	.4628	.3500	.4127	

Table 9.15 Faroe ling. Stock number-at-age

Run title : FAROE LING (ICES DIVISION Vb) LIN_IND

At 23/02/2004 20:18

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	GMST 96-**	AMST 96-**
AGE											
4	1748	966	2611	3521	3982	4795	2539	3478	0	2582	2937
5	2253	1421	831	2247	3014	3385	4108	2124	2957	1984	2192
6	2350	1724	1020	660	1911	2480	2832	3468	1769	1532	1691
7	1969	1718	1207	731	560	1542	1847	2016	2683	1171	1288
8	1143	1394	1024	776	474	429	776	1136	1311	798	873
9	533	786	818	570	297	303	189	455	586	510	551
10	215	360	430	362	167	92	158	100	185	239	271
11	101	128	193	203	148	45	5	54	24	122	136
+gp	75	127	170	209	145	73	14	136	95		
0 TOTAL	10387	8625	8305	9278	10697	13144	12469	12968	9610		

Table 9.16 Faroe ling. Stock summary

Run title : FAROE LING (ICES DIVISION Vb) LIN_IND ,

At 23/02/2004 20:18

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 4	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 6- 9
1996	1748	29546	17541	4896	.2791	.2061
1997	966	21013	15729	5657	.3597	.3524
1998	2611	20156	14300	5359	.3748	.3942
1999	3521	19082	11418	5238	.4588	.5460
2000	3982	24610	8848	3785	.4278	.3759
2001	4795	22468	8819	4588	.5203	.4628
2002	2539	25673	10862	4524	.4165	.3500
2003	3478	26130	13557	5374	.3964	.4127
Arith. Mean	2955	23585	12634	4928	.4042	.3875
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

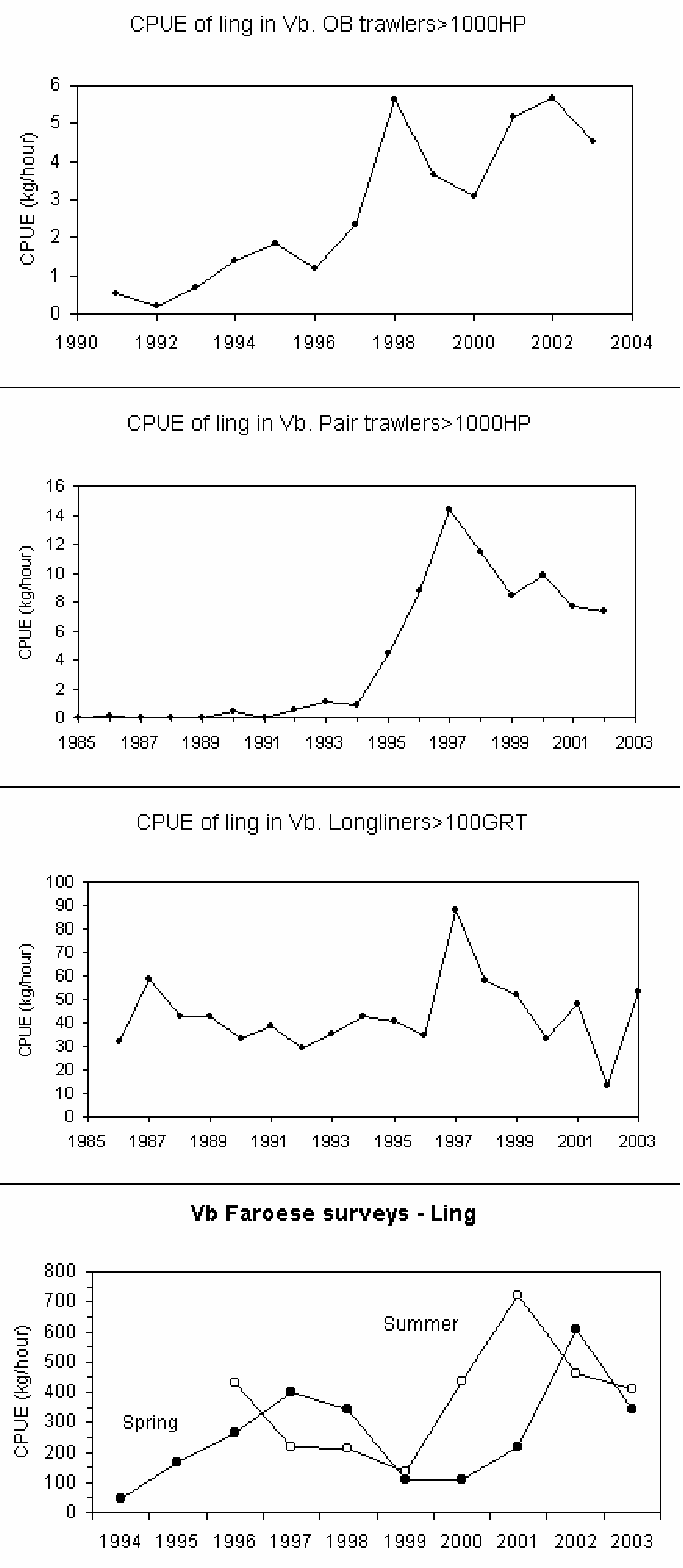


Figure 9.1 Ling in Vb. CPUE for Faroese trawlers, longliners, spring and summer groundfish surveys.

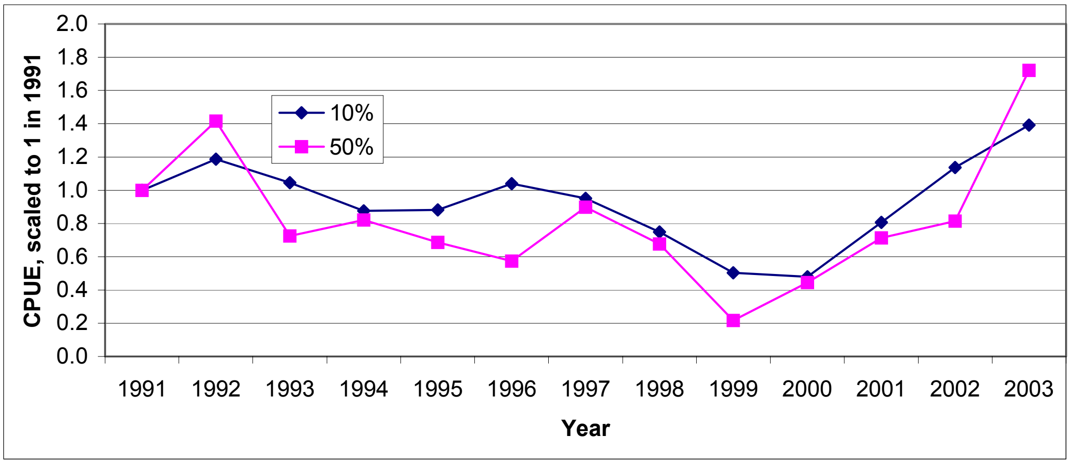


Figure 9.2 Ling. CPUE calculated from the Icelandic trawler fleet. Only about 20% of the ling catches in Icelandic waters is caught by bottom trawl. The lines corresponds to CPUE where 10% (and 50%) or more of the catches for each haul consist of ling.

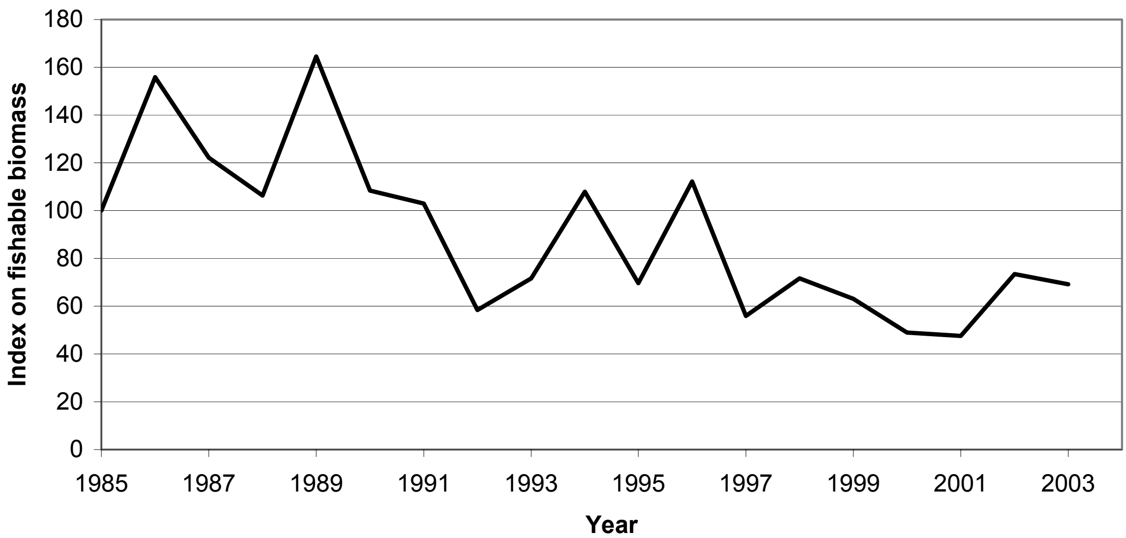


Figure 9.3 Ling. Index on fishable biomass calculated form the Icelandic groundfish survey at the Icelandic shelf.

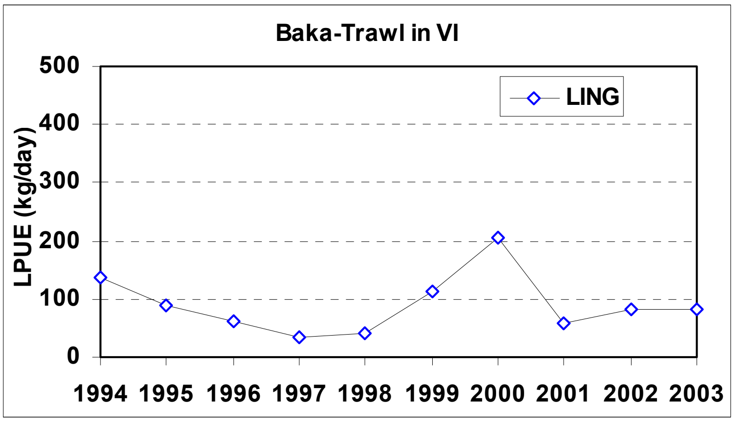


Figure 9.4 Landings per fishing effort of Ling in ICES Subarea VI, of "Baka" trawlers of the Basque Country, in 1994-2003. (Data on 2003 are preliminary).

New values: LPUE = kg/(Nº trip*(mean fishing days/trip) = kg/day)

Old values: LPUE = t/Nº trip.

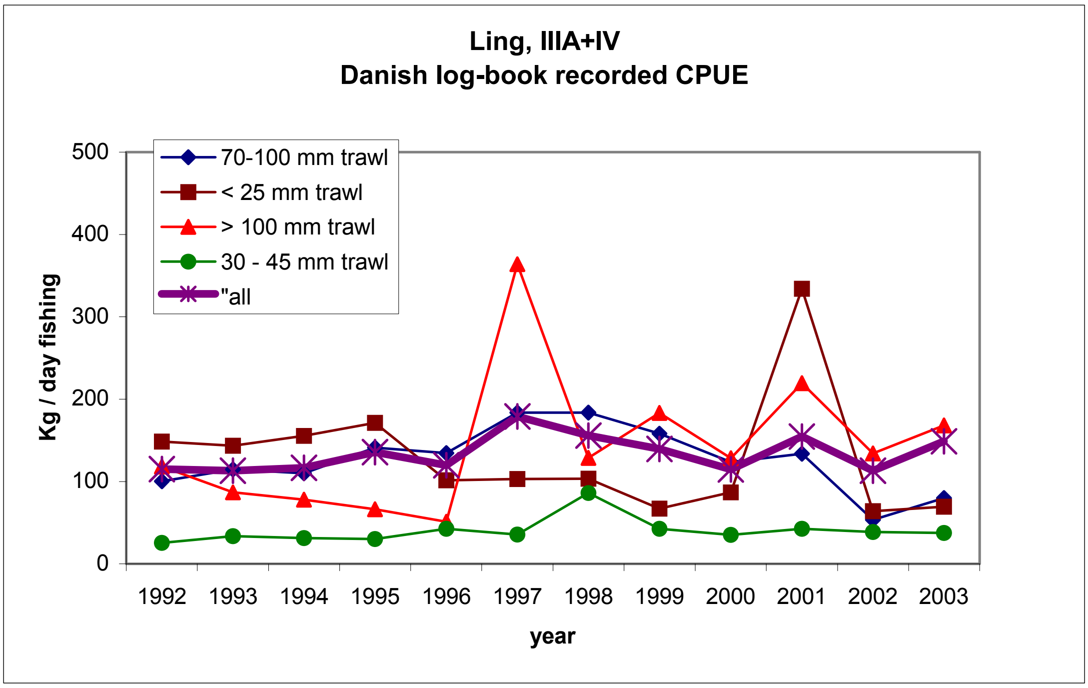


Figure 9.5 Catch per unit effort of Danish trawlers in Subareas IIIa and IV.

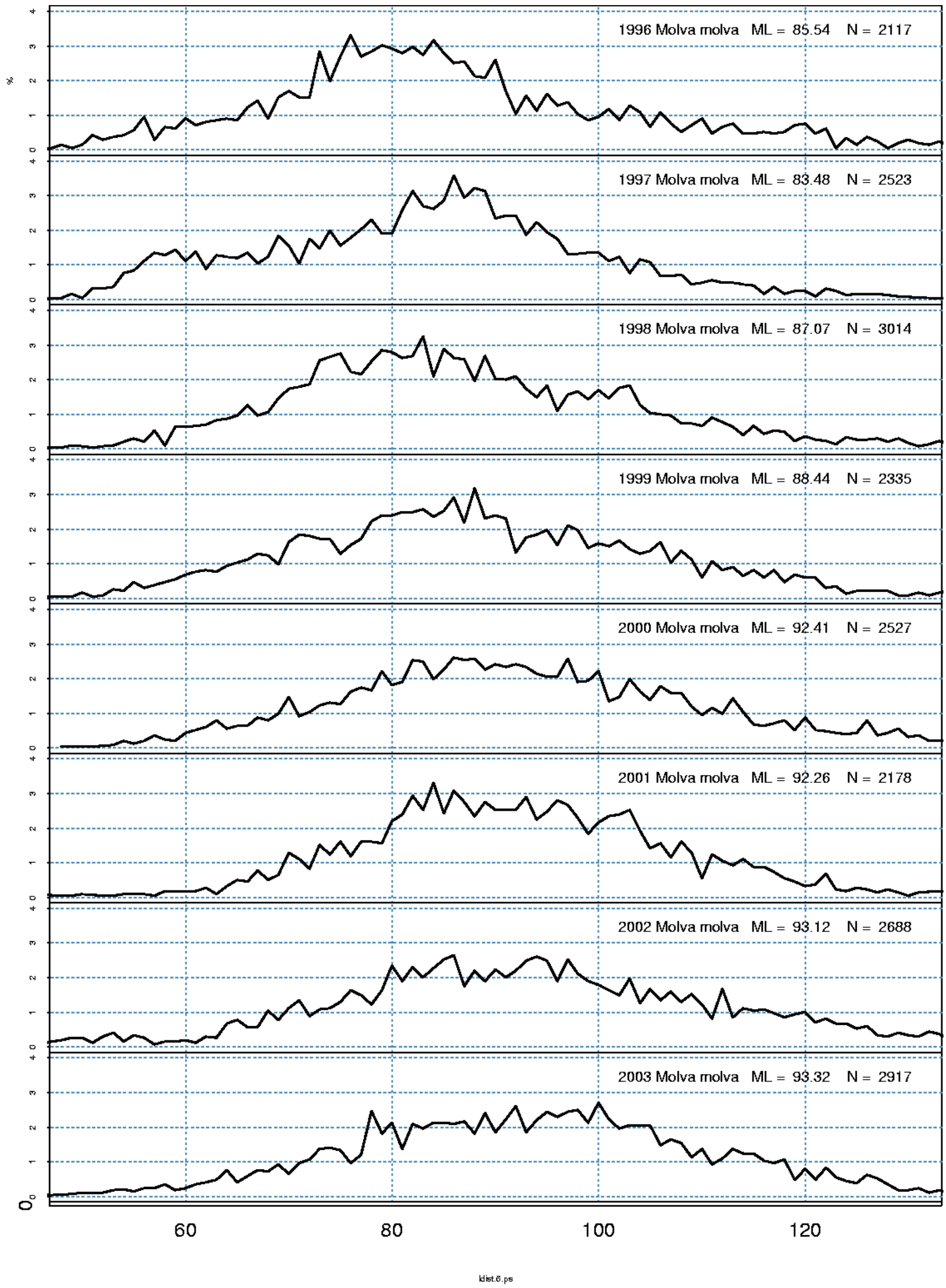


Figure 9.6 Length distribution of ling in the Icelandic catches.

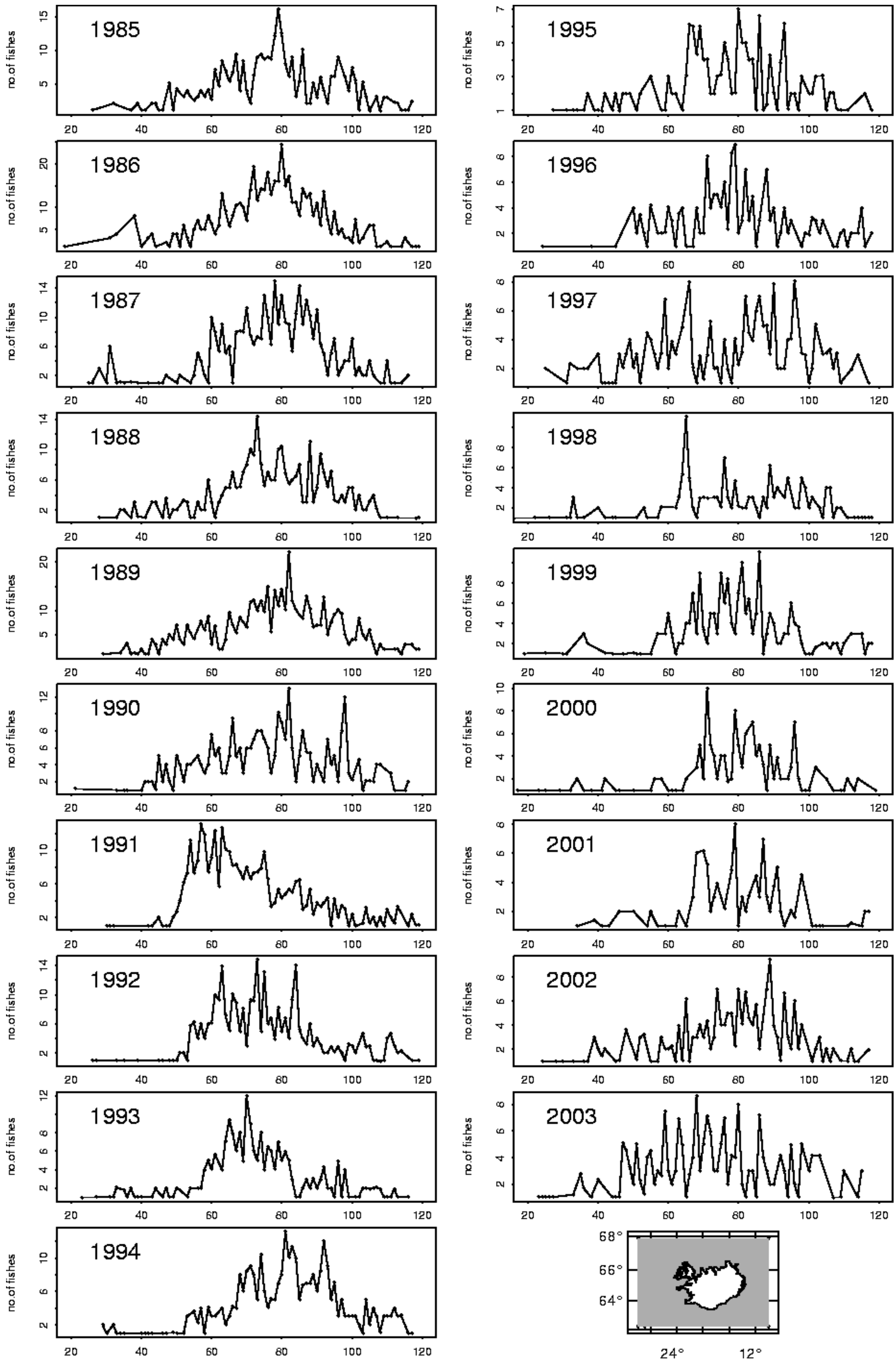


Figure 9.7 Ling in Va. Length distributions in the Icelandic groundfish survey in March 1985-2003

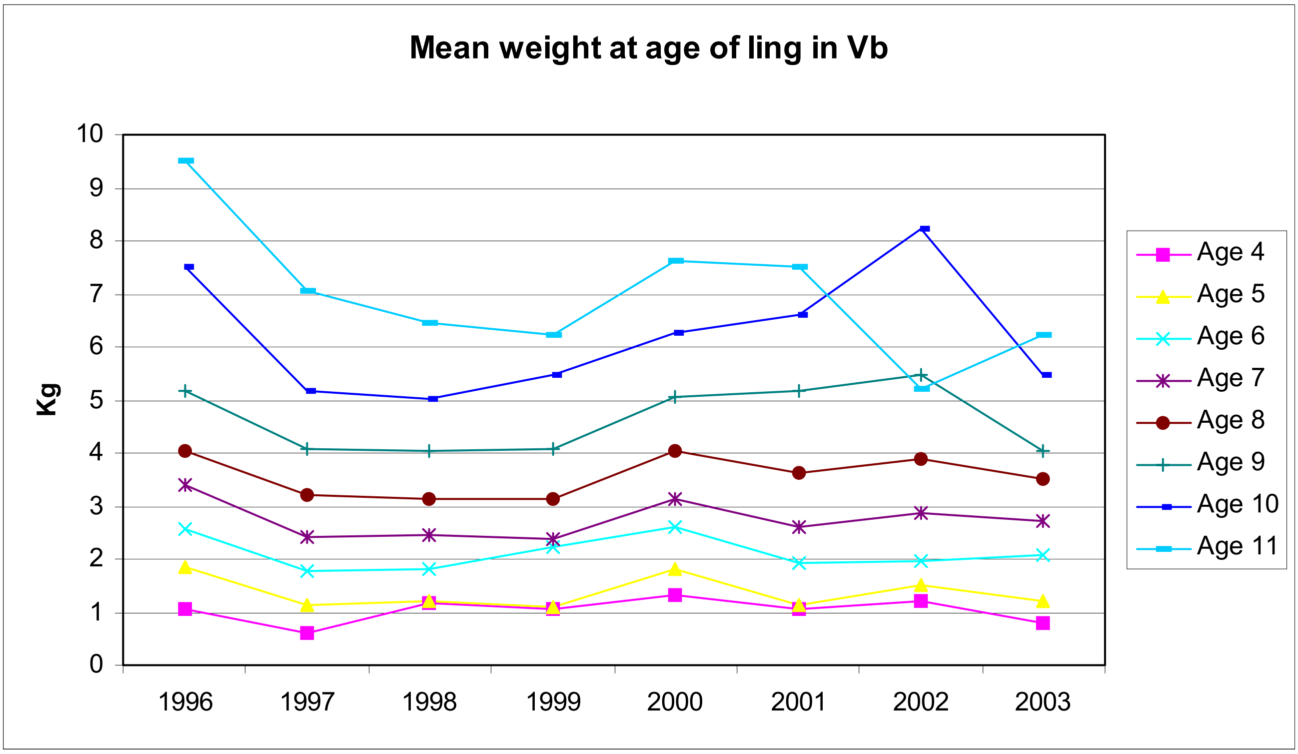


Figure 9.8 Faroe ling. Mean weight-at-age.

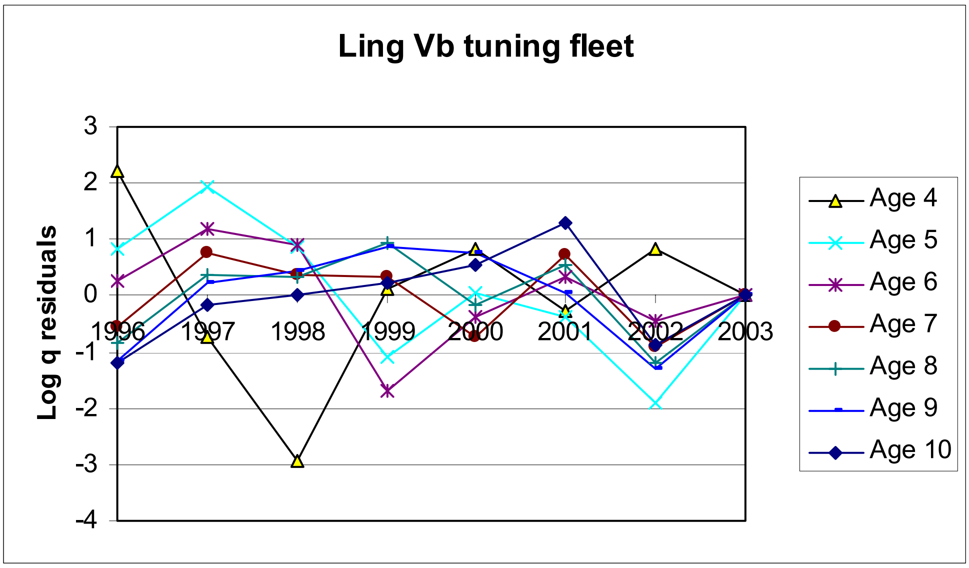


Figure 9.9 Faroe ling. Log q residuals for tuning fleet LL_04

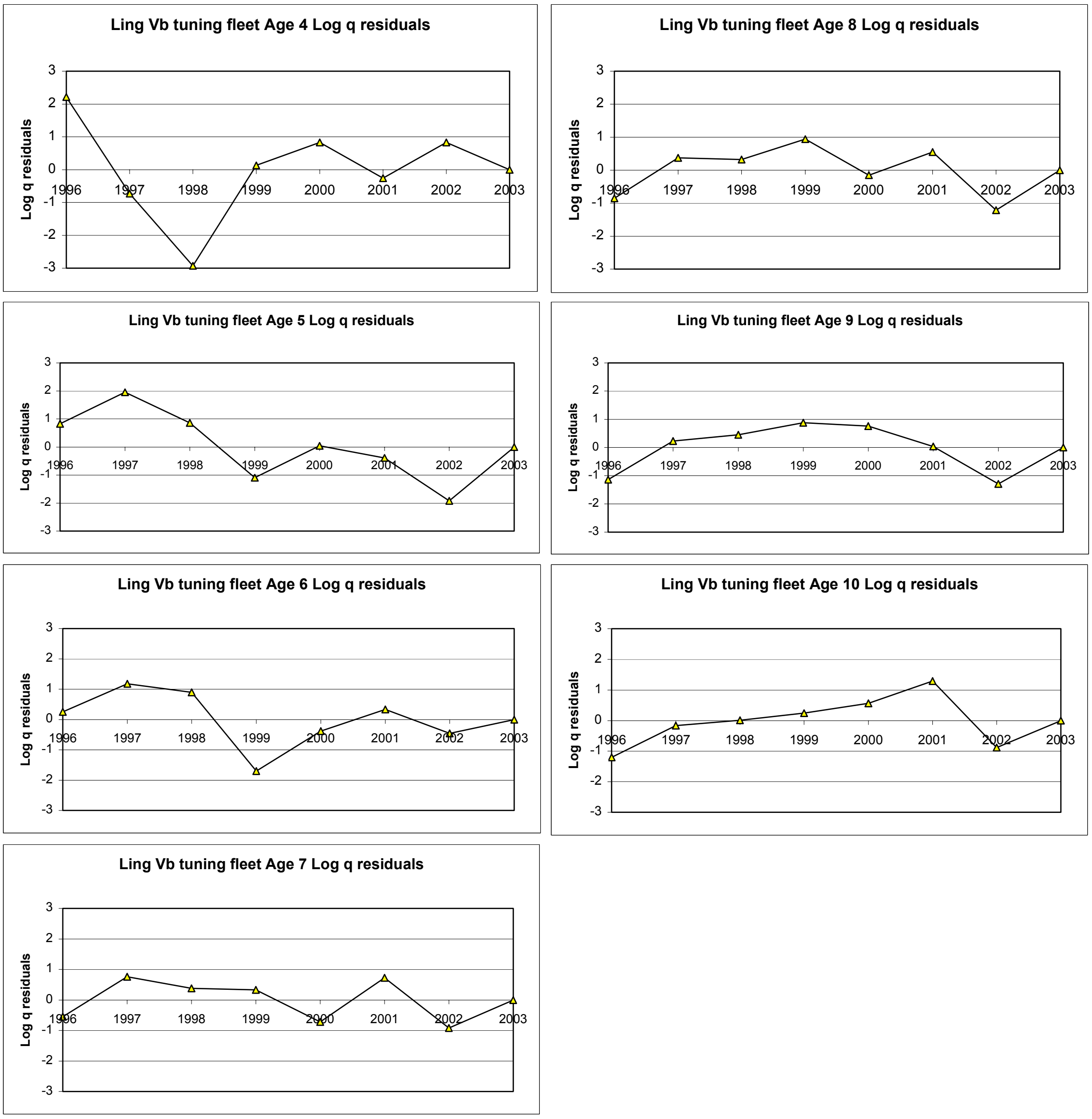


Figure 9.10 Faroe ling. Log q residuals at age for tuning fleet LL_04

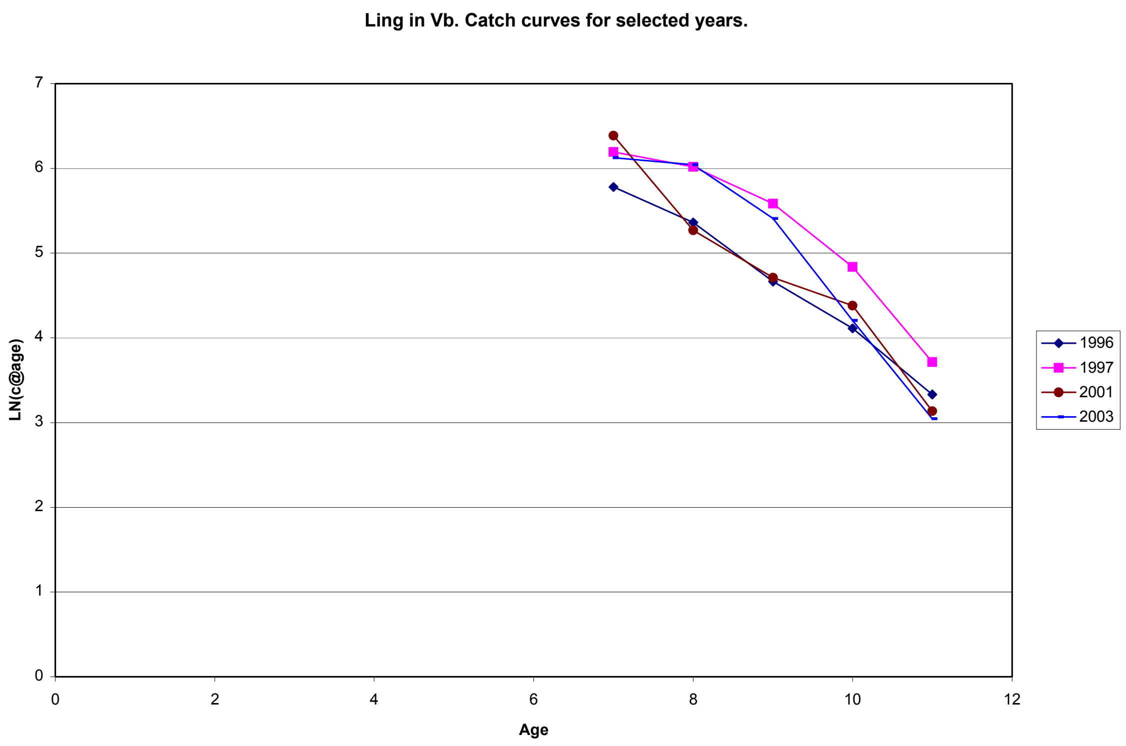


Figure 9.11

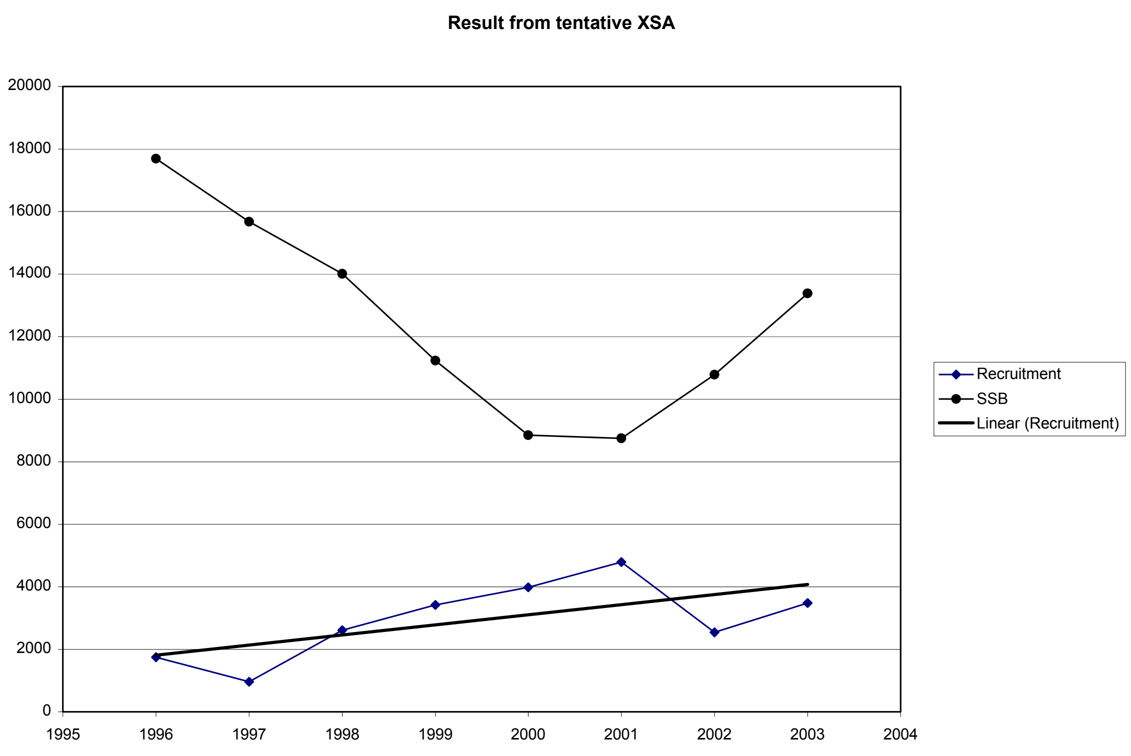


Figure 9.12

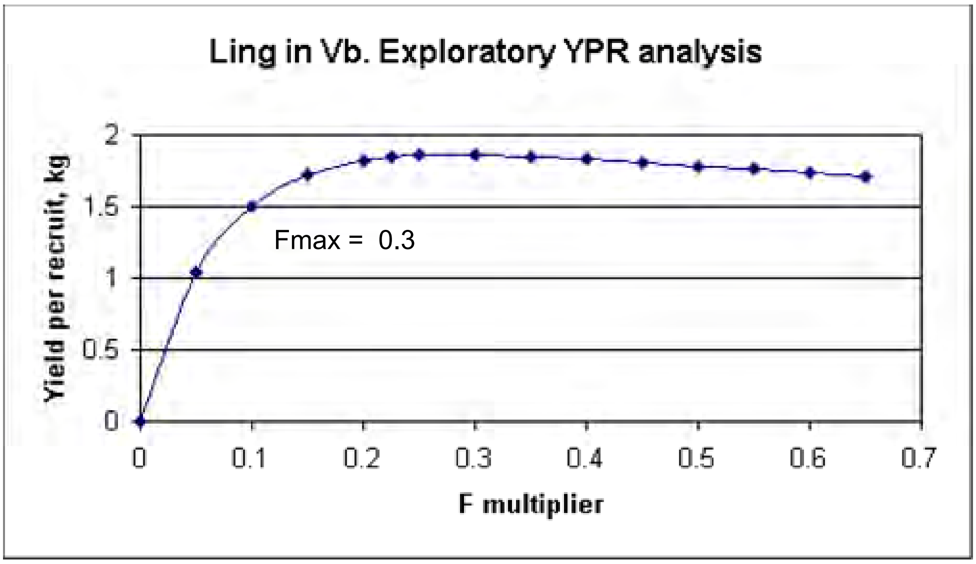


Figure 9.13

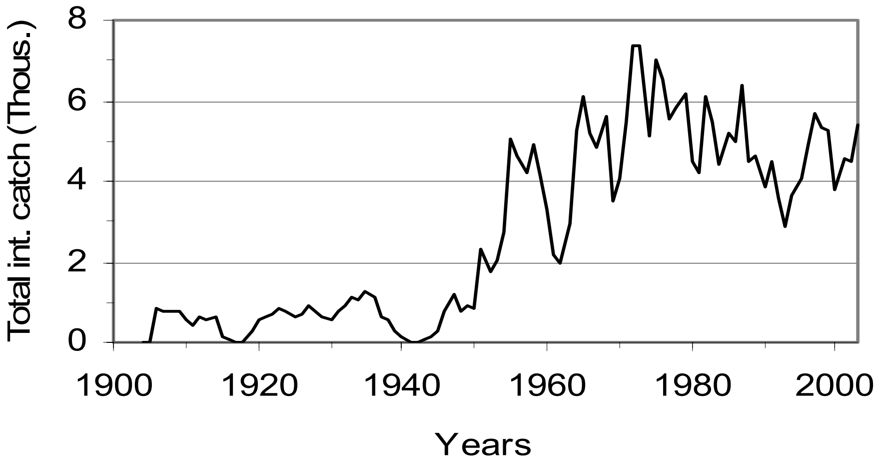


Figure 9.14

10 BLUE LING (MOLVA DYPTERYGIA)

10.1 Landings trends

Table 10.1 gives the landings data for blue ling by ICES Subareas and Divisions as used by the Working Group. The most important areas are II, Va, Vb, VI and XII. Landings are intermediate in Subareas XIV, IV and VII and landings are low in Subareas X, III, VIII, I and IX. There is a general declining trend in total landings in the period 1988-1994 from 25,400 t to 9,600 t. From 1995 to 2001 the landings increased at a steady rate to a peak of 16,200 t in 1999. Since 1999 landings have declined and at 8,000t in 2003 are the lowest in the series. Landings in 2003 may reflect the introduction of restrictive TACs for EU vessels and a cap on fishing effort in the NEAFC Regulatory Area. However, values for 2003 are provisional and may be revised next year.

Landings from Subarea I are very small and are by-catches in other fisheries.

Landings from Division IIa are mainly catches in a gillnet fishery off mid-Norway. The landings declined from 3,400 t in 1988 to 1,000 t in 1993 and have since declined further to a very low level of 100-200 t in recent years.

The relatively minor landings from Subareas III and IV are by-catches in trawl fisheries (EU TAC 25t).

In Division Va, blue ling has been taken mainly as a by-catch by trawlers engaged in the redfish and Greenland halibut fishery in recent years. Iceland takes most of the catches. During the years 1980–1984, a directed fishery for blue ling was carried out in a very limited area on spawning aggregations. No aggregations of spawning blue ling have been detected in this area since, and consequently the landings have declined from about 8 500 t in 1980 to a level of 2,000–3,000 t in 1985. Landings since 1988 have further declined from 2-3,000 t to around 1,000 t. Blue ling can now exclusively be regarded as by-catch in other fisheries. The spatial distribution of the Icelandic fishery is shown in Figure 1.

The total landings from Division Vb fluctuated between 5,000 and 10,000 t during the 1980s, but have declined since to about 2-3000 t in recent years. Most of the landings are taken in the spawning season by trawlers. At other times blue ling is taken as by-catch in other fisheries. In recent years most of the catches have been taken by Faroese and French trawlers. (EU TAC in II,IV,V : 138 t)

The landings from Subarea VI peaked at about 13 000 t in 1985, but have since then declined to 4,000 t in 1994 and increased to 9,000 t in 1999. French trawlers used to take more than 95 % of the total catch but in the most recent years the share of the total catches by UK trawlers has increased considerably. However, this trend as reversed following the introduction of national quotas, and landings in 2003 are the lowest in the time-series at 3, 250 t. (EU TAC for VI, VII : 3678 t)

The landings from Subareas VII, VIII and IX are very small and are by-catches in other fisheries.

The landings from Subarea XII peaked in 1993 at more than 3 300 t but have since been very variable. Faroese and French trawlers used to take most of the catch but since 1997 Spanish vessels have taken much of the catch. Landings in 2002 and 2003 are provisional and do not include landings from Spain. These data were not available to the Working Group but will be updated next year.

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 10.2). This resulted in landings by Iceland of more than 3 000 t from Subarea XIV. The French fleet fished in this area prior to the Icelandic fleet but information on landings is lacking. Landings have been very small in recent years.

10.2 Stocks

Biological investigations in the early 1980s suggested that at least two adult stock components were found within the area, a northern one in Subarea XIV and Division Va with a small component in Vb, and a southern one 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 must be that the 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.

10.3 Catch-Effort Data

Icelandic CPUE series were provided for Subarea Va. The survey index for fishable biomass of blue ling from the Icelandic groundfish survey has decreased by 75% since 1985-92 (Figure 10.3). For the trawler fleet the CPUE for blue ling has been declining since 1993 and was at its lowest in 2003 (Table 10.2, Figure 10.4). CPUE for the long-liners during the years of 1994-2001 shows a positive trend over this period (Table 10.3, Figure 10.5), but this may reflect changes in species-directivity as species other than blue ling are targeted. Also, the level of fishing effort in the long-line fishery is relatively low.

The Icelandic groundfish survey is considered to be the most reliable index of stock abundance.

French and Spanish CPUE series from commercial trawlers are available for Vb,VI,VII and VI respectively (Figures 10.6 and 10.7 and Tables 10.4 and 10.5).

The French trawl CPUE series shows a strong decline from 1989 to 1993 and stability at a low level thereafter. There are some perturbations in recent years but these are relatively small compared with CPUE at the start of the series. Importantly, data available from 1985 to 1989, presented at the 2002 Working Group, which show a strong decline from a level much higher than that observed in 1989, were not available to the Group in the new format for this series.

The Spanish Baka trawl data are available only from 1994 onwards and show and initial increase then a decline until 2001 and then an increasing trend in recent years. It was felt that these trends reflect perturbations at a low level of stock.

CPUE data are also available from Faroese trawlers in Subarea Vb (Figure 10.8), but these data must treated with caution because there has been a shift in directivity in recent years away from saithe and redfish towards deep-water species. This is reflected by a large increase in CPUE for blue ling in recent years.

10.4 Length distribution, age composition, mean weight-at-age, maturity-at-age, natural mortality

Length distributions from landings of blue ling, for Subarea Va, show that the size has been decreasing in recent years (Figure 10.9). However, it is not clear if there is a similar trend in length distributions from an Icelandic trawl survey (Figure 10.10).

In catches of Russian fishing vessel operated in March 2003 in the international waters off Hatton Plateau and Rockall Bank (Division VIb) over depths of 1200 to 1300 m blue ling was 64 to 130 cm long with 86-100 cm predominantly (Figure 10.11). Females were considerably longer then males with length varied 70 to 130 cm (mean 98,1 cm), while males had length of 64-111 cm (mean 87.4 cm).

The length composition of total catches of blue ling from Spanish trawlers fishing on Hatton Bank in 2002 and 2003 and of French landings from Subarea VI from 2001to 2003 are presented in Figures 10.12, 10.13 and 10.14.

Data on age composition, mean weight-at-age and maturity-at-age were available for many Subareas but are not presented in the report due to the difficulties in ageing of this species.

No information was available on natural mortality (M). However, as an estimate of M is required for the DeLury constant recruitment model (see section 10.6), M was estimated using the relationship:

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

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 not very wrong to assume the maximum age for blue ling be 30 years. Given this and the relationship above, M might be in the order of 0.15.

10.5 Biological parameters

Variable	Value	Source/comment
Longevity (years)	Approx. 30	Bergstad and Hareide 1996, Magnusson *et al.* 1997
Growth rate, K	No data	
Natural mortality, M	In the order of 0.15	Based on review by SGDEEP 2000.
Fecundity (absolute)	1-3.5 millions	Gordon and Hunter 1994
Length at first maturity ♂ ♀	75-80 cm 80-85 cm	Moguedet 1988, Magnusson *et al.* 1997
Age at first maturity ♂ ♀	6-7 7-8	Moguedet 1988, Magnusson *et al.* 1997

10.6 Assessment

10.6.1 Southern stock (Vb,VI and VII)

For this assessment, a modified DeLury constant recruitment model, a range of production models and a stock reduction model were attempted, using total international catch data for Division Vb and Subareas VI and VII combined (1963-2003), CPUE from the French trawl fishery (1989-2003) in Subareas VI and VII and CPUE from Spanish trawlers from Subarea VI (1994-2003) (see above).

The CEDA assessment package can only accept a single abundance index, so separate runs were carried out using each CPUE series and the results were compared. The stock reduction program (PMOD) can accept more than one index, but for this analysis would not run with both series. The reason for this was not known. Again, separate runs were carried out using each CPUE series and the results were compared. An M of 0.15 (see above) was assumed throughout and the stock in 1963 was assumed to be virgin.

10.6.1.1 CPUE from French trawlers

DeLury model

The DeLury model fitted the data very poorly (R^2<0.1) for a range of assumptions of error model (linear, log, gamma).

Schaefer model

The fit from the Schaefer model, assuming an exploratory time lag of 0, was poor for a range of error models, with least squares error giving a marginally better fit (R^2=0.295) (in ICES files). More importantly, residual catches from all error models showed a strong pattern with time.

Assuming least squares error, the model was re-run with a range of time lags up to and including 7 years (age of recruitment is 7 years). The only reasonable fit obtained (R^2=0.674) was with a time lag of 7 years. The pattern in residual catches, although less strong, was still evident (in ICES files), reflecting a poor fit to data in the most recent years. A further concern is that the CPUE series comprise data for 15 years only, and therefore available data to fit a time lag of 7 years are quite limited.

Fox model

The fit from the Fox model, assuming an exploratory time lag of 0, was poor for a range of error models, with least squares error giving a marginally better fit (R^2=0.295) (in ICES files). Residual catches from all error models showed a strong pattern with time.

Assuming least squares error, the model was re-run with a range of time lags up to and including 7 years. The fit of the model was poor throughout, with a strong pattern in residual catches (in ICES files).

Pella-Tomlinson model

The fit from the Pella-Tomlinson model, assuming an exploratory time lag of 0, was poor for a range of error models, with least squares error giving a marginally better fit (R^2=0.295) (in ICES files). Residual catches from all error models showed a strong pattern with time.

Assuming least squares error, the model was re-run with a range of time lags up to and including 7 years. The only reasonable fit obtained (R^2=0.674) was with a time lag of 7 years. The pattern in residual catches, although less strong, was still evident (in ICES files).

Assuming least squares error and a time lag of 7, the model was re-run with a range of z shape parameters. A Z value of 2 gave the best fit (R^2= 0.749) and a slightly improved pattern in residual catches with time (in ICES files).

Stock reduction model

The biological parameters used are those from a range of French biological studies and are given in Table 10.6.

A number of technical difficulties were encountered running the stock reduction program (PMOD). Firstly, the model would not accept values of T_0 >1.0. Sensitivity analysis indicated that model was not particularly sensitive to values of between 0 and 1 and so it was decided to proceed with a value of 1.0. Secondly, the results from the model were sensitive to the number of years included. This appeared to be a formatting problem because reasonably consistent results were obtained when 40, 30, 20 years' data were used, but the model generated very different results when a single additional years' data were added. These problems require further investigation and only the results using catch data back to 1964 are presented here. These should be treated with considerable caution and be used for indicative purposes only.

The trend in fishing mortality (Figure 10.15) shows a high in 1988 of 0.32, a further high in 2001 of 0.47 and then a strong decline in 2002 and 2003 consistent with a recent reduction in international catches.

Exploitable biomass is estimated to have declined strongly across the time period (Figure 10.16). Current biomass (21,628 t) is estimated to be 13% of virgin biomass (164,500 t)

The stock reduction model 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. This catch is termed the maximum constant yield (MCY). Given that age of recruitment and age of maturity are reasonably similar for blue ling in this stock, 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.

Assuming the biological parameters in Table 10.6, MCY is estimated to be around 3,100 tonnes, approximately 2% of virgin exploitable biomass.

10.6.1.2 CPUE from Spanish baka trawlers

DeLury model

The DeLury model fitted the data very poorly (R^2<0.1) for a range of assumptions of error model (linear, log, gamma).

Schaefer model

The fit from the Schaefer model, assuming an exploratory time lag of 0, was poor for a range of error models, with log error giving a marginally better fit (R^2=0.310) (in ICES files). Residual catches from all error models showed a strong pattern with time.

Assuming log error, the model was re-run with a range of time lags up to and including 7 years (Table 10.6). The results indicate that the model is unstable and very sensitive to the time lag applied. Although the pattern in residual catches with time is better for fits with high R^2 values, estimates of r are mostly very high. A major concern is that the CPUE series comprise data for 10 years only, and therefore available data to fit a time lag of 7 years are very limited.

Fox model

The fit from the Fox model, assuming an exploratory time lag of 0, was poor for a range of error models, with log error giving a marginally better fit (R^2=0.302) (in ICES files). Residual catches from all error models showed a strong pattern with time.

Assuming log error, the model was re-run with a range of time lags up to and including 7 years. The results were very similar to those from Schaefer, showing high instability and mostly high values of r (in ICES files).

Pella-Tomlinson model

The fit from the Pella-Tomlinson model, assuming an exploratory time lag of 0, was poor for a range of error models, with log error giving a marginally better fit (R^2=0.310) (in ICES files). Residual catches from all error models showed a strong pattern with time.

Assuming log error, the model was re-run with a range of time lags up to and including 7 years. The results were very similar to those from Schaefer and Fox, showing high instability and mostly high values of r (in ICES files).

Given the instability of the model, the effect of changing the Z shape parameter was not explored.

Stock reduction model

The biological parameters used were those described above (Table 10.6). The same technical problems were encountered as described above. The results should, therefore, be treated with considerable caution and only be used for indicative purposes. A further concern is that the Spanish CPUE series is short compared with the historical span of the fishery. The results obtained were very similar to those obtained using the French trawl series (in ICES files). The trend in fishing mortality shows a high in 1988 of 0.33, a further high in 2001 of 0.45 and then a strong decline in 2002 and 2003 consistent with a recent reduction in international catches. Exploitable biomass is estimated to have declined strongly across the time period. Current biomass (24,681 t) is estimated to be 15% of virgin biomass (166,200 t). Assuming the biological parameters in Table 10.6, MCY is estimated to be around 3,100 tonnes, approximately 2% of virgin exploitable biomass.

10.6.2 Northern stock (Va and XIV)

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 an Icelandic 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 long-line 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 (see Figure 10.3).

10.7 Comments on assessments

For blue ling in Vb, VI, VII, the results from DeLury and a range of production models were poor and unstable, respectively. The latter also demonstrated patterns in catch residuals. The results from a stock reduction model are more encouraging, but should be treated with considerable caution given the technical problems with the program and, in the case of the Spanish CPUE, the short time-series available. This latter point also applies to a lesser extent to the French CPUE series. That the results from the stock reduction model for the two CPUE series are similar may also be a concern, given the differences in trend and time-frame between these series. This implies that the model is driven largely by the landings series, biological parameters and, possibly, the steepness of the stock and recruitment relationship assumed in the model. Estimates of MCY, at 3,100 tonnes and approximately 2% of virgin exploitable biomass, seem low given that this is a gadoid with a moderate growth rate.

10.8 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. The Group were aware of this problem but felt that the important issues were the large scale of the decline in CPUE in some areas and the fact that under the Precautionary Approach there is a responsibility to interpret the available data.

Using CPUE as an index of exploitable biomass (U), WGDEEP in 2000 and 2002 concluded that that blue ling Vb,VI,VII was below U_{lim} (20% of virgin biomass). There is no new evidence to suggest that this has changed. It seems reasonable to assume, therefore, that current U remains below U_{lim}. The results from a stock reduction model, although only indicative, support this conclusion.

The status of the stock in Va and XIV is less clear. Although data from the groundfish survey data are very noisy in early years, there is some evidence that CPUE from 1993 onwards is currently about 25% of values 1985-90, if the latter are smoothed. There is also some evidence of a similar decline in CPUE from the Icelandic trawl fishery. However, CPUE from the Icelandic long-line fishery show a positive underlying trend across the period 1994-2002, but this may reflect changes in species-directivity as species other than blue ling are targeted. Also, the level of fishing effort in both the trawl and long-line fishery is relatively low. At previous Working Groups, available evidence has indicated that blue ling in Va is at a low level. Taking into account the relative merits of available abundance indices, this view is unchanged. The length distributions from Division Va and Subareas Vb, VI and VII (presented in previous reports) also indicate that the proportion of large fish in the landings has decreased in the most recent years.

It should be noted that landings reported from the southern parts of Subarea VII southwards as blue ling (*Molva dypterygia*) may comprise a sub-species *Molva macrophthalma*.

Table 10.1 Blue ling (*Molva dypterygia*). Working Group estimates of landings (tonnes)

Blue ling I

Year	Iceland	Norway	Germany	Norway	**Total**
1988					
1989					
1990					
1991					
1992					
1993					
1994		3			**3**
1995		5			**5**
1996					
1997		1			**1**
1998		1			**1**
1999		1			**1**
2000		3			**3**
2001		1			**1**
2002				1	**1**
2003*					

*Preliminary.

Blue ling IIa and b

Year	Faroes	France	Germany	Greenland	Norway	E & W	Scotland	Sweden	**Total**
1988	77	37	5		3,416	2			**3,537**
1989	126	42	5		1,883	2			**2,058**
1990	228	48	4		1,128	4			**1,412**
1991	47	23	1		1,408				**1,479**
1992	28	19		3	987	2			**1,039**
1993		12	2	3	1003				**1,020**
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		7			190	1	2		**200**
2002		1			129	1	17		**148**
2003*					115		1	1	**117**

*Preliminary.

Blue ling III

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**

*Preliminary.

Blue ling IVa

Year	Denmark	Faroes	France	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		6		48	2	25		**89**

*Preliminary

Blue ling IVb

Year	France	E & W	Norway	Faroes	Denmark	Germany	Scotland	**Total**
1988								
1989	2							**2**
1990	6							**6**
1991	7							**7**
1992	1							**1**
1993	0	3						**3**
1994	0							**0**
1995	3	3						**6**
1996	5	5	1					**11**
1997	1							**1**
1998	5		1					**6**
1999	0	1	0					**1**
2000	1							**1**
2001	0							**0**
2002			1					**1**
2003*			1		8			**9**

*Preliminary.

Blue ling IVc

Year	E & W	Norway	**Total**
1988			
1989			
1990			
1991			
1992			
1993			
1994	3		**3**
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002			
2003*			

*Preliminary.

Blue ling Va

Year	Faroes	Germany	Iceland	Norway	E & W	Scotland	**Total**
1988	271		1,893	7			**2,171**
1989	403		2,125	5			**2,533**
1990	1,029		1,992				**3,021**
1991	241		1,582	1			**1,824**
1992	321		2,584	1			**2,906**
1993	40		2,193				**2,233**
1994	89	1	1,542				**1,632**
1995	113	3	1,519				**1,635**
1996	36	3	1,284				**1,323**
1997	25		1,319				**1,344**
1998	59	9	1,086				**1,154**
1999	31	8	1,819	8	8	3	**1,877**
2000	36	7	1,636	25	7		**1,711**
2001	69	12	762	49	22	1	**915**
2002			1265	74	6	4	**1,349**
2003*	1	15	1098	6	15	8	**1,143**

*Preliminary.

Blue ling Vb_1

Year	Faroes	France[3]	Germany[2]	Norway	E & W[2]	Scotland [1]	Ireland	Russia	**Total**
1988	3,487	3,036	49	94					**6,666**
1989	2,468	1,800	51	228					**4,547**
1990	946	3,073	71	450					**4,540**
1991	1,573	1,013	36	196	1				**2,819**
1992	1,918	407	21	390	4				**2,740**
1993	2,088	192	24	218	19				**2,541**
1994	1065	147	3	173					**1,388**
1995	1,606	588	2	38	4				**2,238**
1996	1,100	301	3	82					**1,486**
1997	778	1,656		65	11				**2,510**
1998	1,026	1,411	0	24	1				**2,462**
1999	1,730	1,068	4	38	4				**2,844**
2000	1677[2]	575	1	163	33			1	**2,450**
2001	1820[2]	433	4	130	11		2		**2,400**
2002	1082[2]	574		274	8				**1,938**
2003*	2291[2]	590		12	1				**2,894**

*Preliminary. [1] Included in Vb_2. [2] Includes Vb_2 [3] Reported as Vb.

Blue ling Vb_2

Year	Faroes	Norway	Scotland [1]	E & W	**Total**
1988	2,788	72			**2,860**
1989	622	95			**717**
1990	68	191			**259**
1991	71	51	21		**143**
1992	1,705	256	1		**1,962**
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**

*Preliminary. [1] Includes Vb_1.

Blue ling VIa

Year	Faroes	France	Germany	Ireland	Norway	Spain [1]	E & W	Scotland	**Total**
1988	14	6,614	2		29		2	1	**6,662**
1989	6	7,382	2		143				**7,533**
1990		4,882	44		54			1	**4,981**
1991	8	4,261	18		63		1	35	**4,386**
1992	4	5,483	4		129			24	**5,644**
1993		4,311	48	3	27		13	42	**4,444**
1994		2,999	24	73	90	433	1	91	**3,711**
1995	0	2,835		11	96	392	34	738	**4,106**
1996	0	4,115	4		50	681	9	1407	**6,266**
1997	0	3,845		1	29	190	789	1,021	**5,875**
1998	0	4,644	3	1	21	142	11	1,416	**6,238**
1999	0	3,730		10	55	119	5	1,105	**5,024**
2000		4,443	94	9	102	108	24	1,300	**6,080**
2001		2,693	6	52	117	797	116	2,136	**5,917**
2002		2,005		62	61	285	16	2,027	**4,456**
2003*		1,806		2	106	192	3	428	**2,537**

*Preliminary. [1] Includes VIb

Blue ling VIb

Year	Poland	Russia	Faroes	France	Germany	Norwa	E & W	Scotland	Iceland	Ireland	Estonia	**Total**
1988			2,000	499	37	42	9	14				**2,601**
1989			1,292	61	22	217		16				**1,608**
1990			360	703		127		2				**1,192**
1991			111	2,482	6	102	5	15				**2,721**
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			**1,103**
1998			76	469		13	190	287	122	11		**1,168**
1999			204	690	[1]	9	168	2411	610	4		**4,096**
2000				508		184	500	966		7		**2,165**
2001				202	1	256	337	1803		4	85	**2,688**
2002		3	42	319		273	141	497		1		**1,276**
2003*	4	2		477		102	14	113			5	**717**

*Preliminary. [1] Included in VIa.

Blue ling VIIa

Year	France [1]	UK (Scot)	**Total**
1988			
1989			
1990			
1991		1	**1**
1992			
1993			
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002			
2003*			

*Preliminary. [1] Included in Via

Blue ling VIIb,c

Year	France	Germany	Ireland	Norway	Spain [1]	E & W	Scotland	**Total**
1988	21	1						**22**
1989	269			2				**271**
1990	177							**177**
1991	157							**157**
1992	126			3			6	**135**
1993	106			2		11	28	**147**
1994	100		1	1		6	22	**130**
1995	95		3			3	11	**112**
1996	118			1		15	57	**191**
1997	113		0	2		36	3	**154**
1998	157			1		60	6	**224**
1999	37		3	1		24	7	**72**
2000	46	1	45	5		9	2	**108**
2001	37		169	5		16	3	**230**
2002	21		152			43	1	**217**
2003*	6		12			2		**20**

*Preliminary. [1] Included in VIIg-k

Blue ling VIId,e

Year	France	**Total**
1988		**0**
1989	1	**1**
1990	0	**0**
1991	10	**10**
1992	15	**15**
1993	3	**3**
1994	8	**8**
1995	4	**4**
1996	4	**4**
1997	1	**1**
1998	3	**3**
1999		
2000		
2001		
2002		
2003*		

*Preliminary.

Blue ling VIIg-k

Year	France	Germany	Spain [1]	E & W	Scotland	Ireland	**Total**
1988							
1989	21						**21**
1990	46						**46**
1991	44						**44**
1992	256						**256**
1993	164			5	2		**171**
1994	190		4	3	4		**201**
1995	56		13	40	5		**114**
1996	67		21	42	40		**170**
1997	65	8	0[2]	134	12	9	**228**
1998	92		22 [2]	223	24	10	**371**
1999	40	2[2]	59 [2]	144	11	24	**280**
2000	39	1	65 [2]	22	15	30	**172**
2001	43	2	64 [2]	13	14	325	**461**
2002	17		42 [2]	33	54	120	**266**
2003*	13		18 [2]	6	16	16	**69**

*Preliminary. [1] Included in VIIb,c [2] Reported as VII.

Blue ling VIII & IX

Year	France	Spain	**Total**
1988			
1989			
1990			
1991			
1992			
1993			
1994			
1995			
1996			
1997		14	**14**
1998		33	**33**
1999	1	3	**4**
2000	2	2	**4**
2001	2	4	**6**
2002	3	26	**29**
2003*	2	5	**7**

*Preliminary.

Blue ling XII

Year	Faroes	France	Germany	Spain	E & W	Scotland	Norway	Iceland	Poland	Lithuania	**Total**
1988		263									**263**
1989		70									**70**
1990		5									**5**
1991		1147									**1147**
1992		971									**971**
1993	654	2591	90								**3,335**
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			**1,353**
2000	89	23		406	18	23	21	14			**594**
2001	497	26		415	32	91	103	2			**1166**
2002*	129			N/A	8		9				**146**
2003*		5		N/A		2	40		12	37	**96**

*Preliminary.

Blue ling XIV

Year	Faroes	France	Germany	Greenland	Iceland	Norway	E & W	Scotland	Spain	**Total**
1988	21		218	3						**242**
1989	13		58							**71**
1990			64	5			10			**79**
1991			105	5			45			**155**
1992			27	2		50	27	4		**110**
1993		390	16		3,124	173	21	1		**3,725**
1994	1		15		300	11	57			**384**
1995	0		5		117		16	3		**141**
1996	0		12				2			**14**
1997	1		1				2			**4**
1998	48					1	6			**55**
1999						1	7			**8**
2000					4		2		526	**532**
2001							6		91	**97**
2002						1				**1**
2003*						36	4			**40**

*Preliminary

Blue ling Total landings by Subarea/division and grand total. (Landings from areas VIII,IX and X given in previous reports are now considerd to represent *Molva macrophthalma***.**

Year	I	II	III	IV	Va	Vb	VI	VII	VIII&IX	XII	XIV	Total
1988	0	3,537	22	363	2171	9526	9263	22	0	263	242	25409
1989	0	2,058	23	459	2533	5264	9141	293	0	70	71	19912
1990	0	1,412	21	501	3021	4799	6173	223	0	5	79	16234
1991	0	1,479	21	627	1824	2962	7107	212	0	1147	155	15534
1992	0	1,039	38	554	2906	4702	6291	406	0	971	110	17017
1993	0	1,020	23	415	2233	2836	5150	321	0	3335	3725	19058
1994	3	419	18	424	1632	1644	3970	339	0	752	384	9585
1995	5	359	20	483	1635	2440	4662	230	0	573	141	10548
1996	0	267	12	190	1323	1602	6563	365	0	788	14	11124
1997	1	291	21	270	1344	2798	6978	383	14	417	4	12521
1998	1	278	6	286	1154	2584	7406	598	33	438	55	12839
1999	1	291	6	265	1877	2932	9120	352	4	1353	8	16209
2000	3	249	14	130	1711	2524	8245	280	4	594	532	14286
2001	1	200	24	252	915	2532	8605	691	6	1166	97	14489
2002	1	148	9	377	1349	2091	5732	483	29	146*	1	10366*
2003*	0	117	19	98	1143	3098	3254	89	7	96*	40	7961*

*Preliminary

Table 10.2 Blue ling. Registered catch, hours trawled and CPUE from the Icelandic trawler fleet. Tows used for calculations are those where blue ling was more than 10% of total catch in each particular haul.

year	**catch (t)**	**hours**	**cpue (kg/h)**
1991	515	963	534
1992	643	1197	537
1993	3587	2805	1279
1994	659	1571	419
1995	406	1135	357
1996	185	764	242
1997	186	924	201
1998	267	1015	263
1999	711	2048	347
2000	236	1485	159
2001	132	979	135
2002	228	1934	124
2003	134	840	156

Table 10.3 Blue ling. Effort (number of hooks *1000) and cpue for blue ling, as calculated from the Icelandic long-line logbook data.

Year	Effort	CPUE (g/hook)
1994	269	14.9
1995	840	21.8
1996	586	59.4
1997	236	40.9
1998	64	26.9
1999	809	99.4
2000	619	103.0
2001	265	50.1
2002	375	53.4
2003	239	28.8

Table 10.4 Blue ling. French trawl CPUE in Vb,VI & VII

YEAR	CPUE (kg/hr)
1989	376.29
1990	184.56
1991	220.53
1992	89.51
1993	88.46
1994	64.91
1995	84.53
1996	61.78
1997	80.93
1998	81.68
1999	105.68
2000	140.06
2001	74.07
2002	62.12
2003	140.53

Table 10.5 Blue ling landings, effective effort and LPUE of "Baka" bottom otter trawl of Ondarroa (ON) LPUE = kg/(Nº trips*(mean fishing days/trip) = kg/day) fishing in Subarea VI in the period 1993-2002.

	BAKA trawl-ON-VI		
	BLUE LING		
Year	Landings (kg)	Effort (f. days)	LPUE
1994	193005	635	304
1995	216152	624	346
1996	268538	695	386
1997	208098	710	293
1998	156109	750	208
1999	131051	855	153
2000	50189	763	66
2001	115506	1123	103
2002	284816	1594	179
2003	191345	825	232

Table 10.6 Input parameters for southern blue ling

Parameter	Symbol	Value
Natural mortality	M	0.15
Maximum age	A_{max}	30
Age of recruitment	A_r	7
Age of maturity	A_m	7
vonBertalanffy parameters	L infinity k t_0	125 cm 0.15 1.5
Length-weight parameters	a	2.0 E-6
	b	3.15

Table 10.7 Blue ling in Vb,VI,VII (Schaefer – Spanish trawl CPUE).

Time lag	K (t)	q	r	MSY (t)	Biomass in 2003 (t)	R^2
0	409,490	1.79 E-06	2.28	23	68,167	0.31
1	82,701	4.21 E-06	1.65	34,187	74,511	0.75
2	117,440	2.64 E-06	0.96	28,043	80,041	0.92
3	7,450,453	3.32 E-08	0.97	1,801,757	4,571,838	0.38
4	182,455	2.16 E-06	0.74	33,688	105,311	0.85
5	61,430,080	5.94 E-09	1.82	2.78 E+07	6.03 E+07	0.90
6	126,627	9.91 E-06	0.66	20,876	31,167	0.90
7	115,331	7.76 E-06	0.35	10,163	18,793	0.32

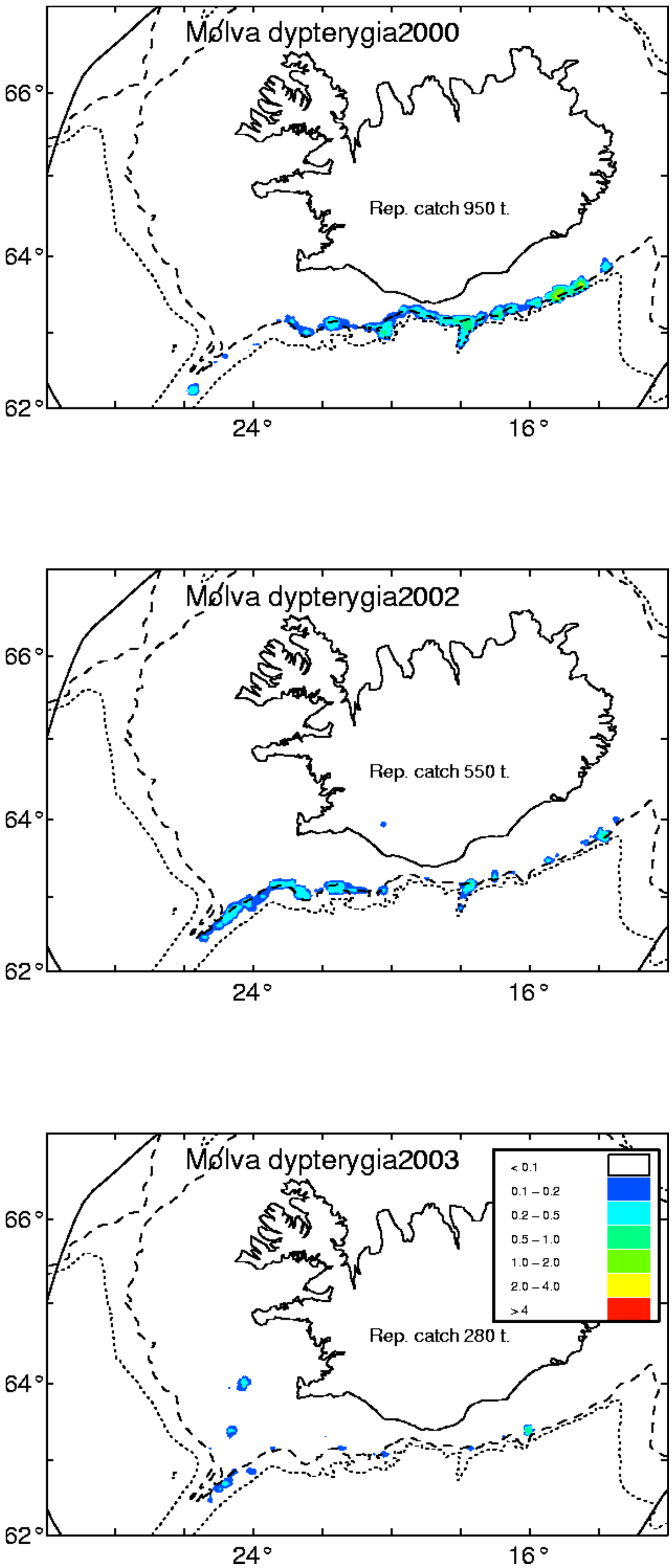


Figure 10.1 **Blue ling**. Icelandic fishery in 2000, 2002 and 2003 as reported in the logbooks. All gear types combined

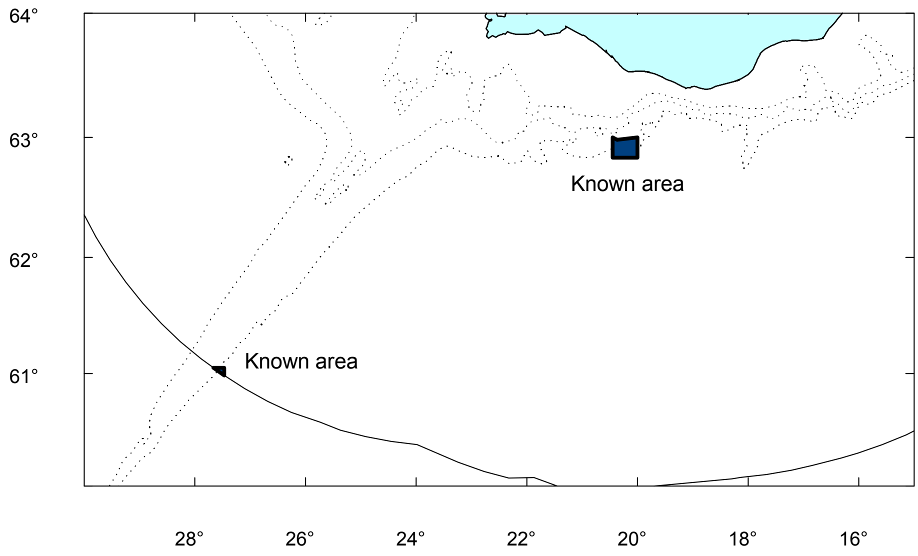


Figure 10.2 Map showing known spawning grounds for blue ling in Icelandic waters. There has been suggested to close these areas for fishing during the spawning period (15 Feb-30 April)

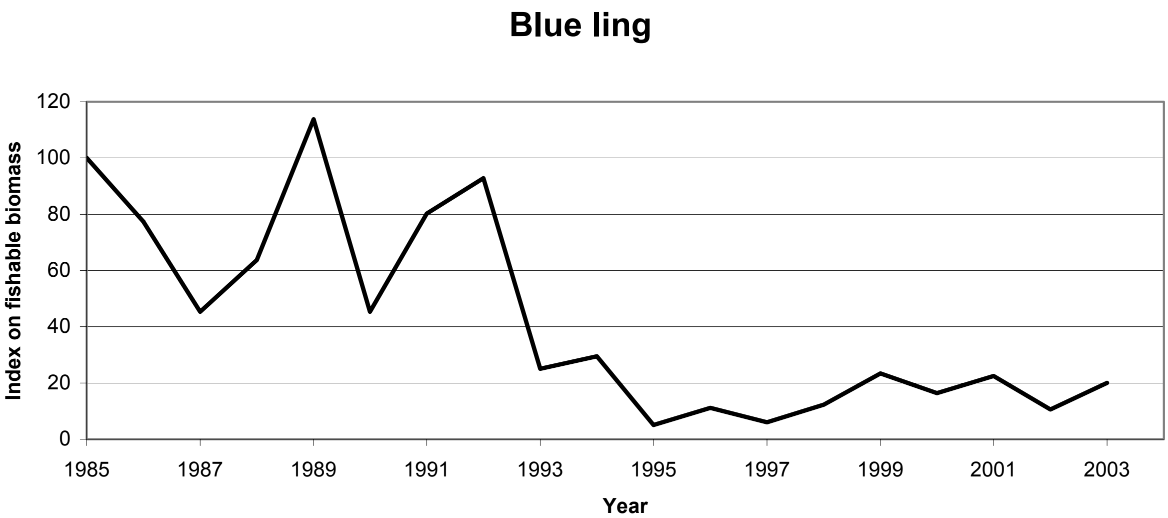


Figure 10.3 Blue ling. Index on fishable biomass calculated form the Icelandic groundfish survey at the Icelandic shelf.

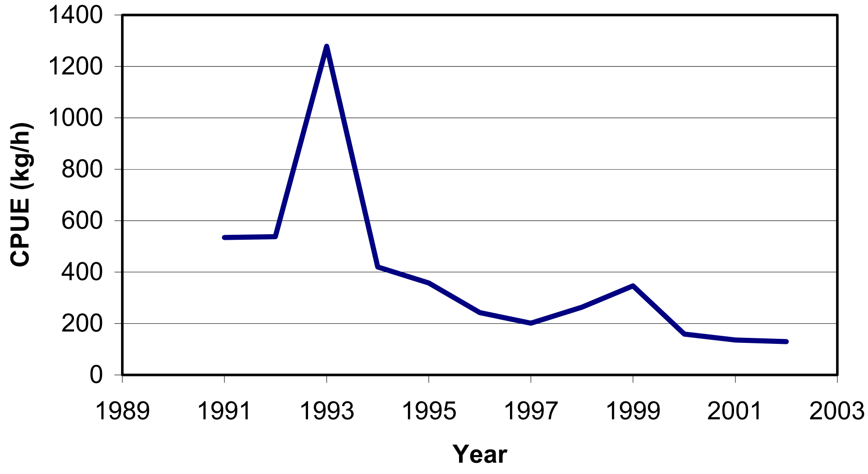


Figure 10.4 Blue ling catch per unit off effort calculated from the Icelandic trawl fishery.

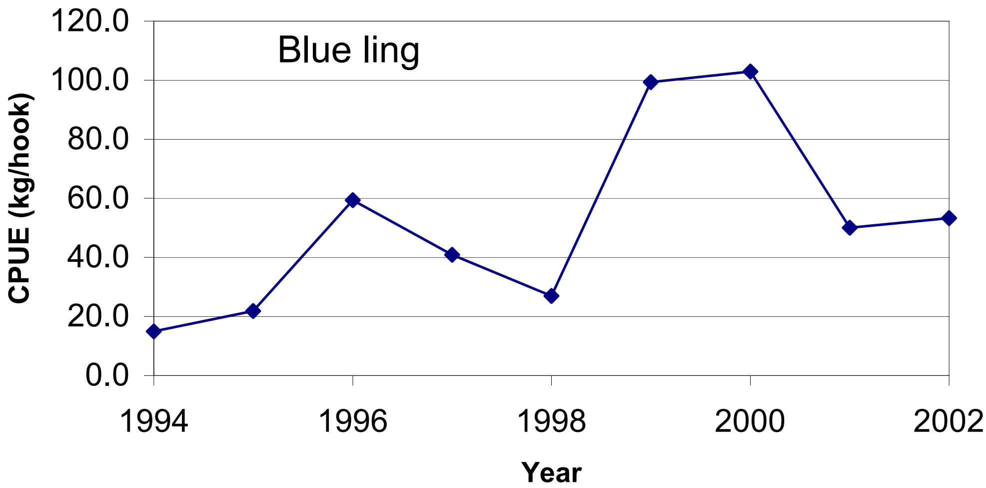


Figure 10.5 Blue ling catch per unit of effort calculated from the Icelandic long-line fishery.

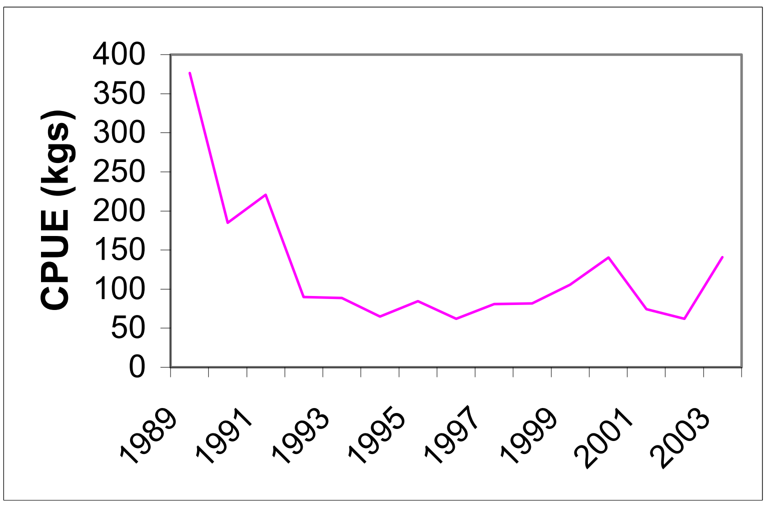


Figure 10.6 Blue ling in Vb,VI,VII - trend in French commercial trawl CPUE

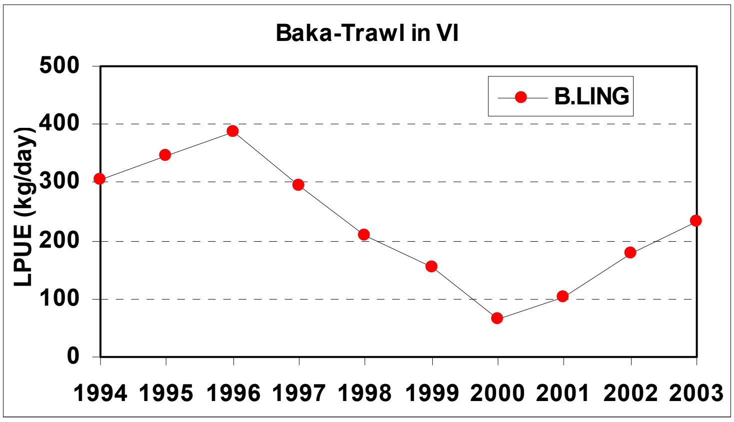


Figure 10.7 Blue ling in VI - trend in Spanish baka trawl CPUE

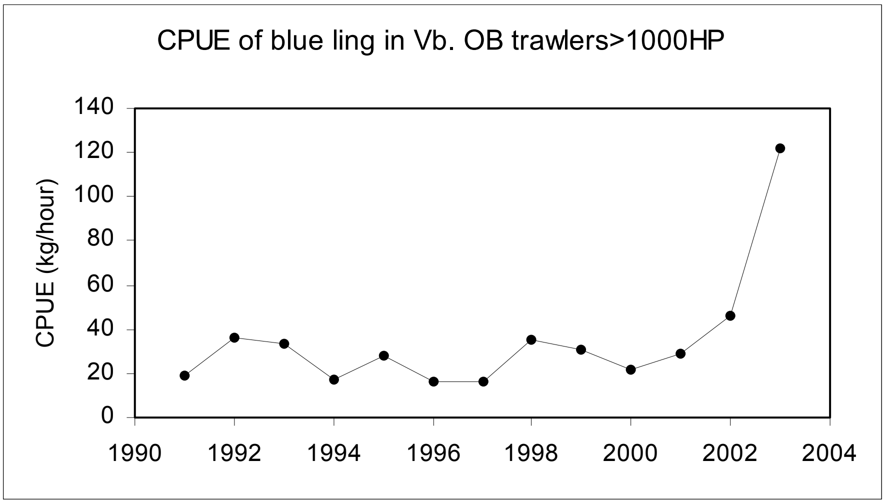


Figure 10.8 Blue ling in VI – trend in Faroese trawl CPUE.

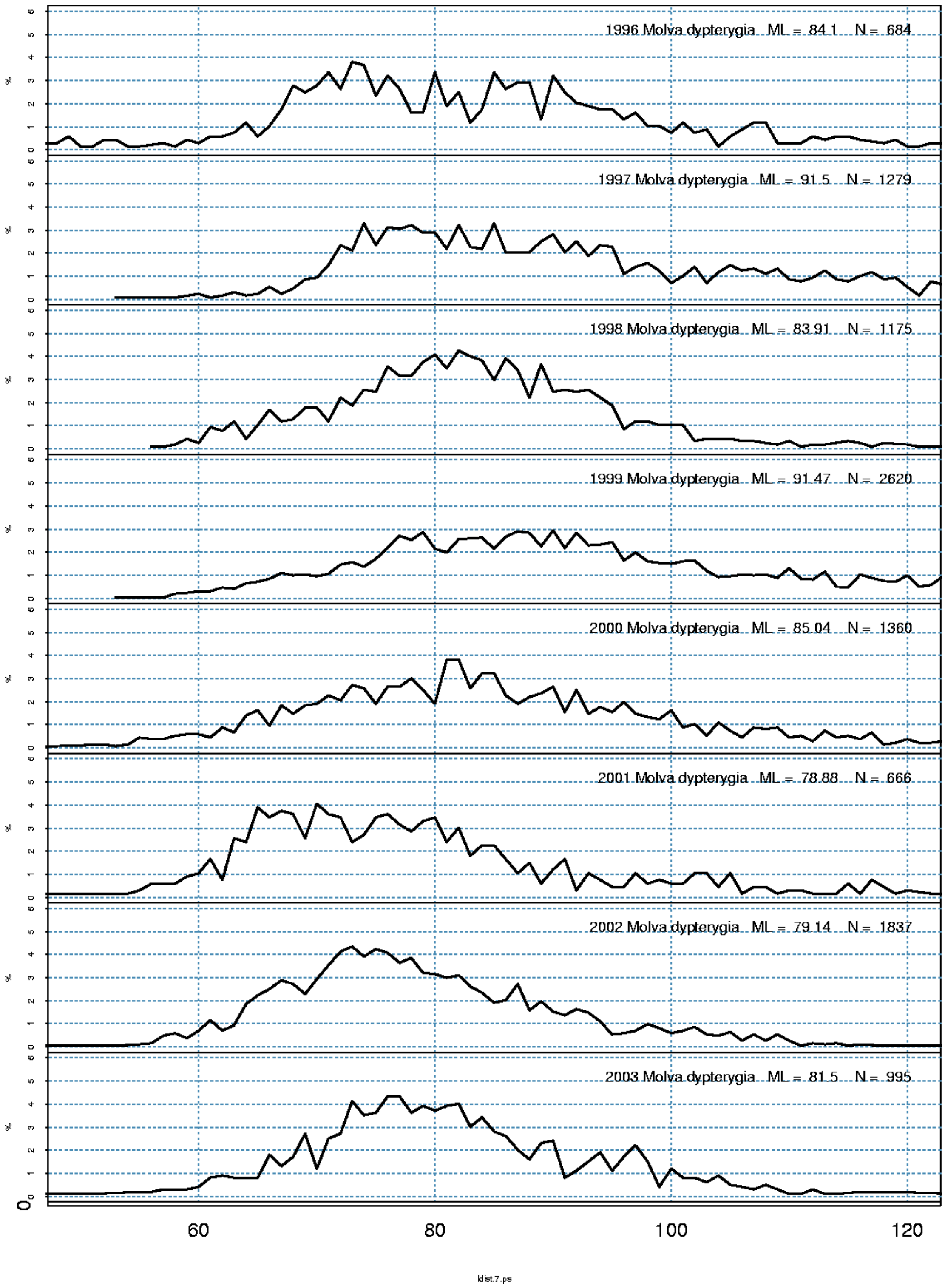


Figure 10.9 Length distribution of blue ling in the Icelandic commercial catches.

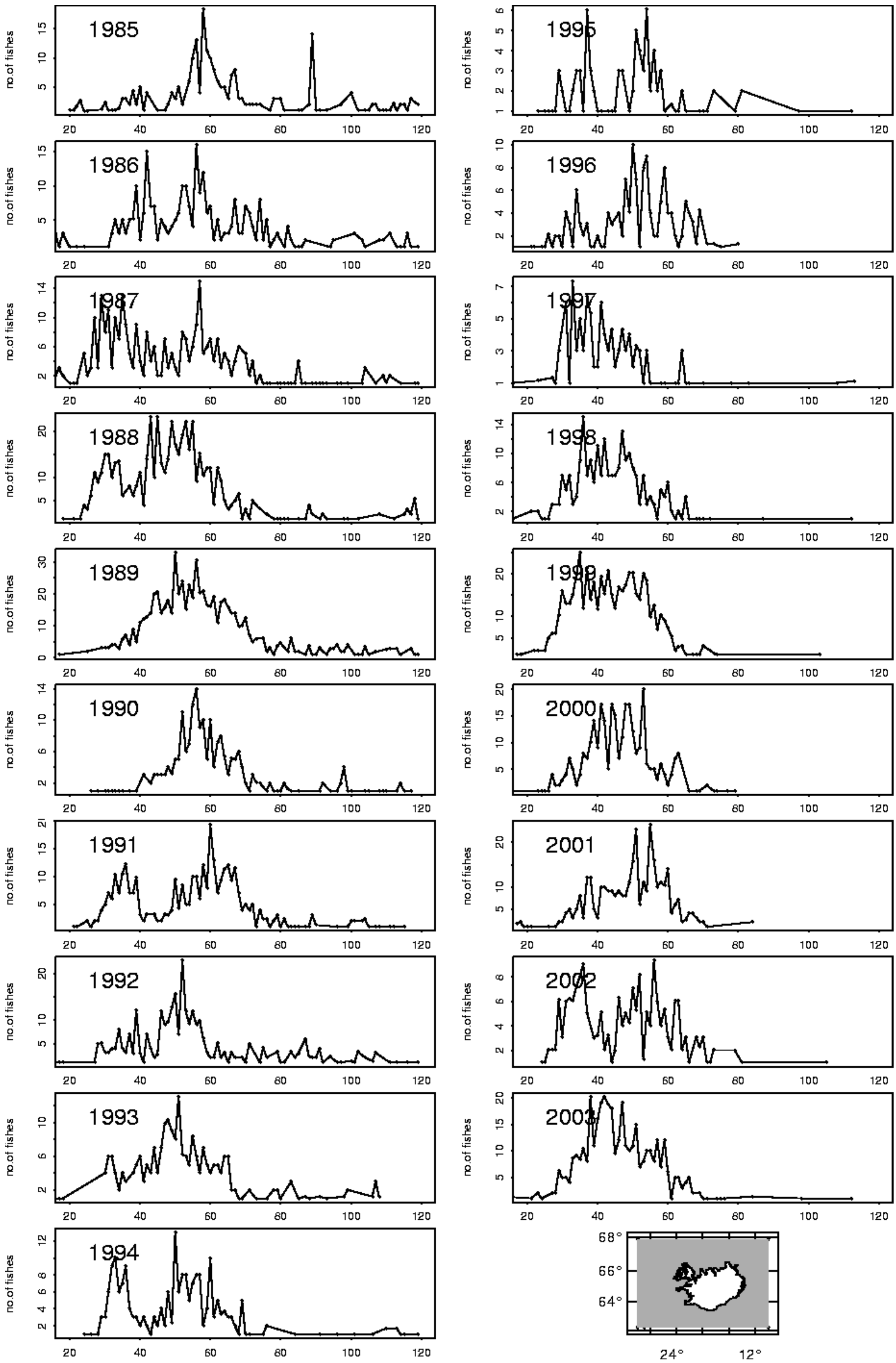


Figure 10.10 Blue ling length distributions in the Icelandic groundfish survey in March 1985-2003.

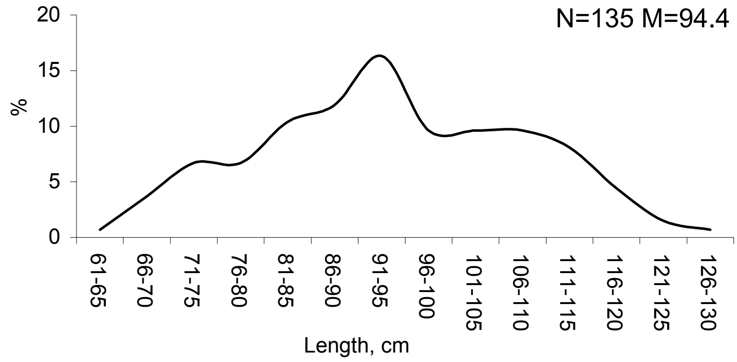


Figure 10.11 Length composition of blue ling in Russian catches in Div. VIb in March 2003

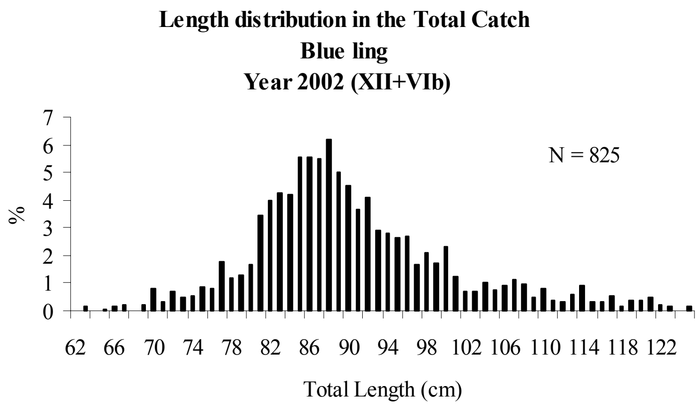


Figure 10.12 Length distribution of the total catch from Spanish trawlers fishing on Hatton Bank in 2002

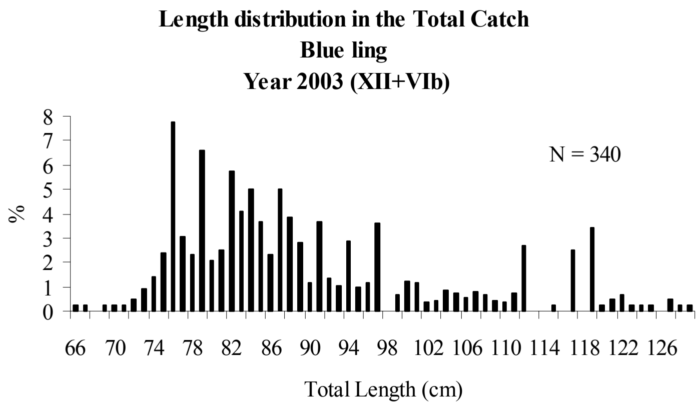


Figure 10.13 Length distribution of the total catch from Spanish trawlers fishing on Hatton Bank in 2003

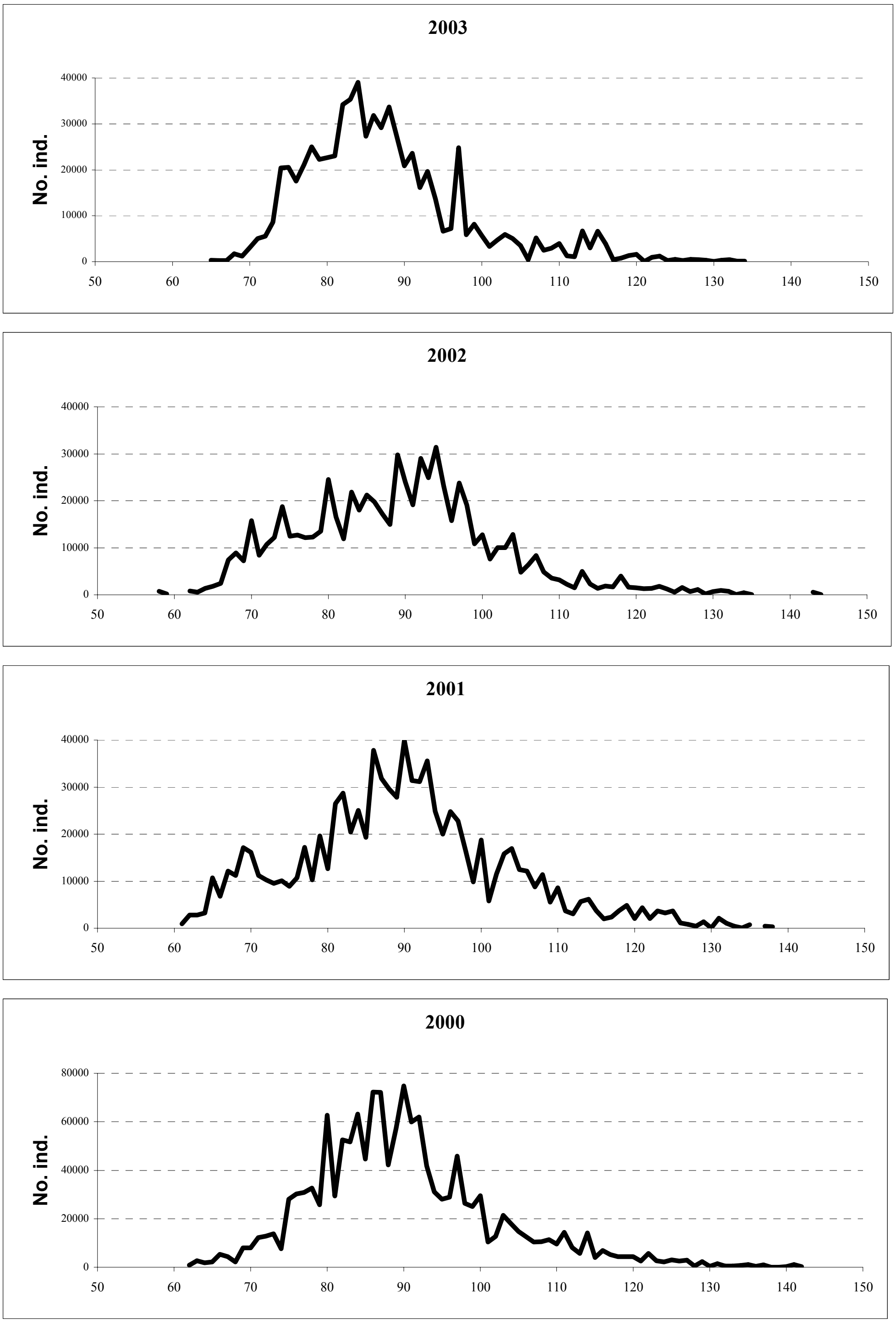


Figure 10.14 Length composition of French trawl landings from Subarea VI.

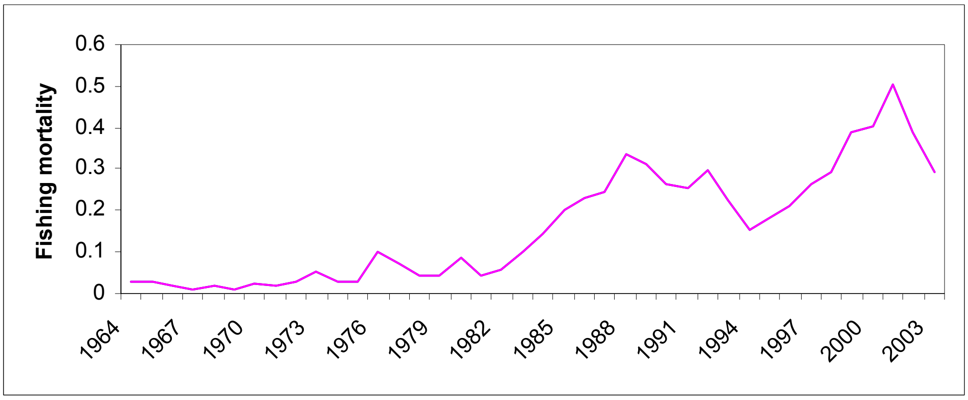


Figure 10.15 Trend with time in fishing mortality – blue ling in Vb,VI,VII (Stock reduction model –French trawl CPUE)

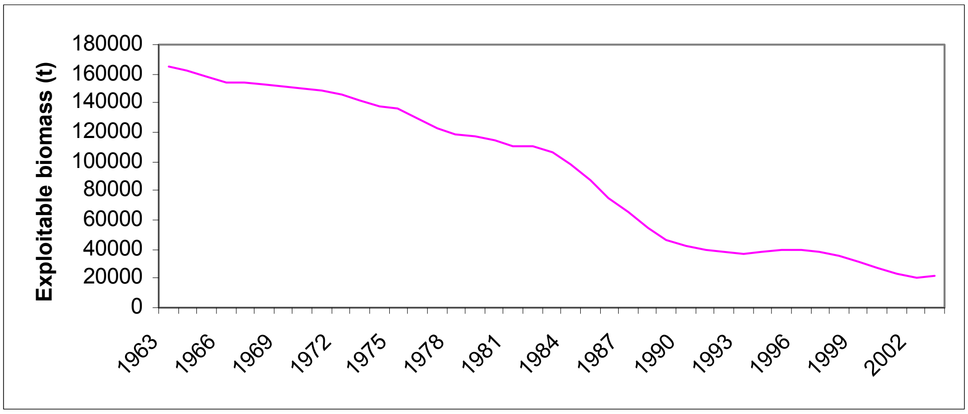


Figure 10.16 Trend with time in exploitable biomass – blue ling in Vb,VI,VII (Stock reduction model – French trawl CPUE)

11 TUSK (BROSME BROSME)

11.1 Catch Trends

The landings of tusk are given in Table 11.1.

In Division IIa the landings increased in 1998 and 1999 after a period with a decreasing trend from 1989 onwards. There has subsequently been a decline to 11,355 t in 2002, and to 7254 t in 2003. The preliminary 2003 landing is the lowest in the series. There was also a decline in Subarea I. The landings are almost entirely Norwegian, and usually around 85% is taken by longlines, 10% by gillnets and the remainder by a variety of other gears.

In Division IVa the landings have been stable around 3,000 t since 1994 but lower than the 4,000–6,500 t in 1988–1993. In 2003 the preliminary figure was only 1965 t. The bulk of the landings come from Norwegian fisheries, and around 90% of the landings are taken by longlines. The remainder of the landings from this area, and also the southern and central North Sea and Division IIIa, come from various trawl fisheries.

In Va and Vb landings increased in the period 1989–1991 but decreased again in 1994–1998. The Va landing for 1999 showed an increase, but then a significant reduction until 2001. The total landings in 2002 and 2003 has stabilized around 5000 tonnes, due to TAC restrictions and closure of juvenile areas. There is no obvious trend in recent landings from Vb, but the level is lower than in the late 1980s-early 1990s. Most of the landings from Va (about 95%) and Vb come from longlines, but only partly from aimed fisheries. Norwegian landings are from fisheries primarily targeting ling.

As reported previously, longline fisheries where tusk is an important target amongst other species has developed on the Hatton Bank (VIb and XII) (WD by Fossen, 2004), but the overall landings from Subarea VI and XII seem rather to decline than increase.

11.2 Stocks

No new information on stock structure was presented. In the 1998 report it was noted that ripening adult tusk and tusk eggs have been found in all parts of the distribution area, but the banks to the west and north of Scotland, around the Faroes and off Iceland, as well as the shelf edge along mid and north Norway seem to be the most important spawning areas (Magnússon *et al.* 1997). Nothing is known about migrations within the area of distribution. Studies of enzyme and haemoglobin frequencies showed no geographical structure, hence it was concluded that tusk in all areas, at least of the Northeast Atlantic, belong to the same gene pool (Bergstad and Hareide, 1996). Widely separated fishing grounds may support separate management units, i.e., stocks. It is suggested that Iceland (Va) and the Norwegian coast (I and II) have self-contained units, while the separation among possibly several stocks to the north and west of the British Isles remains unclear.

Tusk 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.

11.3 Catch And Effort Data

Catch per unit of effort data from Norwegian longliners were presented to the Study Group in 1996 and were further described in Bergstad and Hareide (1996). This series was not extended beyond 1994. A corresponding time-series extended to 1996 based on official statistics for ling and tusk combined was presented in the 1998 report (ICES C.M. 1998/ACFM:12) but this series has not been extended. Tusk is usually not a target species for the longliners, rather a by-catch in the ling fishery.

The Norwegian reference fleet (described in Ch 9 and WD by Helle and Pennington 2004) is providing data for the species-specific weight of the catch, and number of hooks used per day. Table 11.2 contains estimates of catch-per-unit of effort (CPUE) for the limited time-period available. The measure of CPUE presented is the average weight (kg) of fish caught per 1000 hooks per day. The standard error (*se*) could only be estimated if 2 or more vessels collected samples in a particular area.

A series of effort and CPUE from Icelandic longliners in Division Va is given in Table 11.3, and an index of abundance from the Icelandic groundfish survey from the period 1985-2003 is shown in Figure 11.1. The groundfish survey index does however mostly cover the juvenile part of the stock as the survey is restricted to the fishing grounds down to about 500 m depth.

Commercial CPUE data for Division Vb were available from Faroese trawlers and longliners for the period 1986-2003 (Figure 11.2).

CPUE of the Basque trawlers fishing in Subarea VI was presented (Figure 11.3) (WD by Lucio *et al*., 2004).

Data on catch and corresponding effort for the Danish fleet taking tusk in IVa and IIIa are available for the period 1992-2003 from logbooks (Table 11.4). It appears that there is a downwards trend for the entire period, but not for the most recent years. Tusk is a by-catch and the catches are small, hence one should be cautious using these CPUE alone as indicators for the stock in this area.

Catch and effort data from a Norwegian exploratory and subsequently commercial longline fishery on the western slope of the Hatton Bank (VIb) was presented in a WD by Fossen (2004). Effort declined in 2002 to 33% of that in 2002.

11.4 Length Distribution, Age Composition, Mean Weight-at-age, Maturity

Length composition data from Russian longliners in I, IIa and b were presented (Figure 11.4 & 5), and further data were available in a WD by Vinnichenko and Khlivnoy (2004).

Data available from earlier years from different Divisions were indicated in Tables 8.3.1–8.3.6 of the 1996 report (ICES C.M. 1996/ Assess:8). An overview of available Norwegian samples were given in Bergstad and Hareide (1996). Very little data were, however, presented since 1997.

Norway started a program in 2000 to collect data and biological samples directly from selected commercial long-liners, the so-called “reference fleet.” In 2000 only a limited number of fish were measured and only one vessel provided data. In 2001 two vessels participated but due to problems with the electronic measuring board, the sampling was limited. In 2002 and 2003 the sampling scheme has been adjusted to achieve the most effective sampling program (Helle *et al*., 2003) and the sampling was conducted as planned. Three long liners participate in the reference fleet in 2004.

Estimates of mean length of tusk are given in Table 11.5. In column 4 are estimates of the standard error (*se*). The *se* could only be estimated if 2 or more vessels collected samples in a particular area.

Length compositions from Icelandic landings in Va for the period 1995-2003 are shown in Figure 11.6. Length data from the Icelandinc groundfish surveys 1985-2001 are shown in Figure 11.7.

11.5 Biological Parameters

No new information on biological parameters was presented. As noted in the 1998 report (ICES C.M. 1998/ACFM:12), considerable information on growth, maturity etc. from many parts of the distribution area were presented in reports from Nordic projects in 1994-1997, i.e., Bergstad and Hareide (1996), Magnússon *et al.* (1997a) and Bergstad *et al.* (1998). The following text table is a compilation of available data, extracted from the report of WGDEEP in 2001 (ICES C.M. 2001/ACFM: 23):

Variable	**Value**	**Source/comment**
Longevity (years)	Approx. 20	Bergstad and Hareide 1996, Magnusson *et al.* 1997
Growth rate, K	No data	Growth curves available in Bergstad and Hareide 1996.
Natural mortality, M	0.1-0.2	Based on review by SGDEEP 2000.
Fecundity (absolute)	millions	No exact data available.
Length at first maturity	40-45 cm	Magnusson *et al.* 1997
Age at first maturity	8-10 years	Magnusson *et al.* 1997

Russia reported from an experimental longline fishery in IIa and b in 1999 (Working document by Vinnichenko, 2000), and biological data from previous investigations off Rockall (Working document by Vinnichenko, 2000 referring to article by Zaferman and Shaestopal, 1996). Some new data were also presented in 2002 (WD by Vinnichenko *et al.* 2002). Available data for 2003 were presented in a WD by Vinnichenko and Khlivnoy (2004).

11.6 Assessment, CPUE Analyses And Mortality Estimates

The CPUE for the Icelandic longliners in Division Va in 2001 was the lowest on record, and had declined since 1997. The CPUE has increased slightly in 2002-2003, but is still only about 60% of the 1997 level. The abundance index derived from the groundfish survey in Va has shown an almost uninterrupted declining trend since 1985, and since 1995 it has only be about 35% of the level observed at the beginning of the series. Both the CPUE serie and the survey index thus suggest significantly declining abundance. Recruitment indices, however, inicate that recruitment to the fishable stock might increase in the near future and this recruitement has also been observed in the fishery in most recent years. During the 2000 meeting of the SGDEEP, an assessment of tusk was attempted for this Division Vb using a modified DeLury constant recruitment model and a Schaefer surplus production model. There was no insufficient information to carry out similar analysis with data from 2000 and 2001 included.

In Vb the CPUE from trawlers and longliners showed a decreasing trend to a lower level until 1996-1997, but recently there is an apparent increase. It is uncertain if the recent increase reflects changes in abundance or fishery.

The Norwegian CPUE series from the longliners of the reference fleet was too short to be used for assessments, but may prove useful in the future. New efforts were initiated in 2001 to process logbook information for all longline vessels fishing ling and tusk, but the data were not available to the meeting.

The Spanish (Basque) CPUE series is very variable and was not considered useful for assessing abundance trends.

No new data were provided which could be used to update mortality estimates presented previously.

11.7 Comments On Assessment

It is not possible to make age-based assessments for tusk due to lack of good time-series of age-structured data. The group noticed that material to run such analysis in Va have been collected, but otoliths have not been read yet. The group encouraged efforts to work up the material needed to make such analyses.

It is a serious problem that the effort series from the Norwegian longline fishery could not be extended beyond 1996. The Working Group is of the opinion that further improvement in the recording of effort and catch data should be encouraged, since CPUE may be used as an index of abundance and as the basis of production analyses. Such analyses were attempted for Division Vb tusk by SGDEEP in 2000, but could not be conducted in 2002.

11.8 Management Considerations

The state of the stocks in all areas remains uncertain.

There was unsufficient information to update this evaluation presented by SGDEEP in 2000 (ICES CM 2000/ACFM:23) except for Division Va. In that area there appear to be a decline in the CPUE indices from both surveys and the commercial longliners, and based on the survey data, a rather strong decrease in abundance (to 35% of the level in the mid 1980s) is suggested. Action have been taken to prevent the juveniles in Division Va by closing areas of the south and southeast coast of Iceland. The working group welcomes such actions and recommends that juvenile areas should be closed to fishery in order to rebuild the adult stock.

Management actions in place are: In Va juvenile areas have been closed, and there is a TAC management. There is a licencing scheme and effort limitation in Vb. In EU waters the TAC for the EU fleet is 1155 tonnes per year for 2003 and 2004. Norway, who also has a licencing scheme, could in 2003 fish 5000 tonnes in EU waters, and also has bilaterally agreed quotas in Va and Vb. The effort in the NEAFC regulatory area has been frozen for 2003 and 2004.

Table 11.1. Tusk (*Brosme brosme*). Study Group estimates of landings (tonnes)

TUSK I

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*	570	5			5	**580**

TUSK IIa

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		8,642	2	+			**8,667**
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		15	+		11200	1	3	66	5	**11290**
2002		3			11303	1	4	39	5	**11355**
2003*		2			7228		3	21		**7254**

(1)Includes IIb.

Table 11.1 (Cont'd)
TUSK IIb

Year	Norway	E & W	Russia	**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*	42			**42**

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**

Table 11.1 (Cont'd)

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		26	8	2443	1	11		343	1	**3091**
2002	199		21		2438	1	8		294		**2961**
2003*	217		16	6	1531		4		191		**1965**

[1] Includes IVb 1988-1993

TUSK IVb

Year	Denmark	France	Norway	Germany	E & W	Scotland	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	134[1]	-	21	4	3	1	**163**
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**

[1] Includes IVc

Table 11.1 (Cont'd)

TUSK Va

Year	Faroes	Germany	Iceland	Norway	Scotland	E&W	**Total**
1988	3,757	-	3,078	20			**6,855**
1989	3,908	-	3,143	10			**7,061**
1990	2,475	-	4,816	-			**7,291**
1991	2,286	-	6,446	-			**8,732**
1992	1,567	-	6,442	-			**8,009**
1993	1,329	-	4,746	-			**6,075**
1994	1,212	-	4,612	-			**5,824**
1995	979	1	5,245	-			**6,225**
1996	872	1	5,226	3			**6,102**
1997	575		4,819				**5,394**
1998	1,052	1	4,118	0			**5,171**
1999	1,075	2	5,795	391	1		**7,264**
2000	1,302	+	4,714	374	+	1	**6,391**
2001	1133	1	3407	285	+	5	**4831**
2002	1342		3935	372	1	1	**5651**
2003*	969	1	4057	375	1	1	**5404**

*Preliminary

TUSK Vb1

Year	Denmark	Faroes[4]	France	Germany	Norway	E & W	Scotland [1]	**Total**
1988	+	2,827	81	8	1,143	-		**4,059**
1989	-	1,828	64	2	1,828	-		**3,722**
1990	-	3,065	66	26	2,045	-		**5,202**
1991	-	3,829	19	1	1,321	-		**5,170**
1992	-	2,796	11	2	1,590	-		**4,399**
1993	-	1,647	9	2	1,202	2		**2,862**
1994	-	2,649	8	1 [2]	747	2		**3,407**
1995		3,059	16	1 [2]	270	1		**3,347**
1996		1,636	8	1	1,083			**2,728**
1997		1,849	11	+	869		13	**2,742**
1998		1,272	20	-	753	1	27	**2,073**
1999		1956	27	1	1522		11[3]	**3517**
2000		1150	13	1	1191	1	11[3]	**2367**
2001		1810	14	1	1572	1	20	**3418**
2002		869	10		1642	1	36	**2558**
2003*		1076			1504	1	17	**2598**

[1]Included in Vb_2 until 1996. [2])Includes Vb_2. [3]Reported as Vb.[4] 2000-2003 Vb1 and Vb2 combined

Table 11.1 (Cont'd)

TUSK Vb2

Year	Faroe	Norway	E & W	Scotland [1]	**Total**
1988	545	1,061	-	+	**1,606**
1989	163	1,237	-	+	**1,400**
1990	128	851	-	+	**979**
1991	375	721	-	+	**1,096**
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**

[1]Includes Vb1. [2]See Vb_1. [3]Included in Vb_1.

TUSK VIa

Year	Denmark	Faroes	France [1]	Germany	Ireland	Norway	E & W	N.I.	Scot.	Spain[2]	**Total**
1988	-	-	766	1	-	1,310	30	-	13		**2,120**
1989	+	6	694	3	2	1,583	3	-	6		**2,297**
1990	-	9	723	+	-	1,506	7	+	11		**2,256**
1991	-	5	514	+	-	998	9	+	17		**1,543**
1992	-	-	532	+	-	1,124	5	-	21		**1,682**
1993	-	-	400	4	3	783	2	+	31		**1,223**
1994	+		345	6	1	865	5	-	40		**1,262**
1995		0	332	+	33	990	1		79		**1,435**
1996		0	368	1	5	890	1		126		**1,391**
1997		0	359	+	3	750	1		137	11	**1,261**
1998			395	+		715	-		163	8	**1,281**
1999			193	+	3	113	1		182	47	**539**
2000			238	+	20	1327	8		231	158	**1982**
2001			173	+	31	1201	8		279	37	**1729**
2002			113		8	636	5		274	64	**1100**
2003*			87		4	905	3		104	13	**1116**

[1] Not allocated by divisions before 1993. [2]Includes Vib.

Table 11.1 (Cont'd)

TUSK VIb

Year	Faroes	France	Germany	Ireland	Iceland	Norway	E & W	N.I.	Scot.	Russia	**Total**
1988	217		-	-		601	8	-	34		**860**
1989	41	1	-	-		1,537	2	-	12		**1,593**
1990	6	3	-	-		738	2	+	19		**768**
1991	-	7	+	5		1,068	3	-	25		**1,108**
1992	63	2	+	5		763	3	1	30		**867**
1993	12	3	+	32		899	3	+	54		**1,003**
1994	70	1	+	30		1,673	6	-	66		**1,846**
1995	79	1	+	33		1,415	1		35		**1,564**
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	**2,344**
2001		1		31		476	10		157	6	**681**
2002	n/a	9		3		515	8		88		**623**
2003*		7		18		452	11		72	1	**561**

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*		-	-	-

Table 11.1 (Cont'd)

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	3	54	177	4		25	**263**
2002	1	31	30	1		3	**66**
2003*	1	19		1			**21**

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	1	1	-	-		+	6	**8**
2000	3		5	-	-	+	6	**14**
2001	3		-	9	-	+	2	**14**
2002	1				1		3	**5**
2003*	1		1					**2**

Table 11.1 (Cont'd)

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*	-	-	-

TUSK XII

Year	Faroes	France	Iceland	Norway	Scotland	**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**

Table 11.1 (Cont'd)

TUSK XIVa

Year	Germany	Norway	**Total**
1988	2		**2**
1989	1		**1**
1990	2		**2**
1991	2		**2**
1992	+		+
1993	+		+
1994	-		+
1995	-		+
1996			+
1997		-	+
1998		-	+
1999		+	+
2000		-	**-**
2001		0	**0**
2002	-	-	-
2003*	-	-	-

TUSK XIVb

Year	Faroes	Iceland	Norway	E & W	**Total**
1988			-	-	
1989	19	3	-	-	**22**
1990	13	10	7	-	**30**
1991	-	64	68	1	**133**
1992	-	82	120	+	**202**
1993	-	27	53	+	**80**
1994	-	9	16	+	**25**
1995	-	57	30	+	**87**
1996	-	139	142		**281**
1997	-	10	108		**118**
1998	1	-	14		**15**
1999	-	n.a.	9		**9**
2000			11		**11**
2001			69		**69**
2002	n/a	28	30		**58**
2003*			87		**87**

Table 11.1 (Cont'd)

Tusk, total landings by Subareas or Division

Year	**I**	**IIa**	**IIb**	**III**	**IVa**	**IVb**	**Va**	**Vb1**	**Vb2**	**VIa**	**VIb**	**VIIa**	**VIIb,c**	**VIIg-k**	**VIIIa**	**XII**	**XIVa**	**XIVb**	**All areas**
1988		14403	0	61	4429	0	6855	4059	1606	2120	860		17	5	1	1	2	0	**34419**
1989		19350	0	93	6418	4	7061	3722	1400	2297	1593	2	108	86		1	1	22	**42158**
1990		18628	0	60	4254	5	7291	5202	979	2256	768	4	155	33		0	2	30	**39667**
1991		18306	0	84	4537	2	8732	5170	1096	1543	1108	2	52	14		1	2	133	**40782**
1992		15974	0	85	4932	12	8009	4399	992	1682	867	3	218	47		1		202	**37423**
1993		17584	1	79	5141	14	6075	2862	577	1223	1003		120	32		12		80	**34803**
1994		12566	0	51	3375	7	5824	3407	909	1262	1846		94	31		1		25	**29398**
1995		11388	229	42	3348	15	6225	3347	631	1435	1564	1	48	37		18		87	**28415**
1996	587	12047	161	44	3369	163	6102	2728	582	1391	939		58	29		158		281	**28639**
1997	665	8667	94	31	2272	38	5394	2742	577	1261	476	1	75	19		30		118	**22460**
1998	805	14475	73	21	3387	66	5171	2073	637	1281	915	1	33	10	1	1		15	**28965**
1999	907	16250	26	29	2435	34	7264	3517	447	539	953		147	8	0	1		9	**32566**
2000	798	13192	18	36	3259	116	6391	2367	333	1982	2344		164	14		5		11	**31030**
2001	614	11290	146	57	3091	56	4831	3418	469	1729	681	1	263	14		52		69	**26781**
2002	799	11355	37	50	2961	71	5651	2558	281	1100	623		66	5		27		58	**25642**
2003*	580	7254	42	51	1965	8	5404	2598	559	1116	561		21	2		83		87	**20331**

Table 11.2 Norwegian longliners of the "reference fleet". Estimated mean CPUE ([kg/hook]x1000), standard error (*se*) and number sample days for tusk. A dash denotes that only one vessel took samples in a particular area.

TUSK

Area	Year	CPUE ([kg/hook]x1000)	*se*(CPUE)	n
I	2002	2.1	-	43
I	2003	1.5	0.5	80
IIA	2001	22.1	-	46
IIA	2002	41.4	5.2	208
IIA	2003	34.9	11.4	299
IIB	2003	7.8	-	4
IVA	2003	69.3	27.6	43
VB	2003	50.1	23.6	15
VIA	2003	12.9	6.3	48
VIB	2002	36.7	-	29
VIB	2003	30.2	10.5	64
XII	2003	4.9	-	9

Table 11.3 Effort and cpue in tusk, as calculated from the Icelandic long-line logbook data.

	Effort - No of hooks (*10000)	CPUE (g/hook)
1994	7020	45.7
1995	8487	43.0
1996	8130	51.8
1997	5221	74.0
1998	4884	55.2
1999	8176	58.3
2000	9489	40.1
2001	9431	31.6
2002	9219	41.1
2003	7303	42.9

Table 11.4 Tusk. Catch per unit effort of Danish trawlers in Subareas IVa and IIIa.

DENMARK: Log-book recorded catch and effort **Species:** **Tusk** **ICES area:** **IV**

Year	Mesh size in Trawl: >100 mm			70 - 100mm			30 - 45 mm			< 25 mm			All trawls
	Kg	days	CPUE	Kg	days	CPUE	Kg	days	CPUE	Kg	days	CPUE	CPUE
1992	14404	103	139,8	64145	452	141,9	887	20	44,4	39305	334	117,7	**130,6**
1993	2105	12	175,4	47011	330	142,5	2662	49	54,3	10920	148	73,8	**116,3**
1994	200	1	200,0	39169	330	118,7	1080	14	77,1	7220	76	95,0	**113,2**
1995	1490	8	186,3	51129	507	100,8	100	1	100,0	320	8	40,0	**101,2**
1996	90	2	45,0	106118	1171	90,6	1115	17	65,6	465	6	77,5	**90,1**
1997	4530	47	96,4	106343	1130	94,1	110	4	27,5	200	3	66,7	**93,9**
1998	3930	51	77,1	60265	654	92,1	1705	30	56,8	430	10	43,0	**89,0**
1999	7615	86	88,5	111175	1290	86,2	1135	17	66,8	450	6	75,0	**86,0**
2000	6385	75	85,1	144620	1453	99,5	680	15	45,3				**98,3**
2001	28343	224	126,5	163754	1849	88,6	880	24	36,7	600	18	33,3	**91,5**
2002	147035	1749	84,1	3989	55	72,5	680	15	45,3	1315	11	119,5	83,6
2003	**172245**	**1933**	**89,1**	**2660**	**36**	**73,9**	**60**	**2**	**30,0**	**575**	**15**	**38,3**	**88,4**

Table 11.5 Estimated mean length (cm), standard error (*se*), and the number of fish measured of tusk. A dash denotes that only one vessel took samples in a particular area.

TUSK

Area	Year	length	*se*	n
I	2002	51.0	-	193
I	2003	56.6	0.5	365
IIA	2001	52.7	3.9	4145
IIA	2002	53.1	0.4	13183
IIA	2003	51.1	1.5	13321
IIB	2003	55.0	-	50
IVA	2003	47.3	-	2465
VB	2002	65.4	-	392
VB	2003	54.0	-	559
VIA	2003	54.2	2.1	938
VIB	2002	61.4	-	2365
VIB	2003	58.0	3.1	2484
XII	2003	81.0	-	4

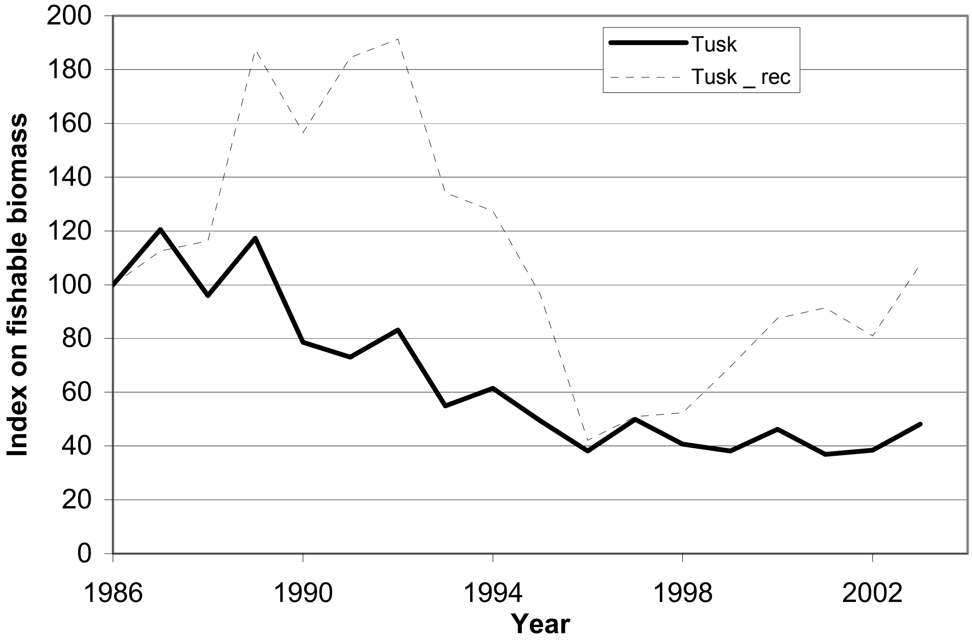


Figure 11.1 Tusk. Index on fishable biomass (>40 cm) and recruitment (25-40 cm) calculated form the Icelandic ground fish survey at the Icelandic shelf.

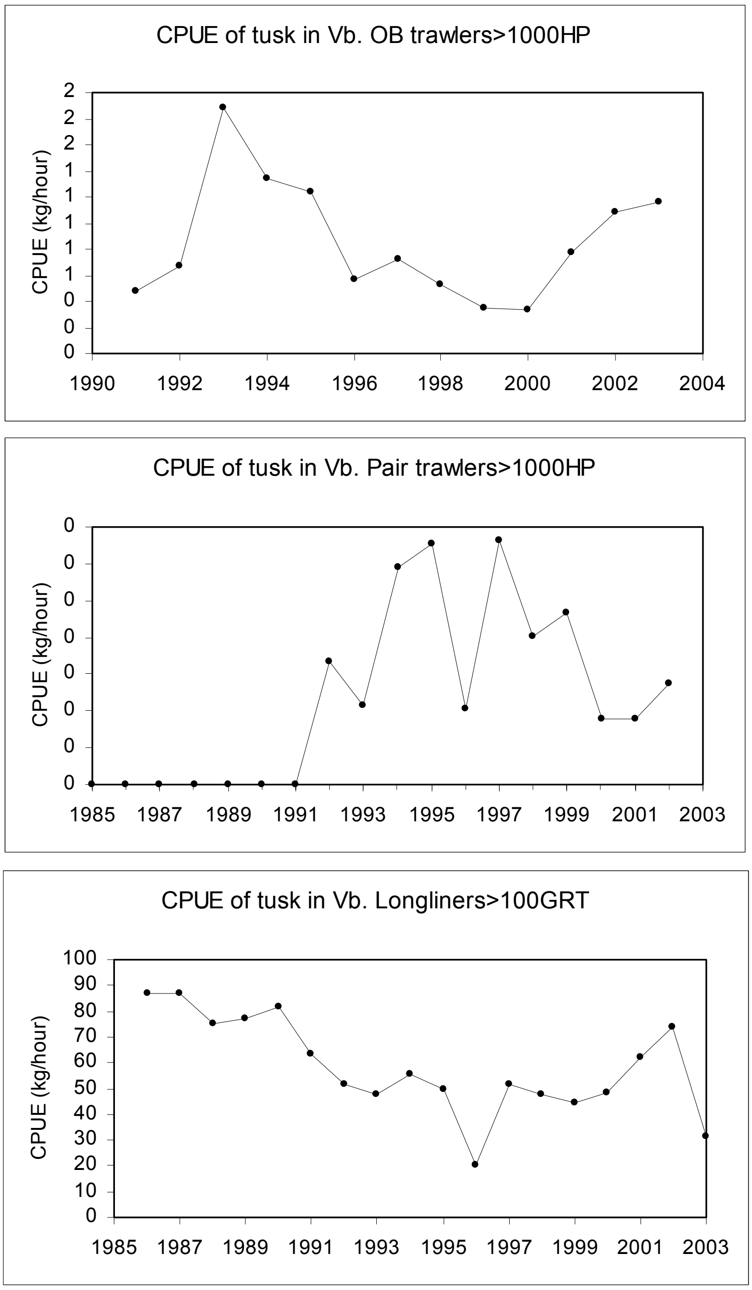


Figure 11.2 CPUE for Faroese fleets of trawlers and longliners fishing in Vb.

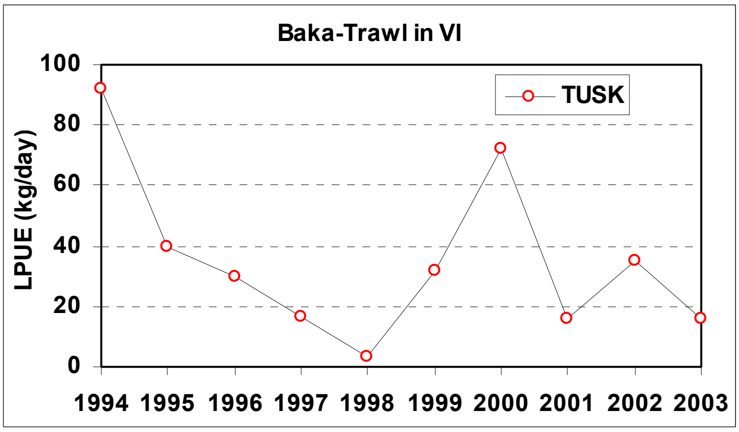


Figure 11.3 Landings per fishing effort of Tusk in ICES Subarea VI, of "Baka" trawlers of the Basque Country, in 1994-2003. (Data on 2003 are preliminary).

New values: LPUE = kg/(Nº trip*(mean fishing days/trip) = kg/day)

Old values: LPUE = t/Nº trip.

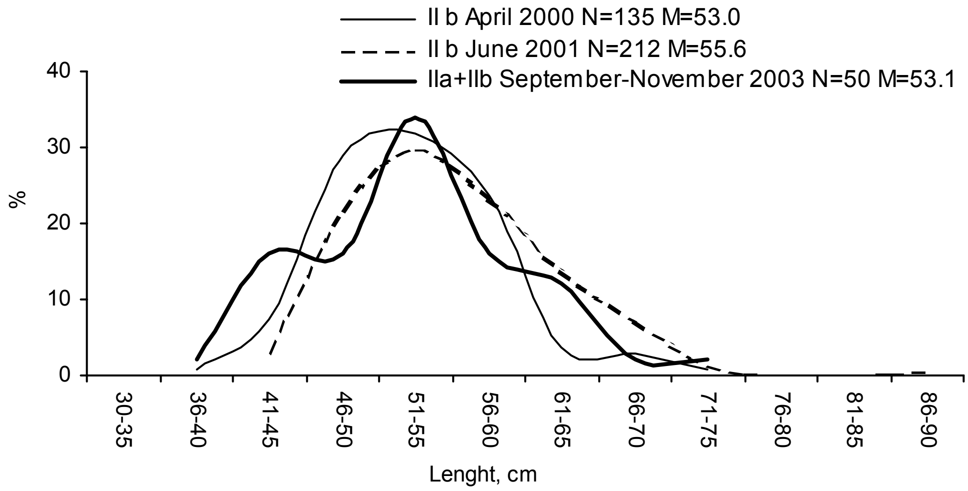


Figure 11.4 Length composition of tusk from catches by long-lines in Subarea II in 2000-2003.

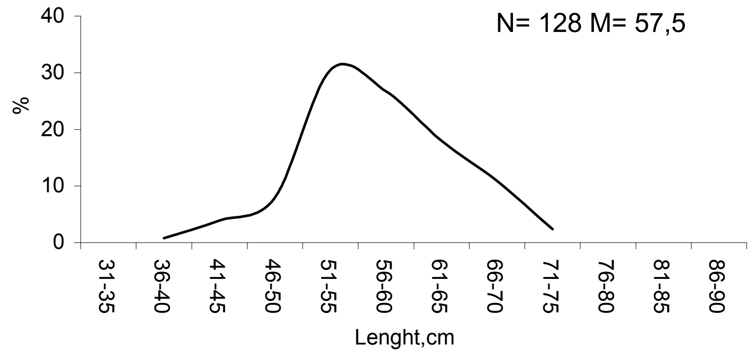


Figure 11.5 Length composition of tusk from catches by long-lines in the Barents Sea (Subarea I) in September-November 2003.

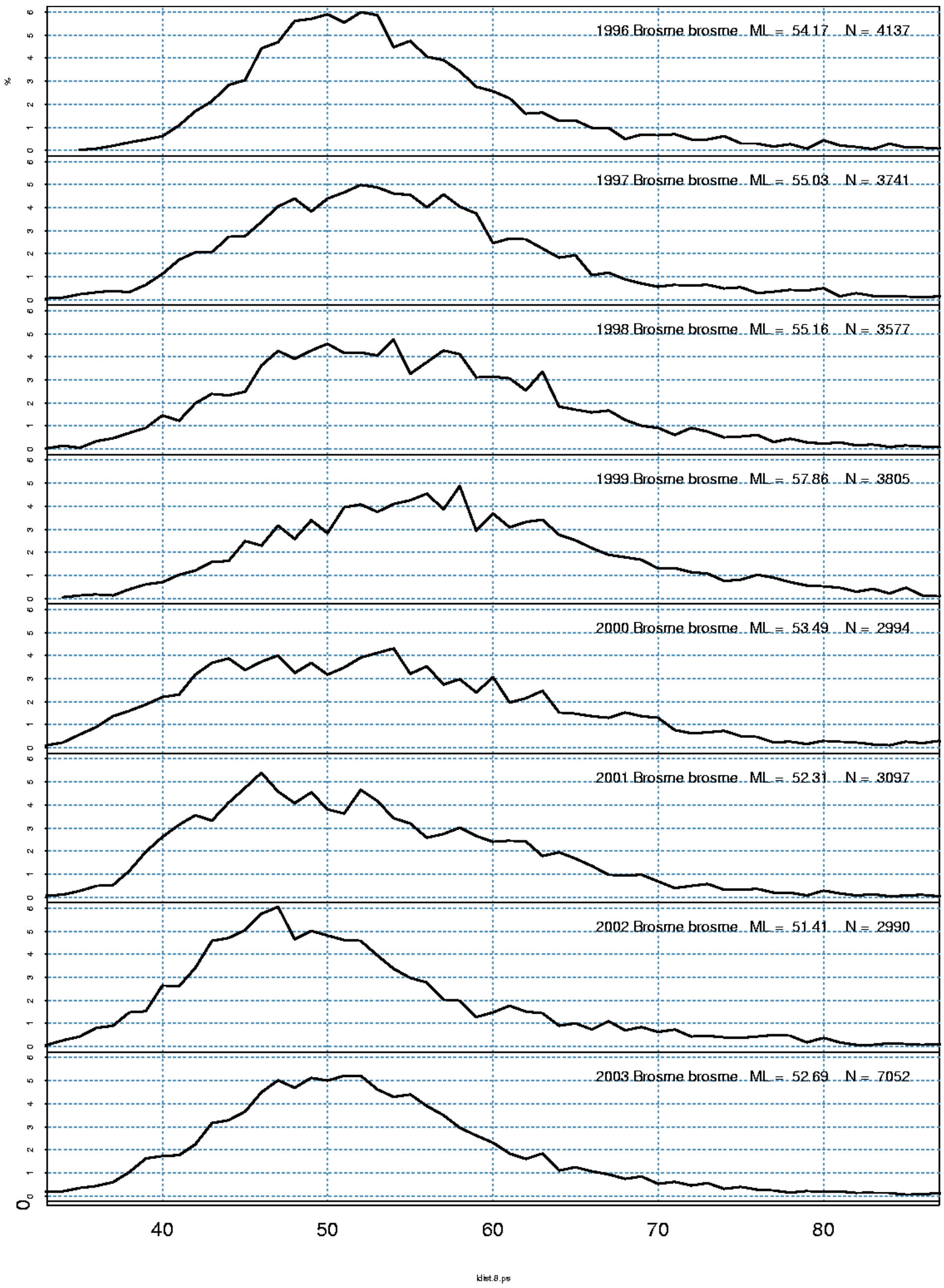


Figure 11.6 Length distribution of tusk in the Icelandic catches since 1995.

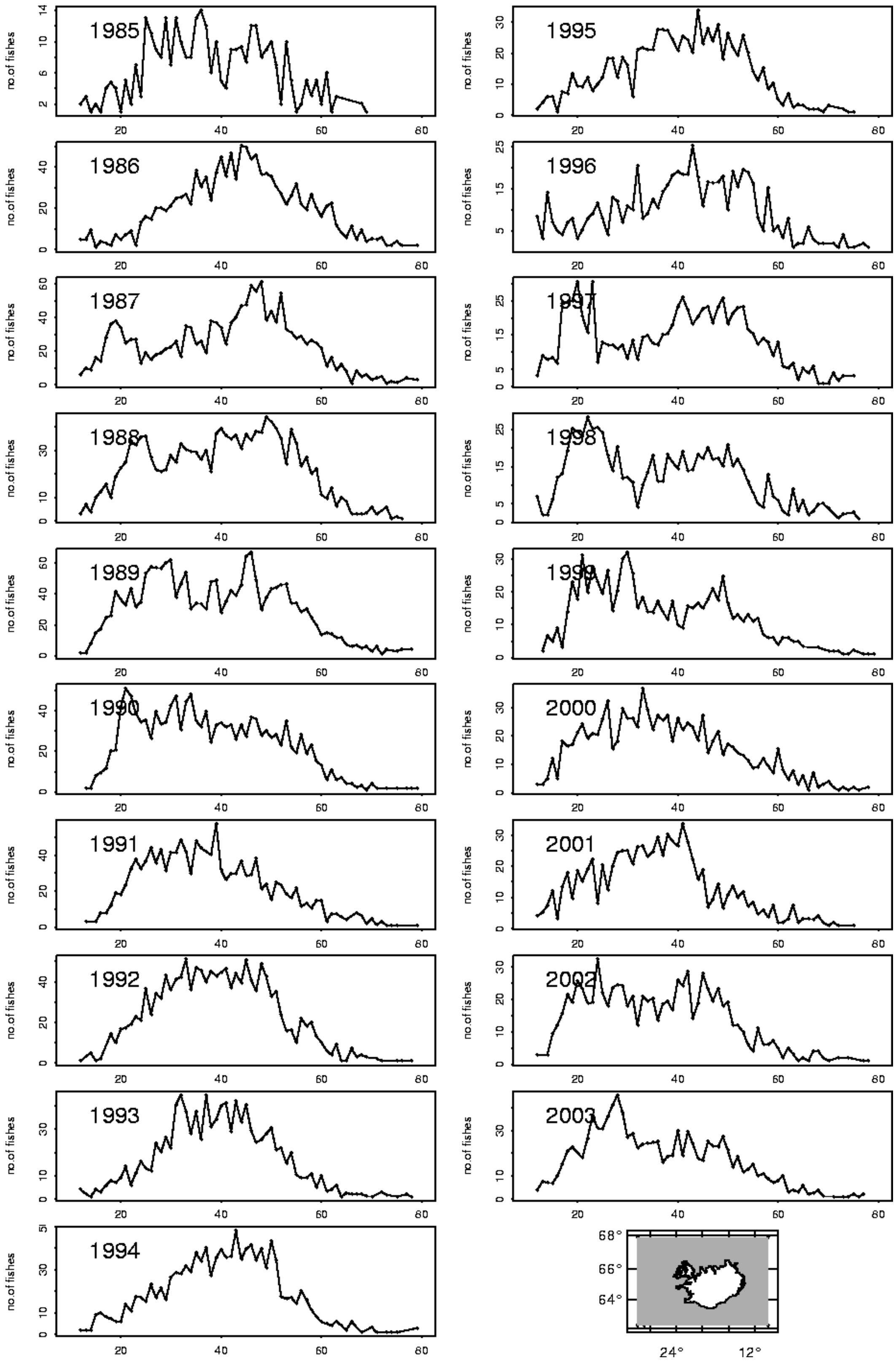


Figure 11.7 Tusk length distributions in the Icelandic groundfish survey in March 1985-2003.

12 GREATER SILVER SMELT (*ARGENTINA SILUS*)

12.1 Catch trends

Table 12.1 shows the landings data for greater silver smelt (or argentine) *Argentina silus* by ICES Subareas/Divisions. Juveniles of the dominant species *Argentina silus* and the much smaller and less abundant *Argentina sphyraena* may be difficult to separate in catches, and the latter species may in some cases have been included in the landing figures (particularly in Subareas III and IV).

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 are stable, but reached high levels in a few years (e.g. 2001 with 14 357 t). It is thought that these fluctuations reflect variation in the market demand rather than changes in abundance of *A. silus.*

Landings in Subareas III and IV are mainly by Denmark, Sweden and Norway. During the last 10 years a few Danish vessels have conducted fisheries targeting roundnose grenadier and greater silver smelt, mainly in the Skagerrak (ICES Subarea IIIA), and there is a by-catch in industrial small-mesh trawl fisheries. Landings have varied between 1 000 and almost 4 500 t. The Danish quota (part of EU TAC) for 2003 was 1 388 t, and the landing was 1 119 t. Sweden has reported annual landings of 200-1000 t in recent years, but no figure was available for 2003 when the quota was 54 t. The Norwegian landings decreased from about 1000-2000 t to very low levels in the mid 1990s and have remained at low levels, probably due to low marketability. The Norwegian by-catch in the industrial fishery for Norway pout and blue whiting, based on sampling at fish meal factories, is very variable and 926 t and 1376 t was estimated for 2002 and 2003, respectively. There is also an unknown by-catch of *A. silus* in the Danish, Norwegian and Swedish fishery for *Pandalus borealis*.

The landings of *A. silus* in Divisions Va increased considerably from 1996-1998 as a direct fishery for the species started. Since 1998 when the catches were 13 000 t the catches have decreased again down to only 2 700 t in 2003. The variations in the catches are largely due to market situations. The situation is very similar in Faroese waters (Vb).

The previously reported considerable decline in the landings of *A. silus* from Subareas VI and VII from a peak in the late 1980s to the mid 1990s has been reversed in recent years and reached an estimated 19 050 t in 2001. The preliminary landing figure for 2003 is only 2 280 t which is the lowest in the series. Until recent years the main catches of greater silver smelt were from Dutch freezer trawlers operating west and north-west of the Hebrides, from depths ranging from 600-700 m, and west of Ireland (Porcupine Bank) where smelt is a minor by-catch in the fishery directed at blue whiting (*Micromesistius poutassou*). 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 t 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 VI a (N). Landings reached over 4700 t in 2000 and an estimated around 7500 t in 2001 and 2002. Preliminary figures for 2003 shows a very low landing of only 95 t. Because of a restrictive quota there was no Irish directed fishery for greater silver smelt. The landing 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 EU introduced TAC management in 2003, and the Irish, Dutch, and UK quotas where 441, 4 971, and 349 t, respectively. All three countries landed substantially less silver smelt than these quotas, and at least in Scotland this was not due to lack of interest or market demand, but reflected apparent decline in abundance in traditional fishing areas.

The Russian by-catch statistic of greater silver smelt in the commercial blue whiting fishery in Division Vb demonstrates considerable catch decline during recent years from 1185 t in 245 t in 2003 with probable stabilization during past two years within 264-245 t range.

In May-August 2003, greater silver smelt was most frequent caught during Russian fisheries for haddock and blue whiting on the Rockall Bank (the depth was 200-300 m). Besides, by-catch of this species was recorded occasionally during fisheries for blue whiting by mid-water trawls above the depth 430-1 300 m, the total catch of great silver smelt was 28 t. In June, a single trawler operated by the bottom trawl in above area during 3 days at the depths 320-560 m. The bulk of the catch (62 %) consisted of gretare silver smelt; blue whiting (24 %), redfishes (6 %), flatfish (5 %) and other species (13 %) were registered as by-catch. Catch per fishing days constituted 9.9 t.

12.2 Stock structure

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 the winter but in the summer the species is widely distributed (Bergstad, 1993).". No new information was presented to the Working Group.

12.3 Commercial catch-effort and research vessel surveys

Logbook catch and corresponding effort data for the Danish fleet in Division IIIa are available for the period 1992-2003 but a closer evaluation is necessary before accepting these CPUEs as indicators (see Table 12.2, Fig. 12.1). The figure for 2003 is only based on 2 fishing days and should be regarded as unreliable.

CPUE indices were presented for two Faroese surveys in Vb (1994 onwards, Fig. 12.2). These are bottom trawl surveys and it is uncertain if the indices reflect abundance for greater silver smelt which is a benthopelagic species.

Spanish research bottom trawl surveys were carried out in Subarea VII (Porcupine) from 2001 to 2003 (Velasco F., pers. com.). Figure 12.3 shows the greater silver smelt distribution. The catch rate was 133, 151 and 140 kg/30 minutes haul for 2001, 2002 and 2003, respectively. Blue whiting is the most abundant species in the survey area.

12.4 Length and Age compositions and mean weights-at-age

An age-length key for greater silver smelt sampled from Irish pelagic trawlers targeting the species in Division VIa was presented in the 2002 report (ICES C.M. 2002/ACFM:16), but no new data were presented this year.

In the Netherlands fishery in Subareas VI and VII a major part of the landings from the Subarea VI in the first four years of this fishery, consisted of specimens older than 20 years. The maximum age observed was 40 years. Since 1994 the 20+ fish have almost disappeared. Samples from the Sub area VII consisted of younger fish (Heessen and Rink 2001). A series of age distributions based on market samples in 1995-2003 was provided to the Working Group, and examples fro two years are shown in Figure 12.4.

Information on the age composition of samples from Norwegian research surveys in Subarea II in the years 1980 and 1983, and 1987 have been published (Bergstad, 1993; Johannessen and Monstad, 2001). No recent data are available.

In Division Va, length distributions are available from catches (Figure 12.5). In 2002 and 2003, the mean length decreased considerably.

Length distributions were available for two Faroese surveys in Vb (1994 onwards) (Figure 12.6 and 12.7). There was no obvious trend in either series.

Figure 12.8 presents the comparison between length frequency distributions from the 2001-2003 Spanish bottom trawl surveys on the Porcupine bank (Velasco F., *pers. com.*). In the last survey does not appear the 22 cm clear mode of the 2001-2002 surveys but the rest of the length distribution is similar to the 2001 survey although with more abundance of individuals between 28 and 31 cm.

Length frequency distributions from Russian trawl fisheries and research surveys from a number of areas for 2002 and 2003 were also presented (Fig. 12.9-12.15), and further information was included in the WD by Vinnichenko and Khlivnoy (2004). The length frequency data on greater silver smelt were obtained when Russian fishery and research were conducted: off Eastern Greenland (Subarea XIV) and off Iceland (Division Va and Subarea XIV) during redfish studies; off Faroe Islands (Division Vb), off West Scotland (Division VIa) and off Porcupine Bank (Divisions VIIb and VIIc) during blue whiting investigations; in international waters off Hatton Plateau and Rockall Bank (Division VIb) from bottom trawl catches; off Southern Ireland (Division VIIghjk) from mid-water trawl catches; in Norwegian and Greenland Seas (Divisions IIa and IIb) during bottom and longline fishery.

Off Eastern Greenland greater silver smelt were registered within the depth range from 300 to 835 m. The largest catches were taken in the area off the Mesting Bank at depths of 320-330 m at water temperature of about 5°C. The length varied 26 to 42 cm, predominantly 33-37 cm (Figure 12.9), while body weights were 100 to 570 g with mean 289 g.

Species considered off Iceland were found within the depth range 100 to 700 m. Maximal catches (up to 4 200 individuals per hour trawling) were registered at depths 140-145 m and 580-585 m at the water temperature 4°C to 7°C. Length of greater silver smelt varied 14 to 49 cm, with 28-33 cm predominantly (Figure 12.10). Weight of fish was from 70 to 914 g with mean 298 g.

In April, southwest off the Faroe Islands greater silver smelt maximum catch (520 individuals per a trawling hour) was obtained by the bottom trawl at the depth 500-550 m. In May, this fish was caught during hauls within the layer 340-490 m above the depths from 500 to 1 000 m. In April, fish length varied from 23 to 38 cm, in May – from 30 to 50 cm with predomination of individuals 32-35 cm and 35-39 cm long, respectively (Figure 12.11).

In March, in the area off the Hatton Plateau over depths 1 200-1 300 m greater silver smelt had length 27 to 39 cm, mostly 31-35 cm (Figure 12.12), while male mean weight constituted 560 g and that of females – 580 g.

In the area off West Scotland greater silver smelt occurred mostly in bottom trawl catches at depths 210-500 m. Fork length of fish varied from 15 to 38 cm, with domination of 16-20 cm and 30-33 cm size classes (Figure 12.13) and mean length of 23.2 cm. In the only catch taken by mid-water trawl in the layer of 340-400 m above the depth 440 m greater silver smelt had length 26-38 cm with mean of 32.4 cm. Fish weight varied from 37 to 155 g.

During trawl-acoustic survey of blue whiting off the Porcupine Bank mid-water trawl catches per hour trawling in the layer 350-390 m above depths 400-450 m reached 1 043 individuals. Some individuals were recorded also in catches taken by the bottom trawl. Fork length of greater silver smelt constituted 18-31 cm, predominantly 22-27 cm (Figure 12.14).

Greater silver smelt off the Southern Ireland were recorded in the number up to 100 individuals during trawling in the layer of 330-400 m above the depth 390-420 m. Fish length constituted 17-29 cm, mainly 21-25 cm, with mean 22.8 cm. Weight varied from 46 to 200 g.

In bottom trawl catches taken in the south (the Faroe Islands) and in the east (the Norwegian Shallows, Nordkyn, Søre and Fugløya Banks, the Kopytov Area) of Division IIa greater silver smelt occurred in small number (tens of individuals) Fish length in December varied from 10 to 34 cm, mainly 12-25 cm (Figure 12.15).

12.5 Discards

Argentina silus can be a very significant discard of the trawl fisheries of the continental slope of Subareas VI and VII. (see Ch. 5), particularly at depths 300-700m (e.g. Girard and Biseau, WD).

12.6 Biological parameters

Some previously unpublished data on sex distribution by depth, age at maturity, spawning and von Bertalanffy growth parameters from Norwegian research surveys in Subarea II between 1980 and 1983 have been given by Monstad and Johannessen (2003).

Various Dutch and Irish data from Subareas VI and VII were presented in 2002 (ICES C.M. 2002/ACFM:16) and will not be included here.

Data on greater silver smelt maturity, sex ratios and diet composition from various areas were provided by Russia:

Off the Eastern Greenland greater silver smelt catches consisted mostly of maturing individuals (37 %) and immature ones (57 %), besides pre-spawning fishes were also registered (6 %). Females were 2 times more in catches than males. Greater silver smelt fed feebly, mainly, on squid, *Themisto* sp. and shrimp (Table 12.3).

Off Iceland most of individuals were mature and were in the post-spawning condition or had ripening gonads. Females in catches were two times more than males. Greater silver smelt fed feebly, mainly, on euphausiids, ctenophores and shrimp (Table 12.4).

In Faroe Islands area sex ratio of greater silver smelt in April and May was 1.4:1 and 1.1:1, respectively. In April, males in the spawning and post-spawning condition, as well as pre-spawning females, predominated (Figure 12.16). In May, the spawning continued. However, the number of pre-spawning fish sufficiently decreased. In April, feeding intensity was low, more than 85 % of stomachs examined were empty, only in some of them there was fish (*Maurolicus muelleri*, predominantly) and euphausids found (Table 12.5). In May, the feeding intensity increased, and in addition to euphausids and fish (blue whiting) in stomachs ctenophores, *Calanus* sp., other plankton organisms and amphipods occurred.

All the greater silver smelt caught off the Hatton plateau in March 2003 was immature. Fish did not feed.

In the area off Porcupine Bank immature and maturing individuals of greater silver smelt were registered. Greater silver smelt fed feebly, most of stomachs (76 %) were empty, in the rest contained fish, ctenophores and euphausiids.

Sex ratio of greater silver smelt off the Southern Ireland was close to equal. Catches contained mostly immature individuals (82 %), as well as maturing (17 %) and pre-spawning (1 %) ones. Feeding intensity was not high; euphausiids (46.6 %), fish (29.1 %) and ctenophores (24.3 %) were found in stomachs.

The following text table is a compilation of available information on biological characteristics:

Variable	**Value**	**Source/comment**
Longevity	~35	Bergstad 1993 (Skagerrak, North Sea)
Growth rate, K	Male 0.20 Female 0.17	Bergstad 1993 Bergstad 1993
Natural mortality	No data	
Fecundity	6-30 thousand	Wood and Raitt 1968
Length and age at first maturity	Male 36.2 cm, 6-9 y Female 37.2 cm, 6-9 y 3-10 y in VI/VII	Magnusson, 1988, Bergstad 1993, Gordon, 1999 Heessen & Rink 2001
L-W relationship	Males: $W = -6.557\ L^{3.459}$ Females: $W = -4.889\ L^{3.017}$	Irish data, Division VIa. (ICES C.M. 2002/ACFM:16)

12.7 Assessment

The Norwegian acoustic surveys of the 1980s and 1990s for Subarea II and parts of VI and VII were presented in the 1998 report (ICES C.M. 1998/ACFM :12). A complete report on these surveys has been published recently (Monstad and Johannessen, 2003).

The CPUE series for the Danish fishery in Division IIIa was not used for assessment. The rise in CPUE in 2003, based on only two fishing days, was not considered reliable. The state of the stock in the Skagerrak-North Sea is not known, and the exploitation rate is uncertain.

The Faroese survey CPUE series from Division Vb showed conflicting results, and there were also concerns with regards to their reliability as indices of abundance of this benthopelagic species. There were no obvious trends in the length distribution data. In Va, lengthe distributions from Icealndic catches showed a pronounced decrease in the last two years.

The Dutch age distributions from 1995-2003 representing Subareas VI and VII were examined with a view to estimate mortality by catch curve analysis, but the data were found to be too variable to permit fitting of linear regressions. The primary reason for the variability was probably small sample sizes.

The 1998 attempt to assess the greater silver smelt in Va was unsuccessful. No new assessments were attempted. Age readings have not been done since 1999 although otoliths have been collected from the catches. The group encouraged efforts to work up the material in order to facilitate age-based assessment for this stock.

12.8 Management considerations

In 2002 the WG expressed concern about the apparent increase in the directed fishery and 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 dicontinued target fisheries due to the restricted quota. Other fleets continued to pursue the fishery, and the decrease may suggest a decline in abundance or availability on traditional grounds.

The data from other areas could not be used to assess the stock status. In Va the decrease in length in the commercial catches may have resulted from exploitation.

In 2003 quota management was introduced in EU waters, and a licencing scheme has been in place for several years in Norway, Iceland, and the Faroes.

Table 12.1. **Greater silver smelt** (*Argentina silus*). Working Group estimates of landings (tonnes). Data from 2003 are preliminary and may be incomplete.

Greater silver smelt (*Argentina silus*) I and II

Year	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	**TOTAL**
1988			11332	5	14			**11351**
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			14357		7	5		**14363**
2002			7405			2		**7407**
2003		555	8344		7	2		**8908**

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				26		20		1	**1166**

Table 12.1 (Cont'd)

Greater silver smelt (*Argentina silus*) Va

Year	Iceland	E & W	**TOTAL**
1988	206		**206**
1989	8		**8**
1990	112		**112**
1991	247		**247**
1992	657		**657**
1993	1255		**1255**
1994	613		**613**
1995	492		**492**
1996	808		**808**
1997	3367		**3367**
1998	13387		**13387**
1999	6681	23	**6704**
2000	5657		**5657**
2001	3043		**3043**
2002	4960		**4960**
2003	2683		**2683**

Greater silver smelt (*Argentina silus*) Vb

Year	Faroes	Russia/USSR	UK (Scot)	UK(EWN)	Ireland	France	Netherlands	**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						**12286**
1996	9495		3					**9498**
1997	8433							**8433**
1998	17570							**17570**
1999	8186		15	23		5		**8214**
2000	3713	1185	247			64		**5209**
2001	9952	414	94		1			**10461**
2002	7782	264	144				5	**8195**
2003	6030	245	1				45	**6321**

Table 12.1 (Cont'd)

Greater silver smelt (*Argentina silus*) VI and VII

Year	Faroes	France	Germany	Ireland	Netherl.	Norway	E & W	Scotland	N.I.	Russia	Spain	**TOTAL**
1988				5454		4984						**10438**
1989	188			6103	3715	12184	198	3171				**25559**
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	**13866**
2001		12	189	7494	3659			7620		76		**19050**
2002			150	7589	4020			4197		29		**15985**
2003				95	1933			89		163		**2280**

Greater silver smelt (*Argentina silus*) *VIII*

Year	Netherl.	**TOTAL**
2002	191	191
2003	37	37

SPA WG data zero in all years 97-2001

Greater silver smelt (*Argentina silus*) XII

Year	Faroes	Iceland	**TOTAL**
1988			
1989			
1990			
1991			
1992			
1993	6		**6**
1994			
1995			
1996	1		**1**
1997			
1998			
1999			
2000		2	**2**
2001			
2002			
2003			

Table 12.1 (Cont'd)

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			

Greater silver smelt *(Argentina silus)* (all areas)

	I + II	III + IV	Va	Vb	VI + VII	VIII	XII	XIV	**Total**
1988	11351	2718	206	287	10438				**25000**
1989	8390	3786	8	227	25559				**37970**
1990	9120	2321	112	2888	7294			6	**21741**
1991	7741	2554	247	60	5197				**15799**
1992	8234	5319	657	1443	5906				**21559**
1993	7913	3269	1255	1063	1577		6		**15083**
1994	6807	1508	613	960	5707				**15595**
1995	6775	1082	492	12286	7546				**28181**
1996	6604	3300	808	9498	5863		1		**26074**
1997	4463	2598	3367	8433	7301				**26162**
1998	8261	3982	13387	17570	5555				**48755**
1999	7163	4319	6704	8214	8856		2		**35258**
2000	6293	2471	5657	5209	13866			217	**33713**
2001	14363	2925	3043	10461	19050			66	**49908**
2002	7407	1811	4960	8195	15985	191			**38549**
2003	8908	1166	2683	6321	2280	37			**21395**

Table 12.2 Danish CPUE for *Argentina silus* in Division IIIa for 1992 to 2003. Data from logbooks not representing the entire landings. Note the low number of fishing days in 2003.

Year	Mesh size in Trawl: >100 mm			70 - 100 mm			30 - 45 mm			< 25 mm			All trawls
	Kg	days	CPUE	Kg	days	CPUE	Kg	days	CPUE	Kg	days	CPUE	**CPUE**
1992				592430	62	9555.3				77601	10	7760.1	**9306.0**
1993				885880	71	12477.2	720000	36	20000.0	77200	4	19300.0	**15162.9**
1994				978300	78	12542.3	212000	7	30285.7				**14003.5**
1995				647140	67	9658.8	423848	98	4325.0	10000	1	10000.0	**6512.0**
1996				1303420	84	15516.9							**15516.9**
1997				808360	69	11715.4				136000	4	34000.0	**12936.4**
1998				703180	56	12556.8							**12556.8**
1999				885900	65	13629.2	907900	66	13756.1	22000	1	22000.0	**13756.1**
2000				767300	89	8621.3	169000	9	18777.8	27600	4	6900.0	**9450.0**
2001				788520	103	7655.5				83000	7	11857.1	**7922.9**
2002	150	5	30,0	791000	92	8597,8							**8156,2**
2003				25000	2	12500,0							**12500,0**

Table 12.3 Diet composition of greater silver smelt off the East Greenland expressed as percent of frequency of occurrence (%FO), June 2003.

Dietary component	FO, %
Shrimp	11.1
Euphausiids	5.6
Themisto sp.	11.1
Squid	61.1
Digested food	11.1

Table 12.4 Diet composition of greater silver smelt off Iceland expressed as percent of frequency of occurrence (%FO), June-July 2003.

Dietary component	FO, %
Euphausiids	13.9
Shrimp	6.2
Squid	1.5
Flounders	1.5
Digested fish	1.5
Sagitta sp.	1.5
Ctenophora	7.7
Slime	41.5
Digested food	24.6

Table 12.5 Diet composition of greater silver smelt off the Faroe Islands (Division Vb) expressed as percent of frequency of occurrence (%FO), April - May 2003.

Dietary component	April	May
Calanus sp.		12.7
Ctenophora		7.9
Euphausids	20.0	31.8
Amphipods		1.6
Other plankton		1.6
Blue whiting		3.2
Pearlsides	50.0	
Digested fish	20.0	11.1
Slime		11.1
Digested food	10.0	19.1
Number of stomachs analyzed	50	71
Number of stomachs with food	8	45

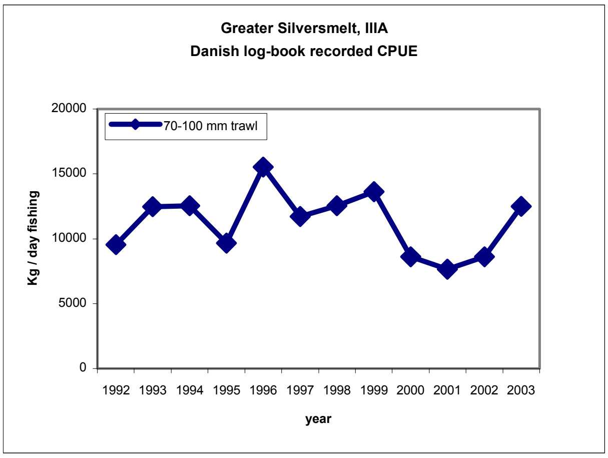
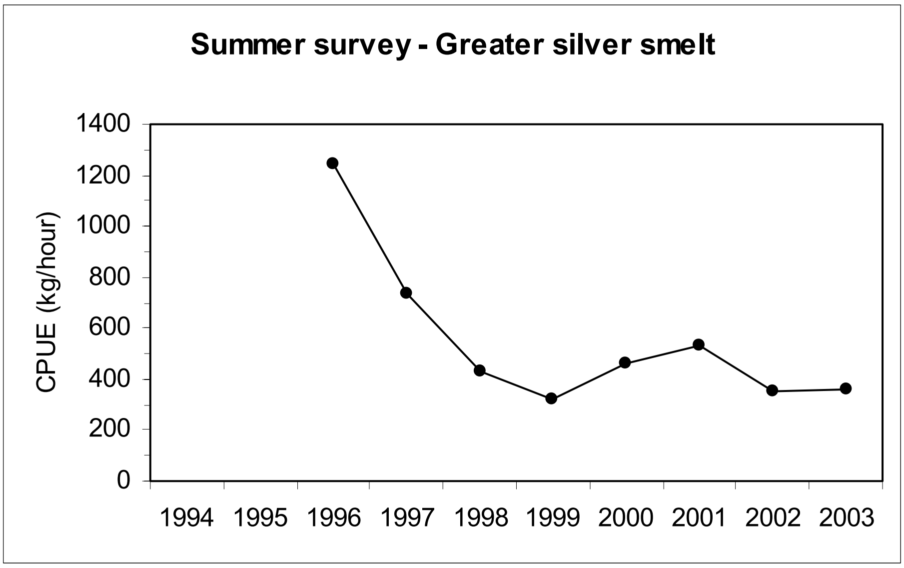


Figure 12.1 CPUE from Danish trawl fisheries in Division IIIa. The rise is 2003 is unreliable, being based on only 2 fishing days.



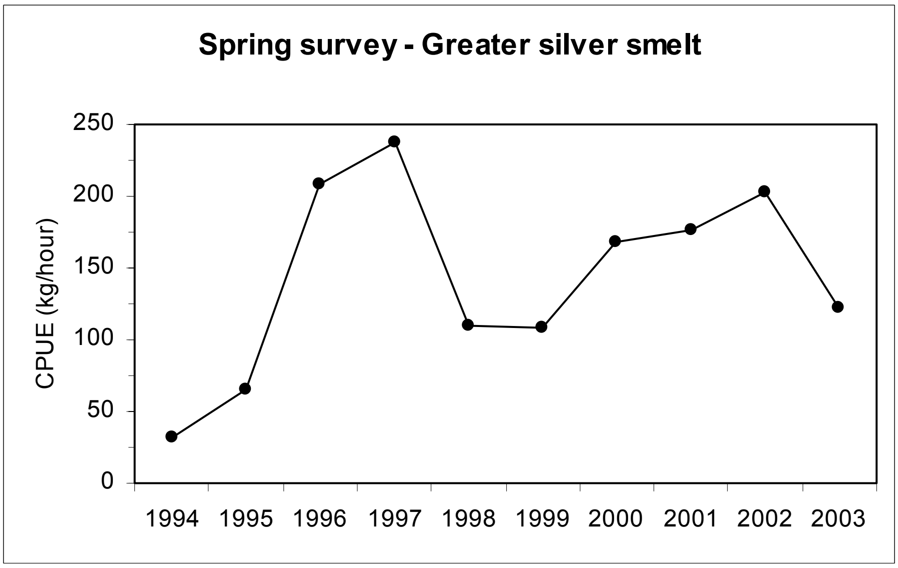
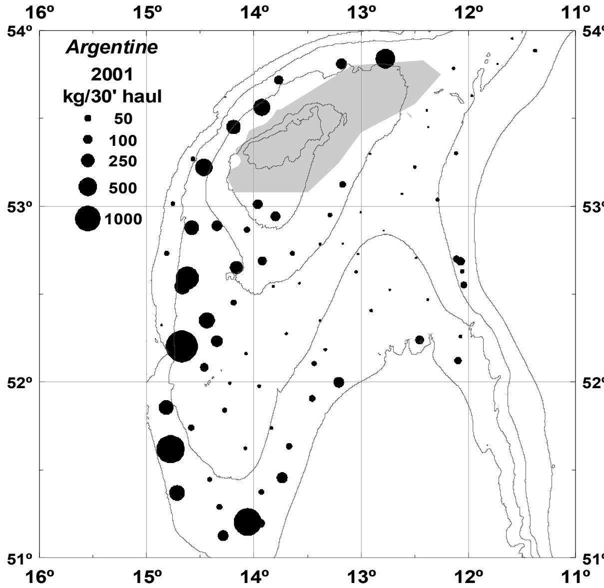
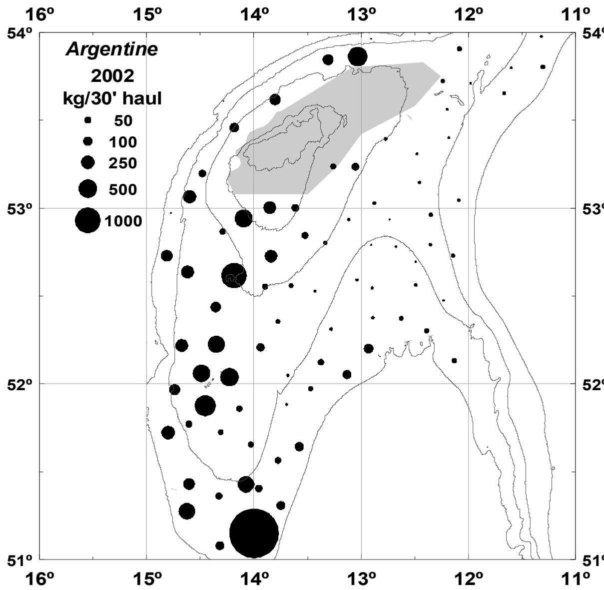


Figure 12.2 CPUE from Faroese surveys in Vb.





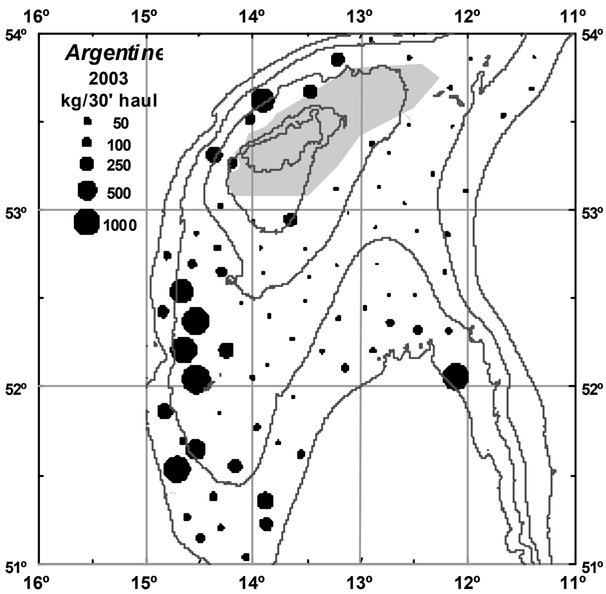


Figure 12.3 Spanish bottom trawl survey in Porcupine area. Argentines catches distribution in biomass (kg/30 min haul) from the 2001-2003 period (Velasco, F., *pers. com.*).

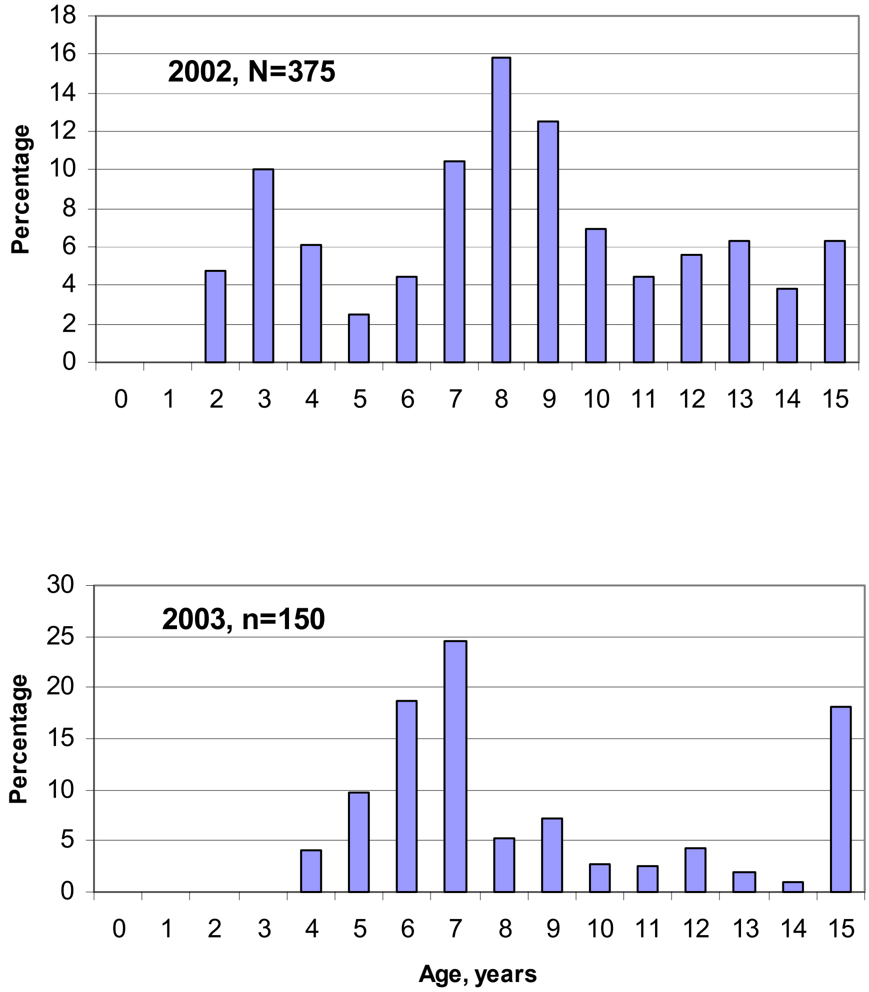


Figure 12.4 Examples of the age distributions from Dutch fisheries in Subarea VI and VII. Data compiled from quarterly data.

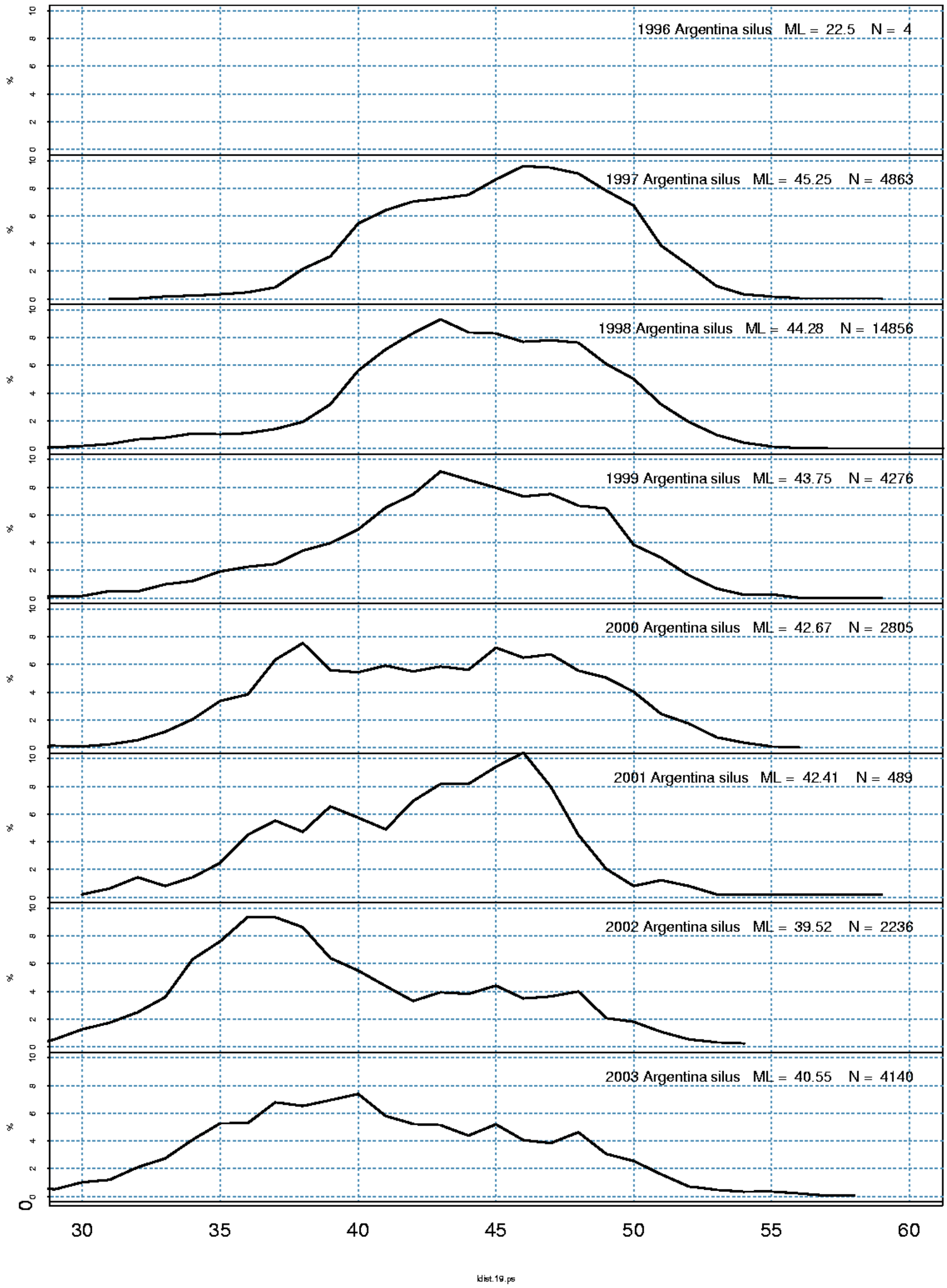


Figure 12.5 Greater silver smelt. Length distributions from Icelandic catches in Va.

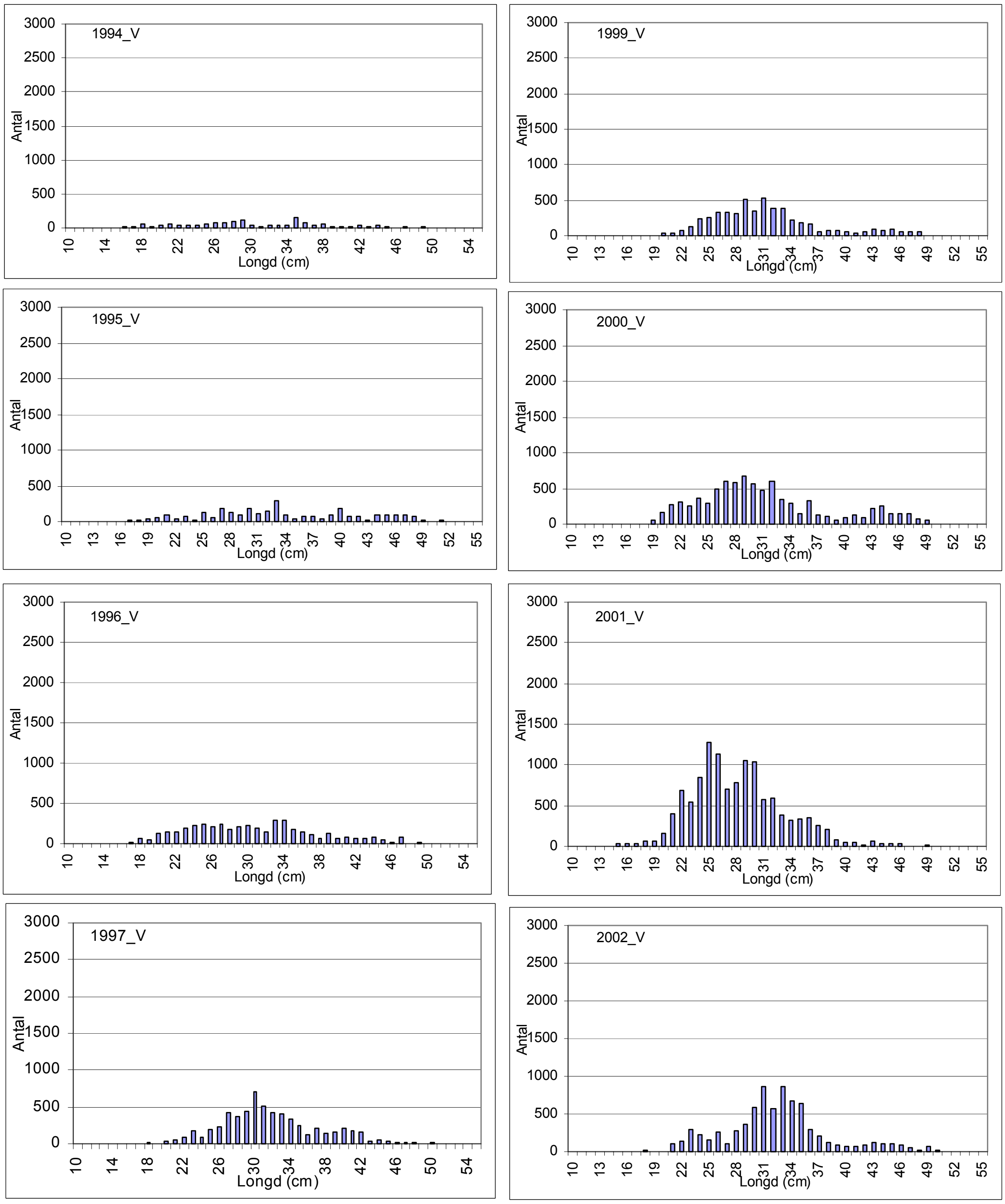


Figure 12.6 Length distributions from Faroese survey in the spring, Division Vb, 1994-2002. (Antal=numbers).

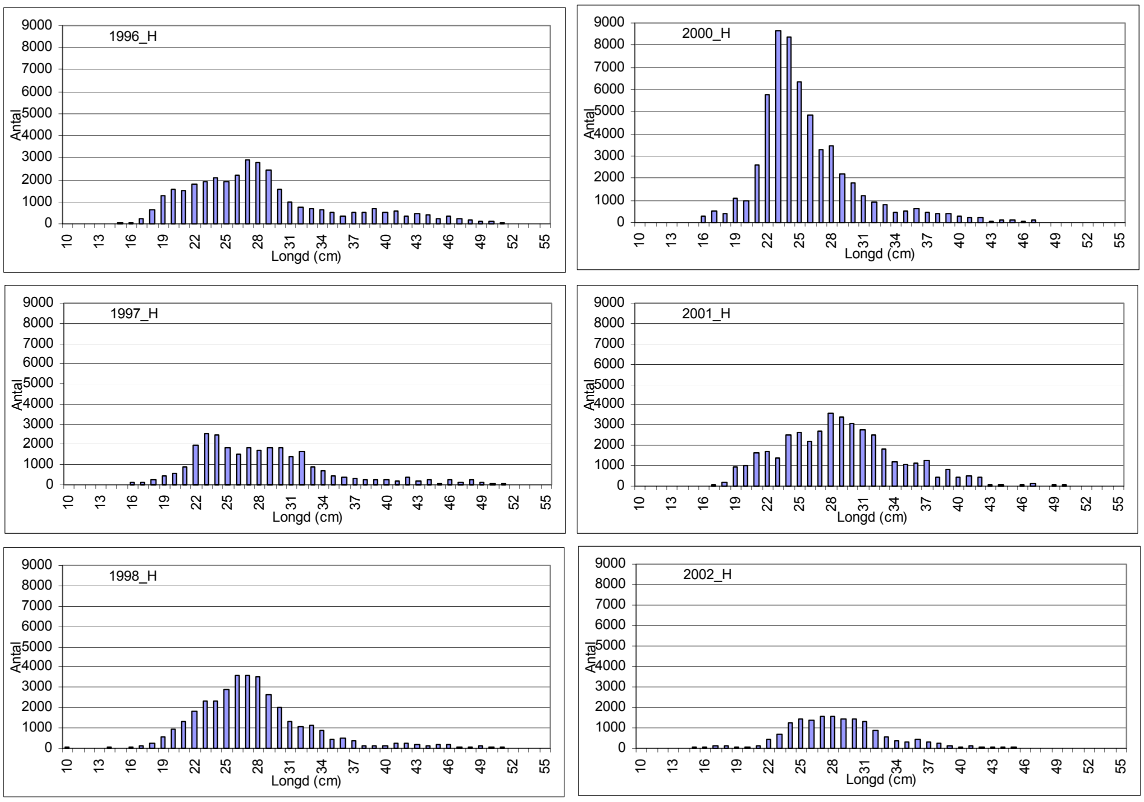


Figure 12.7 Length distributions from Faroese survey in the summer, Division Vb, 1996-2002. (Antal=numbers).

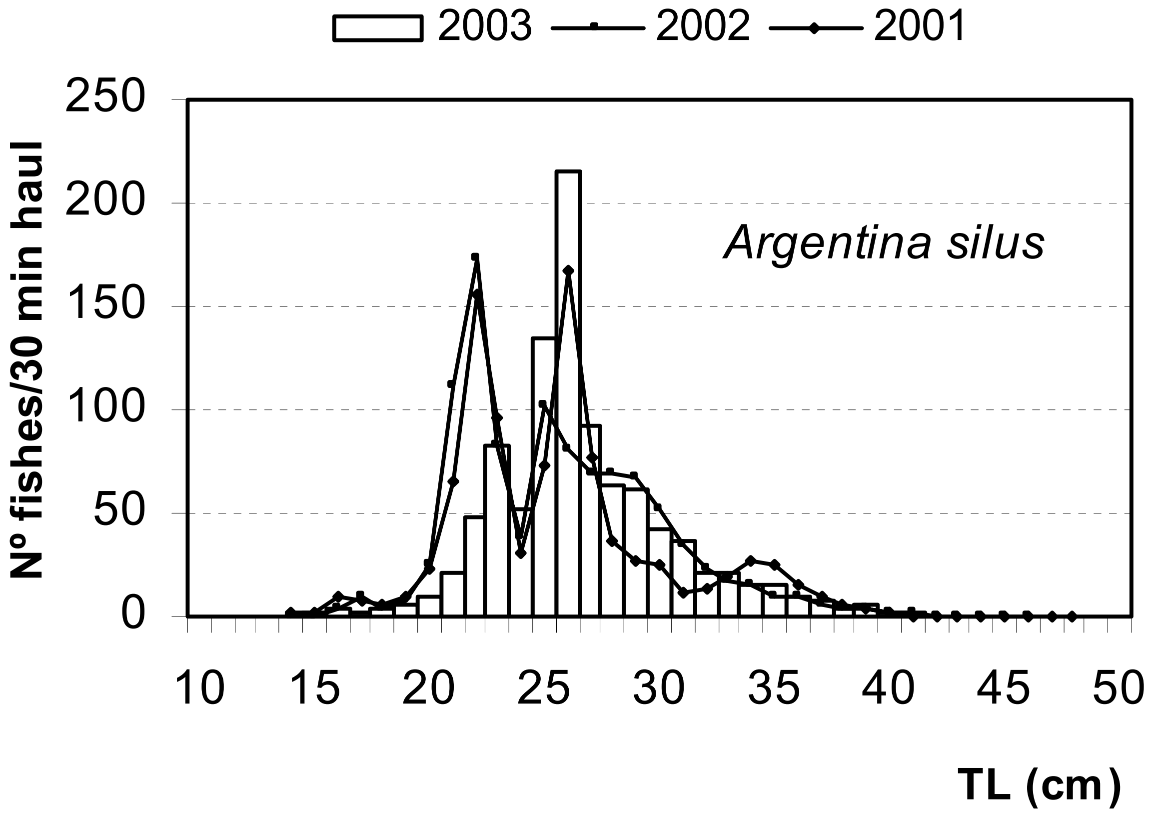


Figure 12.8 Spanish bottom trawl survey in Porcupine area. Comparison between greater silver smelt length frequency distributions from the 2001-2003 period (Velasco, F., *pers. com.*).

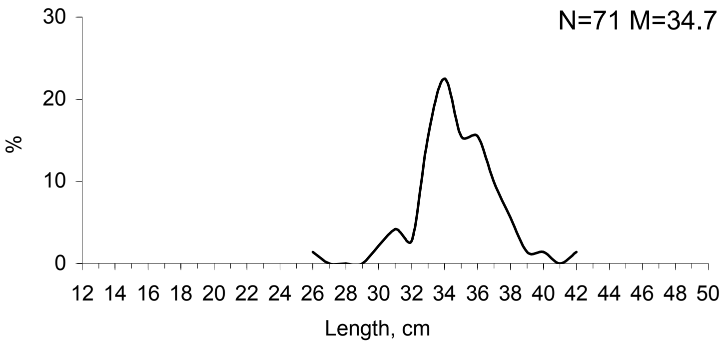


Figure 12.9 Length composition of greater silver smelt near the East Greenland (Subarea XIV)

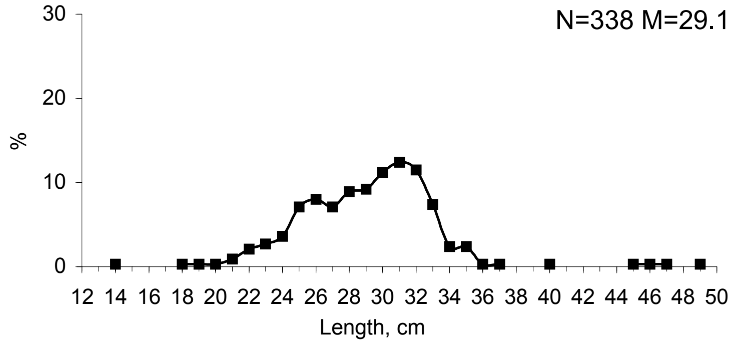


Figure 12.10 Length composition of greater silver smelt in the area of Iceland (Div. Va and Subarea XIV)

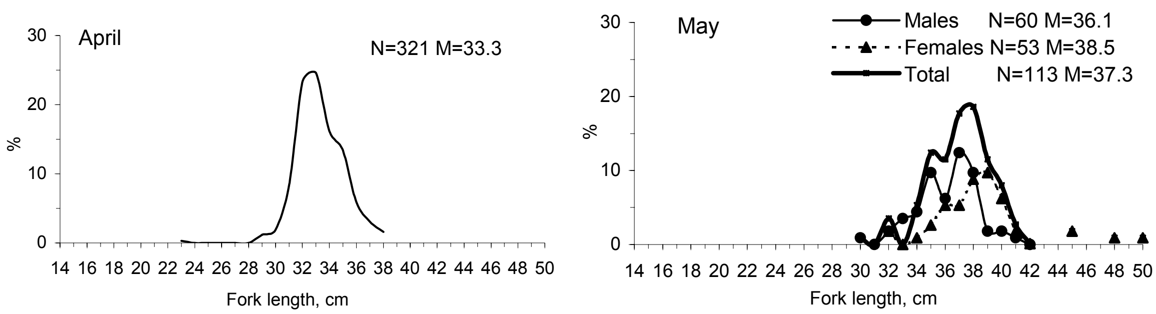


Figure 12.11 Length composition of greater silver smelt near the Faroe Islands (Div. Vb)

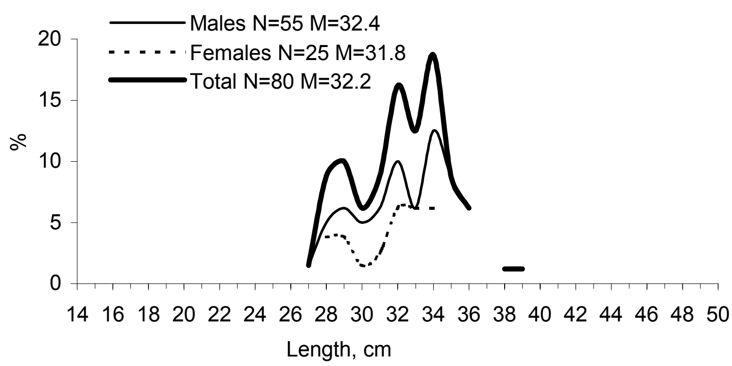


Figure 12.12 Length composition of greater silver smelt in Div. VIb in March 2003

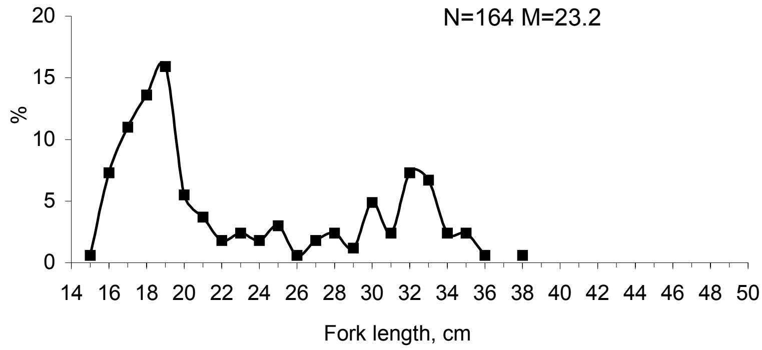


Figure 12.13 Length composition of greater silver smelt in Div. VIa in April 2003

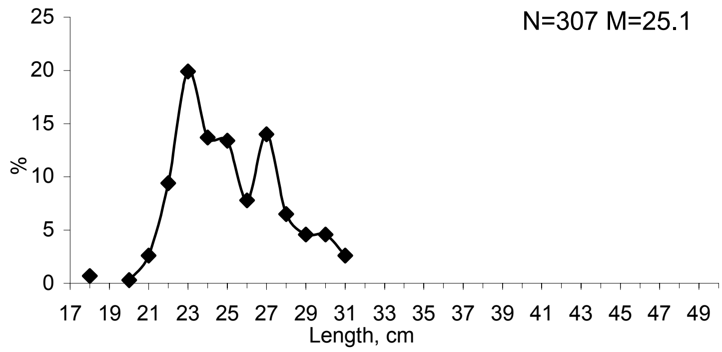


Figure 12.14 Length composition of greater silver smelt in Div. VIIb and VIIc in March 2003

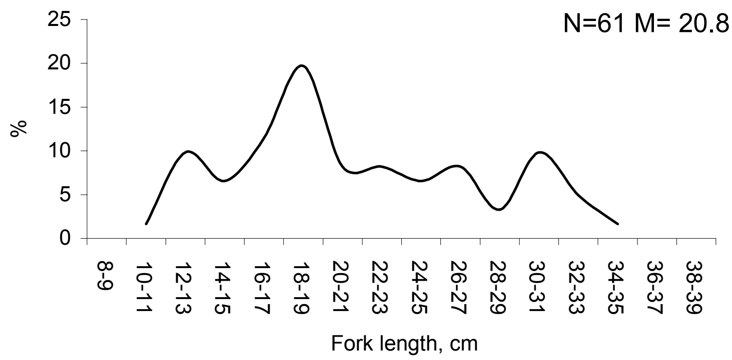


Figure 12.15 Length composition of greater silver smelt in the east of the Norwegian Sea (Subarea II) in December 2003

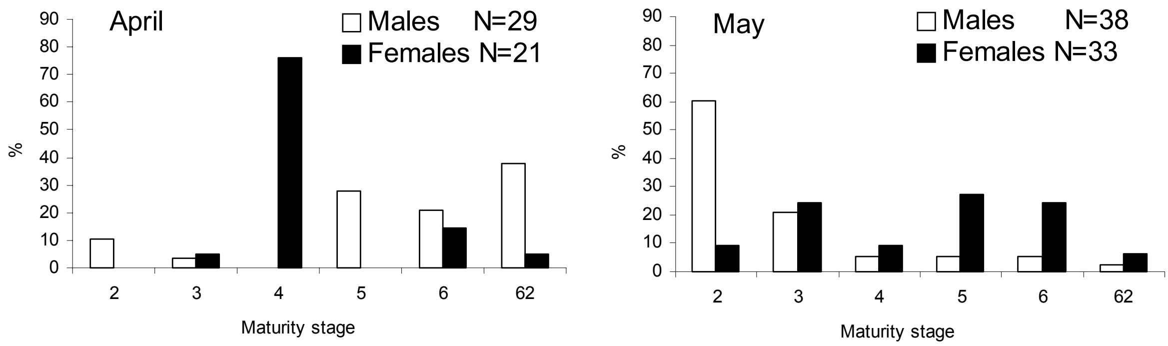


Figure 12.16 Maturity of greater silver smelt near the Faroe Islands (Div. Vb). 2 - immature, 3 - developing, 4 - mature or ripe, 5 - spawning, 6 - spent, 6-2 -post-spawning

13 ORANGE ROUGHY (*HOPLOSTETHUS ATLANTICUS*)

13.1 Catch trends

Table 13.1 shows the landings data for orange roughy for the ICES area as reported to ICES or as reported to the Working Group. The main fishery for orange roughy in the northern hemisphere is that taking place west of Ireland in Subarea VII. French vessels used to prosecute this fishery alone, but since 2001, new Irish vessels have become involved. There has been some fishing for this species on the mid-Atlantic Ridge by Irish, French and New Zealand vessels in recent years.

In Division Va, the fishery peaked with landings of over 700 t in 1993, and landings have declined to very low levels in 2003. In Division Vb, landings were highest in 1995, and have fluctuated at a low level since. Most of these landings were by the Faroes with spasmodic landings from French vessels.

In Subarea VI, there was a French target fishery, centred on spawning aggregations around the Hebrides Terrace Seamount. Landings peaked at 3,500 t in 1991. The fishery began in 1989, and by the end of 1993, 5,300 t had been removed from the stock. This stock is now severely depleted (Anon., 2000) and some recent landings from France and Ireland have been from further south in this Subarea and increased to over 300 t in 2002. It is not clear if over-reporting was a feature of the fishery in this area, in the years preceding the introduction of TAC's. Preliminary catch data in 2003, suggest that the TAC in VI was not exceeded.

In Subarea VII, a French fishery developed in 1989, and landings peaked at over 3,000 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 (preliminary data) have amounted to a further 9,300 t. The fishery takes place on several separate topographical features. Catch data from France are not currently available at a higher spatial resolution, and this prevents a meaningful examination of stock trends. However it can be seen that there have been several pulses in landings. The first occurred in 1992 when over 3,000 t were landed. Landings declined until 1995, but then increased again to the highest in the series in 2002. Misreporting is likely to have been a feature of this fishery in most recent years, with both under- and over-reporting probably taking place. The restrictive quotas that have been introduced in 2003 may have resulted in further species and area misreporting. In addition, there is a likelihood of misreporting of orange roughy as other species. The TAC of 1,349 t appears restrictive when compared with catches in 2002, but is not clear whether this TAC was exceeded or not.

In Subarea VIII, there have been small landings by France since the early 1990's. In Subareas VIII and IX, Spain has recorded small landings in some years.

In Subarea X, there were Faroese landings in some years, 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 1990's, with small landings by France. In recent years, 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.

13.2 Stocks

The fishing grounds so far discovered in the North Atlantic have appeared to support relatively small aggregations of fish, usually associated with seamounts and other topographical features. It would appear that the aggregations fished on the Hebrides Terrace Seamount constituted a separate stock. Further south, it seems likely that the separate aggregations are separate stock units too, though it is not clear. The probability of finding, in the northern Atlantic, stocks comparable in size to the stocks exploited in the south Pacific seems low. As an element of the MAR-ECO project (Ch. 2.4.6) a study of the population structure of orange roughy in the north Atlantic using molecular genetics has been initiated.

13.3 Commercial CPUE

For Division Vb, French CPUE were presented to WGDEEP in 2002 (Anon. 2002). These data are not informative of stock abundance as they represent very small catches. For Subareas VI and VII, CPUE from French trawlers has been described previously (Anon. 2002). In 2004, two additional and up-to-date series are available (Table 13.2). The first is calculated from data generated by the upper 90% of fishing sequences, ranked according to the catch of orange roughy (Bisseau, WD 2004), see Table 13.3. The second is calculated from all data of the reference fleet. The CPUE from the upper 90th percentile of sequences produced higher values than those calculated from total effort. However it should noted that in 1998, the data from the main French participant vessel were not used in calculating CPUE, and the lower estimates are an artefact of the resultant underestimation of catches in that year.

For Subareas VI, VII and XII there are CPUE data are available from observed fishing trips as part of the Irish Sea Fisheries Board Deepwater Programme (BIM, WD, 2002a). These data are presented by ICES Division in Table 13.4 and by area in Table 13.5. The divisional CPUE data are also presented as kg per haul, which is considered to be a more useful estimate of CPUE because even very short hauls can generate large catches. It is considered that haul number, rather than haul duration is a better estimator of effort. These data are not directly comparable with French data, because the Irish fishery was more efficient. Though these data are only for two years, experience shows that orange roughy stocks can be depleted in this time period, so these data can be considered to be very useful.

In Subarea VI, declines in French CPUE were documented (Anon., 2000; 2002), and the 2000 series formed the basis of an assessment by SGDEEP in that year (Figure 13.1). This assessment showed the depletion of a stock in VI, which has subsequently been identified as having resided on the Hebrides Terrace Seamount. However between 1995 and 1996, international catches appear to have stabilised at a low level and from 1996 onwards increased slightly. CPUE from all available series have displayed slight upward trends since 1997. It seems that this reflects the targeting of separate aggregation(s), though it may also reflect some re-targeting of the Hebrides Terrace Seamount or catches of orange roughy on “flat grounds”. The upward trend in most recent years may reflect over-reporting of the species in the year preceding the introduction of TACs.

In Division VIa, Irish data are difficult to interpret, because only one observed haul was made here in 2002. However an examination of the CPUE may suggest declining abundance on the Hebrides Terrace Seamount.

In Subarea VII, the French CPUE series are as described for Subarea VI. The 90th percentile CPUE estimates are up to 5 times higher than the total catch and effort calculated CPUE. The trends in CPUE in this subarea have been explained as sequential depletion of isolated aggregations. The catches of over 1,000 t taken in the early 1990’s were accompanied by declining CPUE in all the available series. However CPUE displayed an upward trend until 2000, excepting 1998 that had an artificially low value due to lack of data. This increase may be explained by changes in the fishing pattern, discovery of new aggregations or increased experience of the skippers. It seems likely that only the most skilled skippers remain in the fishery. In the last two years, targeting of this species by French vessels has declined markedly, and this is reflected in the declining CPUE also. However it is likely that this decline indicates declining abundance also.

In Subarea VII the currently available CPUE are of limited use for stock assessments. It is known that the fishery in Subarea VII takes place on several separate topographical features. Therefore CPUE data are required for each individual area and ideally separate assessments would be run in each. It appears that there was depletion in the early 1990’s when catches dropped from a peak of 3,100 t in 1992. CPUE declines from 1991 to 1995 probably reflect sequential depletion of the various stock units. From 1996 until 2001most of the catches were taken by a single vessel. The cumulative international catch at the end of 2000 was over 14,000 t. In this period the trends in CPUE may be explained as targeting and depletion of separate aggregations. Another explanation is that the fishery stabilised because the fishery only landed a fixed amount of fish in order to avoid depressing the market price. It seems likely that efficiency of the fishery increased throughout the 1990’s as the skippers became better at catching orange roughy. This would suggest that this CPUE series would not be an accurate estimator of stock abundance. Since 2001, the single vessel has ceased to be involved in the fishery, and may explain the declining trend from 2001 to 2003. However anecdotal information from the Irish fishery suggests that catch rates have declined between 2002 and 2003.

In Division VIIb, Irish CPUE declined between 2001 and 2002 and this is reflected in both kg per hour and kg per haul. However this may be in part due to the lower number of observed hauls in 2002 and the consequent lower catch. There are no data by area to compare with (Table 13.5).

In Division VIIc, Irish CPUE displays a marked downward trend from 2002 to 2003 and this is also reflected in the available data by area in Table 13.5 (317 kg per hour in 2001 to 158 kg per hour in 2002). Thus all available CPUE series in this Division have declined by about 50%.

In VIIk, Irish CPUE is difficult to interpret. The CPUE for the division as a whole increased markedly between 2001 and 2002, but the CPUE for both areas in this division displayed downward trends. This may reflect the movement of effort to other areas in VIIk, or simply it may be an artefact of observer coverage.

Irish CPUE are available from Subarea XIIb and VIb for 2002 only. No other CPUE data are available for other areas. But if such data are not made available then it will be impossible to assess the status of stocks in these areas.

13.4 Length and age composition

Standard length weight relationships for orange roughy caught in the Irish developmental fishery in 2001 are presented by the Irish Sea Fisheries Board and documented in BIM (WD, 2002a). The relationships are as follows:

Both sexes:	$y = 0.3108x^{2.3959}$	$R^2 = 0.743$	N = 320
Females:	$y = 0.0136x^{3.2174}$	$R^2 = 0.9237$	N = 23
Males	$y = 1.1410x^{2.0531}$	$R^2 = 0.7643$	N = 58

A relationship between total individual size (L in cm) and weight (W in g) has been derived from French landings taken off the British Islands:

$W = 0.022\ L^{2.95}$

The relationship between standard individual size (Ls in cm) and weight (W in g) has also been derived in subarea X, based on the Azorean exploratory cruise:
$W = 0.08\ Ls^{2.74}$ (females)
$W = 0.10\ Ls^{2.76}$ (males)

Updated, length frequency information is only available from Ireland. Figure 13.2 presents length frequencies from the Irish developmental programme (BIM, WD 2002). Length frequencies from the Irish Marine Institute observer programme in 2003 are presented in Figure 13.3. Most fish were between 45 and 65 cm. Length frequencies for the French fishery during the 1990's are presented in Figures 13.3 and 13.4.

Age estimates were presented by Talman *et al*. (2002) based on samples taken from the Irish developmental fishery in 2001, in VI and VII (BIM, WD 2002). Age estimates from sectioned otoliths ranged from 20 to 187 years (Standard Lengths 30 to 68 cm). Empirical growth curves presented by Talman *et al*. (2002) suggests that growth slows and reaches an asymptote at about 55cm SL and 37 years. These age estimates, though unvalidated, were obtained using the most accepted technique used for New Zealand and Australian fisheries. The orange roughy in the area west of Ireland appear to reach the greatest age of any populations so far examined. Though these data can not be used to infer the age structure of the stocks in this area, they do indicate that the populations consist of a great many age groups.

Based on these age estimates, an estimate of natural mortality of 0.025 is obtained for orange roughy caught in the Irish fishery, from the following equation:

M = ln100 / maximum age (187 years)

13.5 Biological parameters

New information on fecundity and reproduction of the orange roughy west of Ireland was presented by Minto and Nolan (2003; in prep.). Fecundity was reported in the range 20,352 – 244,578 oocytes per female, and mean fecundity was in the range 97,368 (std = 48 322) oocytes per female. Fecundity shows an initial increase with age up to 120 years. Thereafter, fecundity is not seen to rise and may in fact decline with the onset of senescence. Other information on the reproductive biology produced by these authors is presented below.

- Mean relative fecundity: 33,376 oocytes/kg (std = 11 407)
- Youngest fish with maturing oocytes: 21 years
- Length at maturity: 36cm SL. This is higher than in New Zealand and Australia. Maximum size is also greater than in the southern hemisphere.
- With the exception of the Puysegur bank, New Zealand, the mean fecundity of orange roughy, off the Porcupine Bank, is approximately double that of the species in the southern hemisphere.Current estimates of the biological parameters of orange roughy off the British Islands are summarised in the text table below:

Variable	Value	Source/comment
Longevity (years)	130 187	(Allain and Lorance, 2000; Francis and Horn, 1997) Talman et al. (WD, 2002)
Growth rate, K	0.04-0.05	(Annala and Sullivan, 1996; Tracey and Horn, 1999)

Natural mortality, M	0.04 0.025	Annala (1993) Based on data from Talman (WD, 2002)
Fecundity (absolute)	28000-385000 ov./ind. 20,000 – 244,578 ov/ind	Marine station of Concarneau (France) Minto and Nolan (2003; in prep)
Length at first maturity	52 cm 36 cm SL	Berrehar, DuBuit and Lorance (unpublished data) Minto and Nolan (2003; in prep)
Age at first maturity	?	

13.6 Assessment

WGDEEP was not able to make a stock assessment on any of the orange roughy stocks in 2004. This is due to a number of factors. Firstly effort data are urgently required at the level of spatial resolution required for meaningful stock assessment. It is at least necessary to have access to catches by statistical rectangle, and observer data can be used to validate such information. Finally, total international removals by aggregation area are needed.

Despite these problems, it is possible to use the CPUE to describe trends in abundance in orange roughy, being aware of the problems with these data. Furthermore, it is possible to up date information used in previous assessments.

The stock assessment carried out in VIa (Anon. 2000) included total catch for all the Subarea VI, though the effort likely related mainly to the Hebrides Terrace Seamount. It is now clear that other, smaller aggregations occur in this Subarea, but there have not been sufficient data on total removals from those aggregations. In Subarea VI, the initial stock size was estimated to be 6,000 t (95% CI's = 5,400 – 6,300 t) by SGDEEP (Anon., 2000). However cumulative catches from this Subarea are now in excess of 7,000 t. Recent catches are probably higher because of the targeting of orange roughy in the south east slopes of the Rockall Trough. However there is evidence that this aggregation is smaller than that from the Hebrides Terrace Seamount, and consequently could not support even moderate catches. The MSY estimated for the Hebrides Terrace was around 300 t (Anon. 2000).

In Subarea VII, the lack of spatial resolution in the French CPUE precludes any meaningful assessment of the separate stocks in this area. However Irish data were made available at a higher spatial resolution. It seems clear from these Irish data that there is declining abundance in the aggregation areas. No assessment has been possible of orange roughy in VII, to date. However it seems clear that recent catches have been unsustainable.

13.7 Comments on assessment

No assessments were carried out.

13.8 Management considerations

There are TAC's in VI and VII for EU vessels in EU and international waters. These TAC's apply for 2003 and 2004. In VI the TAC is 88 t. In VII the TAC is 1,349 t.

WGDEEP considers that given the experience of fisheries in VI (Hebrides Terrace Seamount), high catch rates will not be sustainable.

Furthermore, the other stocks that are fished in VI and VII are almost certainly smaller than that from the Hebrides Terrace Seamount. The orange roughy in Division VIa, mainly distributed on the Hebrides Terrace Seamount is considered to be still below Upa.

The TAC in VII is lower than the recent landings, although similar to the average landings in the period, 1994 to 1998. Declining CPUE in individual stock units areas of VII is a cause for concern. The individual stock units in VII are most likely smaller than that from the Hebrides Terrace Seamount, and thus sustainable yield for each stock unit or aggregation area will be lower than 300 t.

Current catch rates in VII are very likely to be unsustainable and the stock units in this area probably already much depleted. Populations in other areas such as the Mid-Atlantic Ridge, Hatton Bank and Bay of Biscay will only be able to sustain very low levels of exploitation.

WGDEEP recommend that concerted efforts are essential to collate available data with which to assess the status of the individual stocks or aggregation areas. Furthermore, the current management units (essentially ICES Subareas) are completely inadequate for orange roughy. Experience from around the world shows that management units need to be small, as aggregations on topographical areas are usually considered to be discrete stocks. WGDEEP recommend that current information be used to define smaller and more meaningful management units. WGDEEP further recommend that where such information is lacking, in international waters for instance, the ICES statistical rectangle is a more meaningful spatial management unit.

It seems unlikely that there are any areas that have yet to be discovered in VII. It is to be hoped that the issues of confidentiality that have led to lack of spatial resolution in the data will now be resolved given that the fleets involved in the fishery in VI and VII have access to the information that is available.

In Division VIb, VIII, X and XII catch and effort data are urgently required, in order to assess the stocks. Given the experience of the declining CPUE in VII and depletion of the stock on the Hebrides Terrace Seamount. Therefore international waters fisheries for orange roughy should not be allowed to proceed until accurate assessments are available to advise on sustainable catch levels.

Table 13.1 Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus.*

Orange roughy 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*	+	**+**

*Preliminary.

Orange roughy 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*	-	+	**+**
2003*	1	2	**3**

*Preliminary.

Table 13.1 (Cont'd)

Orange roughy 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*		77			2	-	**79**

* Preliminary.

Orange roughy in Subarea VII

Year	France	Spain	E & W	Ireland	Scotland	Faroes	**Total**
1988	-	-	-	-	-	-	**0**
1989	3	-	-	-	-	-	**3**
1990	2	-	-	-	-	-	**2**
1991	1,406	-	-	-	-	-	**1406**
1992	3,101	-	-	-	-	-	**3101**
1993	1,668	-	-	-	-	-	**1668**
1994	1,722	-	-	-	-	-	**1722**
1995	831	-	-	-	-	-	**831**
1996	879	-	-	-	-	-	**879**
1997	893	-	-	-	-	-	**893**
1998	963	6	-	-	-	-	**969**
1999	1,157	4	-	-	-	-	**1161**
2000	1,019	-	-	1		-	**1020**
2001	1022	-	1	2367	22	-	**3412**
2002*	300		14	5114	33	4	**5465**
2003*	308			172			**480**

*Preliminary.

Table 13.1 (Cont'd)

Orange roughy in Subarea VIII

Year	France	Spain VIII & 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*	21			**21**

Orange roughy in Subarea IX

Year	Spain	**Total**
1988	-	**0**
1989	-	**0**
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*		

*Preliminary. Continued …

Table 13.1 (Cont'd)

Orange roughy in Subarea X

Year	Faroes	France	Norway	E & W	Portugal	**Total**
1988	-		-	-	-	**0**
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	-	-	-	28	-	**28**
2002*	22	-	-	-	-	**22**
2003*						**0**

*Preliminary.

Orange roughy in Subarea XII

Year	Faroes	France	Iceland	Spain	E & W	Ireland	New Zealand	Russia	**Total**
1988	-	-	-	-	-			-	**0**
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	348	14	-	-	2		450	-	**814**
2002*	+	6	-	-	-		na	-	**6**
2003*		39				136	na	-	**175**

*Preliminary.

Table 13.1 (Cont'd)

Orange roughy total international landings in the ICES Area.

Year	Va	Vb	VI	VII	VIII	IX	X	XII	All areas
1988	0	0	0	0	0	0	0	0	0
1989	0	0	5	3	0	0	0	0	8
1990	0	22	15	2	0	0	0	0	39
1991	65	48	3502	1406	0	0	0	0	5021
1992	382	13	1422	3101	83	0	0	8	5009
1993	717	37	429	1668	68	0	1	32	2952
1994	158	170	179	1722	31	0	0	93	2353
1995	64	420	116	831	7	0	0	676	2114
1996	40	79	116	879	22	0	471	818	2425
1997	79	18	146	893	23	1	6	808	1974
1998	28	3	102	969	14	1	177	629	1923
1999	14	5	176	1161	39	1	10	431	1837
2000	68	155	138	1020	52	0	188	259	1880
2001	19	5	280	3412	20	0	28	814	4578
2002*	10	+	323	5465	20	0	22	6	5846
2003*	+	3	79	480	21	0	0	175	758
	1644	**978**	**7028**	**23012**	**400**	**3**	**903**	**4749**	**38717**

Table 13.2 Comparison of four series of French trawler CPUE (kg/hour), along with total and cumulative international catch for Subareas VI and VII. CPUE series are identified by the year in which they were presented to WGDEEP, and in the case of the 2004 series by the method of calculation.

ICES	Year	Int. Catch	Cum. Catch	CPUE 2000	CPUE 2002	CPUE 2004 90 th percentile	CPUE 2004 total
VI	1989	5	5	0		0	0
VI	1990	15	20	3		1	1
VI	1991	3502	3522	403	210	55	18
VI	1992	1422	4944	248	90	134	36
VI	1993	429	5373	118	27	36	7
VI	1994	179	5552	87	9	24	4
VI	1995	116	5668	105	3	23	3
VI	1996	116	5784	169	3	12	2
VI	1997	146	5930	175	5	9	1
VI	1998	102	6032	150	5	10	1
VI	1999	176	6208		10	48	11
VI	2000	138	6346		4	37	5
VI	2001	280	6626		12	72	11
VI	2002	323	6949			168	18
VI	2003	79	7028			109	8
VII	1989	3	3				0
VII	1990	2	5	0		2	1
VII	1991	1406	1411	414	360		119
VII	1992	3101	4512	246	248	279	181
VII	1993	1668	6180	151	124	122	87
VII	1994	1722	7902	159	129	107	62
VII	1995	831	8733	130	101	119	67
VII	1996	879	9612	231	164	410	133
VII	1997	893	10505	400	278	689	127
VII	1998	969	11474	321	243	38	10
VII	1999	1161	12635		278	544	253
VII	2000	1749	14384		192	218	110
VII	2001	3412	17796		251	210	80
VII	2002	5465	23261			79	38
VII	2003	480	23741			65	35

Table 13.3 Two series of CPUE (kg per hour) for French trawlers in Subareas VI and VII. Catches in kg and effort in hours. First series represents effort calculated from the upper 90th percentile of fishing sequences, the second, total effort. Log transformed ratio of first series: second is also presented.

		90th percentile			Total effort			Ratio
Subarea	Year	Catch	Effort	CPUE	Catch	Effort	CPUE	90^{th} %_ile : Total
VI	1989	222	468	0.5	246	622	0.4	1
VI	1990	1973	1905	1.0	2017	2315	0.9	1
VI	1991	63281	1154	54.8	81325	4502	18.1	3
VI	1992	466701	3471	134.5	515548	14422	35.7	4
VI	1993	85885	2382	36.0	103466	13858	7.5	5
VI	1994	32238	1358	23.7	40156	9736	4.1	6
VI	1995	16724	729	22.9	18360	6309	2.9	8
VI	1996	8845	715	12.4	10709	6617	1.6	8
VI	1997	7900	916	8.6	11216	10974	1.0	8
VI	1998	4918	485	10.1	8298	12333	0.7	15
VI	1999	30192	634	47.6	34650	3085	11.2	4
VI	2000	30203	826	36.6	36071	7942	4.5	8
VI	2001	62731	872	71.9	68953	6021	11.5	6
VI	2002	83627	497	168.3	93472	5206	18.0	9
VI	2003	38037	348	109.3	43564	5468	8.0	14
VI	Total	933476	16761	55.7	1068050	109410	9.8	6
VII	1989				8	44	0.2	0
VII	1990	29	19	1.5	34	43	0.8	2
VII	1991				595	5	119.0	0
VII	1992	843773	3027	278.7	962582	5328	180.7	2
VII	1993	480963	3936	122.2	535551	6156	87.0	1
VII	1994	456403	4251	107.4	506896	8175	62.0	2
VII	1995	267576	2245	119.2	288716	4278	67.5	2
VII	1996	553403	1350	409.9	618819	4652	133.0	3
VII	1997	682181	990	689.1	759915	5962	127.5	5
VII	1998	22782	593	38.4	26987	2832	9.5	4
VII	1999	765633	1409	543.5	834332	3301	252.8	2
VII	2000	546334	2508	217.8	599010	5440	110.1	2
VII	2001	654271	3111	210.3	725259	9067	80.0	3
VII	2002	220221	2802	78.6	246401	6451	38.2	2
VII	2003	225661	3458	65.2	255096	7381	34.6	2
VII	Total	5719229	29699	192.6	6360201	69115	92.0	2

Table 13.4 CPUE from observed trips on Irish trawlers in 2001 and 2002, from data made available by BIM. Catch in kg, effort in hours, CPUE in kg per hour and kg per haul. Hauls with zero catches are removed for ease of comparison between years, as zero haul data unavailable for 2001.

Year	ICES	Effort	Catch	CPUE kg per hour	No. hauls	Kg per haul
2001	VIa	47.2	7090	150.3	9	788
2001	VIIb	9.5	33100	3498.9	32	1034
2001	VIIc	124.2	34656	279.1	45	770
2001	VIIj	102.8	4960	48.2	21	236
2001	VIIk	336.9	78037	231.6	84	929
2002	VIa	3.5	10	2.9	1	10
2002	VI b	5.8	40	6.9	5	8
2002	XIIb	29.5	5440	184.4	20	272
2002	VIIc	81.8	11060	135.2	29	381
2002	VIIk	122.5	124930	1019.8	93	1343

Table 13.5 CPUE from Irish observer scheme carried out by the Irish Sea Fisheries Board in 2001 and 2002.

	Area	CPUE in 2001	CPUE in 2002	Comments
1	West of Scotland	173	3	Hebrides Terrace Seamount
2	North Porcupine	426	-	Bordering VI and VII
3	North Porcupine	317	158	Southern slopes of Rockall Trough
4	West Porcupine	1532	+	Porcupine slope
5	West Porcupine	178	121	Porcupine slope
6	West Porcupine	636	139	Southwest Porcupine

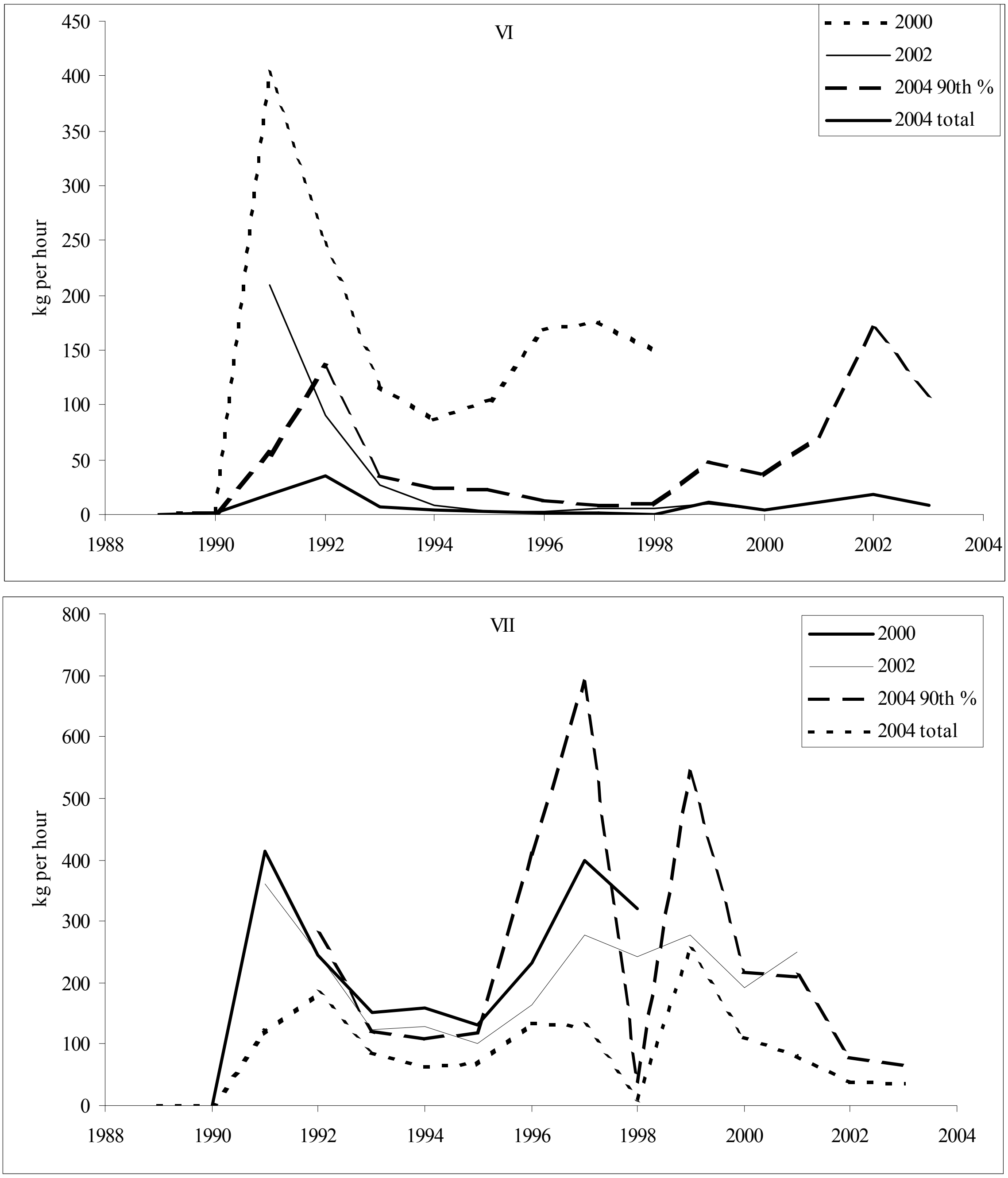


Figure 13.1 Comparison of four series of CPUE from French trawlers in Subareas VI and VII.

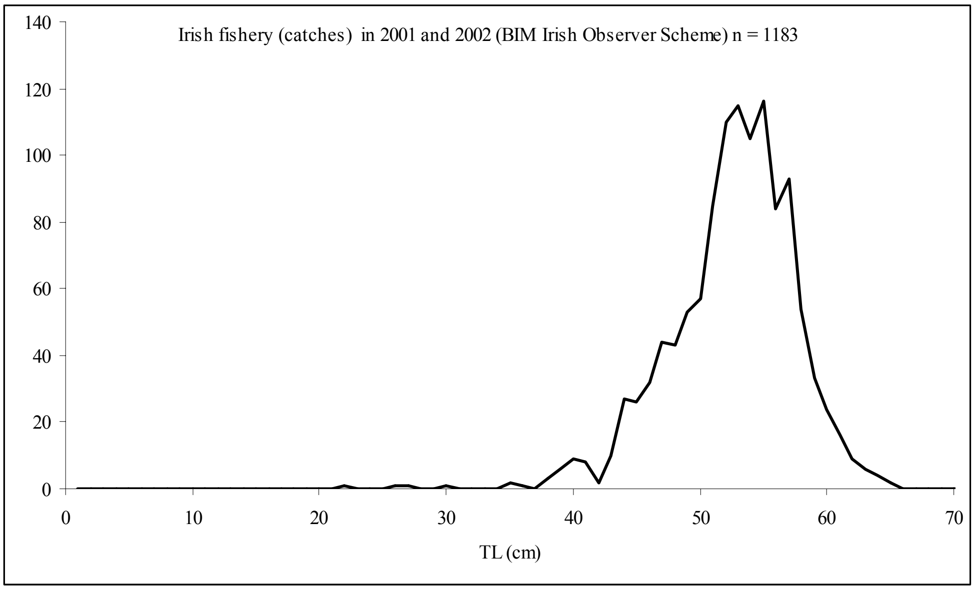


Figure 13.2 Length frequencies from Irish fisheries in 2001 and 2002, data from Irish Sea Fisheries Board observer scheme (BIM, WD 2002).

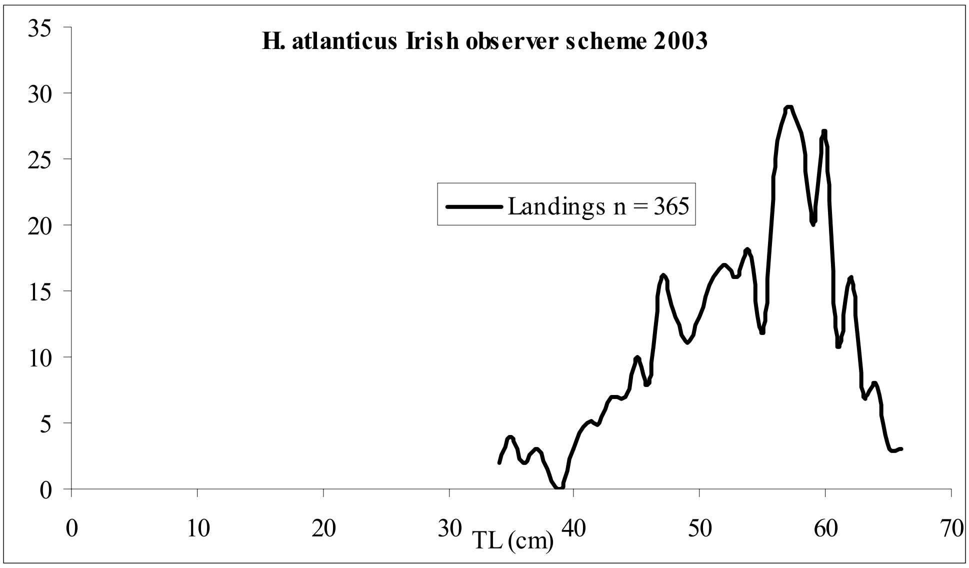


Figure 13.3 Length frequencies from Irish fishery in 2003 (VI and VII) from Irish Marine Institue observer scheme.

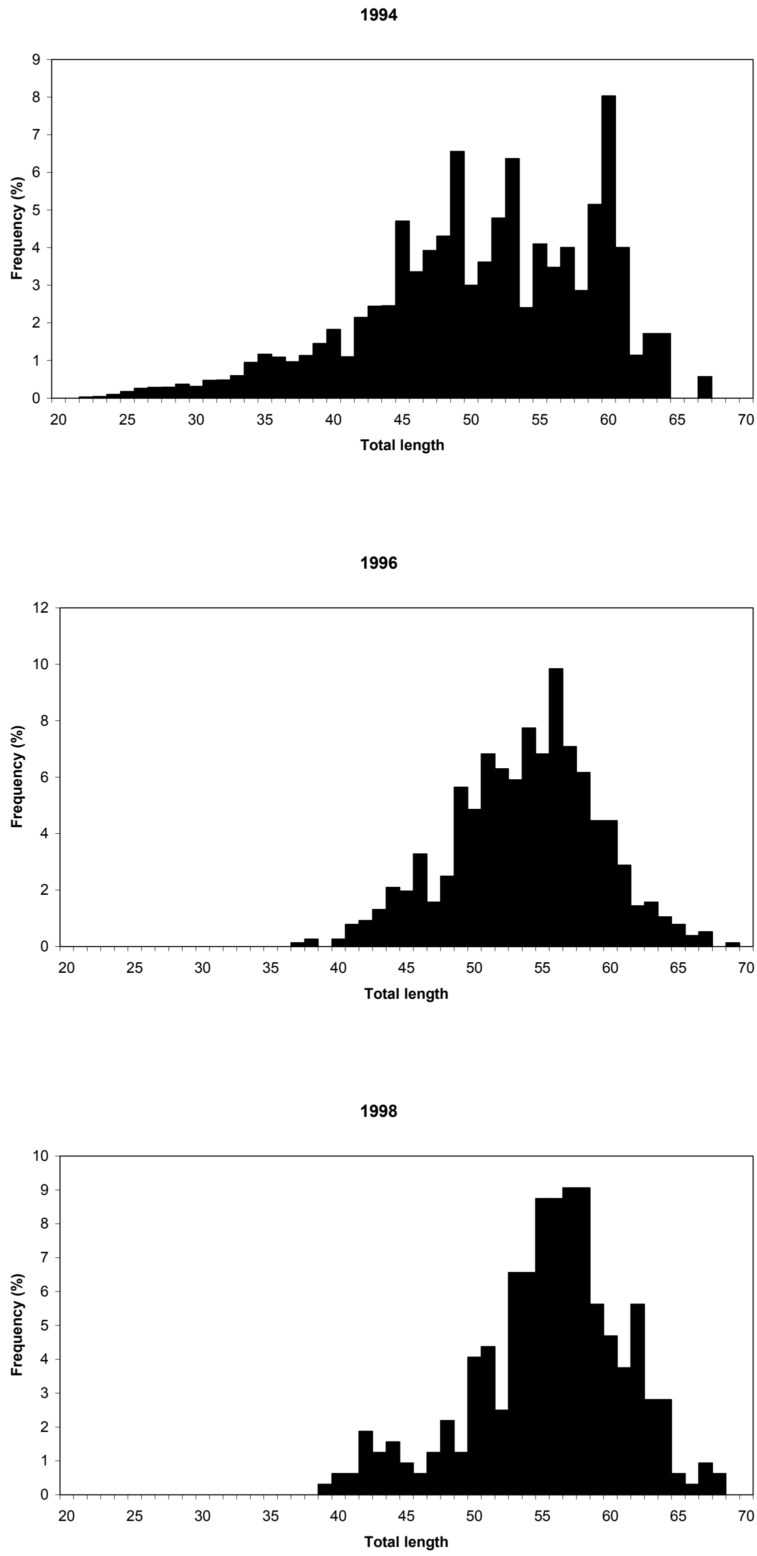


Figure 13.4 Length distribution of French landings of orange roughy from 1994 to 1998.

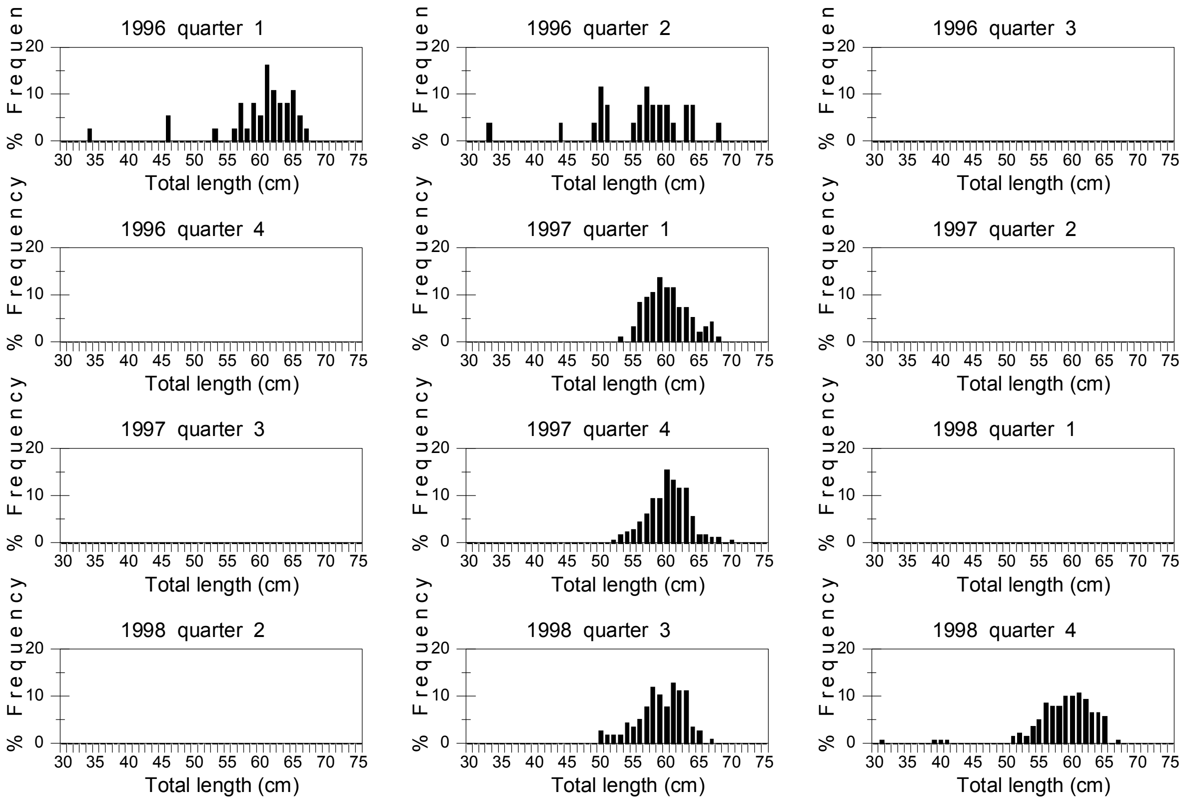


Figure 13.5 Orange roughy, quarterly landings from French vessels landing in Scotland (FRS data) (EC FAIR 1999)

14 ROUNDNOSE GRENADIER (CORYPHAENOIDES RUPESTRIS)

14.1 The fishery

14.1.1 ACFM advice applicable to 2003 and 2004

For 2003, ACFM considered that the state of the stock in Subareas VI and VII and Division Vb is uncertain, and that the state of the stock in other Subareas or Divisions, including IIIa, is also unknown. ACFM recommended regulation of the fishery in all areas in order to control fishing effort. For Subareas VI and VII and Divisions Vb and IIIa significant reductions on effort are necessary. In all other areas, the expansion of fisheries should not be allowed until reliable assessments indicate that increased harvests are sustainable.

14.1.2 Management applicable to 2003 and 2004

Since 2003, management of roundnose grenadier applicable to EU vessels fishing in EU and international waters is carried out by a combination of TAC and licensing system. The 2003 and 2004 TAC and the 2003 uptake are given in the text table below.

	I, II, IV, Va	III	Vb, VI, VII
TAC 2003 & 2004 (t)	20	1870	5106
Uptake in 2003 (t)	17	4302[1]	6210[2]

14.2 Catch trends

Table 14.1 gives the landings data for *Coryphaenoides rupestris* by country and by ICES subareas/Divisions as reported to ICES or to the Working Group.

Small catch in Subareas I, II and IV are reported. The landings from Subarea III have varied over time, but seem to have stabilised around 3000-4000 t in recent years. The bulk of the fish caught in this Subarea is landed for reduction and harvested by Danish trawlers fishing with a mesh size of 70-100 mm. Roundnose grenadier in subarea III is also a common by-catch of the *Pandalus* fishery in the deeper parts of Subarea III.

Icelandic landings in subarea Va have been increasing in the early 1990s to a peak of about 400 t in 1995, then decreasing to a 2002 level of about 60 t. No landings were reported in 2003.

The fishery in Division Vb and Subareas VI and VII is mainly conducted by French and Spanish trawlers. Unallocated landings of grenadier in Vb, VI and VII have been reported in years 2001-2003. Landings have increased in the early nineties and stabilised around 9000 t over 1993-1999. In 2000-2002, landings were well above the historical average, reaching 17000 and 14000 t in 2001 and 2002 respectively. However, these high figures should be examined cautiously. A grenadier TAC was set for the first time in 2003 for divisions Vb, VI and VII, based on recent historical landings. Therefore, there might have been incentives for an element of over-reporting in these divisions in 2001 and 2002, i.e. the years preceding 2003.

In division Vb, the landings from Faroe Islands have fluctuated over 1988-2003, and have increased in recent year. In 2003, the total landings in Vb were shared by Faroese and French vessels. In Subarea VI, the French fishery contributed to most of the landings in the 90ies. However, the contribution of Spanish vessels has probably increased since 2000. In subarea VII, the French landings peaked at more than 1 900 t in 1993-94, then decreased gradually, reaching about 400 t in 2002 and 2003. Landings from other countries were negligible up to 2001. Since 2001, Irish landings have reached similar level to French landings.

Landings are low in subareas VIII, IX and X. In subareas XII, a sharp increase has been observed, and from 1997 to 2001 the total landing has varied between 8 500 t and 12 000 t. Spain contributed to most of these landings. In 2002 and 2003, it was not possible to discriminate between Spanish landings in VIb and XII.

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[1] Includes landings in Norwegian waters

[2] Excludes Spanish landings from Sub-area VI

In 1972-1973 the Soviet research vessels found aggregations of roundnose grenadier over the northern part of Mid-Atlantic Ridge (mainly subarea XII). Starting from 1974 the commercial fishery for grenadier had been commenced and developed considerably. In 1975 grenadier catches obtained by USSR vessels amounted to 29 900t (Figure 14.1). In subsequent years the catches decreased and until 1990 varied from 2 800 to 22 800 t per year. During previous decade Russian catches continued to decrease and varied between 0 and 2 300 t (Vinnichenko, 2002; Vinnichenko *et al.,* 2002). On the other hand in 1990's Latvia and Poland conducted fishery in the area with catches 500 – 6 800 t. In 2001-2003 relatively small catches (500 - 1 700 t) are reported only by Russia (Vinnichenko, Khlivnoy, 2003; Vinnichenko, Khlivnoy, 2004a).

At least in some years, the reported landing may be well below the actual catch as fleets from countries which do not report catches or landings to ICES are thought to have been fishing in that area.

Small landings (on average 20-130 t between 1988 and 2003) are reported in subarea XIV. The German and the Greenland fleets have consistently landed grenadier since 1988. German landings were not available in 2003.

14.3 Stock identity

Results of investigations of Russian R/V “Smolensk” in 2003 show that juvenile roundnose grenadier are distributed not only on the shelf, continental slope and seamounts, but in the pelagic waters of the wide area of the Irminger Sea as well (Vinnichenko, Khlivnoy, 2004b). These data suppose a principal possibility of pelagic juveniles transport by currents from the Mid-Atlantic Ridge to the Canadian continental slopes.

No other new data on stock identity of roundnose grenadier was reported. This topic was discussed in SGDEEP94 and the general view expressed in SGDEEP is summarised below.

Roundose grenadier in subareas II and III may represent separate stock(s) due to physical boundaries to dispersion. For other populations the stock structure remains unclear. On this basis the working group carried out assessment for division Vb and subareas VI and VII combined. As in WGDEEP00 and WGDEEP02, the subarea XII was not included because landings in that area include landings from the Mid-Atlantic ridge and the Western part of Hatton Bank. Moreover, catch in Subarea XII are likely to be significantly under-reported (see above).

14.4 Data available

14.4.1 Landings

Landings data by country and Subarea/Division are shown in Table 14.1. The total international landings in Vb, VI and VII are presented in Figure 14.2. The group expressed some concerns about the validity of the landings data in recent years.

First, in 2002 and 2003, it a was not possible to distinguish between the Spanish landings from subareas VI and XII. As preliminary proxy, the 2002 and 2003 Spanish landings in VI were derived by multiplying the 2002 and 2003 landings in VI+XII by the 2001 landing allocation in VI.

Second, as described in section 14.1.3, the value of landings reported in Vb, VI and VII the years preceding 2003 (TAC year) should be interpreted with caution.

Third, due to the early scheduling of the WGDEEP meeting, some countries had not compiled the whole landing information for year 2003.

As a result, the group considered the 2001-2003 values as preliminary, coarse, proxies, and that the outcome of any analyses based on these data be interpreted cautiously.

14.4.2 Commercial CPUE

Commercial CPUE were available from the French fleet for ICES Division Vb and Subareas VI and VII. The directed CPUE was calculated using the methodology presented in Section 4.1.3. Table 14.2 contrasts the CPUE calculated by WGDEEP04 with those derived by WGDEEP01 and WGDEEP02. The directed French effort and CPUE used by WGDEEP04 are shown in Figure 14.2.

The large fluctuations observed at the beginning of the fishery could have two explanations. First, at that time, a higher proportion of the total effort was directed to other species, probably *Sebastes* in Division Vb and Subarea VI in 1989-1990 (see also WGDEEP02). Second, the large increase observed in 1990 could result from skippers gaining experience in exploiting deep-water species including grenadier. The gradual increase in the CPUE observed over the period 1992-2003 is unclear. The set of vessels used to calculate CPUE has been broadly the same over the whole period of exploitation. Discussions with the fishing industry prior to the WG indicated that there has only been little changes in the gear and equipment on-board (electronics, …) over 1989-2003. This indicates that technical creeping may not be a major issue in the case of the French fleet. However, the examination of the French CPUE series alone does not allow discriminating between changes in stock abundance and shifts in fishing strategies.

CPUE of the Spanish fleet working on the Hatton Bank (Subarea XII and division VIb) was provided for years 2001 and 2002 (WGDEEP02). CPUE for 1996-2001 is given in Durán Muñoz *et al.* (2001).

Data on catch and corresponding effort for the Danish vessels taking roundnose grenadier in IIIa are available for the period 1992-2003 from the logbooks (Table 14.3 and Figure 14.3). However, a closer evaluation of the basic logbook data for this species is necessary before accepting these CPUEs as indicators.

CPUE (catch per fishing day) of the Soviet/Russian fleet working on the Mid-Atlantic Ridge (Subarea XII and XIV) was provided for 1973-2003 (Figure 14.1).

14.4.3 Age and length composition

Length compositions from the French catches in Subarea VI and VII and Division Vb are available over the period 1990-2003 (Table 14.4). French quarterly length composition by market size categories was available over the period 1996-2003. The 1999 length composition was irrelevant due to poor sampling within the smallest market size category. It was re-calculated by combining the 1999 market size category allocation in landings by the 2000 length composition within each market size category. Length composition from French trawlers landing in Scotland and sampled by Scotland were available from 1996 to 2000 (Table 14.5). Both French and Scottish length distributions indicate a declining trend in the average size observed in the landings, and a reduction of the proportion of larger fishes over the period 1990-2001. The mean length in landings have fluctuated around 16 cm over 2001-2003. Length compositions from the Spanish catch and Subarea XII and Division VIb were also available for years 2000-2003 (Table 14.9).

In 2003 the grenadier length composition of catches taken by the Russian R/V "Atlantida" in different parts of the Mid-Atlantic Ridge was various. In the southern part up to 51-52° N total length of large mature fish was 60-80 cm (14-18 cm preanal length) and 700-800 g in weight prevailed. The length composition has changed insignificantly as compared to the data for 1980s (Figure 14.4). Further northwards the distinguished trend to fish size reduction was observed. Between 51° and 55° N total length of fish was 35-65 cm (12-16 cm preanal length) and of 300-400 g of weight prevailed. The mean length shifted in 13 cm to the left as compared to 1980s. Northwards of 55° N the size of grenadier was even less. The predominated total length was 30-60 cm (8-12 cm preanal length) and the mean weight – 300 g. As compared to 1980s the mean length decreased almost twice and the mean weight decreased almost thrice. In some cases the catches at seamounts between 51°and 55° N over the depths of 880-1140 m entirely consisted of juvenile grenadier of 12-30 cm in total length.

According to results of investigations of Russian R/V “Smolensk” in 2003 pre-anal length of pelagic juvenile roundnose grenadier in the Irminger Sea constituted 2-6 cm, individuals 3-4 cm long predominated (Figure 14.5). Weight varied from 1.3 to 18.0 g (the mean was 5.6 g). The age of most of fish constituted 1-3, in some individuals – less than one year (Figure 14.6). A tendency of mean length decreasing on the periphery of the young fish distribution area was revealed (Figure 14.7). The smallest individuals with mean length of 2.3-3.0 cm and age of about 1 year old occurred in pelagic waters above the Mid-Atlantic Ridge. In the central and northern parts of the surveyed area larger individuals with mean length of 3.5-5.0 cm and age of 2-3 year old were caught more often (Figs. 14.7 and 14.8).

On the slope of Greenland length of fish varied from 2 to 7 cm, predominantly 3-4 cm (Figure 14.9). Weight varied from 2 to 65 g (the mean was 7.8 g), the age was from 1 to 6 and predominantly constituted 2 year old (Figure 14.10). Juvenile individuals had the preanal length of 2-5 cm, the age was 1-3, weight – 1.5-20.7 g (the mean weight was 5.8 g). In the Greenland survey (WD, Jorgensen 2004), pre anal fin length ranged from 1 to 19 cm and the over all length distribution was dominated by two modes around 2 and 12 cm (Fig 14.11).

In the area of the Iceland, the Russian survey showed that grenadier was 5-18 cm long, mainly 8-10 cm (Figure 14.12), and with weight from 26 to 1 010 g. Mean weight of males constituted 193.2 g, that of females – 259.1 g. Juveniles were 3-8 cm long, predominantly, 4-6 cm (Figure 14.12), weight was 7-94 g, on average 50.6 g. Males outnumbered females in the ratio 1.3:1. Age of grenadier was 2-11 (Figure 14.13).

The age interpretation for this species do not create major concern since readers generally agree on age readings for the main age groups. Moreover, age were validated for juvenile fish (Gordon & Swan, 1996). Some age-length keys from France and Ireland (Rockall Trough area) and Norway (Skagerrak) are available (Bergstad, 1990; Kelly et al., 1997; Lorance et al. 2001ab). Lorance et al. (2003) suggested that age-length keys can probably be used to derive inputs to age-structured assessment of grenadier, although age-reading for the large individuals (> 20 cm, or > 32 years) is not considered as very reliable, due to the lack of sufficient sampling for these individuals.

Annual French ALK were available for years 1996, 1999, 2002 and 2003. In the absence of more information, the 1996 ALK was used as a first proxy to derive age compositions in 1997, and the 1999 ALK was used as a first proxy to derive age compositions in 1998, 2000 and 2001.

14.4.4 Landings numbers-at-age

The international landings numbers-at-age were raised based on French market sampling and age composition, and these are shown in Table 14.6 and Figure 14.14. No quarterly landing information was available from other countries. Therefore, landings at age were first derived for France for the whole year, and then raised to the international landings.

Figure 14.14 suggests that age composition in landings is consistent over 1996-2001. The distributions observed in 2002 and 2003 differ to those derived in earlier years. In particular, the minimum age observed in 2002-2003 was 17 (versus 11 in 1996-2001), while the maximum age observed was 52 (versus 46 in 1996-2001). The reasons for this shift were unclear, and the group agreed action should be taken to investigate that issue for the next WG.

14.4.5 Weights-at-age

Catch weights-at-age are shown in Table 14.7 and Figure 14.15. Apart from an apparent year effect in 1999, no consistent trend were observed over the time-series. In the absence of annual survey information, stock weights-at-age were assigned to catch weights-at-age.

14.4.6 Tuning fleet

The age composition of the French tuning fleet is shown in Table 14.8.

14.4.7 Discards

Discards in previous years were estimated in the project EC FAIR CT-95-655 (Gordon, 1999). New data were available from the Spanish fleet fishing on the Hatton bank (Division VIb and subarea XII) provided by the Spanish observer programme established since 1996 (Table 14.9), and from the French trawling fleet fishing in subarea VI provided by the French PO PROMA in 2001 and 2002 (Figures 14.16 and 14.17). In subarea VI, the average discard rate of grenadier is of 10-33% over depth strata of 500-1500 m. Discards peak at 10-13 cm, corresponding to ages of 10-18 years.

On the Hatton bank the Spanish fleet has an average discarding rate in weight of about 12% for the period 2002-2003. Length distributions of the discards of the Spanish fleet were provided in Durán Muñoz *et al.* (2001).

14.4.8 Biological data

Available data on biological traits of roundnose grenadier are given in the text table below:

Variable	Value	Source/comment
Longevity (years)	60	Bergstad (1990), Kelly et al. (1997), Lorance et al. (2001)
Growth rate, K	0.13 0.11 0.06 0.04 ALK available	Bergstad (1990), Skagerrak Kelly et al. (1997), Rockall Trough Allain & Lorance (2000), Rockall Trough Lorance et al. (2003) Talman et al. (WD, 2002)
Natural mortality, M	0.1	Lorance et al. (2001a)
Fecundity (absolute)	23 000 (1) 11 000 – 55 000 (2)	Allain (2001), Rockall Trough Kelly et al. (1996)
Pre anal fin length at first maturity (cm)	9 11.5 11 45-62 (total length)	Bergstad (1990), Skagerrak, average of values given for males and females Allain (1999) Durán Muñoz et al. (2001) Hatton Bank. Females Gerber et al. (WD, 2004)
Age at first maturity (years)	9 14	Bergstad (1990), Skagerrak Allain (1999), Rockall Trough

(1) species assessed as a batch spawner, the number of batches per year being unknown
(2) species assessed as a determinated spawner

Length-weight Relationship were compiled for both sex combined for the Hatton Bank (VI + XII) (Durán Muñoz *et al.,* 2001), for Subarea VII by BIM (WD, 2002b), and for the Western Iceland slope by Vinnichenko and Khlivnoy (WD, 2004b).

Reference	No individuals	a	b	R^2	Length range (cm)	Weight range (g)
Durán Muñoz *et al.,* 2001	22642	0.204	2.9636	0.9504	3.5-28	15-3268
BIM (WD, 2002b)	297	0.299	2.796	0.8696	5.5-22.5	34-2000
Vinnichenko and Khlivnoy (WD, 2004b)	91	0.178	3.019	0.974	3-18	7-1010

For the prospect of the analyses carried out in section 14.4, the natural mortality was set at 0.1 for all ages, and the maturity ogive was set at 0 for age groups below 14, and 1 for age groups above 14.

14.5 Assessment of roundnose grenadier in Vb, VI and VII

In WGDEEP02, a Schaefer surplus production model was attempted for the assessment of roundnose grenadier in Vb, VI and VII. However, the estimates of carrying capacity and current population values derived from this assessment were considered not reliable. As a result, the group did not accept this assessment.

In WGDEEP04, an age-based assessment of grenadier in Vb, VI and VII has been attempted using age compositions derived over the period 1996-2003. The software used to carry out this assessment was the Lowestoft VPA suite. The maximum age range allowed by this software was of 25 years.

Few fish younger than 15 were landed (Figure 14.14). However, the French discard survey suggests that age group 15 is subject to high discarding (sections 5 and 14.3.6). Ages above 15 are then considered to be part of the stock, although they are discarded, and the age of recruitment chosen for the analysis was taken as 15 years. In order to accommodate the constraint of using only 25 age groups for the assessment, the plus-group was fixed at 39+. The group noted that this choice resulted in an important plus-group in some years, particularly for the tuning fleet. The age range to calculate mean F was taken as 18-36.

14.5.1 Exploratory runs

The group explored the landings at age matrix using a separable VPA. The residuals resulting from the fit of the log-catch ratios are shown in Figure 14.18. Large residuals appear for the younger ages (15-18), revealing that these age groups are poorly sampled by the fishery. Residuals for the older ages stay within a reasonable range [-2, 2] and vary without trends over time. This preliminary analysis suggests that there are no major inconsistency in the landings at age matrix, except for the younger ages. In particular the unexplained differences in the age composition observed between the periods 1996-2001 and 2002-2003 does not appear to be critical from the separable VPA analysis.

A Laurec-Shepherd analysis was then run with no shrinkage to investigate the tuning fleet landings at age matrix. The log-catchability residuals derived from this analysis are shown in Figure 14.18. Figure 14.18 suggests that there is an overall trend in the residuals. This result means that the CPUE calculated for the tuning fleet is a poor abundance index, and that the overall increase in the CPUE shown in Figure 14.2 is unlikely to be due to a stock increase over the period investigated.

An XSA exploratory run was carried out with no power model. The statistical diagnostics (log-catchability, slopes and F-shrinkage at age) were poor, and the results have not been presented here.

14.5.2 Final run

The final run was carried out using a separable VPA with reference age 24, terminal F of (0.5; 0.1; 0.01) and terminal S of (1.0, 0.8, 0.6).

The exploitation pattern was calculated as F averaged over 2001-2003 and it is shown in Figure 14.19 for the different terminal-F and terminal-S options. Whatever the option, the exploitation pattern increases up to age 18, stabilises around a plateau until age 33, and then cascades down for the oldest ages.

The estimates of fishing mortality and total biomass are shown in Figure 14.20 for the different terminal-F and terminal-S options. The terminal-F value affects the absolute value of F and TSB in the time-series, as would be expected, but it also has an impact on the F and TSB historical trends. With terminal F of 0.5, F increases exponentially over 1996-2003. With terminal F of 0.1 and 0.01, F increases over 1996-2001, and then stabilises (Term-F = 0.1) or decreases (Term-F = 0.01) over 2002-2003. Although the fishing effort of the Spanish fleets is unknown, the sharp decrease observed in the French fishing effort series over 2002-2003 (Figure 14.1) suggests that Term-F is probably lower than 0.5. Although Lorance et al. (2001) suggested an F value of 0.01 in recent years, the uncertainty around fishing effort in recent years does not allow here choosing between terminal-F of 0.1 and 0.01, on the basis of reasonable grounds. If Term-F = 0.1, the total biomass in 2003 appears to be about 35% of what it was in 1996. If Term-F = 0.01, the total biomass in 2003 appears to be about 50% of what it was in 1996.

Therefore, whatever the option taken for Term-F, the total biomass appears to have decreased in the last 8 years.

14.6 Assessment of roundnose grenadier On the Mid-Atlantic Ridge

In May-July 2003, Russian R/V "*Atlantida*" carried out acoustic survey of grenadier in the area of the Mid-Atlantic Ridge located between 47-58°N. During the cruise 40 seamounts were examined. The characteristic echorecords of grenadier were noted at 32 seamounts, including 26 mounts where echosurveys were carried out. The lowest biomass of grenadier at an individual seamount was estimated at around 500 t, while the maximum value was around 20000 t, and the mean biomass was about 5000 t. The stock was distributed over the area rather uniformly. In the southern part of the area up to 51° N the biomass at 7 seamounts was 35 000 t; in the central part between 51-55° N the biomass at 12 seamounts was about 60 000 t, to the north of 55° N – about 34 000 t. Total biomass - about 130 000 t (Figure 14.21). As the subject of estimation was only pelagic aggregations of grenadier, these estimates should be considered as preliminary, and the authors of the WD by Gerber et al. (2004) consider these biomasses to be minimum estimates.

14.7 Comments on assessments

The assessment of roundnose grenadier in Vb, VI and VII should be regarded as a first attempt for running an age-structured assessment to roundnose grenadier. As it stands now, the analysis is subject to a number of limitations, which are listed below:

- The international landings in the most recent years (2001-2003) are very uncertain (section 14.3.1).
- No quarterly information was available from most countries
- Annual French ALK were available only for years 1996, 1999, 2002 and 2003. In the absence of more information, these ALK were used to derive age compositions in 1997, 1998, 2000 and 2001. (section 14.3.3).
- The age distribution in landings was not consistent between 1996-2001 and 2002-2003.
- The age range of 25 years was made to accommodate the input requirements of the Lowestoft VPA suite. This resulted in an important plus-group, particularly in the tuning fleet (section 14.4)
- The tuning fleet available exhibited strong trends in catchability, and it was not appropriate to use it as input to XSA analysis. The final run was carried out with a separable VPA, using different terminal-F and terminal-S options (section 14.4.1)

Despite these limitations, there did not appear to be major inconsistencies in the landings at age matrix used to run the separable VPA. Based on this analysis, the group could not make an assessment of the absolute fishing mortality and biomass for the grenadier. However, the group identified a consistent downwards trend in the total biomass over the period 1996-2003. Depending on the Terminal-F chosen, the total biomass in 2003 is estimated to be 35-50% of what it was in 1996.

The assessment of roundnose grenadier on the Mid-Atlantic Ridge was carried out by acoustic survey over a given period of time. Therefore, while this survey was useful in providing preliminary estimates of stock abundance over the examined period, stock trends could not be derived.

14.8 Management considerations

The current state of the grenadier stocks is overall uncertain. The observed increasing CPUE over recent years in Vb, VI, VII is not believed to reflect an increase of the stock size. It is much more likely to reflect a change in the fishing strategy, in the geographical distribution of effort or in the fish accessibility. Although the age-structured assessment carried out here is of a preliminary nature, the results indicate that the total biomass has been declining consistently since 1996. These results are supported by the size composition of the landings towards smaller fish (Tables 14.4 and 14.5). Therefore, given WGDEEP00 estimated the index of exploitable biomass (U) of grenadier to be below U_{pa} in 2000, the group estimated this year that U has been below U_{pa} over the period 2000-2003.

No analytical assessments could be carried out for the other stocks, but the landings in IIIa have increased substantially in recent years, while fish removals in subarea XII are believed to be underestimated due to misreporting.

The groups feels that overall, the 2003 EU TAC has not efficiently restricted fish removals. The group did not feel in a position to advise on which management measures would be the most appropriate to control exploitation. However, if TAC cannot limit efficiently fish removals, then they should be accompanied by restrictions in fishing selectivity, capacity and/or activity of the vessels.

Roundnose grenadier are taken in a mixed-species fishery, along with other deep-water species (black scabbard and sikis in Vb, VI and VII) or other species (*Pandalus* in the deeper parts of subdivision III). Any measures taken to manage the stocks of grenadier should therefore be based on the advice given for all the species taken in the same deep-water mixed fishery.

Table 14.1 Roundnose grenadier (*Coryphaenoides rupestris*). Study Group estimates of landings (tonnes).

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) I and II

Year	Faroe	Denmark	France	Germany	Norway	Russia/USSR	GDR	UK(E+W)	UK(Scot)	**TOTAL**
1988										**0**
1989			1	2		16	3			**22**
1990			32	2		12	3			**49**
1991			41	3	28					**72**
1992		1	22	0	29					**52**
1993			13	0	2					**15**
1994			3	12						**15**
1995			7							**7**
1996			2							**2**
1997	1		5		100					**106**
1998			0		87	13				**100**
1999			0		44	2				**46**
2000			0						0	**0**
2001			0					2	0	**2**
2002*			0		11	1				**12**
2003*			0		4	0				**4**

* Preliminary data

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) III

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	1103	55		**1158**
1994	517		42	**559**
1995	0		1	**1**
1996	2213			**2213**
1997	0	124	42	**166**
1998	1490	329		**1819**
1999	3113	13		**3126**
2000	2400	4		**2404**
2001	3067	35		**3102**
2002*	4196	24		**4220**
2003*	4302	0		**4302**

* Preliminary data

Table 14.1 continued

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) IV

Year	France	Germany	Norway	Scotland	Denmark	**TOTAL**
1988		1				**1**
1989	167	1		2		**170**
1990	370	2				**372**
1991	521	4				**525**
1992	421			4	1	**426**
1993	279	4			0	**283**
1994	185	2			25	**212**
1995	68	1		15	0	**84**
1996	59			5	7	**71**
1997	1			10	0	**11**
1998	35		0		0	**35**
1999	56		5		0	**61**
2000	2				0	**2**
2001	2				17	**19**
2002*	11		1	26	0	**38**
2003*	0		2	11		**13**

* Preliminary data

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) Va

Year	Faroes	Iceland**	Germany	UK(E+W)	**TOTAL**
1988		2			**2**
1989	2	2			**4**
1990		7			**7**
1991		48			**48**
1992		210			**210**
1993		276			**276**
1994		210			**210**
1995	0	398			**398**
1996	1	139			**140**
1997	0	198			**198**
1998		120	0		**120**
1999		129	0		**129**
2000		67			**67**
2001		57		0	**57**
2002*		60			**60**
2003*					**0**

* Preliminary data

** includes other grenadiers from 1988 to 1996

Table 14.1 continued

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) Vb

Year	Faroes	France	Norway	Germany	Russia/USSR	UK	**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	0		29	**1996**
2000	48	1699		1		43	**1791**
2001	85	1932					**2017**
2002*	178	768				81	**1027**
2003*	513	658				10	**1181**

* Preliminary data

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) VI

Year	Faroes	France	Germany	Ireland	Norway	Spain	E & W	UK (Scot)	Russia	**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	0	6329	2	59				82		**6472**
1996	0	5888						156		**6044**
1997	15	5795		4	-			218		**6032**
1998	13	5170			21	3				**5207**
1999		5637	3	1	-	1				**5642**
2000	0	7478		41	1	1002	1	433		**8956**
2001	12	5897	6	31	32	6942	21	955	3	**13899**
2002*,**	0	7209		12		**	6	741		**7968**
2003*,**	0	4296		11		**	0	185	3	**4495**

* Preliminary data

** Spanish landings included in XII

Table 14.1 continued

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)
VII

Year	Faroes	France	Ireland	Spain	UK(Scotland)	**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		889		0		**889**
2001		947	416	0		**1363**
2002*	1	451	605	0	3	**1060**
2003*		320	213	0	1	**534**

* Preliminary data

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) VIII and IX

Year	France	Spain	**TOTAL**
1988			**0**
1989	0		**0**
1990	5		**5**
1991	1		**1**
1992	12		**12**
1993	18		**18**
1994	5		**5**
1995	0		**0**
1996	1		**1**
1997	0	0	**0**
1998	1	19	**20**
1999	9	7	**16**
2000	5	0	**5**
2001	7	0	**7**
2002*	3	0	**3**
2003*	1	0	**1**

* Preliminary data

Table 14.1 continued

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) X

Year	Faroes	France	UK (E+W)	**TOTAL**
1988				**0**
1989				**0**
1990				**0**
1991				**0**
1992				**0**
1993				**0**
1994				**0**
1995	0			**0**
1996	3			**3**
1997	1			**1**
1998	1			**1**
1999	3	3		**6**
2000	0	0	74	**74**
2001	0			**0**
2002*	2			**2**
2003*	0			**0**

* Preliminary data

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) XII

Year	Faroes	France	Germany	Iceland	Ireland	Latvia	Russia/ USSR	Poland	Spain	UK (E&W)	UK (Scotl.)	Norway	
1988							10600						**10600**
1989		0					9500						**9500**
1990		0					2800						**2800**
1991		14				4296	3200						**7510**
1992		13				1684	300						**1997**
1993		26	39			2176	500						**2741**
1994	457	20	9			675							**1161**
1995	359	285											**644**
1996	136	179		77			200		1136				**1728**
1997	138	111					700	5867	1800				**8616**
1998	19	116					800	6769	4262				**11966**
1999		287				-1	576	546	8251				**9659**
2000	6	391	9				2325		5791		6		**8528**
2001	12	156			3		1714		5922		7	1	**7815**
2002*,**	1	14					737		6497	1	1		**7251**
2003*,**	0	384			1		585		8459		3		**9432**

* Preliminary data

** Spanish landings include VI

Table 14.1 continued

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)
XIV

Year	Faroes	Germany	Greenland	Iceland**	Norway	E & W	Scotland	**TOTAL**
1988		45	7					**52**
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	0	13	14					**27**
1996	0	6	19					**25**
1997	6	34	12		7			**59**
1998	1	116	3		6			**126**
1999		105	0		19			**124**
2000	0	41	11		5			**57**
2001	0	11	5		7	2	72	**97**
2002*	0	25	5		15	1	1	**47**
2003*	0		15		5	1		**21**

* Preliminary data
** includes other grenadiers from 1988 to 1996

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) unallocated landings in Vb, VI and VII

Year	Unallocated	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994		**0**
1995		**0**
1996		**0**
1997		**0**
1998		**0**
1999		**0**
2000		**0**
2001	208	**208**
2002	504	**504**
2003	952	**952**

Table 14.1 continued

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)
all sea areas

Year	I+II	III	IV	Va	Vb	VI	VII	VIII +IX	X	XII	XIV	Unallocated	Total
1988	0	617	1	2	1	32	0	0	0	10600	52	0	**11 305**
1989	22	885	170	4	258	2218	222	0	0	9500	45	0	**13 324**
1990	49	1067	372	7	1549	5515	215	5	0	2800	47	0	**11 626**
1991	72	1528	525	48	2311	7304	489	1	0	7510	29	0	**19 817**
1992	52	2328	426	210	3817	6782	1556	12	0	1997	31	0	**17 211**
1993	15	1158	283	276	1681	8205	1916	18	0	2741	26	0	**16 319**
1994	15	559	212	210	668	5938	1922	5	0	1161	15	0	**10 705**
1995	7	1	84	398	1223	6472	1295	0	0	644	27	0	**10 151**
1996	2	2213	71	140	1078	6044	1051	1	3	1728	25	0	**12 356**
1997	106	166	11	198	1112	6032	1038	0	1	8616	59	0	**17 339**
1998	100	1819	35	120	1667	5207	1157	20	1	11966	126	0	**22 218**
1999	46	3126	61	129	1996	5642	896	16	6	9659	124	0	**21 701**
2000	0	2404	2	67	1791	8956	889	5	74	8528	57	0	**22 773**
2001	2	3102	19	57	2017	13899	1363	7	0	7815	97	208	**28 586**
2002*,**	12	4220	38	60	1027	7968	1060	3	2	7251	47	504	**22 192**
2003*,**	4	4302	13	0	1181	4495	534	1	0	9432	21	952	**20 935**

* Preliminary data

** Spanish landings in VI included in XII

Table 14.2 Roundnose grenadier in divisions Vb, VI and VII. CPUE data used for assessement: total catch, total effort and CPUE or the reference fleet, Total international catch and directed CPUE used in WG01, WG02 and WG04.

ICES subarea	Year	Total international catch (t)	Data for the reference fleet				
			WG01	WG02	WG04		
			cpue (kg/h)	cpue (kg/h)	Catch (t)	effort (h)	cpue (kg/h)
Vb, VI, VII	1989	2698	212	29	244	5615	44
Vb, VI, VII	1990	7279	365	301	2630	13047	202
Vb, VI, VII	1991	10104	312	317	3246	20350	160
Vb, VI, VII	1992	12155	201	179	2455	25492	96
Vb, VI, VII	1993	11802	239	201	2775	25865	107
Vb, VI, VII	1994	8528	202	143	2663	27507	97
Vb, VI, VII	1995	8990	211	177	2300	19036	121
Vb, VI, VII	1996	8173	162	157	2497	21350	117
Vb, VI, VII	1997	8182	166	145	3214	24956	129
Vb, VI, VII	1998	8031	113	108	2327	23477	99
Vb, VI, VII	1999	8534		152	4119	31056	133
Vb, VI, VII	2000	11636		208	5090	28371	179
Vb, VI, VII	2001	17487		170	4712	33072	142
Vb, VI, VII	2002	14065			4963	29359	169
Vb, VI, VII	2003	11406			2966	18859	157

Table 14.3 Roundnose grenadier in division IIIa. Logbook recorded catch and effort from Danish trawlers.

Year	**Mesh size in Trawl:** >100 mm			70 - 100 mm			30 - 45 mm			< 25 mm			All trawls
	Kg	days	CPUE	Kg	days	CPUE	Kg	days	CPUE	Kg	days	CPUE	**CPUE**
1992				668290	68	9827,8	56000	36	1555,6	92500	11	8409,1	**7102,5**
1993	515	2	257,5	567215	71	7988,9	419800	45	9328,9	65000	4	16250,0	**8627,3**
1994				1467785	95	15450,4	121500	46	2641,3				**11271,5**
1995				1105522	66	16750,3	974250	172	5664,2				**8738,5**
1996				1016505	79	12867,2	62100	34	1826,5				**9545,2**
1997				1321280	82	16113,2				35000	3	11666,7	**15956,2**
1998				3893000	132	29492,4	5000	5	1000,0	100000	3	33333,3	**28557,1**
1999				1586175	82	19343,6	450	5	90,0				**18237,1**
2000				1305955	98	13326,1	330000	11	30000,0	160000	6	26666,7	**15617,0**
2001				1922900	130	14791,5				112500	9	12500,0	**14643,2**
2002				2825500	134	21085,8						#DIV/0!	21085,8
2003				**165150**	**26**	**6351,9**							**6351,9**

Table 14.4 Roundnose grenadier, percent length composition (pre-anal fin length) per year of the French landings landed in France.

Pre-anal Length cm	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
10											
11						0.20					0.24
12						1.82	0.27	0.20		0.12	1.84
13				0.34	0.63	5.85	0.77	1.21	0.55	1.82	5.82
14		0.50		1.58	3.87	8.31	3.98	6.06	2.86	8.37	16.33
15	0.47	0.53	0.93	8.61	5.41	14.64	9.00	14.14	9.86	17.23	21.29
16	1.07	2.56	3.47	9.55	12.77	15.32	15.70	11.92	15.76	23.67	19.63
17	5.16	7.39	9.73	16.17	17.65	13.86	15.17	15.96	16.22	21.36	13.54
18	9.89	10.67	15.51	18.18	16.02	14.95	16.23	15.15	16.04	15.17	8.00
19	12.28	14.11	14.56	15.76	14.11	10.25	14.19	9.70	15.12	6.80	5.82
20	15.08	16.19	18.57	14.08	13.36	7.92	10.84	10.71	10.78	3.40	3.32
21	19.05	17.70	11.76	8.37	10.07	5.03	7.97	7.27	6.73	1.09	2.20
22	14.69	14.29	10.99	4.47	3.72	1.25	2.89	5.05	4.24	0.73	1.29
23	12.95	9.50	8.43	2.06	1.37	0.40	1.33	1.62	1.38	0.12	0.49
24	5.77	5.26	4.10	0.54	0.68	0.20	1.11	0.61	0.46	0.12	0.14
25	3.07	0.91	1.20	0.15	0.17		0.56	0.40			0.06
26	0.29	0.39	0.58	0.15							
27	0.24		0.16		0.17						
28											
29											
30											

Table 14.4. continued

Pre-anal Length cm	2001	2002	2003
10	0.05	0.00	0.00
11	0.82	0.54	0.09
12	4.23	1.98	1.46
13	12.89	6.08	5.90
14	19.07	10.95	11.91
15	17.48	16.21	16.20
16	16.25	15.13	16.17
17	10.76	14.44	13.34
18	6.80	13.33	9.49
19	5.99	9.79	11.40
20	3.28	6.61	7.17
21	1.34	2.89	3.11
22	0.79	1.58	2.50
23	0.25	0.34	1.02
24	0.00	0.13	0.25
25	0.00	0.02	0.00
26			
27			
28			
29			
30			

Table 14.5 Roundnose grenadier, percent length composition (pre-anal fin length) per year of French catches landed in Scotland.

Pre-anal fin length	1996	1997	1998	1999	2000
10	0	0	0	0	0
11	0.09	0.13	0.14	0.04	0.05
12	0.24	0.52	0.37	0.93	0.56
13	1.56	3.36	2.26	3.49	4.07
14	6.66	10	8.04	9.6	11.68
15	14.31	15.06	13.96	15.23	15.23
16	18.24	18.89	18.77	19.51	14.05
17	18.85	17.79	19.41	17.7	13.48
18	15.48	13.92	14.66	13.76	14.63
19	11.66	10.21	10.54	10.55	11.94
20	7.57	5.66	7.12	5.31	7.38
21	4.31	2.81	3.47	2.45	4.31
22	0.83	1.02	0.92	0.85	1.79
23	0.2	0.51	0.28	0.27	0.8
24	0	0.08	0.05	0.14	0
25	0	0.04	0	0.16	0
26	0	0	0	0	0

Table 14.6 Roundnose grenadier in IV, VI and VII. Landings numbers-at-age.

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1996	1997	1998	1999	2000	2001	2002	2003
AGE								
15	67	97	117	62	100	337	0	0
16	72	110	142	249	406	1079	0	0
17	205	269	311	426	690	1705	0	46
18	382	488	564	667	1078	1986	136	426
19	483	588	669	726	1183	2151	408	256
20	539	611	662	873	1395	2376	422	438
21	755	856	921	765	1282	2153	968	442
22	636	730	769	1255	1928	3052	634	505
23	728	784	788	930	1246	1845	1497	676
24	775	813	816	878	1286	1833	1094	1126
25	557	578	570	1253	1415	1829	1334	1380
26	569	581	580	1111	886	1279	1419	1291
27	462	477	439	777	814	1095	1274	1099
28	618	618	603	614	698	1002	1028	1069
29	345	331	333	514	397	597	1039	604
30	335	304	290	341	278	355	1006	823
31	342	318	304	273	339	495	994	717
32	271	274	266	146	201	249	565	858
33	201	185	160	347	143	195	562	527
34	213	194	182	50	80	111	500	402
35	144	125	113	195	93	114	246	425
36	68	68	60	32	38	68	369	210
37	81	61	55	100	64	72	172	192
38	20	18	15	156	101	78	203	106
+gp	216	185	167	220	116	176	1142	950
0 TOTALNUM	9084	9663	9896	12960	16257	26232	17012	14568
TONSLAND	8173	8182	8031	8534	11636	17487	14065	11406
SOPCOF %	100	101	101	101	101	101	100	100

Table 14.7 Roundnose grenadier in IV, VI and VII. Landings weights-at-age (kg).

	Table 2	Catch weights at age (kg)							
	YEAR	1996	1997	1998	1999	2000	2001	2002	2003
	AGE								
	15	0,62	0,574	0,568	0,429	0,429	0,411	0,411	0,411
	16	0,574	0,546	0,537	0,437	0,506	0,47	0,47	0,47
	17	0,675	0,64	0,623	0,435	0,508	0,467	0,467	0,701
	18	0,691	0,656	0,634	0,445	0,56	0,512	0,687	0,461
	19	0,742	0,705	0,678	0,458	0,593	0,547	0,598	0,61
	20	0,811	0,768	0,735	0,482	0,602	0,565	0,687	0,51
	21	0,798	0,762	0,734	0,501	0,634	0,614	0,67	0,603
	22	0,811	0,774	0,744	0,515	0,636	0,601	0,707	0,621
	23	0,871	0,829	0,8	0,632	0,711	0,672	0,672	0,643
	24	0,888	0,848	0,814	0,624	0,738	0,727	0,725	0,724
	25	0,911	0,878	0,837	0,695	0,749	0,737	0,647	0,711
	26	0,939	0,89	0,859	0,829	0,874	0,842	0,726	0,745
	27	0,967	0,931	0,905	0,758	0,819	0,798	0,801	0,749
	28	0,925	0,874	0,861	0,729	0,8	0,776	0,86	0,756
	29	0,999	0,923	0,876	0,884	0,954	0,948	0,832	0,71
	30	1,027	0,98	0,962	0,881	1,018	1,001	0,897	0,777
	31	1,009	0,96	0,944	0,786	0,876	0,871	0,923	0,793
	32	0,967	0,934	0,905	0,863	0,956	0,946	0,984	0,865
	33	1,122	1,081	1,023	0,949	1,205	1,166	1,099	0,99
	34	1,067	1,048	1,019	1,064	1,193	1,143	0,999	0,904
	35	1,079	1,031	1,027	0,939	1,123	1,044	1,184	1,036
	36	1,064	1,029	0,996	1,033	1,091	1,059	1,182	1,122
	37	1,223	1,172	1,12	0,834	0,887	0,904	1,168	1,067
	38	1,5	1,489	1,49	0,944	1,227	1,142	0,955	1,137
	+gp	1,186	1,143	1,146	0,908	1,148	1,126	1,106	1,187
0	SOPCOF/	1,0037	1,0059	1,008	1,0053	1,007	1,0127	1,0001	1

Table 14.8. Roundnose grenadier in IV, VI and VII. Tuning data.

Roundnose	grenadier	(Fishing	Areas	Vb,VI&VII)																
101																				
FLT01:	French	trawlers																		
1996	2003																			
1	1	0	1																	
15	34																			
21350	20652	22259	63823	118902	150012	166503	234422	197186	224001	238279	171427	174689	141085	189398	105205	102181	103813	82246	60444	64233
24956	36685	41088	104352	189300	228212	238828	336238	286490	307631	320358	227792	228278	187596	243574	130024	120450	125569	107343	72507	76040
23477	33636	40144	88874	160682	192205	190502	264957	222485	228325	234748	164269	168166	127543	174881	96479	84165	88103	77223	46563	53045
31056	13187	52325	89644	139022	149847	186243	152033	283936	251513	213663	393478	430150	258975	192511	202858	131692	80646	39198	163229	11811
28371	31413	130015	224205	360202	382947	459628	396662	645703	442248	419239	569902	444284	333903	268823	194909	131690	115229	58346	122548	16362
33072	13811	44219	68346	78387	87082	110962	86110	190114	228507	175513	399675	530866	288586	206386	261279	166116	90143	43105	221721	16048
29359	0	0	0	10716	25629	35009	80287	58511	155893	119946	149963	117600	221503	195128	159858	244555	264212	192647	280163	176478
18859	0	0	3981	29009	20266	32528	34022	50780	61784	167121	197322	236540	195853	200453	76060	155917	137674	221299	190891	111393

Table 14.9 Roundnose grenadier in Division VIb and subarea XII. Percent length composition (pre-anal fin length) per year of Spanish catches, sampled on board before sorting out of retained landings and discards.

Pre-Anal Length (cm)	VIb(2000)	VIb(2001)	XII(2000)	XII(2001)	VIb+XII(2002)	VIb+XII(2003)
5	0.03		0.02	0.02	0.0	
5.5		0.03	0.05	0.05	0.1	0.0
6	0.06	0.50	0.07	0.16	0.3	0.0
6.5	0.11	0.47	0.16	0.42	0.4	0.1
7	0.49	0.83	0.29	0.65	0.6	0.1
7.5	0.03	1.09	0.43	0.59	0.6	0.3
8	0.57	0.80	0.66	0.81	1.0	0.7
8.5	0.34	0.93	0.82	0.83	0.9	0.5
9	0.90	1.64	1.18	0.95	1.3	0.8
9.5	0.89	1.77	1.48	1.45	1.5	1.6
10	1.62	2.91	2.34	3.03	2.2	1.8
10.5	2.10	2.48	2.50	2.88	2.4	3.4
11	3.64	3.43	3.82	3.29	3.6	5.0
11.5	4.18	2.97	4.08	3.84	3.5	5.9
12	5.71	4.85	5.29	5.37	5.0	9.0
12.5	7.16	4.25	4.96	5.43	4.9	10.1
13	7.89	6.04	6.28	7.04	6.2	10.3
13.5	9.36	5.81	6.27	6.77	5.5	9.2
14	10.40	7.60	8.22	7.04	7.6	8.0
14.5	8.94	8.49	6.75	6.72	6.6	6.1
15	8.63	7.25	7.68	8.07	7.6	5.3
15.5	5.16	6.34	6.24	6.46	6.1	3.8
16	5.82	5.74	6.31	5.19	6.3	4.1
16.5	4.51	4.55	4.51	4.61	4.0	2.9
17	3.27	5.20	4.83	3.65	4.7	2.4
17.5	2.57	3.12	3.19	3.36	3.1	2.1
18	2.21	2.36	2.84	2.46	3.1	1.3
18.5	1.06	1.78	2.23	2.00	2.0	1.3
19	0.63	1.18	1.62	1.64	2.0	1.1
19.5	0.54	1.29	1.11	1.10	1.5	0.9
20	0.30	1.06	1.03	0.95	1.3	0.7
20.5	0.23	0.78	0.65	0.76	1.0	0.5
21	0.08	0.65	0.70	0.44	0.9	0.4
21.5	0.32	0.43	0.45	0.44	0.5	0.1
22		0.70	0.36	0.48	0.7	0.1
22.5	0.15	0.32	0.17	0.27	0.4	0.0
23	0.08	0.17	0.13	0.19	0.4	0.1
23.5		0.15	0.09	0.11	0.1	0.0
24		0.02	0.09	0.18	0.1	0.0
24.5		0.02	0.04	0.03	0.0	0.0
25			0.07	0.16	0.0	
25.5			0.02	0.05	0.0	
26			0.00	0.02	0.0	
26.5			0.00	0.01	0.0	
27			0.01		0.0	
Catch (tonnes)	1109	2374	6211	8226	55	33
Number fish measured	1170	3939	17947	10043	11487	6360

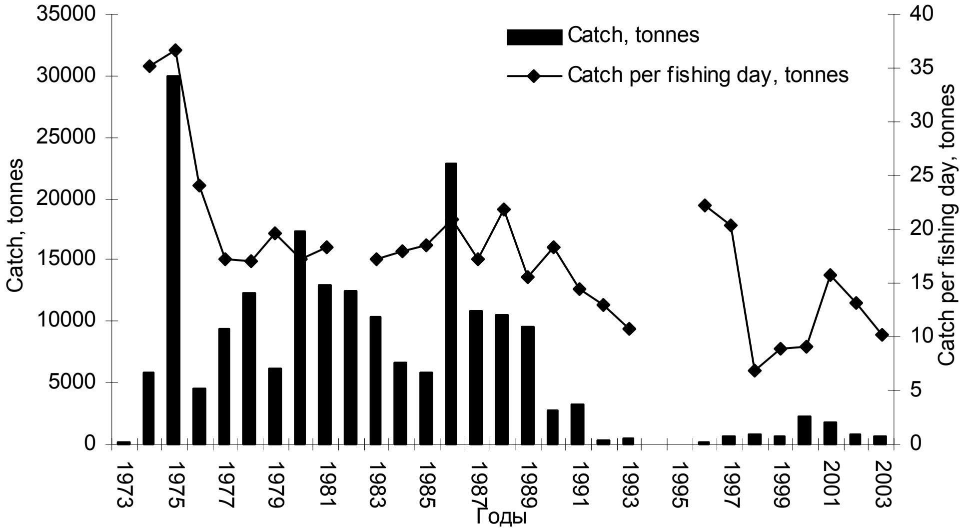

Figure 14.1 Soviet/Russian catch and CPUE of roundnose grenadier on the Mid-Atlantic Ridge in 1973-2003 (Vinnichenko, 2002; Vinnichenko, Khlivnoy, 2004a).

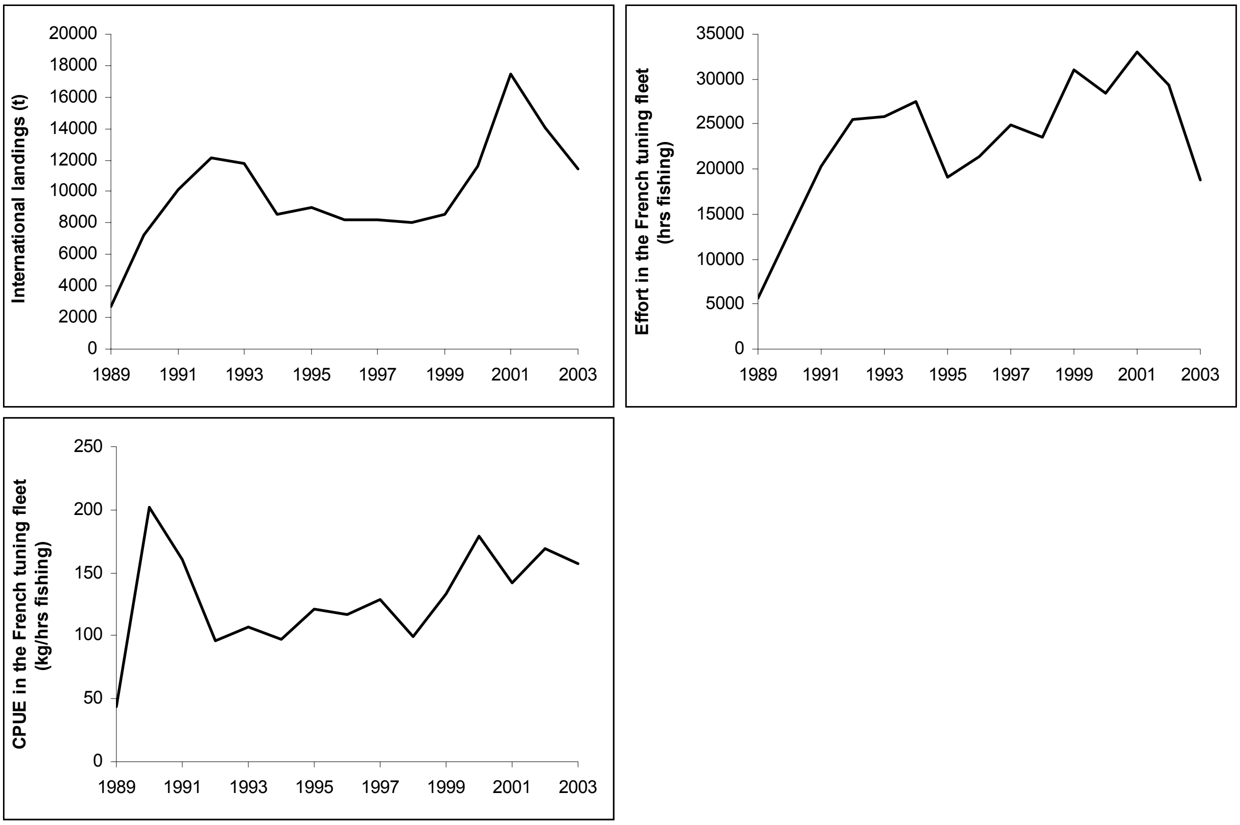

Figure 14.2 Roundnose grenadier in Vb, VI and VII. Total international landings (tonnes), fishing effort (hours) and CPUE (kg/hours) in the French tuning fleet.

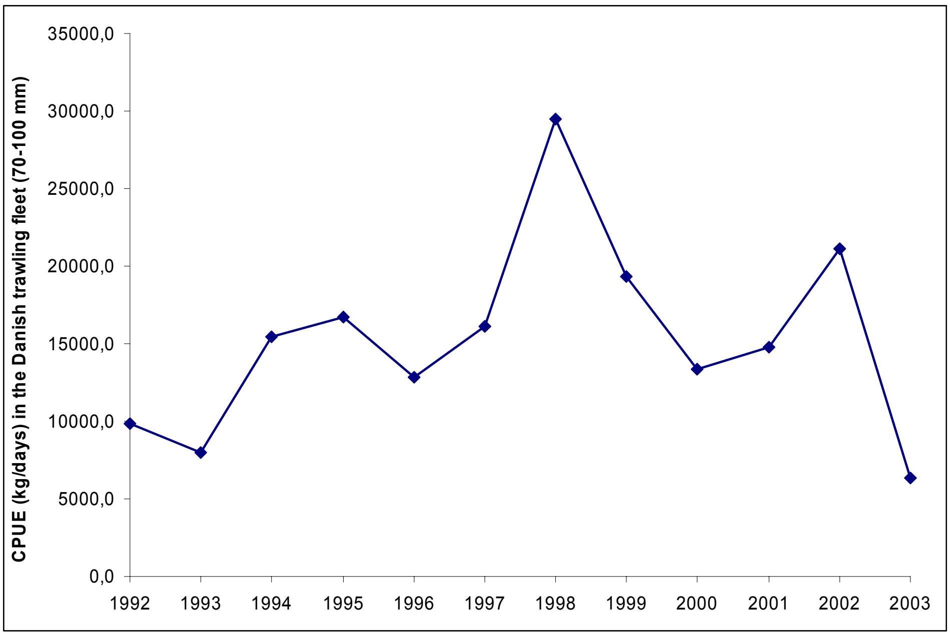

Figure 14.3 Roundnose grenadier in Subarea III. CPUE (kg/days) in the Danish trawling fleet fishing with mesh size of 70-100 mm.

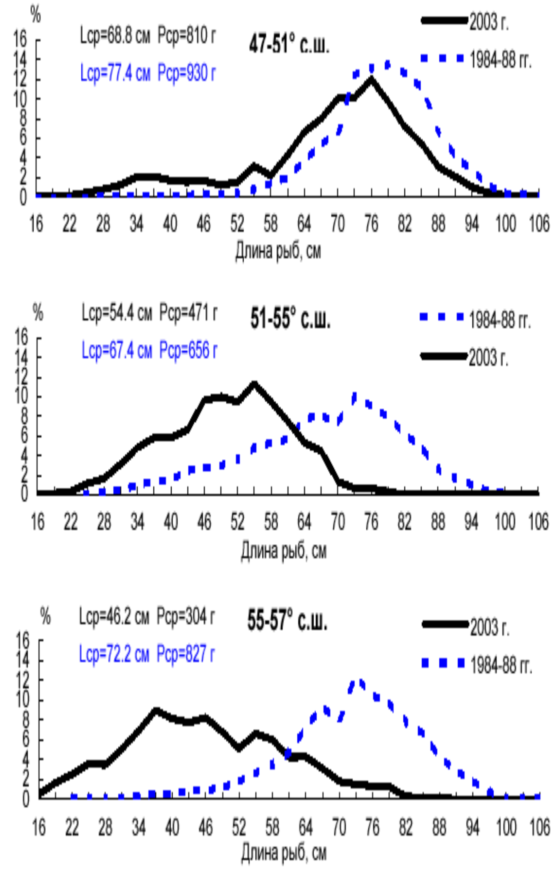

Figure 14.4 Length composition of grenadier by areas of Mid-Atlantic Ridge in 2003 and 1984-88.

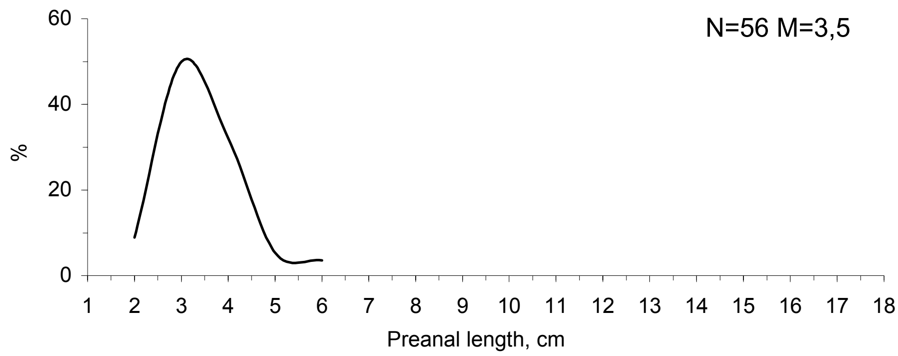

Figure 14.5 Length composition of roundnose grenadier in the Irminger Sea in May-June 2003

Total length, cm

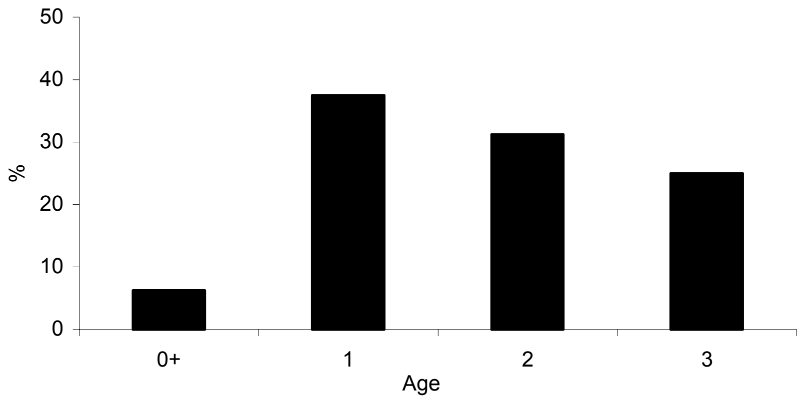

Figure 14.6 Age composition (years) of roundnose grenadier in the Irminger Sea in May-June 2003

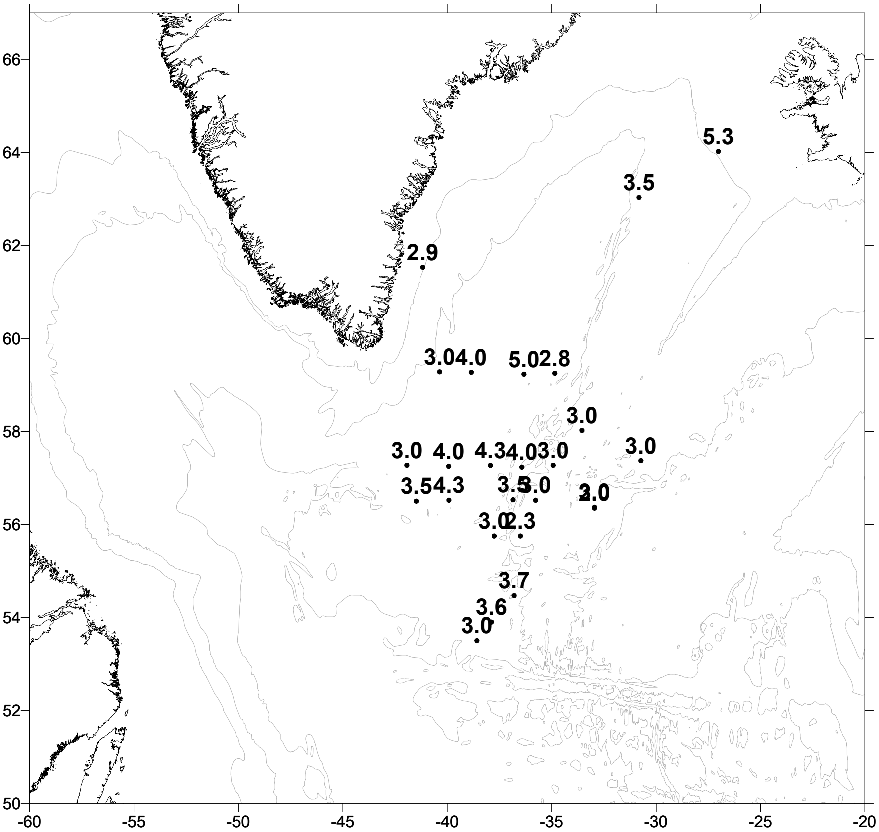

Figure 14.7 Mean preanal length (cm) of young roundnose grenadier in the Northeast Atlantic in May-July 2003

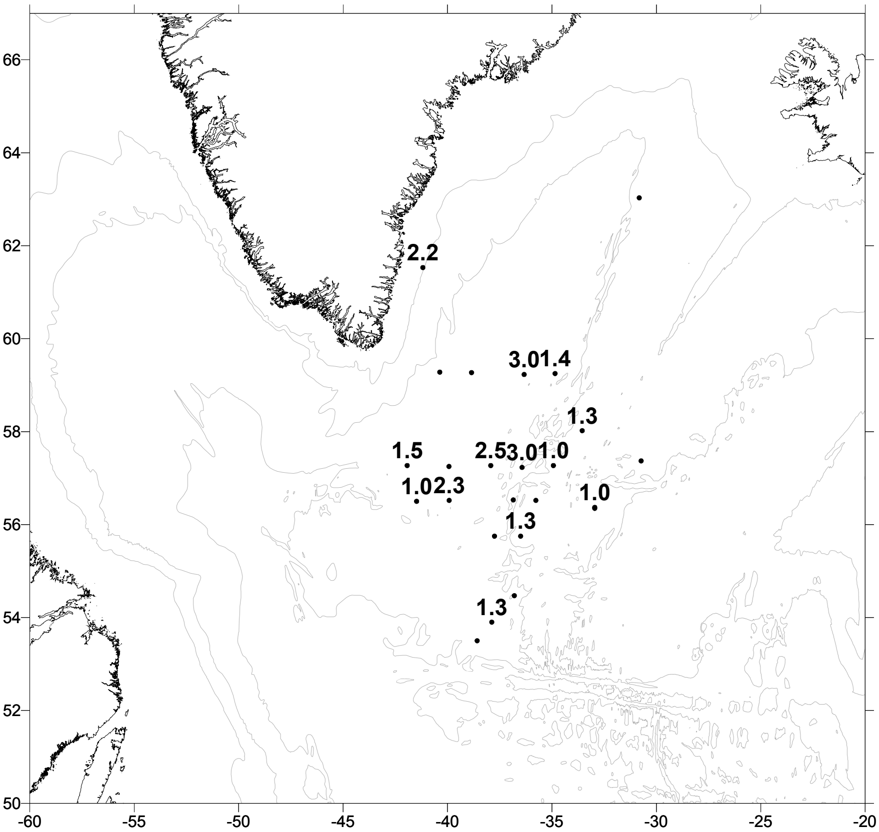

Figure 14.8 Mean age (years) of young roundnose grenadier in the Northeast Atlantic in May-July 2003.

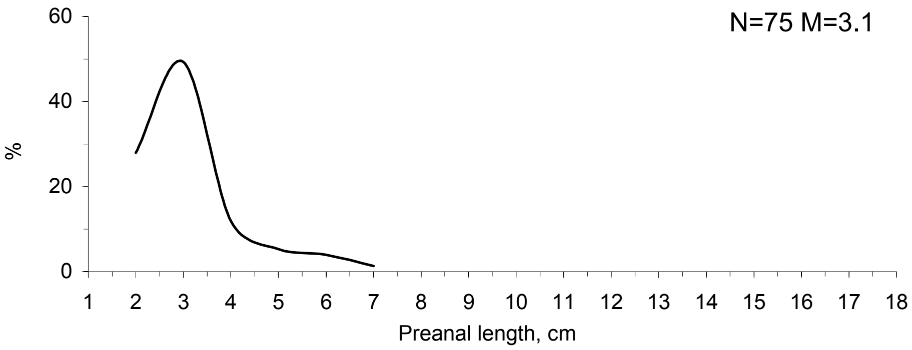

Figure 14.9 Length composition of roundnose grenadier on the East Greenland slope (Tordbnsheld Bank area) in June 2003

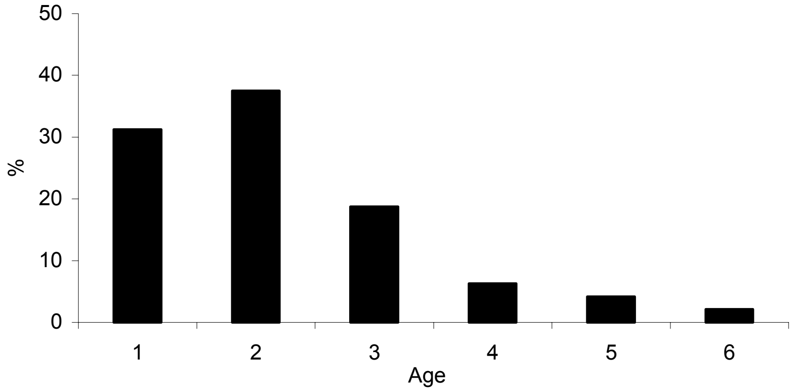

Figure 14.10 Age composition (years) of roundnose grenadier on the East Greenland slope (Tordbnsheld Bank area) in June 2003

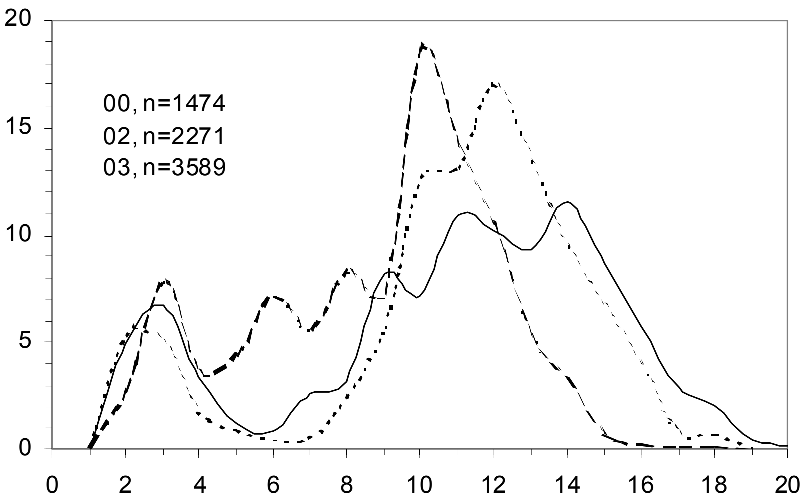

Figure 14.11 Over all length distribution (percent) of roundnose grenadier by year at East Greenland from the Greenland survey. Solid line: 2000. Dashed line 2002. Dotted line:2003.

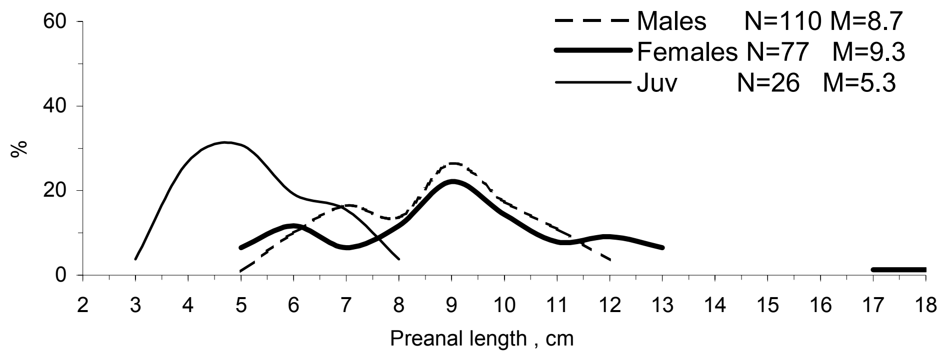

Figure 14.12 Length composition of roundnose grenadier on the West Iceland slope in June-July 2003

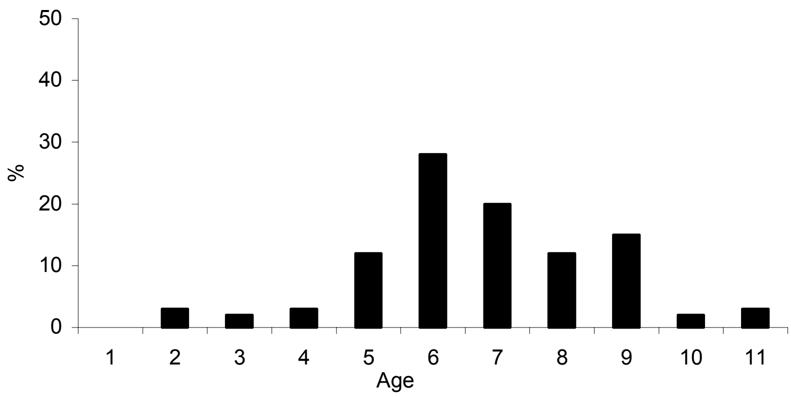

Figure 14.13 Age composition (years) of roundnose grenadier on the West Iceland slope in June-July 2003

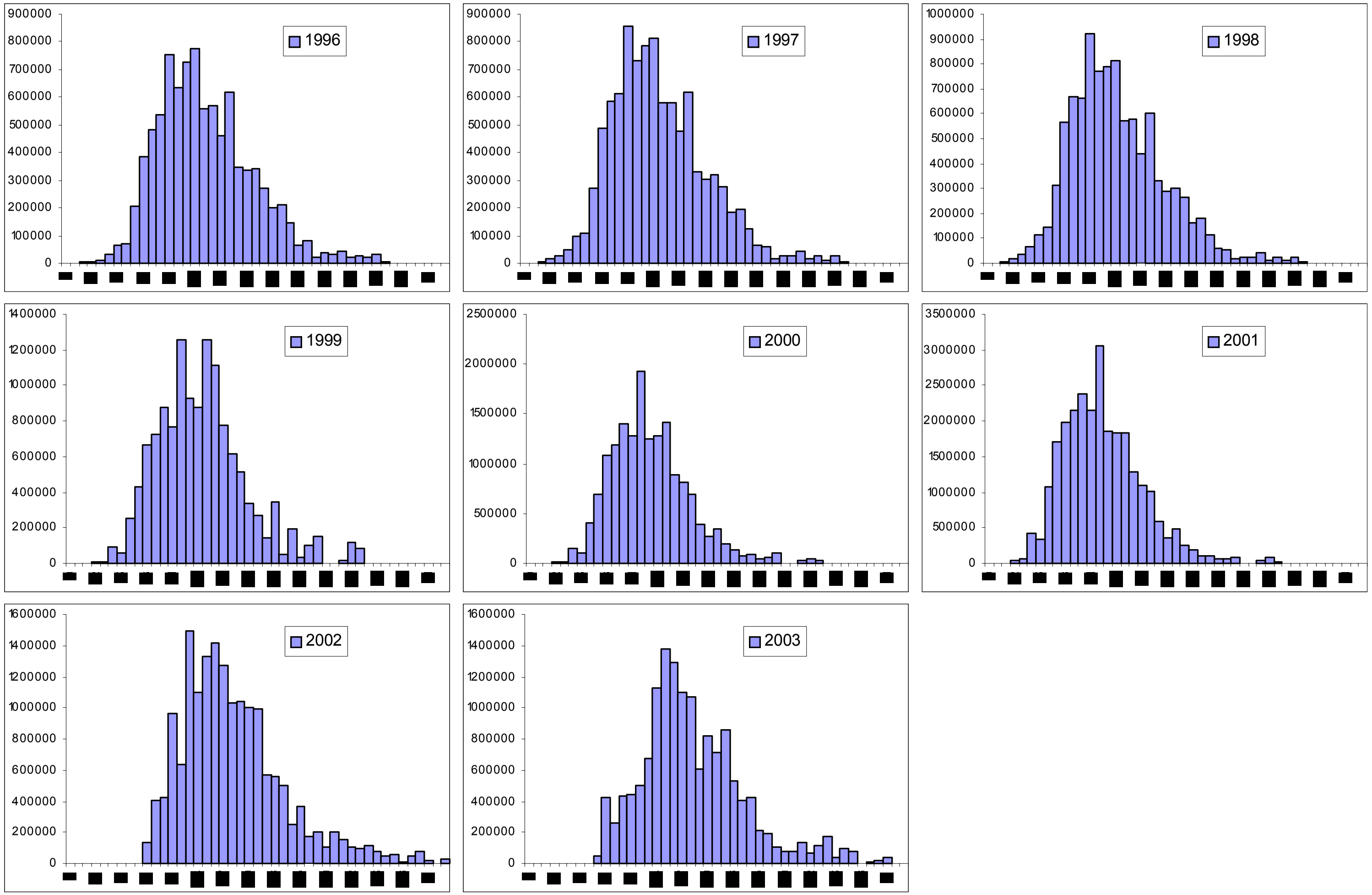

Figure 14.14 Roundnose grenadier in IV, VI and VII. Landings numbers-at-age.

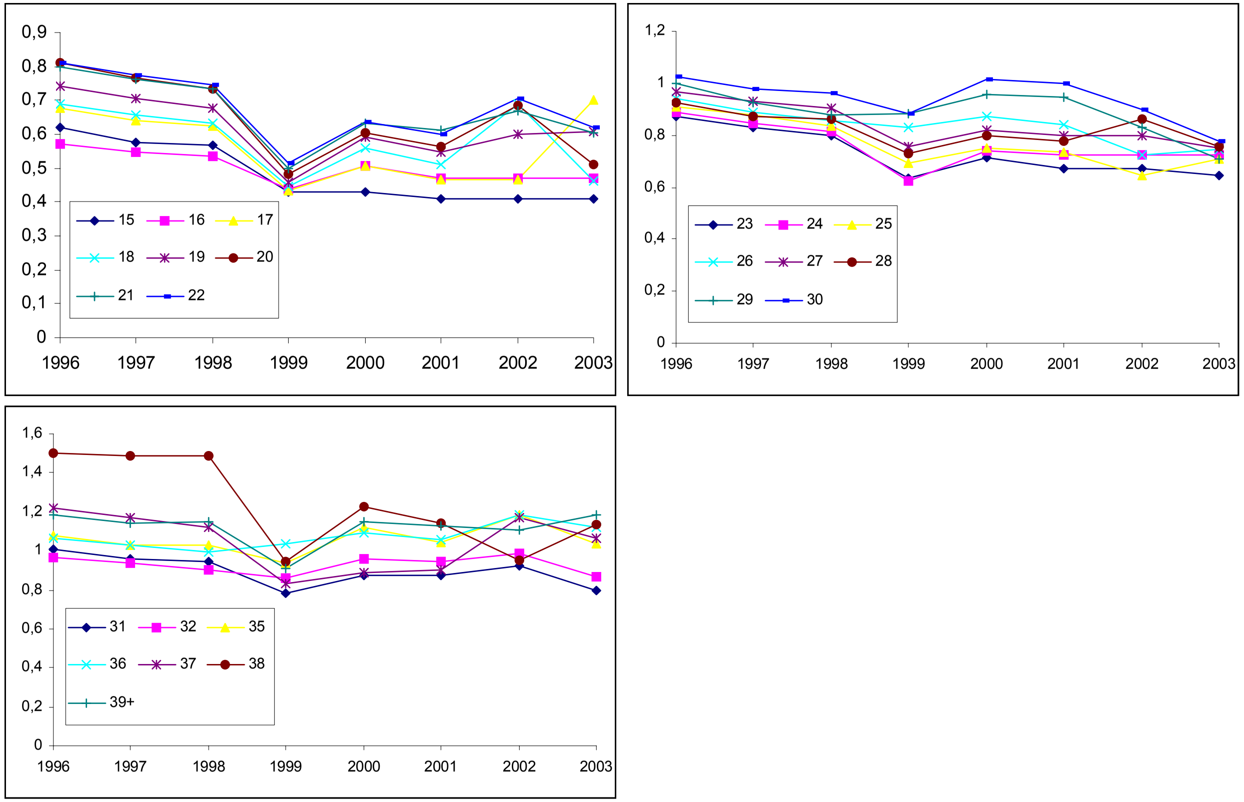

Figure 14.15 Roundnose grenadier in IV, VI and VII. Landings weights-at-age.

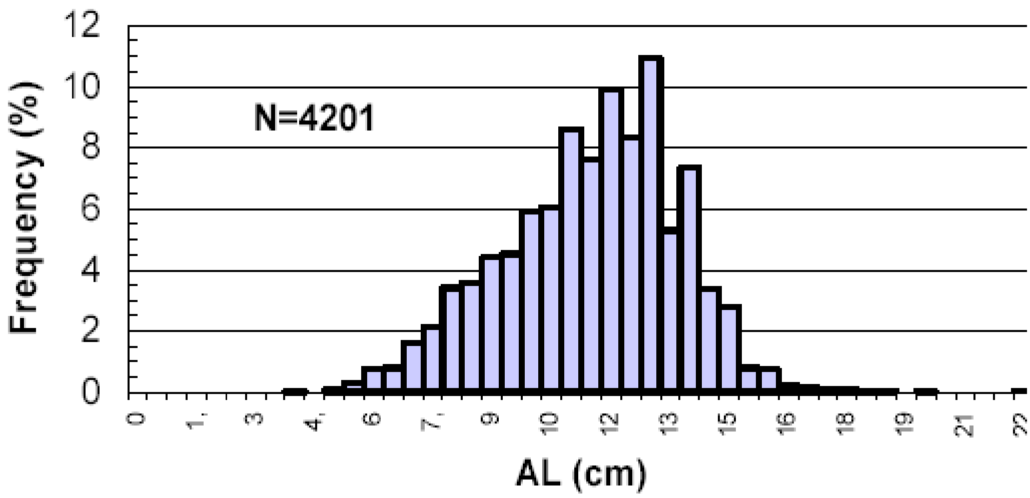

Figure 14.16 Roundnose grenadier in Subarea VI. Percent length composition (pre-anal fin length) per year of discards, sampled on-board French vessels between June 2001 and December 2002.

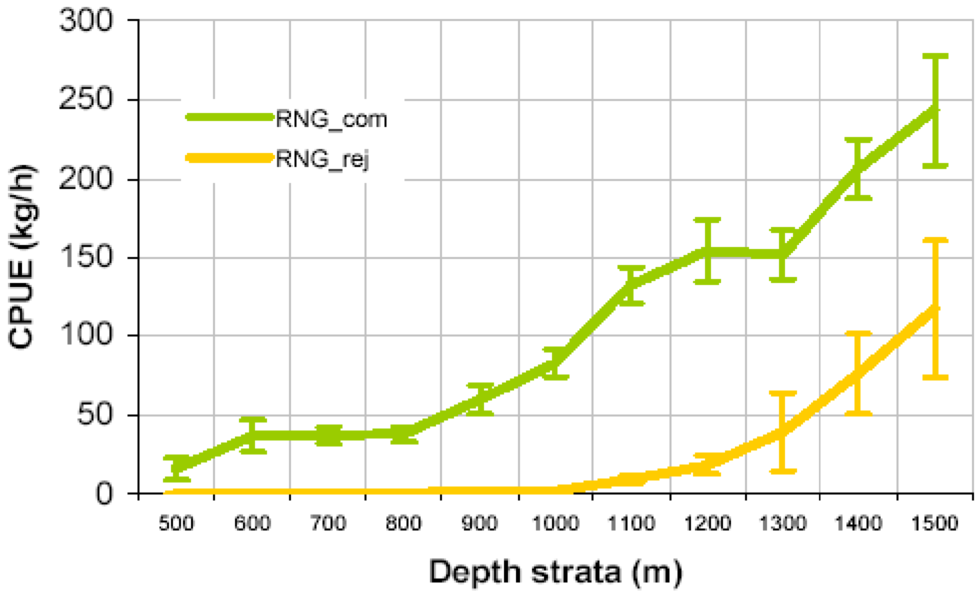

Figure 14.17 Roundnose grenadier in Subarea VI. Specific landings (RNG_com) and discards (RNG_rej) per depth stratum, based on samples on-board French vessels between June 2001 and December 2002.

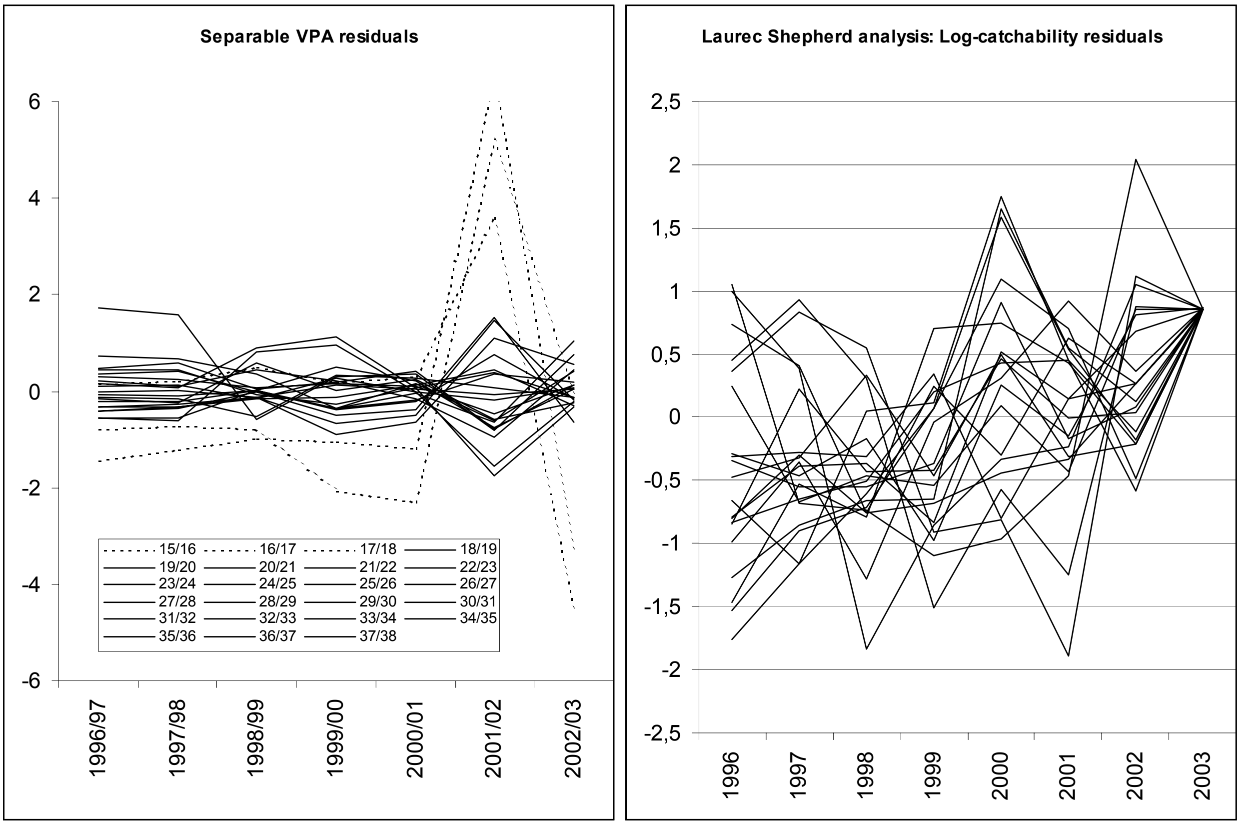

Figure 14.18 Roundnose grenadier in IV, VI and VII. Residuals derived from the Separable VPA and the Laurec-Shepherd analysis.

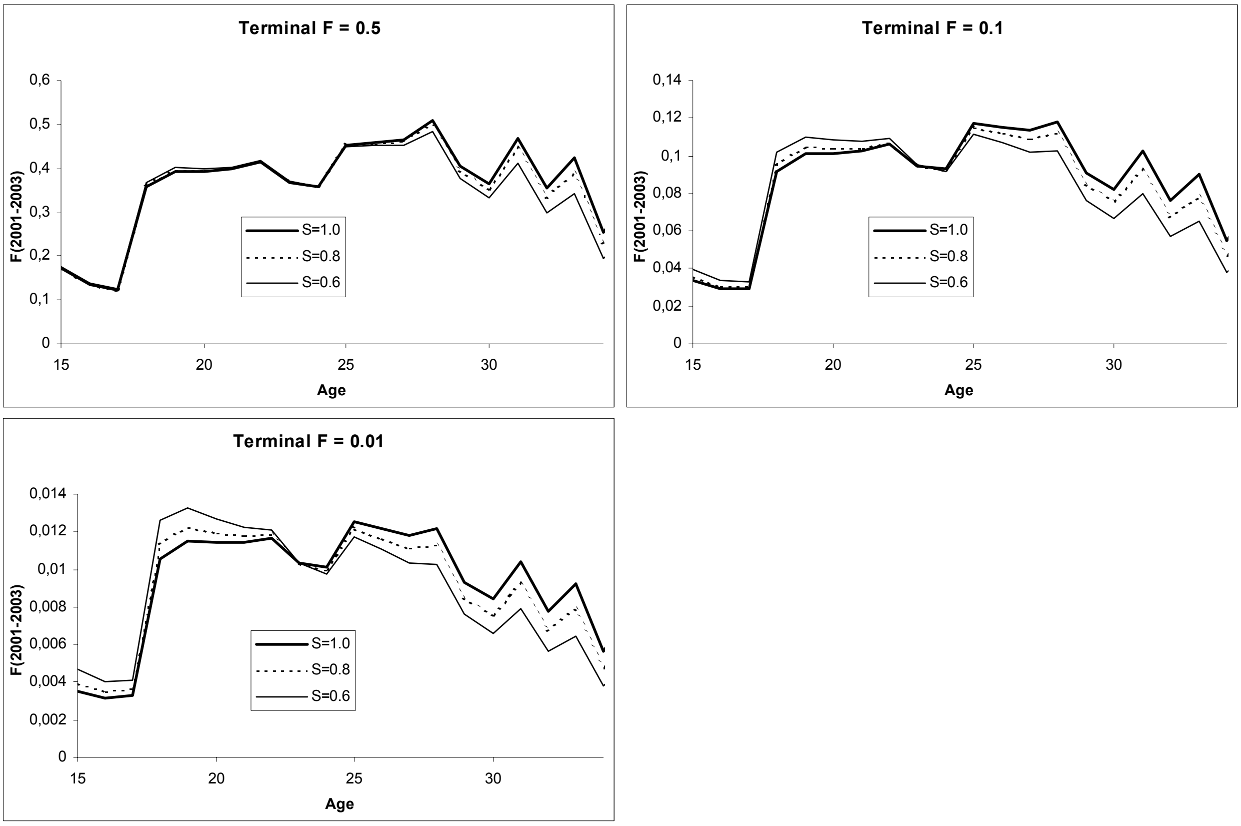

Figure 14.19 Roundnose grenadier in IV, VI and VII. Mean exploitation pattern derived from the separable VPA, for different values of terminal F and terminal S.

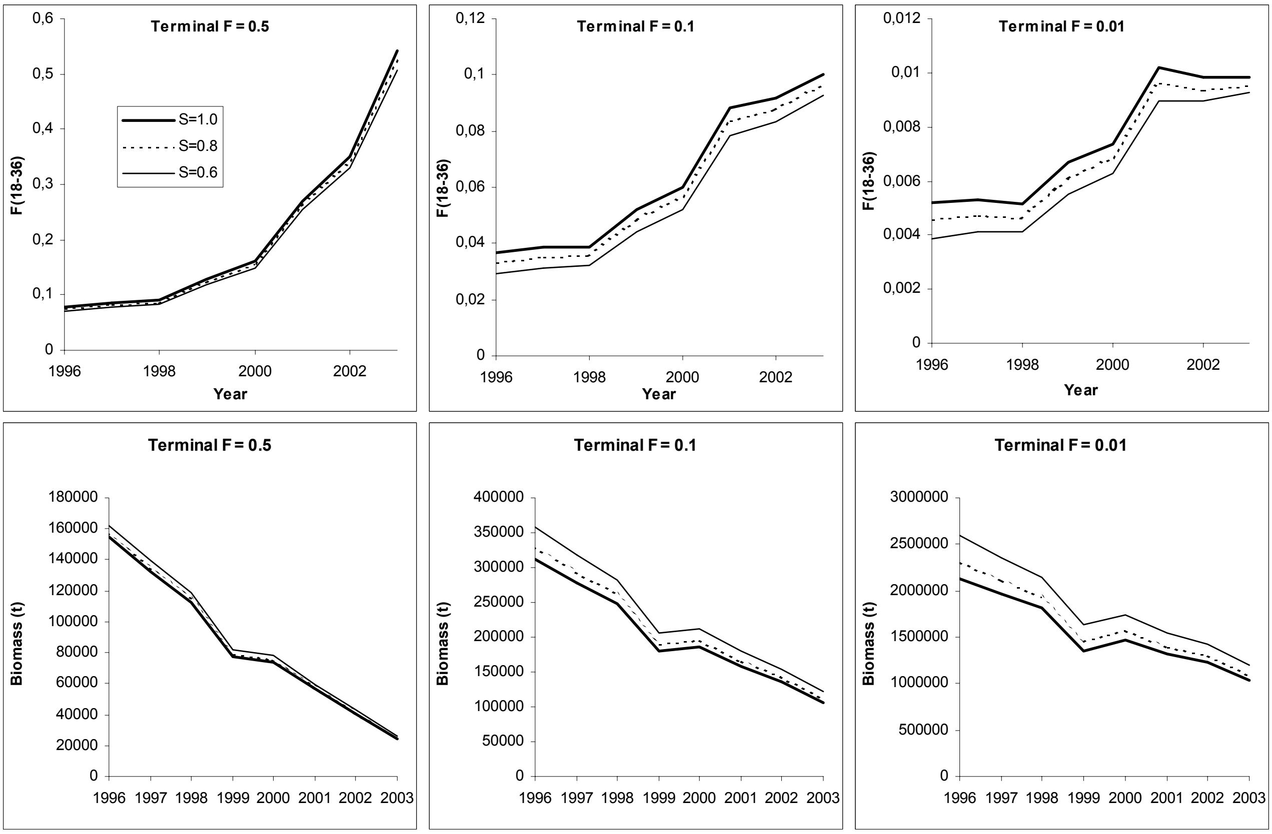

Figure 14.20 Roundnose grenadier in IV, VI and VII. Estimates of fishing mortality and biomass derived from the separable VPA, for different values of terminal F and terminal S.

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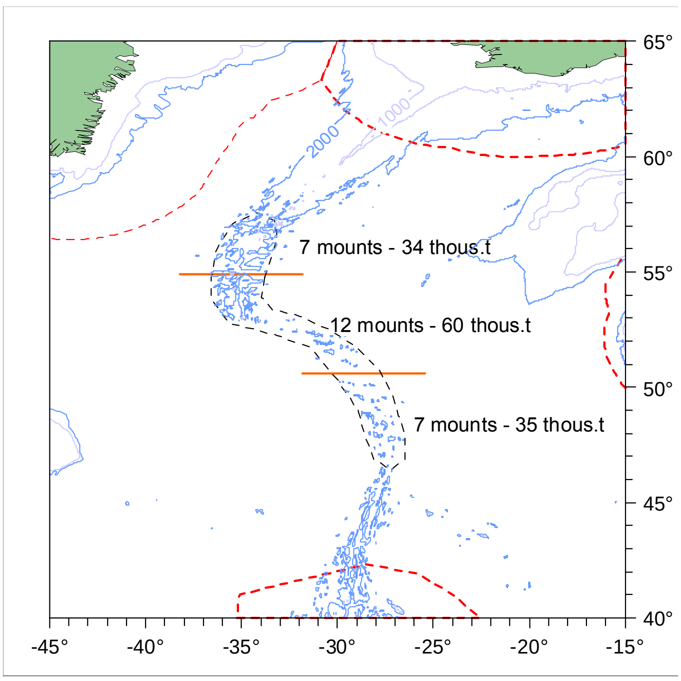


Figure 14.21 Distribution of grenadier biomass in MAR area on the basis of observation from R/V Atlantida in May-July 2003.

15 BLACK SCABBARDFISH (*APHANOPUS CARBO*)

15.1 Catch trends

Table 15.1 shows the landings data for Black Scabbardfish, *Aphanopus carbo,* by ICES Subarea either as reported to ICES or by the Working Group. Landings from French trawlers in ICES areas VI, VII, from the Portuguese long liners in Subarea IXa and from Faroes trawlers (2002 and 2003) in Subarea Vb exceed 1000t. Considering all ICES areas, during the last decade, excluding 2002, there was a rather stable trend on black scabbardfish landings. In 2002 there I misreported may have happened (pre-TAC year in EU waters).

The increasing trend on landings was particularly noticeable in Subarea Vb (Fig. 15.1). In the first Subarea the increase registered in 2002 and 2003 was derived from landings from Faroese trawlers. In Subareas VI and VII the general increasing trend was mainly due to the French landings although in 2001 and in 2002 there was also a considerable increase in Scottish and Irish landings (Tab. 15.1.). The decrease of landings registered in 2003, particularly in Subareas VI and VII, although still preliminary might reflect the implementation of TAC in these Subareas.

Portuguese landings represent the major fraction of black scabbardfish landings in ICES Subareas VIII and IXa. From 1988 up to now the Portuguese landings fluctuated around 3000 tons (Figueiredo and Machado, 2002 WD), with a slight decreasing trend in recent years, which however, was not considered significant.

Landings from ICES Subarea X have fluctuated strongly, mainly as a result of exploratory surveys carried out in this area, and landings are thus not from fisheries targeting this species (Table 15.1).

15.2 Management applicable to 2003 and 2004

Since 2003, management of black scabbardfish by EU vessels fishing in EU and international waters includes a combination of TAC and licensing system. The 2003 and 2004 TAC and the 2003 uptake are given in the table below:

	I II III & IV	V, VI, VII & XII	IX & X
Uptake in 2003	4	5074	2658
TAC (2003 & 2004)	30	3110	4000

Landings given are international, not exclusively EU vessels.

15.3 Stock structure

There is very little objective information available on the stock structure of this species. Distribution of the species has led to hypothesis of a single stock but this remains uncertain.

Previous studies on this subject were inconclusive, e.g., studies of otolith microchemistry (elemental composition of the otoliths). Despite that this technique can be a useful for analysing this problem (Swan, Gordon, and Shimmield, 2001). Norwegian researchers have recently initiated genetic studies using samples from different areas of the NE Atlantic.

15.4 Commercial catch and effort data

French trawl CPUE data for Vb, VI and VII are available for the period 1991–2003 (calculated as decribed in Ch 4.1.3) (Tab. 15.2 and Fig. 15.2). Since the 2000 WGDEEP there have been a changes in the method of estimation of total French CPUEs for deep sea species including Black scabbardfish (Ch 4.1.3).

The two CPUE series presented at this meeting present similar trends. Initially there was a sharp increase of CPUE from 1989 to 1990, followed by a decline. From 1991 till 1998 a slight decreasing trend was observed followed by an increasing trend after 1999. The upward trend seen in more recent years was not fully understood, i.e. it could be interpreted as indicator of increase in stock abundance or it merely reflected a change in exploitation pattern by the French fleets.

The Portuguese long-line CPUE data (Fig. 15.3) are based on catch and effort information from a sample of long-liners representing around 40% of the total vessels that compose the long-liner fleet (ICES Subarea IXa). Fishing patterns and fishing power are considered to have been stable with time. The estimate of CPUE was calculated for each vessel by year according to the following expression:

$$\frac{\text{total landed weight}}{\text{number of trips} \times \text{number of hooks}}$$

The adequacy of information provided by the sampled vessels was evaluated by comparing the trends of annual landings from selected vessels and of the annual landings from the whole fleet. Differences in fishery CPUE values between years and between vessels were test using Friedman rank sum test. The null hypotheses tested were: i) no differences on CPUE estimates between years; ii) no differences on CPUE estimates between vessels. .In both tests the null hypothesis was not rejected: (i) p-value =0.14; (ii) p-value=0.26. The overall CPUE of the black scabbardfish fishery of Sesimbra did not change significantly during the time period analyzed (Figueiredo and Machado, 2002 WD). The mean Portuguese longline CPUEs fluctuated over the years without any particular trend. (Fig. 15.3).

A CPUE series from the Faroes commercial trawlers was presented (Fig. 15.4). This fleet traditionally has participated in a mixed deep-sea fishery for blue ling, redfish, black scabbardfish, and roundnose grenadier, but also fish in more shallow waters for saithe, cod and haddock. The upward trend towards the end of the time-series reflects the fact that the fishery is taking place at deeper fishing grounds (see Faroese fishery description).

15.5 Length and Age compositions and mean weights-at-age

Information on the size composition by Black scabbardfish in the NE Atlantic is available for the various fisheries exploiting this species, (Anon, 2000). Differences in length structure are observed for black scabbardfish between the northern and southern areas. Those differences can to some extent be explained by the difference of the fishing gear used but may also reflect differences on the length structure between subareas of the range of the species.. Length data obtained during exploratory surveys performed by Portuguese long-liners and Spanish trawlers in Subarea X emphasises the role of selectivity on such difference in the length composition of the catches from different fishing gears.

In ICES Subarea IXa mean lengths of black scabbardfish from recent years do not differ from those landed at the beginning of this fishery. The range of total length of landed specimens varies from 80 to 134 cm (Fig. 15.5). Information available from fishermen indicates that in this fishery there are almost no discards and that smaller specimens are occasionally caught by the longline.

Length frequency distributions of black scabbardfish caught by Spanish commercial bottom trawlers at Hatton Bank (ICES Subareas VIa and XII) in 2001 and 2002 are shown in Figure 15.6.

Length frequency distribution of black scabbardfish extrapolated to international landings from ICES Subareas VI and VII, based on data from Irish observer scheme in 2003 is presented in Figure 15.7. It is interesting to remark the presence of small individuals, not commonly caught by trawlers.

15.6 Biological parameters

The reproductive strategy and dynamics of black scabbardfish is not fully understood. Spawned eggs of black scabbardfish have never been found, but a few larvae were taken in samples taken off the Azores (Vinnichenko, 2002). In general juvenile fish (recruits) are rare in catches. In Madeiran waters there appears to be no seasonality in the occurrence of juveniles, which are found in small numbers throughout the year (Morales-Nin and Sena-Carvalho, 1996). This lack of seasonality in juvenile occurrence may be ascribed to a complex stock structure. Spawners have also been observed around the Azores from November to April (Vinnichenko, 2002). At the Rockall Trough there is a weak indication that juveniles enter this region during the last quarter of the year.

Studies on the reproductive behaviour of the species showed that vitellogenesis begins at the same time of the year both in Madeira and Sesimbra (ICES Subarea IXa). However only the specimens from Madeira continue their gonadal development towards maturation and egg release. In Sesimbra (Portugal Mainland ICES Subarea IXa), early maturing specimens larger than the length of first maturity enter into an intense process of atresia after October with a maximum in March (Figueiredo *et al*. 2003 a).

The results from intercalibration of the age readings, using otoliths exchanged among the participating laboratories of the EU project BASBLACK (Anon., 2000) showed that the growth increments used for age determination, using whole otoliths, were consistent. Some discrepancies were found between otoliths from different areas, probably due to the complex spatial distribution of the species and the differing length structure of the samples obtained, which may or may not have resulted from the selectivity of the fishing methods used. Interpretation criteria for reading whole otoliths were defined and the relative simple preparation technique proved successful (Morales-Nin *et al*., 2002).

The comparison of the von Bertalanffy parameter estimates using likelihood ratio tests indicated significant differences on growth parameters between sexes but no significant differences in immature specimens of each sex between Madeira and Sesimbra. Significant differences on growth parameters between immature and mature females were also detected (Figueiredo *et al.*, 2003 b).

The differential growth patterns (different growth rates) between immature and mature females may be thus interpreted as a way to optimise the energetic balances. This optimisation strategy is perfectly suited considering the food-constrained environment in which black scabbardfish lives (Gordo *et al.*, 2004 WD).

Considerable variability in otolith shape has been observed between different geographic areas. This has not yet been further investigated, but could be related to the existence of a complex stock structure or to migratory behaviour associated with species' spatial distribution (Morales-Nin *et.al*., 2002).

Variable	Value	Source/comment
Linf (cm)	132.6	Anon, 2000
Maximum Age (year)	8 (whole otolith) 32 (sectionned otolith) but with high inconsistency on age reading	Morales-Nin and Carvalho 1996 Kelly *et al*., 1998
Growth rate, K	0.177	Anon, 2000
Natural mortality, M	0.17	Martins *et al*.,1989
Length 1st capture (cm)	110 long-liners, subarea IX	Figueiredo and Bordalo 2002
Length 1st maturity	102.8 cm (Total length)	Anon, 2000; Figueiredo et al. 2003 a
Age 1st maturity (years)	7	Anon, 2000
Spawning season(s)	Sept. – Dec. (Madeira) Set - Febr. (Madeira)	Carvalho, 1988; Anon, 2000 Figueiredo at al., 2003 a
Spawning time in relation to size of spawners	Larger individuals undertake spawning later in the spawning season (Jan - Febr).	Figueiredo at al., 2003 a
Female growth parameters	**Immature** Linf (cm) 138.3(s.e. 8.52); k 0.285(s.e. 0.013); t0 1.74(s.e0.18) **Mature** Linf (cm). 130.5 (s.e2.150); k 0.2606(s.e 0.0026); t0 0.374(s.e 0.0036)	Figueiredo *et al.*, 2003 b

15.7 Assessment

Given the lack of conclusive stock discriminatory data the WG agreed to use the following separate assessment units used at previous Working Groups, until such time that stock structure is properly elucidated:

Subareas V,VI,VII and XII

Landing data from trawl fleets operating at these ICES Subareas were fitted using ASPIC model. The input estimates of CPUE series is derived from French trawlers according to the methodology described in Ch 4.1.3. Two runs were performed assuming errors in effort, the first (run a) by not fixing any parameter and the second (run b) by fixing the q parameter (0.002742) which corresponds the posterior median after running a Bayesian approach of Schaeffer model (number of iterations = 30000; burn in =1000 and thin=25) the prior used for this parameter was a uninformative prior uniform[1.0E-5,1.0E-1]

node	mean	sd	MC error	5.00%	median	95.00%	start	sample	MC error/sd
q	0.00297	0.001746	0.0000657	0.000552	0.002742	0.006326	10000	800	0.0376

The following table summarises the main results obtained for Aspic outputs

run	r	K	q	B1R	B/B_{MSY}	F/F_{MSY}	MSY	r^2
a	0.3567	75680	0.000829	3.504	1.508	0.498	6749	0.305
b*	0.757	28050	0.002740	3.036	1.092	0.881	5308	0.286

* q was fixed at the value 0.002740.

In both runs the fit is poor with an R^2 around 30%. The bootstrap analysis showed high relative inter-quartile ranges and higher relative bias in both runs.

Subarea VIII and IX

The data used in the assessment comprised total international catch data for Subareas VIII and IX from 1990 to 2003, where the majority of landings are taken in Subarea IX by the Portuguese longliners. Landing data from trawl fleets operating in these ICES Sub areas were fitted using an ASPIC model. The input estimates of CPUE series is derived from Portuguese longliners.

Two runs were performed assuming errors in effort, the first (run a) by not fixing any parameter and the second (run b) by fixing the r parameter (0.642) which corresponds the posterior median after running a Bayesian approach of Schaeffer model (number of iterations = 15000; burn in =4000 and thin=25) the prior used for this parameter was a lognormal distribution with a ln(0,523) and a C.V. of 75%.

run	r	K	q	B1R	B/B_{MSY}	F/F_{MSY}	MSY	r^2
a	0.8744	12260000	1.67E-08	1.346	1.999E+00	4.962E-04	2679000	0.26
b*	0.642	49430000	4.16E-09	1.43	2.00E+00	1.68E-04	7934000	0.237

The following table summarises the main results obtained for ASPIC outputs

* r was fixed at the value 0.642.

In both runs the fit is poor with a R^2 around 25%. The bootstrap analysis shows high relative inter-quartile ranges and higher relative bias in both runs.

15.8 Management considerations

The French trawl CPUE is difficult to interpret and use for assessment purposes. Historical CPUE was high during the first two years followed by a decline until 1998 and then an apparent increase after 1999. It is unlikely that this increase represents an improvement in stock *status*, but as already reported in WGDEEP 2002, merely reflects a change in exploitation pattern by the French fleets. The state of the stock is uncertain, and as a consequence any change in management advice for this species in V, VI, VII and XII would not be in accordance to the precautionary approach.

Despite the poor fit obtained by the various essays used, the stability on CPUE data from the long-liners in Subarea IXa, the abundance in this area appears to have remained relatively stable during the past decade. This stability should be taken into consideration when giving management advice for the fishery in that area.

In the Azorean EEZ (ICES Subarea X) there are no special management recommendations since the fishery is not yet developed beyond an exploratory stage.

In some ICES Subareas, particularly in Sub area V black scabbardfish, initially taken as a by-catch of mixed fisheries, is now a target species.

Table 15.1 Black Scabbardfish. Study Group estimates of landings by ICES Subareas.

Black scabbardfish in Sub-areas III and IV

Year	France	Germany	Scotland	E&W&NI	**Total**
1988	2	-	-	-	**2**
1989	0	-	-	-	**0**
1990	57	-	-	-	**57**
1991	0	-	-	-	**0**
1992	0	-	-	-	**0**
1993	0	-	-	-	**0**
1994	13	3	-	-	**16**
1995	-	-	2	-	**2**
1996	3	-	1	-	**4**
1997	0	-	2	-	**2**
1998	-	-	9	-	**9**
1999	4	-	3	-	**7**
2000	2	0	3	-	**5**
2001	1	0	10	1	**12**
2002	0		24		**24**
2003*	0		4		**4**

* Preliminary.

Black scabbardfish in Division Va

Year	Iceland	**Total**
1988	-	**0**
1989	-	**0**
1990	-	**0**
1991	-	**0**
1992	-	**0**
1993	0	**0**
1994	1	**1**
1995	+	**+**
1996	0	**0**
1997	1	**1**
1998	0	**0**
1999	9	**9**
2000	18	**18**
2001	8	**8**
2002	13	**13**
2003*		

* Preliminary.

Black scabbardfish in Division Vb

Year	Faroes	France	Germany	Scotland	E&W&NI	**Total**
1988	-	-	-	-	-	
1989	-	166	-	-	-	**166**
1990	12	407	-	-	-	**419**
1991	1	151	-	-	-	**152**
1992	4	29	-	-	-	**33**
1993	202	76	9	-	-	**287**
1994	114	45	1	-	-	**160**
1995	249	175	-	-	-	**424**
1996	57	129	-	-	-	**186**
1997	18	50	-	-	-	**68**
1998	36	144	-	-	-	**180**
1999	31	135	-	6	-	**172**
2000	116	186	0	9	-	**311**
2001	409	371	0	20	0	**800**
2002	1365	311		80		**1756**
2003	1352	102		11		**1465**

* Preliminary.

Table 15.1 (cont.)

Black scabbardfish in Sub-areas VI and VII

Year	Faroes	France	Germany	Ireland	Spain	Scotland	E&W&NI	**Total**
1988								
1989	46	108						**154**
1990		1060						**1060**
1991		2759						**2759**
1992	3	3433						**3436**
1993	62	3411	48	8				**3529**
1994		3050	46	3		2		**3101**
1995		3257	3			18		**3278**
1996		3650	2			36	1	**3689**
1997	3	2754		0	1	235	2	**2995**
1998		1815		0	3	148	1	**1967**
1999		1973		1	0	191	1	**2166**
2000		3235	0	59	1	377	40	**3712**
2001	3	3692	0	68	150	673	37	**4623**
2002		3912		1050	N/A	1320	43	**6325**
2003*		2368		159	N/A	119	5	**2651**

* Preliminary.

Black scabbardfish in Sub-areas VIII and IX

Year	France	Portugal	Spain	**Total**
1988	-	2602	-	**2602**
1989	-	3473	-	**3473**
1990	0	3274	-	**3274**
1991	1	3978	-	**3979**
1992	0	4389	-	**4389**
1993	0	4513	-	**4513**
1994	0	3429	-	**3429**
1995	-	4272	-	**4272**
1996	126	3686	3	**3815**
1997	2	3553	1	**3556**
1998	2	3147	3	**3152**
1999	11	2741	0	**2752**
2000	32	2371	1	**2404**
2001	22	2744	1	**2767**
2002	32	2692	1	**2725**
2003	28	2630		**2658**

* Preliminary. ** January to November

Black scabbardfish in Sub-area X

Year	Faroes	Portugal	France	**Total**
1988	-	-	-	**0**
1989	-	-	-	**0**
1990	-	-	-	**0**
1991	-	166	-	**166**
1992	370	-	-	**370**
1993	-	2	-	**2**
1994	-	-	-	**0**
1995	-	3	-	**3**
1996	11	0	-	**11**
1997	3	0	-	**3**
1998	31	68	-	**99**
1999	-	46	66	**112**
2000	-	112	1	**113**
2001	-	0	0	**0**
2002		0	0	**0**
2003*				**0**

* Preliminary.

Table 15.1 (cont.)

Black scabbardfish in Sub-area XII

Year	Faroes	France	Germany	Spain	Scotland	Ireland	E&W&NI	**Total**
1988	-	-	-	-	-			**0**
1989	-	-	-	-	-			**0**
1990	-	-	-	-	-			**0**
1991	-	-	-	-	-			**0**
1992	-	512	-	-	-			**512**
1993	1051	-	93	-	-			**1144**
1994	779	-	45	-	-			**824**
1995	301(1)	-	-	-	-			**301**
1996	187	4	-	253	-			**444**
1997	102	-	-	98	-			**200**
1998	20	-	-	134	-			**154**
1999	-	3	-	109	0			**112**
2000	1	6	0	237	-			**244**
2001	3	3	0	115	-			**121**
2002		0	0	N/A	1		0	**1**
2003*		4		N/A		1		**5**

* Preliminary (1) Includes VIb.

Black scabbardfish in Sub-area XIV

Year	Faroes	Spain	**Total**
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		0	**0**
2003*			**0**

* Preliminary.

Black Scabbardfish (*Aphanopus carbo*) unallocated landings from Subareas V, VI,VII and XII

1998	2092
1999	547
2000	742
2001	650
2002	826
2003	952

Black Scabbardfish (*Aphanopus carbo*) All ICES areas

	III+IV	Va	Vb	VI+VII	VIII+IX	X	XII	XIV	Unallocated	**Total**
1988	2	0	0	0	2602	0	0	0		**2604**
1989	0	0	166	154	3473	0	0	0		**3793**
1990	57	0	419	1060	3274	0	0	0		**4810**
1991	0	0	152	2759	3979	166	0	0		**7056**
1992	0	0	33	3436	4389	370	512	0		**8740**
1993	0	0	287	3529	4513	2	1144	0		**9475**
1994	16	1	160	3101	3429	0	824	0		**7531**
1995	2 +		424	3278	4272	3	301	0		**8280**
1996	4	0	186	3689	3815	11	444	0		**8149**
1997	2	1	68	2995	3556	3	200	0		**6825**
1998	9	0	180	1967	3152	99	154	2	2092	**7655**
1999	7	9	172	2166	2752	112	112	0	547	**5877**
2000	5	18	311	3712	2404	113	244	90	742	**7639**
2001	12	8	800	4623	2767	0	121	0	650	**8981**
2002	24	13	1756	6325	2725	0	1	0	826	**11669**
2003	4	0	1465	2651	2658	0	5	0	952	**7736**

Table 15.2 Black Scabbardfish. Estimates of CPUE from French trawlers in Subareas V, VI, VII and XII. The right column represents all vessels, the '90%' is the 90 percentile of the vessels that landed black scabbardsfish, ranked according to catch. (see Ch 4.1.3).

Year	90%	All
1989	150.8	58.4
1990	198.9	72.3
1991	58.0	27.8
1992	71.2	28.2
1993	51.4	23.6
1994	67.1	26.2
1995	41.5	21.0
1996	54.9	18.0
1997	41.0	16.5
1998	23.7	9.9
1999	26.5	18.1
2000	51.7	29.7
2001	78.0	43.8
2002	82.3	45.1
2003	66.7	41.8

Table 15.3 Black Scabbardfish. CPUE mean estimates for the Portuguese longline (ICES Subarea IXa).

Year	CPUE
1990	0.163
1991	0.154
1992	0.213
1993	0.201
1994	0.211
1995	0.256
1996	0.235
1997	0.222
1998	0.196
1999	0.206
2000	0.191
2001	0.170
2002	0.173
2003	0.199

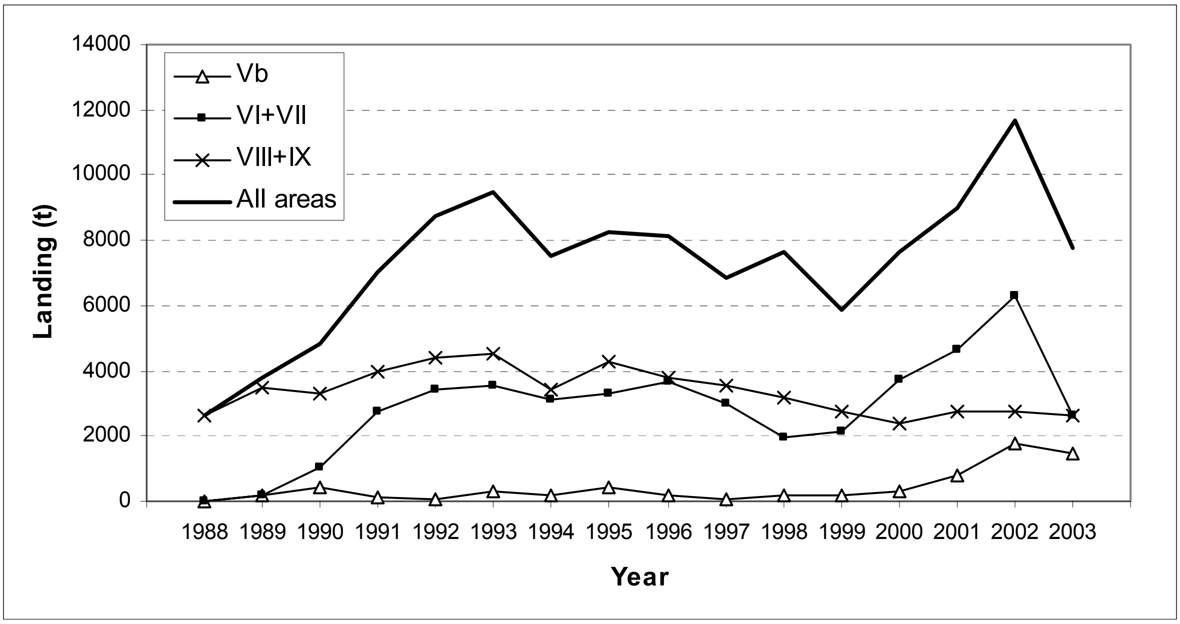


Figure 15.1 Annual landings from Subareas with the highest values (1988 to 2003). The values from 2003 are provisional and in the case of Portuguese landings (ICES Subarea IXa) December landings are not included.

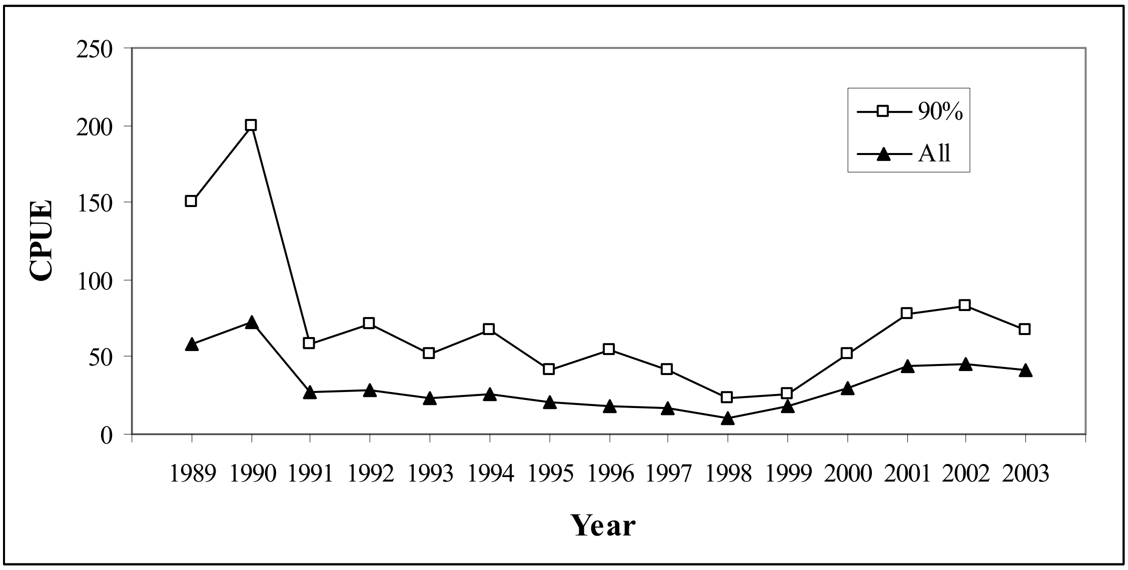


Figure 15.2 French trawl CPUE data series for subareas V, VI, VII and XII. The two lines represent represents respectively all vessels, and the 90 percentile of the vessels that landed black scabbardsfish, ranked according to catch. (see Ch 4.1.3).

Figure 15.3 Annual CPUE average estimates for the Portuguese longliners (1990 and 2003). Black bars indicate mean variation interval (mean ± st. deviation).

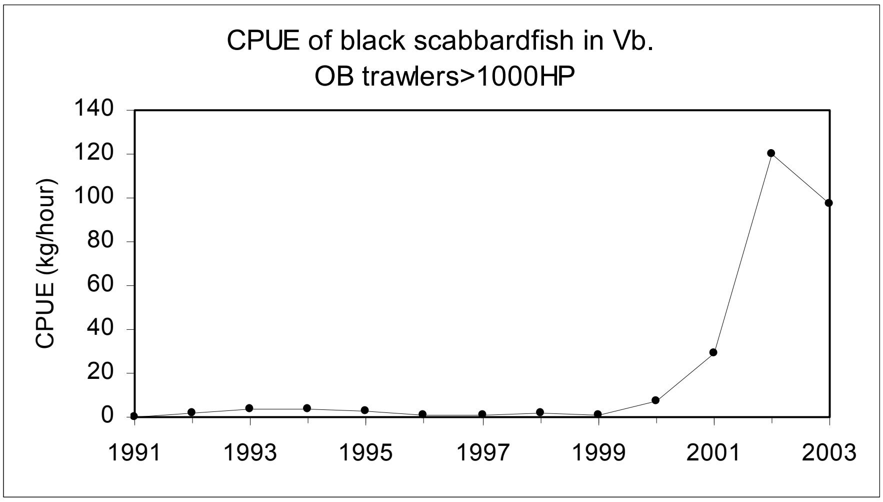


Figure 15.4 Faroese commercial CPUE series in ICES Subarea Vb.

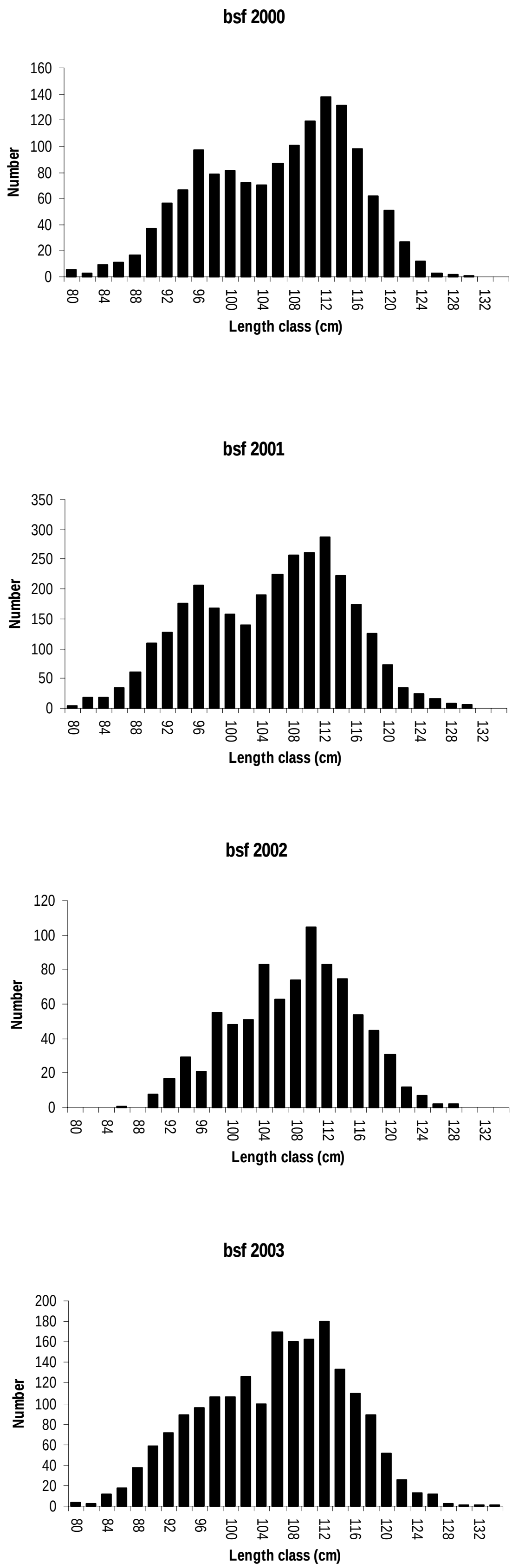


Figure 15.5 Annual length frequency distribution of black scabbardfish caught by longliners from Sesimbra (ICES Subarea IXa) from 2000 to 2003.

16 RED (=BLACKSPOT) SEABREAM (*PAGELLUS BOGARAVEO*)

16.1 Catch 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 16.1. No data on discards of this species have been presented to the Group.

Landings in the Subareas VI, VII and VIII, from France, Spain and UK peaked at more than 24 000 t in 1974 (ICES C.M.1998/Assess:8) but then declined. But some of the high historical catches could be misreported as they included some other species of *Pagellus* and/or other *Sparidae*, i.e. “seabream” in general. A more detailed study of official international catches by country in Subarea VI+VII+VIII indicated that about 7 000 t were landed in 1979 and then there was a decrease to 2 100 t in 1985 (Table 16.2). In Table 16.1 landings in the Subareas VI, VII and VIII are given for 1988 onwards, as since then the landings values are more reliable to correspond to *Pagellus bogaraveo sensu stricto*. In this period landings fell from more than 461 t in 1989 to 52 t in 1996, then they increased until 2000 (290 t), and since 2001 they have been decreased continuously (55 t in 2003, preliminary data). In most of the years of the series, landings from Subarea VIII are much higher than in Subarea VI+VII. It is clear that, when the present landings are compared with those obtained 20 and more years ago, the red seabream fishery seems to continue in a “quasi depleted” situation. Most of the red seabream catches in this area, at present almost all by-catches, are taken by the longliner fleet, but trawlers also occasionally land this species. In the period considered (1988-2003), most of the estimated landings from this area were taken by Spain (69%), followed by UK (16%), France (13%) and Ireland (3%).

In Subarea IX, catches -most of them taken by longliners- correspond to Spain (72%) and Portugal (28%). Spanish landings data from this area are available from 1983 and Portuguese from1988 onwards. The maximum catch in this period was obtained in1993-1994 and 1997 (about 1 000 t) and the minimum in 2002 (359 t). Catches in 2003 amount to 477 t. Almost all Spanish catches in this area are taken in waters close to the Gibraltar Strait (Southern Div. IXa). Until 2002 they were restricted to two ports (Tarifa and Algeciras), but in 2002 and 2003 significant catches were obtained also by artisanal Spanish boats of a third port (Conil) in different fishing grounds of the same area. In the northern Div. IXa (Galicia) the Spanish landings have increased since 1998 (1 t) to 2001 (58 t) and then have decreased to 28 t in 2003. In the Portuguese landings no clear tendency is observed. The maximum values took place in 1988 (379) and in 1998 (357) and the minimum one in 2000 (83 t), and since then they have increased successively in the last three years (142 t in 2003).

Landings data in Subarea X (Azores) are available at least from 1982 onwards. They have ranged from 369 t (in 1982) to a maximum of 1222 t (in 1999). In 2002 and 2003 1193 t and 1068 t were landed. No clear trends can be observed in the landings since 1992 oscillating around 1000 t. All catches were taken by the Azorean fleet and mainly by longline. (See Section 14.2.1 for a more complete description of this fishery).

In Subarea XII, landings data are available from only one year (1994). They amount to 75 t and were reported by Latvia.

When the historical landings series for the three sea areas are compared, whereas Subareas [VI+VII+VIII] and Subarea IX show an opposite tendency, Subarea X, with no clear trend in their catches, cannot be related to the other two sea areas (Figure 16.1).

In the present Working Group a new attempt has been carried out to compile the historical information available on red seabream catches from the different sea areas (Table 16.3). However doubts remain on the quality of the information because it is suspected that figures complied do not only include catches of *P. bogaraveo* (*sic*) but also of other species related (“seabreams” in general sense).

Two extended series on French catches related to Northeastern Atlantic without distinction of Subareas, have been obtained from two different sources. One series extends with no interruptions from 1977 to 1987; its information very probably relate to *P. bogaraveo* (*sic*) catches and the period in which red seabream catches were declining substantially in that sea area. They range between 120 and 2 210 t. The other one, more extended (1950-1987), presents many gaps, but perhaps offer some clues on the likely higher abundance of this species during a period of twenty five years from the middle of the 20th century. The catches vary between 120 and 8 370 t. However doubts on the identity of the species caught remain.

Portugal (M. Pinho, pers. com.) has presented a comprehensive series (1948-1987) of the catches from the two sea areas separately. The catches from Subarea X (Azores) can be considered of *P. bogaraveo* (*sic*),and they range between 8 and 700 t. The catches from Subarea IX can include other species related to red seabream; they range between 370 and 2 950 t in the period considered.

Two Spanish extended series have been compiled from the data available in the files of previous ICES SG-WGDeep's. One of them (Lucio, WD 1996) refer to the catches obtained from 1948 to 1987 in the eastern part of the Cantabrian sea (*i.e.* in the eastern Div. VIIIc (mainly) and in southern Div. VIIIb) by the artisanal Basque fishery directed on *P. bogaraveo* (*sic*); they extend between 110 and 1 350t. The other one, available in the SGDeep 1996 report, indicate important catches of seabream from 1960 to 1986 -they range between 1 800 and 10 000 t. But there are doubts on the identity of the species, as catches of other seabreams and from other sea areas -not only from Subareas [VI+VII+VIII]- may have included in the series

Finally, some extended information has been collected on the UK (England & Wales) seabream catches. They refer to the period 1978-1987. data and range between less than 10 and 160 t.

According to the preliminary results of this incomplete compilation, a new estimation of the maximum value of the historical catches of *P. bogaraveo* (*sic*) in the period 1960-1985 and in the sea area considered (Subareas VI+VII+VIII) could be established in less than 15,000 t.

16.2 Stock structure and stock-specific accounts

Information on red (blackspot) seabream, *P. bogaraveo*, has been split into three different components, as referred to in the previous Reports (ICES C.M.1996/Assess:8; ICES C.M.1998/ACFM:12; ICES C.M. 2001/ACFM:23; ICES C.M. 2002/Assess:16):

- *P. bogaraveo* in Subareas VI, VII and VIII
- *P. bogaraveo* in Subarea IX
- *P. bogaraveo* in Subarea X (Azores region)

This separation does not pre-suppose that there are three different stocks of *P. bogaraveo*, but it offers a better way of recording the available information. The inter-relationships of the red seabream from the Subareas VI, VII, VIII and the northern part of Division IXa, and their migratory movements within these areas have been described in the past by tagging methods (Gueguen, 1974; ICES, C.M.1996/Assess:8). Possible links between red seabream of the Azorean region with the southern Subarea IX, Moroccan waters, Sahara Bank and Subareas VI+VII+VIII and the northern part of Division IXa have not been studied extensively. However, genetic studies show that there are no differences between populations from different ecosystems within the Azores region (Eastern, Central and Western group of Islands, and Princes Alice bank) but there are genetic differences between Azores (ICES area X) and mainland Portugal (ICES area IXa) (Menezes *et al*., 2001).

Thus, due to the very different present status of the red seabream fishery in the three areas and the current scientific information on migration and genetics relevant to each, it has been considered appropriate to continue to present the following chapter split by sea area.

16.2.1 *P. bogaraveo* in the Azores region (Subarea X)

An updated description of the Azorean fishery in Subarea X, has been presented to the Working Group by Pinho (WD 2004).

The Azorean demersal fishery is a multispecies and multigear fishery where *P. bogaraveo* is considered the target species. The directed deep-water fishery is a hook-and-line fishery where two components of the fleet can be defined: the artisanal (hand lines) and the long liners. The artisanal fleet is composed of small open deck boats (<12m) that operate on local areas near the coast of the islands using several types of hand lines. Long liners are closed deck boats (>12m) that operate in all areas, including banks and seamounts. However, other components of the fleet operate seasonally on deep-water fishery, namely those from crustacean, swordfish, and tuna fisheries during the winter. Also interactions from different fleets are observed, as the case of the tuna fleet that catch juveniles (age 0) as live bait.

The main target species are distributed by assemblages where depth is the main distribution factor. Usually, a shallow (0-200m), medium (300-600) and deep (700-1200m) assemblages are identified (Pinho *et al*., 1999, Menezes, 2003).

In the Azorean waters (Subarea X) three phases can be described in the development of the target fishery of red seabream (Figure 14.2). In the Predevelopment phase (1948-1971) a traditional fishery was carried out by small open-deck boats (<12 m). These operated near the coast, using mainly handline gears, obtaining small (<100 t by year) and selective catches. The second or Growth phase (1972-1991) was characterised by an important development of the fishery with the introduction of the bottom longline gear and new fishing vessels (longliners >12 m and < 30 m). As a consequence new species and new fishing areas and depths were explored, new markets were developed, and an abrupt increase in the total demersal catches, namely in the red seabream catches (400-900 t), as well in the fishing effort were observed. In the third or Full exploited Phase (1992 onwards) the fishery is characterized by a specialization of different vessels, relative to the fishing areas, depth, season, gears and species. In this phase a red seabream annual catch averaged 1000 t during the last decade, peaking at 1200 t in 1999.

Fishing effort increased until 1993 and fluctuated thereafter but total catches continued at an average value of 1000 t since 1992. Variability on fishing effort may reflect specialization of vessels relative to the fishing areas, depth, season, gears and species. Whether the multispecies effects mask the observed trend is unresolved. However, target red (blackspot) seabream fishing effort is considered high since 1995.

Since 1998, several technical management measures have been introduced in order to reduce the effort. In 1998 a new license regime based on minimum landing threshold was introduced, and in 2000 areas restrictions by gear and vessel length was introduced, creating in practice a box of 3 miles around the islands where only artisanal component (open deck) operating with hand lines are permitted to fish. Long liners can only operate in banks and seamounts.

For 2003, by first time, a regime of TAC and Quotas has been applied to the *P. bogaraveo* fishery in Subarea X: 1136 t to be distributed between Portugal (most of the TAC), Spain and United Kingdom.

16.2.1.1 Commercial LPUE and Research Surveys

No update effort data is available from the Azores for the 2004 assessment because there was a significant change on the regime of operation of the standard long line fleet due to areas restrictions to the fishing. Long liners operate since 2001 almost on the seamounts, implying that effort distribution does not matches with the species distribution. Data up to 2000 was already reported during 2002 meeting (ICES CM 2002/ACFM:16).

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 dynamic of the target fishery is not well understood because the data available until now lack enough detail. The complexity of the system is even greater because of the seasonal movements of vessels from other fisheries, namely those from crustacean, swordfish, and tuna fisheries during the winter. This uncertainty adds complexity to effort estimation and is a major shortcoming for the assessment because the fishery CPUE may not be a reliable measure of the species abundance.

Detailed analysis to attempt mapping the effort is on going by the Azorean deep-water Scientists. Methods and definition of standard criteria for better compilation and standardization of the effort by species, vessel component, statistical areas, depth strata and gears, from the landings data and from the recent available data from inquiries, will be explored in detail and results will be reported to the next working group meeting.

An index of relative abundance in number or “Relative Population Number” (RPN) and in weight or “Relative Population weight” (RPW) has been estimated by species from the Azorean Spring bottom longline survey results since 1995 (Pinho, 2003). The results for *P. bogaraveo* are resumed in Figure 16.3.

16.2.1.2 Length and Age compositions

No update fishery length composition and catch-at-age are available to the working group on time for the 2004 assessment, although the data have been collected. Available data for the blackspot seabream assessment was already reported during the 2002 meeting (ICES CM 2002/ACFM: 16 Ref. G).

Fishery length data have been collected since 1982 through a landing sampling program conducted by Department of Oceanography and Fisheries (DOP/UAç). Length samples were stratified by area, month, and commercial size category (large, medium, and small) and then weighted by landings to estimate the fishery length frequency by area, month, and size category. The resultant length frequencies were summed by area, month, and size category to estimate the total length frequency. This methodology is also under revision in order to evaluate the stratification and the amplification levels as well as the coverage sampling effort.

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. These data were updated on annual base for all species and results are illustrated in Figure 16.4.

The age composition of commercial catches is usually estimated by applying an age-length key to the length distribution. Age length keys are only available from survey data, from length stratified age samples, for the years 1995-2003. From the fishery no data is available to construct an annual age-length-key unless we combine the data from small number of different years. Thus, the annual fishery catch-at-age have been created by slicing the fishery length composition using the growth equations. This methodology is also under revision in order to collect all available historical data to create catch-at-age by species, even if in different years, and compare catch-at age estimated from different methods.

16.2.1.3 Biological parameters

Considerable biological information (growth, reproduction, etc) has been collected by species in the Azores region, from surveys and under the regional port-sampling program, and is reported elsewhere (Krug et al, 1998, Mendonça et al, 1998, 2004, Estacio et al, 2001, Menezes et al, 2001, Menezes, 2003, Morato et al, 2001). However, biological data is usually not in the assessment format, i.e. it is not update annually for the assessment purposes. Data limitations related with the methodology (sampling coverage, aging methods, biological sampling protocols, etc), usually are not analysed and reported.

Analyse of the biological data from surveys for *P. bogaraveo* have shown very high variability. For example sex-ratio presents high annual variability with-out an evident reason. Recent paper from the Mediterranean speculated that sex cannot be accurately addressed macroscopically because the hermaphroditic character of the species.

These results suggest that probably some additional data must be collected from the fishery under the port-sampling program. Working to address this problems are ongoing (see Menezes et al, 1999; Mendonça et al, 2004) in order to clarify the situation and establish adequate methodology to collect this kind of data.

All this information will be analysed and reported by stock to the next working group meeting.

16.2.1.4 Assessment

The Working Group did not attempt an assessment of the red seabream of this area because there was insufficient information. The assessment methodology used previously by the Working Group for this species seems not to be appropriate for this hermaphrodite, and other methods must be explored. It was also a concern that it remains unclear if the measure of fishing effort unit chosen in the past provides a true reflection of the real effort.

16.2.1.5 Biological reference points

As the Working Group did not carry out an assessment, no biological reference points could be considered.

16.2.1.6 Comments on the assessment

No comments because no assessment.

16.2.1.7 Management considerations

As no assessment has been carried out, no conclusions about the state of the stock in this area can be taken out. However the different technical management measures introduced regionally since 1998, in order to reduce the effort can benefit the state of the stock, whatever would be its present state. The rather constant level of the catches in the last twelve years (around 1000 t). could indicate a threshold to be maintained as precautionary until the state of the stock can be derived from a full assessment. The current TAC 2003-2004 (1136 t) for this Subarea X seems to fit that estimated level and could be maintained in the present conditions.

16.2.2 *P. bogaraveo* in Subarea IX

Although *P.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 Div. IXa, i.e., close to the Strait of Gibraltar. In Figure 16.5 the evolution of the catches of the three regional components -the Portuguese fishery, the Spanish fisheries in the northern and in the southern Div.IXa- is presented for the period 1988-2003.

In relation to the Spanish fishery in the southern Div.IXa, an updated description of it has been presented to the Working Group by Gil *et al.* (WD 2004), that complete the information offered in the previous working groups (Gil *et al.*, 2000; Gil *et al.*, 2002).

Description of the Spanish fishery in southern Division IXa

Since the early 1980s a new artisanal longline fishery targeted red seabream (*Pagellus bogaraveo*, "voraz") has been developed along the Strait of Gibraltar area (Figure 16.6). Actually this fishery covers almost all the Spanish landings for the species in the Div. IXa. The "*voracera*", a particular mechanised hook and line baited with sardine, is the gear used by the fleet. The base ports of the boats involved in this fishery are two: Algeciras and mainly Tarifa (Cádiz, SW Spain). Fishing is carried out taking advantage of the turnover of the tides in bottoms 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, in 1999, were as below:

Port	Length (m)	G.T.R. (t)	N
Tarifa	8.95	5.84	79
Algeciras	6.52	4.00	28

The decline of the landings after 1997 caused a serious concern by the fishermen and the authorities. Thus a study project on monitoring this fishery was planned and carried out by the *Instituto Español de Oceanografía* (IEO) at the request of the Fishermen Corporations. Moreover, some technical measures have been set up by the Spanish Central Government, in 1998, and by the Regional Government of Andalucía in 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),…

Recently a part of the boats of the port of Algeciras that used to fish *P. bogaraveo* have changed its activity towards the fishery of *Lepidopus caudatus* ("Pez sable") using bottom longline and fishing in different grounds as they used for red seabream.

In 2002 artisanal boats from other port, Conil, have began to direct its fishing activity to *P. bogaraveo* in different fish grounds than the boats of Tarifa and Algeciras.

For 2003, by first time, a regime of TAC and Quotas has been applied also to the *P. bogaraveo* fishery in Subarea IX: 1271 t to be distributed between Spain (most of the TAC), and Portugal.

16.2.2.1 Commercial CPUE and Research Surveys

To estimate the commercial landings per unit effort (LPUE) fishery information was gathered from the sale sheets for the period 1983-2003: monthly landings, monthly number of sales, number of days where sales were carried out and number of fishing boats that at least once per month landed fish.

The number of sales was chosen as unit of effort because it represents the number of daily trips for fishing (without consideration that boats could have made catches or not in that day). Hence, the LPUE is estimated as:

$$LPUE = \sum Landings(kg) / \sum Sales$$

The results on the LPUE development in the period 1983-2003 are presented in Figure 16.7. Since 1994 landings have been decreasing, except in1996 and 1997, to the minimum value of 220 t in 2001. (The landings from the traditional ports of Tarifa and Algeciras have continued decreasing in 2002 and 2003, but this fall has been compensated by the catches of the fleet of Conil, fishing in different grounds but in the same southern Div. IXa (J.Gil, pers. com.)). Fishing effort increased, however, in number of fishing units until 1997 and then it has decreased continuously. But at the same time, important technological improvements (automatic machines for hauling the gear, echo-sounders, GPS, etc.), difficult to quantify in terms of effective effort, have been introduced in the boats.

It is important to emphasize also that the effort unit chosen can not be too appropriate as do not consider the missing effort. Thus, in the recent years this missing effort increases substantially (fishing vessels with no catches and precisely why with no sale sheet to be recorded). This way it is advisable to interpret with caution the LPUE trend (Figure 16.7) in the last years because it can not be a real image of the resource abundance.

16.2.2.2 Length and Age compositions

It can be observed that the fishery resource suffers a decrease in the catch mean length mainly from 1995 to 1998 (Figure 16.8). It is necessary to point out that species probably does not have an homogeneous geographic and bathymetric distribution related to their length. This fact could explain the different landed mean length between ports. The mean length of the landings get progressively increasing from 1999 on, with the introduction of the recovery plans -in 2003 the total mean length reach 38,4 cm.

16.2.2.3 Biological parameters

No new information is available in relation to the presented to the working group in 2002 (ICES C.M. 2002/Assess:16).

Tagging

Updated results of the four tagging surveys conducted in 1997, 1998, 2001 and 2003 are summarised below.

Survey	Date	Gear type	Depth range	Tagged fish	Size range	Recaptures
Estepona 97	August 1997	Traps	43-103 m	1590	13-28 cm	116
Sotogrande 98	August 1998	Traps	43-103 m	1428	12-27 cm	19
Tarifa 01	March 2001	*Voracera*	179-485 m	979	21-52 cm	142
Tarifa 03	May-June 2003	*Voracera*	192-522 m	623	21-48 cm	21
			Total	4620	[12-52 cm]	298

Many recoveries have been obtained 200 and more days after the tagging, 10 fish more than 900 days, being the maximum record 5 years after tagging. Recoveries obtained until now indicate in most cases that there were no important movements. However, juveniles tagged in the southern Mediterranean region moved to the west to the Strait of Gibraltar and also few fish moved from the Strait of Gibraltar to the Mediterranean. This seems to indicate a link between the Spanish south Atlantic and the western Mediterranean red seabream populations.

16.2.2.4 Assessment

The Study Group did not attempted an assessment of the red seabream of the total area (Subarea IX) neither on the Spanish fishery in the Strait of Gibraltar because there was insufficient information. In relation to the Spanish fishery in the Strait of Gibraltar there is a concern because it remains unclear if the measure of fishing effort fishing effort unit chosen provides a true reflection of the real effort.

16.2.2.5 Biological reference points

No biological reference points have been considered, because no assessment was carried out by the Working Group.

16.2.2.6 Comments on assessment

No comments because no assessment.

16.2.2.7 Management considerations

No management considerations can be provided to the total area (Subarea IX). In relation to the Spanish fishery in the Strait of Gibraltar e Spanish, although no assessment has been carried out, the decreasing trend observed in the landings and in their mean lengths might justify, from a precautionary point of view, the local technical measures adopted by the Regional Recovery Plan of *P. bogaraveo* related to this Spanish fishery. In 2003 a regime of TAC (1271 t) and Quotas for 2003-2004 was established for whole Subarea IX.

16.2.3 *P. bogaraveo* in Subareas VI, VII and VIII

Description of the trends of this fishery is given above (Ch 16.1). In the last decade this fishery can be considered as residual and purely by-catch.

As the big changes and the drastic fall in the red seabream catches of this area component seem to have taken place in the eighties of the past century -between the end of the 70s and the end of the 80s-, it appears to be very necessary to try to obtain the best compilation of the catches data by Subarea, country, gear and year.

It has been speculated that the collapse of this fishery has been the result of a combination of factors. Its peculiar reproductive biology makes red seabream specially vulnerable by a fishery concentrated in the spawning season and focused on the bigger fish, that are mainly females. Probably there was also an excessive increase of the fishing effort since the middle of the 60s. There was no monitoring of the fishery. The effort and the fishing activity was not controlled or regulated nor in relation to the traditional and artisanal gears, such as the bottom longline, nor in relation to the new trawl gears such as the pelagic trawl, that was implemented precisely at the beginning of the 80s above all in the Bay of Biscay and south of British Islands. And, finally, perhaps other oceanographic features and cyclic changes not yet identified, could have contributed decisively with some (or with all of the) factors above indicated to the sharp declining of this international fishery in the north eastern Atlantic (Lucio, 2002).

For 2003, by first time, a regime of TAC and Quotas has been applied also to the *P. bogaraveo* fishery in Subareas VI-VII-VIII: 350 t to be distributed between Spain (most of the TAC), United Kingdom , France, Ireland and others.

16.2.3.1 Commercial CPUE and Research Surveys

No data were available to the Working Group.

16.2.3.2 Length and Age compositions

No data were available to the Working Group.

16.2.3.3 Biological parameters

No new biological parameters were available to the Working Group since the 1996 meeting of SGDEEP (ICES C.M.1996/Assess:8).

16.2.3.4 Assessment

Due to the lack of basic data, the Working Group attempted no assessment.

16.2.3.5 Biological reference points

As the Working Group carried out no assessment, no biological reference points have been considered.

16.2.3.6 Comments on assessment

No comments because no assessment.

16.2.3.7 Management considerations

In the Subareas VI, VII and VIII, there have for many years been no directed fisheries on *Pagellus bogaraveo* due to the very low yields obtained since the middle of 1980s. Therefore most of the catches must be considered as very occasional by-catches of the fleets, mainly longliners, targeting other demersal species. For this reason, in spite of the obvious "collapse" situation of this traditional fishery, no special management considerations can be suggested. In 2003 a regime of TAC (359 t) and Quotas for 2003-2004 was established for the total area (Subarea VI, VII, VIII, together considered). This current *P. bogaraveo* TAC is only allowed for by-catches.

Table 16.1 Red (=blackspot) seabream (*Pagellus bogaraveo*): Study Group estimates of landings (tonnes).

RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) VI and VII						
Year	France	Ireland	Spain	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	0	8	0	15		**23**
2000	4	n/a	3	13		**20**
2001	1	11	2	37		**51**
2002	3	0	9	13		**25**
2003*	11	0	1	20		**32**
* Preliminary						
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) VIII						
Year	France	Spain	England	**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	20	84	0	**104**		
2000	81	189	0	**270**		
2001	11	168	0	**179**		
2002	19	111	0	**130**		
2003*	5	18	0	**23**		
* Preliminary						
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) IX						
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	335	**477**			
* Only until November 2003 (Portugal)						

Table 16.1 continued

RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) X		
Year	Portugal	**TOTAL**
1988	637	**637**
1989	924	**924**
1990	889	**889**
1991	874	**874**
1992	1100	**1100**
1993	830	**830**
1994	983	**983**
1995	1115	**1115**
1996	1052	**1052**
1997	1012	**1012**
1998	1119	**1119**
1999	1222	**1222**
2000	947	**947**
2001	1034	**1034**
2002	1193	**1193**
2003*	1068	**1068**
*Preliminary		

RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) XII		
Year	Latvia	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994	75	**75**
1995		**0**
1996		**0**
1997		**0**
1998		**0**
1999		**0**
2000		**0**
2001		**0**
2002		**0**
2003*		**0**
* Preliminary		

RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) in Madeira (Portugal) (CECAF area)		
Year	Portugal	**TOTAL**
1988		**0**
1989		**0**
1990	6	**6**
1991	8	**8**
1992	7	**7**
1993	8	**8**
1994	7	**7**
1995	8	**8**
1996	4	**4**
1997	5	**5**
1998	14	**14**
1999	13	**13**
2000		**0**
2001		**0**
2002		**0**
2003*		**0**
*Preliminary		

Table 16.1 continued

RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) All ICES sea areas						
Year	VI+VII	VIII	IX	X	XII	**TOTAL**
1988	252	137	689	637	0	**1715**
1989	189	272	676	924	0	**2061**
1990	134	312	594	889	0	**1929**
1991	123	134	532	874	0	**1663**
1992	40	124	797	1100	0	**2061**
1993	22	175	1000	830	0	**2027**
1994	10	131	1004	983	75	**2203**
1995	11	110	829	1115	0	**2065**
1996	29	23	978	1052	0	**2082**
1997	56	25	1011	1012	0	**2104**
1998	17	104	877	1119	0	**2117**
1999	23	104	543	1222	0	**1892**
2000	20	270	421	947	0	**1658**
2001	51	179	374	1034	0	**1638**
2002	25	130	359	1193	0	**1707**
2003*	32	23	477	1068	0	**1600**
* Preliminary						

Year	VI-VII	VIII	VI-VII-VIII	IX	X	Others	TOTAL
1979	1559	5451	7010	1282	597	5	8894
1980	1682	4784	6466	1354	366	11	8197
1981	191	3707	3898	1174	416	0	5488
1982	139	3931	4070	1026	371	0	5467
1983	738	3010	3748	1121	505	2	5376
1984	622	2009	2631	1386	642	6	4665
1985	502	1598	2100	1168	624	1	3893
1986	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1987	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1988	252	137	389	689	637	0	1715
1989	189	272	461	676	924	0	2061

Table 16.2 Official international catches, in tonnes, of "seabreams", by Subareas in the Northeastern Atlantic, in the period 1979-1985. (ICES SGDeep, 1996. Table 14.2.1. Source: ICES Fisheries Statistics). Data for 1986-1987 are not available by Subarea. Data for 1988-1989, for *Pagellus bogaraveo* (*sic*), from present ICES WGDeep (Table 16.1), are included for comparison.

Table 16.3 Estimated historical landings (in t) of Red (=Blackspot) Seabream (Pagellus bogaraveo) of France, Portugal, Spain and United Kingdom, in the period 1948-1987.

	France				Portugal				Spain						United Kingdom (E&W)		
Year	VI+VII	VIII	VI+VII+ +VIII	(VI+VII+ +VIII)*	IX	X (Azores)	IX+X	CECAF (Madeira)	VI+VII	VIIIa,b,d	VIIIc	VI+VII+ +VIII	IX	N.E. Atlantic*	VI+VII	VIII	(VI+VII+ +VIII)*
1948					666	8	674	4			456	456					
1949					520	16	536	5			556	556					
1950				8370	580	19	599	4			458	458					
1951					715	19	734	6			348	348					
1952					556	24	580	9			903	903					
1953					572	27	599	12			743	743					
1954					618	26	644	13			367	367					
1955					424	18	442	12			400	400					
1956					792	17	809	14			613	613					
1957					835	19	854	13			771	771					
1958					783	55	838	27			551	551					
1959					884	40	925	4			542	542					
1960				5600	870	38	908				788	788		8342			
1961					1106	29	1136				757	757		8300			
1962					1445	44	1490				384	384		9635			
1963					1212	49	1261				483	483		6901			
1964					1000	53	1053				567	567		6587			
1965				5014	737	55	792				615	615		6519			
1966					800	60	860				302	302		7619			
1967					1036	67	1103				246	246		8209			
1968					1125	44	1169				249	249		9586			
1969					1107	60	1168				502	502		7971			
1970				4840	2386	108	2494	16			1350	1350		8443			
1971					2957	365	3322	42			807	807		8772			
1972					1987	264	2251	8			861	861		9121			
1973					2412	247	2659				679	679		7509			
1974					1672	222	1894	1			836	836		10217			
1975				3667	1651	303	1954	3			385	385		9169			
1976					1733	336	2069	3			564	564		9098			
1977			2214		1572	378	1950	4			440	440		7338			
1978			2090		1378	248	1626	2			360	360		4986			18
1979			969		1090	336	1426	3			675	675		5860			6
1980			1253	1906	858	445	1303	17			851	851		4783			92
1981			1006	1401	650	407	1057	9			428	428		3188			34
1982			689		665	369	1034	7			931	931		4410			9
1983			602	864	738	520	1258	8			486	486	101	3136			31
1984			391	579	726	700	1426	7			395	395	166	2698			13
1985			252		638	672	1310	8	155	n/a	290	445	196	2146			55
1986			123		511	730	1241	10	89	n/a	178	267	225	1811			68
1987			123	123	372	631	1003	8	51	n/a	114	165	296				163
1988	52	37	89		370	637	1007	8	47	n/a	91	137	319		153	9	162

Table 16.3 continued

Sources of the landings data from:

France	Years 1977-1987: Landings of *P.bogaraveo* (*sic*?) from the Northeast Atlantic. M.Pinho, pers. com. Source: SGDeep 1995
	(*) Years 1950-1984: Landings of *Pagellus sp*. ("seabreams") from the Northeast Atlantic. Source: Dardignac (1988), quoted by Castro (1990). SGDeep 1996. Table 14.2.3
Portugal	Subarea IX. Years 1948-1987: Landings of *P.bogaraveo* (*sic*?). M.Pinho, pers. com. Source: H. Krug (for 1948-1969) and SGDeep 1995 (for 1970-1987)
	Subarea X. Years 1948-1987: Landings of *P.bogaraveo* (*sic*). M.Pinho, pers. com. Source: H. Krug (for 1948-1969) and SGDeep 1995 (for 1970-1987)
Spain	Years 1948-1984: Landings of *P.bogaraveo* (*sic*) from "Div. VIIIc" -mainly Div. VIIIc (eastern) + Div. VIIIb (southern)- correspond only to the Basque ports. Source: Cofradias de Pescadores. (Lucio, 1996).
	Years 1985-1987: Landings of *Pagellus sp*. (mainly *P. bogaraveo*). Source: SGDeep 1996. Table 14.2.4
	Years 1983-1987: Landings of *P.bogaraveo* (*sic*) from Div. IXa correspond only to southern IXa (Tarifa & Algeciras ports). Source: Cofradias de Pescadores. (WD Gil, 2004).
	(*) Years 1960-1986: Landings of *Pagellus sp*. ("seabreams") from the Northeast Atlantic. Source: Anuarios de Pesca maritima. Castro (1990). SGDeep 1996. Table 14.2.3
U.K.	Years 1978-1987: Landings of *P.bogaraveo* (*sic?*) from the Northeast Atlantic. M.Pinho, pers. com. Source: SGDeep 1995

Data on 1988 onwards come from the SGDeep1996 and following WGDeep's

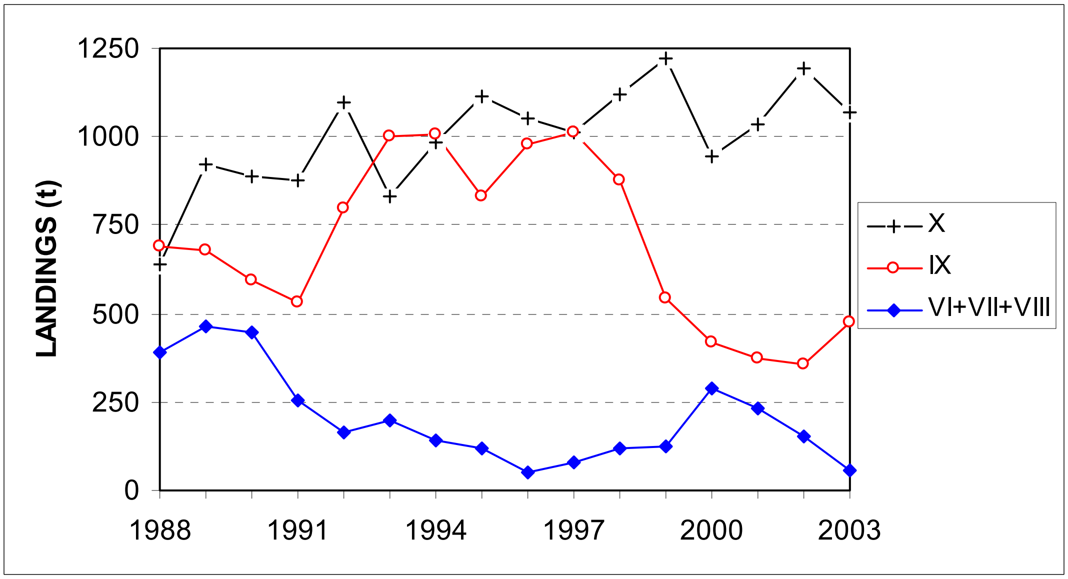


Figure 16.1 Evolution of the landings of *Pagellus bogaraveo* in the three sea areas considered (VI+VII+VIII, IX and X) in the period 1988-2003.

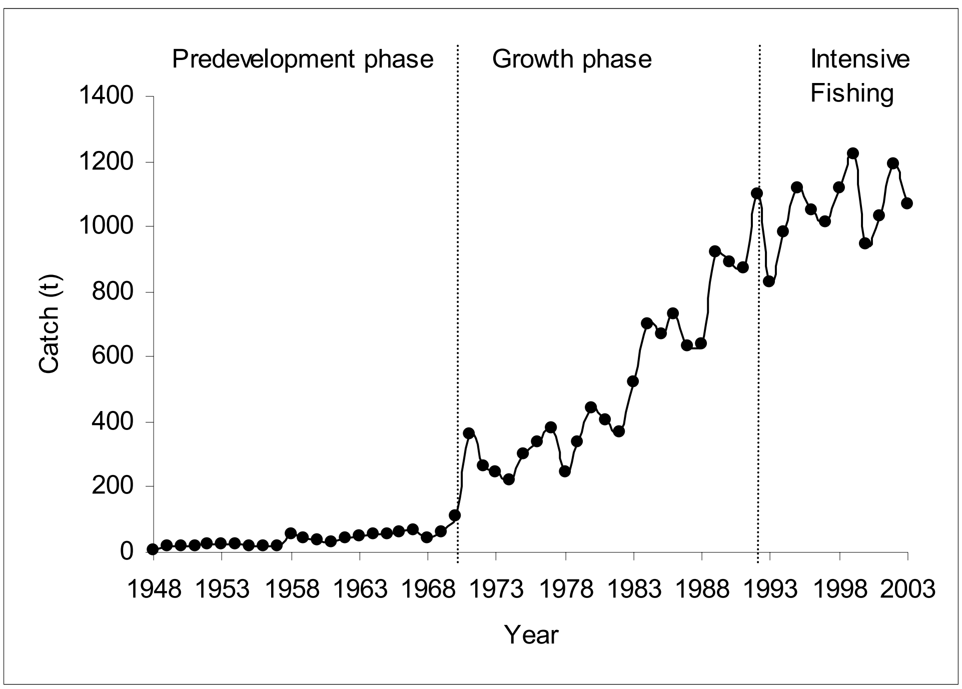


Figure 16.2 Historical catches of *Pagellus bogaraveo* in Azorean waters (ICES Subarea X) in the period 1948-2003. (Vertical lines divided the three considered development phases of the Azorean fishery).

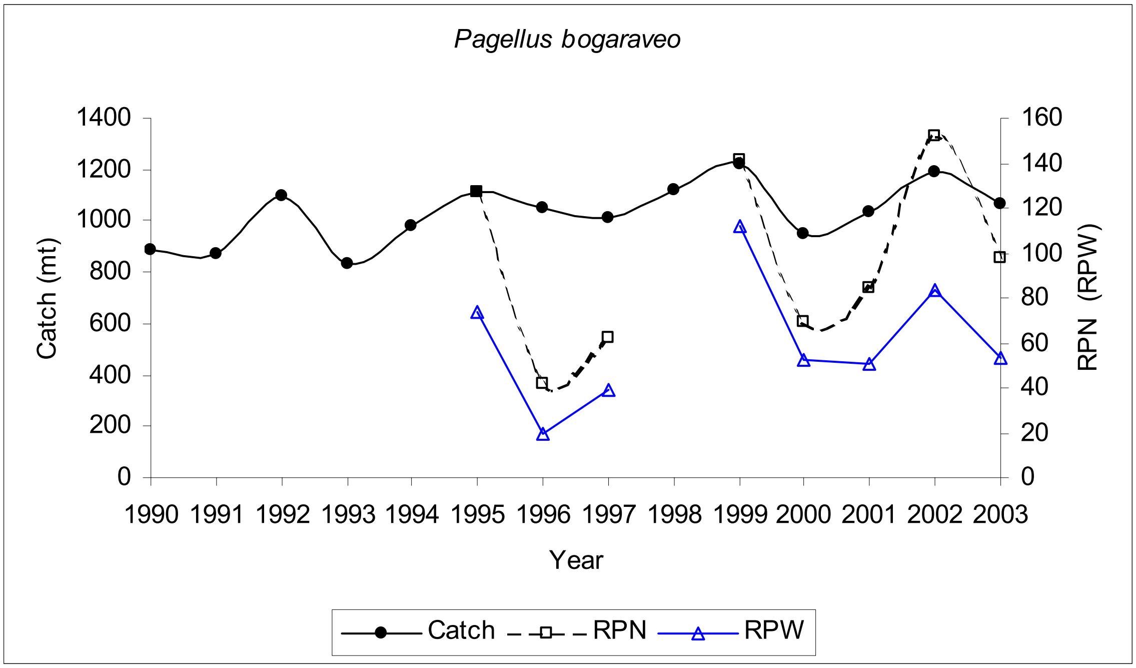


Figure 16.3 Catches and abundance indices of *Pagellus bogaraveo* estimated from the Azorean longline survey (1995-2003). Abundance indices are expressed by Relative Population Numbers (RPN) and by Relative Population Weight (RPW).

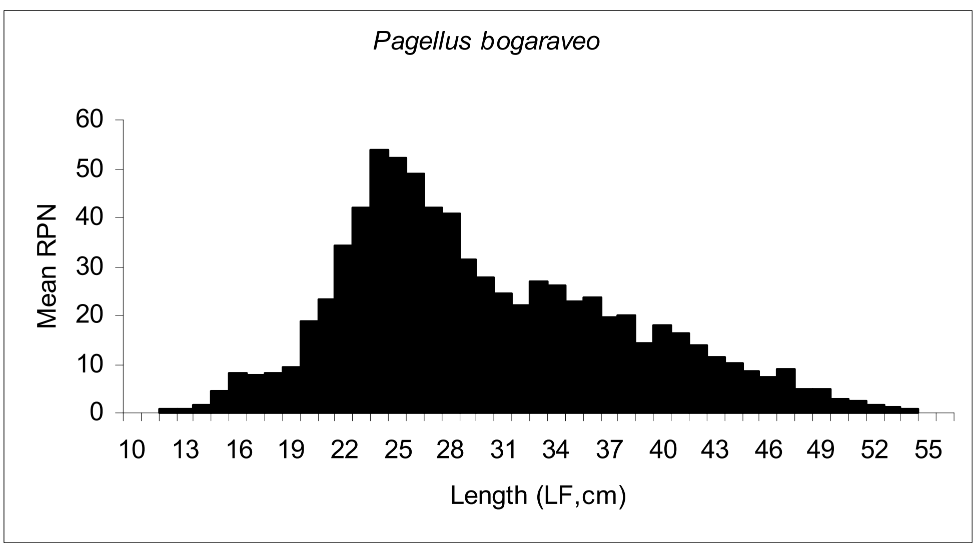


Figure 16.4 Mean length composition of the *Pagellus bogaraveo* catches from the Azorean longline survey (1995-2003).

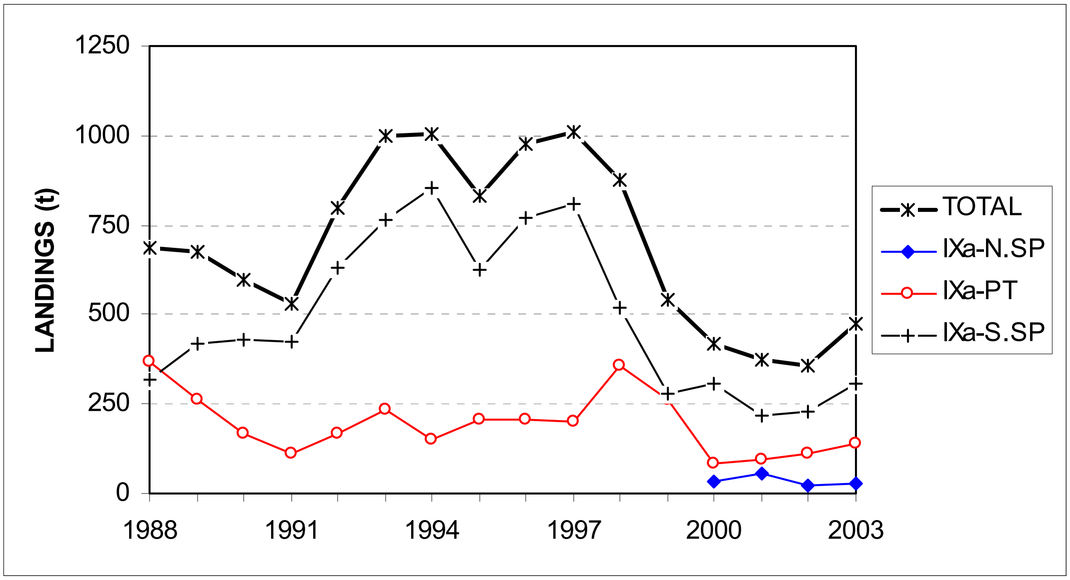


Figure 16.5 Evolution of the landings of *Pagellus bogaraveo* in the Subarea IX in the period 1988-2003. Spanish landings in northern Div. IXa (IXa-N.SP) and in southern Div. IXa (IXa-S.SP), and Portuguese landings (IXa-PT) are represented separately.

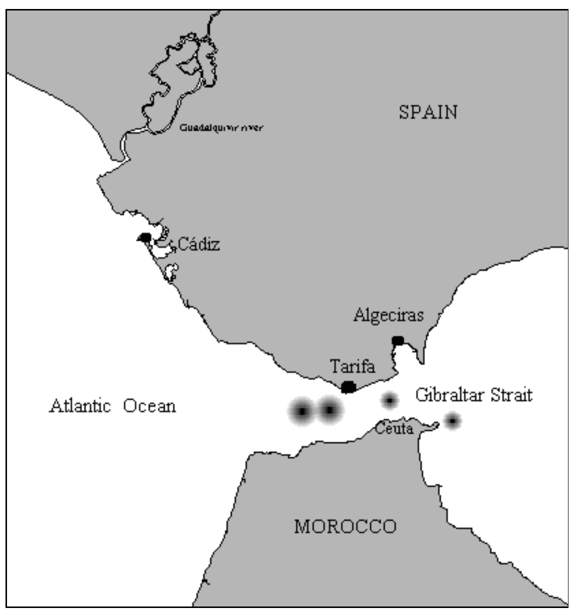


Figure 16.6 Main landing ports and fishing areas of the artisanal longline ("voracera") fishery on *Pagellus bogaraveo*, in the Strait of Gibraltar (from Gil *et al.*, 2000).

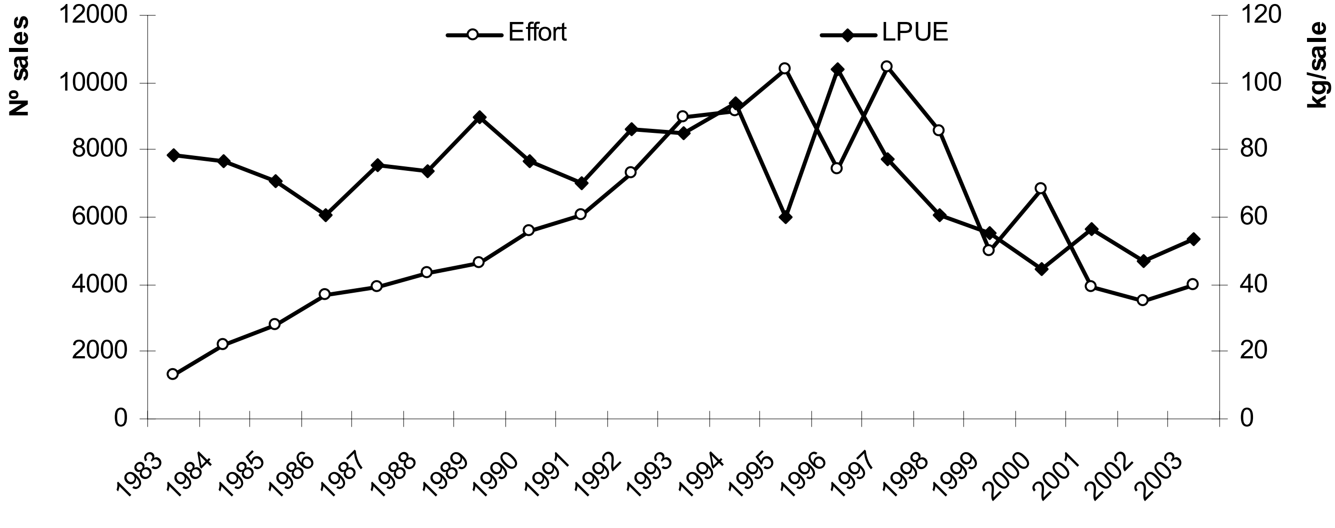


Figure 16.7 Evolution of effort and LPUE of *Pagellus bogaraveo* in southern Div. IXa, Strait of Gibraltar, in the period 1983-2003.

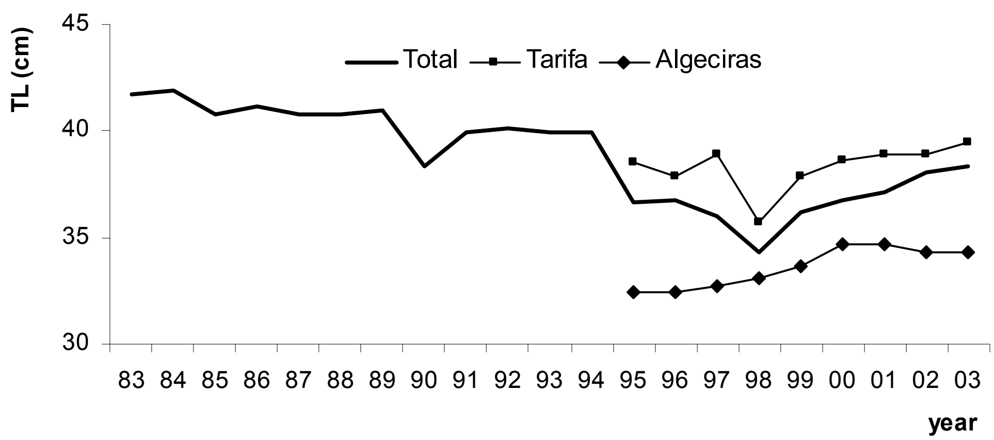


Figure 16.8 Landings mean length evolution by port of *Pagellus bogaraveo* in southern Div. IXa, Strait of Gibraltar, in the period 1983-2003.

17 GREATER FORKBEARD (*PHYCIS BLENNOIDES*)

17.1 Catch trends

Table 17.1 shows the landings of *Phycis blennoides* by ICES Subareas as reported to ICES or as reported (estimated) to the Working Group. The 2003 data are provisional. Greater forkbeard may be considered as a by-catch species in the traditional demersal trawl and longline fisheries targetting species such as hake, megrim, monkfish, ling, blue ling..., or mixed fisheries. The majority of landings came from the West of Scotland/Rockall Trough, West of Ireland/Western Approaches, Biscay and off the Portuguese Coast. Landings from some areas and countries also contain Mora. Since the began 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 in 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).

In Subareas I, II, III, IV and V the landings registered mainly by Norway have declined since1993. The Norwegian longliners which fish in these areas catch *P. blennoides* as a by-catch in the ling fishery. The quantity of this by-catch depends on market price. Thus, in Subarea V landings in 2001 increased to 98 tonnes. Later, data from 2002 shows a huge increase of the landings, passing 1050 tonnes, mainly from Norway with the 96 % of the total of this year in this Subarea. So, this ups and downs does not reflect increases/decreases in the resource abundance, it is changes in the amounts sell.

In Subareas VI, VII and XII landings presents true stability till 1994 with an average of 1698 tonnes. Then, these ranged between 2000 and 2495 tonnes from 1995 until 2003 with a peak of 4356 tonnes landed in 2001. Landings fluctuation probably represents a change in target species rather than variations in the abundance of *P. blennoides*. Scottish landings from 1999 to 2003 includes abroad landings which increases their values regards to previous years. From Subarea XII Norway landings mainly come from a Norway commercial longline targetting Greenland Halibut at Hatton Bank established in 2000 and expanded in 2001 (Hareide *et al*., 2002 WD). Also are available small French and UK landings. Landings from Subareas VI and VII comprises more than the 50 % of the total landings of the species in ICES area in the 2000-2003 period.

In Subareas VIII and IX the bulk of the landings are Spanish and have increased from 81 tonnes in 1988 to 665 tonnes in 1998. This is probably because of the start of a longline directed deep water fishery from Asturias and Cantabria ports. Landings from the 2000-2002 period seems stable rounding an average of 450 tonnes. The 2003 low value is not taken into consideration dues to very preliminarity feaure of the Spanish data. Portuguese landings are probably underestimated due to the low comercial value of the species and to the fact than an important part of the landings are reported as *Phycis spp*.

In the subarea X (Azorean region) landings by Portugal includes Moridae. Like in other cases is not a target fishery of the demersal fleet and landings shows ups and downs which does not reflects resource abundance trends.

17.2 Stock structure

The Greater forkbeard is a gadoid fish which is widely distributed in the Northeastern 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 800meters 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. The above separation does not pre-suppose the existence of four different stocks of *P. Blennoides* only offers a way of recording the available information.

17.3 Commercial CPUE and research surveys

Norway organized a feasibility fishery in 2001 with three longliners and one trawler on Hatton Bank (Kjerstad *et al*., 2002). In addition to what was presented in the 2002 WGDEEP Report from Hareide *et al*. (2002 WD), Fossen (WD) recalculated the 2001 value and gives a new one for 2003 for the Norwegian longline fishery in Hatton Bank. Thus, catch rates for this spspecies are 25.6 and 14.3 kg/1000 for 2001 and 2003, respectively.

Spanish research bottom trawl surveys were carried out in Subarea VII (Porcupine) from 2001 to 2003 (Velasco F., *pers. com.*). Figure 17.1 shows the Greater forkbeard biomass catches distribution. This species with a total abundance of 11, 10 and 22 kg/30 minutes haul for the 2001, 2002 and 2003, respectively, presents a notably increase both in biomass and number in the last year, but its distribution remains quite uniform along the studied area.

Lucio *et al*. (WD) presents the 2000-2003 estimated spatial distribution of Greater forkbeard anual landings by ICES statistical rectangles by Basque fleets (mainly bottom trawlers and longliners).

In March, a Russian trawler with an observer on board carried out one trawl in the area of Hatton Plateau over depths of 1200-1300 m. Greater forkbeard comprises only the 3,7% of 10 tonnes total catch (Vinnichenko & Khlivnoy, WD).

17.4 Length and age composition

Figure 17.2 presents the comparison between length frequency distributions from 2001-2003 Spanish bottom trawl surveys in Porcupine (Velasco F., *pers. com.*). Length distribution shows a mode of small individuals, 12-14 cm, and another most abundant mode between 28 and 30 cm in the first two surveys. In contrast in the last year, 2003, there is a decrease these small ones (ranged 12-18 cm) and a notable increase of largest sizes individuals (from 22 to 32 cm) which established a clear mode of 26-27 cm. Great forkbeard mean catch length from these surveys are: 33.1, 28.0 and 28.6 cm for the 2001, 2002 and 2003, respectively.

Size distribution from the a Russian trawl in the Hatton Plateau comprises fish from 45 to 52 cm with a mean length of 48,0 cm for males and 50,0 cm for females. Also Greater forkbeard, ranged 20-55 cm length were observed in single bottom trawl catches at 410-490 m depth in the West area of Scotland (Vinnichenko & Khlivnoy, WD).

17.5 Discards

No new data on discards are available.

17.6 Biological parameters

In 2002 WGDEEP Report (ICES C.M. 2002/ACFM: 16) available data were presented in a text table, and no new information was presented at this meeting.

Variate	**Value**	**Source/comment**
Longevity (years)	15? 14 ♂ 7 ♀ 9	Gordon (FAIR)) 1999, Sub-t. 5.12, Doc.55 Casas & Piñeiro, 2000 Kelly, 1997
Growth rate, K	♂ 0.217 ♀ 0.087 ♂ 0.43 ♀ 0.39	Casas & Piñeiro, 2000 Kelly, 1997
Natural mortality, M		
Fecundity (absolute)		
Length at first maturity	♂ 31 cm ♀ 32 cm	Kelly, 1997

17.7 Assessment

No assessment was attempted by the Working Group due to the lack of suitable data in all ICES Subareas.

17.8 Biological reference points

As no assessment was carried out by the Working Group, no biological reference points have been considered.

17.9 Comments on Assessment

No comments because no assessment.

17.10 Management considerations

No special management considerations can be suggested because there is no assessment. The general character of this fishery as a by-catch means that CPUE data are unreilable. This fact makes it no manageable according to a single-species regulation. Anyway a clear distinction must be taken account between the species *Phycis blennoides* and *Phycis phycis* and also with Morids in all future management proposals.

Table 17.1 Greater forkbeard (*Phycis blennoides*): Working Group estimates of landings (tonnes)

GREATER FORKBEARD (*Phycis blennoides*) I and II

Year	Norway	France	Russia	UK (Scot)[1]	Germany	**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				**153**

*Preliminary data
(1) Includes Moridae

GREATER FORKBEARD (*Phycis blennoides*) III and IV

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	3		0	7		**11**
2001	5		1	19	2	**26**
2002	2	561	1	21	0	**585**
2003*	1	224	0	7		**231**

*Preliminary data
(1) Includes Moridae

Table 17.1 continued

GREATER FORKBEARD (*Phycis blennoides*) Vb

Year	France	Norway	UK (Scot)(1)	UK (EWNI)	**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	7	92	1	0	**100**
2002	10	133	5	0	**148**
2003*	7	55	7	0	**69**

*Preliminary data
(1) Includes Moridae

GREATER FORKBEARD (*Phycis blennoides*) VI and VII

Year	France	Ireland	Norway	Spain	UK (EWNI)	UK (Scot)(1)	Germany	Russia	**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	317	686	183	824	929	518	1		**3458**
2000	623	743	380	1613	731	820	8	2	**4919**
2001	626	663	536	1332	538	640	10	4	**4349**
2002	548	481	300	1049	421	545	9	0	**3352**
2003*	386	319	492	383	245	661		1	**2486**

*Preliminary data
(1) Includes Moridae

Table 17.1 continued

GREATER FORKBEARD (*Phycis blennoides*) VIII and IX

Year	France	Portugal	Spain	**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	655	**664**
1999	7	10	361	**378**
2000	31	6	374	**411**
2001	33	8	454	**494**
2002	63	8	418	**489**
2003*	23	11	101	**135**

*Preliminary data

GREATER FORKBEARD (*Phycis blennoides*) X

Year	Portugal(1)	**TOTAL**
1988	29	**29**
1989	42	**42**
1990	50	**50**
1991	68	**68**
1992	81	**81**
1993	115	**115**
1994	135	**135**
1995	71	**71**
1996	45	**45**
1997	30	**30**
1998	38	**38**
1999	41	**41**
2000	94	**94**
2001	83	**83**
2002	57	**57**
2003*	45	**45**

*Preliminary data
(1) Includes Moridae

Table 17.1 continued

GREATER FORKBEARD (*Phycis blennoides*) XII

Year	France	UK (Scot)[1]	Norway	UK (EWNI)	**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	**6**
2003*	1		8	0	**9**

*Preliminary data
(1) Includes Moridae

GREATER FORKBEARD (*Phycis blennoides*) all ICES Subareas

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	81	1	**2128**
1993	1	34	27	1462	395	115	1	**2035**
1994	0	12	4	1571	320	135	3	**2045**
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	664	38	1	**3763**
1999	0	31	34	3458	378	41	0	**3941**
2000	0	11	32	4919	411	94	6	**5472**
2001	8	26	100	4349	494	83	8	**5068**
2002	315	585	148	3343	489	57	6	**4943**
2003*	153	231	69	2486	135	45	9	**3130**

*Preliminary data

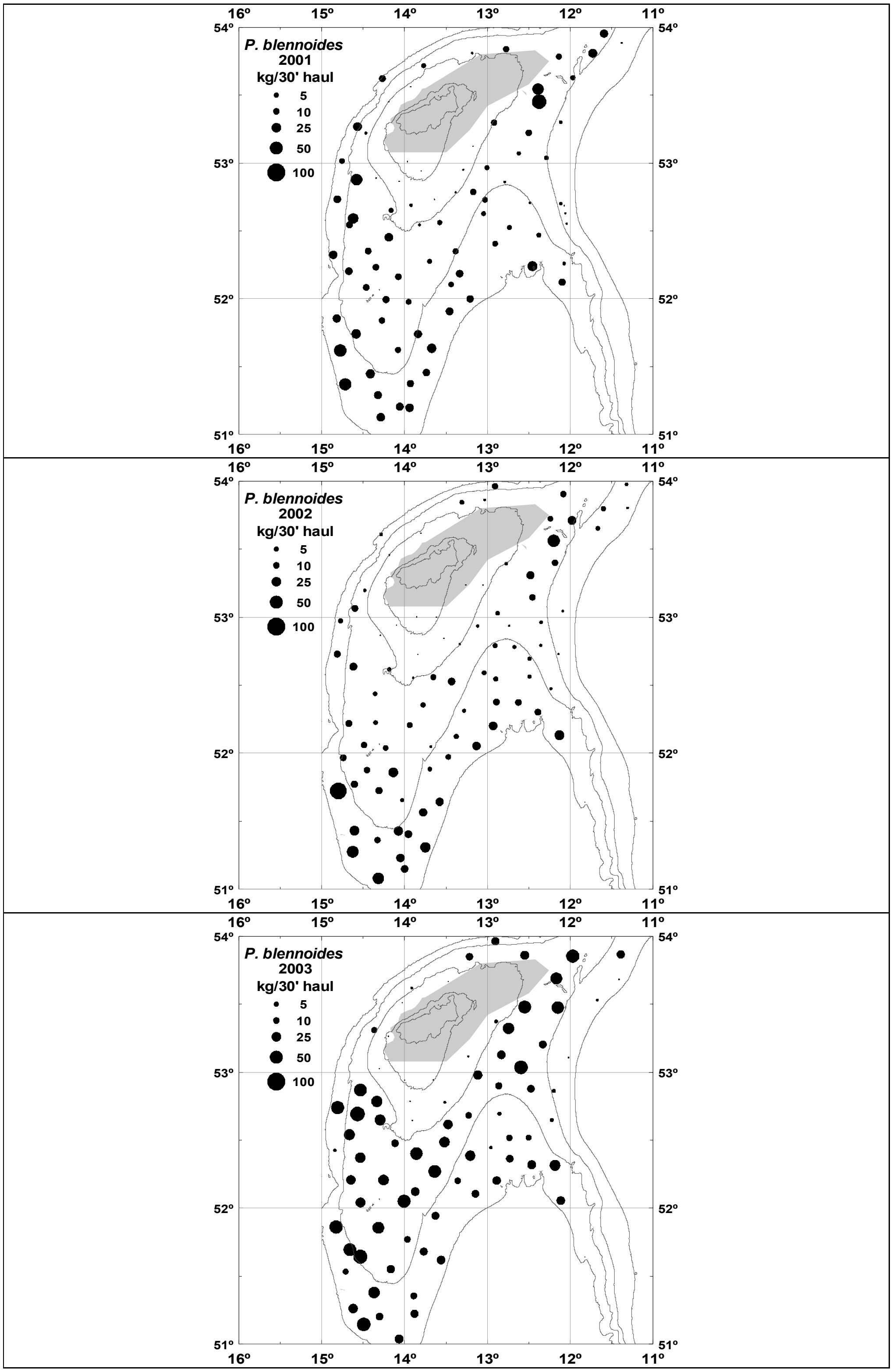


Figure 17.1 Spanish bottom trawl survey in Porcupine Bank. Greater forkbeard catches distribution (kg/30 min haul) from the 2001-2003 period (Velasco, F., *pers. com.*).

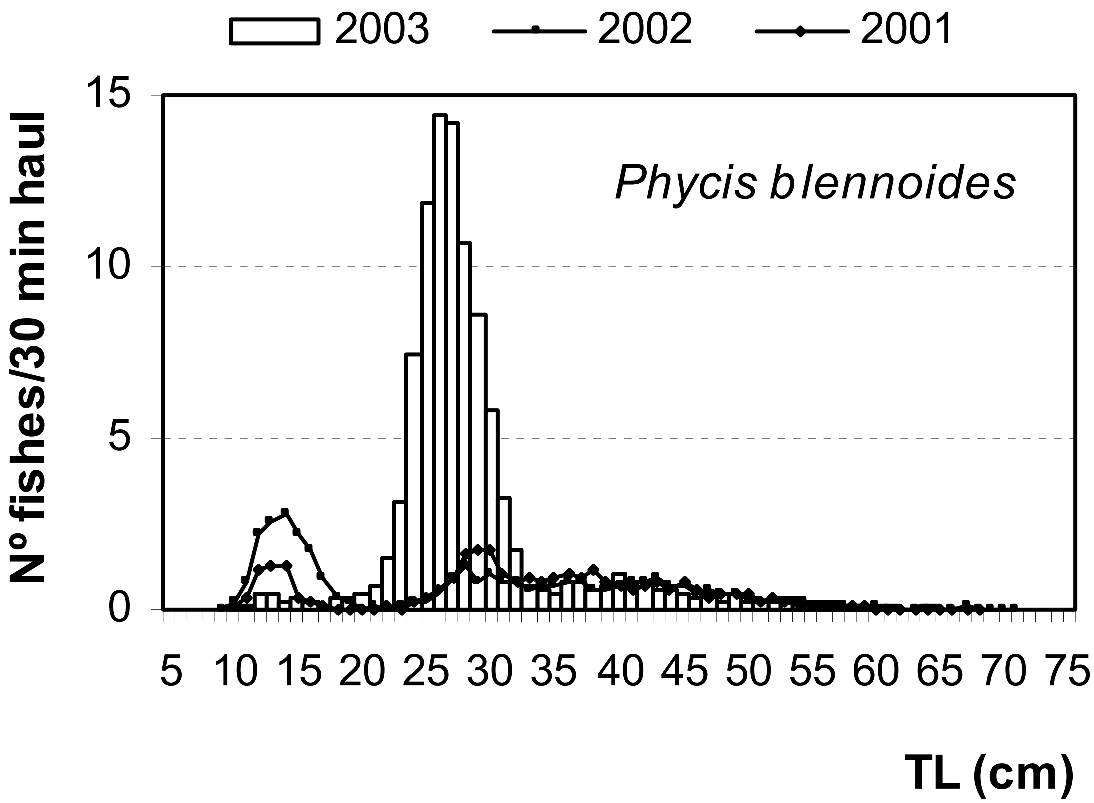


Figure 17.2 Spanish bottom trawl survey in Porcupine Bank. Comparison between Greater forkbeard length frequency distributions from the 2001-2003 period (Velasco, F., *pers. com.*).

18 ALFONSINOS/GOLDEN EYE PERCH (*BERYX* SPP)

18.1 Catch trends

Table 18.1 shows the landings data for Alfonsinos, (*Beryx* spp), by ICES Subareas/Divisions as officially reported to ICES or to the Working Group. No data on discards have been presented. In most cases the statistics refer to both species combined (*Beryx splendens* and *Beryx decadactylus*). In general, it is not known if the annual variations in landings are due to changes in fish abundance, changes in the targeting of the fisheries or to more accurate reporting or monitoring of the landings. Alfonsinos are usually a by-catch of demersal fisheries targeting other species.

Landings reported from Subareas IV-V are very small and most were taken by French vessels.

In Subareas VI-VII, landings were very small and variable until 1995, ranging from 12 t (in 1989) to 1 t (in 1993). In 1996, however, landings increased to 178 t, taken as by-catch of the Spanish demersal, mainly longline fisheries in Subarea VII. In 1998 and 1999 landings amounted to about 80 t and were reported by France and Spain. Between 2000 and 2002 landings amounted to about 100 t and were reported only by Spain. During 2003 the catches decrease to 18t reported mainly from France.

In Subareas VIII-IX, the reported landings were very small (1-2 t) and scattered until 1994, but they have increased continuously from 1995 onwards. In 1998 they amounted to 269 t. In the period 1999-2001 the reported landings varied between 160 t and 224 t, mainly due to the Spanish landings. Most of these landings can be regarded as by-catches of the Spanish and Portuguese demersal fisheries in these Subareas. During 2003 the catches decrease to 9t reported only by France.

Overall, most of the alfonsino 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 185 t in 1987 to 636 t in 1994 and then decreased to 175 t in 1999. During the last four years the landings fluctuated around 200 t. The decrease is observed in both species being significantly for *B. decadactylus* in 1999. The landings series in the period 1988-2003 for both species separately is presented in the text table below and in Figure 18.1 &18.2 (WD Pinho, 2004).

Landings (tonnes) of *Beryx* spp. in Azorean waters are presented:

Year	*B. splendens*	*B. decadactylus*	Total
1988	122	103	225
1989	113	147	260
1990	137	201	339
1991	203	168	371
1992	274	176	450
1993	317	217	533
1994	404	231	636
1995	335	194	529
1996	379	171	550
1997	268	111	378
1998	161	68	229
1999	119	56	175
2000	172	37	209
2001	182	17	199
2002	223	20	242
2003	150	22	172

Landings of *Beryx* spp. by former USSR trawlers were estimated to be around 1800 t during 1978–1979. Landings by Russian trawlers in the North Azores area were also estimated for some years in the 1990s. They oscillated between 100 and 864 t. From 1997 no landings were reported by Russia for the Subarea X. In 2000 one trawler worked a few days in the area catching 5 t.

Finally, in Subarea XII, landings (2 t) were reported only in 1995, by the Faroe Islands.

18.2 Stocks

Preliminary genetic results for *Beryx splendens* suggest that significant genetic differentiation may occur between populations of *Beryx splendens* within the North Atlantic. This may have some implications for the management of the fisheries. Further investigations of the stock structure of *Beryx splendens* should be given priority to elucidate the stock structure of this species (Menezes *et al.* 2001).

New information on genetics results for alfonsinos from the OASIS and MAR-ECO projects will be available to the working group during the next meeting.

18.3 Commercial CPUE and Research Surveys

No data are available on commercial CPUEs.

Information on length frequency distributions as well as relative abundance for *Beryx* spp. by stratum (geographical area and depth) is available from 1995, but only for the Azorean waters. These information on the Relative Abundance Index (RPN) and length composition for *Beryx splendens* and for *Beryx decadactylus* from the Azorean spring longline surveys has been annually updated (ICES C.M.2000/ACFM:8; WD Pinho, 2004).

Relative abundance index by species from the Azorean longline survey from 1995 to 2003 where presented to the group and are illustrated in Fig. 18.3 & 18.4. Survey index seems to show the same decreasing trend of the catches. However, the geographic distribution of this species is not known and may be broader than the survey areas. Thus, any generalizations about the population status must be interpreted with care because the species may have not been sampled adequately in the Azorean standard survey (WD Pinho, 2004).

In the period from 12 to 19 December 2003 r/v "Atlantida" has fulfilled a short-time complex of works in the area of the Mid-Atlantic Ridge northwards off EEZ of the Azores (42º30′ - 45º30′ N, 25º -29º30′ W). Seven seamounts with the minimum depths from 511 to 920 m were surveyed. Weak echoes were recorded above the ground of four seamounts. Nine hauls were made by pelagic trawl with a rigid footrope up to bottom. In two cases the catches of Alfonsino *(Beryx splendens*) amounted to 100 and 25 kg.

18.4 Length and Age compositions

Annual length data from the Azorean longline survey (area X) was updated for the period 1985-2003. Average length distributions for that period are presented in Figure 18.5.

Length of Alfonsino (*B. splendens*) from Russian survey in MAR during December 2003 was 21-40 cm, mainly 23-25 and 31-35 cm (figure 18.6). Mean weight constituted 353 g.

18.5 Biological parameters

Information on the length-weight relationship, spawning season, depth distribution and other biological characteristics for both *Beryx* species from Subarea X (Azorean region and the Mid-Atlantic Ridge) were reported in 1996 (ICES C.M.1996/Assess:8), 1998 (ICES C.M.1998/ACFM:12), 2000 (ICES C.M.2000/ACFM:8), 2001 (ICES C.M.2001/ACFM:23) and 2002 (ICES C.M.2002/ACFM:16).

During the MAR Russian 2003 survey some *B. splendens* individuals were caught and sampled. The ratio between number of males and females was 1:1.1. The majority of individuals had the ripening gonads (Figure 18.7). Some pre-spawning individuals and fish with gonads in the status of post-spawning recovery were also registered. Alfonsino fed feebly, mainly, on shrimp.

18.6 Assessment

As in previous years, the Working Group attempted no assessment due to the lack of the necessary basic data.

18.7 Biological reference points

As the Working Group carried out no assessment, no biological reference points have been considered.

18.8 Comments on the Assessment

No comments because no assessment.

18.9 Management considerations

The stock structure of alfonsino is not clear (Menezes *et al*. 2001), and the possible interactions of the fishing activities on the Mid Atlantic Ridge outside the Azores EEZ and the landings of alfonsino from the traditional fishery within the Azorean EEZ, continues to be unclarified.

Russian investigations in the MAR region (Vinnichenko, 2002), suggest that *B. splendens* has relatively isolated populations on each of many oceanic seamounts, and that alfonsino stocks were intensely exploited on most exploitable seamounts in the previous decade.

The state of the stocks is uncertain.

Table 18.1 Alfonsinos. Working Group estimates of landings (tonnes).

ALFONSINOS (*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**

*Preliminary

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**

*Preliminary

Table 18.1 (Cont'd)

ALFONSINOS (*Beryx* spp.) VI and VII

	France	E & W	Spain	Ireland	**TOTAL**
1988					
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	4		**25**
1998	10	0	71		**81**
1999	55	0	20		**75**
2000	31	2	100		**133**
2001	58	13	115		**186**
2002	34	15	69		**118**
2003*	14	0	0	4	**18**

*Preliminary

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	259		**269**
1999	11	29	161		**201**
2000	6	40	117	4	**167**
2001	7	43	179	0	**229**
2002	12	60	38	14	**124**
2003*	9	0	0	0	**9**

*Preliminary

Year

Table 18.1 (Cont'd)

ALFONSINOS (*Beryx* spp.) X

	Faroes	Norway	Portugal	Russia	E & W	**TOTAL**
1988			225			**225**
1989			260			**260**
1990			339			**339**
1991			371			**371**
1992			450			**450**
1993		195	533			**728**
1994		0	636	864		**1500**
1995	0	0	529	100		**629**
1996	0	0	550	0		**550**
1997	5	0	378	600		**983**
1998	0	0	229	0		**229**
1999	0	0	175	0		**175**
2000	0	0	209	5	15	**229**
2001	0	0	199	0	0	**199**
2002	0	0	242	0	0	**242**
2003	0	0	172	0	0	**172**

*Preliminary

ALFONSINOS (*Beryx* spp.) XII

Year	Faroes	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994		**0**
1995	2	**2**
1996	0	**0**
1997	0	**0**
1998	0	**0**
1999	0	**0**
2000	0	**0**
2001	0	**0**
2002	n/a	**n/a**
2003*	0	**0**

*Preliminary

Table 18.1 (Cont'd)

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	n/a	**n/a**
2001	n/a	**n/a**
2002	n/a	**n/a**
2003	n/a	**n/a**

ALFONSINOS (*Beryx* spp.). All areas.

	IV	Vb	VI+VII	VIII+IX	X	XII	**TOTAL**
1988					225		**225**
1989			12		260		**272**
1990	1	5	8	1	339		**354**
1991					371		**371**
1992	2	4	3	1	450		**460**
1993			1		728		**729**
1994			5	2	1500		**1507**
1995		1	3	82	629	2	**717**
1996			178	88	550		**816**
1997			25	135	983		**1143**
1998			81	269	229		**579**
1999			75	201	175		**451**
2000			133	167	229		**529**
2001			186	229	199		**614**
2002			118	124	242	n/a	**484**
2003*			18	9	172		**199**

*Preliminary

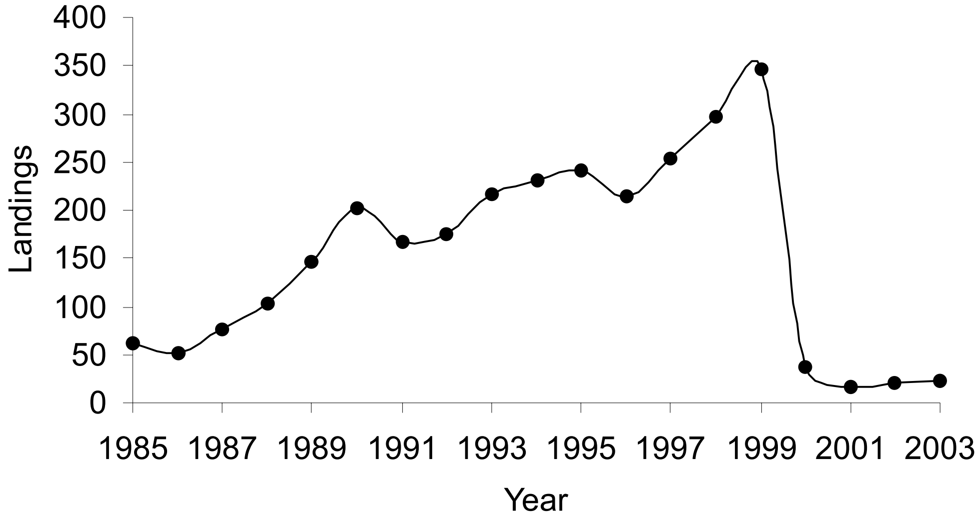


Figure 18.1 *Beryx decadactylus* landings in the Azores region (ICES Subarea X), in the period 1985-2003.

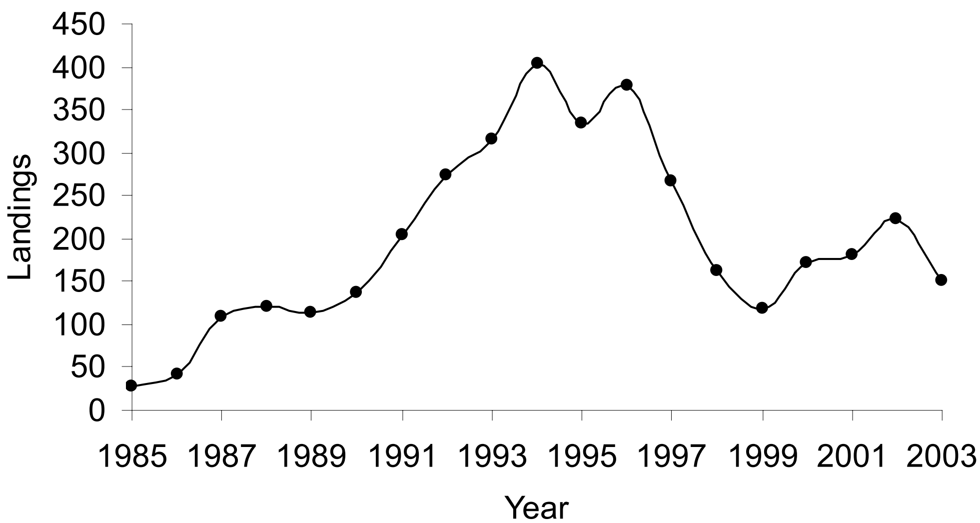


Figure 18.2 *Beryx splendens* landings in the Azores region (ICES Subarea X), in the period 1985-2003.

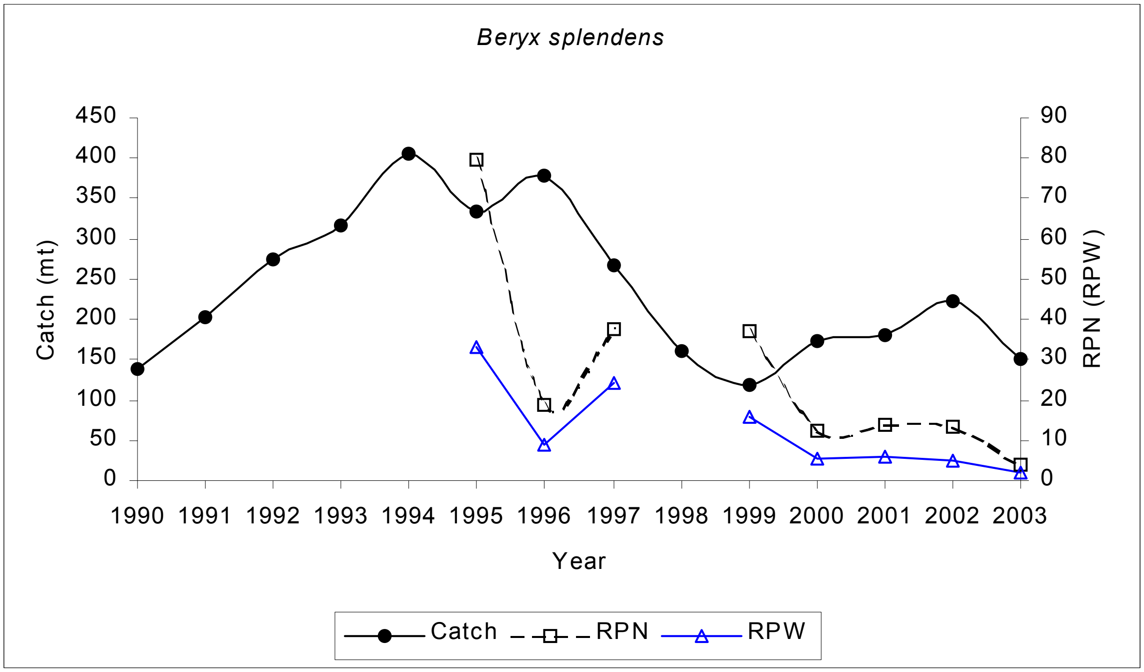


Figure 18.3 Relative abundance indices in number (RPN-Relative Population Number) and in weight (RPW-Relative Population Weight) for *Beryx splendens* from the Azorean longline survey (ICES area x). Catch data is also presented in the figure for trend illustration.

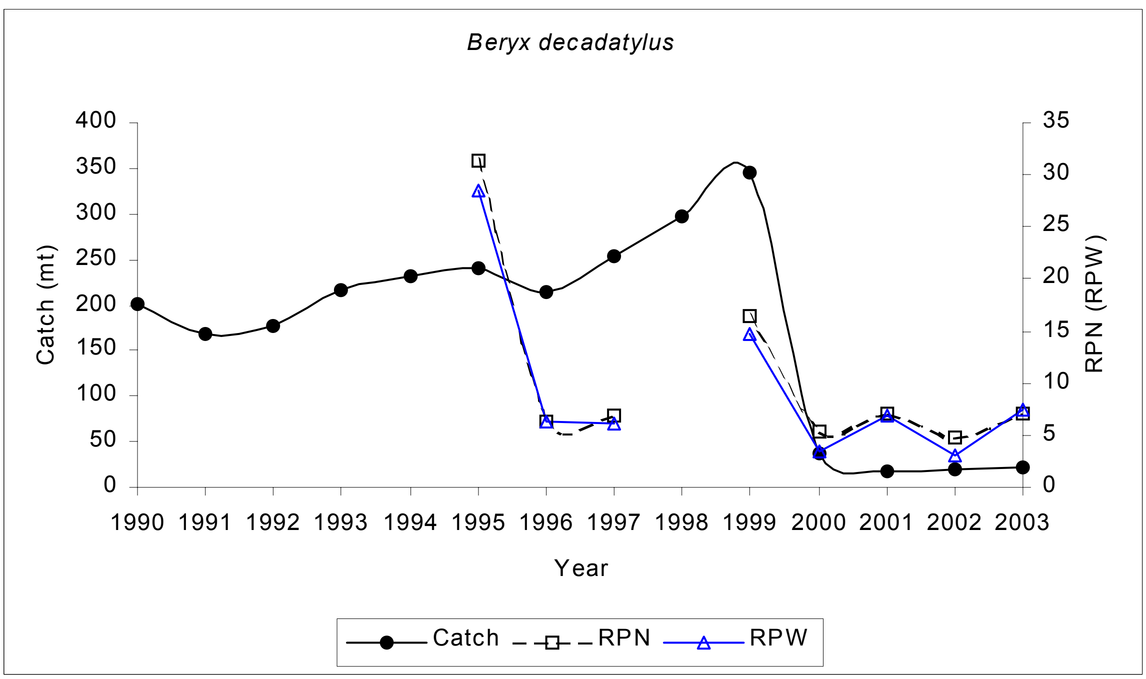
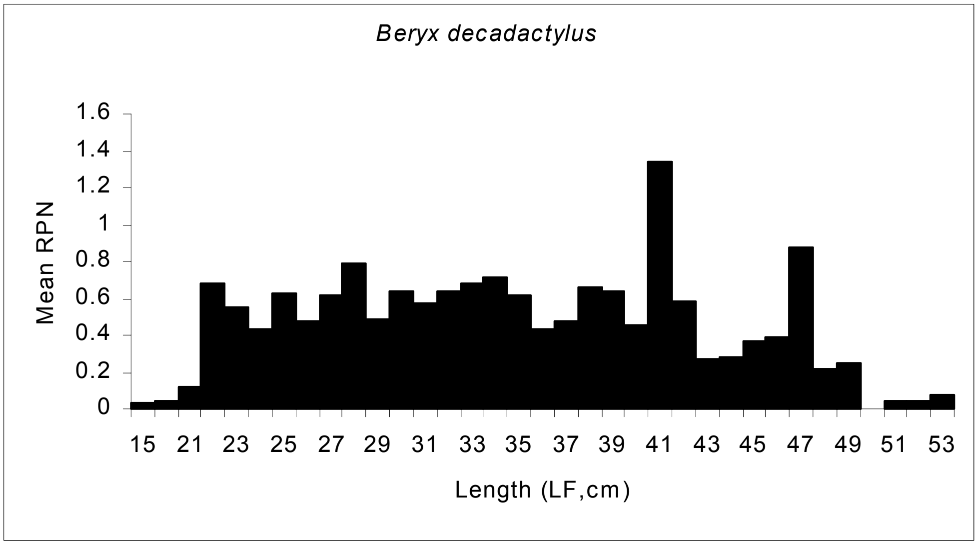


Figure 18.4. Relative abundance indices in number (RPN-Relative Population Number) and in weight (RPW-Relative Population Weight) for *Beryx decadactylus* from the Azorean longline survey (ICES area x). Catch data is also presented in the figure for trend illustration.



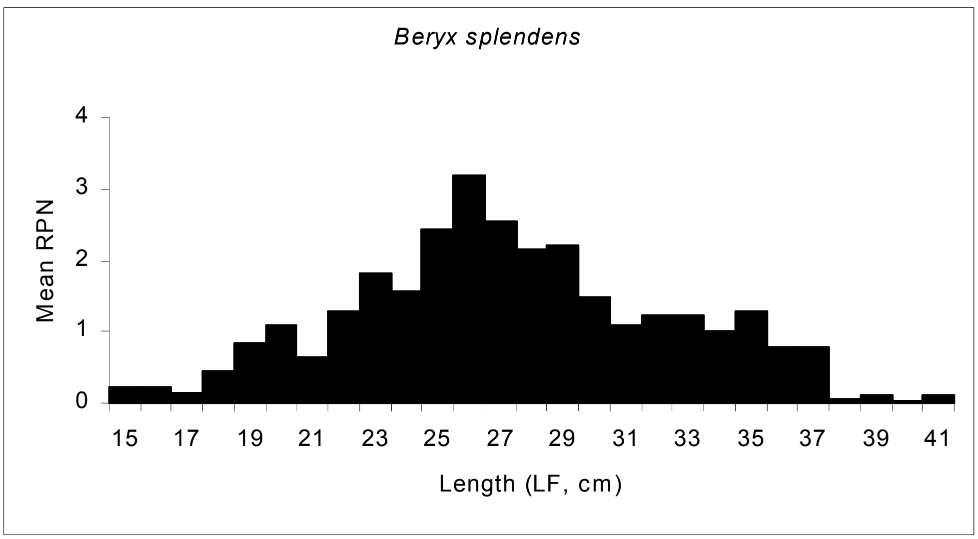


Figure 18.5 Average (1985-2003) length composition of *Beryx decadactylus* and *Beryx splendens* from the Azores longline survey for the ICES area X.

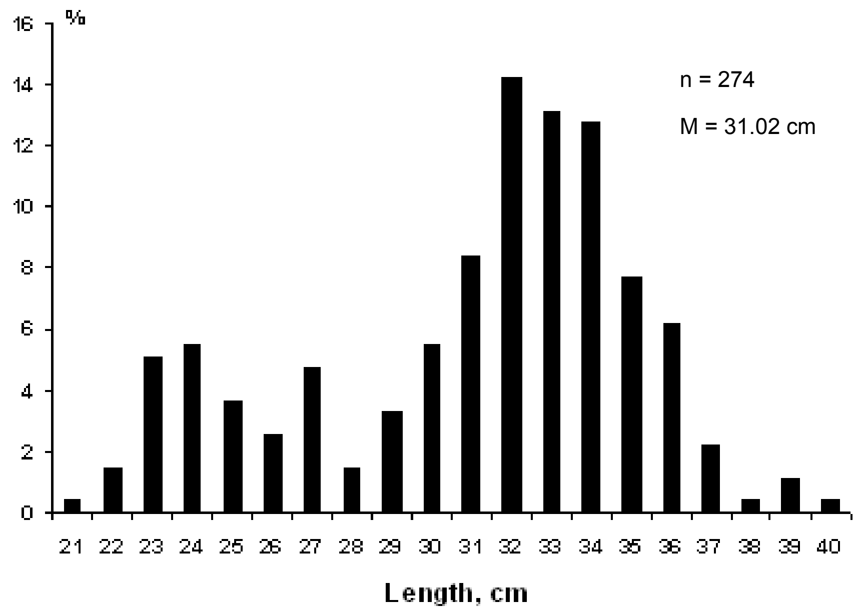


Figure 18.6 Length frequency of golden eye perch *Beryx splendens* off the North Azores banks area, from Russian survey conducted during December 2003.

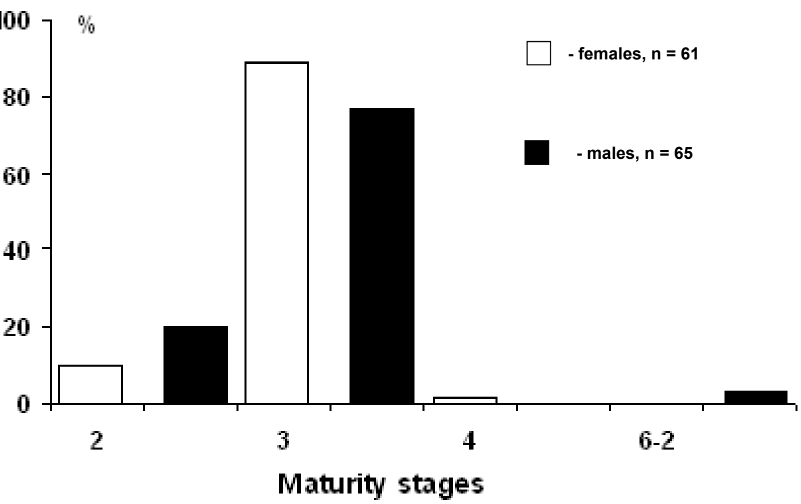


Figure 18.7 Maturity stages of golden eye perch, *Beryx splendens,* off the North Azores banks area, from Russian survey conducted during December 2003 (2 – immature, 3 developing 4-mature, 6-2- post spawning).

19 OTHER SPECIES

This section updates the biological information on individual species given in previous Working Group reports.

The summary of the available data arising from working documents provided to the WGDEEP 2004 is given in Table 19.1.1.

19.1 Roughhead grenadier (*Macrourus berglax*)

The landings of *Macrourus berglax* are given in Table 19.1.1

Some information on landings and length for roughhead grenadier for Norwegian long liners in Hatton bank area (Division VIb and Subarea XII) is given in Fossen, 2004 WD. In the Norwegian Greenland halibut fishery, the main by-catch species were rabbit fish (*Hydrolagus affinis & H. pallidus*), Portuguese dogfish (*Centroscymnus coelolepis*) and roughhead grenadier (*Macrourus berglax*).

Information on depth ranges, catch rates, length composition, fish weights, sex-ratio, maturity (Figures 19.1.1 and 19.1.2) and feeding (Tables 19.1.4 and 19.1.5) in several areas of the Northeast Atlantic in 2003 are given by Vinnichenko and Khlivnoy, 2004 WD.

The length frequency distribution of roughhead grenadier from catches by Russian long-lines in Div. IIa and IIb in November 2003 is given in Figure 19.1.3.

Data on roughhead grenadier from Greenland halibut survey in Division XIVb in june 2003 is given in Jorgensen, 2004, WD. This species was caught in 30 of the 40 hauls and catches ranged from 0.1 kg to 67.0 kg. The species was found in all strata except at 601-800 m in Q3 (Figure 19.1.4). The total biomass of roughhead grenadier was estimated at 3039.7 (S.E.516.9) compared to 4631.2 tons (S.E. 1537.8) in 2002, as is shown in the following table:

	1998	1999	2000	2002	2003
Biomass	3508.6	5437.0	3538.8	4631.2	3039.7
S.E	550.9	859.7	370.2	1537.8	516.9

The highest density and biomass was observed at 801-1000 in Q1 (0.8 tons/km^2/509 tons). Most of the decrease (1400 tons) was observed in depth stratum 401-600 m in Q1, but the 2002 estimate was based on one figure only. Minor decreases in biomass were observed in most of the other strata, too.

The abundance was estimated at $3.362*10^6$ (S.E. $0.802*10^6$), which is slightly below previous years level (statistically insignificant, 95% level), as is shown in the following table:

	1998	1999	2000	2002	2003
Abundance	$4.029*10^6$	$6.262*10^6$	$3.985*10^6$	$5.492 *10^6$	$3.362*10^6$
S.E	$0.638*10^6$	$1.108*10^6$	$0.380*10^6$	$2.143*10^6$	$0.802*10^6$

Pre anal fin length ranged from 2.0 to cm 42 cm. The length distributions in the three subareas Q1, Q2, and Q5 and the over all length distribution were all dominated by modes around 19 cm as seen in previous years (Figure 19.1.5 and Figure 19.1.6).

19.2 Common mora (*Mora moro*) and Moridae

The landings of Morid fishes are given in Table 19.2.1 Some problems with data still exist as at least one country still mixes this species with greater forkbeard in landings. The increase in landings in subareas VI and VI since 1999 may partly be due to improved recording of data.

Some information on landings and length for *Mora moro* and *Antimora rostrata* from Norwegian long liners in the Hatton bank area (Division VIb and Subarea XII) is given in Fossen, 2004 WD. As during previous years, *Mora moro* was targeted in depths between 500 and 1 100 meter. During 2003, represented the 10.1% of the catches.

Data on landings of *Mora moro* in the basque deep-sea fisheries (Spain) is given in Lucio et al., 2004 WD.

For *Mora moro*, some data on landings from the Azorean demersal fishery and the mean length frequency (Figure 19.2.1) from the Azorean longline survey in Subarea X (1995-2003) is given in Pinho 2004, WD.

Length distribution of common mora (year 2003), provided by the port sampling scheme developed by the Irish Marine Institute is given in Figure 19.2.2.

19.3 Rabbit fish (*Chimaera monstrosa and Hydrolagus spp*)

The landings of *Chimaera monstrosa* are given Table 19.3.1. Greatest landings of this species come from French and Irish trawl fisheries in subareas VI and VII. The apparent decline in 2002 and 2003 is due to lack of data from these fisheries rather than any real change in fishery status.

The size structure for *Chimaera monstrosa* for the discard fraction in the french fishery in Subarea VI is given in Girard and Biseau, 2004 WD. Lengths ranged from 27 to 102 cm. Females reached the minimum and maximum size observed.

Information on landings and average length for *Hydrolagus affinis* and *H. palidus* for Norwegian long liners in Hatton bank area (Division VIb and Subarea XII) is given in Fossen, 2004 WD. In the Greenland halibut fishery, the main by-catch species were rabbit fish (*Hydrolagus affinis & H. pallidus*), Portuguese dogfish (*Centroscymnus coelolepis*) and roughhead grenadier (*Macrourus berglax*).

Biomass estimates (CPUE's) from two Faroese surveys in Vb (1994 onwards) for rabbit fish (*Chimaera monstrosa*) is given in Reinet, 2004 WD (Figure 19.3.1)

19.4 Baird's smoothhead (*Alepocephalus bairdii*) and Risso's smoothhead (*A. rostratus*)

The landings of *Alepocephalus bairdii* are given in Table 19.4.1.

In recent years the *Alepocephalus bairdii* are almost entirely landed by Spain from Subareas XII and VIb (data for 2002 and 2003 are not available). As in the previous years, in this fishery there was a high degree of retention of smoothheads (89%-96%).

The length frequency distribution of *Alepocephalus bairdii* from Spanish catches (retained catch and discards included) in 2002 and 2003 (ICES Division VIb and Subarea XII combined), is shown in Figure 19.4.1.

The corresponding length frequency of the discards in 2002 is given in Figure 19.4.2.

Information on discards of *Alepocephalus bairdii* in the french fihery in Subarea VI is given in Girard and Biseau, 2004 WD. In the discards specimens of Baird's smoothhead, length ranges from 15 to 93 cm.

Some records of young individuals of Baird's smoothhead (*Alepocephalus bairdii*) in the North East Atlantic are reported in Vinnichenko and Khlivnoy, 2004 WD.

Data on fish length and weight of Risso's smoothhead (*A. rostratus*) are given in the above mentioned russian WD. This species were caught from depths more than 800 m. Fish length in catches constituted 24-51 cm, weight fluctuated from 66 to 730 g. The main number of fish (85 %) was immature.

19.5 Wreckfish (*Polyprion americanus*)

The landings of *Polyprion americanus* are given in Table 19.5.1

Data on landings of wreckfish in the basque deep-sea fisheries (Spain) is given in Lucio et al., 2004 WD.

Some data on landings from the Azorean demersal fishery and abundance indices (Figure 19.5.2) from the Azorean longline survey in Subarea X (1995-2003) is given in Pinho, 2004 WD.

19.6 Bluemouth (Helicolenus dactylopterus)

The landings of *Helicolenus dactylopterus* are given in Table 19.6.1 Landings in areas VI an VII have reduced considerably in recent years and this cannot entirely be attributed to missing data. As this species is caught as a by-catch in fisheries targeted at other species, changes in landings may have as much to do with changes in the pattern of the fishery as with changes in stock abundance.

Data on landings of bluemouth in the basque deep-sea fisheries (Spain) is given in Lucio *et al*., 2004 WD.

Some data on landings from the Azorean demersal fishery, abundance indices (Figure 19.6.1) and mean length from the Azorean longline survey (Figure 19.6.2) in Subarea X (1995-2003) is given in Pinho, 2004 WD.

Spanish bottom trawl surveys were carried out in Subarea VII (Porcupine bank) from 2001 to 2003 (Velasco, F., *pers. com.*). Figure 19.6.3 shows the bluemouth catches distribution (kg/30''). This species with a total abundance of 17, 20 and 31 kg/30 minutes haul for the 2001, 2002 and 2003, respectively, presents a significative increase in the last survey respects 2001 one.

Figure 19.6.4 presents the comparison between bluemouth length frequency distributions from 2001-2003 Spanish bottom trawl surveys in Porcupine (Velasco, F., *pers. com.*). There are very similar in the first two surveys but the 2003 one shows an important increases of 20-23 cm fishes and a little mode in 12 cm which could indicates a better recruitment compared with the 2001 and 2002 surveys.

19.7 Silver scabbard fish (*Lepidopus caudatus*)

The landings of *Lepidopus caudatus* are given in Table 19.7

Since three years ago a new artisanal deep fishery targeted to the Silver scabbardfish *(Lepidopus caudatus*) has been developing in the Strait of Gibraltar (ICES IXa south) by Spanish bottom longlines, in depths from 150-400 meters (Gil, J. *pers. com.).* Catches increase from 225 tonnes in 2001 to in 719 tonnes in 2003.

Some data on landings from the Azorean demersal fishery, abundance indices (Figure 19.7.1) and mean length from the Azorean longline survey (Figure 19.7.2) in Subarea X (1995-2003) is given in Pinho, 2004 WD.

19.8 Deep-water cardinal fish (*Epigonus telescopus*)

The landings of *Epigonus telescopus* for the years 1999 to 2001 are given in Table 19.8.

Faroese landings of deep-water cardinal fish is given in Reirnet., 2004 WD.

No new biological data were available.

19.9 Lesser silver smelt (*Argentina sphyraena*)

Some information on depth ranges, catch rates and length composition (Figure 19.9.1) in diferent areas of the Northeast Atlantic in 2003 are given by Vinnichenko and Khlivnoy, 2004 WD.

19.10 Spiny eel (*Notacanthus chemnitzii*)

Depth range and biological information derived from single individuals caught in several areas of the Northeast Atlantic in 2003 is presented by Vinnichenko and Khlivnoy, 2004 WD.

In the Eastern Greenland (subarea XIV) spiny eel were found as single individuals in the depth range 500-600 and 800-835 m. The ripening individuals 63-92 cm long with weight of 1 140 - 2 630 g were caught. Spiny eel fed intensively. Feeding objects were not identified since they were at the high measure digested.

In Iceland (Division Va and Subarea XIV)spiny eel occurred in catches as single individuals at depths more than 400 m. Their length constituted 63-95 cm and weight 551-2 325 g. About half of fish (51 %) were immature, some females had ripening and post-spawning gonads. Spiny eel fed intensively on benthos and jelly-fish.

19.11 Offshore rockfish (*Pontinus kuhli*)

Some data on landings from the Azorean demersal fishery, abundance indices (Figure 19.10.1) and mean length from the Azorean longline survey (Figure 19.10.2) in Subarea X (1995-2003) are given in Pinho, 2004 WD.

Table 19.1 Available data on landings, CPUE's, survey indices and biology of "other species" arising from working documents provided to WGDEEP 2004.

Species	ICES Subareas and Divisions										
	II+IIb	Va+IV	Vb	VI	VIa	VIb	VII	VIIIabdc	X	XII	VIb+XII	XIV
Roughhead grenadier (*Macrourus berglax*)	1,3,4 (R)	3,4 (R)	3 (R)		3 (R)						1,2 (N)	3,4, (R); 3,5 (G)
Common mora (*Mora moro*)								1 (Sb)	1,3 (A)		1,2,3 (N)	
Rabbitfish (*Chimaera monstrosa*)			5 (FA)	3 (F)								
Rabbitfish (*Hydrolagus spp*)											1,3 (N)	
Baird's smoothhead (*Alepocephalus bairdii*)				3 (F)	3 (R)	3 (R)	3 (R)				3 (Sa)	
Risso's smoothhead (*Alepocephalus rostratus*)		3,4 (R)										
Wreckfish (*Poliprion americanus*)							1 (Sb)	1 (Sb)	1,2,5 (A)			
Bluemouth (*Helycolenus dactylopterus*)				1 (Sb)			1 (Sb)	1 (Sb)	1,2,3,5 (A)			
Silver scabbardfish (*Lepidopus caudatus*)									1,2,3 (A)			
Deep-water cardinal fish (*Epigonus telescopus*)			1 (FA)							1 (FA)		
Lesser silver smelt (*Argentina sphyraena*)	3 (R)					3 (R)						
Spiny eel (*Notacanthus chemnitzii*)		3,4 (R)										3,4 (R)
Offshore rockfish (*Pontinus kuhli*)									1,2,3,5 (A)			

Notes: 1 – Landing (catch) data, 2 – CPUE data, 3 – Length data, 4 – Biological parameters; 5 – Survey indices; A – Portuguese WD by Pinho, 2004; F – French WD by Girard & Biseau, 2004; FA – Faroese WD by Reirnert, 2004; N – Norwegian WD by Fossen, 2004; R – Russian WD by Vinnichenko & Khlivnoi, 2004; G – Greenland WD by Jorgensen; Sa – Spanish WD by Durán Muñoz et al., 2004; Sb – Spanish WD by Lucio et al., 2004.

Table 19.1.1 Roughhead grenadier *(Macrurus berglax)*. Working Group estimates of landings (tonnes). Data from 2002 and 2003 are preliminary.

ROUGHHEAD GRENADIER (*Macrourus berglax*) I and II

Year	Germany	Norway	Russia	**TOTAL**
1988				
1989				
1990	9	580		**589**
1991		829		**829**
1992		424		**424**
1993		136		**136**
1994				
1995				
1996				
1997		17		**17**
1998		55		**55**
1999				
2000		35	13	**48**
2001		74	20	**94**
2002		28	1	**29**
2003		47	30	**77**

ROUGHHEAD GRENADIER (*Macrourus berglax*) III and IV

Year	France	Ireland	Norway	Scotland	**TOTAL**
1991					
1992			7		**7**
1993					
1994					
1995					
1996					
1997	36				**36**
1998					
1999					
2000		1	3	+	**4**
2001	1	1	9		**11**
2002			3	+	**3**
2003			2		**2**

ROUGHHEAD GRENADIER (*Macrourus berglax*) Va

Year	Iceland	**TOTAL**
1995		
1996	15	**15**
1997	4	**4**
1998	1	**1**
1999		
2000	5	**5**
2001	3	**3**
2002	11	**11**
2003		

Table 19.1.1 contd.

ROUGHHEAD GRENADIER (*Macrourus berglax*) Vb

Year	France	Norway	Scotland	**TOTAL**
1997				
1998	9			**9**
1999	58			**58**
2000	1			**1**
2001	2	2		**4**
2002	3		+	**3**
2003	N/A			

ROUGHHEAD GRENADIER (*Macrourus berglax*) VI and VII

Year	UK (EW)	France	Norway	Scotland	**TOTAL**
1988					
1989					
1990					
1991					
1992					
1993	18				**18**
1994	5				**5**
1995	2				**2**
1996					
1997					
1998					
1999		34			**34**
2000	+	1		8	**9**
2001		1	27	16	**44**
2002		4	2	6	**12**
2003			2		**2**

ROUGHHEAD GRENADIER *(Macrourus berglax*) X

Country	France	**TOTAL**
1998		
1999	3	**3**
2000		
2001		
2002		

ROUGHHEAD GRENADIER *(Macrourus berglax*) XII

Country	Norway	**TOTAL**
1999		
2000	7	**7**
2001	10	**10**
2002	7	**7**
2003	2	**2**

Table 19.1.1 contd.

ROUGHHEAD GRENADIER *(Macrourus berglax)* XIV

Country	Greenland	Norway	Russia	**TOTAL**
1992				
1993	18	34		**52**
1994	5			**5**
1995	2			**2**
1996				
1997				
1998		6		**6**
1999		14		**14**
2000				
2001		26		**26**
2002		49	4	**53**
2003		33		**33**

ROUGHHEAD GRENADIER *(Macrourus berglax)*. All areas

Year	I and II	III and IV	Va	Vb	VI and VII	X	XII	XIV	**TOTAL**
1988									
1989									
1990	589								**589**
1991	829								**829**
1992	424	7							**431**
1993	136				18			52	**206**
1994					5			5	**10**
1995					2			2	**4**
1996			15						**15**
1997	17	36	4						**57**
1998	55		1	9				6	**71**
1999				58	34	3		14	**109**
2000	48	4	5	1	9		7		**74**
2001	94	11	3	4	44		10	26	**192**
2002	29	3	11		12		7	53	**115**
2003	77	2			2		2	33	**116**

Table 19.2.1 Moro mora and Moridae. Working Group estimates of landings (tonnes). Data from 2002 and 2003 are preliminary.

MORIDAE II

Year	Norway	**TOTAL**
2000		
2001	1	1
2002	1	1
2003		

MORIDAE Vb

Year	Norway	France	**TOTAL**
1988			
1989			
1990			
1991	5		**5**
1992			
1993			
1994			
1995			
1996			
1997			
1998			
1999		1	**1**
2000		+	
2001	100		**100**
2002	19		**19**
2003	2		**2**

MORIDAE VI and VII

Year	UK (E+W)	France	Ireland	UK (Scot) (1)	Norway	**TOTAL**
1988						
1989						
1990						
1991					1	**1**
1992					25	**25**
1993						
1994						
1995						
1996						
1997						
1998						
1999		12			8	**20**
2000	3	59	39		48	**146**
2001		72	32		86	**190**
2002		50	44		64	**158**
2003		N/A	72		193	**265**

(1) Included with *Phycis blennoides*

Table 19.2.1 contd.

MORIDAE VIII and IX

Year	France	Spain	**TOTAL**
1995		83	**83**
1996		52	**52**
1997		88	**88**
1998			
1999			
2000	5	21	**26**
2001	2	18	**20**
2002	1	10	**11**
2003	N/A	10	**10**

MORIDAE X

Year	Portugal*	**TOTAL**
1988	18	**18**
1989	17	**17**
1990	23	**23**
1991	36	**36**
1992	31	**31**
1993	33	**33**
1994	42	**42**
1995		
1996		
1997		
1998		
1999		
2000		
2001	1	**1**
2002	267	**267**
2003	316	**316**

* source of data 1988 to 1994 unknown, may be unreliable

MORIDAE XII

Year	France	Spain	Norway	**TOTAL**
1999				
2000	+	1		**1**
2001	+		87	**87**
2002			13	**13**
2003			15	**15**

Table 19.2.1 (Cont'd)

MORIDAE (all areas)

Year	Vb	VI and VII	VIII and IX	X*	XII	**TOTAL**
1988				18		**18**
1989				17		**17**
1990				23		**23**
1991	5	1		36		**42**
1992		25		31		**56**
1993				33		**33**
1994				42		**42**
1995			83			**83**
1996			52			**52**
1997			88			**88**
1998						**0**
1999	1	20				**21**
2000		146	26		1	**173**
2001	100	190	20	1	87	**398**
2002	19	158	11	267	13	**468**
2003	2	265	10	316	15	**608**

* source of data 1988 to 1994 unknown, may be unreliable

Table 19.3.1 Rabbitfish *(Chimaera monstrosa* and *Hydrolagus spp*). Working Group estimates of landings (tonnes). Data from 2002 and 2003 are preliminary.

RABBIT FISH *(Chimaera monstrosa* and *Hydrolagus spp*) I & II

Year	France	Norway	Denmark	**TOTAL**
1997				
1998				
1999	1			**1**
2000	6			**6**
2001	5		+	**5**
2002	2	13		**15**
2003		15		**15**

RABBIT FISH *(Chimaera monstrosa* and *Hydrolagus spp*) III/IV

Year	Denmark	France	Scotland	Norway	**TOTAL**
1991					
1992	122				**122**
1993	8				**8**
1994	167				**167**
1995					
1996	14				**14**
1997	38				**38**
1998	56				**56**
1999	45		+		**45**
2000	17	15	1		**33**
2001	10	10			**20**
2002	21	3			**24**
2003	15	+		4	**19**

RABBIT FISH *(Chimaera monstrosa*) Va

Year	Iceland	**TOTAL**
1988		
1989		
1990		
1991	499	**499**
1992	106	**106**
1993	3	**3**
1994	60	**60**
1995	106	**106**
1996	21	**21**
1997	15	**15**
1998	29	**29**
1999	2	**2**
2000	5	**5**

Table 19.3.1 contd.

RABBIT FISH *(Chimaera monstrosa*) Vb

Year	Faroes	France	Scotand	Norway	Iceland	**TOTAL**
1988						
1989						
1990						
1991						
1992						
1993						
1994						
1995	1					**1**
1996	+					
1997	+					
1998						
1999		3	+			**3**
2000		54				**54**
2001		82		1	1	**84**
2002		47	+	17		**64**
2003			1	2		**3**

RABBIT FISH *(Chimaera monstrosa*) VI and VII

Year	UK(EW)	France	Ireland	Scotland	Spain	Norway	**TOTAL**
1988							
1989							
1990							
1991							
1992							
1993							
1994			2				**2**
1995							
1996							
1997							
1998							
1999		235		1			**236**
2000	3	347	3	+	2		**355**
2001	1	622	14	32	6	47	**722**
2002		543	16	7		7	**573**
2003		N/A	N/A	33		15	**48**

RABBIT FISH *(Chimaera monstrosa*) VIII

Year	France	**TOTAL**
1997		
1998		
1999	2	**2**
2000	2	**2**
2001	7	**7**
2002	6	**6**
2003	N/A	

Table 19.3.1 contd.

RABBIT FISH *(Chimaera monstrosa*)

XII

Year	Spain	France	Ireland	Norway	**TOTAL**
1995					
1996					
1997	32				32
1998	42				42
1999	114	1			115
2000	46	2			48
2001	61	1	1	16	79
2002	N/A			9	9
2003	N/A			3	3

RABBIT FISH *(Chimaera monstrosa*)

XIV

Year	Norway	**Total**
2001		
2002		
2003	1	**1**

RABBIT FISH *(Chimaera monstrosa*). All areas.

Year	I/II	III/IV	Va	Vb	VI/VII	VIII	XII	XIV	**TOTAL**
1988									
1989									
1990									
1991			499						**499**
1992		122	106						**228**
1993		8	3						**11**
1994		167	60		2				**229**
1995			106	1					**107**
1996		14	21						**35**
1997		38	15				32		**85**
1998		56	29				42		**127**
1999	1	45	2	3	236	2	115		**404**
2000	6	33	5	54	355	2	48		**503**
2001	5	20		84	641	7	63		**820**
2002	15	24		64	550	6	9		**668**
2003	15	19		3	47		12	1	**97**

Table 19.4.1 Smoothhead *(Alepocephalus* spp). Working Group estimates of landings (tonnes). Data from 2002 and 2003 are preliminary.

SMOOTHHEAD *(Alepocephalus* spp.)
Va

Year	Iceland	TOTAL
1988		
1989		
1990		
1991		
1992	10	**10**
1993	3	**3**
1994	1	**1**
1995	1	**1**
1996		
1997	+	
1998		
1999		
2000		
2001		
2002		
2003		

SMOOTHHEAD (*Alepocephalus* spp.) VI and VII

Year	Spain	Scotland	Russia	Ireland	Estonia	Germany	TOTAL
2000	978						**978**
2001	4689				154	1	**4844**
2002	N/A	1			259		**260**
2003	N/A		6	2	N/A		**8**

SMOOTHHEAD (*Alepocephalus* spp.) XII

Year	Spain	Luthuania	TOTAL
1988			
1989			
1990			
1991			
1992			
1993			
1994			
1995			
1996	230		**230**
1997	3692		**3692**
1999	4643		**4643**
1999	6549		**6549**
2000	4146		**4146**
2001	3132	460	**3592**
2002	N/A		
2003	N/A		

Table 19.4.1 contd.

SMOOTHHEAD (*Alepocephalus* spp.) XIV

Year	Germany	Spain	**TOTAL**
1988			
1989			
1990			
1991			
1992			
1993			
1994			
1995			
1996			
1997			
1999			
1999			
2000	12		**12**
2001			
2002			
2003			

SMOOTHHEAD (*Alepocephalus* spp.). All areas.

Year	Va	VI	XII	XIV	**TOTAL**
1988					
1989					
1990					
1991					
1992	10				**10**
1993	3				**3**
1994	1				**1**
1995	1				**1**
1996			230		**230**
1997			3692		**3692**
1999			4643		**4643**
1999			6549		**6549**
2000		978	4146	12	**5136**
2001		4844	3592		**8436**
2002		260	N/A		**260**
2003		8	N/A		**8**

Table 19.5.1 Wreckfish (*Polyprion americanus*). Working Group estimates of landings (tonnes). Data from 2002 and 2003 are preliminary.

WRECKFISH (*Polyprion americanus*) VI and VII

Year	France	Ireland	Spain	E & W	**TOTAL**
1988	7				**7**
1989					
1990	2				**2**
1991	10				**10**
1992	15				**15**
1993	0				
1994					
1995					
1996	4		79		**83**
1997					
1998			12		**12**
1999	9		5		**14**
2000	13		1		**14**
2001	15	1	+	1	**17**
2002	9		+	+	**9**
2003	N/A		1		**1**

WRECKFISH (*Polyprion americanus*) VIII and IX

Year	France	Portugal	Spain	UK (EW)	**TOTAL**
1988	1	188	9		**198**
1989	1	283			**284**
1990	2	161			**163**
1991	3	191			**194**
1992	1	268			**269**
1993		338			**338**
1994		406	3		**409**
1995		372	19	2	**393**
1996	3	214	69	8	**294**
1997		170	44		**214**
1998		164	63		**227**
1999	7	137	7		**151**
2000	12	72	37		**121**
2001	6	77	84		**167**
2002	6	88	62		**156**
2003	N/A	209	15		**224**

Table 19.5.1 contd.

WRECKFISH (*Polyprion americanus*) X

Year	France	Portugal	Norway	**TOTAL**
1988		191		**191**
1989		235		**235**
1990		224		**224**
1991		170		**170**
1992	3	234		**237**
1993		308	3	**311**
1994		428		**428**
1995		240		**240**
1996		240		**240**
1997		177		**177**
1998		139		**139**
1999		133		**133**
2000		268		**268**
2001		229		**229**
2002		283		**283**
2003		270		**270**

WRECKFISH (*Polyprion americanus*) All areas

	VI and VII	VIII and IX	X	**TOTAL**
1988	7	198	191	**396**
1989		284	235	**519**
1990	2	163	224	**389**
1991	10	194	170	**374**
1992	15	269	237	**521**
1993		338	311	**649**
1994		409	428	**837**
1995		393	240	**633**
1996	83	294	240	**617**
1997		214	177	**391**
1998	12	227	139	**378**
1999	14	151	133	**298**
2000	14	121	268	**403**
2001	17	167	229	**413**
2002	9	156	283	**448**
2003	1	224	270	**495**

Table 19.6.1 Bluemouth (*Helicolenus dactylopterus*). Working Group estimates of landings (tonnes). Data from 2002 and 2003 are preliminary.

BLUEMOUTH *(Helicolenus dactylopterus)* III/IV

Year	UK (EW)	UK (SCO)	**TOTAL**
1999	5	+	**5**
2000		+	
2001			
2002			

BLUEMOUTH *(Helicolenus dactylopterus)* Vb

Year	UK (EW)	UK (SCO)	France	**TOTAL**
1999	58	+		**58**
2000	16			**16**
2001				
2002				
2003			+	

BLUEMOUTH *(Helicolenus dactylopterus)* VI

Year	France	Spain	UK (EW)	UK (SCO)	Ireland	**TOTAL**
1999	57	91		58		**206**
2000	37	64	28	85		**214**
2001	44	9	33	103		**79**
2002	32		14	45		**91**
2003	N/A		13	41	+	**54**

BLUEMOUTH *(Helicolenus dactylopterus)* VII

Year	France	UK (EW)	UK (SCO)	Spain	Ireland	**TOTAL**
1999	66	112	19	+		**197**
2000	61	49	18	+		**128**
2001	61	21	28	+		**110**
2002	16	25	24			**49**
2003	N/A	14	26		57	**97**

BLUEMOUTH *(Helicolenus dactylopterus)* VIII and IX

Year	France	Portugal	Spain	**TOTAL**
1999	7	15	9	**31**
2000	17	12	7	**36**
2001	14	22	7	**43**
2002	1	17		**17**
2003	N/A	16		**16**

Table 19.6.1 contd.

BLUEMOUTH *(Helicolenus dactylopterus)* X

Year	Portugal	TOTAL
1999	320	**320**
2000	452	**452**
2001	296	**296**
2002	280	**280**
2003	338	**338**

BLUEMOUTH *(Helicolenus dactylopterus).* All areas

Year	III and IV	Vb	VI	VII	VIII and IX	X	TOTAL
1999	5	58	206	197	31	320	**817**
2000		16	214	128	36	452	**846**
2001			79	110	43	301	**533**
2002			59	49	17	280	**405**
2003			54	97	16	338	**505**

Table 19.7.1 Silver scabbardfish (*Lepidopus caudatus*). Working Group estimates of landings (tonnes). Data from 2002 and 2003 are preliminary.

SILVER SCABBARDFISH (*Lepidopus caudatus*) VI and VII

Year	France	Germany	UK (SCO)	UK (EW)	TOTAL
1993		2			**2**
1999	18				**18**
2000		3	12	1	**15**
2001	1		5		
2002	1			+	**1**
2003					

SILVER SCABBARDFISH *(Lepidopus caudatus)* VIII and IX

Year	France	Portugal	Spain	Russia/USSR	TOTAL
1988		2666			**2666**
1989		1385			**1385**
1990		547		37	**584**
1991		808			**808**
1992		1264		110	**1374**
1993		2397			**2397**
1994		1054			**1054**
1995		5672			**5672**
1996		1237			**1237**
1997		1725			**1725**
1998		966			**966**
1999	2	3067			**3069**
2000	1	15			**16**
2001	15	37	256		**308**
2002	23	72	389		**484**
2003	N/A	22	719		**741**

Table 19.7.1 contd.

SILVER SCABBARDFISH (*Lepidopus caudatus*) X

Year	Latvia	Portugal	**TOTAL**
1988		70	**70**
1989		91	**91**
1990		120	**120**
1991		166	**166**
1992	1905	255	**2160**
1993	1458	264	**1722**
1994		373	**373**
1995	8	781	**789**
1996		815	**815**
1997		1115	**1115**
1998		1186	**1186**
1999		86	**86**
2000		28	**28**
2001		44	**44**
2002		10	**10**
2003		25	**25**

SILVER SCABBARDFISH (*Lepidopus caudatus*)
XII

Country	Russia/USSR	**TOTAL**
1988		
1989	102	**102**
1990	20	**20**
1991		
1992		
1993	19	**19**
1994		

SILVER SCABBARDFISH (Lepidopus caudatus). ALL AREAS

	VI and VII	VIII and IX	X	XII	**TOTAL**
1988		2666	70		**2736**
1989		1385	91	102	**1578**
1990		584	120	20	**724**
1991		808	166		**974**
1992		1374	2160		**3534**
1993	2	2397	1722	19	**4140**
1994		1054	373		**1427**
1995		5672	789		**6461**
1996		1237	815		**2052**
1997		1725	1115		**2840**
1998		966	1186		**2152**
1999	18	3069	86		**3173**
2000	15	16	28		**59**
2001		308	44		**352**
2002	1	484	10		**495**
2003		741	25		**766**

Table 19.8.1 Deep-water cardinal fish (*Epigonus telescopus*) . Working Group estimates of landings (tonnes). Data from 2002 and 2003 are preliminary.

DEEP_WATER CARDINAL FISH (*Epigonus telescopus*) Vb

Year	France	**TOTAL**
1999	8	**8**
2000	2	**2**
2001	7	**7**
2002		
2003		

DEEP_WATER CARDINAL FISH (Epigonus telescopus) VI

Year	France	Ireland	UK (SCO)	E & W	Spain	**TOTAL**
1999	54					**54**
2000	60	1	+			**61**
2001	66	10	1	21		**98**
2002	34	3		+	48	**85**
2003	N/A	15				**15**

DEEP_WATER CARDINAL FISH (Epigonus telescopus) VII

Year	France	Faroes	Ireland	Spain	**TOTAL**
1999	221	4			**225**
2000	178		2		**180**
2001	78		207		**285**
2002	29		845	17	**891**
2003	N/A		971		**971**

DEEP_WATER CARDINAL FISH (Epigonus telescopus) VIII and IX

Year	France	Portugal	Spain	**TOTAL**
1999		3		**3**
2000	2	3		**5**
2001	+	4		**4**
2002		3	5	**8**
2003		3		**3**

DEEP_WATER CARDINAL FISH (Epigonus telescopus) X

Year	France	Portugal	**TOTAL**
1999			
2000	3		**3**
2001			
2002		14	**14**

Table 19.8.1 contd.

DEEP_WATER CARDINAL FISH (Epigonus telescopus) XII

Year	Ireland	Faroes	TOTAL
2001			
2002			
2003	1	+	**1**

DEEP_WATER CARDINAL FISH (Epigonus telescopus). All areas.

Year	Vb	VI	VII	VIII and IX	X	XI	TOTAL
1999	8	54	225	3			**290**
2000	2	61	180	5	3		**251**
2001	7	98	285	4			**394**
2002		85	891	8	14		**998**
2003		15	971	3		1	**990**

Table 19.1.4 Frequency of occurrence of food objects (%) in roughhead grenadier in the area of East Greenland by respect of R/V "Smolensk" research in June 2003.

Food objects	Frequency of occurrence
Shrimp	25.0
Digested fish	12.5
Brittle stars	6.3
Jelly-fish	25.0
Digested food	31.2

Table 19.1.5 Frequency of occurrence of food objects (%) in roughhead grenadier in the area of Iceland by respect of R/V "Smolensk" research in June-July 2003.

Food objects	Frequency of occurrence
Euphausiids	6.3
Shrimp	18.7
Squid	6.3
Platytroctidae gen. sp.	6.3
Polychaeta	12.5
Brittle stars	18.7
Digested food	31.3

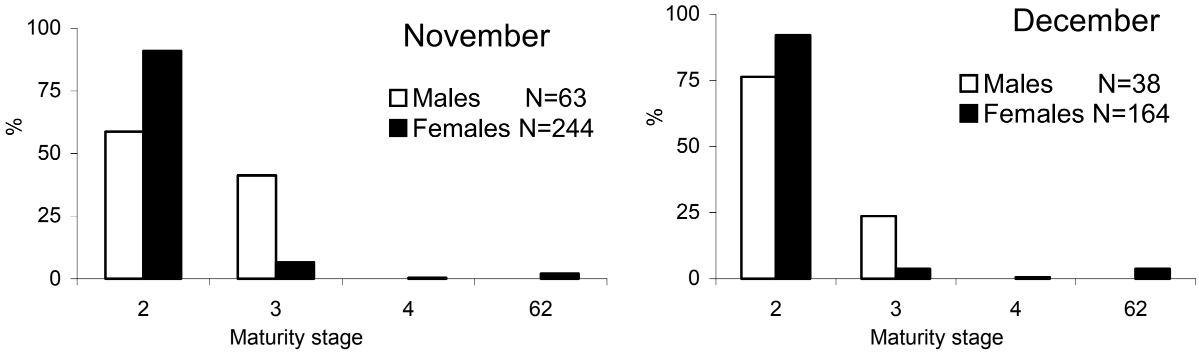


Figure 19.1.1 Maturity of roughhead grenadier in catches by long-lines in Div. IIb in November-December 2003. Maturity stage: 2 = Inmature; 3 = Developing; 4 = Mature (pre-spawning); 5 = Spawning; 6 = Spent; 62 = Post-spawning.

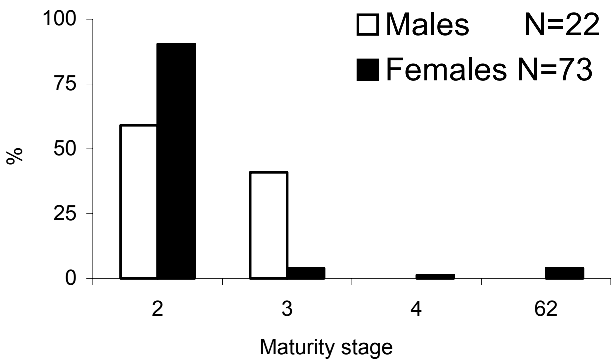


Figure 19.1.2 Maturity of roughhead grenadier in catches by long-lines in Div. IIa in November 2003. Maturity stage: 2 = Inmature; 3 = Developing; 4 = Mature (pre-spawning); 5 = Spawning; 6 = Spent; 62 = Post-spawning.

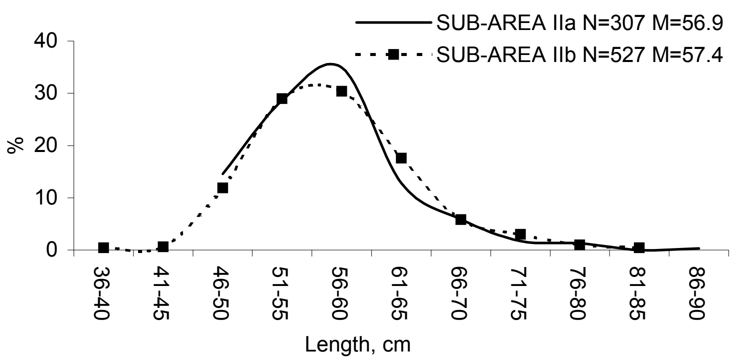


Figure 19.1.3 Length composition (total length) of roughhead grenadier from catches by Russian long-lines in Div. IIa and IIb in November 2003.

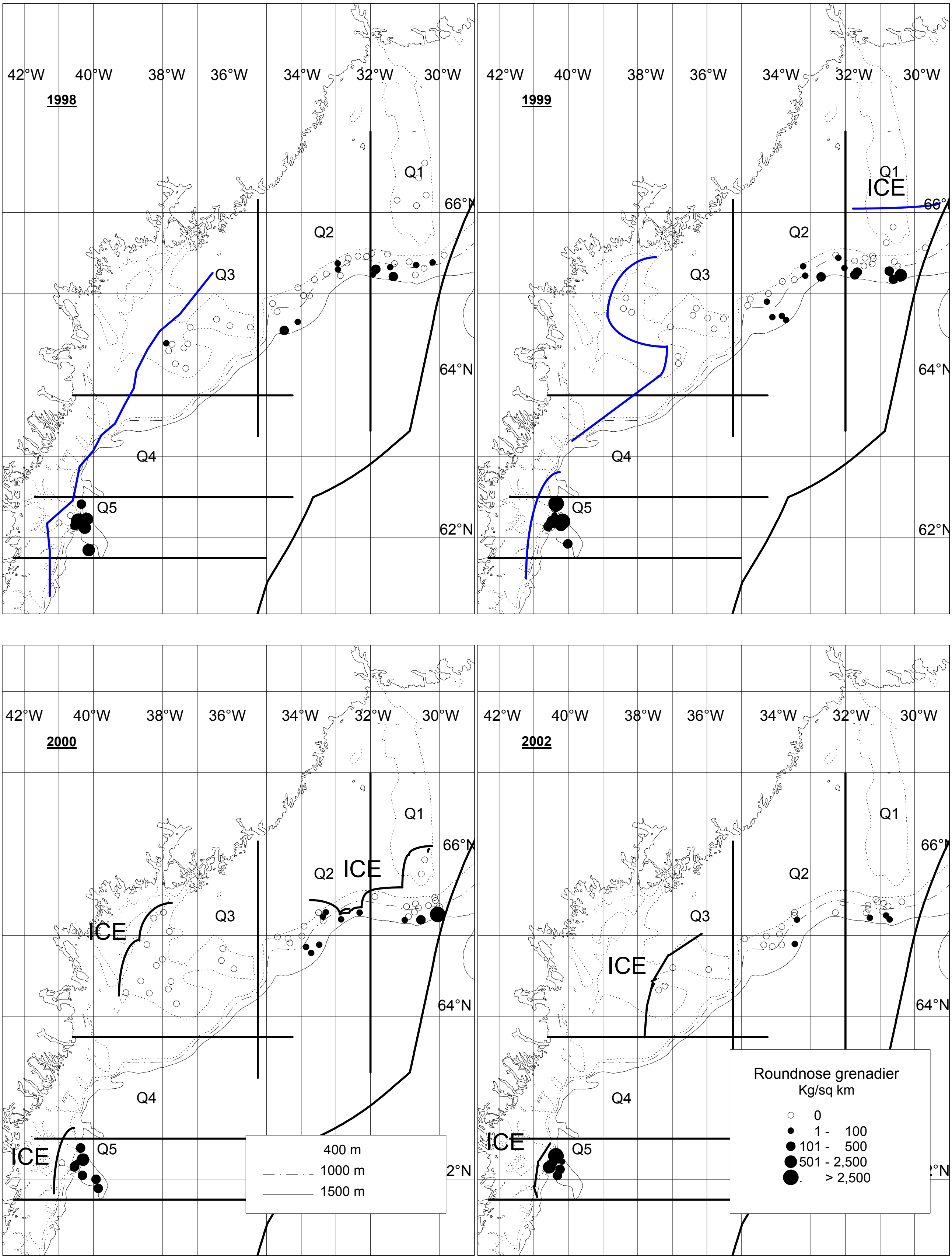


Figure 19.1.4 Distribution of catches of roughhead grenadier at East Greenland in 1998 - 2002.

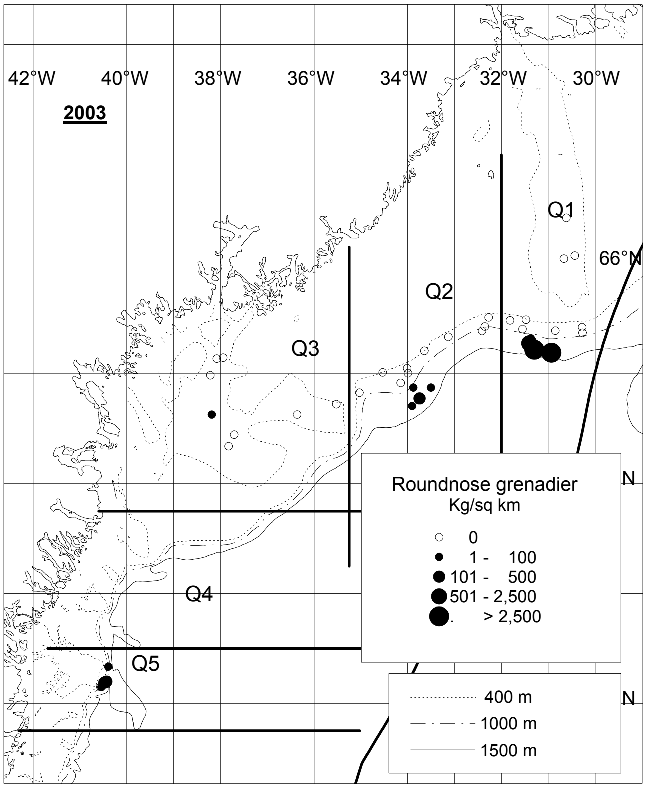


Figure 19.1.4. cont Distribution of catches of roughhead grenadier at East Greenland in 2003.

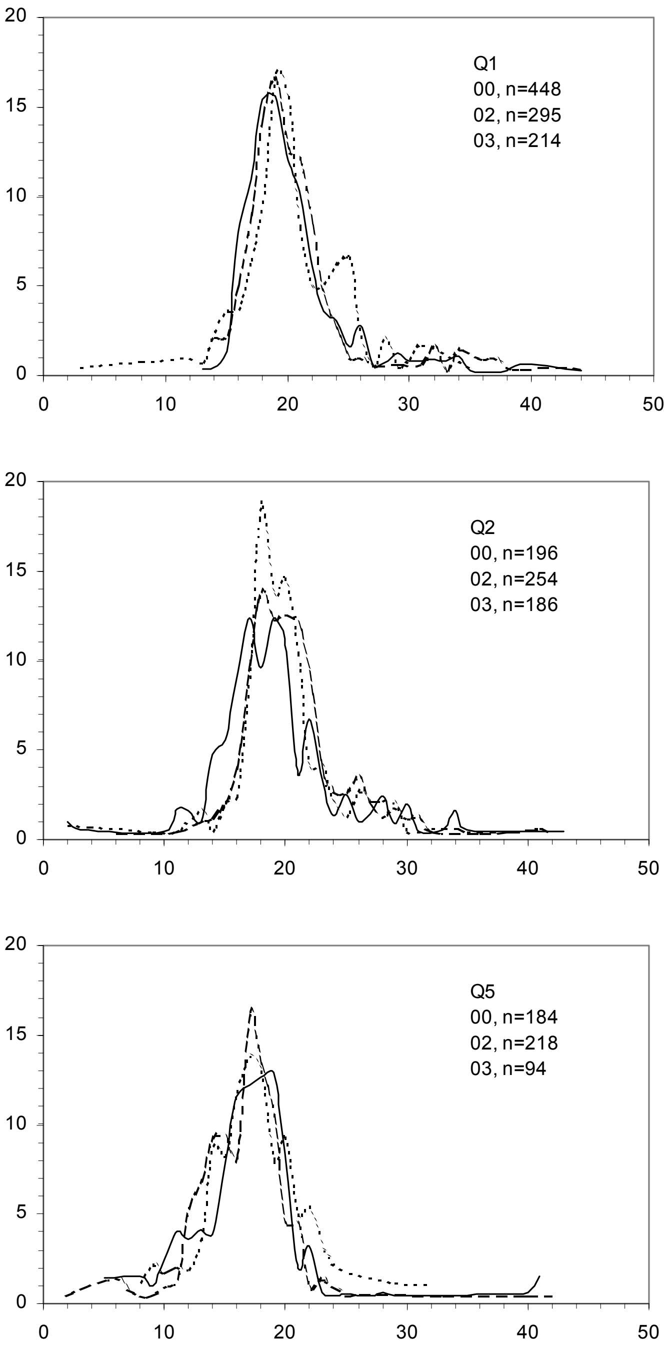


Figure 19.1.5 Length (pre anal fin length (cm)) distributions (percent) of roughhead grenadier by year and area. Only areas with more than 20 observations are included. Solid line: 2000. Dashed line: 2002. Dotted line:2003.

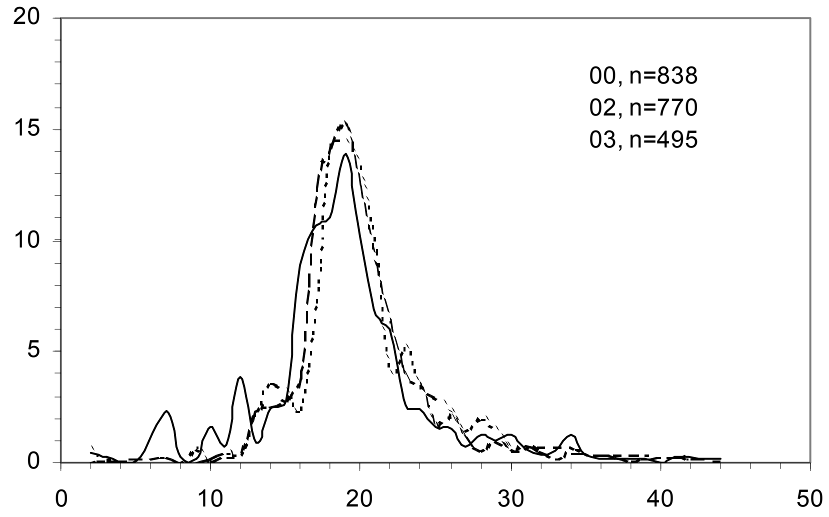


Figure 19.1.6 Overall length distributions (percent) of roughhead grenadier by year. Solid line: 2000. Dashed line: 2002. Dotted line: 2003.

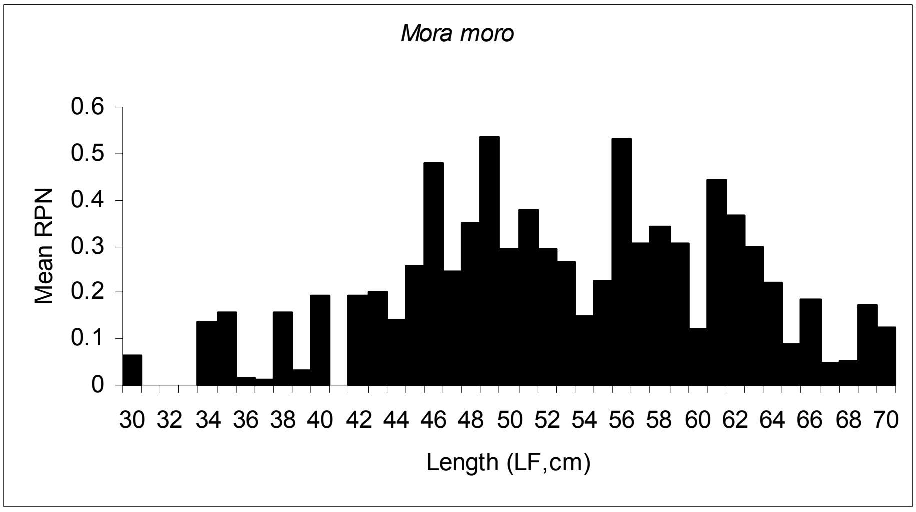


Figure 19.2.1 Mean (1995-2003) length composition of *Mora moro* from the Azorean longline survey.

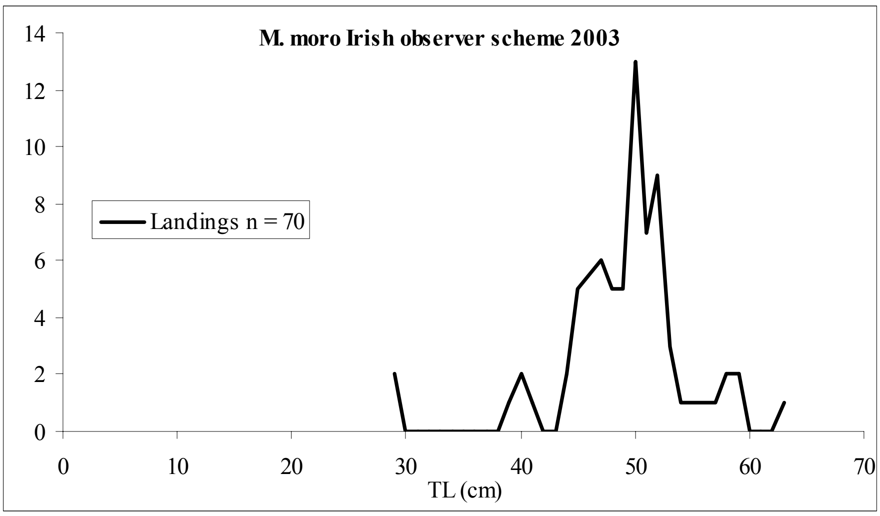


Figure 19.2.2 Length distribution of *Mora moro* provided by the Irish observer scheme (port sampling).

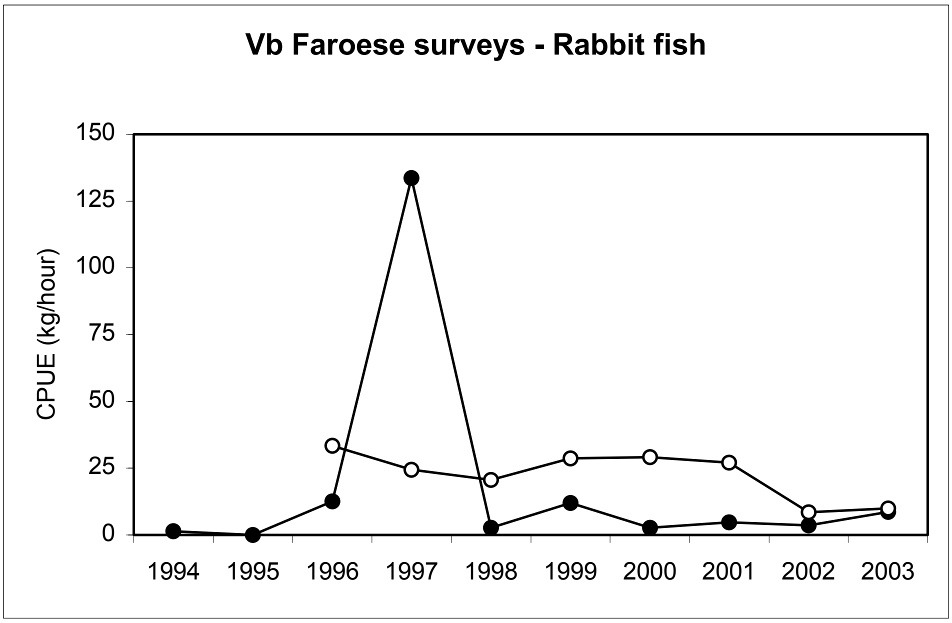
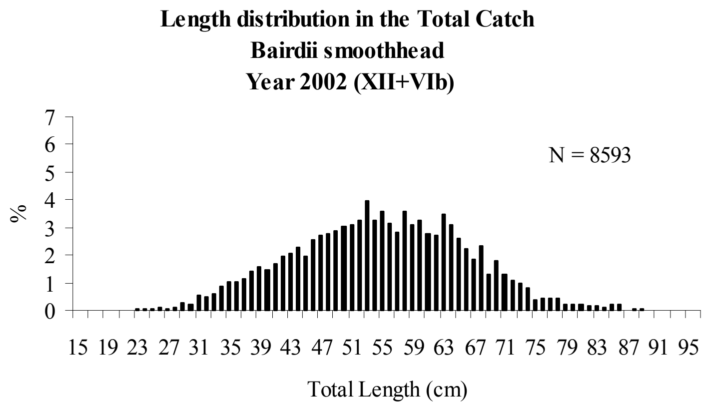


Figure 19.3.1 Biomass estimates (CPUE's) from two Faroese surveys in Vb (1994 onwards) for rabbit fish (*Chimaera monstrosa*) .



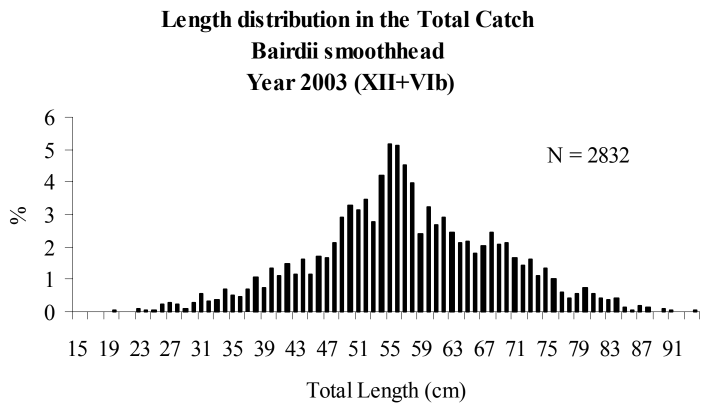


Figure 19.4.1 Length frequency distribution of *Alepocephalus bairdii* from Spanish catches (retained catch and discards included) in 2002 and 2003 (ICES Division VIb and Subarea XII combined). Preliminary figures.

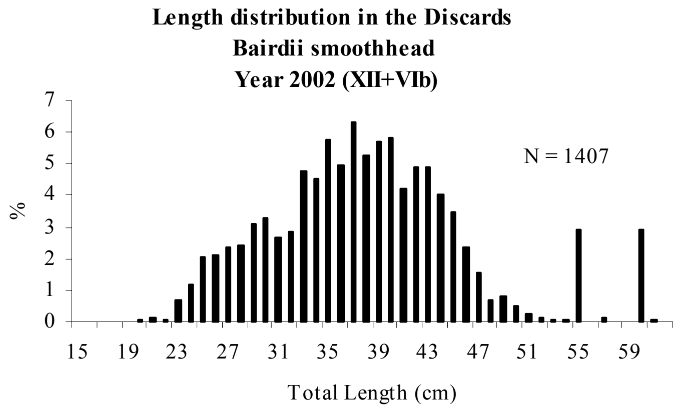


Figure 19.4.2 Length frequency distributions of the discarded *Alepocephalus bairdii* in 2002 in the Spanish fishery (ICES Division VIb and Subarea XII combined). Preliminary figure.

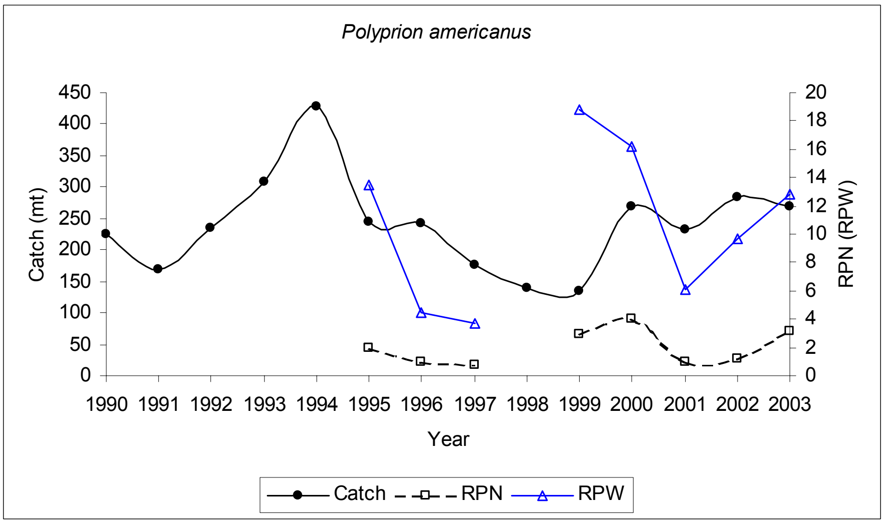


Figure 19.5.1 Wreckfish abundance indices estimated from the Azorean longline survey (1995-2003). Relative Population Numbers (RPN) and Relative Population Weight (RPW). Catch data is also presented in the figure for trend illustration.

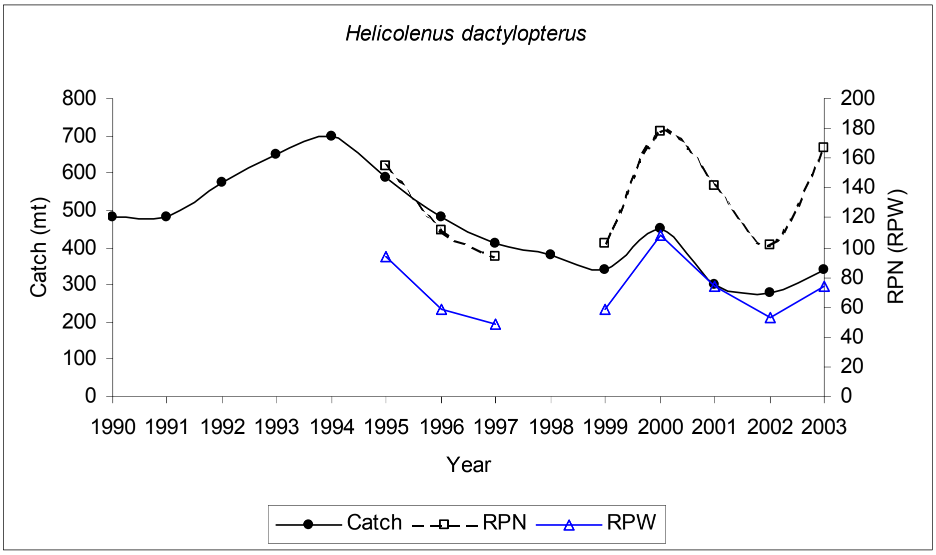


Figure 19.6.1 Bluemouth abundance indices estimated from the Azorean longline survey (1995-2003). Relative Population Numbers (RPN) and Relative Population Weight. Catch data is also presented in the figure for trend illustration.

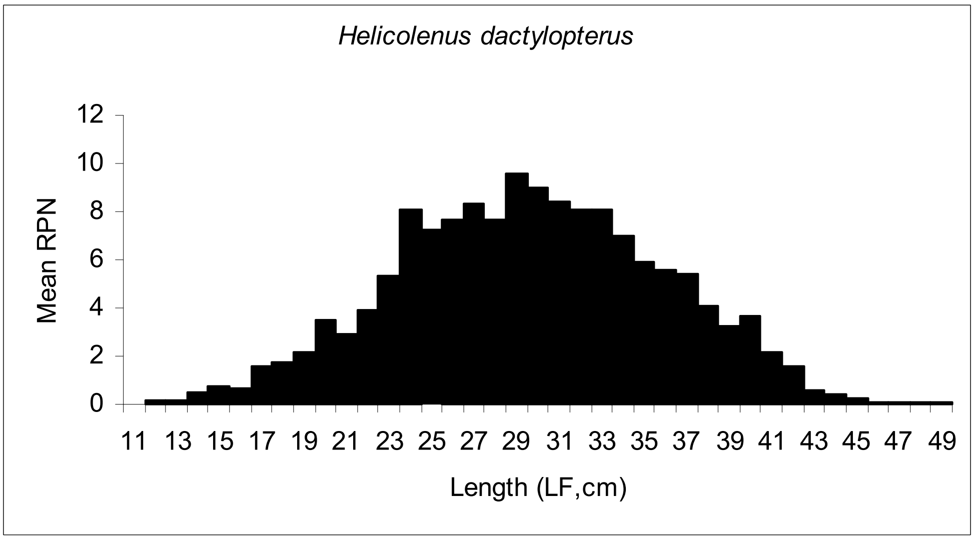


Figure 19.6.2 Bluemouth mean (1995-2003) length composition from the Azorean longline survey.

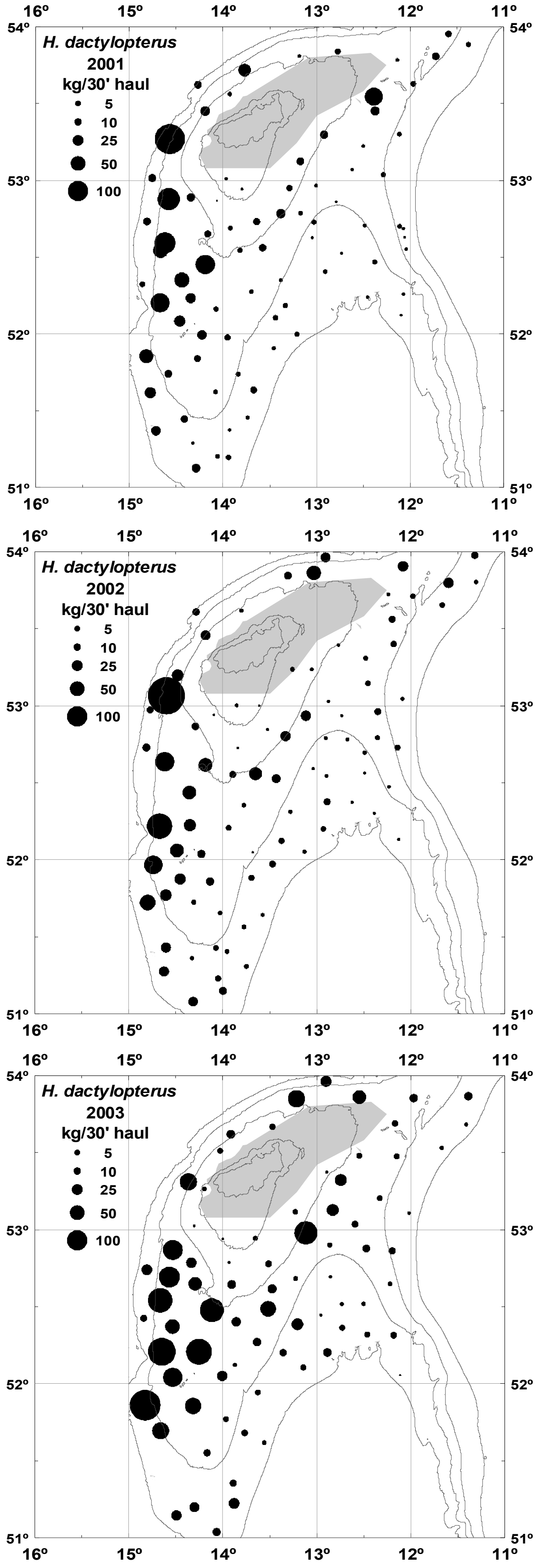


Figure 19.6.3 Bluemouth catches distribution (kg/30’’) in the Spanish bottom trawl surveys in Subarea VII (Porcupine bank): 2001-2003 (Velasco, F., *pers. com.*).

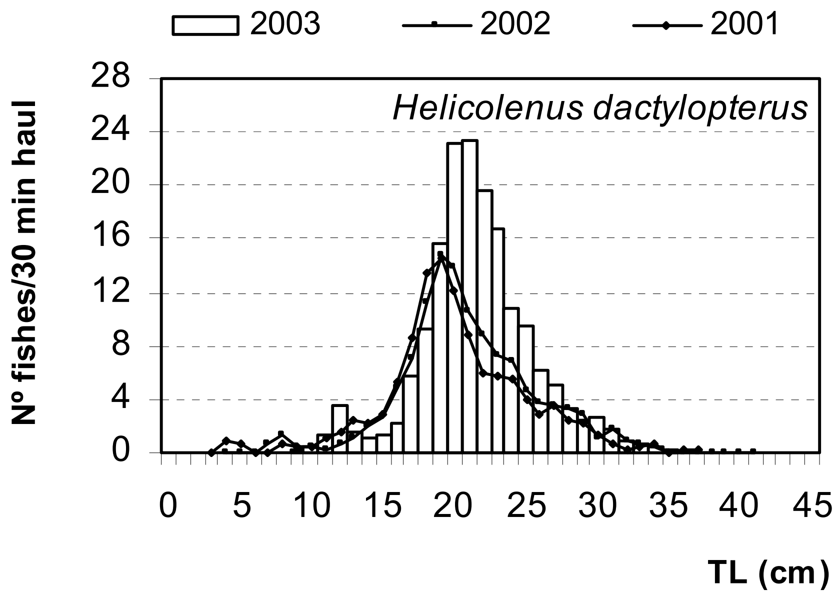


Figure 19.6.4 Comparison between bluemouth length frecuency distributions in the Spanish bottom trawl survey in Subarea VII (Porcupine bank): 2001-2003. (Velasco, F., *pers. com.*).

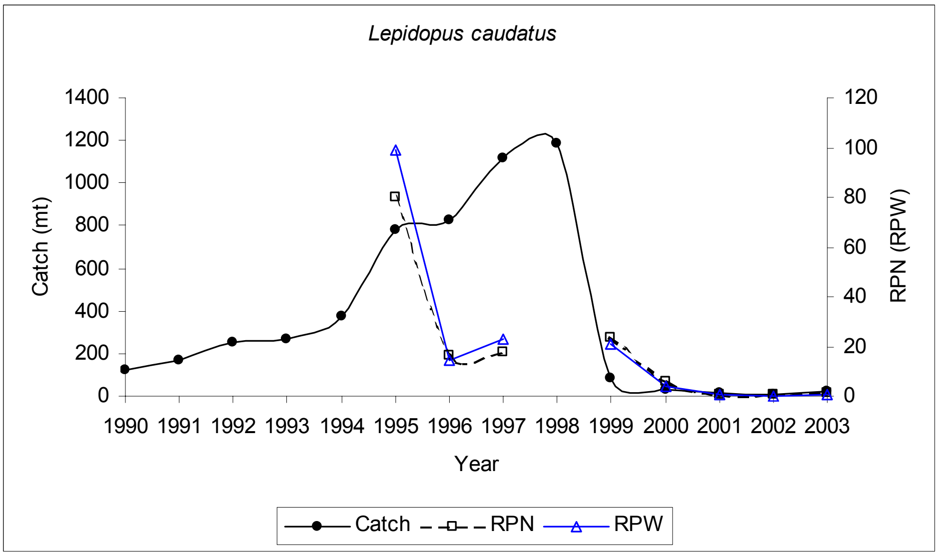


Figure 19.7.1 Silver scabbard fish abundance indices estimated from the Azorean longline survey (1995-2003). Relative Population Numbers (RPN) and Relative Population Weight (RPW). Catch data is also presented in the figure for trend illustration.

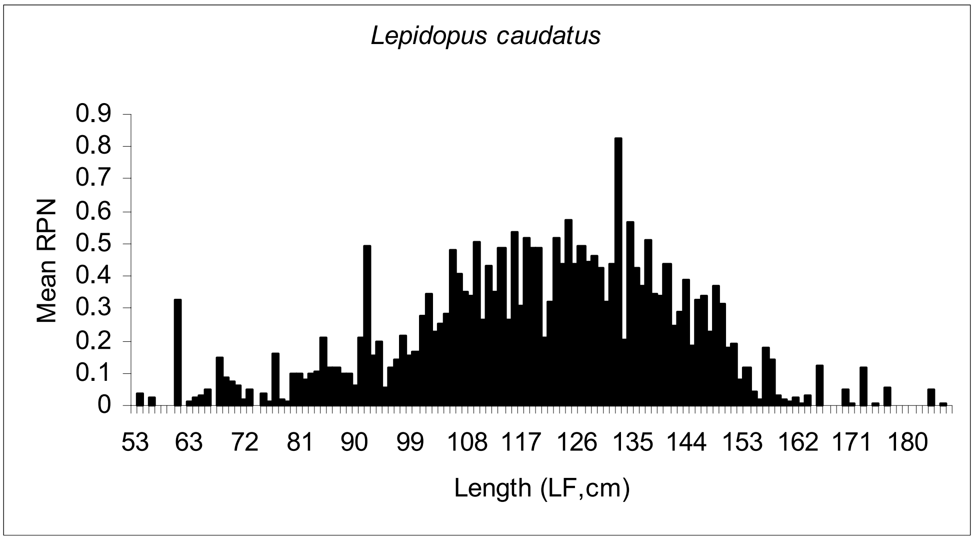


Figure 19.7.2 Silver scabbard fish mean (1995-2003) length composition from the Azorean longline survey.

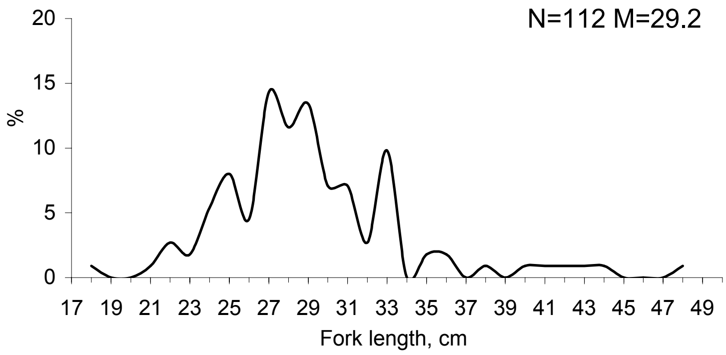


Figure 19.9.1 Length composition of lesser silver smelt in Div. IIa in December 2003.

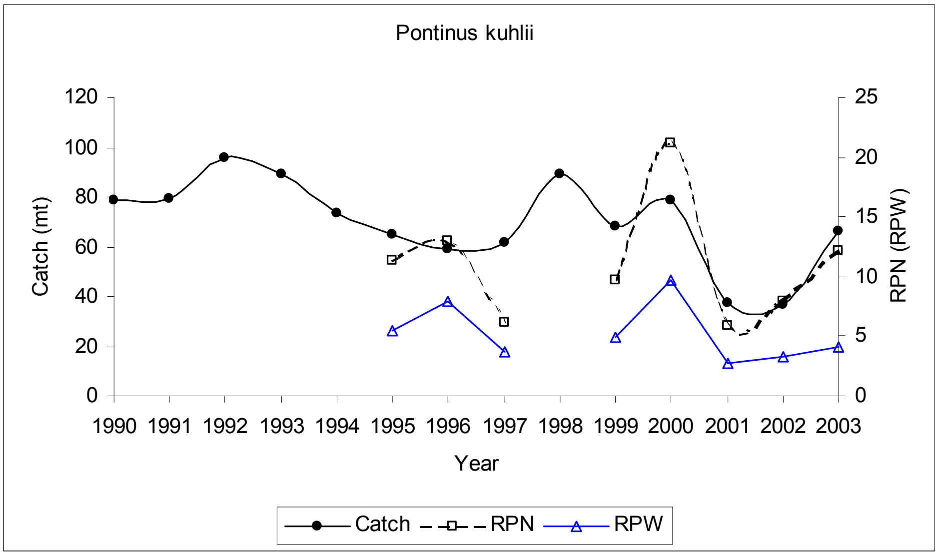


Figure 19.10.1 Offshore rockfish **a**bundance indices estimated from the Azorean longline survey (1995-2003). Relative Population Numbers (RPN) and Relative Population Weight (RPW). Catch data is also presented in the figure for trend illustration.

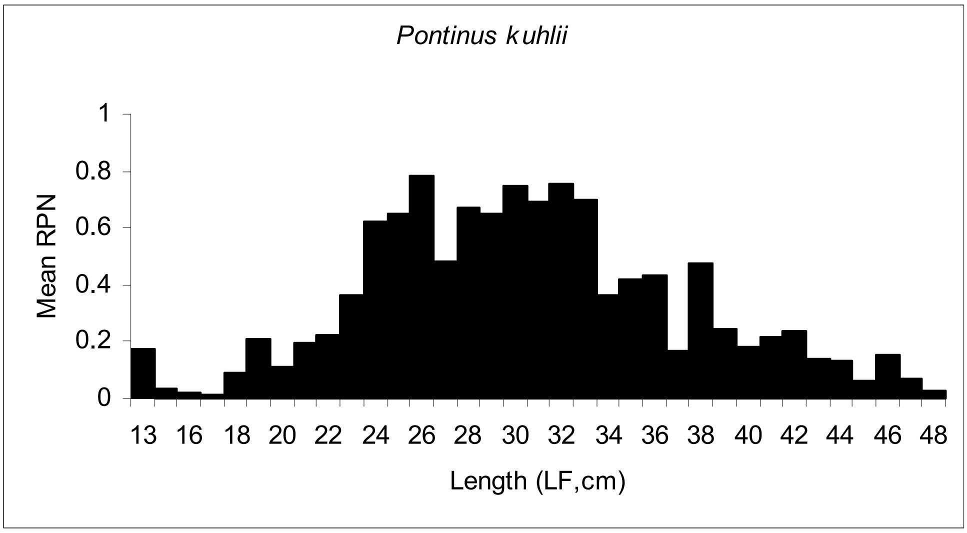


Figure 19.10.2 Offshore rockfish mean (1995-2003) length composition from the Azorean longline survey.

20 GEO-REFERENCED DATA ON SPAWNING/AGGREGATION AREAS FOR BLUE LING AND ORANGE ROUGHY

It is important to identify aggregations of these two species that form vulnerable aggregations. In order to define sensible spatial units for management, it is necessary to have information from official logbooks, from biological sampling and VMS. Areas defined need to be sufficiently large to be administratively feasible, yet sufficiently defined to ensure that they achieve the desired management objective.

The following is an account of new and previously provided information, but it may not constitute an exhaustive account due to lack of reporting or loss of historical information.

20.1 Research Surveys

Data from research surveys provide the best information on the position of such aggregations. However such data are limited in extent.

20.1.1 Orange roughy

As part of the Irish Marine Institue Deepwater Survey Programme, a voyage was conducted on the Olympus Seamount in 1995 (Subarea X). Aggregations of orange roughy were fished on. Due to gear damage, the number of hauls was limited to 6 in total. However this exercise allows the identification of aggregations of this species. This was the only directed survey carried out by the Irish Marine Institue, on orange roughy. Anecdotal information suggests that French vessels fished in this areas in some years. The positions are presented in Table 20.1.

Table 20.1 Positions of aggregations of orange roughy on the Olympus Seamount, taken from Irish Marine Institue Deepwater Survey, in November 1995.

Latitude shot	Longitude shot	Latitude hauled	Longitude hauled	Mean depth
45:37:00	27:17:00	45:35:81	27:21:53	1400
45:37:00	27:17:00	45:35:81	27:21:53	1400
45:11.9	27:54.3	45:13:44	27:51:15	1088
45:10.6	27:50.1	45:12:19	27:46:52	975
45:35.2	27:19.9	45:34:64	27:20:72	1300
45:34.5	27:17.4	45:35:46	27:18:11	880

Survey data from France are of use in identifying aggregations of this species too, and are available for the Hebrides Terrace Seamount (Division VIa) from the PROSPEC Survey in 1996 and from recent work carried out on the slopes of the Bay of Biscay in Subarea VIII.

20.1.2 Blue ling

Five areas were cited in the NEAFC request on management advice for blue ling. Of these five areas, the Irish Marine Institute has information on the last one. Marine Institute trawl surveys in the Rockall Trough were carried out from 1993-1997. One survey was carried out in April 1993, and spawning blue ling were found at latitude 58 ^{0} 01 55 N and 9 ^{0} 40 10 W. Table 2 shows the details of this haul. Ripe and running fish were encountered in this area. These data could be used along with other information from elsewhere to verify that spawning occurs in this area.

Table 20.2 Numbers of blue ling in each stage of maturity, from Irish Marine Institute Deepwater Trawl Survey, April 1993. Sample taken from Hebrides Terrace (824 m depth), north west of St. Kilda in Division VIa. Latitude 58 ^{0} 01 55 N and 9 ^{0} 40 10 W.

Gonad maturity	f	m	Grand Total
1 virgin	1	7	10
2 developing virgin	20	10	30
3 early maturing	66	33	99
4 late maturing	4	16	20
5 ripe	15	5	20
6 running	6	6	12
7 spent	35	126	161
8 recovering	128	96	224
Grand Total	275	299	574

20.2 Commercial Fisheries Data

20.2.1 Blue ling

This species is not as commercially valuable as orange roughy. However the positions of the spawning aggregations are also commercially sensitive.

Positional information for blue ling are available for blue ling in Va, from fisheries dependent data. These are a location in Division Va on the Reykjanes Ridge at the southern border of the Icelandic EEZ and a location in Division Va south of the Vestmanna Isles (see Figure 12.3). There is also a location in Division Vb. In addition there used to be a spawning aggregation in the Storegga area at about 62^{o} N, in Division IIa: 62^{0} 30 to 64^{0} N and 5^{0} E on the continental slopes of the Norwegian Sea. This aggregation supported a gillnet fishery for this species in the 1980s. There is also a spawning aggregation in the northern part of the Rockall Trough in Division VIa (see Research survey section above). A summary of fisheries dependent data are presented in Table 20.3.

Table 20.3 Positional information on spawning aggregations of blue ling.

ICES Division	Area	Positions
Va	Reykjanes Ridge at the southern border of the Icelandic EEZ	61^{0} N and 27^{0} 30 W Depth c. 500 m
Va	South of the Vestmanna Isles, in Icelandic EEZ	21^{0} 30 and 62^{0} 50 Depth c. 500 m
Vb	A location in Division Vb	
IIa	Storegga, on the continental slopes of the Norwegian Sea	63^{0} 64^{0} N and 5^{0} E Depth of 500 to 650 m

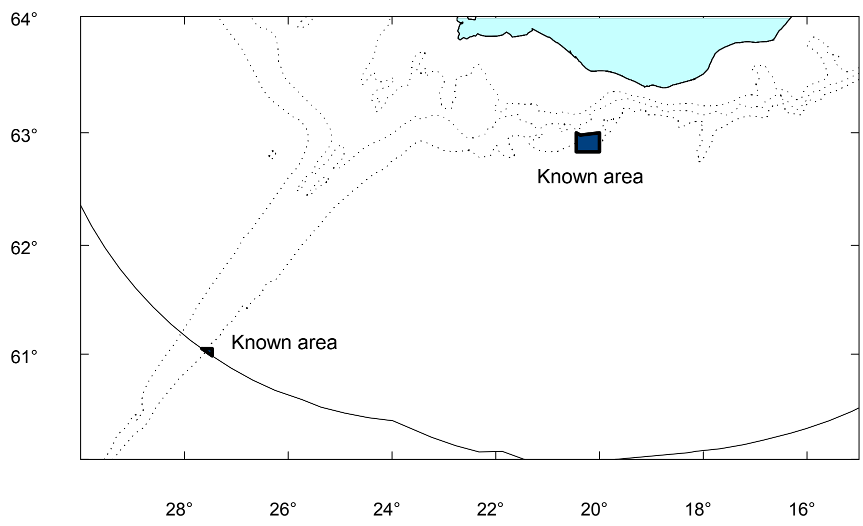


Figure 20.1 Map showing known spawning grounds for blue ling in Icelandic waters. There has been suggested to close these areas for fishing during the spawning period (15 feb-30 april).

20.2.2 Orange roughy

The TAC is now restrictive in Subareas VI and VII. Therefore, data on the positions of aggregations of this valuable species are yet more commercially sensitive than heretofore. However, data from commercial fisheries can be used to describe the general position of aggregations of this species, in VI and VII, without providing commercially sensitive information. In 2001, the Irish Sea Fisheries Board conducted an observer scheme. This extensive programme was described in several working documents presented to WGDEEP in 2002 (BIM, WD, 2002a). The spatial information presented in this document allow to describe the main areas of fishing in that year in waters west of the British Isles. The positions fished can be considered to be the same as those fished by the French orange roughy fishery, as the Irish fishery made extensive use of French positional information. The positional information (Table 20.3) were compiled from BIM

(WD, 2002) and the data were combined with catch data from BIM, made available to WGDEEP to produce catch rates for 2001 and 2002. By examining the catch composition in the areas (BIM, WD, 2002) it can be seen that the clusters of fishing positions in the North Porcupine and West Porcupine areas were most important for orange roughy and this is reflected in the CPUE from these areas.

These spatial data are presented in Figures 20.1 and 20.2. Positions presented in Table 20.3 are necessarily general, because they were taken from visual material. There may be other aggregations of this species in this area, but there is no indication of this from these maps or the catch by haul data. This information can be used to verify the catches by statistical rectangle for France and Ireland to verify that these are the main centres of orange roughy in this region.

Table 20.3 Positional information on aggregations of orange roughy. Positions given are defined by latitude and longitude are from the continental slopes, from the observer scheme on the Irish fishery in 2001 (BIM, WD, 2002a, Figure 2).

	Area	Position	CPUE in 2001	CPUE in 2002	Comments
1	West of Scotland	56^0 30 N 10^0 19 W	173	3	Hebrides Terrace Seamount
2	North Porcupine	54^0 10 to 54^0 30 11^0 30	426	-	Bordering VI and VII
3	North Porcupine	54^0 N 13^0 W	317	158	Southern slopes of Rockall Trough
4	West Porcupine	53^0 N 15^0 W	1532	+	Porcupine slope
5	West Porcupine	52^0 to 52^0 30 N 15^0 W	178	121	Porcupine slope
6	West Porcupine	51^0 - 51^0 43 N 15^0 W	636	139	Southwest Porcupine

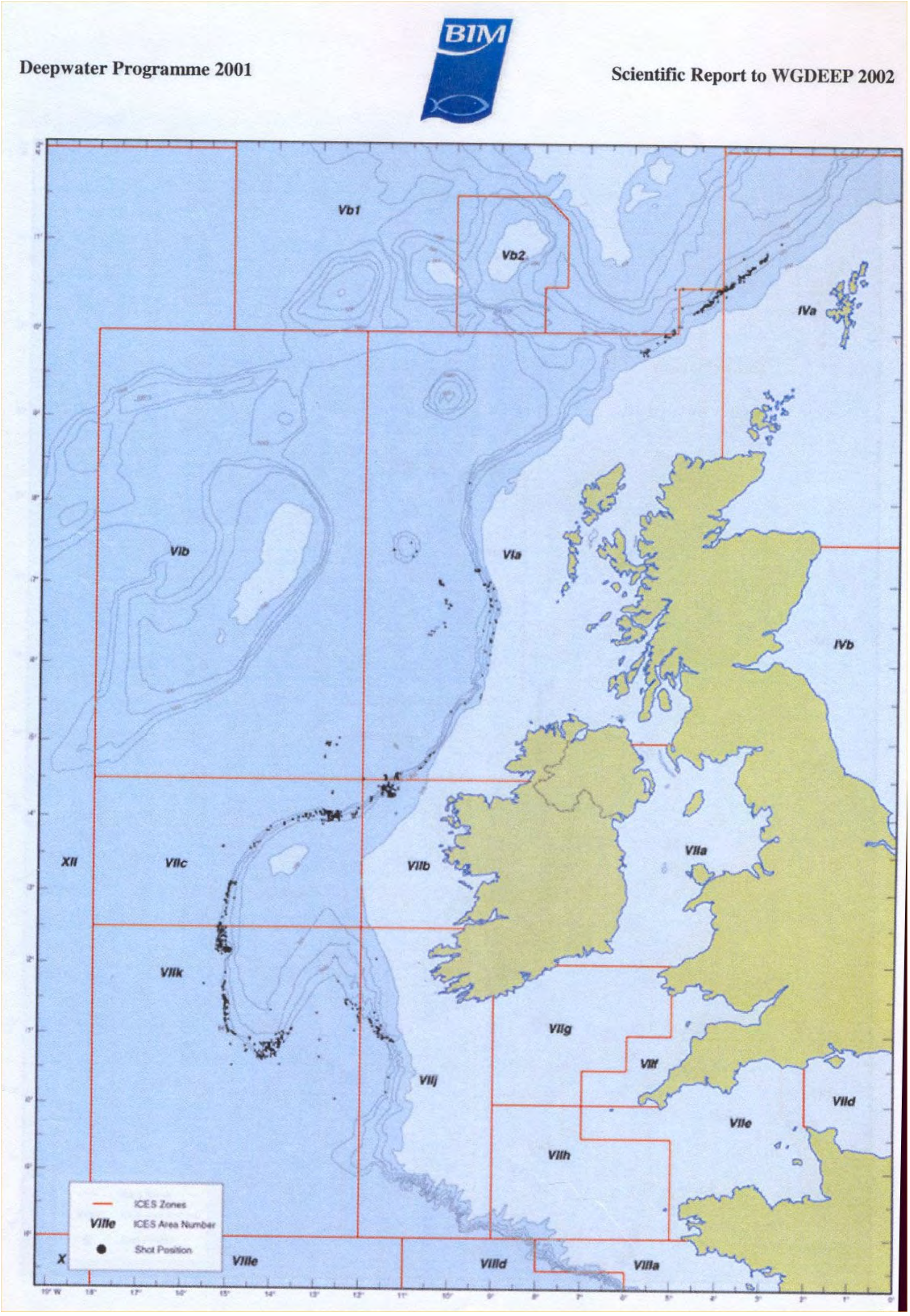


Figure 20.2. Location of observed fishing hauls completed in 2002. (BIM, WD, 2002a).

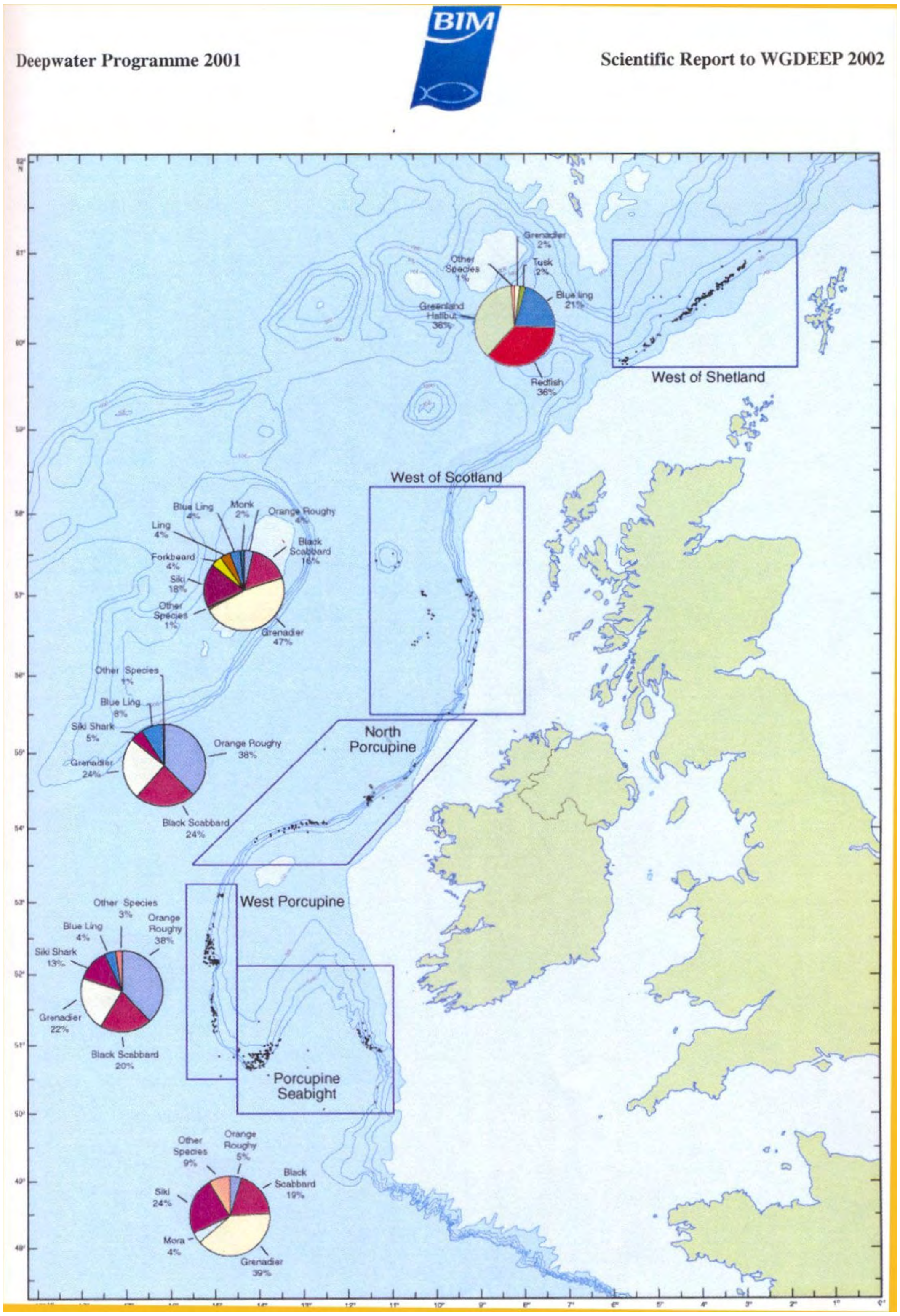


Figure 20.3 Catch composition of observed fishing hauls completed in 2001 (BIM, WD, 2002a).

21 SAMPLING AND REPORTING SCHEMES

With reference to Item f) of the TOR, the Group discussed sampling schemes and data requirements for different species and principal fishing gears (fisheries). The latter was obviously difficult to do in detail, since many deepwater fleets harvest deep-sea species, and very often in a mixture with other species.

The Tables 21.1-21.2 provides information mostly relevant for routine sampling by market sampler or onboard observers, not necessarily personnell going on research surveys.

Sampling priorities for species are indicated in Table 21.1. For each species there may be several stocks or aggregations, and individual stock may be treated separately. The stock delineations are however usually not very clear. Routine data needs for assessments are emphasised. E.g. age determiniation may be very useful for biological studies, but was not given priority as a routine task for all species.

Table 21.1 Summary of biological sampling priorities

Species	Length sampling	Age sampling	Discard sampling	Maturity sampling
Orange roughy	Yes	No	Yes	Yes
Black scabbardfish	Yes	No	Yes	Yes
Roundnose grenadier	Yes	Yes	Yes	Yes
Blue ling	Yes	No	Yes	Yes
Alfonsino	Yes	No	Yes	Yes
Ling	Yes	Yes	Yes	Yes
Red (blackspot) seabream	Yes	Yes	No	Yes
Tusk	Yes	Yes	No	Yes
Greater forkbeard	Yes	No	Yes	No
Mora moro	Yes	No	Yes	No
Helicolenus dactylopterus	Yes	No	Yes	No

Table 21.2 Fishing effort reporting requirements

Fishing gear	Nominal effort					
Trawl	Days fished	Kw*hrs	Type of trawl	Gear & operational characteristics	Vessel characteristics & equipment	
Longline	Days fished	Hook*sets *soaktime	Type of longline	ditto	ditto	
Nets	Days fishing	Length* soaktime	Type of net	ditto	ditto	Gear loss

Table 21.2 lists data needed on the fishing activity in order to calculate effort, and hence CPUE if accompanying catch information is provided. Three principal gears are used for deep-sea fishing, but within these broad categoreies there are many varieties of designs and operational methods.

Table 21.3 Fishing location requirements

Fishing location	Rect	Depth	VMS position			

Table 21.3 includes the essential spatial data needed, and the Group continues to stress the requirement for improved spatial resolution of the catch and effort data. If location information is unavailable, statistical rectangle is desired. A measure of depth is also highly recommended.

Access to VMS data would be a grat help, especially for fisheries utilizing aggregations. Such data would also facilitate cross-qhecking of geographically resolved effort data. The Group recognises that confidentiality issues need to be resolved.

Many of the questions raised in the discussion (which due to time constraints became rather too short), showed that a fishery based approach would be useful. Sampling is directed at fisheries, then species.

22 RECOMMENDATIONS

1) The Working Group remains concerned that the landings statistics as presented may not reflect the true scale of the recent fishing activity. The Working group recommends that member states should be encouraged to collect statistical rectangle specific catch, landings, effort data and biological data from exploratory and commercial fishing activities in national and international waters and report it to ICES. Any documented information that member states may have on fishing activity from non-member states should also be reported to ICES. It remains difficult to separate landings from international waters and areas under national or EU jurisdiction.

2) In the absence of fishery-independent data, commercial CPUE are used for the assessment of deep-water species, though the group is aware of the many difficulties in interpreting these data. It caused concern in the Working Group that some CPUE series for several species, notably ling, blue ling and tusk, could not be updated. The Working Group recommends that member states maintain and refine long-term data series on catch and effort and where possible collate historical data. It is recommended that at future meetings of the Working Group the results of such analyses including diagnostics be provided to allow for an evaluation of the reliability.

3) Provision of research survey data, partcularly time-series data from surveys designed for assessment purposes, is strongly encouraged, as is analyses of existing survey information. It is noted that additional financial resources are required.

4) For several species there is concern that catch rates can only be maintained by sequential depletion of relatively isolated concentrations/sub-units of a stock. The smallest unit for which data are reported at present is the ICES Subareas and Divisions, and this spatial resolution may not be appropriate for monitoring this type of fishing activity. The depth range within an area may be very wide, and the sizes of the areas are very different. It is therefore recommended that systems are developed and implemented for recording effort and catches at a finer temporal and geographical scale. Countries should be encouraged to provide access to VMS data.

5) Black scabbardfish is widely distributed in the NE Atlantic. Although the knowledge on the biology of this species has increased in recent years, information on its spatial and seasonal distribution is still very limited and uncertain. Modelling the actual state of species exploitation is severely impaired by the lack of relevant data. Nevertheless, as a consequence of the uncontrolled increase in fishing pressure on this species, the need for improved scientific advice is increasing. Therefore, it is strongly recommended to pursue scientific investigations of this species related to fisheries management, particularly through a detailed analysis of historical and recent data in a spatial context.

6) The status and identity of alfonsino stocks is poorly understood, and the knowledge of its population biology is unsatisfactory.

7) Age determination of blue ling remains difficult and unvalidated, and efforts are recommended to develop and calibrate age reading techniques.

8) The Working Group agreed that there is considerable merit in pursuing an age-based assessment for Pagellus bogaraveo in IX and X, *and* Helicolenus dactylopterus in Subarea X when time is available to reflect on better formulations of the assessment model. It is recommended that assessment work be carried out intersessionally using age based methods.

9) Efforts should be made to compile historical species-specific landings data for the *Pagellus* fisheries in Subarea VI, VII and VIII.

10) The Working Group continues to encourage discard sampling and recommends a standard discard-reporting format to allow for uniform incorporation of available data in future assessments. WGDEEP should communicate with the Study Group on Discarding to further this process.

11) The Working Group initiated efforts to define deep-water fisheries and fleets, and should in the future take further action to collect fishery based data in line with the recommendations of SGDFF.

23 REFERENCES AND WORKING DOCUMENTS

23.1 References

Allain, V. 1999. Ecologie, biologie et exploitation des populations de poissons profonds de l'Atlantique du nord-est. *Océanologie Biologique*. Brest, Université de Bretagne Occidentale**:** 376.

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23.3 Presentations:

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APPENDIX 1.

WORKING GROUP ON THE BIOLOGY AND ASSESSMENT OF DEEP-SEA FISHERIES RESOURCES

ICES Headquarters, 18–24 February 2004

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TECHNICAL MINUTES

Review Group, Baltic Fisheries Assessment (WGBFAS)

May 2004

Present:
Sub-group chair: Willy Vanhee
Presenter: Tomas Grohsler (WG chair)
Noel Cadigan
Henrik Sparholt
Rick Officer (by correspondence)

1. GENERAL COMMENTS TO THE REPORT

1. There is a need for inter-sessional work on problems in the assessments. When problems are identified in the WG report, these should be addressed (or at least attempted) for the next year's report.
2. The stock weights should represent weight at spawning time. These can be interpolated from catch and/or survey weights.
3. The WG is encouraged to consider modeling the maturity data. This can include testing for annual differences in the proportion mature-at-age, and if the annual differences are not significant then use annually constant values. The maturities can also be modeled along cohorts.
4. Single fleet runs with all ages and years, runs for excluded fleets, and other important exploratory runs should be available in stock files, along with plots of catchability residuals. This is useful information for the review group.
5. Figures of CPUE and effort should be in the report, for all stocks.
6. Values for short-term forecasts in the ACFM summary sheets (i.e. standard graphs) should be marked.
7. The WG is encouraged to consider methods for pre-screening indices (e.g. Surba), many of which are outlined in the WGMG 2004 report.
8. Recruitment for projections should be based on the "standardized" method, which is the geometric mean for all years after a shift, if it exists, but not including the last year.
9. Details of computations need to be recorded so that the computations can be replicated in the future if required.
10. Tuning fleets should be presented with a discussion about the ages and years used.
11. The review group appreciated XSA-formulation comparison tables.
12. The WG is commended for dealing with unreported catch. The WG is encouraged to indicate the annual and overall level of misreporting for each stock, and also the precision with which the assumed raising factors are calculated.
13. Any exploration runs for appropriate settings etc. should be referenced in an update assessment.

1.1 Kattegat cod

1. The WG should describe why a medium-term projection was not conducted.
2. Why was there was no attempt for to quantify for discards? It seems desirable for the WG to attempt to deal with discards in a consistent manner.
3. Text on pg 70, end of Sec. 2.2.7. The 2000 and 2003 year class estimates are not similar in the 1Q IBTS survey.
4. No information is provided on the impact of allocating the Danish age compositions to all landings. The WG should investigate if there has historically been good agreement between the age compositions from Denmark and Sweden.
5. Sec. 2.2.11. There does not seem to be a good reason to re-evaluate Blim.
6. Are the zero's at age 1 in 2003 for the commercial cpue indices (in Table 2.2.10) correct?
7. The Stock Annex indicates that stock weights for ages 1-3 are usually derived from the Swedish 1st quarter IBTS survey but Section 2.2.3 indicates that the 2003 "IBTS survey data was not considered reliable". This rationale needs to be described.
8.

1.2 Cod in Subdivisions 22-24

1. The units in all tables need to be specified.
2. Table 2.3.4. The % for 2002 age 0 should be 100.
3. The WG is encouraged to review the historic weights-at-age calculations. The WG's approach of fixing recent stock weights in order to avoid biasing recent estimates of SSB is illogical. The approach ignores probably the

most accurate estimates of stock weights from recent surveys and ensures that any biases will be incorporated into SSB estimates for the most recent period which is of most concern to managers.

4. The rationale for the fleets used in the RCT analysis needs to be described, especially since some fleets are not used in XSA.
5. Although it is difficult to account for the impact that the BACOMA window will have on the selectivity used in short- and medium-term predictions, it will introduce extra bias in these forecasts.
6. The WG is asked to reevaluate the existing reference points, especially the appropriateness of present Bpa value, taken into account SSB/recruit plot.

1.3 Cod in Subdivisions 25-32

1. Age-aggregated CPUE information was not utilized in the analytic assessment. The WG is encouraged to explore ways (ICA, AMCI) to utilize this information.
2. The WG is encouraged to explore length-based approaches (e.g. CSA) for the analytic assessment.
3. There appears to be little value in producing a relative table like 2.4.28 (with TAC's identified!) compared to the standard forecast table.
4. The review group recognized that the change in survey occurred in 2001, and the anonymously high survey index occurred in 2002 (back-shift year 2001 in XSA). This suggests that the 2002 "outlier" may be caused by factors other than the change in survey.

1.4 Sole in Division IIIA

1. Recruitment for the projection should be based on the "standardized" method, which is the geometric mean for all years after a shift, if it exists (e.g. 1994-2002), but not including the last year.
2. In Sec. 3.10. A lack of a stock and recruitment relationship is not a reason to not do a medium term projection. Such a projection may be useful.
3. There is a potential danger in excluding CPUE sets with small catches, especially if the aggregation of the species changes over time.
4. The review group recognized that the levels of sampling have been variable and anticipate in the future that the precision of the age-compositions will be quantified (EU Data Directory), presented in the report, and used to assess the adequacy of the catch-at-age data.
5. It would be desirable to have fisheries-independent surveys, because the CPUE indices comprise a large portion of the catch, in which case the population estimates can be in serious error and yet the XSA fit may appear good.

1.5 Flounder

1. Missing inputs and outputs from the RCT3 analysis, and retrospective plots.
2. It would be useful to see runs with shrinkage values of 0.8, 1.0, and 1.5.
3. The XSA estimates of year class strength in 2000 seem reliable, and there is no reason to use different values, as suggested in Sec. 4.2.7.
4. Sec. 4.2.9 does not say much, and more detail is required.
5. The review group found the text table in Sec 4.2.6.2 to be very useful.
6. The WG should consider if the two indices in SD 24 and 25 can be combined using calibration data, if this data exists and is reliable.
7. If there are concerns about the effects of the gear conversion on age-specific catch rates, the WG should consider splitting the survey time-series as soon as a sufficient number of years exist under the new design to facilitate tuning.

1.6 Herring in SD 25-29, 32, excluding Gulf of Riga

1. Use the appropriate average (i.e. starting in 1988) for recruitment in the projection.

1.7 Herring in Gulf of Riga

1. A new fleet was introduced, and it should first be screened with a single stock XSA plus diagnostics. This holds regardless of the type of assessment.
2. The number of biological samples should be indicated, or referred to.
3. The WG should consider using less shrinkage. This is because the surveys seem to be OK and they should provide the basis for the assessment rather than the high shrinkage.

1.8 Herring in SD 30

1. The WG should give figures for effort and CPUE, like for sole in IIIA (see Figure 3.2-3.3 on pg 217-218).
2. Put the amount of shrinkage in the text table on pg. 357.
3. Why is high shrinkage used? Noise in catch data is not a good argument for high shrinkage. We acknowledge it was an update assessment.
4. The WG should show the "scaled-down" stock-recruit function used in medium term projections.
5. The WG is encouraged to re-examine the value used for M in the XSA.
6. The rationale should be described, or referenced, for using tuning data after 1994.
7. Sec. 2.4.6.2. The text on catchability at age 2 is incorrect. Also, a power model is used for age 1, but there are no CPUE indices at age 1.
8. In the next full (benchmark) assessment, try to resolve the different trends in residuals in the bottom and pelagic trawls. Both indices seem to be based on the same gear and are just sampling different parts of the water column, and combining the two series should be considered.

1.9 Herring in SD 31

1. The WG introduced tapered-weighting, but in a fashion that gives little effect; that is, a 20 year tri-cubic on a 10 year time series will result in very little change in the weighting.
2. For the next benchmark assessment, environmental effects on recruitment should be included.
3. The WG should include standard graphs in the report.
4. A power model is used for age 1, but there are no CPUE indices at age 1?

1.10 Sprat in SD 22-32

1. The WG is advised to try shrinkage at 1.0 and 1.5 in next full assessment.
2. The WG is encouraged to examine the independence of the two acoustic surveys.
3. The WG should check if the stock-recruit model estimates in Figure 7.10 are "transformation-bias" corrected.