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20–27 March 2015

Copenhagen, Denmark

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CIEM Conseil International pour l'Exploration de la Mer

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1 Executive summary

WGDEEP met at ICES Headquarters in Copenhagen, Denmark on 20–27 March 2015. The group was chaired by Pascal Lorance from France and Gudmundur Thordarson from Iceland. Terms of Reference of the Working Group are given in Section 2.

WGDEEP gives advice according to an advice schedule where, in short, half of the stocks advice is given in year *y* and the other half has advice in year *y+1*. The exception from this schedule is stocks from Va (Iceland) that have advice annually. Available time-series for international landings and discards, fishing effort, survey indices and biological information were updated and for all stocks and are presented in Sections 4 to 14 of the report.

Significant discrepancies found in previous years for some fisheries between official landings data supplied to ICES and scientific estimates of landings were lesser for 2014 landings. In order to maintain the consistency of time-series (which previously used only scientific estimates), some landings have been included in the data tables as "unallocated landing" (see Section 2.2).

The assessment of ling in VA using GADGET, developed as exploratory assessment in recent years, is now benchmark as a fully analytical model. The spawning stock of ling in Va is estimated to have reached in 2013 a highest observed level in 30 years, three times above the 1982–2002 average. The state of other ling stocks is diverse and overall less favourable.

Blue ling stocks also showed different status amongst stock units with strong variations in catch, recruitment and biomass in Va, a sustained increased in biomass in relation to a decrease fishing mortality in Vb, VI and VII, and a persistent low level in other areas. The updated assessment for areas Vb, VI and VII suggested that the stock has recovered to B_{MSY} level and the exploitation rate in 2014 was well below F_{MSY}. There is no directed fishery for blue ling in other areas. The landings are now only bycatches. All Subareas within the assessment unit other areas show a declining trend in landings and the stock seems to be depleted in ICES Subarea II.

Assessment of tusk was carried out as described in the stock annex, the main progress being made is the standardization of cpue series for many of the stock units and a new estimate of F_{MSY} for tusk in Va. Estimates of biomass for tusk in Va from the GADGET model were revised downward the main reason being a significant drop in the tuning series in 2014 (Icelandic March survey).

Until 2014, ICES advised on two stock units of greater silver smelt, in Va and other areas. Following proposal form the group to split the other areas GSS into three advisory units; Area I and II, Vb and VIa and finally other areas, assessment were carried out and advice will be delivered for these three units. In areas I and II, data from Norwegian fisheries do not show any negative trends in recent years. Larger and older fish are caught from Norwegian surveys than from the fisheries in the same area. Acoustic biomass estimates in 2012 show some reduction compared to 2009, but marked upward trend again in 2014. Trawl cpue series show an upward trend since 2004. The advice for greater silver smelt in Vb and VIa is based on trends in cpue (kg/hour) from the Faroese summer survey on the Faroe Plateau, which show a slight decrease in the latest years. In 2014, the Faroese authorities set a law of species-specific management of greater silver smelt for Faroese waters. The TAC in 2014 was 16 000 tons and the TAC for 2015 was 14 400 tons. Six trawlers have licences to direct fishery of greater silver smelt. The regulation also includes limitations in e.g. bycatch, mesh size and fishing area. The EU introduced TAC management in 2003. For 2013 the EU TAC was set to 4316 tons in area V, VI, VII. For 2014 and 2016 the EU TAC was set to the same as in 2013 (V, VI, VII = 4316 tons). Most, if not all, of theEU TAC is caught in ICES Division VIa, therefore from the Vb–VIa stock unit. The fishery is smaller in other areas where the species is also discarded by various fisheries in quantities that could not be estimated.

Little new data and no new assessment were presented for orange roughy in 2015. The species appears is very small amount in discards of some fleets in EU waters. There is a Faroese fishery on the Mid-Atlantic Ridge.For this particularly long-lived species, the results Productivity Susceptibility Analysis (PSA) presented in 2013 remain appropriate and do no need yearly updating.

The status of the roundnose grenadier stocks are varied. Roundnose grenadier in Vb, VI, VII and XIIb is assessed using a Bayesian surplus production model since 2010. The fishing pressure in recent years is estimated low, the biomass is slowly rebuilding after two decades of overexploitation.No advice is required in 2015. Exploratory assessments were carried out using the abundance indices from the Marine Scotland Deepwater Science Survey instead of the usual French tallybook indices (which was also run for comparison between models). Estimated trends in stock biomass using the survey of the tallybook indices are consistent. However, the stock biomass in recent years is estimated to increase at a substantially higher rate when the model is fit to the survey index. The survey covers the main distribution range of thee stock and the main fishing grounds. It is therefore most likely to provide a realistic index of the stock abundance. It may further be conservative as it does not cover the fully area of distribution part of which has not been fished in recent years. WGDEEP proposed the stock for benchmarking in 2017, in order to review the use of biomass indices and investigate alternative to the current assessment model.

The fishery for roundnose grenadier in Division IIIa has been stopped since 2006 and landings are now insignificant. The bycatch from other fisheries is also low. The only information to assess this stock is now a Norwegian survey index from the same area. This index has shown a declining trend since 2006 and is now at the lowest level recorded during the time-series from 1984. The state of roundnose grenadier stocks on the Mid-Atlantic Ridge is unclear owing to limited data. This stock was intensively exploited in the 1970s and 1980s, the fishery declined in the 1990s and was insignificant in the 2000s and resumed in 2011. In other areas, roundnose grenadier is only a bycatch and catch are insignificant.

An assessment and advice was requested for the roughhead grenadier (*Macrourus berglax*) in the Northeast Atlantic owing to landings reported in previous years. Data were compiled and a catch based advice was prepared. This species is caught and subject to TAC management in the NAFO area. In the ICES area, it occurs at a much lower level, it is however known to occur at east Greenland (Division XIVb, Iceland (Va), Faroe Islands (Vb), Northern North Sea (IVa), Norwegian and Barents Sea (I and II). The landings level reported in some previous years were not plausible as high densities are not known to occur in reported catch areas. An advice reflecting possible level of sustainable catch was prepared.

Similarly, an assessment and advice was requested for the roundsnout grenadier (*Trachyrincus scabrus*) in the Northeast Atlantic (see chapter 15). This species is considered to have none or only minor commercial interest. The request for an advice came from landings reported in previous years. These landings were considered to be either minor bycatch or species misreporting. The advice is that the possible small landings of the species are counted against existing roundnose and roughhead grenadiers TACs.

The assessment of black scabbardfish was benchmarked at WKDEEP 2014. This species was formerly assessed in three units in the ICES area. Although no final conclusion is reached all available evidence suggest that a single stock does a large clockwise migrations in the Northeast Atlantic and further south in the CECAF areas where spawning occurs. Whether fish in Azorean waters and on the Mid-Atlantic Ridge (ICES Subareas X and XII) belongs to the same widely distributed stock is uncertain and the picture in Subarea X is further blurred by the mixing with the closely related intermediate scabbardfish (*Aphanopus intermedius*).

Greater forkbeard is caught mostly as a bycatch. Adults are a landed bycatch in slope fisheries for hake, monkfish, megrims and deep-water species and juveniles are a discarded bycatch in numerous fisheries. The assessment is based upon indices from four surveys. The increasing trend in abundance and biomass in recent years seems to be reverting. Time-series of survey indices display pluri-annual fluctuations, probably related to recruitment variability.

Alfonsinos are a mixture of two species (*Beryx splendens* and *Beryx decadactylus*. These species are oceanic demersal species occurring at the top of seamounts and along slopes, where they form local aggregations. They are widespread in the Northeast Atlantic from Iceland to the Azores and along the continental slope, in particular to the west of Iberia and Bay of Biscay. The stock structure is uncertain and data very limited. Although a longline survey is carried out in the Azores, where most of the catch occur, the reliably of survey indices is uncertain for these species owing to their large and patchy spatial distributions. As a consequence, the perception of the status of these stocks relies primarily on catch trends.

Three stocks of blackspot sea bream are assessed by WGDEEP. In ICES Subarea IX Target fishery only take places in the Strait of Gibraltar, while the species is taken as a bycatch of artisanal fleets which uses mainly longlines. In 2014, landings and lpue from the Spanish "*voracera*" target fishery seemed increasing and the mean length in the catchwas slightly larger. However, the VMS-based lpue developed in recent years could not be updated and the assessment this stock is undermined by the lack of data from the Mediterranean and CECAF area as the same stockstraddles over ICES, CECAF and GFCM areas, where management regimes are different. Although no advice is given in 2015 for blackspot sea bream stocks, the WGDEEP report reminds that a recovery plan involving all parties is necessary for this stock. The stock of the same species in the Azores (ICES Subarea X) also showed signs of overexploitation. Exploratory analyses of the natural and fishing mortalities were conducted using catch curves in order to investigate optimal exploitation reference points (yield-per-recruit analysis). Results show that modelling the fraction of population that change sex is a key issue to better estimating the trajectory of the spawning biomass. Data collection on sex ratio, maturity and sex change has been updated and analysed. Traditional models should be extended to incorporate the sex change issue. The third blackspot sea bream stock in ICES Subareas VI, VII and VIII remains at a low level, since it collapsed in the 1980s.

In response to a request from the NEAFC, the working group update descriptions of deep-water fisheries in the NEAFC and ICES areas by compiling data on catch/landings, fishing effort and known spawning areas and areas of local depletionat the finest spatial resolution possible by ICES subarea and division (Chapter 15).

2 Introduction

The **Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources** (WGDEEP), chaired by Pascal Lorance, France, and Gudmundur Thordarson, Iceland, met at ICES Headquarters, 20–27 March 2015.

Sixteen participants from eight countries and one ICES secretariat staff contributed to the report. The full participants list is in Annex 1.

2.1 Terms of Reference

The Terms of Reference are given below:

a) Address generic ToRs for Regional and Species Working Groups (see table below).

b) Evaluate the harvest control rule for data-limited stocks developed by WKLIFE and further develop methods to provide quantitative advice consistent with the MSY framework for stocks assessed by WGDEEP.

   a) Complete the development of Stock Annexes for all the stocks assessed by WGDEEP.

   b) Update the description of deep-water fisheries in both the NEAFC and ICES area(s) by compiling data on catch/landings, fishing effort (inside versus outside the EEZs, in spawning areas, areas of local depletion, etc.), and discard statistics at the finest spatial resolution possible by ICES Subarea and Division and NEAFC RA and describe and prepare a first Advice draft of any emerging deep-water fishery with the available data in the NEAFC RA.

   c) Continue work on exploratory assessments for deep-water species.

   d) Evaluate the stock status of Icelandic stocks for the provision of annual advice in 2015.

   e) Evaluate the stock status of all non-EU stocks for the provision of biennial advice in 2015.

   f) Prepare for an evaluation of the stock status for the rest of stocks for the provision of a rollover advice on 2015 and a biennial advice in 2016.

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

Material and data relevant for the meeting must be available to the group no later than 14 days prior to the starting date.

WGDEEP will report by 25 April 2015 for the attention of ACOM.

This was coordinated as indicated in the table below.

Fish Stock	Stock name	Stock Coord.	Assess. Coord.	Next Advice year	Advice frequency
alf-comb	Alfonsinos/Golden eye perch (*Beryx* spp.) in the Northeast Atlantic	Mário Rui Rilho de Pinho	Mário Rui Rilho de Pinho	2016	Biennial
arg-icel	Greater silver smelt (*Argentina Silus*) in Division Va	Bjarki T. Elvarsson	Bjarki T. Elvarsson	2015	Annual
arg-I II	Greater silver smelt (*Argentina silus*) in Subareas I and II	Elvar Halldor Hallferdsson	Elvar Halldor Hallferdsson	2015	Biennial
Arg-5b6a	Greater silver smelt (Argentina Silus) in Divisions Vb and VIa	Lise Helen Ofstad	Lise Helen Ofstad	2015	Biennial
arg-oth	Greater silver smelt (*Argentina Silus*) in Subareas IV, VIb, VII, VIII, IX, X, XII, and XIV, and Divisions IIIa (other areas)	Hege Overboe Hansen	Elvar Halldor Hallferdsson	2015	Biennial
bli-5a14	Blue ling (*Molva dypterygia*) in Division Va and Subarea XIV (Iceland and Reykjanes ridge)	Gudmundur Thordarson	Gudmundur Thordarson	2015	Annual
bli-5b67	Blue ling (*Molva dypterygia*) in Subdivision Vb, and Subareas VI and VII	Pascal Lorance	Pascal Lorance	2016	Biennial
bli-oth	Blue ling (*Molva dypterygia*) in Divisions IIIa, and IVa and Subareas I, II, VIII, IX, and XII	Hege Overboe Hansen	Hege Overboe Hansen	2015	Biennial
bsf-nea89(1)	Black scabbardfish (*Aphanopus carbo*) in the Northeast Atlantic	Ivone Figueiredo	Ivone Figueiredo	2016	Biennial
gfb-comb	Greater forkbeard (*Phycis blennoides*) in the Northeast Atlantic	Guzmán Diez	Guzmán Diez	2016	Biennial
lin-arct	Ling (*Molva molva*) in Subareas I and II	Kristin Helle	Kristin Helle	2015	Biennial
lin-icel	Ling (*Molva molva*) in Division Va	Bjarki T. Elvarsson	Bjarki T. Elvarsson	2015	Annual
lin-faro	Ling (*Molva molva*) in Division Vb	Lise	Lise	2015	Biennial
lin-oth	Ling in (*Molva molva*) Divisions IIIa and IVa, and in Subareas VI, VII, VIII, IX, XII, and XIV (other areas)	Kristin Helle	Kristin Helle	2015	Biennial

Fish Stock	Stock name	Stock Coord.	Assess. Coord.	Next Advice year	Advice frequency
ory-comb (ory-scrk; ory-vii; ory-rest)	Orange roughy (*Hoplostethus atlanticus*) in the Notheast Atlantic	Tom Blasdale	Tom Blasdale	2016	Biennial
rng-1012;	Roundnose grenadier (*Coryphaenoides rupenstris*) in in Mid-Atlantic Ridge (Xb, XIIc, Va1, XIIa1, XIVb1)	Dmitriy Aleksandrov	Dmitriy Aleksandrov	2015	Biennial
rng-kask	Roundnose grenadier (*Coryphaenoides rupenstris*) in Division IIIa	Hege Overboe Hansen	Hege Overboe Hansen	2016	Biennial
rng-675b	Roundnose grenadier (*Coryphaenoides rupenstris*) in Subareas VI and VII, and Divisions Vb and XIIb	Lionel Pawlowski	Lionel Pawlowski	2016	Biennial
rng-oth	Roundnose grenadier (*Coryphaenoides rupenstris*) in all other areas (I, II, IV, Va2, VIII, IX, XIVa, and XIVb2)	Dmitriy Aleksandrov	Dmitriy Aleksandrov	2015	Biennial
sbr678	Red (=blackspot) sea bream (*Pagellus bogaraveo*) in Subareas VI, VII and VIII	Guzmán Diez	Guzmán Diez	2016	Biennial
sbr-ix	Red (=blackspot) sea bream (*Pagellus bogaraveo*) in Subarea IX	Juan Gil	Juan Gil	2016	Biennial
sbr-x	Red (=blackspot) sea bream (*Pagellus bogaraveo*) in Subarea X (Azores region)	Mário Rui Rilho de Pinho	Mário Rui Rilho de Pinho	2016	Biennial
usk-arct	Tusk in Subareas I and II (Arctic)	Kristin Helle	Kristin Helle	2015	Biennial
usk-icel	Tusk in Division Va and Subarea XIV	Gudmundur Thordarson	Gudmundur Thordarson	2015	Annual
usk-mar	Tusk in Division Subarea XII, excluding XIIb (Mid Atlantic Ridge)	Kristin Helle	Kristin Helle	2015	Biennial
usk-oth	Tusk in Divisions IIIa, Vb, VIa, and XIIb, and Subareas IV, VII, VIII, and IX (other areas)	Kristin Helle	Kristin Helle	2015	Biennial
usk-rock	Tusk in Division VIb (Rockall)	Kristin Helle	Kristin Helle	2016	Biennial

Fish Stock	Stock name	Stock Coord.	Assess. Coord.	Next Advice year	Advice frequency
tsu-nea	Roundsnout grenadier (*Trachiryncus scabrus*) in the Northeast Atltantic	Pascal Lorance	Pascal Lorance	2015	One-off advice
rhg-nea	Roughhead grenadier(*Macrourus berglax*) in NEAFC and Va (North Atlantic)	Elena Guijarro-Garcia	Elena Guijarro-Garcia	2015	Biennial
oth-comb	Other deep-sea species combined	Tom Blasdale	Tom Blasdale	2015	Collated data

ToR a) Address the general ToRs

The general ToRs were not addressed systematically for all the stocks.

ToR b) Evaluate the harvest control rule for data-limited stocks developed by WKLIFE

WGDEEP evaluated thoroughly the DLS framework. The main particular case is that of black scabbardfish (see Section 10).

ToR c) Complete the development of Stock Annexes for all the stocks assessed by WGDEEP

Due to time constraints little work was done on this ToR. Stock annexes were produced at WKDEEP 2014 for stocks of black scabbardfish, blue ling and ling. The stock structure of black scabbardfish was reviewed by WKDEEP 2014, resulting in one stock annex (SA) for Division Vb and Subareas VI, VI, VII and IX. For blue ling a SA was produced for the stock in Division Vb and Subareas VI and VII and for ling a SA was produced for the stock in Division Va. SAs are available for greater forkbeard in the Northeast Atlantic, for the three stocks of blackspot sea bream considered by ICES and for, for roundnose grenadier in Divisions Vb and XIIb and Subareas VI and VII. SAs for two stocks of greater silver smelt (Va and other areas) were produced by WKDEEP 2010. The stock structure for this species was revised in WGDEEP 2015, resulting in three stocks being now taken into account for the previous "other areas". SAs corresponding to this revised stock structure have not been drafted.

For several other stock SAs have not been written. These stocks are evaluated under the DLS framework.

ToR d) Update the description of deep-water fisheries in both the NEAFC and ICES area(s)

A subgroup addressed this ToR and the work is presented in Chapter 15.

ToR e) Continue work on exploratory assessments for deep-water species

At the meeting exploratory assessments were presented for the following stocks:

- Greater Silver Smelt in Va using Gadget. The model was initially presented to the group in 2012 but has been further developed. The main problem at present is the fit to the tuning series. However that is not a modelling issue but rather a result of the high variances in the time-series.

- The new stock assessment unit Greater Silver Smelt in Vb and VIa using XSA. The model has been presented to the group before and the main update is that the level of biomass appears more stable than in the past. However the model only uses landings and data from Vb but not from other fisheries nearby such as VIa the model cannot be considered a realistic assessment tool, specially taking into account the poor diagnostic from the XSA.
- The new stock assessment unit Greater silver smelt in Subareas I and II was assessed based on catch trends. The potential used of acoustic surveys was presented, the current time-series is too short for assessment purposes.
- The new stock assessment unit greater silver smelt in other areas was assessed based on the *Pandalus* Norwegian survey and categorized stock category3.2.
- Ling in Vb using XSA. The model was presented to the group six years ago. The main issues are that the catch-at-age matrix is not complete for the terminal years and age–length keys were used. The retrospective analysis indicate a strong bias. The model is tuned with a commercial cpue and it was suggested rather to use the Faroe summer survey as it is a standardized survey and additionally may have some information on recruitment of ling in Vb.
- An exploratory assessment for roundnose grenadier in Division Vb and XIIb and Subareas VI and VII was presented, using the Marine Scotland deep-water Science Survey as a tuning index instead of the French tallybook index.

The exploratory assessments are further discussed in the relevant sections of the report and a full description of them can be found in working documents attached to the report.

An assessment and advice was requested for the roughhead grenadier (*Macrourusberglax*) in the Northeast Atlantic was requested owing to landings reported in previous years. Data were compiled and a catch based advice was prepared. An assessment and advice was requested for the roundsnout grenadier (*Trachyrincusscabrus*) in the Northeast Atlantic (see chapter 15).

ToRs g, h and i) Evaluate stock status and draft advice

Addressing these ToRs was the bulk of the work by WGDEEP, all assessments and draft advice sheets were presented in plenary and agreed on by the group.

2.2 Unallocated landings data

Since 2012, The Spanish Authority for Fisheries (Secretaría General de Pesca, SGP), which is also the National authority for the Data Collection Framework, established a new policy and general approach for the provision of official data on catches and fishing effort. This new plan, including the control of fishing activity, has been developed in agreement with the corresponding European Commission authorities. Before 2012, the SGP has had an agreement with the Spanish research institutions IEO and AZTI for the provision of all the catch, effort and biological data in ICES area.

As a result, all Spanish landings data provided since 2013 are official catches which for some stocks may not match the scientific estimates. This may cause a problem where there are significant discrepancies between official data and scientific estimates differences which could affect the coherence of stock historical series. Official statistics are based on logbooks and Auction sheets. It is expected that over time the differences found for some stocks will diminish and official data converge with scientific estimates. To get the best possible assessment of the stock status, the WG considers useful to use unallocated catches as adjustments (positive or negative) to the official catches made for any special knowledge about the fishery for which there is firm external evidence.

3 Area overviews

3.1 Stocks and fisheries of the Oceanic Northeast Atlantic

3.1.1 Fisheries overview

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

This Section deals with fisheries on the MAR and the Azores.

Azores EEZ

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

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

Mid-Atlantic Ridge

The Northern MAR is a huge area located between Iceland and Azores. There are more than 40 seamounts of commercial importance (Table 3.7.1).

The deep-water fishery on the MAR started in 1973, when dense concentrations of roundnose grenadier (*Coryphaenoides rupestris)* were discovered. Later aggregations of alfonsino *(Beryx splendens)*, orange roughy *(Hoplostethus atlanticus)*, cardinal fish *(Epigonus telescopus)*, tusk (*Brosme brosme*), 'giant' redfish (*Sebastes marinus)* and blue ling (*Molva dypterigia)* were found. Trawl and longline fisheries were conducted in Subareas X, XII, XIV and V (Figure 3.7.1) by Russian, Icelandic, Faroese, Polish, Latvian and Spanish vessels.

3.1.2 Trends in fisheries

Azores EEZ

Since the mid-1990s the landings of deep-water species show a decreasing tendency (Figure 3.7.2 and Table 3.7.2), reflecting the change in the fleet behaviour towards targeting blackspot sea bream.

Since 2000, the use of bottom longlines in the coastal areas has significantly been reduced, as a result of the interdiction by the local authorities of the use of longlines in the coastal areas on a range of 6 miles from the islands coast. Large vessels (>24 m) are restrict to seamount areas outside 30 miles from the islands. As a consequence, the smaller boats that operate in the islands coast area have changed their gears to several types of handlines, which may have increased the pressure on some species. The deep-water bottom longline is at present only a seamount fishery. An expansion on the fishing area has been observed for this fleet class during the last decade.

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

Mid-Atlantic Ridge

The greatest annual catch of roundnose grenadier (almost 30 000 t) on the MAR was taken by the Soviet Union in 1975, fluctuating in subsequent years between 2800 and 22 800 t. The fishery for grenadier declined after the dissolution of the Soviet Union in 1992. In the last 15 years, there has been a sporadic fishery (Figure 3.7.1) by vessels from Russia (annual catch estimated at 200–3200 t), Poland (500–6700 t), Latvia (700–4300 t) and Lithuania (catch data are not available). A new Spanish fishery has developed in Division XIVb since 2010. Official Spanish landings of roundnose grenadier in this fishery in 2011 was 2440 t and 2014 was 2075 t. Grenadier has also been taken as bycatch in the Faroese orange roughy fishery and Spanish blue ling fishery. During the entire fishing period to 2011, the catch of roundnose grenadier from the northern MAR amounted to more than 236 000 t, mostly from ICES Subarea XII. Catches from Areas VIb, XII and XIVb and for the year 2012 were reported from the Spanish trawl fishery. Spanish catches of roundnose grenadier reported from Subarea XIVs amounted to 1876 tonnes; however there were also significant unallocated catches from this area (7326 t from XIV and 5472 t from XII).

The deep-water fisheries off Iceland tend to be on the continental slopes although a short-lived fishery on spawning blue ling (*Molva dypterygia*) was reported on a "small steep hill" at the base of the slope near the Westman Islands. The fishery began in 1979, peaked at 8000 t in 1980 and subsequently declined rapidly. French trawlers found a small seamount in southerly areas of the Reykjanes Ridge and were fishing for blue ling there in 1993 with 390 t of catch. The maximum Icelandic catch in that area was more 3000 t also in 1993. Catches declined sharply to 300 and 117 t for next two years and no fishery was reported later (Figure 3.7.1). A fishery on the seamount was resumed by Spanish trawlers in the 2000s with biggest catch about 1000 t.

Orange roughy occurs in areas along of the MAR, where it can be abundant on the tops and the slopes of narrow underwater peaks. In 1992 the Faroe Islands began a series of exploratory cruises for orange roughy beginning in their own waters and later extending into international waters. Exploitable concentrations were found in late 1994 and early 1995. Several vessels began a commercial fishery but only one vessel managed to maintain a viable fishery. Most of the fishery took place on five banks. In the northern area (ICES Subarea XII) catches peaked in 1995–1998 (570–802 t), and since then have generally been less than 300 t (Figure 4.7.1). Catches from 6 to 470 t per annum were also made in ICES Subarea X in 1996–1998, 2000–2001, 2004–2011, 2012 and 2014. The black scabbard fish was the main bycatch species and in recent years it amounted bulk of catches (45–313 t for both Subareas in 2009–2014).

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

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

The first commercial catches of alfonsino in this area were taken by pelagic trawling on the Spectre seamount in 1977 and this and other seamounts were exploited in 1978 and 1979. No commercial fishing took place during the 1980s but nine exploratory and research cruises yielded about 1000 t of mixed deep-water species, mostly alfonsino, but also commercial catches of cardinal fish, orange roughy, black scabbardfish and silver roughy (*Hoplostethus mediterrraneus)*. A joint Norwegian-Russian survey in 1993 used a bottom trawl to survey three seamounts and a catch of 280 t, mainly alfonsino and cardinal fish, was taken from two of them. Orange roughy, black scabbard fish and wreckfish *(Polyprion americanus)* were also of commercial importance. Commercial fishing yielded more than 2800 t over the next seven years (Figure 3.7.2). In recent years there have been no indications of a fishery for alfonsino. Since the discovery of the seamounts in the North Azores area Soviet and Russian, vessels have taken about 6000 t, mainly of alfonsino. Vessels from the Faroe Islands and the UK have also taken small catches of the species in the area. There are no fisheries reported for MAR north of the Azores during the last two years.

Deep-water fisheries in the MAR have declined to very low levels in the recent years in Subareas X and XII, due to many reasons, including the implementation of a range of management measures (Figure 3.7.3). Spain reported landings from Area XIVb1, and XIIa for the years 2012, 2013 and 2014. The main species caught was Roundnose greanadier, *Macrourus berglax, berBaird's slickhead*and and *Sebastes mentella*. Landings from Va were also reported being the main species caught the Roundnose greanadier, *Macrourus berglax, Lepidopus caudatus* and *Baird's slickhead*. Detailed catch information was presented for Area XIIb for 2012 and 2013.

3.1.3 Technical interactions

Azores EEZs

The fishery is multispecies and so technological interactions are observed. In the past the bycatch of this fishery was considered insignificant, according to a pilot study conducted in 2004 (ICES, 2006). However, reported discards from observers in the longline fishery from 2004 to 2010 shows that for some species, like deep-water sharks, the discards may be important. Actually, commercial value species like red blackspot sea bream and wreck fish, alfonsinos among others, are also discarded. These changes may be due to the management measures introduced, particularly the TAC/quotas, minimum size and fishing area restrictions that changed the fleet behaviour on targeting, expanding the fishing areas to more offshore seamounts and deeper strata. Fisheries occurring outside the ICES area to the south of the Azores EEZ may be exploiting the same stocks as considered here.

Mid-Atlantic Ridge

The possible interactions between local fishing grounds (e.g. seamounts) and the status of the stocks at a larger scale are unknown. In particular, seamount aggregating species such alfonsinos and orange roughy are sensitive to sequential local depletion. However, no data were available to assess such effects. Little is understood about the stock structure of these species and it is not known that whether the industrial fleets fishing on the MAR fish the same stocks that are exploited by the Azorean fishery.

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

3.1.4 Ecosystem considerations

Azores EEZ

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

Mid-Atlantic Ridge

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

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

3.1.5 Management of fisheries

Azores EEZ

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

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

Mid-Atlantic Ridge

EC vessels fishing on the MAR are covered by Community TACs. There is NEAFC regulation of fishing effort in the fisheries for deep-water species and closed areas to protect vulnerable habitats.

Current NEAFC measures include VME regulations of bottom fisheries (which includes closures and other area restrictions, encounter protocols, etc.) and a general effort restriction in deep-sea species fisheries as well as a gillnet ban deeper than 200 m.

Specific measures were introduced for roundnose grenadier, orange roughy, blue ling and deep-water sharks. (http://neafc.org/managing_fisheries/measures/current).

Table 3.7.2. Overview of landings in Subareas X (a1,a2,b), XII (c, a1) (does not include information from XIIb, Western Hatton Bank) and XIVb1).

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
ALFONSINOS (*Beryx* spp.)	731	1510	384	229	725	484	199	243	172	139	161	192	211	252	312	245	232	222	168	131
ARGENTINES (*Argentina silus*)		1			2					4										
BLUE LING (*Molva dypterigia*)	602	814	438	451	1363	607	675	1270	1069	644	35	65	1			72	0	16	9	
BLACK SCABBARDFISH (*Aphanopus carbo*)	304	455	203	253	224	357	134	1062	502	384	198	73		80	162	240	163	16	206	85
BLUEMOUTH (*Helicolenus dactylopterus*)	589	483	410	381	340	452	301	280	338	282	190	209	275	281	267	213	231	190	235	200
DEEP WATER CARDINAL FISH (*Epigonus telescopus*)						3		14	16	21	4	10	7	7	7	5	5	4	4	2
GREATER FORKBEARD (*Phycis blennoides*)	75	47	32	39	41	100	91	63	56	46	22	134	201	18	26	14	11	6	8	9
LING (*Molva molva*)	50	2	9	2	2	7	59	8	19		2				1			0	0	
MORIDAE						1	88	113	140	91	69	127	86	53	68	54	55			
ORANGE ROUGHY (*Hoplostethus atlanticus*)	676	1289	814	806	441	447	839	28	201	711	324	104	20	108	26	74	112	139		58
RABBITFISHES (*Chimaerids*)			32	42	115	48	79	98	81	128	193				22	0		2	6	
ROUGHHEAD GRENADIER (*Macrourus berglax*)					3	7	10	7	2	28	8	8			6	0	0	2726	868	448
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	644	1739	8622	11979	9696	8602	7926	11 468	10 805	10 748	513	86	2	13	5	315	2440	3822	1907	3480
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)	1115	1052	1012	1119	1222	947	1034	1193	1068	1075	1383	958	1070	1089	1042	687	624	613	692	663
SHARKS, VARIOUS	1385	1264	891	1051	50	1069	1208	35	25	6	14	104	63	12	1	7	5	31	70	
SILVER SCABBARDFISH (*Lepidopus caudatus*)	789	826	1115	1187	86	28	14	10	25	29	31	35	55	63	64	68	148	282	0	713
SMOOTHHEADS (*Alepocephalidae*)		230	3692	4643	6549	4146	3592	12538	6883	4368	6872							160	17	
Trachipterus sp																		54		
TUSK (*Brosme brosme*)	18	158	30	1	1	5	52	27	83	16	66	64	19		2	107	0	29		
WRECKFISH (*Polyprion americanus*)	244	243	177	140	133	268	232	283	270	189	279	497	664	513	382	238	266	226	209	121
TOTAL	7222	10113	17861	22323	20993	17578	16533	17272	10950	8161	10364	2666	2674	2489	2393	3715	5218	7441	4398	4493

Table 3.7.1. Summary data on seamount fisheries on the MAR.

Main species	Discovery		No. of commercial seamounts	Maximum catch/yr ('000 t)
	Year	Country		
Coryphaenoides rupestris	1973	USSR	34	29.9
Beryx splendens	1977	USSR	4	1.1
Hoplostethus atlanticus	1979	USSR	5	0.8
Molva dypterigia	1979	Iceland	1	8.0
Epigonus telescopus	1981	USSR	1	0.1
Aphanopus carbo	1981	USSR	2	1.1
Brosme brosme	1984	USSR	15	0.3
Sebastes marinus	1996	Norway	10	1..0

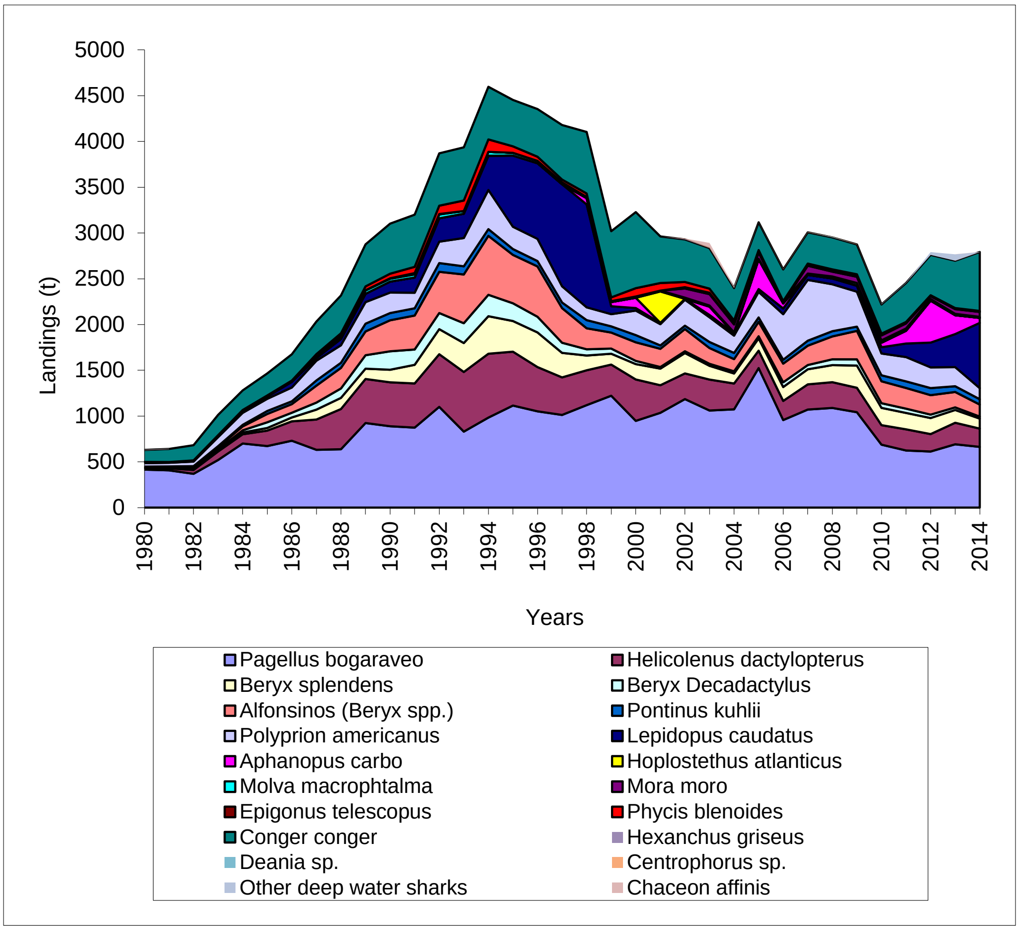

Figure 3.7.2. Annual landings of major deep-water species in Azores from hook and line fishery (1980–2011).

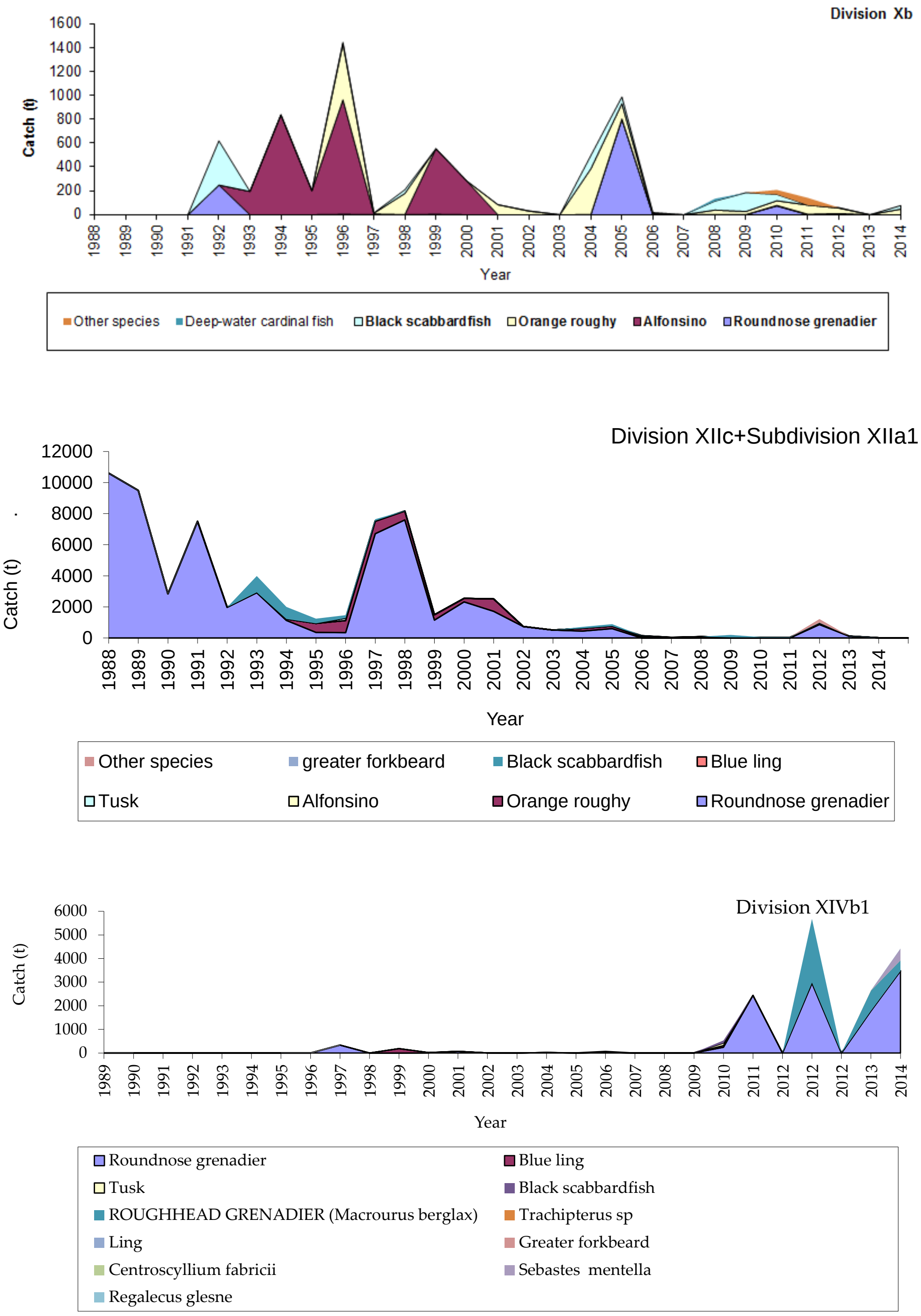

Figure 3.7.1. Annual catch of major deep-water species on MAR in 1988–2014.

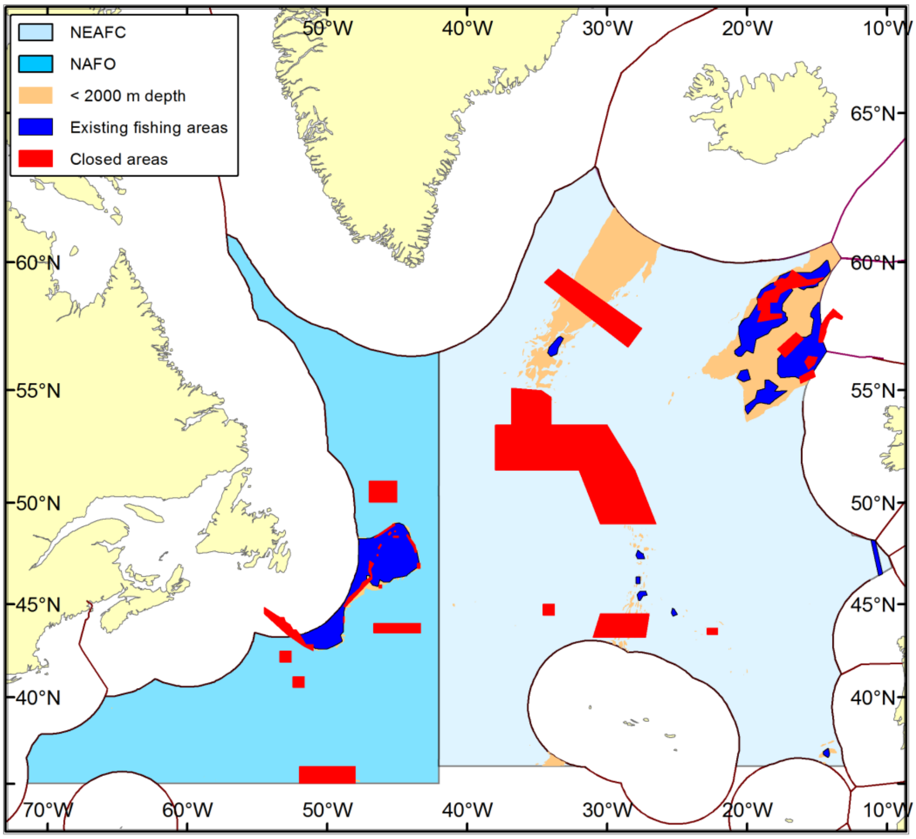

Figure 3.7.3. RFMO regulatory areas of Mid-Atlantic Ridge, and closures introduced by NEAFC and NAFO (red) (from WD Bergstad and Høines, 2011).

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

4.1 Stock description and management units

4.2 Ling (*Molva Molva*) in Division Vb

4.2.1 The fishery

A general description of the fisheries in Faroese waters is provided in the Faroe overview section. The fishery for ling in Vb has changed in 2011–2013 as the Norwegian longliners were not allowed to fish in Faroese waters due to the mackerel allocation. The Faroese were landing almost all the catches and do also utilize the fishing areas that the Norwegian longliners used to fish. In 2014, the Norwegian longliners were allowed to fish in Faroese waters again.

Around 65–75% of the ling in Vb was caught by Faroese longliners in 2010–2014 and the rest mainly by trawlers (25–35%). The longline fisheries were mainly on the slope on the Faroe Plateau and some of it is on the bank area and Wyville-Thomson Ridge (Figure 4.2.1). Ling was also caught as bycatch by trawlers mainly fishing saithe on the Faroe Plateau (Figure 4.2.2).

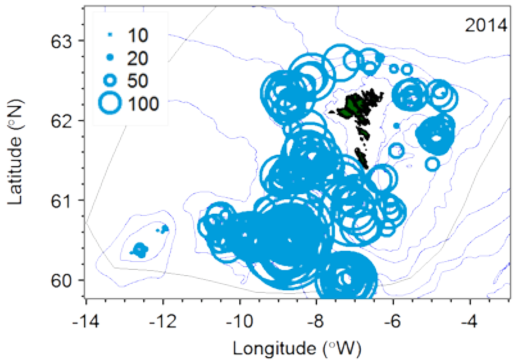

Figure 4.2.1. Ling in Vb. Spatial distribution (kg/1000 hooks) of five selected longliners in 2014 where ling was in the catch and tusk+ling >60% of the total catch the sets. These are the data behind the longliners cpue series of ling.

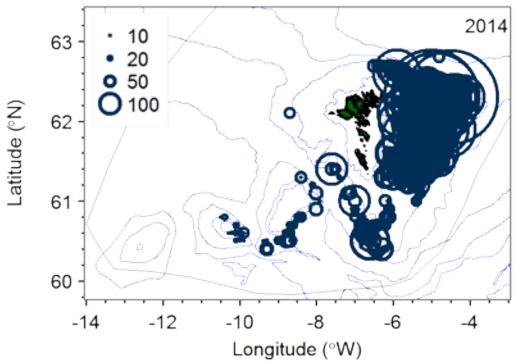

Figure 4.2.2. Ling in Vb. Spatial distribution (kg/hour) of pair trawler hauls in 2014 where ling was in the catch and saithe >60% of the total catch. These are the data behind the pair trawler by-catch cpue series of ling.

4.2.2 Landings trends

Landings data for this stock are available from 1904 onwards. Landing statistics for ling by nation for the period 1988–2014 are given in Tables 4.2.1–4.2.3 and total landings data from 1904 onwards are shown in Figure 4.2.3. Total landings in Division Vb have in general been very stable since the 1970s varying between around 4000 and 7000 tonnes. In the period from 1990–2005 around 20% of the catch were fished in area Vb2, and in the period 2006–2014 this has decreased to around 10%. The preliminary landings of ling in 2014 were 6684 tons, of which the Faroes caught 90%. The reason for the low foreign catches in 2011–2013 was because of no bilateral agreement on fishing rights between the Faroes, Norway and EU.

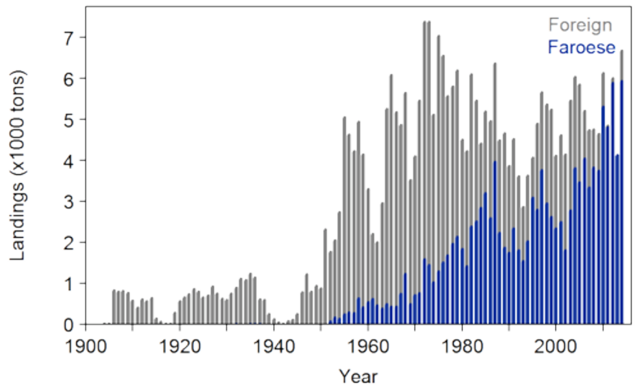

Figure 4.2.3. Ling in Vb. Total international landings since 1904.

4.2.3 ICES Advice

The 2016 advice for this stock is biennial and valid for 2017 (see ICES, 2015): Based on the ICES approach for data-limited stocks, ICES advises that there should be a 20% reduction in effort.

4.2.4 Management

For the Faroese fleets, there is no species-specific management of ling in Vb, although licences are needed in order to fish. The main fleets targeting ling are each year allocated a total allowable number of fishing days to be used in the demersal fishery in the area. The recommended minimum landing size is 60 cm, but that is not enforced because of the discard ban. Mostly 25% of the ling catch (per settings/hauls) can be juveniles e.g. smaller than 75 cm. Other nations are regulated by TACs. Details on management measures in Faroese waters are given in the Faroe overview section.

4.2.5 Data available

Data on length, gutted weight and age are available for ling from the Faroese landings and Table 4.2.4 gives an overview of the levels of sampling since 1996.

Due to limited resources at Faroe Marine Research Institute (FaMRI), the sampling intensity of ling otoliths has been low from year 2007. Hence, in order to perform an age-based assessment, it has been necessary to combine age samples from all fleets/seasons and even between years to make an age–length key.

There are also catch and effort data from logbooks for the Faroese longliners and trawlers.

From the two annual Faroese groundfish surveys on the Faroe Plateau, especially designed for cod, haddock and saithe, biological data (length and round weight) as well as catch and effort data are available. Data of ling larvae from the annual 0-group survey on the Faroe Plateau was also used.

In addition, there are also data available on catch, effort and mean length from Norwegian longliners fishing in Faroese waters.

4.2.5.1 Landings and discards

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

4.2.5.2 Length compositions

Length composition data are available from the Faroese commercial longliners, the trawler fleet that captures ling as bycatch and two groundfish surveys (Figures 4.2.4–4.2.7).

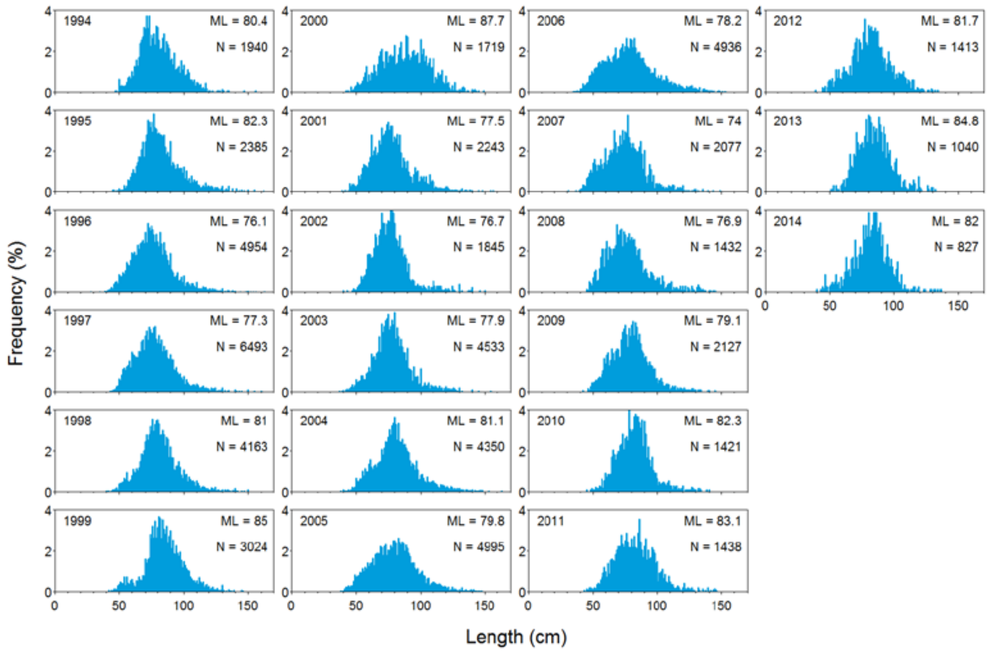

Figure 4.2.4. Ling in Vb. Length distribution in the landings of ling from Faroese longliners (>110 GRT). ML-mean length and N-number of length measures.

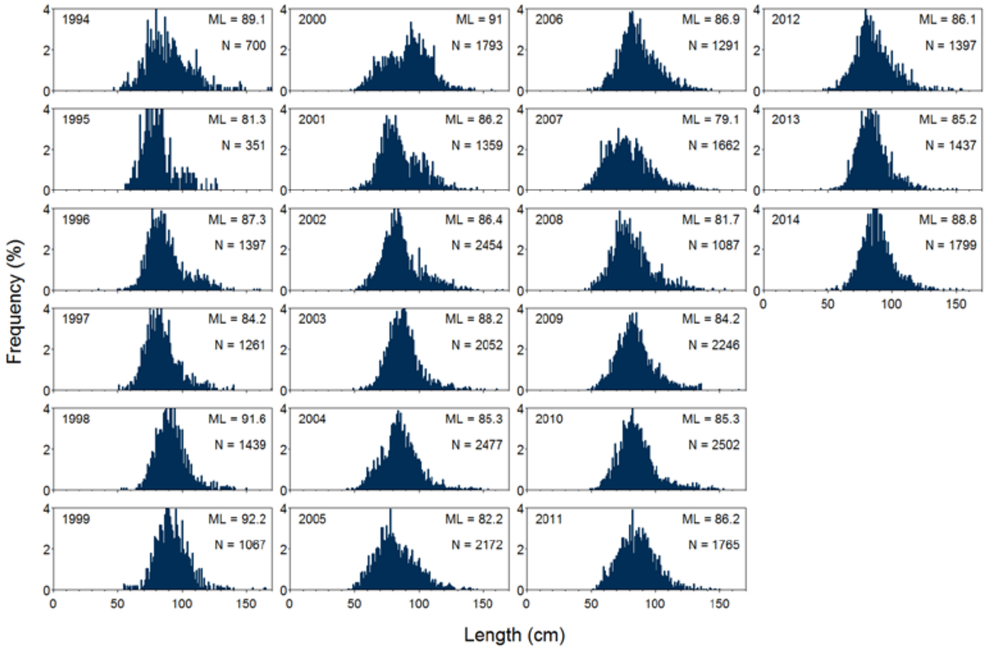

Figure 4.2.5. Ling in Vb. Length distribution in the landings of ling from Faroese trawlers (>1000 HP). ML-mean length and N-number of length measures.

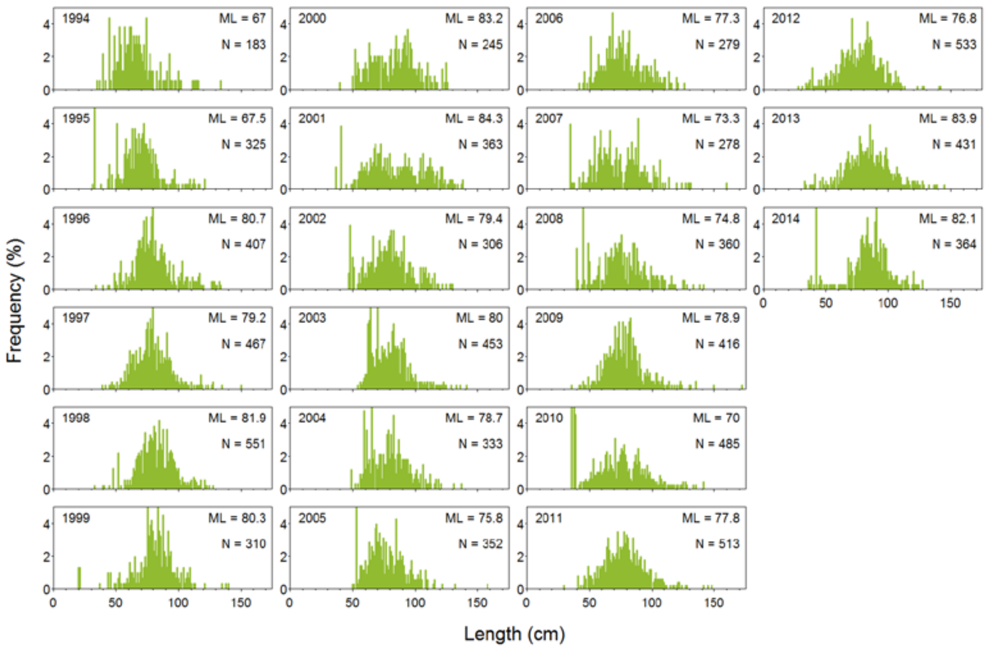

Figure 4.2.6. Ling in Vb. Length distribution from the spring groundfish survey. ML- mean length, N- number of calculated length measures. The small ling are often sampled from a sub-sample of the total catch, so the values are multiplied to total catch.

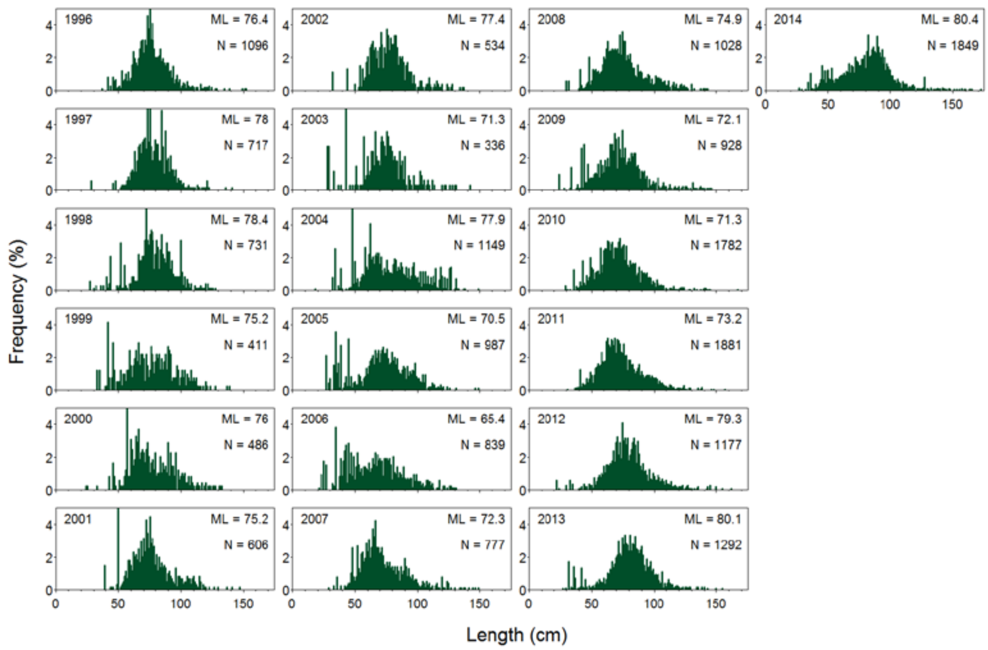

Figure 4.2.7. Ling in Vb. Length distribution from the summer groundfish survey. ML- mean length, N- number of calculated length measures. The small ling are often sampled from a sub-sample of the total catch, so the values are multiplied to total catch.

4.2.5.3 Catch-at-age

Catch-at-age data were provided for Faroese landings in Vb for the period 1996–2014. Due to few age data in the recent period were all ages from 1996-2014 combined (the same age–length key for all these years). Thereafter were the age–length data distributed on the lengths for the distinct years and fleets (longliners and trawlers) (Table 4.2.5, Figure 4.2.8). The common ages in the landings are from five to nine years and the mean age is around 7–8 years.

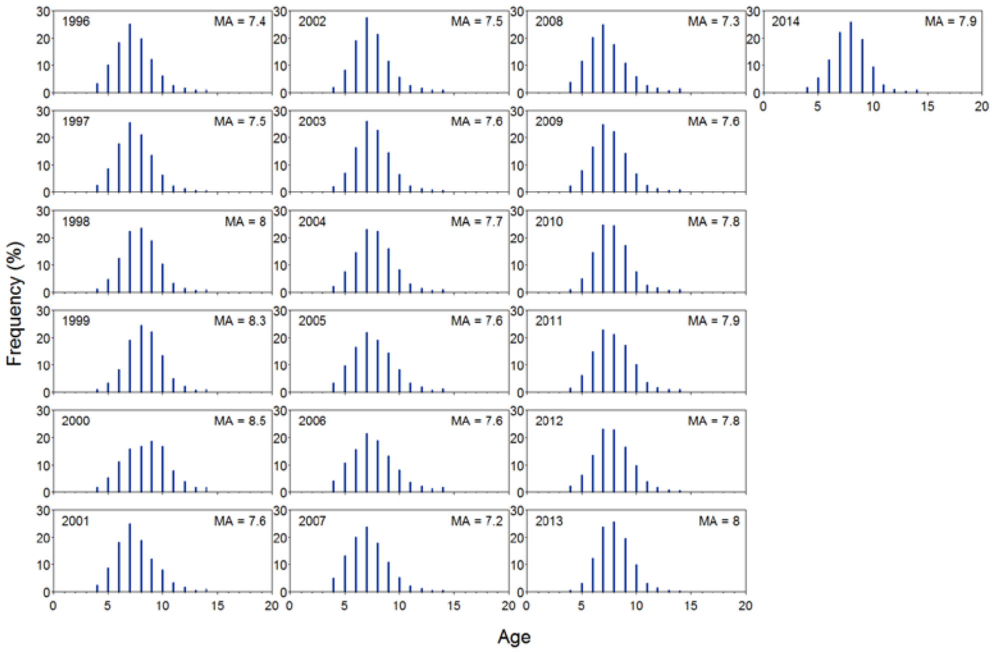

Figure 4.2.8. Ling Vb. Catch-at-age composition used in the exploratory assessment. MA- mean age.

4.2.5.4 Weight-at-age

Mean weight-at-age data from the landings in Vb were modelled by using all the age samples from landings (1996–2014) combined before they were distributed on the length distribution for the distinct year and fleet (longliners and trawlers). There is no particular decreasing trend in the mean weights over the period (Figure 4.2.12). The common ages in the landings were from 5 to 9 years and the mean age was around 7-8 years (Table 4.2.6).

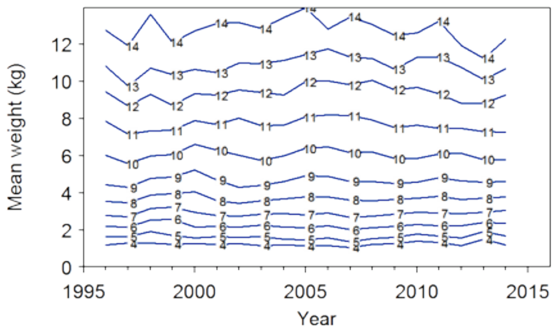

Figure 4.2.9. Ling in Vb. Mean weight-at-age in the catches.

4.2.5.5 Maturity and natural mortality

Data from the groundfish surveys in 2013–2014 of 850 ling (lengths from 25–150 cm) indicated a L_{50} at around 70–74 cm, and ages from 850 ling (2–16 years old) indicated an A_{50} around 6 years. This fit well with the statement that ling become mature at ages 5–7 (60–75 cm lengths) in most areas, with males maturing at a slightly lower age than females (Magnusson *et al*., 1997).

No annual measurements of maturity-at-age were available and knife-edge maturity for age 7 and older has been assumed in the assessment.

A natural mortality of 0.15 was assumed for all ages in the exploratory assessment.

4.2.5.6 Catch, effort and research vessel data

Commercial cpue series

There are catch per unit of effort (cpue) data available from three commercial series, the Faroese longliners, the Faroese pair trawlers (bycatch) and Norwegian longliners fishing in Vb. The Faroese cpue data are from five longliners (GRT>110) and 6–10 pair trawlers (HP>1000). The effort obtained from the logbooks was estimated as 1000 hooks from the longliners, number of fishing (trawling) hours from the trawlers and the catch as kg stated in the logbooks. The selection of data and standardization are described in the stock annex for ling in Vb.

The standardized cpue data from Norwegian longliners fishing in Vb are described in the stock annex for ling in IIa (Section ling in I and II) and in Helle *et al*., 2015. The sets where ling >30% of the total catch were used. The Norwegian and Faroese longliners are comparable and both have ling (and tusk) as target species.

Both the Faroese longline series (directed effort measured as number of 1000 hooks) and the trawl bycatch series (effort measured as hours) was used as tuning series in the exploratory assessments.

Fisheries independent cpue series

Cpue estimates (kg/hour) for ling are available from two annual groundfish surveys on the Faroe Plateau designed for cod, haddock and saithe. Both surveys are restricted to the area on the Faroe Plateau (Vb1) and do as such not cover the whole distribution area for ling since the Faroe Bank (Vb2) is not included. The summer survey series were used as tuning series for ling in Vb. Ages from 850 otoliths were used in the combined age–length key, and then distributed out on length distribution of each distinct year (1996–2014). Information on the surveys and standardization of the data are described in the stock annex.

A potential recruitment index was calculated from ling less than 40 cm from the survey. In addition, an index was calculated from the annual 0-group survey on the Faroe Plateau.

4.2.6 Data analyses

Mean length in the length distribution from commercial catches from Faroese longliners and trawlers showed an increase in mean length from 2007–2014 (Figure 4.2.4–4.2.5). The mean length in length distributions for the Norwegian longliners fishing in Faroese waters, in the period 2003–2009 were around 87 cm. The Faroese trawlers have a slightly higher mean length in the catches as the Faroese longliners.

Length distributions from the two groundfish surveys on the Faroe Plateau showed high interanual variation in mean length, from 65 to 85 cm, which may partly be explained by occasional high abundance of individuals smaller than 60 cm (Figures 4.2.6–4.2.7).

Fluctuations in abundance

Information on abundance trends can be derived from the cpue data from the Faroese longliners (Figure 4.2.10), Norwegian longliners fishing in Vb (Figure 4.2.11), bycatch eries from the Faroese pair trawlers fishing saithe (Figure 4.2.10) and from the Faroese groundfish surveys (Figure 4.2.12). The data from these series are presented in Table 4.2.7–4.2.8.

The Faroese longline cpue series and the Faroese trawl bycatch cpue series show a positive trend since around 2001. The Norwegian longline series show a small decrease in the last three years. There are very few data from Norwegian longliners in 2009–2013 (Table 4.2.8).

The two survey cpue series indicate a stable situation since the late 1990s and an increase in recent years.

A potential recruitment index was calculated from the two surveys as the number of ling smaller than 40 cm (Figure 4.2.13). This shows indications of increasing recruitment in recent years. In addition, a potential recruitment index was calculated from the annual 0-group survey on the Faroe Plateau 1983–2013 (Figure 4.2.14). These recruitment indices support an indication of increasing recruitment in recent years.

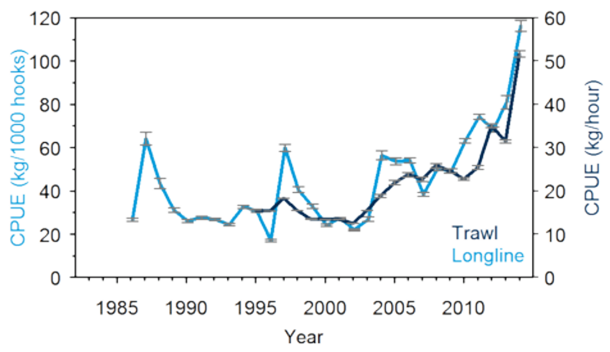

Figure 4.2.10. Ling in Vb. Standardized cpue from Faroese longliners (turquoise line) and pair trawlers (bycatch, dark blue line) fishing in Faroese waters. Data from longliners (>110 GRT) are from sets where ling was caught and ling+tusk>60% of the total catch. Data from trawlers are from hauls where ling was caught and saithe >60% of the total catch. The error bars are SE.

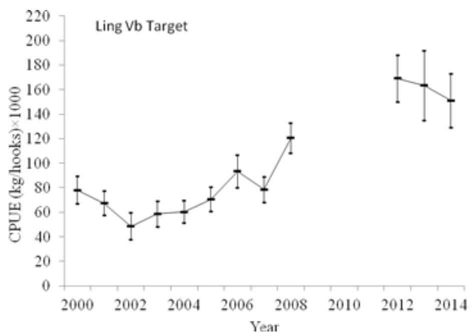

Figure 4.2.11. Ling in Vb. Standardized cpue (kg/ 1000 hooks) of ling from Norwegian longliners fishing in Vb. The bars denote the 95% confidence intervals. Note that there are very few data since 2009 (WD Helle and Pennington, WGDEEP 2015).

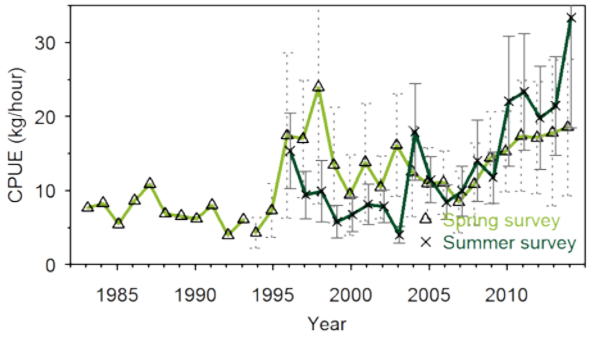

Figure 4.2.12. Ling in Vb. Standardized cpue (kg/h) from the two annual Faroese groundfish surveys on the Faroe Plateau. The error bars are SE. The data for 1983–1993 were not standardized.

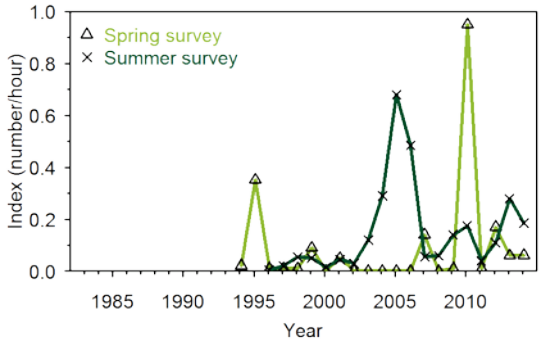

Figure 4.2.13. Ling in Vb. Index (number/hour) of ling smaller than 40 cm from the spring- and summer survey on the Faroe Plateau.

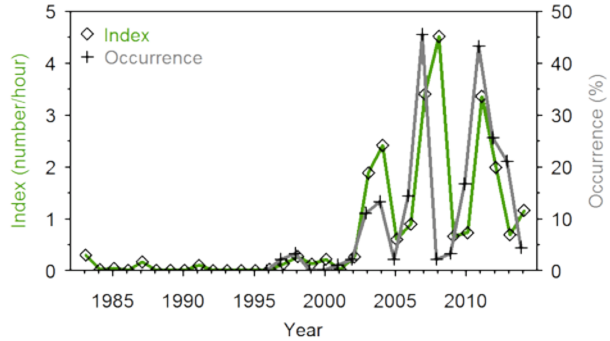

Figure 4.2.14. Ling in Vb. Index (number/hour) and occurrence (%) of ling (2–3 cm in length) caught in the annual 0-group survey on the Faroe Plateau.

Analytical assessment

An exploratory assessment of ling in Vb was done by using an age-based extended survivor analysis model (XSA) (Ofstad, WD WGDEEP 2015). Due to few otolith samples in the period from 2007–2013 the otolith samples for all years were combined in the age–length key before they were multiplied to the actual years length distributions per fleet.

Outputs from the XSA model showed seasonal problems in the log q residuals. The summer survey series was used as tuning series to get better data smaller fish in addition to the longliners series and trawl bycatch series. The longliner series, the trawler bycatch series had approximately same weight in the model for age 6 to 11.

The results from the XSA model supported that ling in Faroese waters is at a high level as both the total biomass and SSB were above long-term mean in the latest five years (Table 4.2.9). The recruitment since 1996 was between 1.9 and 8 million. The total biomass ranged between 23 and 61 thousand tons with an increase in the last seven years and the total SSB varied between 12 and 34 thousand tons. The fishing mortality varied between 0.16 and 0.48 and the natural mortality was set to 0.15 for all ages. The retrospective pattern showed that recruitment and fishing mortality tended to be underestimated, whereas the biomass and SSB tended to be overestimated.

A modified yield per recruit analysis was used to calculate F_{MAX} and $F_{0.1}$. The selection patterns, as well as the weights, were calculated as the average for the whole assessment period (1996–2014). In this case the F_{MAX} was well-defined (F-factor of 0.95 giving an absolute F of 0.35) and could be used as the target F. Fishing of F_{MAX} gave a catch of around 4800 tons and a biomass of 28 000 tons. The estimate of $F_{0.1}$ (F-factor of 0.45 giving an absolute F of 0.16) gave a catch of around 4400 tons and biomass of around 40 000 tons (Figure 4.2.15).

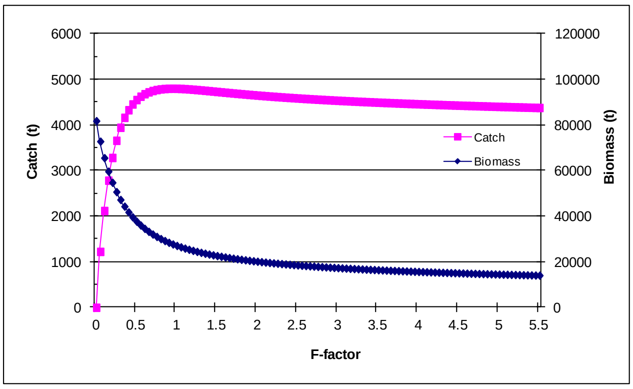

Figure 4.2.15. Ling in Vb. A modified yield-per-recruit plot. The YPR estimates indicated F_{MAX} to be around 0.35 (catch around 4800 t) and $F_{0.1}$ to be around 0.16 (catch around 4400 t).

Fproxy

Changes in relative fishing mortality (F_{proxy} = yield / abundance (kg/hour) from the summer survey) are presented in Figure 4.2.16. The abundance from the groundfish summer survey on the Faroe Plateau was chosen for F_{proxy} calculation because the survey covers both the distribution area and the fishing area. In addition, the summer survey covers the Plateau best as it has twice as many stations than the spring survey. Compared with the first years of the series, F_{proxy} in 2010–2014 was relatively stable but at lowest values of the series. Average of the five last years was used to calculate the target F_{proxy}. The target F_{proxy} was calculated to be 33 = 6684 (yield in 2014)/ 200 (abundance in the summer survey in 2014). This gives a target catch of around 7900 tons = 236 (average abundance for 2010–2014) *33 (target F_{proxy}).

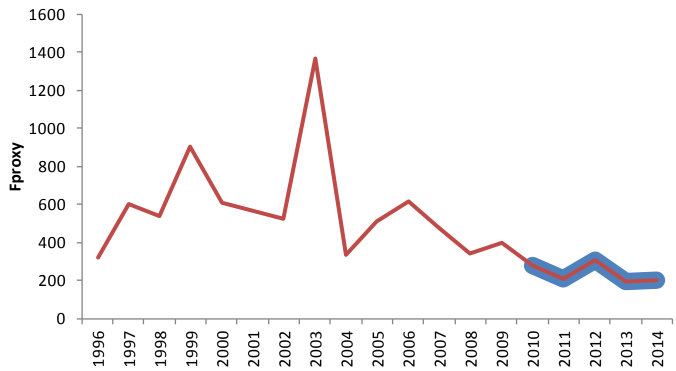

Figure 4.2.16. Ling in Vb. Changes in relative fishing mortality (F_{proxy}). Summer groundfish survey abundance (kg/h) for the Faroe Plateau was used in the calculations.

4.2.6.1 Reference points

No reference points have been proposed for this stock. However, as adult abundance as measured by surveys is above the average of the time-series, expert judgement considered it likely that SSB is above any candidate values for MSY $B_{trigger}$.

4.2.7 Comments on assessment

All signs from commercial catches and surveys indicate that ling in Vb is at present in a good state. This is confirmed in the exploratory assessment using three tuning series. The cpues from longline and trawl fishery were used as tuning series and they represent around 95% of the total fishery of ling. In addition, the summer survey was used as tuning series to give better data on smaller fish.

There is a clear seasonal pattern in log q residuals and there need to be a closer look at the diagnostic to find the best settings. It is a need to look closer at the ALK for the whole period to try to solve the strong log q residual patterns. Still, the assessment shows that there is an increase both in stock biomass and spawning–stock biomass during the last seven years period. The recruitment since 1998 to 2012 was stable between 3.0 and 5.0 million and then increased to 8 million in 2014.

It will be further work on the assessment of ling in Vb during a Faroese project that ends in 2015. There were enough otoliths from small ling in the surveys for use in a tuning series from the summer groundfish survey which gave higher recruitments when using the summer survey as tuning series.

Ling in Vb is a category 3 stock according to the ICES DLS approach proposed by the ADG in 2012. There are possibilities to increase ling in Vb to a category 1 stock with the excising data.

4.2.8 Management consideration

Stability in landings and trends in abundance indices suggest that ling in Division Vb has been stable since the middle of the 1980s, with an increasing trend in the last seven years. The available dataseries do not cover the entire period of the fishery (back to the early 1900s; see Figure 4.2.3) and no information is available on stock levels prior to 1986. There is evidence of increased recruitment in the last seven years compared to earlier levels.

The only species-specific management for Faroese fisheries of ling in Division Vb is the recommended minimum landing size (60 cm), but this does not appear to be enforced because of the discard ban. Mostly 25% of the ling catch (per settings/hauls) can be juveniles e.g. smaller than 75 cm.

The exploitation of ling is influenced by regulations aimed at other groundfish species, e.g. cod, haddock, and saithe such as closed areas. The fisheries by other nations are regulated by TACs.

Table 4.2.1. Ling in Vb1. Nominal landings (1988–2014).

Year	Denmark (2)	Faroes	France	Germany	Norway	E&W (1)	Scotland (1)	Russia	Total
1988	42	1383	53	4	884	1	5		2372
1989		1498	44	2	1415		3		2962
1990		1575	36	1	1441		9		3062
1991		1828	37	2	1594		4		3465
1992		1218	3		1153	15	11		2400
1993		1242	5	1	921	62	11		2242
1994		1541	6	13	1047	30	20		2657
1995		2789	4	13	446	2	32		3286
1996		2672			1284	12	28		3996
1997		3224	7		1428	34	40		4733
1998		2422	6		1452	4	145		4029
1999		2446	17	3	2034	0	71		4571
2000		2103	7	1	1305	2	61		3479
2001		2069	14	3	1496	5	99		3686
2002		1638	6	2	1640	3	239		3528
2003		2139	12	2	1526	3	215		3897
2004		2733	15	1	1799	3	178	2	4731
2005		2886	3		1553	3	175		4620
2006	3	3563	6		850		136		4558
2007	2	3004	9		1071		6		4092
2008		3354	4		740	32	25	11	4166
2009	13	3471	2		419		270		4174
2010	28	4906	2		442		121		5500
2011	49	4270	2		0		0		4321
2012	117	5452	7		0		0		5576
2013	3	3734	7		0		0		33744
2014*		5653	9		308		36	13	6019

***Preliminary.**

(1) Includes Vb2.

(2) Greenland 2006–2013.

Table 4.2.2. Ling in Vb2. Nominal landings (1988–2014).

Year	Faroes	France	Norway	Total
1988	832		1284	2116
1989	362		1328	1690
1990	162		633	795
1991	492		555	1047
1992	577		637	1214
1993	282		332	614
1994	479		486	965
1995	281		503	784
1996	102		798	900
1997	526		398	924
1998	511		819	1330
1999	164	4	498	666
2000	229	1	399	629
2001	420	6	497	923
2002	150	4	457	611
2003	624	4	927	1555
2004	1058	3	247	1308
2005	575	7	647	1229
2006	472	6	177	655
2007	327	4	309	640
2008	458	3	120	580
2009	270	1	198	469
2010	393	1	236	630
2011	522	0	0	522
2012	434	1	0	435
2013	255	1	0	256
2014*	276		389	665

***Preliminary.**

Table 4.2.3. Ling in Vb. Nominal landings (1988–2013).

Year	Vb1	Vb2	Vb
1988	2372	2116	4488
1989	2962	1690	4652
1990	3062	795	3857
1991	3465	1047	4512
1992	2400	1214	3614
1993	2242	614	2856
1994	2657	965	3622
1995	3286	784	4070
1996	3996	900	4896
1997	4733	924	5657
1998	4029	1330	5359
1999	4571	666	5238
2000	3479	629	4109
2001	3686	923	4609
2002	3528	611	4139
2003	3897	1555	5453
2004	4731	1308	6039
2005	4620	1229	5849
2006	4558	655	5213
2007	4092	640	4731
2008	4166	580	4747
2009	4174	469	4643
2010	5500	630	6129
2011	4321	522	4843
2012	5576	435	6011
2013	3830	256	4086
2014*	6019	665	6684

***Preliminary.**

Table 4.2.4. Ling in Vb. Overview of the sampling from commercial landings since 1996.

Year	Length	Weight	Age
1996	6399	410	1084
1997	7900	541	1526
1998	5912	538	1081
1999	4536	360	480
2000	3512	360	360
2001	3805	420	420
2002	4299	180	300
2003	6585	360	661
2004	6827	1169	659
2005	7167	3217	540
2006	6503	4038	276
2007	4031	1713	120
2008	2521	1945	60
2009	4373	4348	232
2010	4345	4279	180
2011	3405	2828	0
2012	2810	2447	50
2013	2477	2076	0
2014	2831	2274	20

Table 4.2.5. Ling in Vb. Catch number-at-age (thousands) from the commercial fleet.

YEAR\AGE	4	5	6	7	8	9	10	11	12	13	14+
1996	47	143	265	362	284	173	87	36	22	11	12
1997	42	148	301	433	359	230	108	38	21	10	11
1998	16	62	159	288	306	245	134	43	20	9	14
1999	12	37	94	221	285	257	158	57	25	9	11
2000	13	44	91	130	138	154	138	64	32	13	12
2001	31	111	233	320	241	154	101	44	21	8	13
2002	22	96	226	326	254	136	65	30	19	11	11
2003	31	111	257	403	352	228	103	35	20	11	10
2004	35	119	229	365	354	250	131	49	24	12	17
2005	49	145	249	328	288	218	124	48	27	12	19
2006	54	141	207	283	248	175	107	48	27	16	21
2007	72	191	292	349	258	159	75	32	18	8	9
2008	51	157	276	340	243	147	80	33	21	10	19
2009	29	106	217	324	290	188	89	32	17	7	10
2010	15	76	229	390	387	268	119	41	25	13	14
2011	17	73	179	273	255	205	119	41	19	10	11
2012	30	97	210	359	354	257	151	59	26	9	8
2013	5	32	125	245	265	202	101	33	16	5	4
2014	31	90	201	377	442	336	159	47	20	7	13

Table 4.2.6. Ling in Vb. Catch weight-(kg) at-age from the commercial landings.

YEAR/AGE	4	5	6	7	8	9	10	11	12	13	14+
1996	1.200	1.650	2.207	2.773	3.531	4.431	6.016	7.862	9.438	10.821	12.736
1997	1.280	1.650	2.162	2.716	3.456	4.294	5.567	7.156	8.663	9.736	11.917
1998	1.302	1.906	2.544	3.141	3.889	4.767	5.995	7.343	9.288	10.703	13.622
1999	1.224	1.697	2.576	3.229	3.944	4.836	6.053	7.351	8.710	10.357	12.102
2000	1.253	1.582	2.168	2.934	4.066	5.221	6.602	7.880	9.340	10.657	12.714
2001	1.221	1.642	2.192	2.761	3.559	4.679	6.286	7.682	9.262	10.468	13.137
2002	1.244	1.587	2.143	2.735	3.450	4.299	6.020	8.007	9.540	11.007	13.151
2003	1.165	1.639	2.247	2.831	3.561	4.411	5.744	7.608	9.398	10.949	12.855
2004	1.198	1.506	2.145	2.873	3.675	4.607	5.973	7.629	9.254	11.119	13.451
2005	1.148	1.480	2.116	2.828	3.794	4.903	6.390	8.089	9.985	11.431	13.963
2006	1.171	1.553	2.217	2.911	3.775	4.872	6.487	8.206	10.026	11.749	12.833
2007	1.054	1.371	2.005	2.683	3.614	4.617	6.156	8.159	9.809	11.313	13.494
2008	1.212	1.542	2.123	2.736	3.587	4.607	6.192	7.926	10.046	11.247	13.066
2009	1.247	1.605	2.202	2.856	3.641	4.516	5.847	7.495	9.557	10.661	12.461
2010	1.384	1.762	2.305	2.943	3.711	4.555	5.835	7.660	9.698	11.290	12.598
2011	1.323	1.671	2.241	2.909	3.821	4.814	6.107	7.486	9.328	11.317	13.252
2012	1.157	1.580	2.240	2.882	3.654	4.639	6.111	7.473	8.821	10.747	11.928
2013	1.492	1.907	2.395	2.965	3.703	4.563	5.789	7.290	8.819	10.101	11.250
2014	1.175	1.687	2.366	3.050	3.795	4.623	5.796	7.274	9.268	10.690	12.268

Table 4.2.7. Ling in Vb. Data on the cpue series from Faroese commercial fleets and groundfish surveys. Only the spring survey data from 1983–1993 was not standardized. N- number of sets/hauls behind the commercial cpue.

	Longline			Trawl (bycatch)			Spring survey		Summer survey	
Year	Mean	se	N	Mean	se	N	Mean	se	Mean	se
1983							7.7			
1984							8.3			
1985							5.5			
1986	26.8	0.7	87				8.6			
1987	64.1	3.0	49				10.9			
1988	43.4	2.4	29				6.9			
1989	31.1	1.1	35				6.6			
1990	26.1	0.7	85				6.2			
1991	27.6	0.7	177				8.0			
1992	26.9	0.6	174				4.0			
1993	24.5	0.6	187				6.1			
1994	32.7	0.7	284				4.3	2.1		
1995	30.7	0.7	232	15.7	0.1	242	7.3	3.6		
1996	17.2	0.6	20	15.4	0.1	212	17.4	11.2	15.3	5.1
1997	60.0	1.7	85	18.3	0.0	568	17.0	7.9	9.4	3.2
1998	40.6	1.4	73	15.5	0.0	588	23.9	15.8	9.9	4.1
1999	32.9	0.9	94	13.5	0.0	910	13.4	7.8	5.8	2.2
2000	24.1	0.6	70	13.4	0.0	846	9.4	5.5	6.8	2.3
2001	27.3	0.4	65	13.4	0.0	899	13.8	8.0	8.1	2.7
2002	22.0	0.5	17	12.6	0.0	791	10.4	4.2	7.9	2.2
2003	27.0	1.1	28	15.5	0.0	701	16.1	6.9	4.0	1.1
2004	56.5	2.1	52	19.0	0.3	590	12.5	6.1	17.9	6.5
2005	53.6	1.7	84	22.1	0.5	754	11.0	4.8	11.4	3.1
2006	54.1	1.3	142	24.0	0.6	658	11.1	4.3	8.4	2.4
2007	38.3	0.9	77	23.0	0.5	682	8.4	4.2	9.9	3.4
2008	50.2	0.9	200	26.1	0.6	599	10.8	5.6	14.0	5.5
2009	49.4	0.8	187	24.9	0.5	750	14.4	6.2	11.7	3.4
2010	63.2	1.1	232	23.1	0.4	737	15.2	5.4	22.1	8.8
2011	74.2	1.2	215	25.8	0.5	507	17.4	7.5	23.3	7.9
2012	68.4	1.3	201	35.7	0.5	874	17.1	7.6	19.8	7.0
2013	81.0	3.1	66	31.8	0.4	792	17.8	9.9	21.4	6.7
2014	116.4	2.5	213	51.7	0.7	945	18.5	9.2	33.3	14.9

Table 4.2.8. Ling in Vb. Data from the Norwegian longliners cpue series. Mean cpue is from longliners with more than 30% ling in the sets. CI- 95% confidence interval, N- average number of days that each Norwegian longliner operated in an ICES subarea/division (WD 2015, Helle and Pennington).

Year	Mean cpue	CI	N
2000	53.1	33.2	12
2001	20.7	20.5	17
2002	9.7	25.7	18
2003	71.2	39.7	24
2004	38.3	19.4	34
2005	42.2	19.4	21
2006	78.2	21.9	11
2007	55.6	19.3	15
2008	76.5	21.5	11
2009			4
2010			0
2011	152.4	25.9	2
2012	167.0	24.7	2
2013	160.7	25.8	1
2014	134.1	20.4	4

Table 4.2.9. Ling in Vb. Summary table from XSA.

	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	F_{BAR} 6-11
	Age 4					
1996	1915	24377	13597	4896	0.360	0.397
1997	1909	22938	14065	5657	0.402	0.445
1998	2457	24145	14725	5359	0.364	0.423
1999	2922	23548	13000	5238	0.403	0.480
2000	2945	23221	11726	4109	0.350	0.413
2001	2692	23951	11887	4609	0.388	0.444
2002	2481	23813	12662	4139	0.327	0.339
2003	2521	24803	14173	5453	0.385	0.418
2004	2833	24532	14230	6039	0.424	0.464
2005	3350	24618	13546	5849	0.432	0.456
2006	3513	25876	13064	5213	0.399	0.417
2007	3559	25192	12729	4731	0.372	0.358
2008	4020	29451	14901	4747	0.319	0.312
2009	4685	33006	16327	4643	0.284	0.302
2010	4750	38976	18799	6129	0.326	0.350
2011	4233	40416	20439	4843	0.237	0.253
2012	4369	42897	24406	6010	0.246	0.284
2013	6719	52227	27822	4131	0.149	0.156
2014	8166	61276	34402	6684	0.194	0.199
Arith.						
Mean	3686	31014	16658	5183	0.335	0.364
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

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

4.3.1 The fishery

Ling has been fished in Subareas I and II for centuries, and the historical development is described in, e.g. Bergstad and Hareide (1996). In particular, the post-World War II increase in catch caused by a series of technical advances, is well documented. Currently the major fisheries in Subareas I and II are the Norwegian longline and gillnet fisheries, but bycatches of ling are taken by other gears, such as trawls and handlines. Around 50% of the Norwegian landings are taken by longlines and 45% by gillnets, partly in the directed ling fisheries and in part as bycatch in fisheries for other groundfish. Other nations catch ling as bycatch in their trawl fisheries. Figure 4.3.1 shows the spatial distributions of the total catches for the Norwegian longline fishery in 2013 and 2014.

The Norwegian longline fleet (vessels larger than 21 m) increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number decreased to 26 in 2014. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The average number of days that the longliners operated in ICES Subareas I and II has declined since its peak in 2011. During the period 2000 to 2014 the main technological change in Subareas I and II was that the average number of hooks per day increased from 31 000 hooks to 37 000 hooks. During the period 1974 to 2014 the total number of hooks per year has varied considerably, but with a downward trend since 2002 (for more information see Helle and Pennington, WD 2015).

Since the total number of hooks per year takes into account; the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, it follows that it may be a suitable measure of changes in applied effort. Based on this gauge, it appears that the average effort for the years 2011–2014 is 43% less than the average effort during the years 2000–2003.

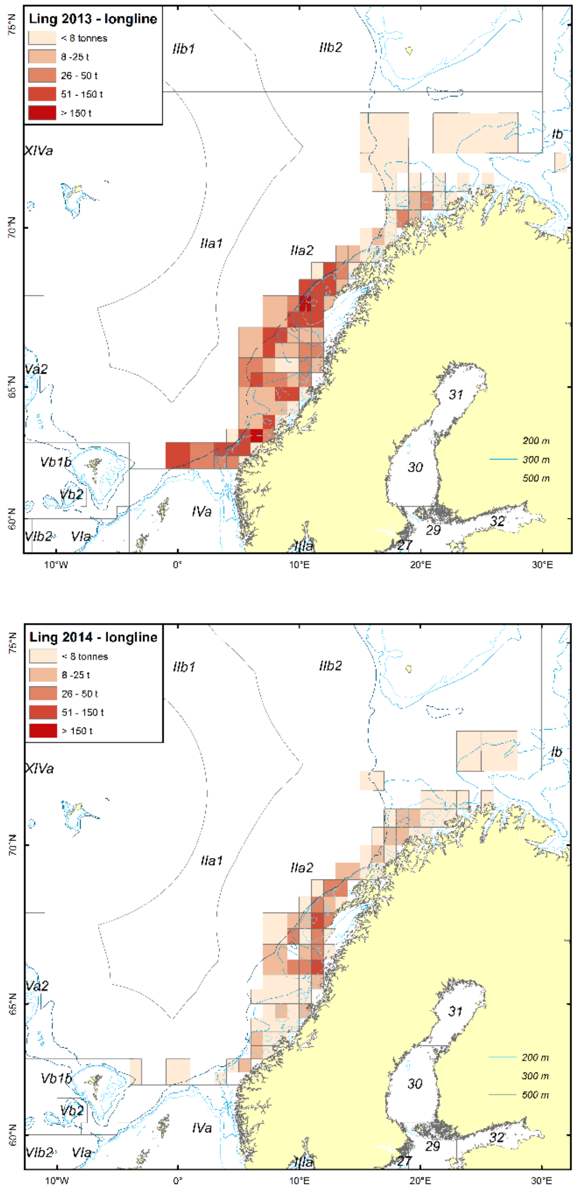

Figure 4.3.1. Distribution of the total catches in Subareas I and II taken by the Norwegian long-line fishery in 2014.

4.3.2 Landings trends

Landing statistics by nation in the period 1988–2014 are in Tables 4.3.1a–d. During the period 2000–2005 the landings varied between 5000 and 7000 t, which were slightly lower than catches in the preceding decade. In 2007, 2008 and 2010 the landings increased to over 10 000 t. The preliminary amount of landing for 2014 is 9606 t. Total international landings in Areas I and II are given in Figure 4.3.2.

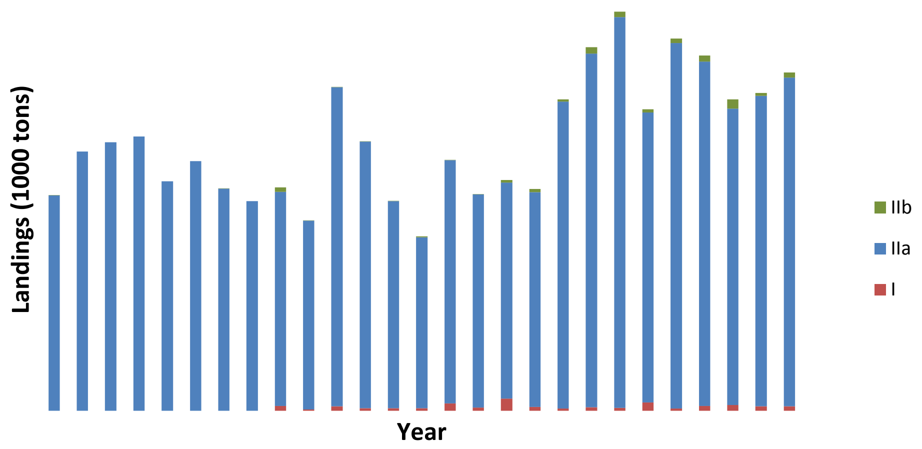

Figure 4.3.2. Total international landings of ling in Subareas I and II.

4.3.3 ICES Advice

Advice for 2013 to 2015: Based on the ICES approach for data-limited stocks, ICES advises that there should be a 20% reduction in effort. This would result in a total catch of no more than 8825 tonnes in 2015.

4.3.4 Management

There is no quota set for the Norwegian fishery for ling but the vessels participating in the directed fishery for ling and tusk in Subareas I and II are required to have a specific licence. The ling quota for the EU in Norwegian waters (Areas I and II) is 950 t in 2014. There is no minimum landing size in the Norwegian EEZ.

The quota for ling in EU and international waters was set at 36 t in 2014.

4.3.5 Data available

4.3.5.1 Landings and discards

Amounts landed were available for all relevant fleets. No estimates of the amount of ling discards are available. But since the Norwegian fleets are not regulated by TACs, and there is a ban on discarding, the incentive for illegal discarding is believed to be low. The landings statistics are therefore regarded as being adequate for assessment purposes.

4.3.5.2 Length compositions

Length composition data are available for the longliners and gillnetters in the Norwegian Reference fleet Figure 4.3.3 shows the length distribution of ling in Areas I and II for the period 2001 to 2014. The median length in Area I has varied slightly, while the length in Area IIa has been very stable. Length compositions from the Russian fisheries investigations are given in Aleksandrov and Vinnichenko, WD, 2015.

The relation between weight and length is shown in Figure 4.3.4, and the length distribution based on data from the Norwegian Reference fleet is in Figure 4.3.5.

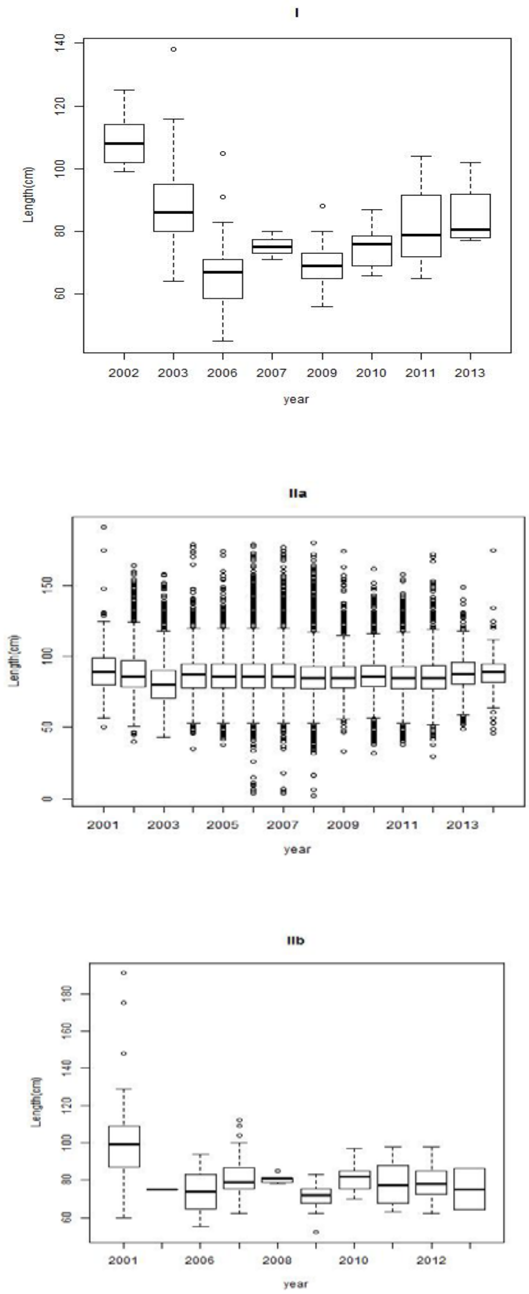

Figure 4.3.3. Plots of the length distributions of ling in Areas I, IIa and IIb for the period 2001 to 2014.

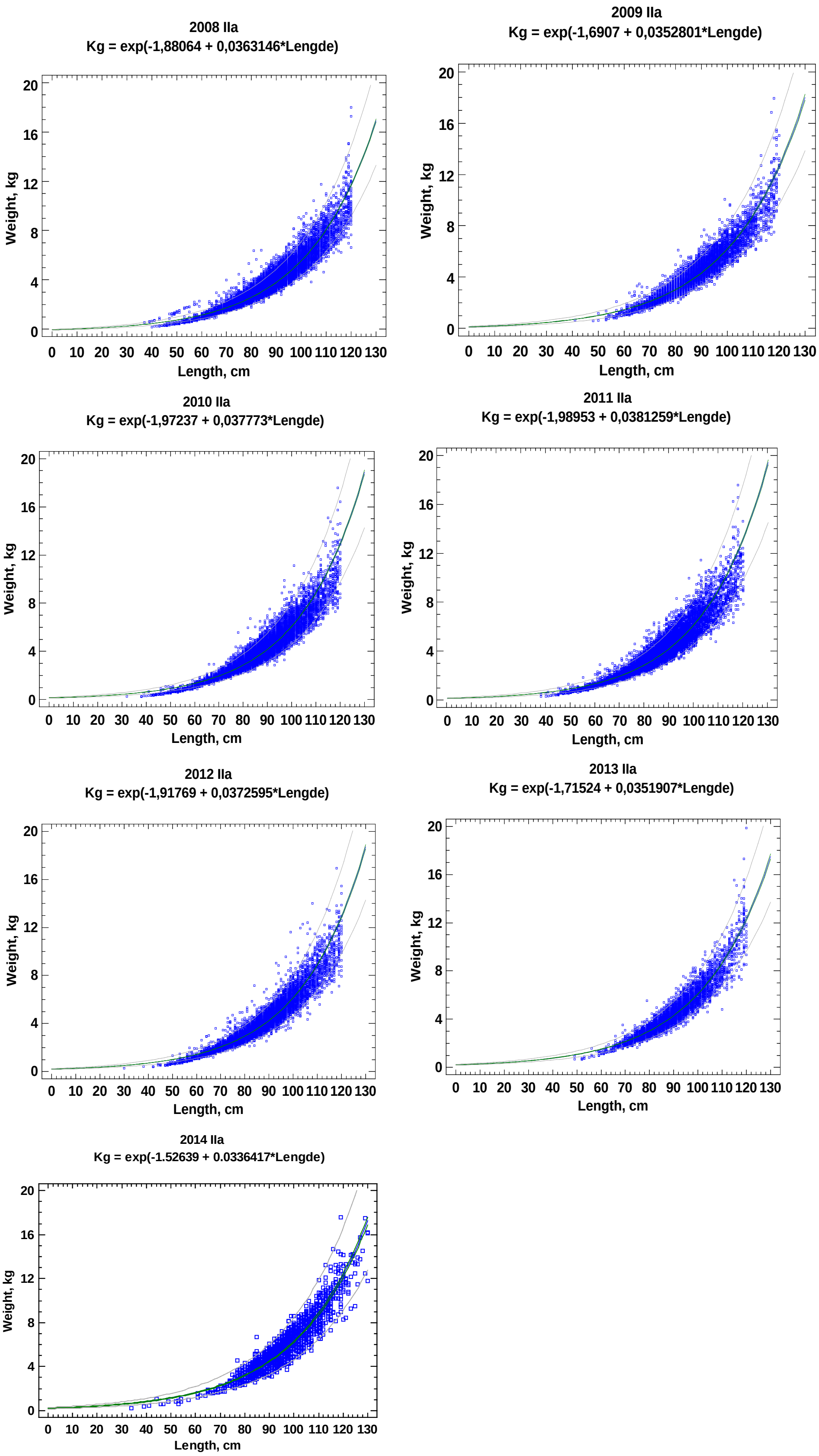

Figure 4.3.4. Weight–length relationship for the period 2008–2014. Data were collected by the Norwegian Reference Fleet.

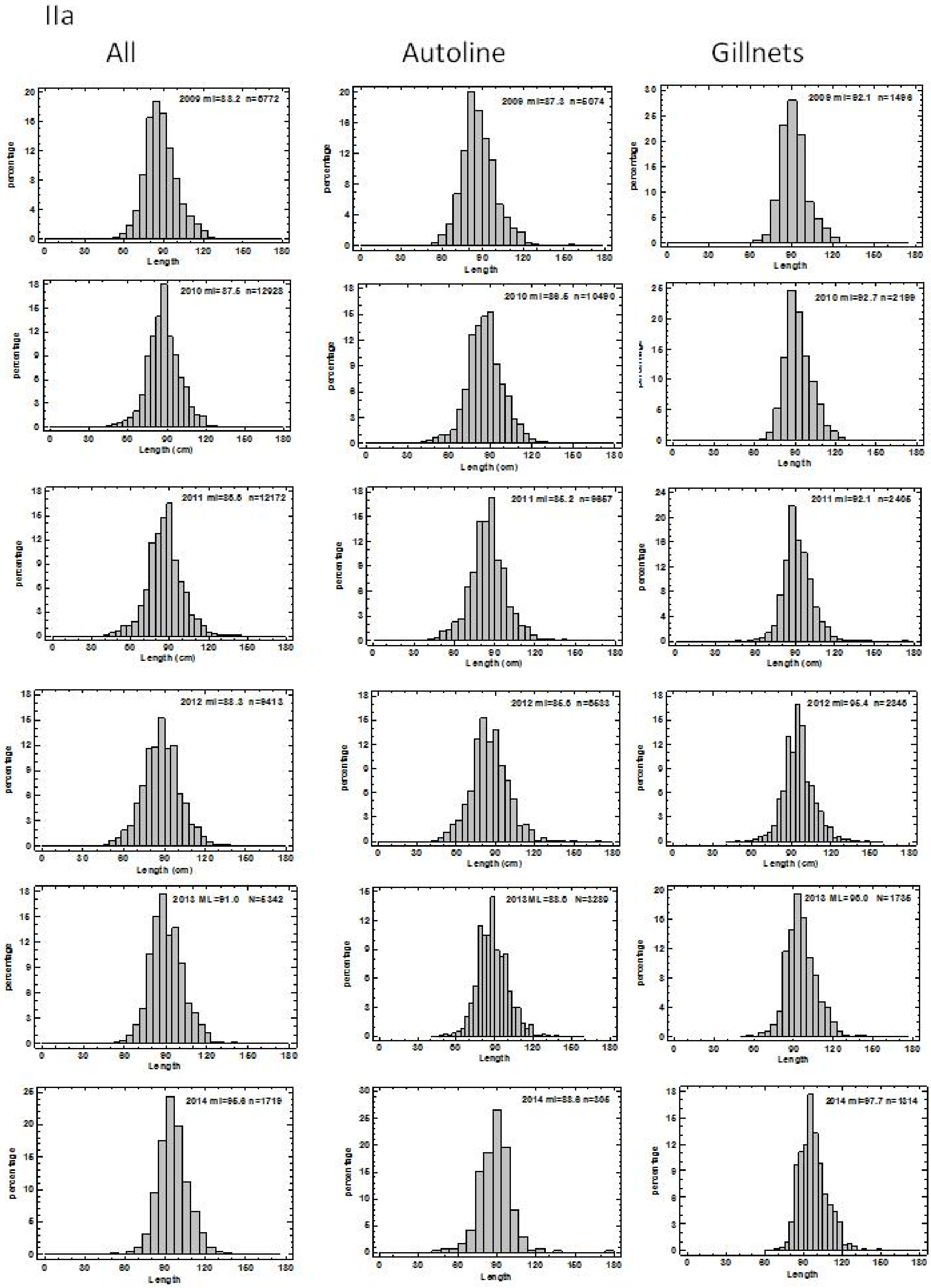

Figure. 4.3.5. The length composition of catches, taken by longliners and gillnetters during the period 2009–2014.

4.3.5.3 Age compositions

The estimated age distribution of the catch in the ling caught in the longline and in the gillnet fishery for the time period 2009–2013 is shown in Figure 4.3.6.

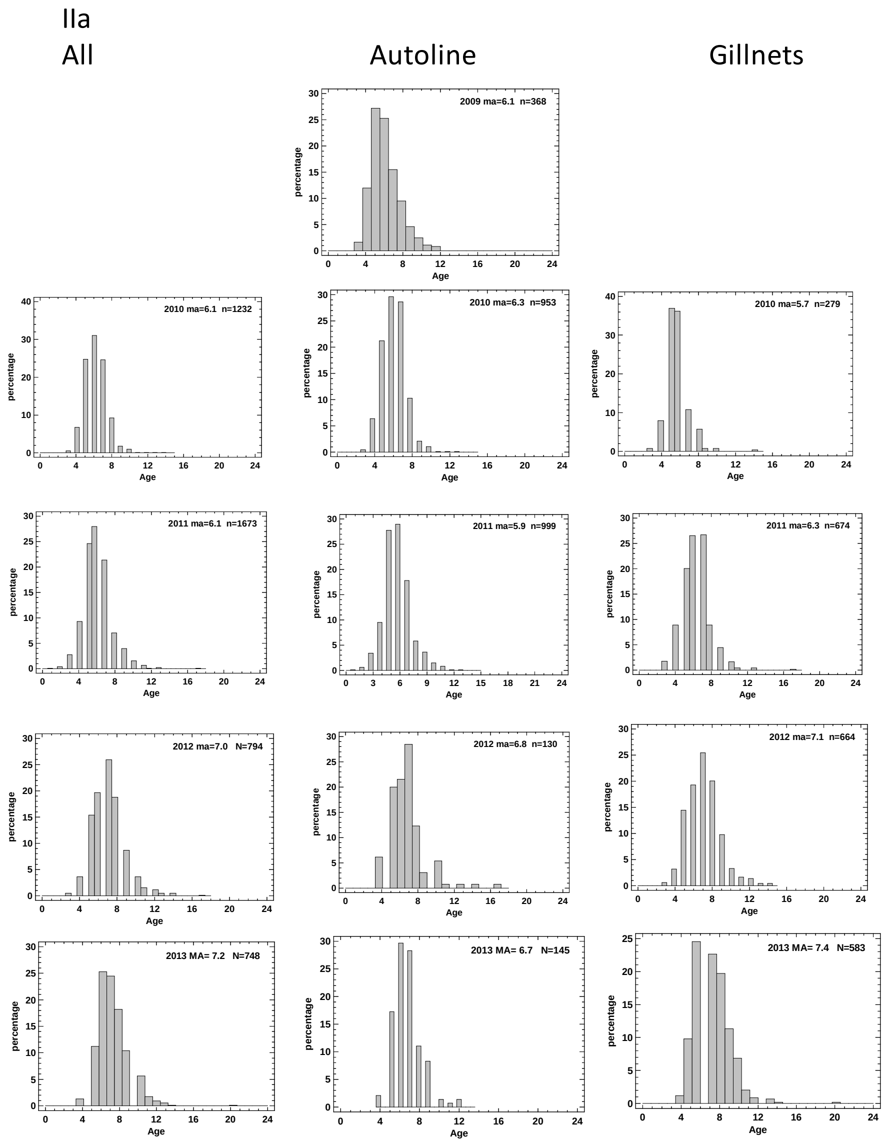

Figure 4.3.6. Age composition of the fish, taken by longliners and gillnetters during the period 2009–2013.

4.3.5.4 Length and weight-at-age

Figure 4.3.7 gives the average mean length and mean weight-at-age for the years 2009–2013.

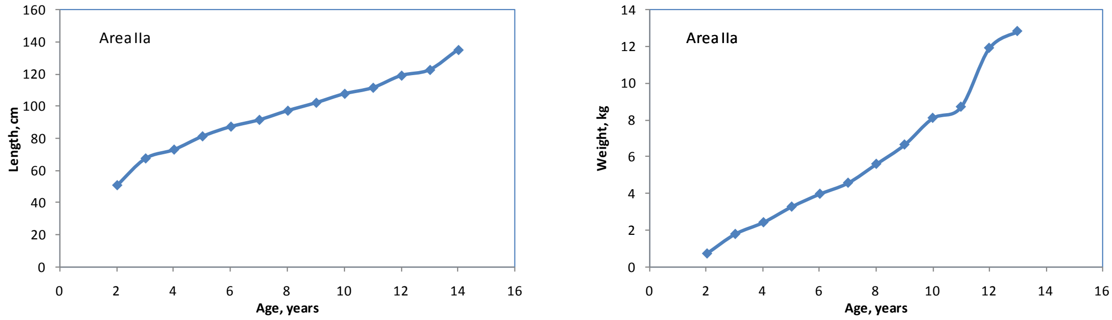

Figure. 4.3.7. Average mean length and mean weight-at-age for the period 2009–2013.

4.3.5.5 Maturity and natural mortality

No new data were presented.

4.3.5.6 Catch, effort and research vessel data

A standardized cpue series for 2000–2014 for Norwegian longliners is in Figure 4.3.8. The series was based on all data available and a subset of data for the days when ling was targeted (made up more than 30% of the total catch by weight). No research vessel data are available.

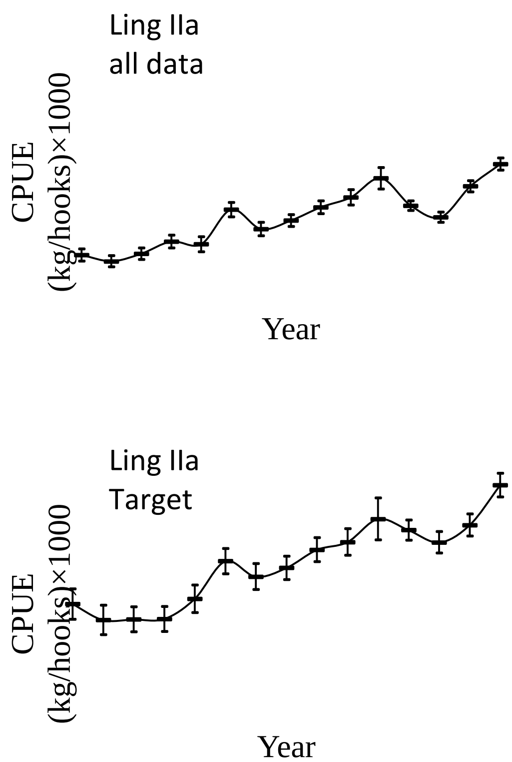

Figure4.3.8. Ling in IIa. Estimates of cpue (kg/1000 hooks) based on all available data and on catches when ling was considered the target species 2000–2014. The bars denote the 95% confidence intervals. The data are from skipper's logbooks.

4.3.6 Data analyses

Length distribution

Figures 4.3.3 and 4.3.5 show plots of the length distributions in Areas I and II for the period 2001 to 2014. It appears that the mean length in Area I has varied slightly, while the mean length in Area IIa and IIb has been very stable. The average length is slightly higher in the gillnet fishery than in the longline fishery.

Cpue

No analytical assessments were possible due to lack of age-structured data and/or tuning series.

Graphs of two standardized GLM-based cpue series estimated from all data and from a subset of the data for which ling made up more than 30% of the catches are shown in Figure 4.3.8. The cpue series starting in 2000 shows an upward trend for the entire period. No further analyses were carried out. The method is described in Helle *et al.*, 2015.

Biological reference points

Estimates of L_{MAX} and AFC were identified and made available to WKLIFE.

4.3.7 Comments on the assessment data analyses

The two new standardized cpue series based on all data and when ling was targeted show a stable and positive trend. The trends are similar to the previous cpue series based on a super-population model presented in 2012.

4.3.8 Management considerations

Catch levels since 2006 do not appear to have had a detrimental effect on the stock given that the cpue continued to increase steadily. Current catch levels are considered to be appropriate. The size of the longline fleet fishing for ling has decreased because of greater access to quotas for Arcto-Norwegian cod. Since the catches have been stable and the indicator series show an increasing trend it is suggested that the 20% buffer should not be applied.

Table 4.3.1a. Ling Ia and b. WG estimates of landings.

Year	Norway	Iceland	Scotland	Faroes	France	Total
1996	136					136
1997	31					31
1998	123					123
1999	64					64
2000	68	1				69
2001	65	1				66
2002	182		24			206
2003	89					89
2004	323			22		345
2005	107					107
2006	58					58
2007	96					96
2008	55					55
2009	236					236
2010	57					57
2011	129					129
2012	158					158
2013	126					126
2014*	122				1	123

***Preliminary.**

Table 4.3.1b. Ling IIa. WG estimates of landings.

Year	Faroes	France	Germany	Norway	E & W	Scotland	Russia	Ireland	Iceland	Total
1988	3	29	10	6070	4	3				6119
1989	2	19	11	7326	10	-				7368
1990	14	20	17	7549	25	3				7628
1991	17	12	5	7755	4	+				7793
1992	3	9	6	6495	8	+				6521
1993	-	9	13	7032	39	-				7093
1994	101	n/a	9	6169	30	-				6309
1995	14	6	8	5921	3	2				5954
1996	0	2	17	6059	2	3				6083
1997	0	15	7	5343	6	2				5373
1998		13	6	9049	3	1				9072
1999		12	7	7557	2	4				7581
2000		9	39	5836	5	2				5891
2001	6	9	34	4805	1	3				4858
2002	1	4	21	6886	1	4				6917
2003	7	3	43	6001		8				6062
2004	15	0	3	6114		1	5			6138
2005	6	5	6	6085	2		2			6106
2006	9	8	6	8685	6	1	11			8726
2007	18	6	7	9970	1	0	55	1		10 058
2008	22	4	7	11 040	1	1	29	0		11 104
2009	10	2	7	8189	0	19	17			8244
2010	10	0	18	10 318	0	2	47			10 395
2011	4	6	6	9763			19			**9798**
2012	21	6	9	8334		7	45		3	**8425**
2013	7	9	7	8677		1	114		4	**8819**
2014*	3	13	3	9243			73			**9335**

***Preliminary.**

Table 4.3.1c. Ling IIb. WG estimates of landings.

Year	Norway	E & W	Faroes	France	Total
1988		7			7
1989		-			
1990		-			
1991		-			
1992		-			
1993		-			
1994		13			13
1995		-			
1996	127	-			127
1997	5	-			5
1998	5	+			5
1999	6				6
2000	4	-			4
2001	33	0			33
2002	9	0			9
2003	6	0			6
2004	77				77
2005	93				93
2006	64				64
2007	180		0		180
2008	162	0	0		162
2009	84				84
2010	128				128
2011	164			7	171
2012	266				266
2013	76				76
2014*	96	52			148

***Preliminary.**

Table 4.3.1d. Ling I and II. Total landings by subarea or division.

Year	I	IIa	IIb	All areas
1988		6119	7	6126
1989		7368		7368
1990		7628		7628
1991		7793		7793
1992		6521		6521
1993		7093		7093
1994		6309	13	6322
1995		5954		5954
1996	136	6083	127	6346
1997	31	5373	5	5409
1998	123	9072	5	9200
1999	64	7581	6	7651
2000	69	5891	4	5964
2001	66	4858	33	4957
2002	206	6917	9	7132
2003	89	6062	6	6157
2004	345	6138	77	6560
2005	107	6106	93	6306
2006	58	8726	64	8848
2007	96	10 058	180	10 334
2008	80	11 104	161	11 346
2009	236	8244	84	8564
2010	57	10395	128	10580
2011	129	9798	171	10098
2012	158	8425	266	8849
2013	126	8819	76	9021
2014*	123	9335	148	9606

***Preliminary.**

4.4 Ling (*Molva Molva*) in Division Va

4.4.1 The fishery

The fishery for ling in Va has not changed substantially in recent years. Around 150 longliners annually report catches of ling, around 50 gillnetters around 60 trawlers and ten *Nephrops* boats. Most of ling in Va is caught on longlines and the proportion caught by that gear has increased since 2000 to around 65% in 2009–2011. At the same time the proportion caught by gillnets has decreased from 20–30% in 2000–2001 to 3–8% in 2008–2011. Catches in trawls have varied less and have been at around 20% of Icelandic catches of ling in Va (Table 4.4.1).

Table 4.4.1. Ling in Va. Number of Icelandic boats and catches by fleet segment participating in the ling fishery in Va.

Year	Number of boats			Catches in tonnes				Sum
	Longliners	**Gillnetters**	**Trawlers**	**Longline**	**Gillnet**	**Trawl**	**Others**	
2000	165	88	68	1537	703	729	236	3526
2001	146	114	57	1086	1056	492	223	3174
2002	128	92	56	1277	649	661	248	3111
2003	137	73	54	2207	453	580	336	3840
2004	144	67	68	2011	548	656	506	4000
2005	152	60	72	1948	517	1081	766	4596
2006	167	51	81	3733	634	1242	669	6577
2007	155	59	76	4044	667	1396	492	6889
2008	138	43	78	5002	509	1509	714	7993
2009	141	46	67	6230	747	1540	1096	9867
2010	156	50	68	6531	390	1537	1411	10143
2011	151	58	59	5595	241	1677	1279	9060
2012	156	48	58	7477	264	1398	1551	10952
2013	163	45	57	6781	354	2805	254	10194
2014	128	30	60	10342	673	2722	228	13965

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

Most of the ling caught in Va by Icelandic longliners is caught at depths less than 300 m and by trawlers, less than 500 m (Figure 4.4.1). The main fishing grounds for ling in Va as observed from logbooks are in the south, southwestern and western part of the Icelandic shelf (Figure 4.4.2). The main trend in the spatial distribution of ling catches in Va according to logbook entries is the decreased proportion of catches caught in the southeast and increased catches on the western part of the shelf. Around 40% of ling catches are caught on the southwestern part of the shelf (Figure 4.4.3). In recent years the main fishing pressure has shifted towards shallower waters (Figure 4.4.1).

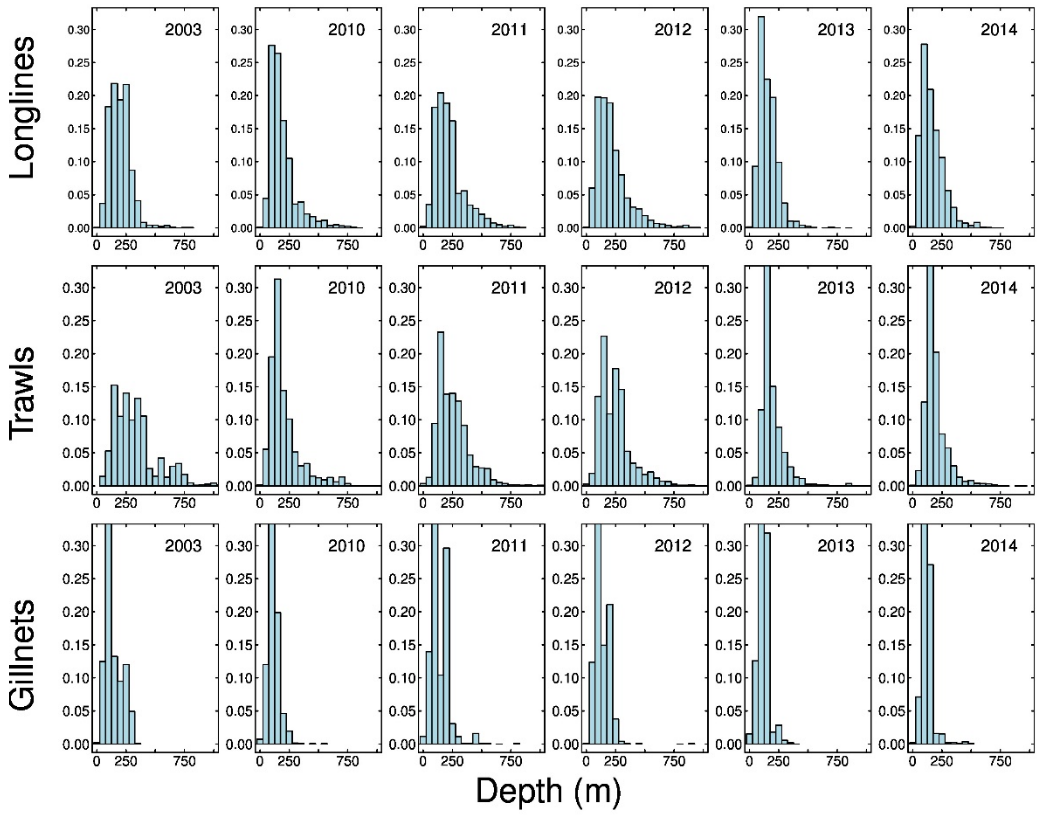

Figure 4.4.1. Ling in Va. Depth distribution of ling catches from longlines, trawls and gillnets from Icelandic logbooks.

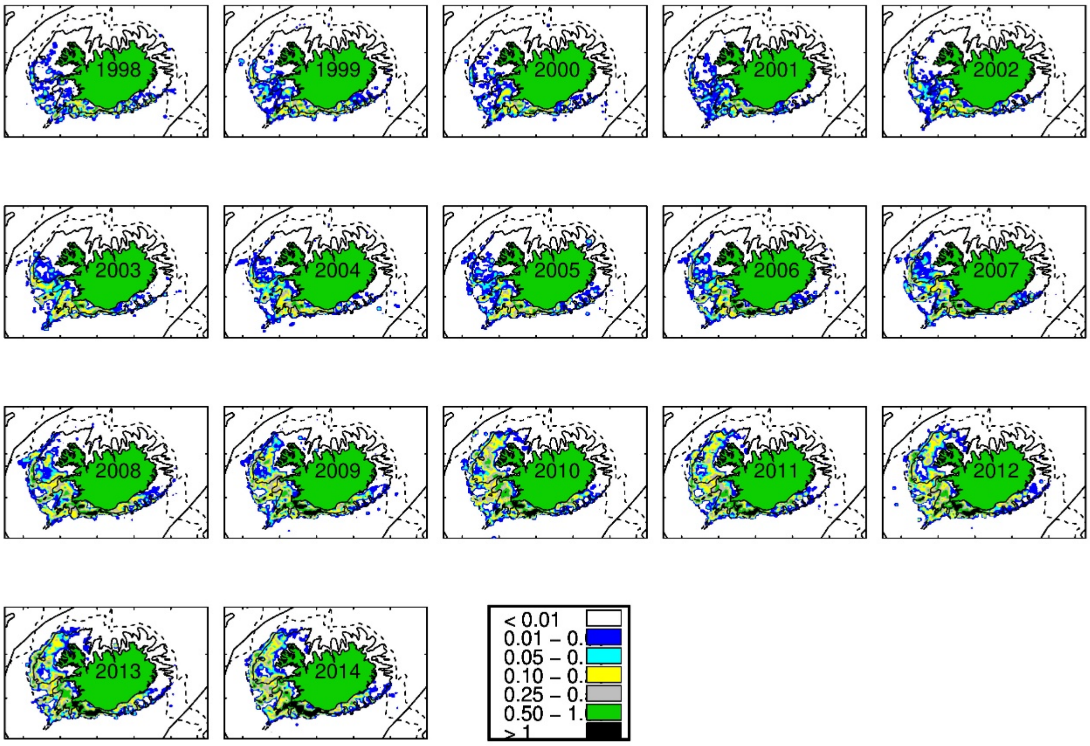

Figure 4.4.2. Ling in Va. Geographical distribution (tonnes/square mile) of the Icelandic ling fishery since 1998 as reported in logbooks by the Icelandic fleet. All gears combined.

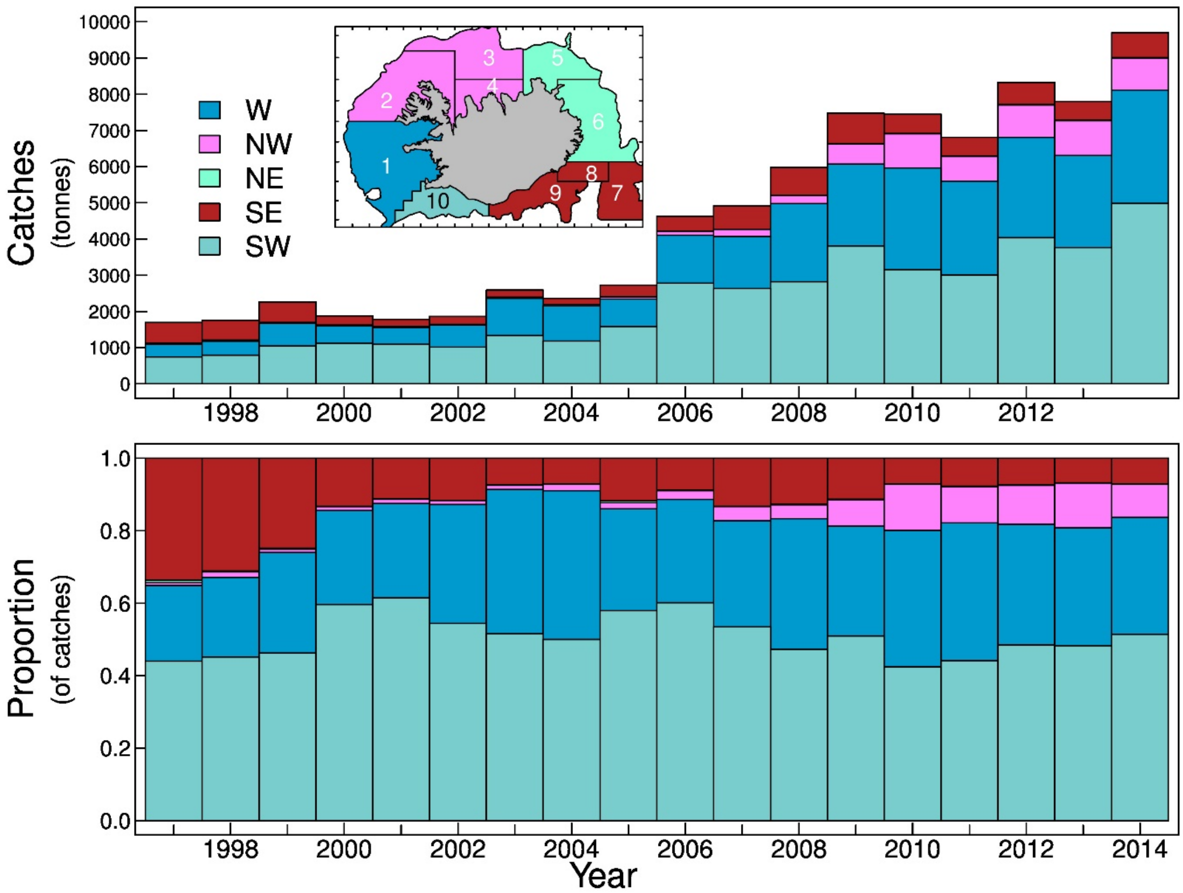

Figure 4.4.3. Ling in Va. Changes in spatial distribution of ling catches as recorded in Icelandic logbooks.

4.4.2 Landings trends

In 1950 to 1971 landings of ling in Va ranged between 7 kt to 15 kt. Landings decreased between 1972 and 2005 to between 3 kt to 7 kt as a result of foreign vessels being excluded from the Icelandic EEZ. In 2001 to 2010 catches increased substantially year on year and reached 11 kt in 2010 and remained at that level until 2014, apart from 2011 catches of 9.6 kt, when the catches increased to 16 kt. This catch level has not been reached since the early seventies. (Table 4.4.6 and Figure 4.4.4).

4.4.3 ICES Advice

The ICES advice for 2014 states: ICES advises on the basis of an MSY approach that catches should be no more than 14 362 t. All catches are assumed to be landed.

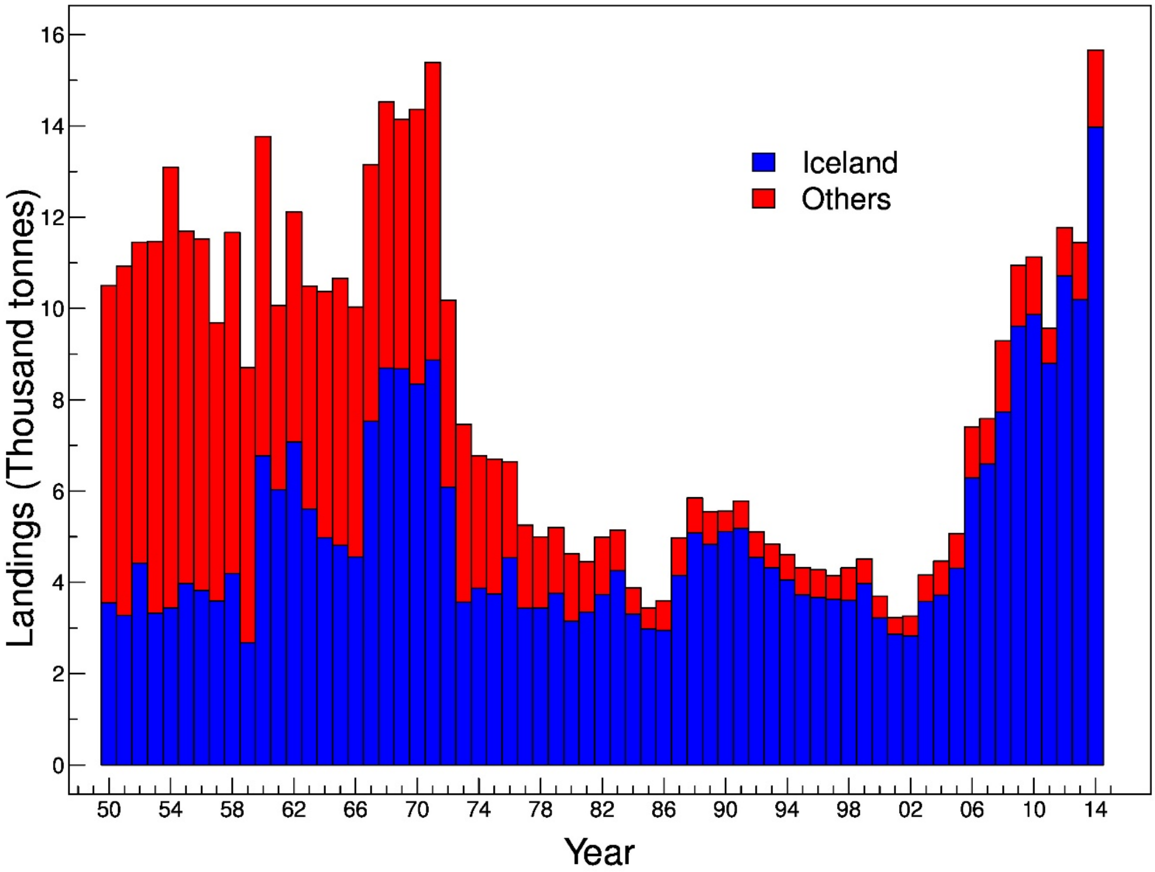

Figure 4.4.4. Ling in Va. Nominal landings.

4.4.4 Management

The Icelandic Ministry of Industries and Innovation (MII) is responsible for management of the Icelandic fisheries and implementation of legislation. The Ministry issues regulations for commercial fishing for each fishing year (1 September–31 August), including an allocation of the TAC for each stock subject to such limitations. Ling in Va has been managed by TAC since the 2001/2002 fishing year.

Landings have exceeded both the advice given by MRI and the set TAC in all fishing years except 2001/2002 (Table 4.4.2). Overshoot in landings in relation to advice/TAC has been decreasing steadily since the 2009/2010 fishing year, with an overshoot of 53% to 35% in 2010/2011, 24% in 2011/2012, 4% in 2012/2013 and 7% in 2013/2014. The reasons for the implementation errors are transfers of quota share between fishing years, conversion of TAC from one species to another and catches by Norway and the Faroe Islands by bilateral agreement. The level of those catches is known in advance but has until recently not been taken into consideration by the Ministry when allocating TAC to Icelandic vessels. There is no minimum landing size for ling in Va.

Table 4.4.3 gives an overview of the composition of the total landings by Icelandic vessels in Va of Ling. In general there is always something left of last year’s quota (column 3 in Table 4.4.3). This indicates that the holders of ling quota do not utilize it fully in these years. However this is normally quite small proportion of the set TAC. In recent years the landings have exceeded the 'available' TAC (columns 6 and 7 in Table 4.4.3). This fishing in excess of the 'available' TAC is then met with converting TAC from other species to ling quota. This is a reversal of the trend at the beginning of the table when considerable proportion of the TAC was either converted to other species or moved to the next Quota year. In the 2011/2012 slightly less was transferred of other species quota for fishing ling (column 8) relative to the few preceding quota years and the two quota years following net transfers were negative, i.e. the quota for ling was changed into other species.

In the fishing years that came after the 2010/2011 fishing year the TAC allocated to Icelandic vessels (column 1 in Table 4.4.3) is lower than the total TAC set by the MII (National TAC column in Table 4.4.2). This is a response by the managers to constrain total catches close to set TAC, i.e. taking into account catches by foreign fleets (see below).

There are agreements between Iceland, Norway and the Faroe Islands relating to a fishery of vessels in restricted areas within the Icelandic EEZ. Faroese vessels are allowed to fish 5600 t of demersal fish species in Icelandic waters which includes maximum 1200 tonnes of cod and 40 t of Atlantic halibut. The rest of the Faroese demersal fishery in Icelandic waters is mainly directed at tusk, ling and blue ling. Further description of the Icelandic management system can be found in the stock annex.

Table 4.4.2. Advice given by MRI, set national TAC by the Ministry of Fisheries and Agriculture and landings by fishing year (1st of September–31st of August). Landings for 2011/2012 are preliminary.

Fishing year	MRI–advice	National–TAC	Landings
1999/2000			3961
2000/2001			3451
2001/2002	3000	3000	2968
2002/2003	3000	3000	3715
2003/2004	3000	3000	4608
2004/2005	4000	4000	5238
2005/2006	4500	5000	6961
2006/2007	5000	5000	7617
2007/2008	6000	7000	8560
2008/2009	6000	7000	10 489
2009/2010	6000	7000	10 713
2010/2011	7500	7500	10 095
2011/2012	8800	9000	11 133
2012/2013	12 000	11 500	12 445
2013/2014	14 000	13 500	14 983
2014/2015	14 300		

Table 4.4.3. Ling in Va.

QUOTA	SET	OTHER	P.Y.	VESSEL	EFF.	LAND.	TAC	SPECIES	TAC	TAC	CONF.	U.TAC
Year	TAC	TAC	TAC	Tr.	TAC		- Land	Tr	left	moved		n.-tr.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2001/2002	3.0	0.007	0.000	0	3.007	2.546	0.460	-0.145	0.315	0.220	0.006	0.101
2002/2003	3.0	0.008	0.220	0	3.228	3.134	0.094	0.188	0.282	0.208	0.004	0.078
2003/2004	3.0	0.008	0.208	0	3.216	3.796	- 0.580	0.838	0.258	0.210	0.002	0.050
2004/2005	4.0	0.007	0.210	0	4.216	4.461	- 0.245	0.576	0.331	0.281	0.005	0.054
2005/2006	5.0	0.010	0.281	0	5.292	5.853	- 0.561	0.902	0.341	0.310	0.007	0.038
2006/2007	5.0	0.012	0.310	0	5.321	6.609	- 1.288	1.961	0.674	0.638	0.005	0.041
2007/2008	7.0	0.021	0.638	0	7.659	6.733	0.925	0.255	1.180	1.044	0.000	0.137
2008/2009	7.0	0.030	1.044	0	8.074	9.178	- 1.104	1.459	0.355	0.359	0.010	0.006
2009/2010	7.0	0.017	0.359	0	7.375	9.616	- 2.241	2.351	0.110	0.105	0.008	0.012
2010/2011	6.0	0.017	0.084	0	6.101	7.355	- 1.254	1.548	0.294	0.296	0.009	0.007
2011/2012	7.2	0.021	0.296	0	7.517	7.981	- 0.464	0.615	0.151	0.142	0.002	0.011
2012/2013	9.2	0.023	0.142	0	9.365	8.793	0.572	0.376	0.196	0.187	0.001	0.01
2013/2014	10.765	0.055	0.187	0	11.007	9.398	1.61	-0.968	0.642	0.628	0	0.014
2014/2015												

(1) TAC for the quota-year set by the Ministry of Fisheries and Agriculture.

(2) TAC by other means such as quota allocated to rural towns.

(3) TAC transferred from previous fishing year.

(4) TAC transferred between ships (should be zero).

(5) Total TAC in effect (the sum of the previous three columns).

(6) Landings during the fishing year.

(7) TAC minus landings.

(8) Nett species TAC transfers. Negative number indicates the TAC of species in question to have been changed to a TAC for another species.

(9) Effective TAC left, taking in all the numbers in previous columns.

(10) TAC transferred to next fishing year.

(11) Catch in excess of TAC, confiscated by the Directorate of Fisheries/Icelandic Coast Guard.

(12) TAC that can not be moved to the next fishing year.

4.4.5 Data available

In general sampling is considered good from commercial catches from the main gears (longlines and trawls). The sampling does seem to cover the spatial distribution of catches for longlines and trawls but less so for gillnets. Similarly sampling does seem to follow the temporal distribution of catches (see WGDEEP 2012).

4.4.5.1 Landings and discards

Landings by Icelandic vessels are given by the Icelandic Directorate of Fisheries. Landings of Norwegian and Faroese vessels are given by the Icelandic Coast Guard. Discarding is banned by law in the Icelandic demersal fishery. Based on limited data, discard rates in the Icelandic longline fishery for ling are estimated very low (<1% in either numbers or weight) (WGDEEP, 2011:WD02). Measures in the management system such as converting quota share from one species to another are used by the fleet to a large extent and this is thought to discourage discarding in mixed fisheries. A description of the management system is given in the area overview.

4.4.5.2 Length compositions

An overview of available length measurements is given in Table 4.4.4. Most of the measurements are from longlines. The number of available length measurements has been increasing in recent years in line with increased landings. Length distributions from the Icelandic longline and trawling fleet are presented in Figure 4.4.5.

Table 4.4.4. Ling in Va. Number of available length measurements from Icelandic commercial catches.

Year	Longlines	Gillnets	D. Seine	Trawls	Sum
2000	1624	566	0	383	2573
2001	1661	493	0	37	2191
2002	1504	366	0	221	2091
2003	2404	300	0	280	2984
2004	2640	348	46	141	3175
2005	2323	31	101	499	2954
2006	3354	645	0	1558	5557
2007	3661	0	76	400	4137
2008	5847	357	15	969	7188
2009	9014	410	0	966	10 390
2010	7322	57	0	2345	9724
2011	7248	0	150	1995	9393
2012	12 770	85	150	2748	15 753
2013	10 771	267	122	2337	13 497
2014	6448	1286	120	5053	13 610

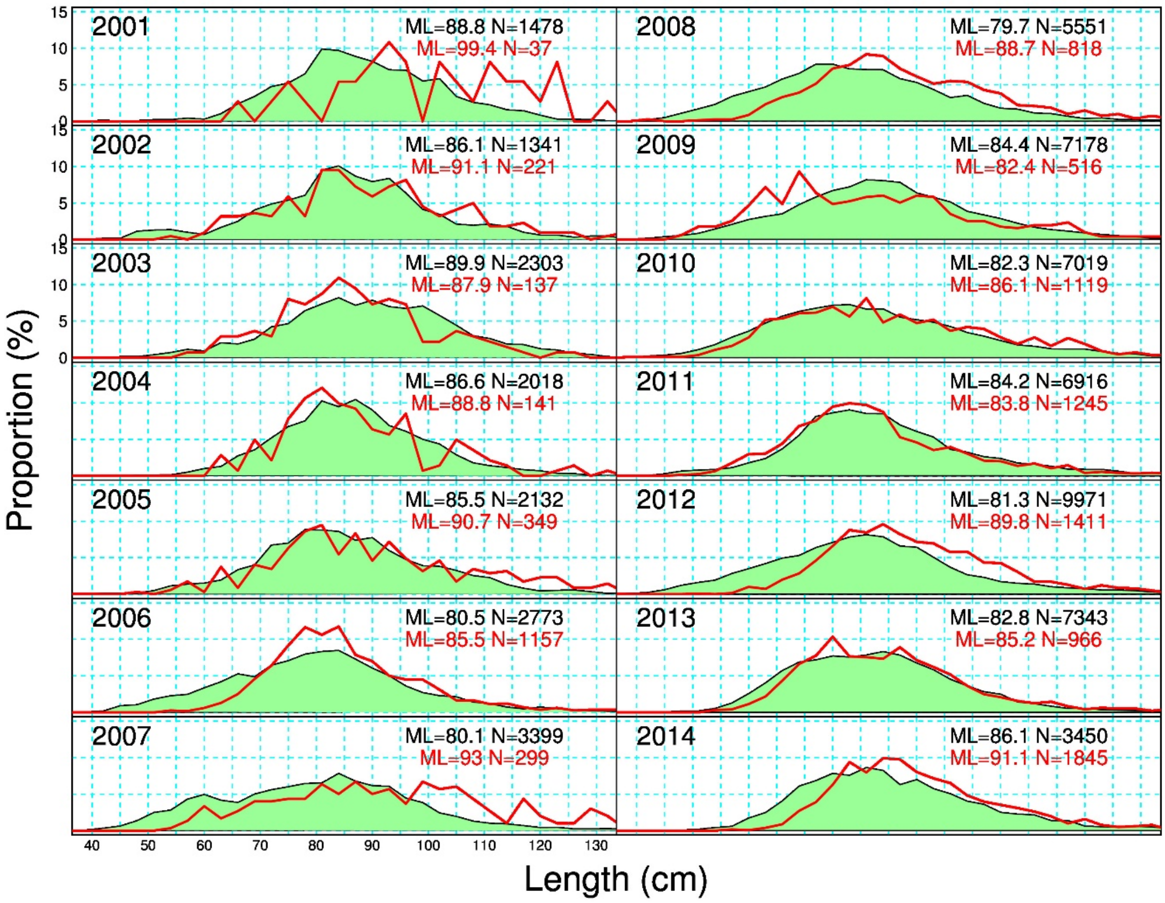

Figure 4.4.5. Ling in Va. Length distributions from the Icelandic longline fleet (light green area) and trawls (red lines).

4.4.5.3 Age compositions

A limited number of otoliths collected in 2010 were aged and a considerable difference in growth rates was observed between the older data and the 2010 data (WGDEEP, 2011:WD07). Substantial progress has been made since 2010. Now aged otoliths are available from the 2000 onwards (Table 4.4.5). Most of the ling caught in the Icelandic spring survey is between age 5 and 8 but from longlines the age is between 6 to 9 (Figure 4.4.6).

Table. 4.4.5. Ling in Va. Number of available aged otoliths from the commercial catches.

Year	Longlines	Gillnets	D. Seine	Trawls	Total
2000	650	200	0	150	1000
2001	550	193	0	37	780
2002	519	166	0	150	835
2003	900	100	0	150	1150
2004	750	100	46	100	996
2005	750	0	0	231	981
2006	1137	288	0	550	1975
2007	1300	0	50	100	1450
2008	1950	150	0	365	2465
2009	2550	150	0	400	3100
2010	2498	50	0	850	3398
2011	2546	0	50	700	3296
2012	4031	50	50	941	5072
2013	2863	100	50	800	3813
2014	665	225	20	913	1823

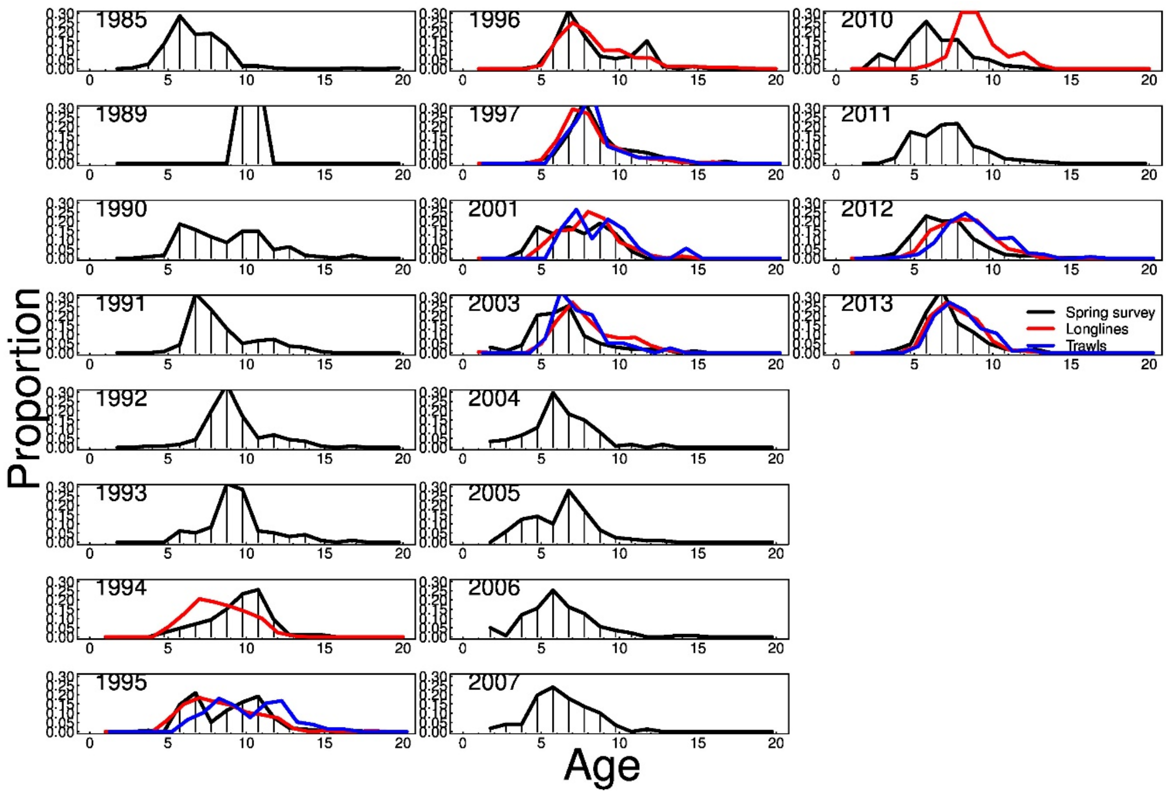

Figure 4.4.6. Ling in Va. Age distribution of ling in the Icelandic spring survey and commercial catches (raw data).

4.4.5.4 Weight-at-age

No data available.

4.4.5.5 Maturity and natural mortality

No new data available (See stock annex for current estimates).

No information is available on natural mortality of ling in Va, set to 0.15 in the analytical assessment.

4.4.5.6 Catch, effort and research vessel data

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

Figure 4.4.7 shows nominal catch per unit of effort (cpue) and effort in the Icelandic longline fishery. Cpue is calculated using all logbook data where catches of the species were registered, with no standardization attempted. The cpue estimates of ling in Va have not been considered representative of stock abundance.

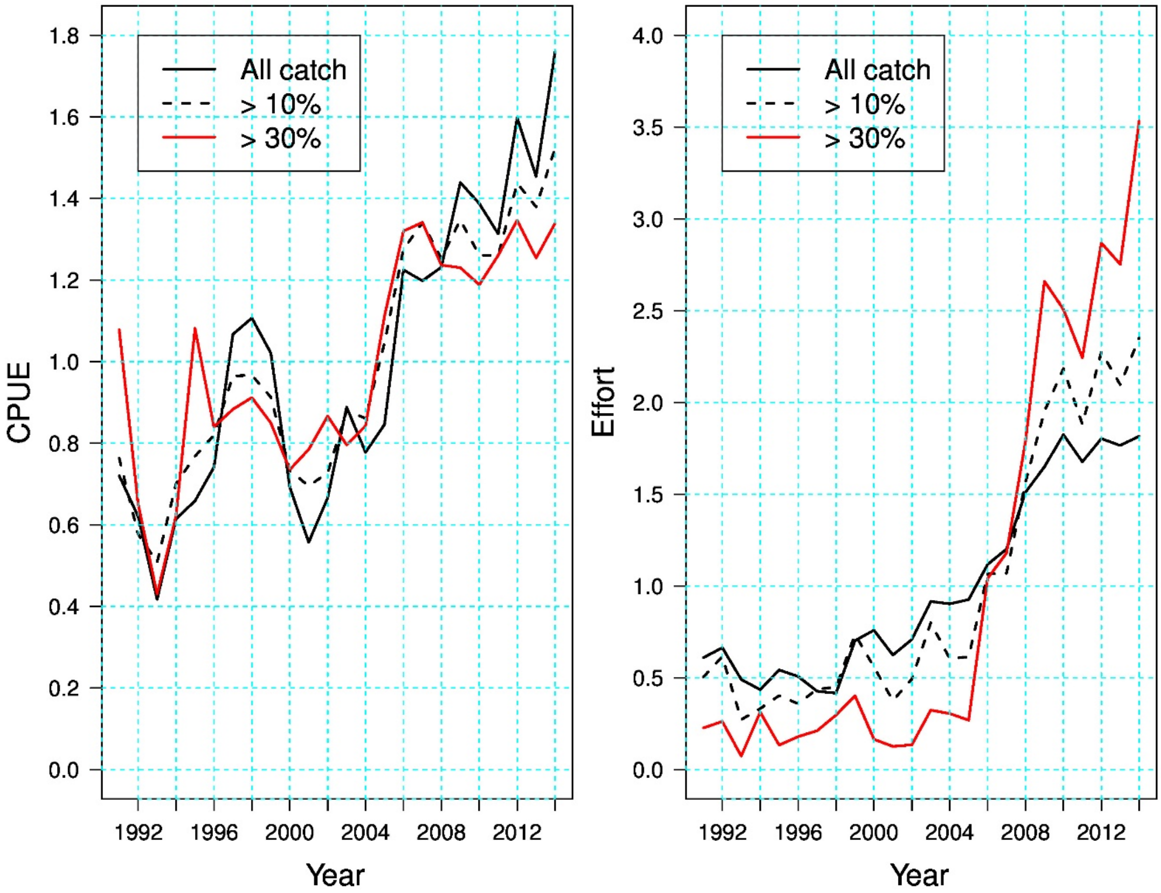

Figure 4.4.7. Ling in Va. Index of raw cpue (sum(yield)/sum(effort)) and effort (number of hooks) of ling from the Icelandic longline fishery based on logbooks 1991–2013. The criteria for the calculations were all sets where ling was reported in the logbooks and where ling composed at least 10% and 30% of the total catch in each set.

Icelandic survey data

Indices: The Icelandic spring groundfish survey, which has been conducted annually in March since 1985, covers the most important distribution area of the ling fishery. In addition, the autumn survey was commenced in 1996 and expanded in 2000 however a full autumn survey was not conducted in 2011 and therefore the results for

2011 are not presented. A detailed description of the Icelandic spring and autumn ground-fish surveys is given in the stock annex.

Figure 4.4.8 shows both a recruitment index and the trends in biomass from both surveys. Length distributions from the spring survey are shown in Figure 4.4.9 (abundance) and changes in spatial distribution the spring survey are presented in Figure 4.4.10.

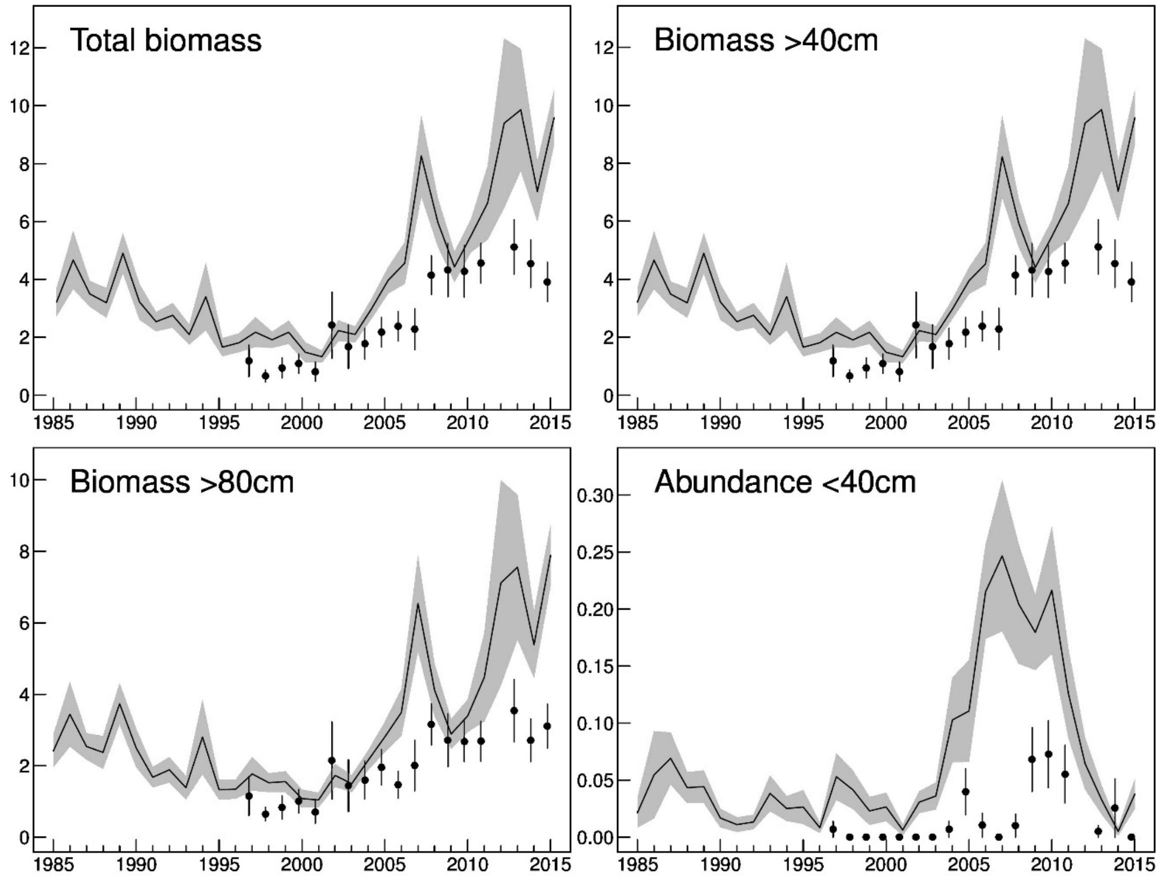

Figure 4.4.8. Ling in Va. Shown are a) Total biomass indices, b) biomass indices larger than 40 cm, c) biomass indices larger than 80 cm and d) abundance indices smaller than 40 cm. The lines with shades show the spring survey index from 1985 and the points with the vertical lines show the autumn survey from 1997. The shades and vertical lines indicate +/- standard error.

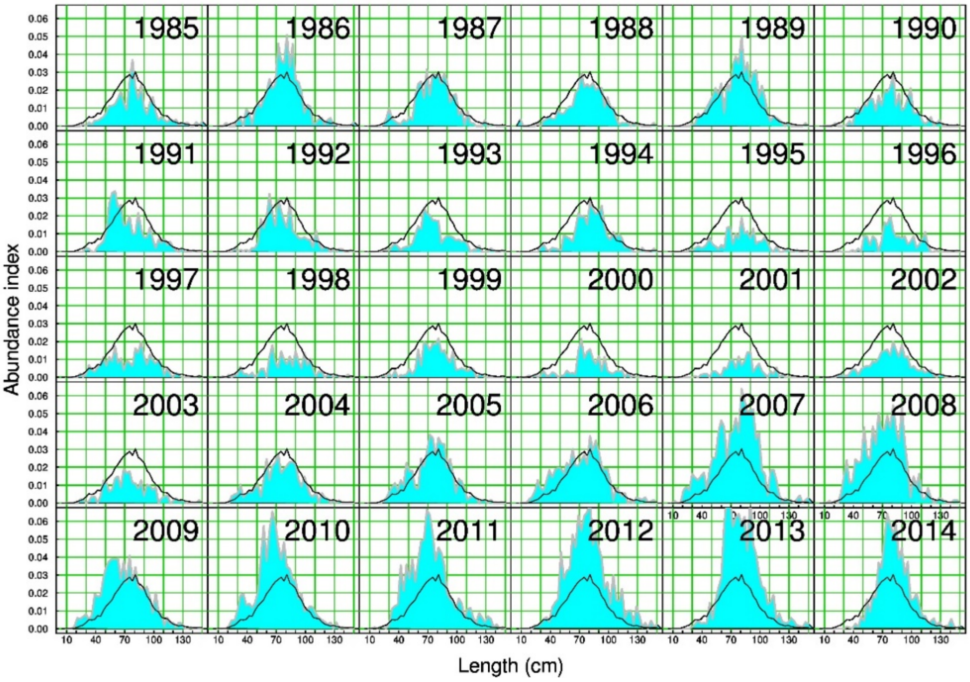

Figure 4.4.9. Ling in Va. Abundance indices by length (3 cm grouping) from the spring survey since 1985. Black line is the average over the whole period.

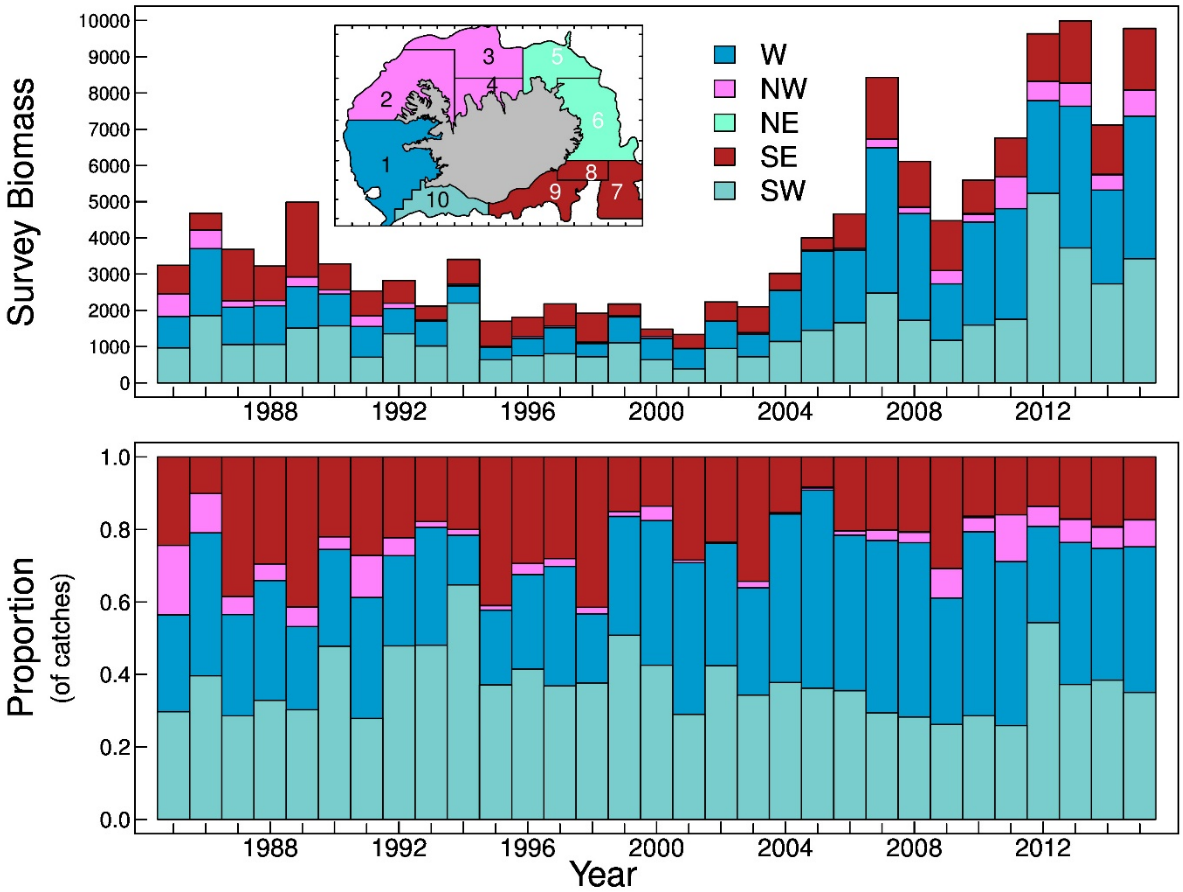

Figure 4.4.10. Ling in Va. Estimated survey biomass in the spring survey by year from different parts of the continental shelf (upper figure) and as proportions of the total (lower figure).

4.4.6 Data analyses

There have been no marked changes in the number of boats participating in the ling fishery in Va. Catches have increased by around 2 kt between 2011 and 2012 mainly because of an increase in the Icelandic catches. Most of ling catches are taken at depths less than 250 meters however in recent years there has been an increase in the proportion in deeper waters by longliners (Figure 4.4.1). This is most likely the result of increased targeting of blue ling in deeper waters by the longline fleet. Spatial distribution of catches has been similar since 2000 with around 80% of catches caught on the western and southwestern part of the shelf (Figures 4.4.2 and 4.4.3).

Sampling from commercial catches of ling is considered good; both in terms of spatial and temporal distribution of samples in relation to landings (WGDEEP 2012). Mean length as observed in length samples from longliners decreased from 2000 to 2008 from around 91 cm to 80 cm (Figure 4.4.5). This may be the result of increased recruitment in recent years rather than increased fishing effort. However mean length increased slightly in 2009 to 2011 to around 83–84 cm but has again reached around 80 cm in 2012. It is premature to draw conclusions from the limited age-structured data. It can only be stated that most of the ling caught in the Icelandic spring survey is between age 5 and 8; but from longlines the age is between the ages of 6 to 9 (Figure 4.4.6).

The cpue estimates of ling in Va have not been considered representative of stock abundance, however they do show the same trend as the survey data. Ling commercial cpue has been relatively stable over the time period since 2006 (Figure 4.4.6).

Ling in both in the spring and autumn surveys are mainly found in the deeper waters south and west off Iceland. Both the total biomass index and the index of the fishable biomass (>40 cm) in the March survey gradually decreased until 1995 (Figure 4.4.8). In the years 1995 to 2003 these indices were half of the mean from 1985–1989. In 2003 to 2007, the indices increased sharply and to their then highest observed value in 2007 or about two times higher than that observed in the late 1980s. The indices then fell sharply again in 2008 and 2009 to a similar level as in the late 1980s. In 2010 to 2013 the indices increased again to similar levels in 2012 as observed in 2007 but decreased sharply again in 2014. The index of the large ling (90 cm and larger) shows similar trend as the total biomass index (Figure 4.4.8). The recruitment index of ling, defined here as ling smaller than 40 cm, also showed a similar increase in 2003 to 2007 and but then decreased by around 25% and remained at that level until 2010. For the last two years the index has fallen by a factor of three from its level in 2010 and is currently below the level observed before 2004, although slight indications of an increase were observed in the 2015 survey (Figure 4.4.8). In the WGDEEP-2010 report it was suggested that the consistently high indices (overall length groups) in the spring survey in 2007 might have been an outlier because of unexplained changes in catchability rather than actual change in stock size. However given another high value in the biomass index it is possible that there may be considerable interannual changes in the catchability rather than in the biomass of the stock. However it is noted that recruitment has been high in recent years and these year classes may contribute to the increase in biomass indices.

The shorter autumn survey shows that biomass indices were low from 1996 to 2000, but have increased since then (Figures 4.4.8). There is a consistency between the two survey series; the autumn survey biomass indices are however derived from substantially fewer ling caught. Also there is an inconsistency in the recruitment indices (<40 cm), where the autumn survey show much lower recruitment, in absolute terms compared with the spring survey (Figure 4.4.8). This discrepancy is likely a result of much lower catchability of small ling (due to different gears) in the autumn survey, where ling less than 40 cm has rarely been caught. No marked changes are observed between the 2010 and 2012 autumn survey in terms of total biomass. Length distributions from the spring survey show that the ling caught in the spring survey in 2012 is on average larger than usually observed in the survey (Figure 4.4.9).

Changes in spatial distribution as observed in surveys: According to the spring survey most of the increase in recent years in ling abundance is in the western area, but an increase can be seen in most areas (Figure 4.4.10). However most of the index in terms of biomass comes from the southwestern area or around 50% compared to around 30% between 2003 and 2011. A similar pattern is observed in the autumn survey.

Analytical assessment on Ling using Gadget

In 2014 a model of Ling in Va developed in the Gadget framework (see http://www.hafro.is/gadget for further details) was benchmarked for the use in assessment. The relevant reference points were developed using a specialised bootstrap (see stock annex for further details).

Data used and model settings

Data used for tuning are given in the stock annex.

Model settings used in the Gadget model for ling in Va are described in more detail in the stock annex.

Diagnostics

Likelihood components and their respective weights

In a typical Gadget model parameters are estimated using a weighted negative log-likelihood. The weights are assigned using an iterative reweighting procedure, described in detail in the stock annex. In the procedure each likelihood component is emphasized in turn in order to achieve the "best" fit to a particular dataset. The weights assigned to each component are based on this best fit for each of the components. Table 4.4.6 shows the various likelihood component scores in relation to the final score and, when a likelihood score is emphasized, to other components. This table should give an indication of potential data conflicts. There is little indication of major conflicts however some differences are noteworthy. The recruitment likelihood component (si2049) appears to be downweighted, indicating that other data sources, such as age data, adjust the recruitment. Data arising from longline fleets appear to have some conflicts when other data sources are emphasized however this appears not to have an effect in the final estimate.

An additional overview of the model fit is illustrated in Figure 4.410b where the likelihood component scores are tracked through the model time. Slight variation is observed in the model fit by component. For instance for the length distribution from the survey the score seems to increase for the last few years. This increase may be explained by the higher abundance ling in the spring survey in these years.

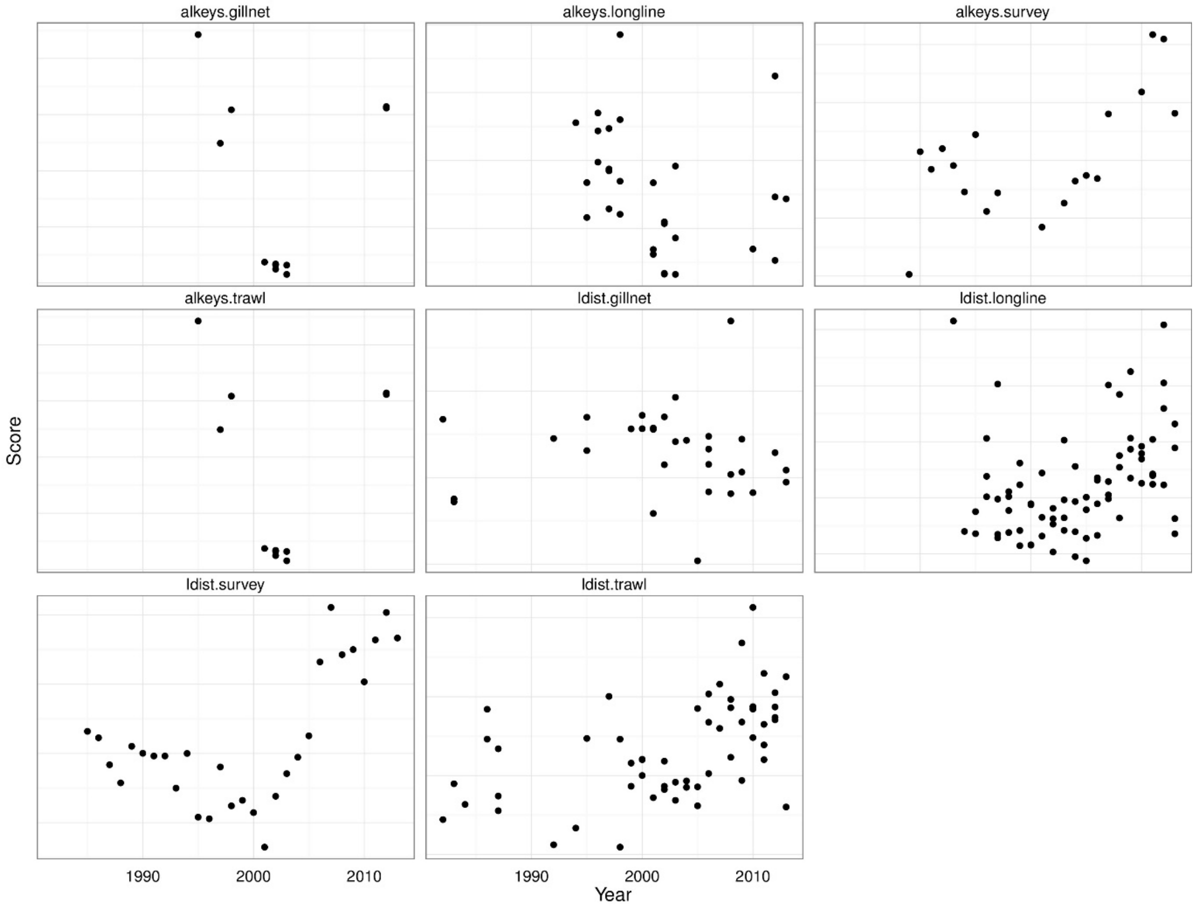

Figure 4.4.10b. Ling in Va. Overview of the likelihood component scores by year from the Gadget model for Ling in Va. The panels indicate the likelihood component.

Table 4.4.6. Ling in Va. Likelihood component scores from the Gadget model of ling in Va. The rows indicate the likelihood component groups emphasized while the columns the scores from a particular component. The bottom line gives the scores of each component in the final optimisation run.

Component	alkeys gillnet	alkeys longline	alkeys survey	alkeys trawl	ldist gillnet	ldist longline	ldist survey	ldist trawl	si2049	si5069	si70180
Survey indices	1.685	15.000	11.530	2.370	18.260	191.700	31.660	28.430	2578	6784	14 720
Survey data	1.718	10.550	7.790	1.718	17.380	311.400	12.800	44.930	9742	21 140	55 190
longline data	1.699	10.020	8.570	1.699	20.550	42.650	12.840	41.550	9901	26 100	45 780
Other commercial data	1.191	10.260	8.738	1.639	10.560	104.700	13.280	14.680	13 750	28 670	54 950
Final run	1.707	10.190	8.250	1.707	8.049	41.930	12.580	14.630	9528	14 300	17 260

Observed and predicted proportions by fleet

Overall fit to the predicted proportional length and age–length distributions is close to the observed distributions. (Figures 4.4.11 to 4.4.18). In the initial years of the spring the observed length proportions appear have greater noise in, however as the number of samples caught the noise level decreases. Similarly for gears where only a small portion of the ling catch is caught, such as the gillnets, the overall noise is greater than for those gears with greater number of samples.

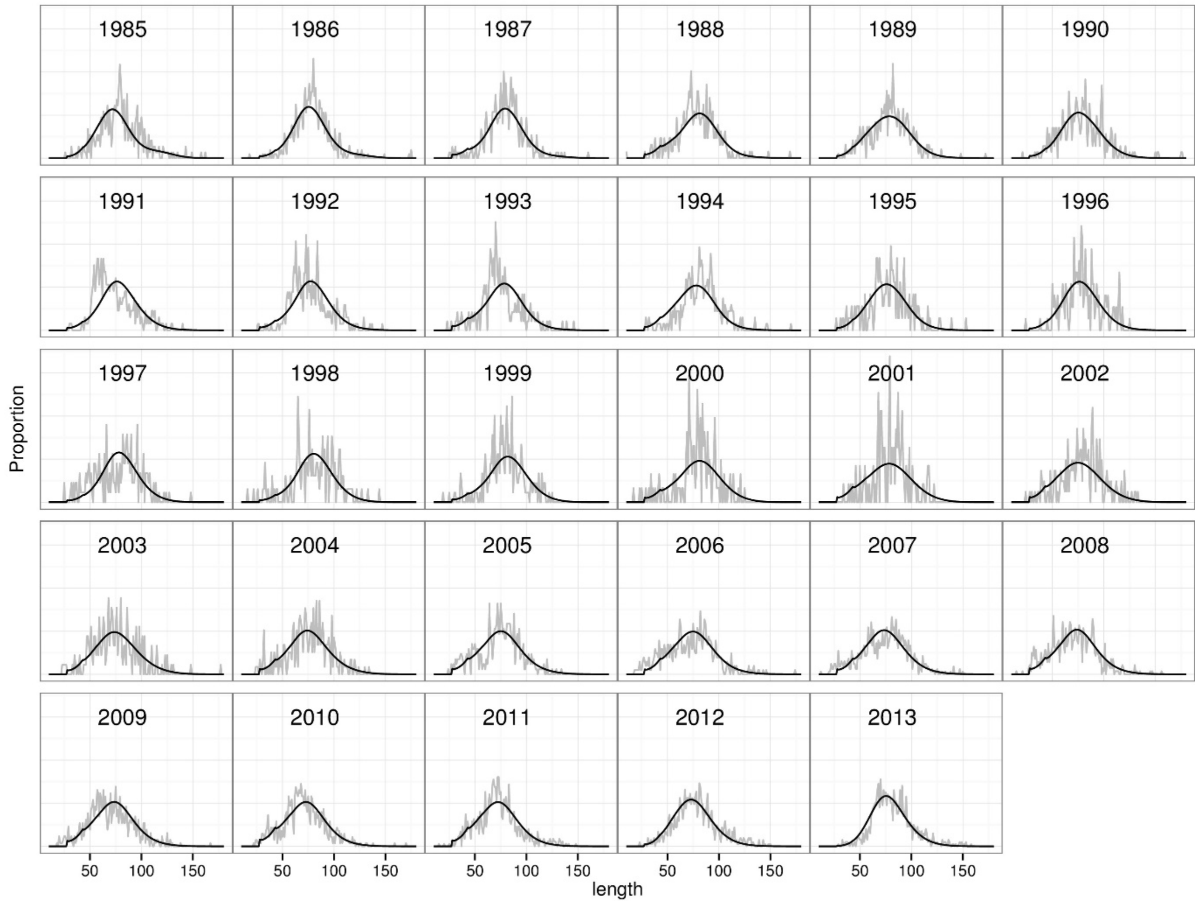

Figure 4.4.11. Ling in Va. Fitted proportions-at-length from the Gadget model (solid lines) compared to observed proportions in the spring survey (grey lines).

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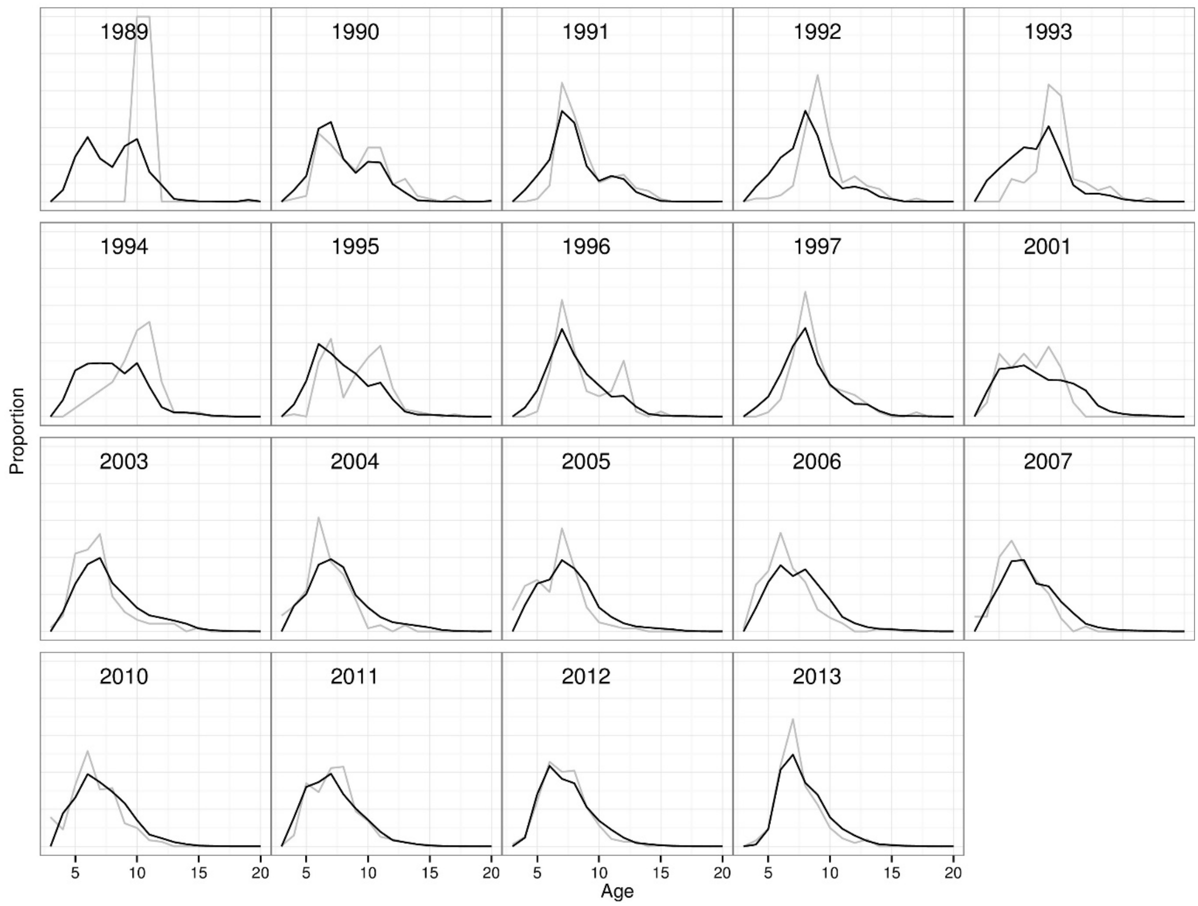

Figure 4.4.12. Ling in Va. Fitted proportions-at-age from the Gadget model (solid lines) compared to observed proportions in the spring survey catches (grey lines).

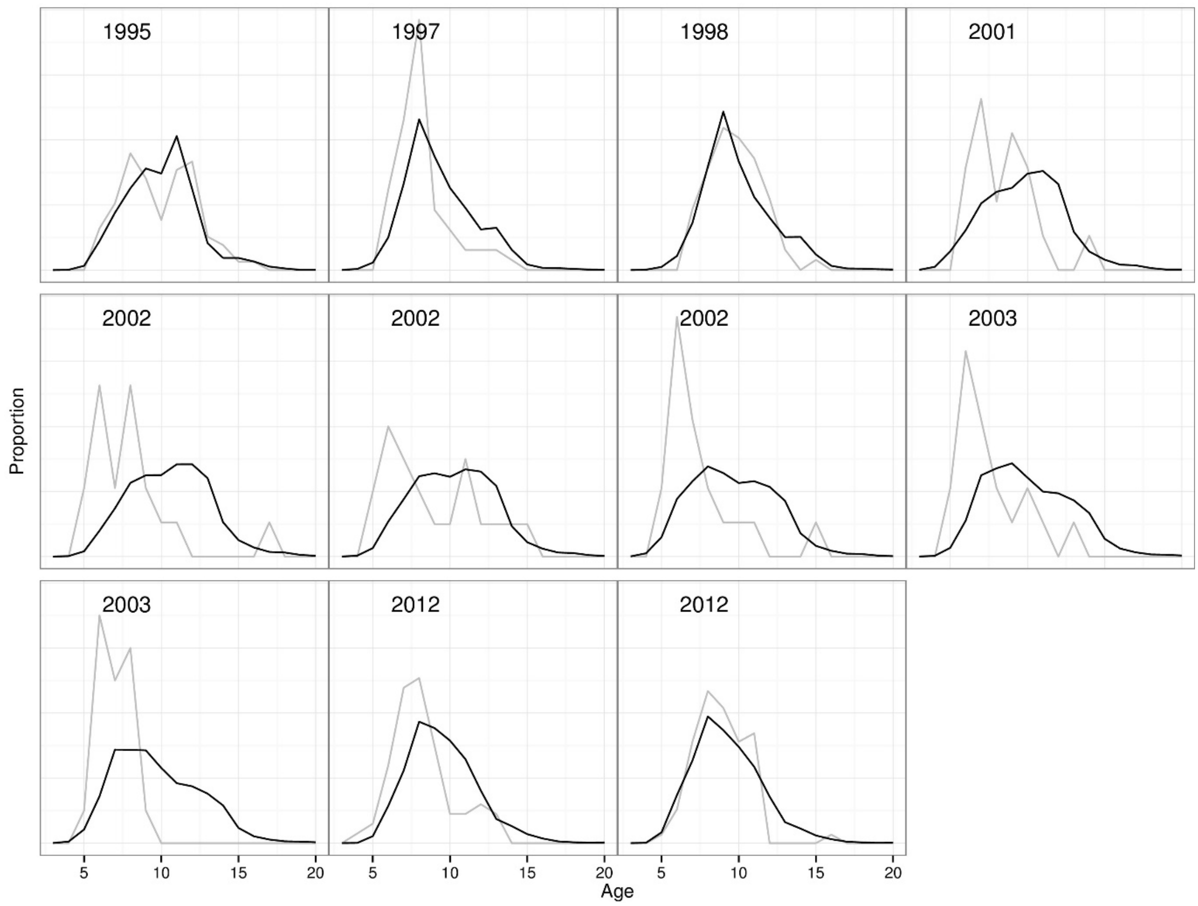

Figure 4.4.13. Ling in Va. Fitted proportions-at-age from the Gadget model (solid lines) compared to observed proportions in gillnet catches (grey lines).

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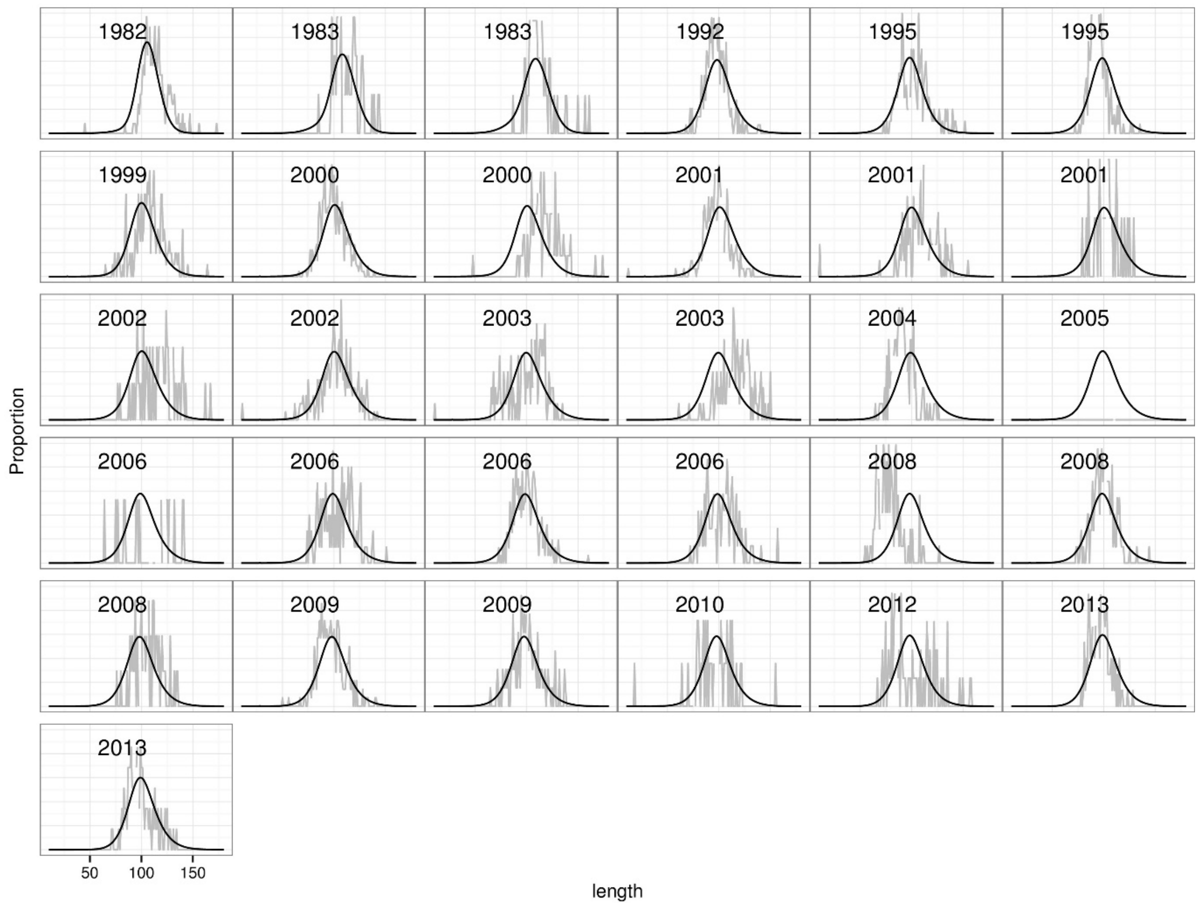

Figure 4.4.14. Ling in Va. Fitted proportions-at-length from the Gadget model (solid lines) compared to observed proportions from gillnet catches (grey dots).

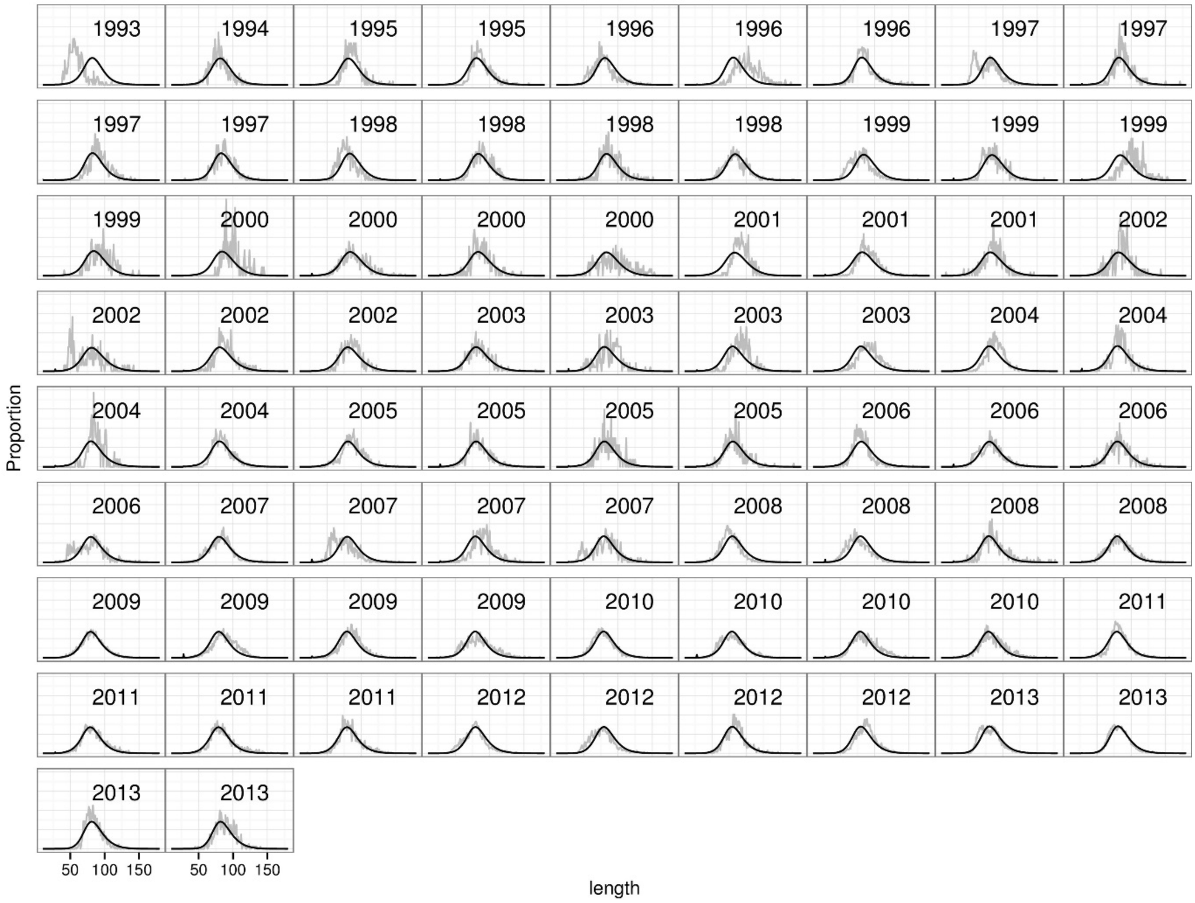

Figure 4.4.15. Ling in Va. Fitted proportions-at-length from the Gadget model (solid lines) compared to observed proportions from longline catches (grey dots).

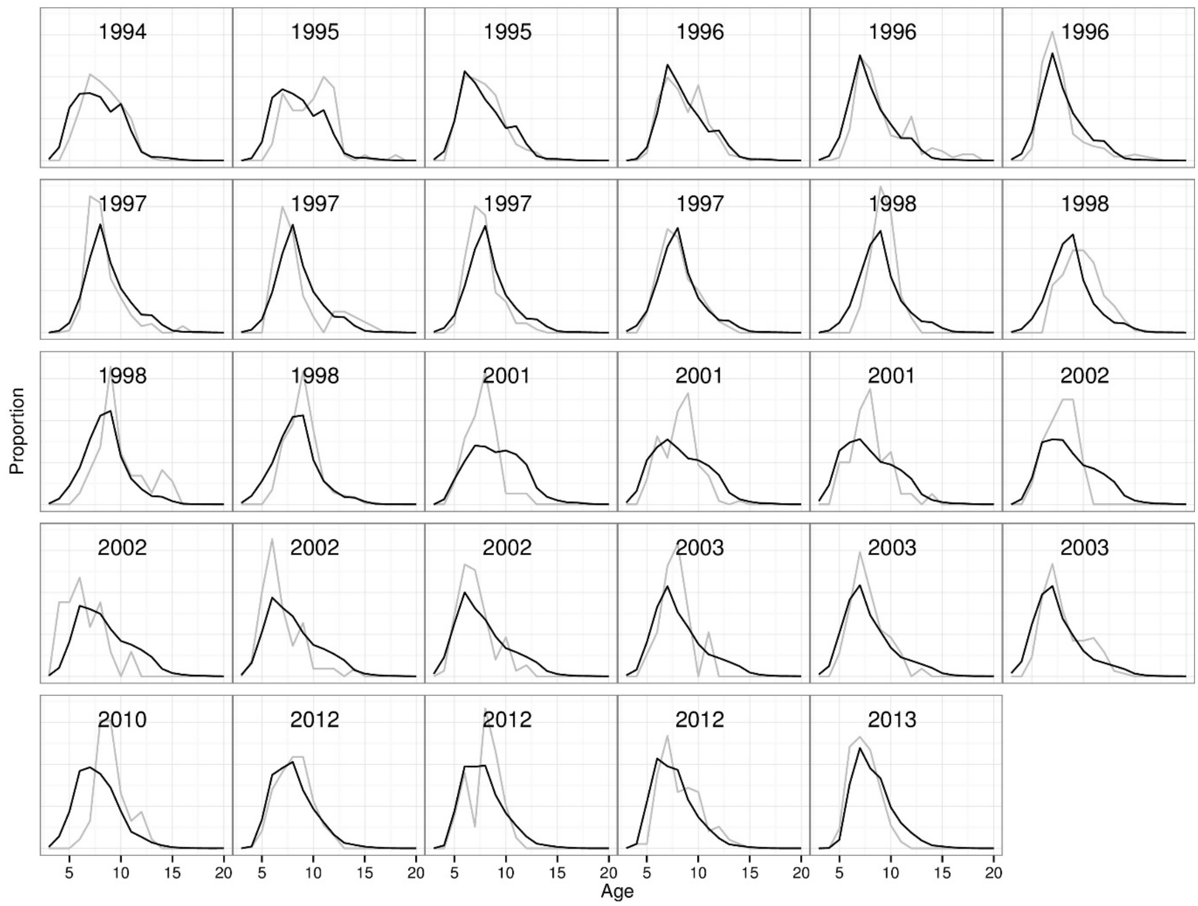

Figure 4.4.16. Ling in Va. Fitted proportions-at-age from the Gadget model (solid lines) compared to observed proportions from longline catches (grey lines).

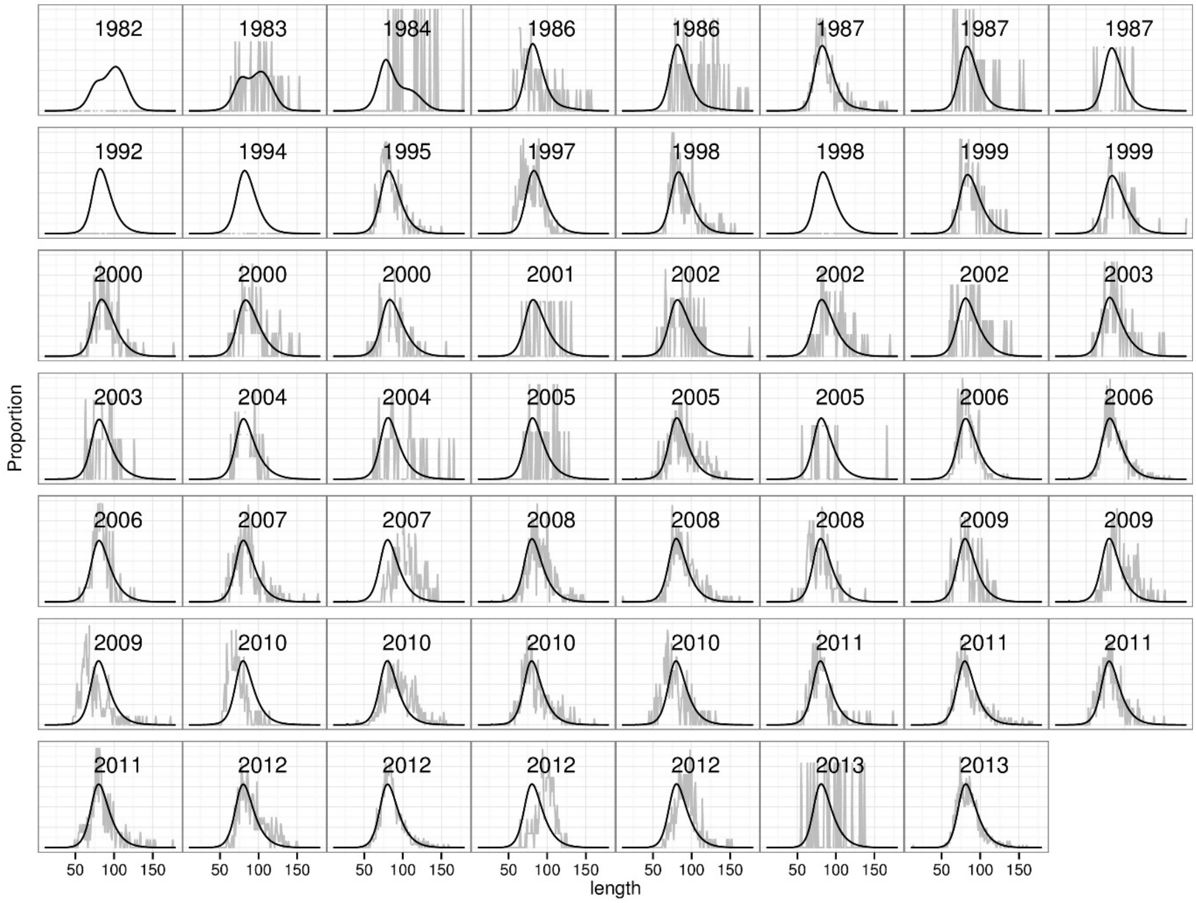

Figure 4.4.17. Ling in Va. Fitted proportions-at-length from the Gadget model (solid lines) compared to observed proportions from trawl catches (grey dots).

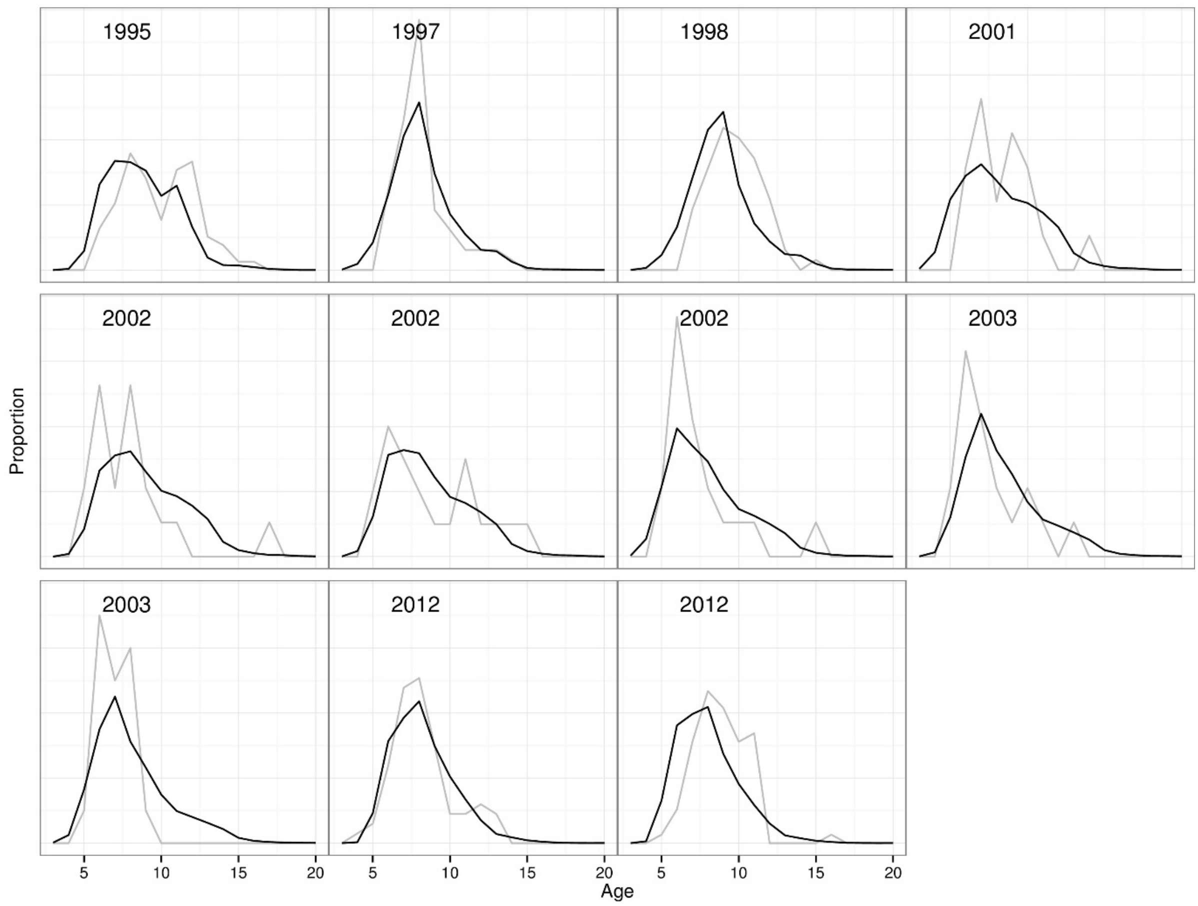

Figure 4.4.18. Ling in Va. Fitted proportions-at-age from the Gadget model (solid lines) compared to observed proportions from trawl catches (grey lines).

Model fit

Figure 4.4.19 shows the overall fit to the survey indices described in the stock annex. In general the model appears to follow the stock trends historically. Furthermore the terminal estimate is not seen to deviate substantially from the observed value for most length groups, with model overestimating the abundance in the two largest length groups. Looking at the first three length groups (20–50, 50–60, 60–70) the model appears to discount the recruitment peak observed between 2005 and 2010 as the increase is not observed in the bigger length classes to the same degree.

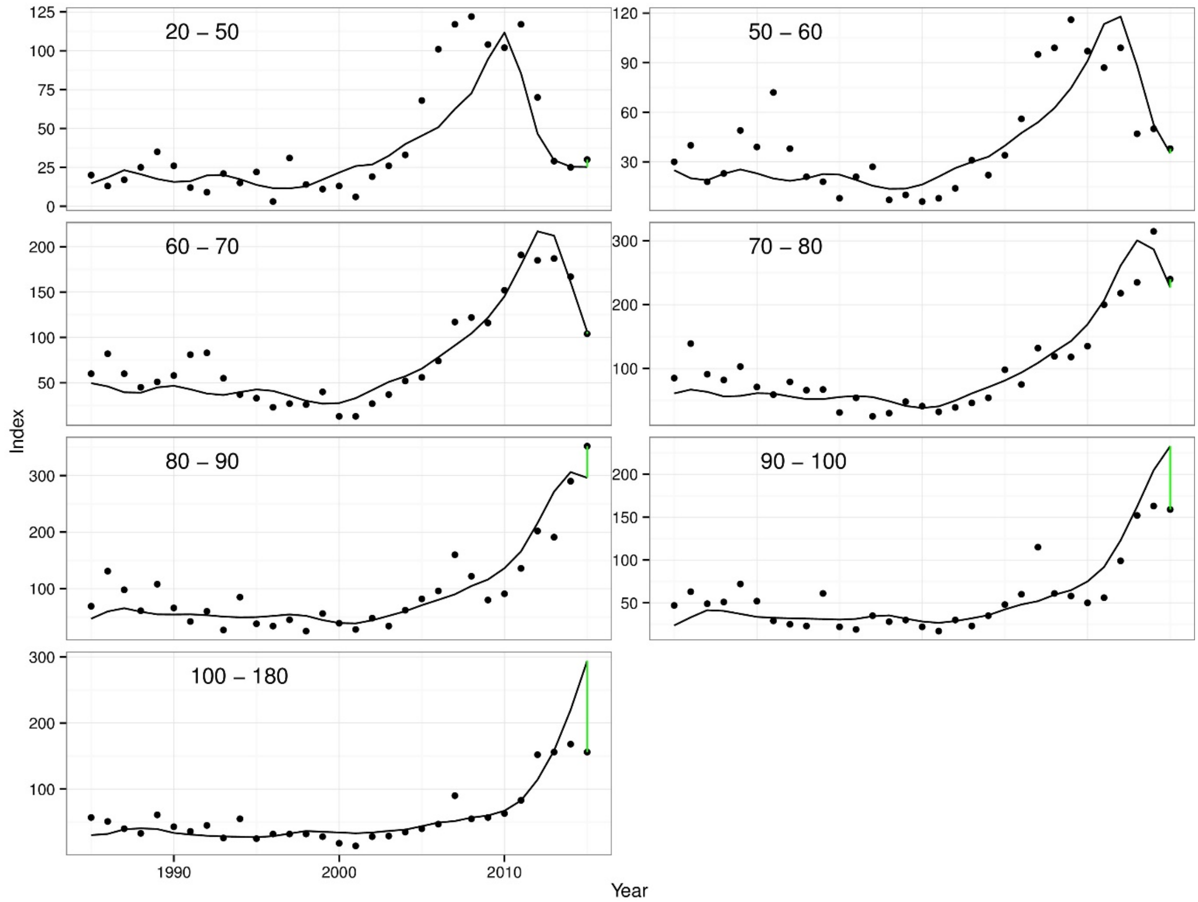

Figure 4.4.19. Fitted spring survey index by length group from the Gadget model (black solid lines) and the observed number of ling caught in the survey. The top left panel indicates the overall biomass fit. The green line indicates the difference between the terminal fit and the observations.

Results

The results are presented in Table 4.4.7 and Figures 4.4.20 and 4.4.21. Recruitment peaked in 2009 to 2010 but has decreased and is estimated in 2013 to have been the lowest observed. Spawning–stock biomass has increased since 2000 and is now estimated close to the highest SSB estimate in the time-series. Similarly harvestable biomass is estimated at its highest level in the time-series. Fishing mortality for fully selected ling (age 14–19) has decreased from 0.62 in 2008 to 0.245 in 2014. Estimates of the selection curve indicate a similar selection between trawler and longliners while the gillnetters catch substantially larger ling. Spring survey selection appears to have a similar l50 as longlines and trawls but a more gradual slope. The yield per recruit gives an estimate of F_{MAX} equal to 0.24, which is in line with the F_{MSY} of 0.24 estimated for the 2014 benchmark. The stock–recruitment relationship indicates a response to changes in the environment and/or stock composition however, as noted during the 2014 benchmark, it is uncertain what the main drivers behind these changes are.

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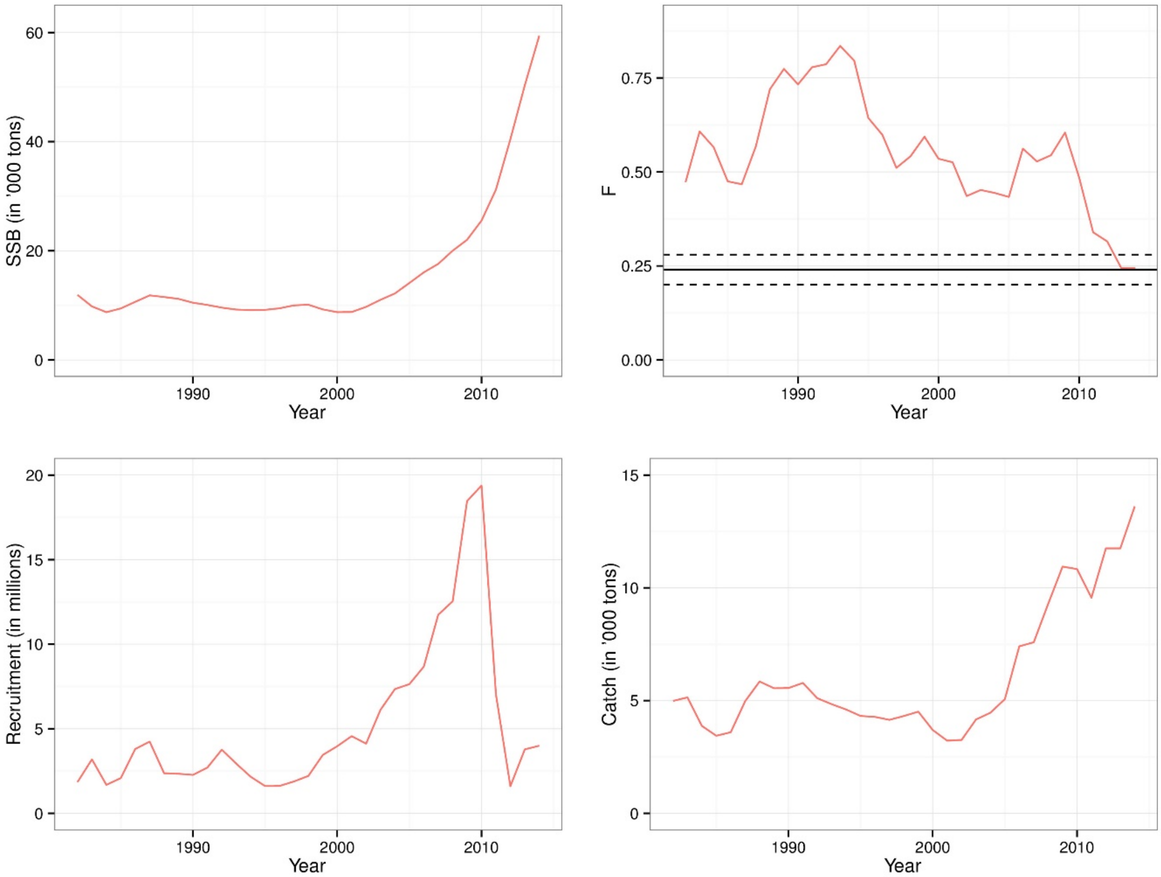

Figure 4.4.20. Ling in Va. Estimated recruitment, biomass, fishing mortality and total catches.

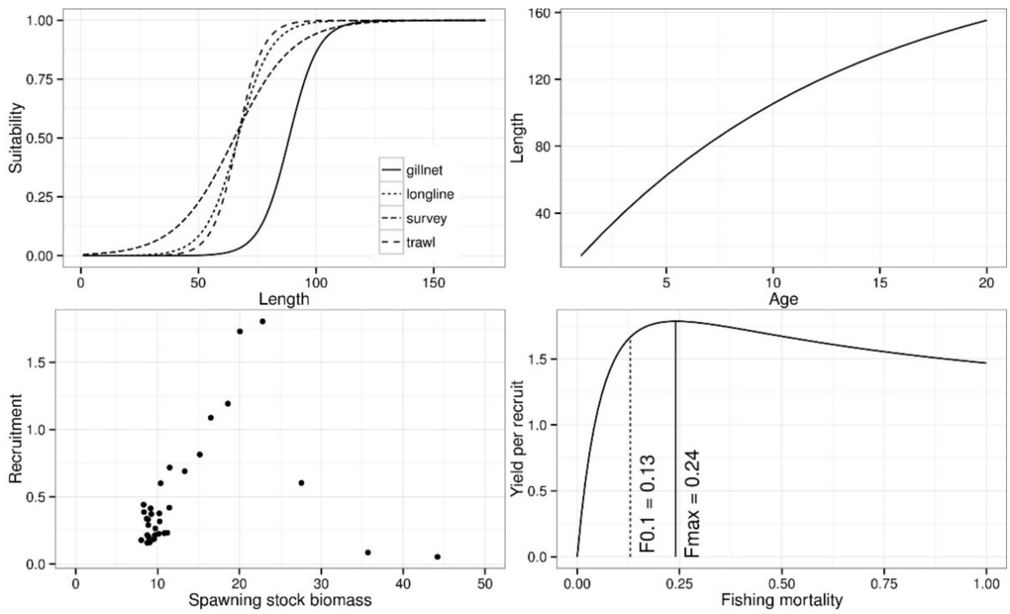

Figure 4.4.21. Ling in Va. Estimated fleet selection, growth, Stock–recruitment relationship and yield per recruit.

Table 4.4.7. Ling in Va. Estimates of recruitment, biomass, harvestable biomass and fishing mortality for ling as fully recruited into the fishery i.e. selection is 1 on a logistic selection curve along with reported catches.

Year	Total biomass (in kt)	Harvestable biomass (in kt)	Spawning-stock biomass (in kt)	Fishing mortality	Catch (in kt)	Recruitment (num. Individuals in millions)
1982	17,728	12,095	11,904	0,473	4,985	1,852
1983	17,130	9,672	9,795	0,608	5,143	3,191
1984	17,044	8,456	8,741	0,566	3,878	1,685
1985	18,258	9,188	9,428	0,475	3,441	2,086
1986	19,870	10,565	10,640	0,467	3,597	3,805
1987	21,551	11,874	11,818	0,568	4,975	4,243
1988	21,266	11,519	11,523	0,720	5,847	2,374
1989	20,899	11,080	11,178	0,774	5,548	2,341
1990	19,849	10,354	10,476	0,733	5,557	2,274
1991	18,977	9,997	10,071	0,779	5,783	2,707
1992	18,382	9,532	9,574	0,787	5,107	3,766
1993	18,106	9,155	9,219	0,835	4,841	2,941
1994	18,074	9,012	9,127	0,796	4,605	2,166
1995	17,817	9,039	9,167	0,644	4,319	1,614
1996	17,502	9,386	9,449	0,599	4,278	1,622
1997	17,464	10,040	9,990	0,511	4,147	1,886
1998	17,100	10,228	10,112	0,541	4,317	2,215
1999	16,211	9,326	9,249	0,594	4,510	3,454
2000	16,361	8,742	8,750	0,535	3,697	3,970
2001	17,663	8,650	8,771	0,526	3,223	4,566
2002	20,074	9,503	9,712	0,436	3,257	4,123
2003	23,157	10,745	11,007	0,452	4,163	6,125
2004	26,320	11,869	12,174	0,444	4,463	7,350
2005	30,591	13,738	14,091	0,433	5,067	7,639
2006	35,087	15,591	16,038	0,562	7,407	8,675
2007	39,788	17,032	17,596	0,528	7,585	11,742
2008	45,863	19,341	20,006	0,544	9,289	12,539
2009	52,963	21,147	22,010	0,605	10,943	18,463
2010	62,748	24,422	25,521	0,486	10,832	19,381
2011	71,744	29,892	31,204	0,339	9,561	7,039

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Year	Total biomass (in kt)	Harvestable biomass (in kt)	Spawning-stock biomass (in kt)	Fishing mortality	Catch (in kt)	Recruitment (num. Individuals in millions)
2012	80,753	39,367	40,433	0,315	11,750	1,605
2013	87,259	50,209	50,324	0,244	11,750	3,785
2014	90,929	60,554	59,391	0,245	13,611	3,999
2015	92,588	68,495	66,421	0,248	12,265	3,999
Prognosis						
2016	87,263		66.027	0,24	16,156	4.233
2017	81,342		63.263	0,24	15,366	4,233
2018	74,983		58.735	0,24	14,162	4,233
2019	68,981		53.682	0.24	12,871	4,233

Projections

Forward projections were conducted using Gadget. The main assumptions were:

Recruitment (age 3) set as equal to mean recruitment in 2000 to 2003, in order to reduce the effects of the recruitment spike in the years post-2003. This should however not affect the projected catch level in 2015 to 2016.

Catches in the remainder of the 2014/2016 fishing year were set based on the remainder of the unallocated quota.

The projections were run to 2018 for F_{MSY} = 0.24 (Table 4.4.7). According to the projections SSB and harvestable biomass will peak in 2016, however total biomass will peak a year earlier. Catch levels will peak at 16.2 kt in 2016 but decrease after 2016 from to 12.9 kt in 2019.

4.4.7 Comments on the assessment

4.4.7.1 Management considerations

All the signs from commercial catch data and surveys indicate that ling in Va is at present in a good state. This is confirmed in the Gadget assessment. However the drop in recruitment since 2010 will result in decrease in sustainable catches from those proposed for the fishing year 2015/2016 of 16 155 tonnes to catches being considerably lower than 12 900 tonnes by 2019.

Currently the longline and trawl fishery represent 95% of the total fishery, while the remainder is assigned to gillnets. Should those proportions change dramatically, so will the total catches as the selectivity of the gillnet fleet is substantially different from other fleets.

Table 4.4.6. Ling in Va. Catches by country.

YEAR	BELGIUM	FAROE	FRANCE	GERMANY	ICELAND	NORWAY	UK	TOTAL
1950					3551			10 497
1951					3278			10 929
1952					4420			11 454
1953					3325			11 470
1954					3442			13 095
1955					3972			11 693
1956					3823			11 525
1957					3591			9687
1958					4195			11 663
1959					2681			8700
1960					6774			13 770
1961					6032			10 066
1962					7073			12 117
1963					5607			10 492
1964					4976			10 374
1965					4811			10 658
1966					4559			10 032
1967					7531			13 152
1968					8697			14 526
1969					8677			14 138
1970					8345			14 362
1971					8867			15 391
1972					6085			10 177
1973	1080	984	0	586	3564	418	829	7461
1974	681	890	0	486	3868	318	532	6775
1975	736	732	23	375	3748	522	562	6698
1976	431	498	0	404	4538	502	268	6641
1977	442	613	0	254	3433	506	0	5248
1978	541	534	0	0	3439	484	0	4998
1979	508	536	0	0	3759	399	0	5202
1980	445	607	0	0	3149	423	0	4624
1981	196	489	0	0	3348	415	0	4448
1982	116	524	0	0	3733	612	0	4985
1983	128	644	0	0	4256	115	0	5143
1984	103	450	0	0	3304	21	0	3878
1985	59	384	0	0	2980	17	0	3440
1986	88	556	0	0	2946	4	0	3594
1987	157	657	0	0	4161	6	0	4981
1988	134	619	0	0	5098	10	0	5861
1989	95	614	0	0	4896	5	0	5610
1990	42	399	0	0	5153	0	0	5594
1991	69	530	0	0	5206	0	0	5805
1992	34	526	0	0	4556	0	0	5116

YEAR	BELGIUM	FAROE	FRANCE	GERMANY	ICELAND	NORWAY	UK	TOTAL
1993	20	501	0	0	4333	0	0	4854
1994	3	548	0	0	4049	0	0	4600
1995	0	463	0	0	3729	0	0	4192
1996	0	358	0	0	3670	20	0	4048
1997	0	299	0	0	3634	0	0	3933
1998	0	699	0	0	3603	0	0	4302
1999	0	500	0	0	3973	120	1	4594
2000	0	0	0	0	3196	67	3	3266
2001	0	362	0	2	2852	116	1	3333
2002	0	1629	0	0	2779	45	0	4453
2003	0	565	0	2	3855	108	5	4535
2004	0	739	0	1	3721	139	0	4600
2005	0	682	0	1	4311	180	20	5194
2006	0	960	0	1	6283	158	0	7402
2007	0	807	0	0	6592	185	0	7584
2008	0	1366	0	0	7736	176	0	9278
2009	0	1157	0	0	9613	172	0	10 942
2010	0	1095	0	0	9867	168	0	11 130
2011	0	519	0	0	8789	249	0	9557
2012	0	811	0	0	10952	248	0	12011
2013	0	1310	0	0	10712	61	0	11771
2014	0	1525	0	0	11927	158	0	13610

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

4.5.1 The fishery

Significant fisheries for ling have been conducted in Subarea III and IV at least since the 1870s, pioneered by Swedish longliners. Since the mid-1900s and currently, the major targeted ling fishery in IVa is by Norwegian longliners conducted around Shetland and in the Norwegian Deep. There is little activity in IIIa. Of the total Norwegian 2012 landings in III and IV, 79% were taken by longlines, 11% by gillnets, and the remainder by trawls. The bulk of the landings from other countries were taken by trawls as bycatches in other fisheries, and the landings from the UK (Scotland) are the most substantial. The comparatively low landings from the central and southern North Sea (IVb,c) are bycatches from various other fisheries.

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

When Areas III–IV and VI–XIV are pooled over the period 1988–2014, 42% of the total landings were in Area IV, 31% in Area VIa, and 26% in Area VIb.

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

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

The Norwegian fishery

The Norwegian longline fleet increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number decreased to 26 in 2014. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The average number of days that each Norwegian longliner operated in an ICES division was highly variable for IVa, stable for VIb and declining for VIa . The average number of hooks has remained relatively stable in IVa and VIa. During the period 1974 to 2014 the total number of hooks per year has varied considerably, but with a downward trend since 2002 (For more information see Helle and Pennington, WD 2015).

Since the total number of hooks per year takes into account; the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, it follows that it may be a suitable measure of changes in applied effort. Based on this gauge, it appears that the average effort for the years 2011–2014 is 43% less than the average effort during the years 2000–2003.

The French fishery

The French fleets operating in VI, VIIbck were mainly otter trawlers, gillnetters and longliners. The catch of ling was around 1000 t in 2013 and 2014, and the catch was mainly from otter trawlers (738 t). Gillnetters and longliners both landed around 160 t.

The number of otter trawlers operating in this region has decreased from around 70 in the beginning of the 2000s to 33 in 2013–2014. The number of gillnetters has been relatively stable, between 12 and 20 vessels. The number of longliners has increased from one in 2000 to nine in 2014 (Table 4.5.3).

Since 2000, otter trawlers have decreased fishing effort by a factor of 2. Gillnetters effort peaked in mid-2000, and then effort decreased by a factor of 5 since 2010. The reported fishing effort by longliners was erratic due to lack of information in the first part of the 2000s. The fishing activity seems to have peaked in 2007 followed by a sharp decrease afterwards. Since 2009, the effort has been steadily increasing.

The landings of ling by otter trawlers have increased since 2004. For gillnetters and longliners, landings are closely related to changes in applied effort. Since 2011 landings were stable for gillnetters and increasing for longliners.

Overall, the total fishing effort for the three major fleets has decreased , but there is a clear increasing trend in effort for otter trawler and gillnetters , while and stable for longliners.

The Spanish fishery

The Spanish fleet fishes for ling in ICES Subarea VII, for the most part in Divisions b, c and g–k, and the catch is mainly taken by longliners. However there are also important bycatches of ling by trawlers operating in the area. Porcupine Bank important fishing area for the trawlers, therefore the results from the Porcupine Bank Spanish groundfish survey could be useful as an indicator of the abundance and status of ling in the area.

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4.5.2 Landings trends

Landing statistics by nation in the period 1988–2014 are in Tables 4.5.1 and 4.5.2 and Figures 4.5.1 and 4.5.2.

There was a decline in landings from 1988 to 2003, since then the amout landed has been stable. When Areas III–IV are pooled, the total landings averaged around 32 000 t in the period 1988–1998 and afterwards the average catch varied between 16 000 and 17 000 tons per year. The preliminary landings for 2014 was 10 024 t.

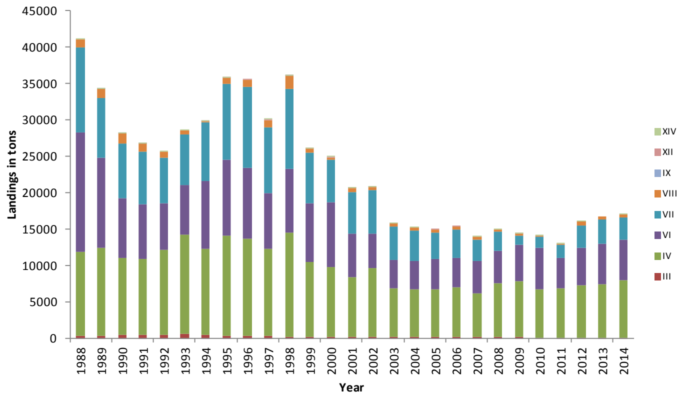

Figure 4.5.1. International landings. Ling in other areas.

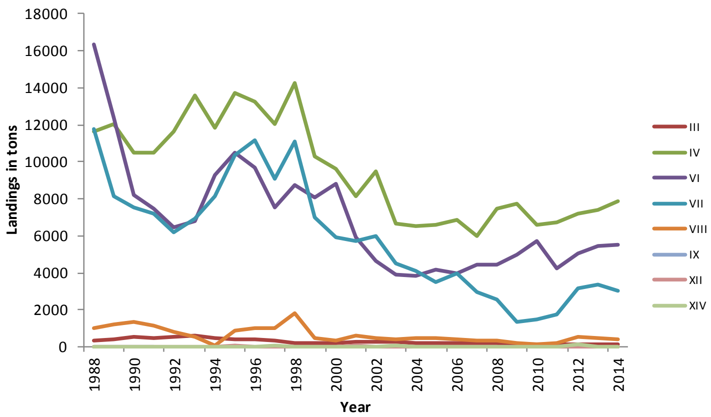

Figure 4.5.2. International landings. Ling in other areas.

4.5.3 ICES Advice

Advice for 2013 to 2015: "Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 10 800 tonnes."

4.5.4 Management

Norway has a licensing scheme in EU waters, and in 2015 the Norwegian quota in the EC zone was 5500 t The Faroe Islands have a quota of 200t in VIa and VIb . The quota for the EU in the Norwegian zone (Area IV) is set at 950 t.

EU TACs for areas partially covered in this section are in 2015:

Subarea III	87 t
Subarea IV	2428 t
Subarea VI, VII (EU and international waters)	8464 t.

In addition, there is a temporal EU area closure for tusk,ling and blue ling fisheries (EU No 40/2013) where it is prohibited to fish or retain on board tusk, blue ling and ling in the Porcupine Bank during the period from 1 May to 31 May 2013. Spatial positions of the closure are given in the regulation.

4.5.5 Data available

4.5.5.1 Landings and discards

Landings were available for all relevant fleets. Within the Norwegian EEZ and for Norwegian vessels fishing elsewhere discarding is prohibited and so there is no information on discarding. Discard data have been reported from some fleets by Spain, who in 2012 discarded 46 tons ,in 2013 101 tons and in 2014, discarded 54 tons of ling. Ireland also reported discards; i 176 t in 2012, 160 t in201, and in 2014 435 t in 2014.

The French discards in 2013 and 2014 were 29 and 15 t respectively.

4.5.5.2 Length composition

Data from the Norwegian reference fleet

Average fish length, weight–length relationships and the length distribution from the Norwegian longline and gillnet fishery in Areas IVa, VIa, VIb are shown in Figures 4.5.3–4-5.7. Data are from the Norwegian longline reference fleet. Weight as a function of length for ling in Areas VI and VII based on Spanish data (Figure 4.5.8).

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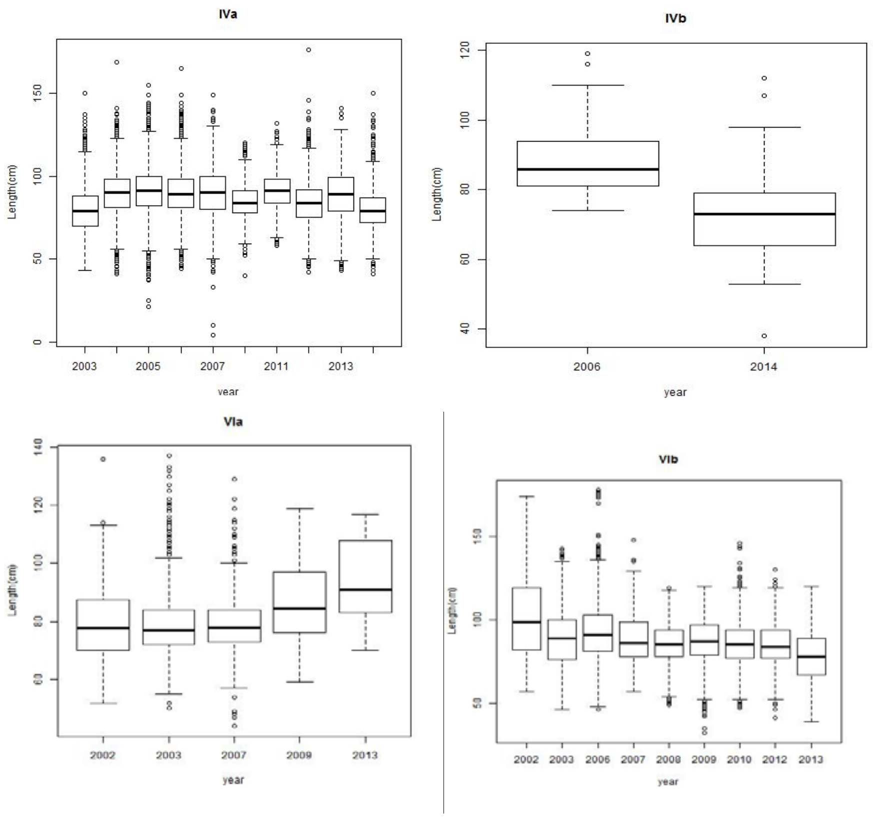

Figure 4.5.3. Box and whisker plots of length distribution of the Norwegian longline reference fleet in IVa, IVb, VIa and VIb.

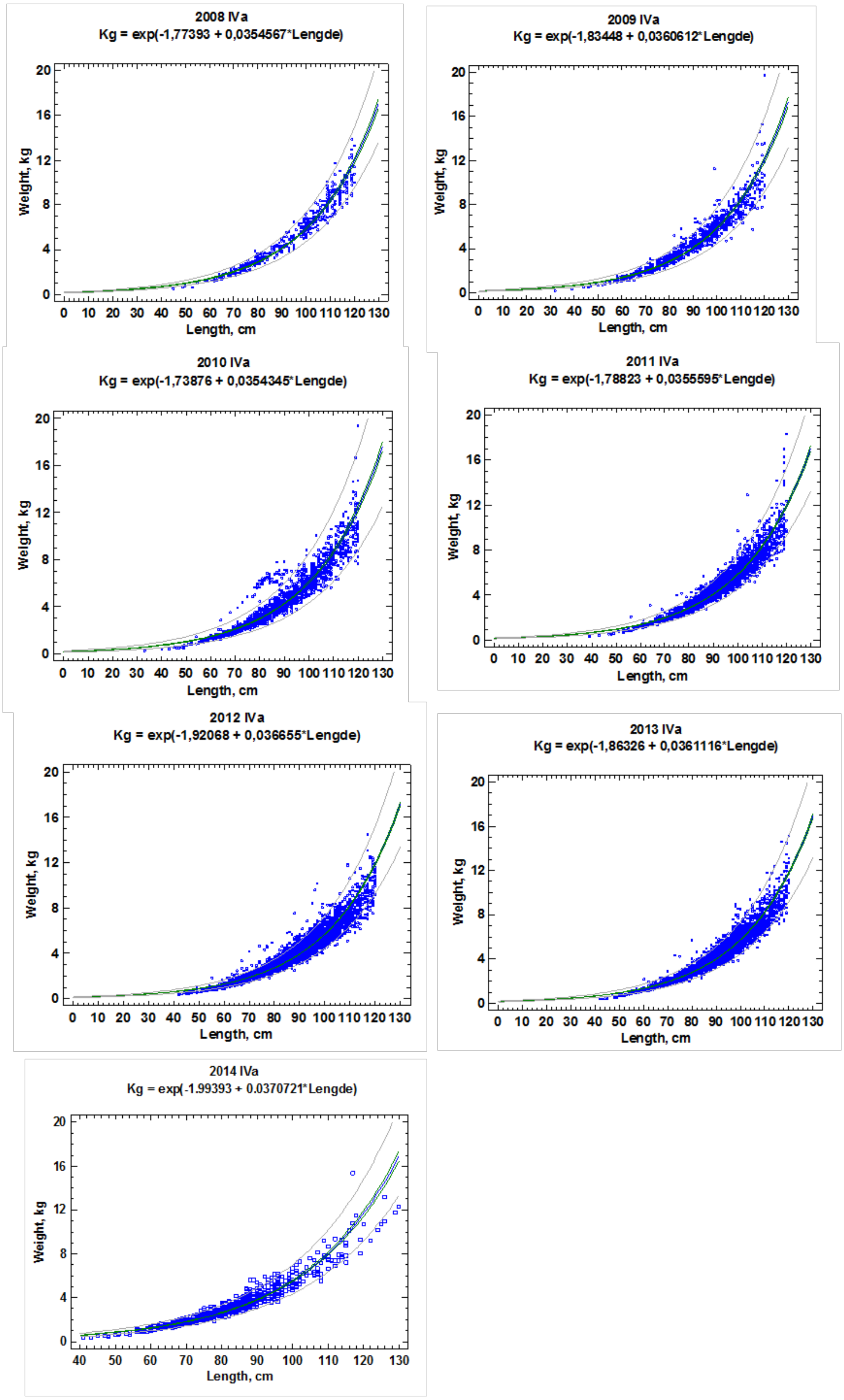

Figure 4.5.4. Weight versus length for ling in Area IVa based on all available Norwegian data.

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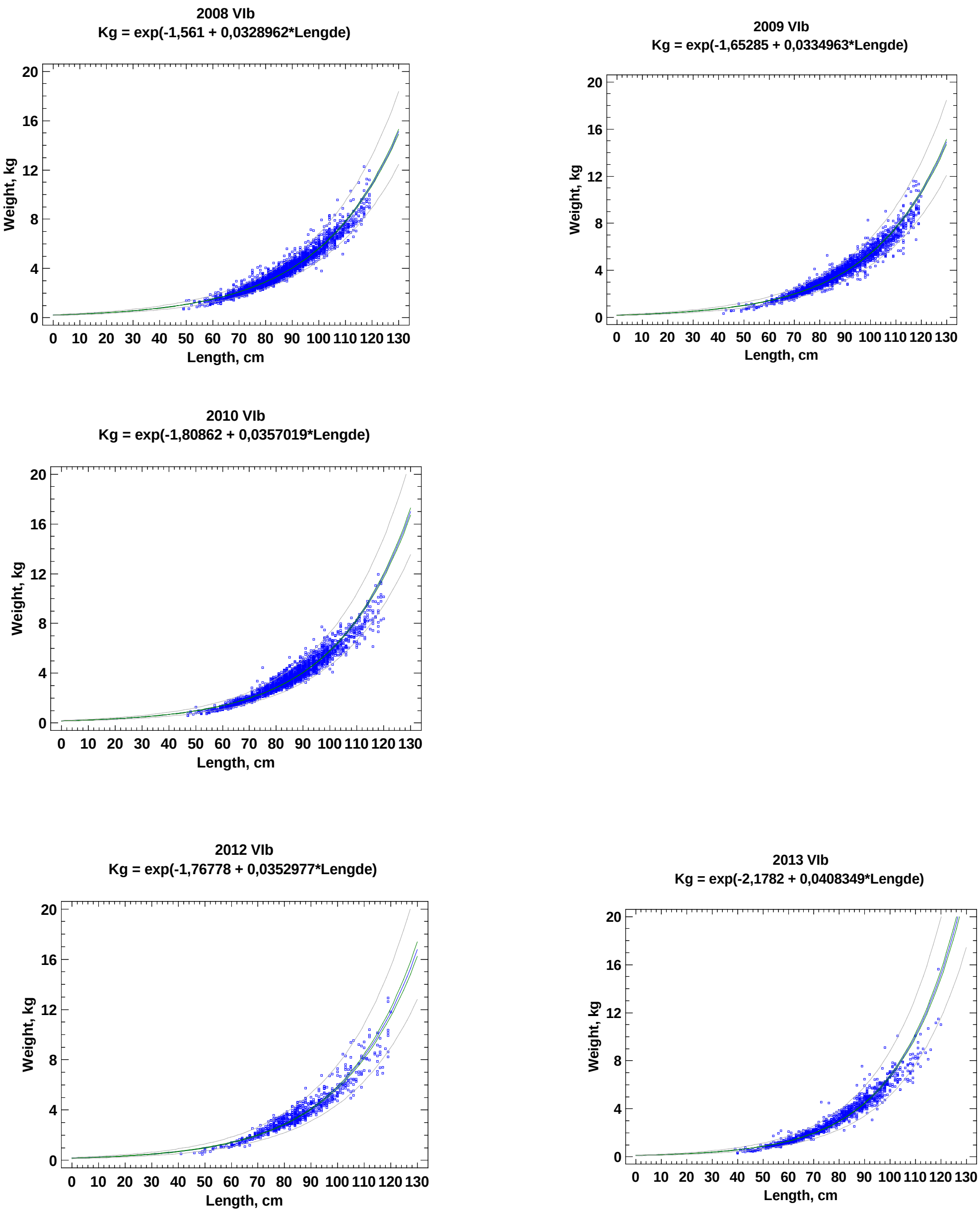

Figure 4.5.5. Weight as a function of length for ling in Area IVb based on all available Norwegian data.

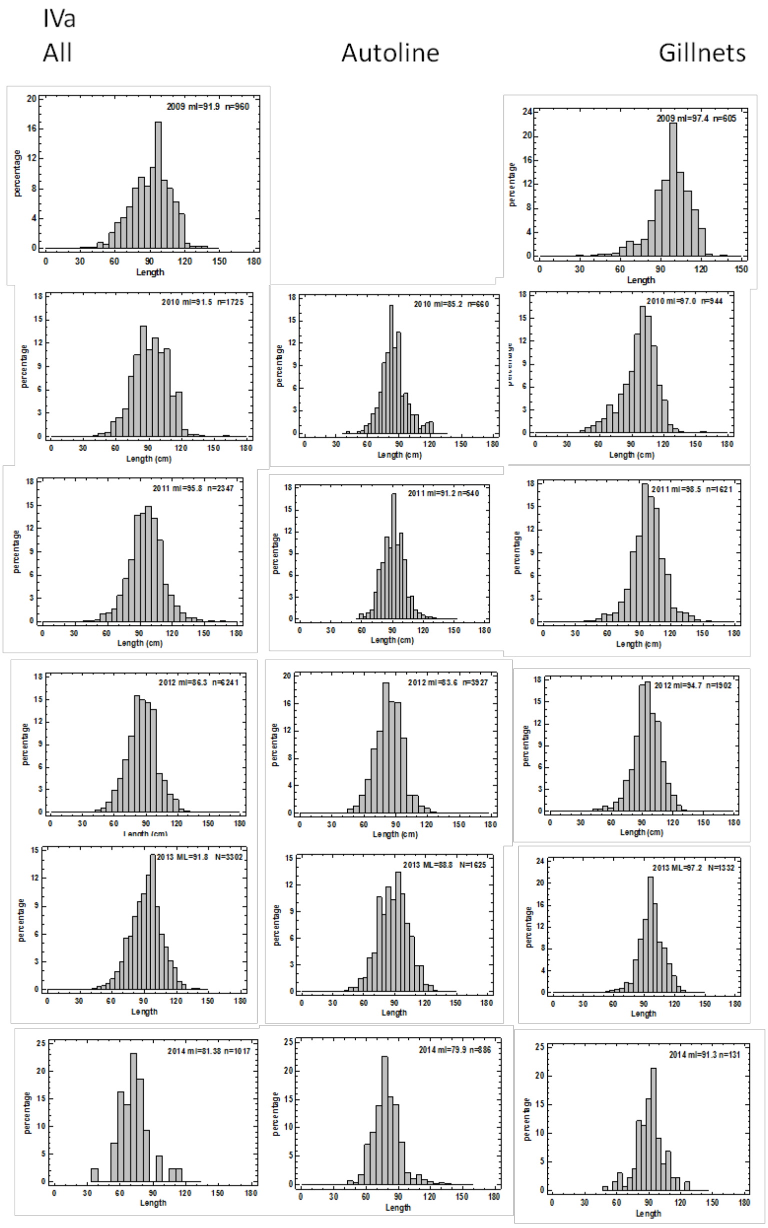

Figure 4.5.6. Length distributions in Area IVa for all, autoline vessels and gillnets fished ling.

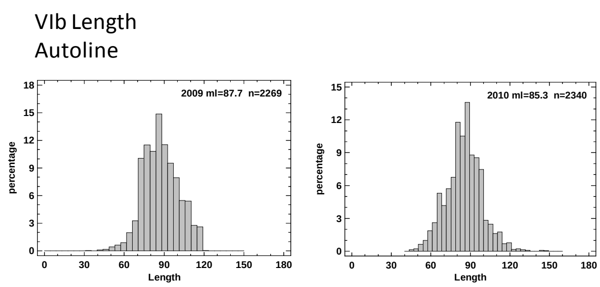

Figure 4.5.7. Length distribution in Area IVa for all, autoline vessels and gillnets.

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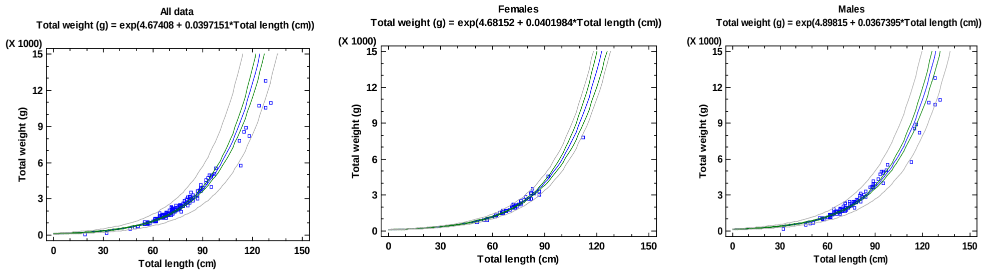

Figure 4.5.8. Weight as a function of length for ling in Areas VI and VII based on Spanish data.

The estimated length distribution (cm) of the landings of ling by quarter in the French fishery based on-board observations, raised to landings weight Figure 4.5.8.

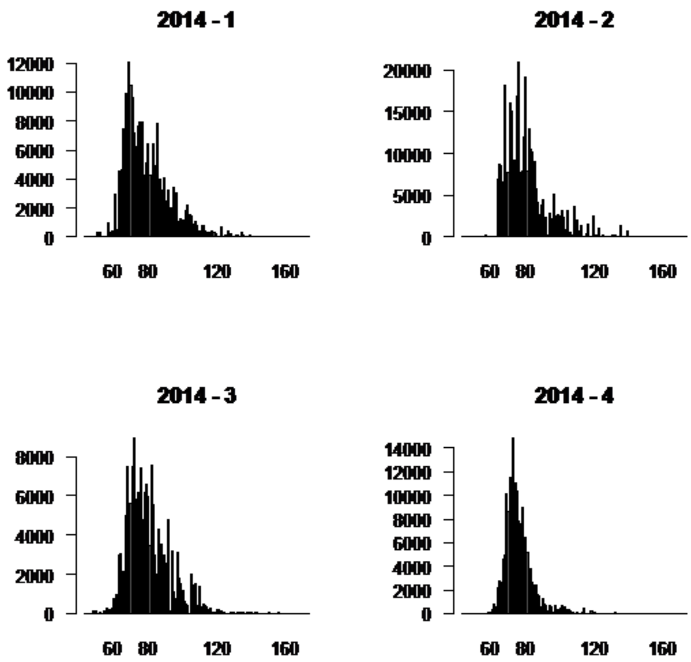

Figure 4.5.8. Estimated length distribution (cm) of French landings of ling by quarter, from on-board observations, raised to landings weight.

Length composition of Ling for the commercial bottom trawl catches in ICES Division VIb (Rockall Bank) in April 2014 (Figure 4.5.9). For more information about the Russian fisheries and investigations of deep-water fish in the Northeast Atlantic see Aleksandrov and Vinnichenko (WD 2015).

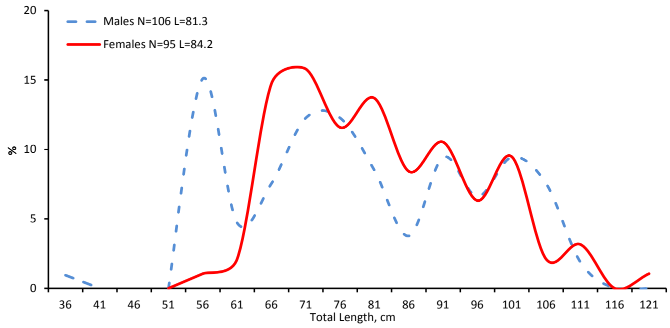

Figure 4.5.9. Length composition of Ling for the commercial bottom trawl catches in ICES Division VIb (Rockall Bank) in April 2014.

Estimated Length distributions based on the Spanish Porcupine Bank (NE Atlantic) surveys

In Figure 4.5.10 are the estimated length distributions for the years 2001–2014. The estimated length distributions appear to be quite a stable with a length range from ca. 30 cm to ca. 130 cm. The mode of the distributions tends to be around 70 cm, and there are no clear recruitment signals, which imply that Porcupine Bank is not a recruitment area for ling. Some small ling were found close to the central mount of the Porcupine Bank, and a few were also observed on the Irish shelf slope and to the east of the survey area. In 2012, when the abundance of ling peaked, no ling less than 30 cm were caught. In general, ling tends to dwell close to the central mound of the Bank, which cannot be surveyed using a trawl. During the last two years the survey area was expanded and ling were observed on the southern tip of the expanded survey area. The substrate in the south is completely different from the rocky state in the northwestern part of the survey (For more information see Fernández-Zapico *et al.*, WD 2015).

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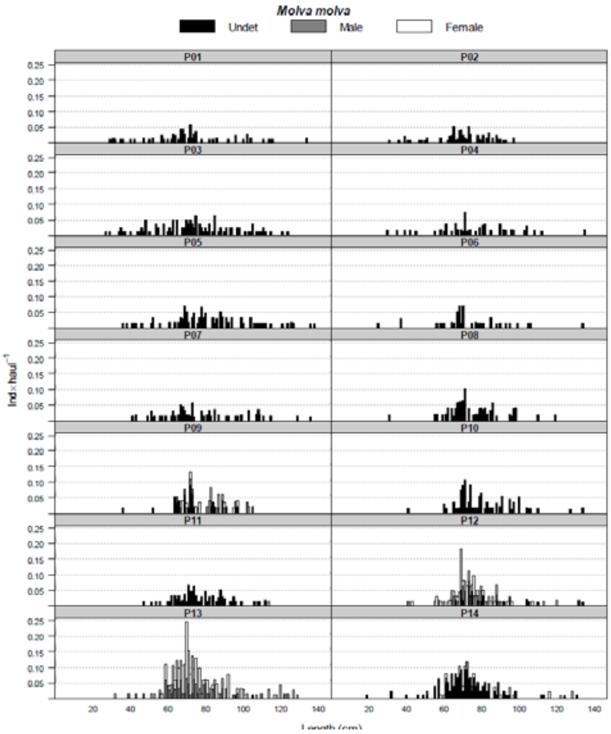

Figure 4.5.10. Estimated length distributions of ling (*M. molva*) based on the Porcupine Bank Spanish survey (2001–2014).

4.5.5.3 Age compositions

Estimated age distributions based on data from the Norwegian Reference fleet for Areas IVa and VIb for the years 2009–2013 are shown in Figures 4.5.11 and 4.5.12. The average age is about 6.5 in Area IVa and 6.1 in Area VIb.

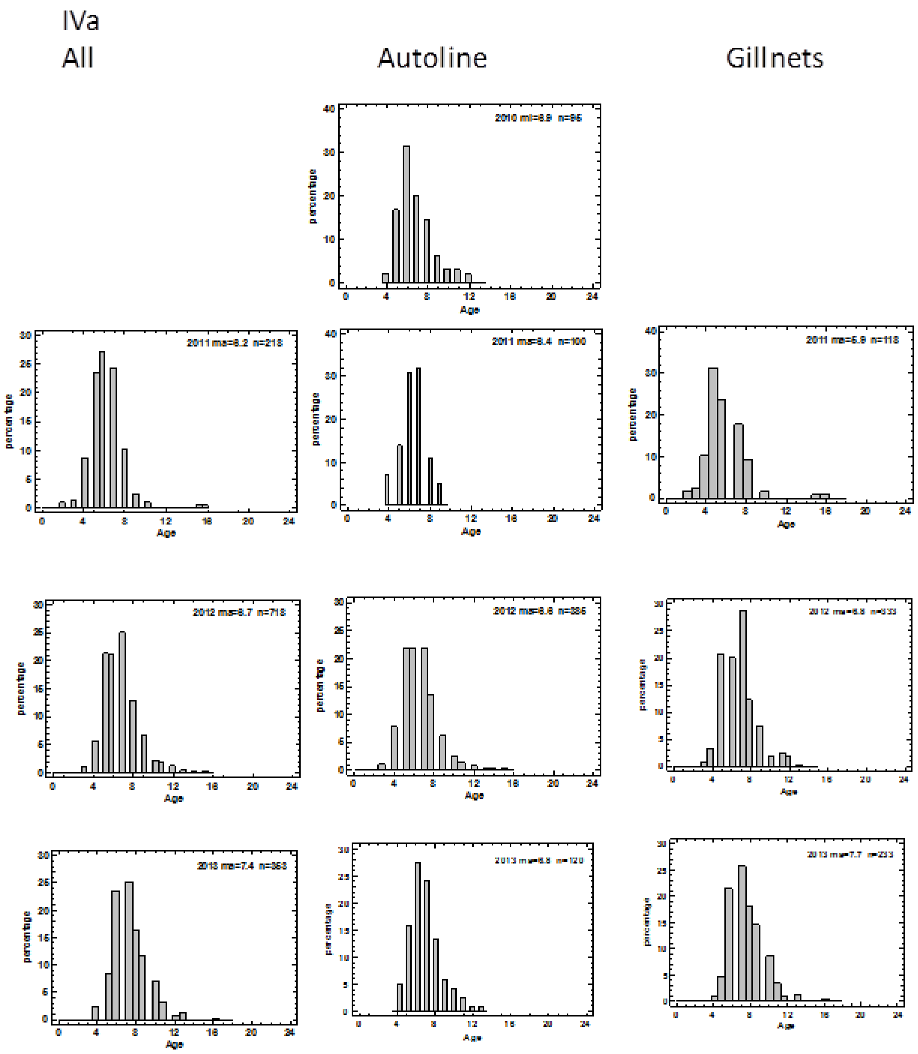

Figure 4.5.11. Length distributions in Area IVa for all catches, and catches taken by longliners and gillnetters during the period 2010–2013.

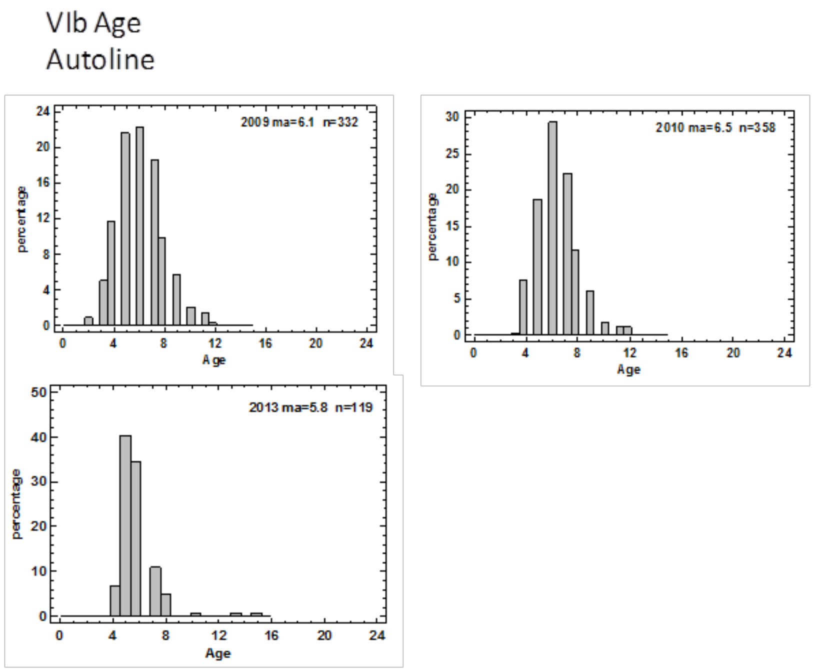

Figure 4.5.12. Age distributions in Area VIb for all catches taken by longliners during the years 2009, 2010 and 2013.

4.5.5.4 Weight-at-age

Average weight and length-at-age for 2009 to 2013 was available for Areas IVa and IVa based on data from the Norwegian reference fleet Figure 4.5.13. and Average length-at-age and average weight -at-age for the Spanish ling 2014 on Porcupine Bank (Figures 4.5.14 and 4.5.15).

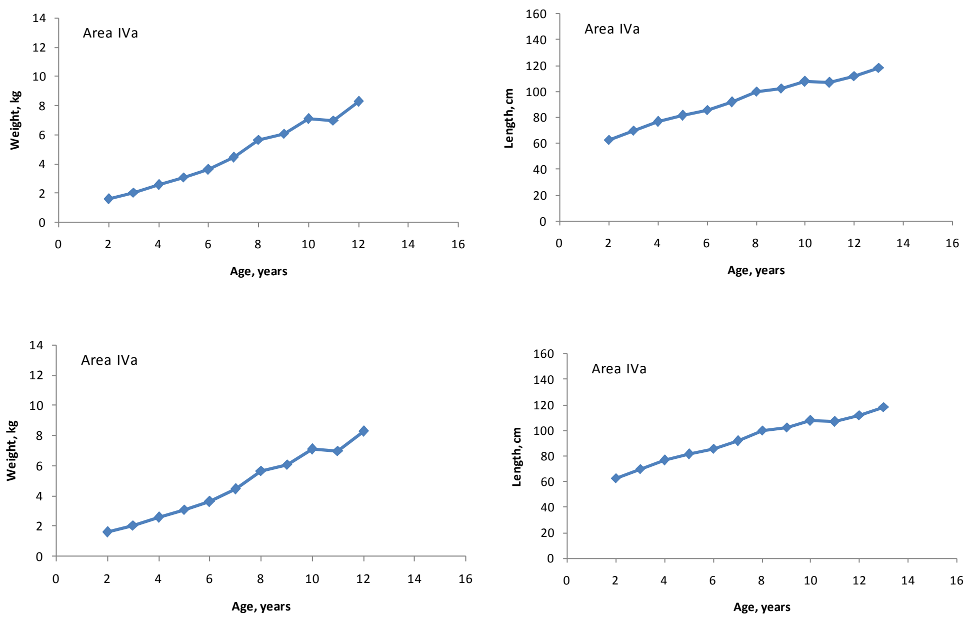

Figure 4.5.13. Average weight and length-at-age for 2009 to 2013 for Areas IVa and IVa.

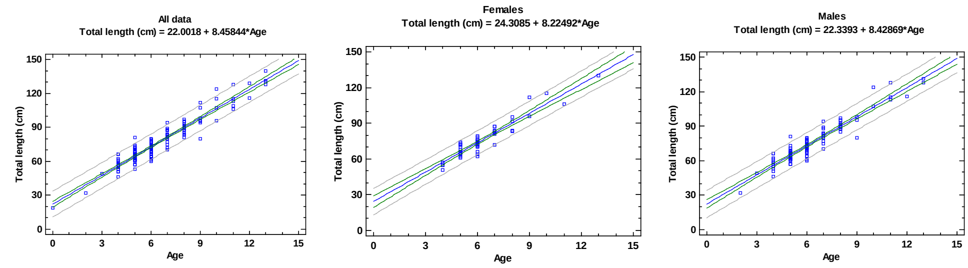

Figure 4.5.14. Average length-at-age based on Spanish data from 2014.

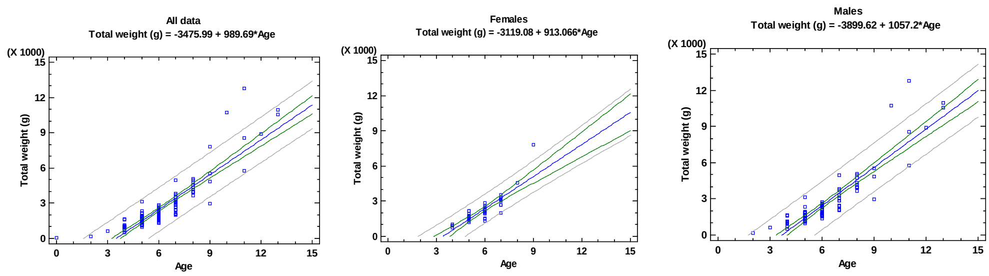

Figure 4.5.15. Average weight-at-age based on Spanish data from 2014.

4.5.5.5 Maturity and natural mortality

No new data were presented.

4.5.5.6 Catch, effort and research vessel data

Spanish ling 2014 Porcupine Bank (NE Atlantic) survey

Estimated biomass and abundance indices based on the Porcupine Survey for the years 2001–2014 (Figure 4.5.16). Taking into account the 80% confidence limits, the abundance indices for ling have been quite stable, for the years 2001 to 2014.

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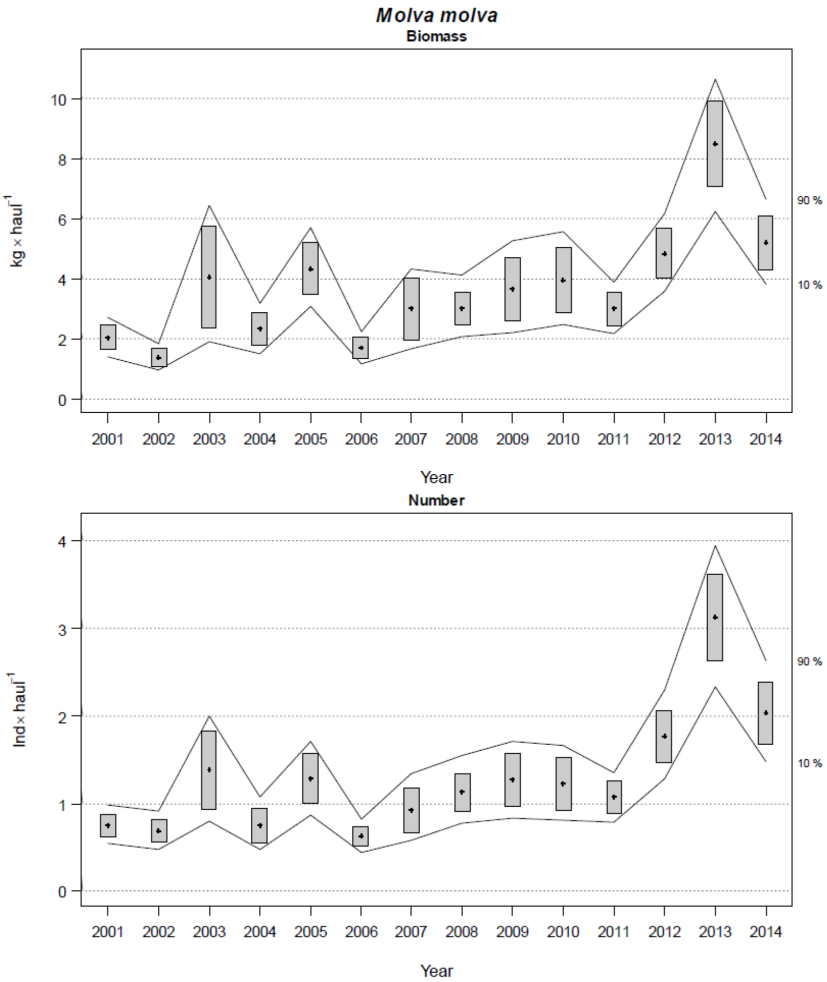

Figure 4.5.16. Estimated biomass and abundance indices based on the Porcupine Survey for the years 2001–2014. Boxes denote the standard error of the stratified abundance index. Lines denote the 80% confidence intervals (based on 1000 bootstrap iterations).

French IBTS survey

Ling is caught in small numbers in the French western-IBTS area, also referred to as EVHOE. Population indices (swept area raised abundance and biomass, mean length and the percentiles) for the Bay and Biscay and Celtic Sea (ICES Divisions VIIg,hjk and VIIIa,b,d) combined were provided for years 1997–2014 (Figure 4.5.17). The survey covers depths from 30 to 600 m and is stratified by depth and latitude. The percentiles are based on a very small number per year and are the reason for the small error bar in the percentile graph.

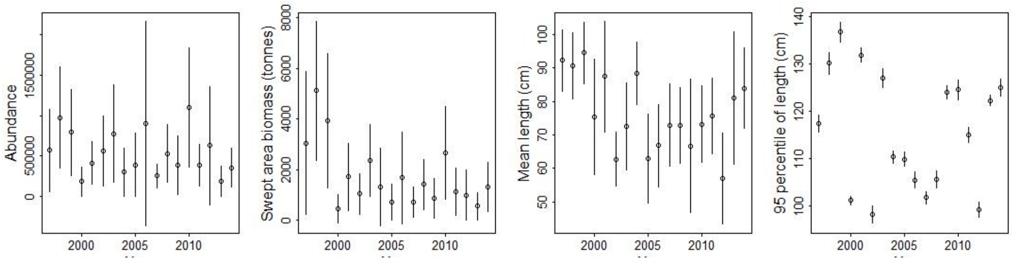

Figure 4.5.17. Population indices (swept area raised abundance and biomass as well as mean length) for the Bay and Biscay and Celtic Sea (ICES Divisions VIIg,hjk and VIIIa,b,d) for the years 1997–2014.

Commercial cpues

French lpue

The landings of ling by otter trawlers of ling have been increasing since 2004. For gillnetters and longliners, landings are closely related to the change s in effort. Since 2011 landings have been stable for gillnetters and increasing for longliners.

Overall, while total fishing effort has decreased in the area for the three major French fleets, there is a clear increasing trend for otter trawlers and gillnetters lpue. Lpues seem to be stable for longliners.

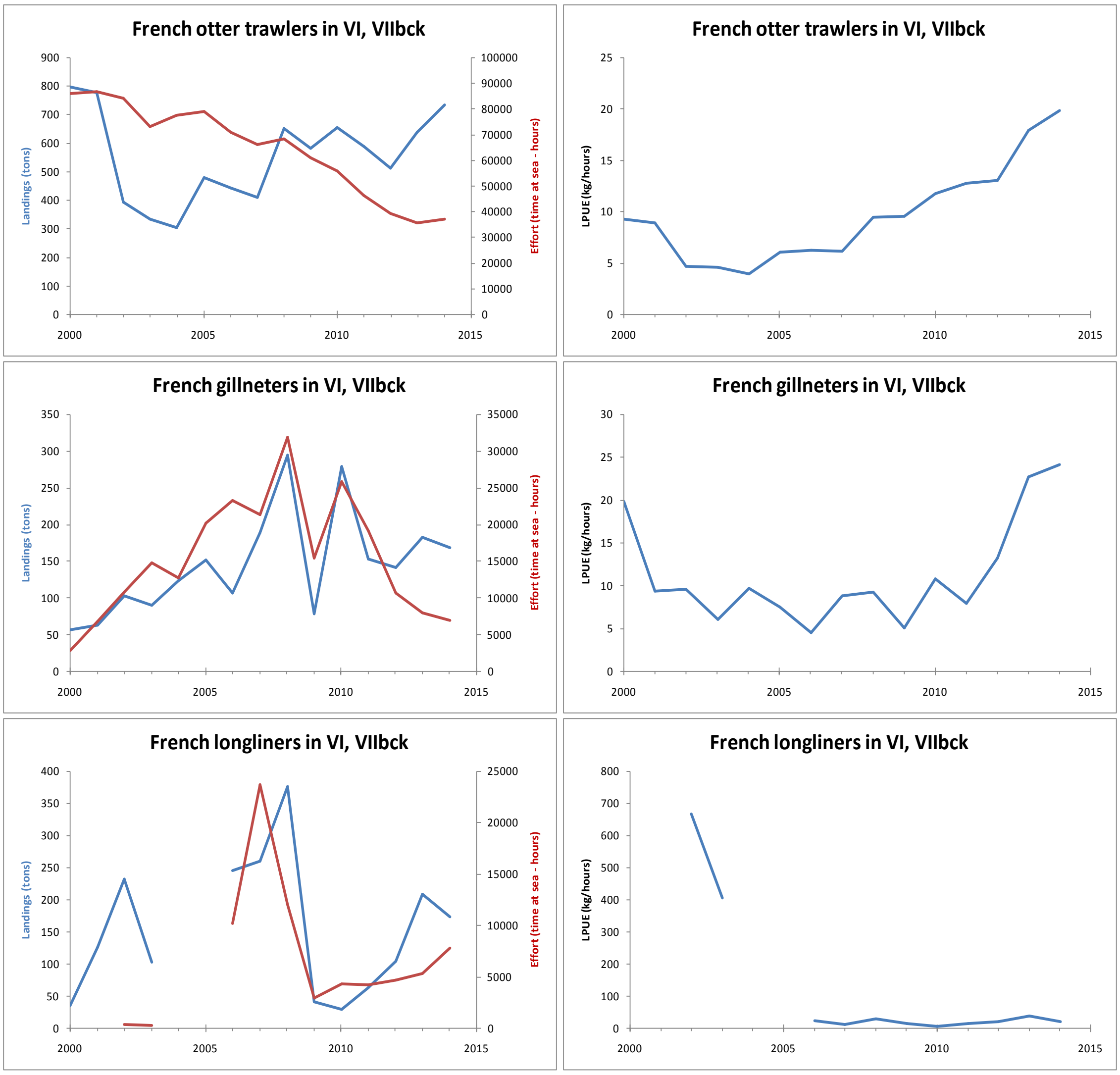

Figure 4.5.13. Lpue series for the main French fleets operating in VI, VIIb,c,k.

Norwegian longline cpue

A standardised commercial cpue by the Norwegian longline reference fleet was presented based mn methods described in Helle *et al*., 2015.

For the standardised Norwegian cpue series, data were available from official logbooks for 2000 onwards. All catch data, and a subset where ling appeared to have been targeted (>30 percent of total catch), were used to estimate a standardized cpue.

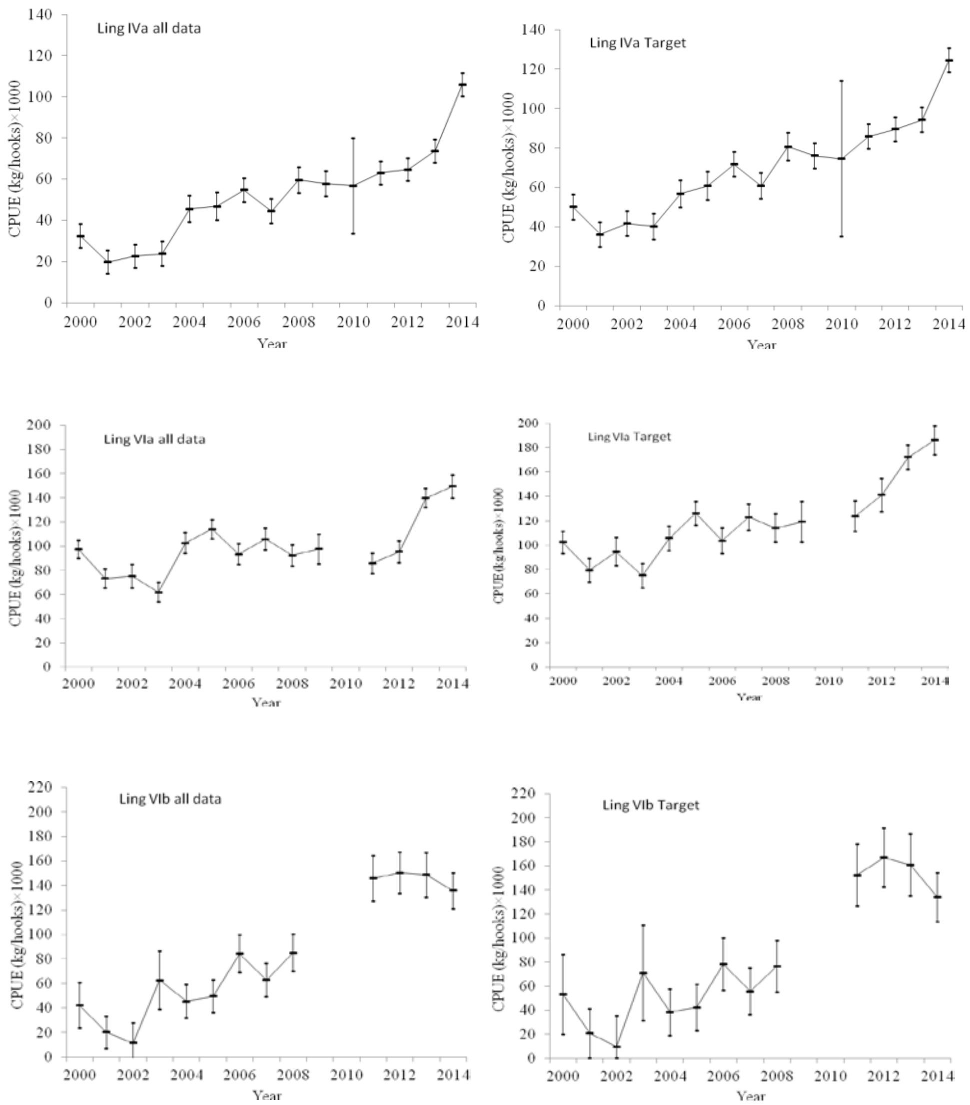

Figure 4.5.15. Cpue series for ling for the period 2000–2014 based on all available data and when ling appeared to have been targeted. The bars denote the 95% confidence intervals.

The ling stocks in Areas (IIIa, IV, VI, VII, VIII, IX, X, XII, XIV) are best covered by the Norwegian longline fleet. It was therefore decided in plenary that a combined cpue series should be made in order to give advice for the entire area, and that the data from the targeted fishery should be used. The combined series is shown in Figure 4.5.16.

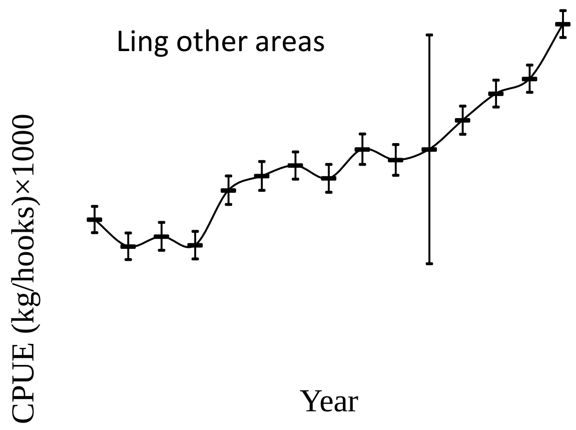

Figure 4.5.16. Cpue series for ling, areas combined, for the period 2000–2014 based on data when ling appeared to have been targeted. The bars denote the 95% confidence intervals.

4.5.6 And data analyses

Length data analysis

Mean lengths from commercial catches by the Norwegian longlining refernce fleet fluctuate are around 90 cm for Areas IV and VIb and around 80 cm for Area VIa. Data do not indicate any apparent time trends.

The French IBTS survey (EVHOE)

Total abundance varies with no apparent trends. The biomass may have been higher in the early years of the time-series, and the mean length may be decreasing. However, the numbers of ling caught in the survey are low and variable so that confidence intervals are wide.

French lpue

Overall, while total fishing effort has decreased in the area for the three major French fleets, there is a clear increasing trend for otter trawler and gillnetters. Lpues seem to be stable for longliners.

Spanish ling 2014 Porcupine Bank (NE Atlantic) survey

The abundance indices of ling based on the survey have been quite stable from 2001 up to 2012 and 2013, when there was an increase of the abundance, especially in the last year when more than 10 kg and three individuals per tow on average were caught. Nevertheless in 2014, levels went back to 2012, still larger than the rest of the time-series but with no significant differences.

Cpue series based on the Norwegian longline fleet

For ling there is a positive development in cpue for all areas. A large part of Rockall (Area VIb) was closed for fishing in the beginning of 2007. After 2007 the cpue for ling has increased considerably with a small decline in the two last years.

4.5.7 Comments on the assessment

The standardised cpue time-series of the Norwegian longliners shows similar trends as the superpopulation model presented in 2012 and the the unstandardised time-series as presented in 2011. The trend is either stable (IVa and VIa) or increasing (VIb) in the last decade (Figure 4.5.5). The confidence intervals are wider due the way the uncertainty was calculated based on the super-population model and the GLM based cpue. Both methods for calculating cpue series indicated that the cpue values were statistically significantly higher at the end of the period than at the beginning.

All data in Areas IVa, VIa and VIb was combined in order to make one index for the entire area. These show the same positive trend as for each area separate. The positive trend is also reflected in the French lpue and the Spanish biomass and abundance indices.

4.5.8 Management considerations

The cpues series based on commercial data either indicate a stable or an increasing trend. Since the catches have been stable and the indicator series have been showing an increasing trend it is suggested not to apply the 20% buffer.

Table 4.5.1. Ling IIIa, IVa, VI, VII, VIII, IX, XII and XIV. WG estimates of landings.

LING III

Year	Belgium	Denmark	Germany	Norway	Sweden	E & W	Total
1988	2	165	-	135	29	-	331
1989	1	246	-	140	35	-	422
1990	4	375	3	131	30	-	543
1991	1	278	-	161	44	-	484
1992	4	325	-	120	100	-	549
1993	3	343	-	150	131	15	642
1994	2	239	+	116	112	-	469
1995	4	212	-	113	83	-	412
1996		212	1	124	65	-	402
1997		159	+	105	47	-	311
1998		103	-	111	-	-	214
1999		101	-	115	-	-	216
2000		101	+	96	31		228
2001		125	+	102	35		262
2002		157	1	68	37		263
2003		156		73	32		261
2004		130	1	70	31		232
2005		106	1	72	31		210
2006		95	2	62	29		188
2007		82	3	68	21		174
2008		59	1	88	20		168
2009		65	1	62	21		149
2010		58		64	20		142
2011		65		57	18		140
2012		66	<1	61	17		144
2013		56	1	62	11		130
2014*		65	1	54	14		134

***Preliminary.**

Table 4.5.1. (continued).

LING IVa

Year	Belgium	Denmark	Faroes	France	Germany	Neth.	Norway	Sweden[1)]	E&W	N.I.	Scot.	Total
1988	3	408	13	1143	262	4	6473	5	55	1	2856	11 223
1989	1	578	3	751	217	16	7239	29	136	14	2693	11 677
1990	1	610	9	655	241	-	6290	13	213	-	1995	10 027
1991	4	609	6	847	223	-	5799	24	197	+	2260	9969
1992	9	623	2	414	200	-	5945	28	330	4	3208	10 763
1993	9	630	14	395	726	-	6522	13	363	-	4138	12 810
1994	20	530	25	n/a	770	-	5355	3	148	+	4645	11 496
1995	17	407	51	290	425	-	6148	5	181		5517	13 041
1996	8	514	25	241	448		6622	4	193		4650	12 705
1997	3	643	6	206	320		4715	5	242		5175	11 315
1998	8	558	19	175	176		7069	-	125		5501	13 631
1999	16	596	n.a.	293	141		5077		240		3447	9810
2000	20	538	2	147	103		4780	7	74		3576	9246
2001		702		128	54		3613	6	61		3290	7854
2002	6	578	24	117			4509		59		3779	9072
2003	4	779	6	121	62		3122	5	23		2311	6433
2004		575	11	64	34		3753	2	15		1852	6306
2005		698	18	47	55		4078	4	12		1537	6449
2006		637	2	73	51		4443	3	55		1455	6719
2007		412	-	100	60		4109	3	31		1143	5858
2008		446	1	182	52		4726	12	20		1820	7259
2009		427	7	90	27		4613	7	19		2218	7408
2010		433		62	40		3914		28		1921	6398
2011		541		90	62		3790	8	18		1999	6508
2012		419		105	47		4591	6	28		1822	7018
2013		548		104	83		4273	5	15		2169	7197
2014*		404		182	53		5035	3	23		2046	7746

***Preliminary.**

[(1)] Includes IVb 1988–1993.

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Table 4.5.1. (continued).

LING IVbc

Year	Belgium	Denmark	France	Sweden	Norway	E & W	Scotland	Germany	Netherlands	Total
1988					100	173	106	-		379
1989					43	236	108	-		387
1990					59	268	128	-		455
1991					51	274	165	-		490
1992		261			56	392	133	-		842
1993		263			26	412	96	-		797
1994		177			42	40	64	-		323
1995		161			39	301	135	23		659
1996		131			100	187	106	45		569
1997	33	166	1	9	57	215	170	48		699
1998	47	164	5		129	128	136	18		627
1999	35	138	-		51	106	106	10		446
2000	59	101	0	8	45	77	90	4		384
2001	46	81	1	3	23	62	60	6	2	284
2002	38	91		4	61	58	43	12	2	309
2003	28	0		3	83	40	65	14	1	234
2004	48	71		1	54	23	24	19	1	241
2005	28	56		5	20	17	10	13		149
2006	26	53		8	16	20	8	13		144
2007	28	42	1	5	48	20	5	10		159
2008	15	40	2	5	87	25	15	11		200
2009	19	38	2	13	58	29	137	17	1	314
2010	23	55	1	13	56	26	10	17		201
2011	15	59	0		85	24	11	17		211
2012	12	45	1	10	84	25	7	8		192
2013	15	47	1	5	71	0	21	12	4	176
2014*	16	46	0	6	41	7	14	15	3	148

***Preliminary.**

Table 4.5.1. (continued).

LING VIa update for Spain.

Year	Belgium	Denmark	Faroes	France [1]	Germany	Ireland	Norway	Spain(2)	E&W	IOM	N.I.	Scot.	Total
1988	4	+	-	5381	6	196	3392	3575	1075	-	53	874	14 556
1989	6	1	6	3417	11	138	3858		307	+	6	881	8631
1990	-	+	8	2568	1	41	3263		111	-	2	736	6730
1991	3	+	3	1777	2	57	2029		260	-	10	654	4795
1992	-	1	-	1297	2	38	2305		259	+	6	680	4588
1993	+	+	-	1513	92	171	1937		442	-	13	1133	5301
1994	1	1		1713	134	133	2034	1027	551	-	10	1126	6730
1995	-	2	0	1970	130	108	3156	927	560	n/a		1994	8847
1996			0	1762	370	106	2809	1064	269			2197	8577
1997			0	1631	135	113	2229	37	151			2450	6746
1998				1531	9	72	2910	292	154			2394	7362
1999				941	4	73	2997	468	152			2264	6899
2000	+	+		737	3	75	2956	708	143			2287	6909

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Year	Belgium	Denmark	Faroes	France (1)	Germany	Ireland	Norway	Spain(2)	E&W	IOM	N.I.	Scot.	Total
2001				774	3	70	1869	142	106			2179	5143
2002				402	1	44	973	190	65			2452	4127
2003				315	1	88	1477	0	108			1257	3246
2004				252	1	96	791	2	8			1619	2769
2005			18	423		89	1389	0	1			1108	3028
2006			5	499	2	121	998	0	137			811	2573
2007			88	626	2	45	1544	0	33			782	3120
2008			21	1004	2	49	1265	0	1			608	2950
2009			30	418		85	828	116	1			846	2324
2010			23	475		164	989	3	0			1377	3031
2011			102	428		95	683	8				1683	2999
2012			30	585		47	542	862				1589	3655
2013			50	718		54	1429	899	10			1500	4660
2014*			0	937		39	1006	1005	6			1768	4761

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

Table 4.5.1. (continued).

LING VIb

Year	Faroes	France (2)	Germany	Ireland	Norway	Spain (3)	E & W	N.I.	Scotland	Russia	Total
1988	196		-	-	1253		93	-	223		1765
1989	17		-	-	3616		26	-	84		3743
1990	3		-	26	1315		10	+	151		1505
1991	-		-	31	2489		29	2	111		2662
1992	35		+	23	1713		28	2	90		1891
1993	4		+	60	1179		43	4	232		1522
1994	104		-	44	2116		52	4	220		2540
1995	66		+	57	1308		84		123		1638
1996	0		124	70	679		150		101		1124
1997	0		46	29	504		103		132		814
1998		1	10	44	944		71		324		1394
1999		26	25	41	498		86		499		1175
2000	+	18	31	19	1172		157		475	7	1879
2001	+	16	3	18	328		116		307		788
2002		2	2	2	289		65		173		533
2003		2	3	25	485		34		111		660
2004	+	9	3	6	717		6		141	182	1064
2005		31	4	17	628		9		97	356	1142
2006	30	4	3	48	1171		19		130	6	1411
2007	4	10	35	54	971		7		183	50	1314
2008*	69	6	20	47	1021		1		135	214	1513
2009	249	5	6	39	1859		3		439	35	2635
2010	215	2		34	2042		0		394		2687
2011	12	5		16	957		1		268		1259
2012	60	7		13	1089	3			218		1390
2013		19		8	532	6			229	1	795
2014*	60	7		10	435	2			258	2	774

***Preliminary. (1) Includes XII. (2) Until 1966 included in VIa. (3) Included in Ling VIa.**

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LING VII

Year	France	Total
1988	5057	5057
1989	5261	5261
1990	4575	4575
1991	3977	3977
1992	2552	2552
1993	2294	2294
1994	2185	2185
1995	-1	
1996	-1	
1997	-1	
1998	-1	
1999	-1	

***Preliminary.**

Table 4.5.1. (continued).

LING VIIa

YEAR	BELGIUM	FRANCE	IRELAND	E & W	IOM	N.I.	SCOTLAND	TOTAL
1988	14	-1	100	49	-	38	10	211
1989	10	-1	138	112	1	43	7	311
1990	11	-1	8	63	1	59	27	169
1991	4	-1	10	31	2	60	18	125
1992	4	-1	7	43	1	40	10	105
1993	10	-1	51	81	2	60	15	219
1994	8	-1	136	46	2	76	16	284
1995	12	9	143	106	1	-2	34	305
1996	11	6	147	29	-	-2	17	210
1997	8	6	179	59	2	-2	10	264
1998	7	7	89	69	1	-2	25	198
1999	7	3	32	29		-2	13	84
2000	3	2	18	25			25	73
2001	6	3	33	20			31	87
2002	7	6	91	15			7	119
2003	4	4	75	18			11	112
2004	3	2	47	11			34	97
2005	4	2	28	12			15	61
2006	2	1	50	8			27	88
2007	2	0	32	1			8	43
2008	1	0	13	1			0	15
2009	1	36	9	2			0	48
2010		28	15	1			0	44
2011	1	2	23	1			1	28
2012	2		11	1			0	14
2013	1		6				23	30
2014*	2	0	11				16	29

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

Table 4.5.1. (continued).

LING VII b, c

Year	France (1)	Germany	Ireland	Norway	Spain (3)	E & W	N.I.	Scotland	Total
1988	-1	-	50	57		750	-	8	865
1989	-1	+	43	368		161	-	5	577
1990	-1	-	51	463		133	-	31	678
1991	-1	-	62	326		294	8	59	749
1992	-1	-	44	610		485	4	143	1286
1993	-1	97	224	145		550	9	409	1434
1994	-1	98	225	306		530	2	434	1595
1995	78	161	465	295		630	-2	315	1944
1996	57	234	283	168		1117	-2	342	2201
1997	65	252	184	418		635	-2	226	1780
1998	32	1	190	89		393		329	1034
1999	51	4	377	288		488		159	1366
2000	123	21	401	170		327		140	1182
2001	80	2	413	515		94		122	1226
2002	132	0	315	207		151		159	964
2003	128	0	270			74		52	524
2004	133	12	255	163		27		50	640
2005	145	11	208			17		48	429
2006	173	1	311	147		13		23	668
2007	173	5	62	27		71		20	358
2008	122	16	44	0		14		63	259
2009	42		71	0		17		1	131
2010	34		82	0		6		131	253
2011	29		58			28		93	208
2012	126	1	39	230	370	1		246	1013
2013	267	2	46		379	136		180	1010
2014*	118		57		279	19		59	532

***Preliminary. (1) See Ling VII. (2) Included with UK (EW). (3) Included with VIIg–k until 2011.**

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Table 4.5.1. (continued).

LING VIId, e

Year	Belgium	Denmark	France (1)	Ireland	E & W	Scotland	Ch. Islands	Netherlands	Spain	Total
1988	36	+	-1	-	743	-				779
1989	52	-	-1	-	644	4				700
1990	31	-	-1	22	743	3				799
1991	7	-	-1	25	647	1				680
1992	10	+	-1	16	493	+				519
1993	15	-	-1	-	421	+				436
1994	14	+	-1	-	437	0				451
1995	10	-	885	2	492	0				1389
1996	15		960		499	3				1477
1997	12		1049	1	372	1	37			1472
1998	10		953		510	1	26			1500
1999	7		545	-	507	1				1060
2000	5		454	1	372		14			846
2001	6		402		399					807
2002	7		498		386	0				891
2003	5		531	1	250	0				787
2004	13		573	1	214					801
2005	11		539		236					786
2006	9		470		208					687
2007	15		428	0	267					710
2008*	5		348		214	2				569
2009	6		186		170			1		363
2010	4		144		138				8	294
2011	5		238		176				6	425
2012	7		255	1	164	2			7	436
2013	5		259		218					482
2014*	4		338	1	262					605

***Preliminary.**

Table 4.5.1. (continued).

LING VIIf

YEAR	BELGIUM	FRANCE [1]	IRELAND	E & W	SCOTLAND	TOTAL
1988	77	-1	-	367	-	444
1989	42	-1	-	265	3	310
1990	23	-1	3	207	-	233
1991	34	-1	5	259	4	302
1992	9	-1	1	127	-	137
1993	8	-1	-	215	+	223
1994	21	-1	-	379	-	400
1995	36	110	-	456	0	602
1996	40	121	-	238	0	399
1997	30	204	-	313		547
1998	29	204	-	328		561
1999	16	108	-	188		312
2000	15	91	1	111		218
2001	14	114	-	92		220
2002	16	139	3	295		453
2003	15	79	1	81		176
2004	18	73	5	65		161
2005	36	59	7	82		184
2006	10	42	14	64		130
2007	16	52	2	55		125
2008	32	88	4	63		187
2009	10	69	1	26		106
2010	10	42	0	17	0	69
2011	20	39	2	94		155
2012	28	80	<1	59	<1	167
2013	22	68	1	93	40	224
2014*	61	182	0	91		334

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

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Table 4.5.1. (continued).

LING VIIg–k

Year	Belgium	Denmark	France	Germany	Ireland	Norway	Spain [(2)]	E&W	IOM	N.I.	Scot.	Total
1988	35	1	-1	-	286	-	2652	1439	-	-	2	4415
1989	23	-	-1	-	301	163		518	-	+	7	1012
1990	20	+	-1	-	356	260		434	+	-	7	1077
1991	10	+	-1	-	454	-		830	-	-	100	1394
1992	10	-	-1	-	323	-		1130	-	+	130	1593
1993	9	+	-1	35	374			1551	-	1	364	2334
1994	19	-	-1	10	620		184	2143	-	1	277	3254
1995	33	-	1597	40	766	-	195	3046		-3	454	6131
1996	45	-	1626	169	771		583	3209			447	6850
1997	37	-	1574	156	674		33	2112			459	5045
1998	18	-	1362	88	877		1669	3465			335	7814
1999	-	-	1220	49	554		455	1619			292	4189
2000	17		1062	12	624		639	921			303	3578
2001	16		1154	4	727	24	559	591			285	3360
2002	16		1025	2	951		568	862			102	3526
2003	12		1240	5	808		455	382			38	2940
2004	14		982		686		405	335			5	2427
2005	15		771	12	539		399	313			4	2053
2006	10		676		935		504	264			18	2407
2007	11		661	1	430		423	217			6	1749
2008	11		622	8	352		391	130			27	1541
2009	7		183	6	270		51	142			14	673
2010	10		108	1	279		301	135			14	848
2011	15		260		465		16	157			23	936
2012	23		584	2	516		201	138			56	1520
2013	24		622		495		190	74			203	1608
2014*	13		535		445		177	185			202	1557

***Preliminary. [(1)] See Ling VII. [(2)] Includes VIIb, c until 2011. [(3)] Included in UK (EW).**

Table 4.5.1. (continued).

LING VIII

Year	Belgium	France	Germany	Spain	E & W	Scot.	Total
1988		1018			10		1028
1989		1214			7		1221
1990		1371			1		1372
1991		1127			12		1139
1992		801			1		802
1993		508			2		510
1994		n/a		77	8		85
1995		693		106	46		845
1996		825	23	170	23		1041
1997	1	705	+	290	38		1034
1998	5	1220	-	543	29		1797
1999	22	234	-	188	8		452
2000	1	227		106	5		339
2001		245		341	6	2	594
2002		316		141	10	0	467
2003		333		67	36		436
2004		385		54	53		492
2005		339		92	19		450
2006		324		29	45		398
2007		282		20	10		312
2008		294		36	15	3	345
2009		150		29	7		186
2010		92		31	11		134
2011		148		47	6		201
2012		349		201	2		552
2013		281		139	35	4	459
2014*		280		110	4	1	395

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LING IX

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

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Table 4.5.1. (continued).

LING XII

Year	Faroes	France	Norway	E & W	Scotland	Germany	Ireland	Total
1988				-				0
1989				-				0
1990				3				3
1991				10				10
1992				-				0
1993				-				0
1994				5				5
1995	5			45				50
1996	-		2					2
1997	-		+	9				9
1998	-	1	-	1				2
1999	-	0	-	-	+	2		2
2000		1	-		6			7
2001		0	29	2	24		4	59
2002		0	4	4	0			8
2003			17	2	0			19
2004								
2005				1				1
2006	1							1
2007								0
2008								0
2009		0	1					1
2010								0
2011		1						1
2012	3						1	4
2013								0
2014*								

Table 4.5.1. (continued).

LING XIV

Year	Faroes	Germany	Iceland	Norway	E & W	Scotland	russia	Total
1988		3	-	-	-	-		3
1989		1	-	-	-	-		1
1990		1	-	2	6	-		9
1991		+	-	+	1	-		1
1992		9	-	7	1	-		17
1993		-	+	1	8	-		9
1994		+	-	4	1	1		6
1995	-	-		14	3	0		17
1996	-			0				0
1997	1			60				61
1998	-			6				6
1999	-			1				1
2000			26	-				26
2001	1			35				36
2002	3			20				23
2003				83				83
2004				10				10
2005								0
2006								0
2007				5				5
2008					1		1	2
2009	+	3						3
2010		3						3
2011	2			1				3
2012	1		105					106
2013								0
2014*	2014*	1	6	1	1			9

***Preliminary.**

Table 4.5.2 Ling. Total landings by subarea or division.

Year	III	IVa	IVbc	VIa	VIb	VII	VIIa	VIIbc	VIIde	VIIf	VIIg-k	VIII	IX	XII	XIV	All areas
1988	331	11 223	379	14 556	1765	5057	211	865	779	444	4415	1028		0	3	41 056
1989	422	11 677	387	8631	3743	5261	311	577	700	310	1012	1221		0	1	34 253
1990	543	10 027	455	6730	1505	4575	169	678	799	233	1077	1372		3	9	28 175
1991	484	9969	490	4795	2662	3977	125	749	680	302	1394	1139		10	1	26 777
1992	549	10 763	842	4588	1891	2552	105	1286	519	137	1593	802		0	17	25 644
1993	642	12 810	797	5301	1522	2294	219	1434	436	223	2334	510		0	9	28 531
1994	469	11 496	323	6730	2540	2185	284	1595	451	400	3254	85		5	6	29 823
1995	412	13 041	659	8847	1638		305	1944	1389	602	6131	845		50	17	35 880
1996	402	12 705	569	8577	1124		210	2201	1477	399	6850	1041		2	0	35 557
1997	311	11 315	699	6746	814		264	1780	1472	547	5045	1034	0	9	61	30 097
1998	214	13 631	627	7362	1394		198	1034	1500	561	7814	1797	2	2	6	36 142
1999	216	9810	446	6899	1175		84	1366	1060	312	4189	452	1	2	1	26 013
2000	228	9246	384	6909	1879		73	1182	846	218	3578	339	1	7	26	24 916
2001	262	7854	284	5143	788		87	1226	807	220	3360	594	0	59	36	20 720
2002	263	9072	309	4127	533		119	964	891	453	3526	467	0	8	23	20 756
2003	261	6433	234	3246	660		112	524	787	176	2940	436		19	83	15 912
2004	232	6306	241	2769	1064		97	640	801	161	2427	492		0	10	15 240
2005	210	6449	149	3028	1142		61	429	786	184	2053	450		1	0	14 942
2006	188	6719	144	2573	1411		88	668	687	130	2407	398		1	0	15 414
2007	174	5858	159	3119	1314		43	358	710	125	1749	312		0	5	13 927
2008	168	7259	200	2950	1551		15	259	569	187	1541	345		0	1	15 045
2009	149	7408	314	2324	2635		48	131	363	106	673	186		1	3	14 341
2010	142	6398	201	3031	2687		44	253	294	69	848	134		0	3	14 104
2011	140	6508	211	2999	1259		28	208	425	155	936	201		0	3	13 073
2012	145	7018	192	3655	1390		14	1013	436	167	1520	552		0	106	16 208
2013	130	7197	176	4660	795		30	1010	482	224	1608	459		0	0	16 771
2014	134	7746	148	4761	774		29	532	605	334	1557	395		0	9	17 024

***Preliminary**

Table 4.5.3. Number of French fishing vessels (otter trawlers, gillnetters and longliners) during the period 2000–2014.

Numbers of ships	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Otter trawlers	65	77	66	61	52	46	44	42	37	38	29	32	36	33	33
Gillnetters	12	13	15	19	22	24	20	20	20	20	21	18	15	14	13
Longliners	1	2	3	2	0	1	6	7	7	6	2	3	4	8	9

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

5.1 Stock description and management units

Biological investigations in the early 1980s suggested that at least two adult stock components were found within the area, a northern stock in Subarea XIV and Division Va with a small component in Vb, and a southern stock in Subarea VI and adjacent waters in Division Vb. 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 in each of areas of the northern and southern stocks and elsewhere suggest further stock separation. However, in most areas small blue ling below 60 cm do not occur and fish appear in survey and commercial catch at 60–80 cm suggesting scale large spatial migrations and therefore limited population structuring. The conclusion is that stock structure is uncertain within the areas under consideration.

As in previous years, in addition to one stock in Division Vb and Subareas VI and VII and one in Division Va and XIV. All remaining areas are grouped together as “other areas". This latter unit includes Subareas I and II and Division IVa and IIIa were historical landing have been significant and southern areas, VIII, IX and X were the species do not occur. Landings reported in VIII, IX and X can be ascribed to the related Spanish ling (*Molva macrophtalma*). The situation in XII is different as this Subarea includes part of the Mid-Atlantic Ridge (XIIa1, XIIa2, XIIa4 and XIIc) and the western slope of the Hatton Bank (XIIc). None of these have represented major landings in the 2000s. However, based upon the continuity of bathymetric features and lesser abundance, blue ling from the western Hatton Bank is likely to be similar to those from the northern Hatton Bank (VIb). Therefore, including ICES Division XIIb in the assessment unit Vb, VI and VII could be considered. Because of the much lesser abundance of blue ling on the Hatton Bank, this should not have a major impact on stock modelling.

Historical total international landings show that blue ling have been exploited for long (Figure 5.1.1). Before the start of the time-series used by WGDEEP, Norway landed 1000–2000 t per year in the 1950s and 1960s might have been from Subareas I and II. German landings starting in the 1950s were mainly reported in Statlant from ICES Division Va and Vb. Except in a few recent years where large amount where caught in Division Va, the stock unit of Division Vb and Subareas VI and VII have had the main contribution to total landings (Figure 5.1.2).

Blue ling is known to form spawning aggregations. From 1970 to 1990, the bulk of the fishery for blue ling was seasonal fisheries targeting these aggregations which were subject to sequential depletion. Known spawning areas are shown in Figure 5.1.3. In Iceland, the depletion of the spawning aggregation in a few years was documented (Magnússon and Magnússon, 1995) and blue ling is an aggregating species at spawning time. To prevent depletion of adult populations temporal closures have been set both in the Icelandic and EU EEZs.

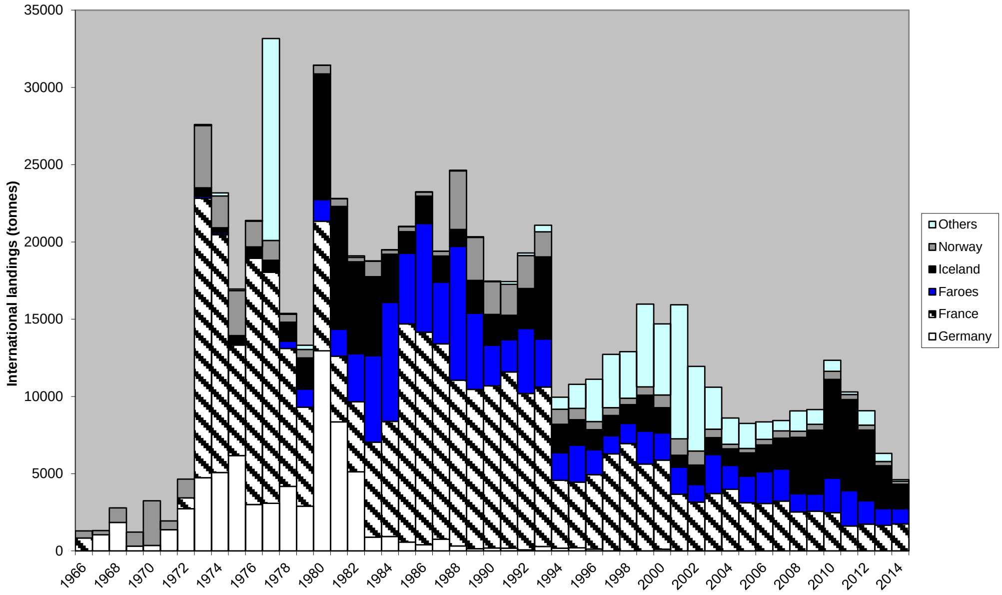

Figure 5.1.1. Total international landings of blue ling in the Northeast Atlantic, by country, 1966–2014.

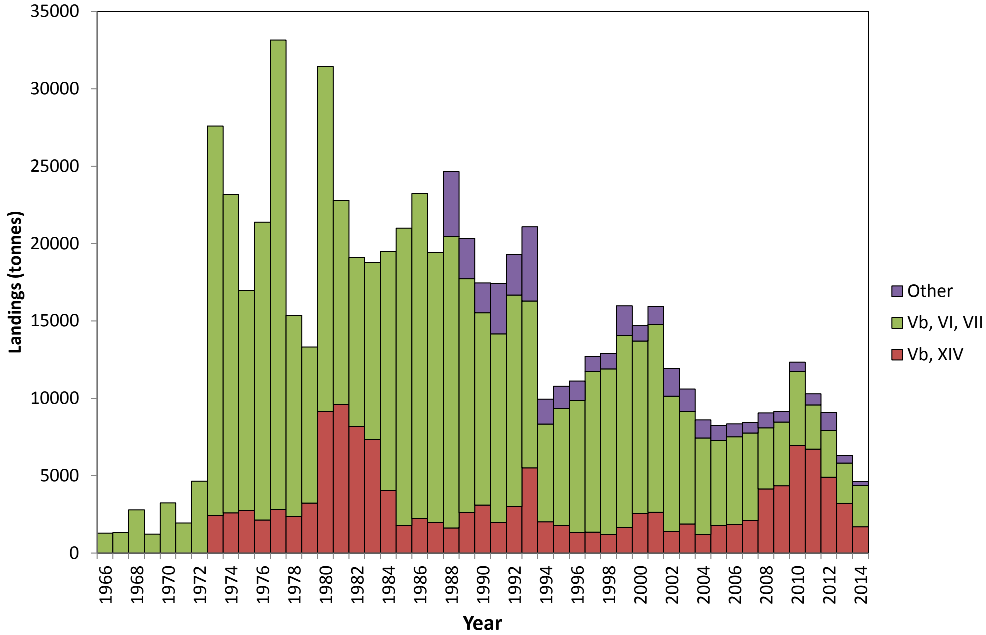

Figure 5.1.2. Total international landings of blue ling in the Northeast Atlantic, by stock unit, 1966–2014.

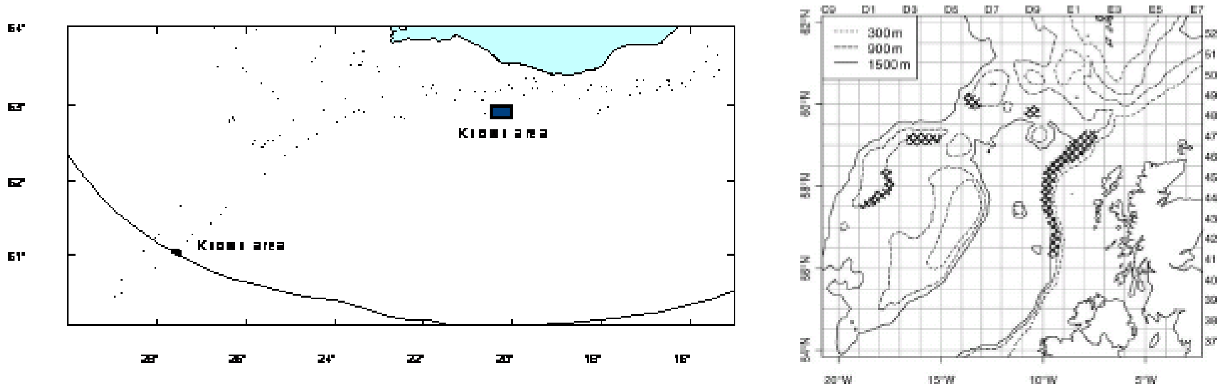

Figure 5.1.3. Known spawning areas of blue ling in Icelandic water (a) and to the West of Scotland (b, from Large *et al.*, 2010).

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

5.2.1 The fishery

The change in geographical distribution of the Icelandic blue ling fisheries from 1999, to 2014 (Figure 5.2.1 and 5.2.2) indicates that there has been an expansion of the fishery of blue ling to northwestern waters. This increase may partly be the result of increased availability of blue ling in the north-western area, but more likely because of an increase in effort or reporting.

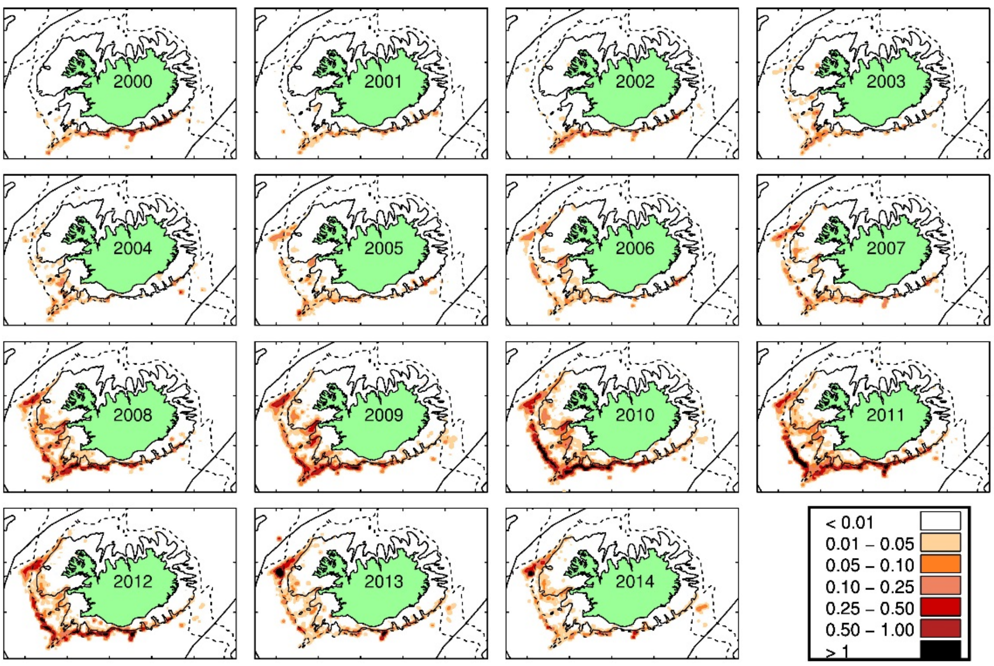

Figure 5.2.1. Blue ling in Va and XIV. Geographical distribution (tonnes/square mile) of the Icelandic blue line fishery since 1998 as reported in logbooks. All gear types combined.

Before 2008 the majority of the catches of blue ling in Va were by trawlers, as bycatch in fisheries targeting Greenland halibut, redfish, cod and other demersal species (Table 5.2.3). Most of the catches by trawlers are taken in waters shallower than 700 m and by longliners until 2008 mostly at depths shallower than 600 m.

After 2007 there was a substantial change in the fishery for blue ling in Va (Table 5.2.3). The proportion of catches taken by longliners increased from 7–20% in 2001–2007 to around 70% in 2011 as longliners started targeting blue ling. The trend has reversed and in 2014 the proportion of longline catches decreased to 39%. At the same time longliners have started fishing in deeper waters than before 2008 and since then the bulk of the longline catches have been taken at depths greater than 500 m (Figure 5.2.3).

Historically the fisheries in Subarea XIV have been relatively small but highly variable.

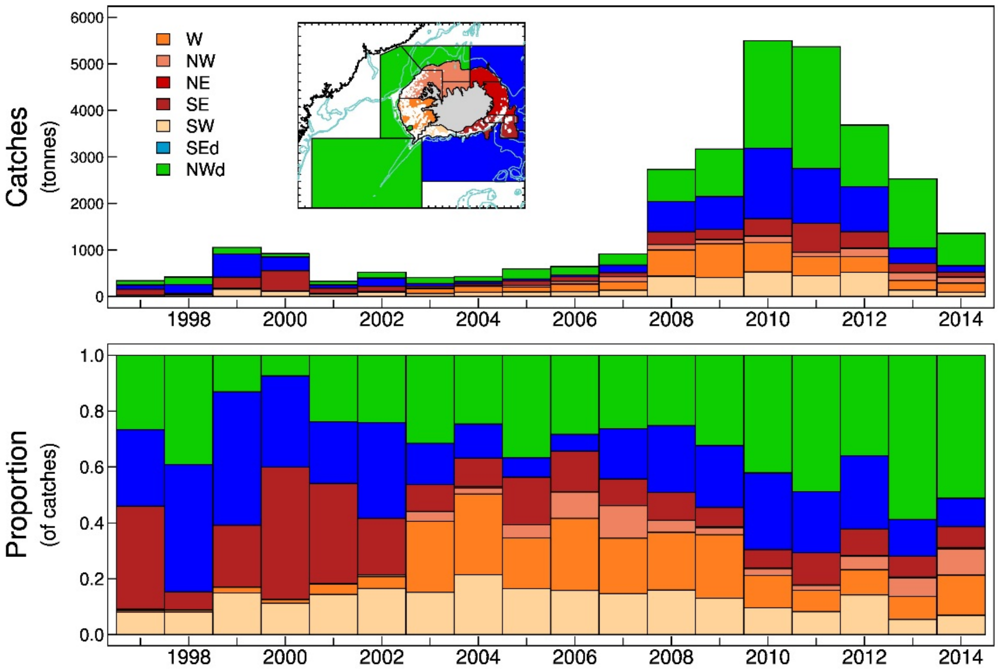

Figure 5.2.2. Blue ling in Va and XIV. Spatial distribution of reported catches in Va in tonnes (upper) and as annual proportions (lower). The inserted map shows the area division and location of operations in 2013 (hauls and lines) as white points.

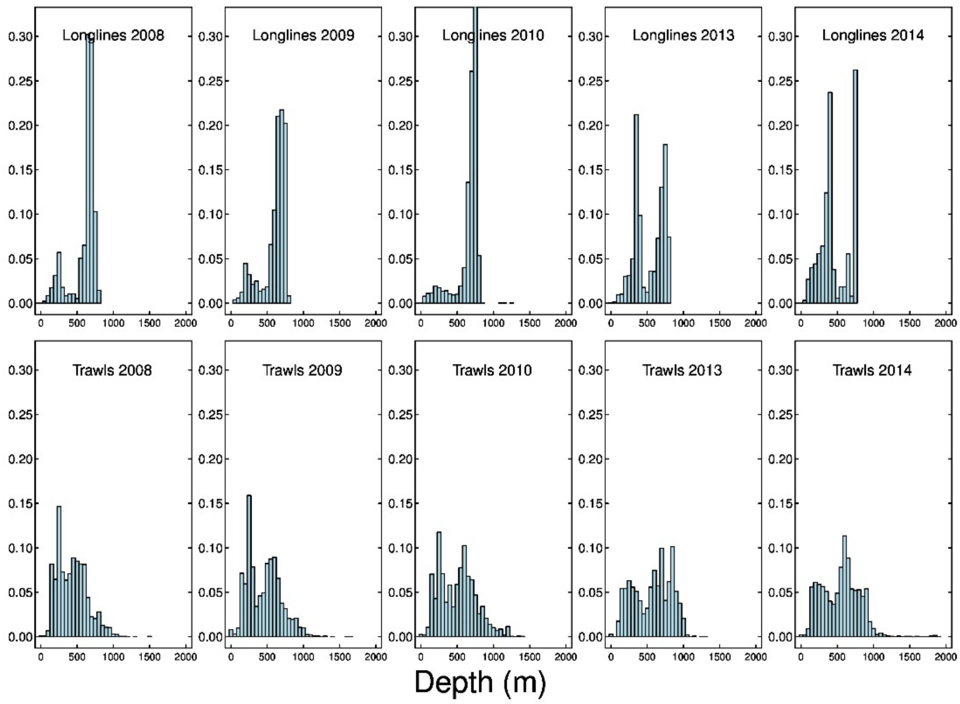

Figure 5.2.3. Blue ling in Va and XIV. Depth distribution of longlines (upper row) and trawls (lower row) catches in Va according to logbook entries.

5.2.2 Landings trends

The preliminary total landings in Va 2014 were 1689 t of which the Icelandic fleet caught 1588 t. (Table 5.2.2 and Figure 5.2.4). Catches of blue ling in Va increased by more than 370% between 2006 and 2010, the main part of this increases can be attributed to increased targeting of blue ling by the longline fleet. Since then catches in Va decreased compared to 2010 or by around 3600 tonnes (Table 5.2.3).

Total international landings from XIV (Table 5.2.2) have been highly variable over the years, ranging from a few tonnes in some years to around 3700 t in 1993 and 950 t in 2003. Most of the landings in 2003 were taken by Spanish trawlers (390 t), but there is no further information available on this fishery. These larger landings are very occasional and in most years total international landings have been between 50 and 200 t. Preliminary landings in 2014 were 3 t.

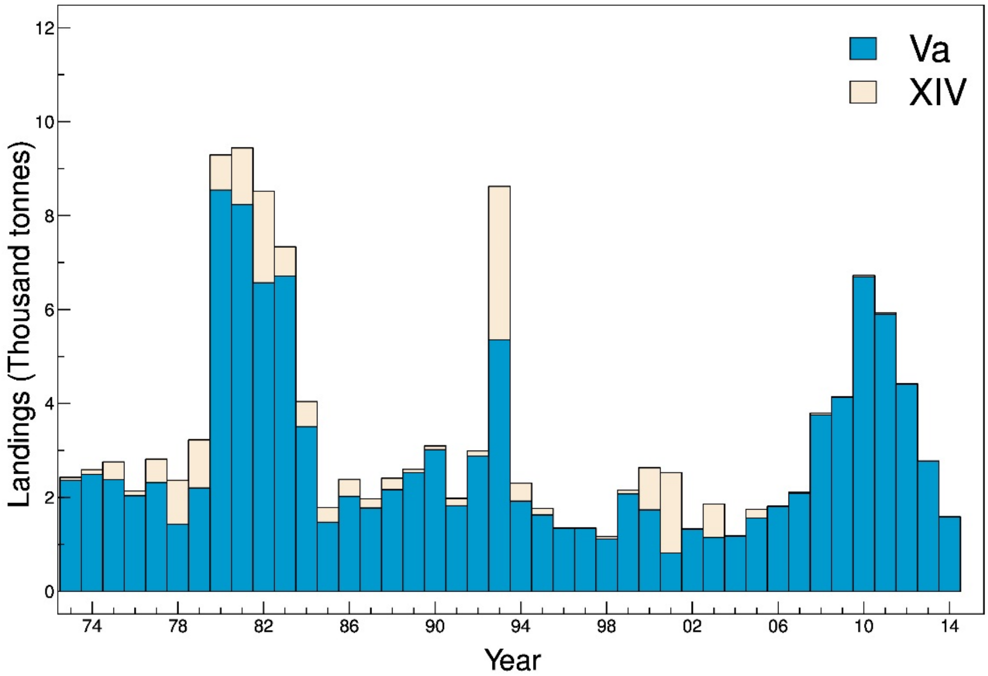

Figure 5.2.4. Blue ling in Va and XIV. Nominal landings.

5.2.3 ICES Advice

The ICES advice for 2015 is: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 3085 tonnes. Area closures to protect spawning aggregations should be maintained and expanded as appropriate.

The basis for the advice was the following: For data-limited stocks with reliable abundance information from fisheries-independent data and a target F_{proxy}, where abundance is considered above MSY $B_{trigger}$, ICES uses a harvest control rule that calculates catches based on the F_{proxy} target multiplied by the most recent survey biomass estimates.

For this stock the F_{proxy} of 1.7 is applied as a factor to the 2013 biomass estimate of 1762 t, resulting in catch advice of no more than 3085 t. ICES does not implement the uncertainty cap of 20% used for other data-limited stocks because recently the fishing mortality increased far above what is considered the F_{MSY} proxy.

The 20% precautionary buffer is therefore not applied because the stock is above possible reference points and an F_{MSY} proxy is used.

5.2.4 Management

Before the 2013/2014 fishing year the Icelandic fishery was not regulated by a national TAC or ITQs. The only restrictions on the Icelandic fleet regarding the blue ling fishery were the introduction of closed areas in 2003 to protect known spawning locations of blue ling, which are in effect. As of the 2013/2014 fishing year, blue ling is regulated by the ITQ system (regulation 662/2013) used for many other Icelandic stocks such as cod, haddock, tusk and ling. The TAC for the 2014/2015 fishing year was set at 3100 based on the recommendations of MRI using the same advisory procedure as in 5.2.3.

5.2.5 Data available

In general sampling is considered adequate from commercial catches from the main gears (longlines and trawls). The sampling does seem to cover the spatial distribution of catches for longlines and trawls. Similarly sampling does seem to follow the temporal distribution of catches (WGDEEP 2012).

5.2.5.1 Landings and discards

Landings data are given in Tables 5.2.1 and 5.2.2. Discarding is banned in the Icelandic fishery. There is no available information on discarding of blue ling in Va and XIV. Being a relatively valuable species and not being subjected to TAC constraints before 2013/2014 fishing year nor minimum landing size there should be little incentive to discard blue ling in Va.

5.2.5.2 Length compositions

Length distributions from the Icelandic trawl and longline catches for the period 1999–2014 are shown in Figure 5.2.5. Mean length from trawls has varied from about 75 cm to 86 cm in the period without any obvious trend. On average mean length from longlines is higher than from trawls.

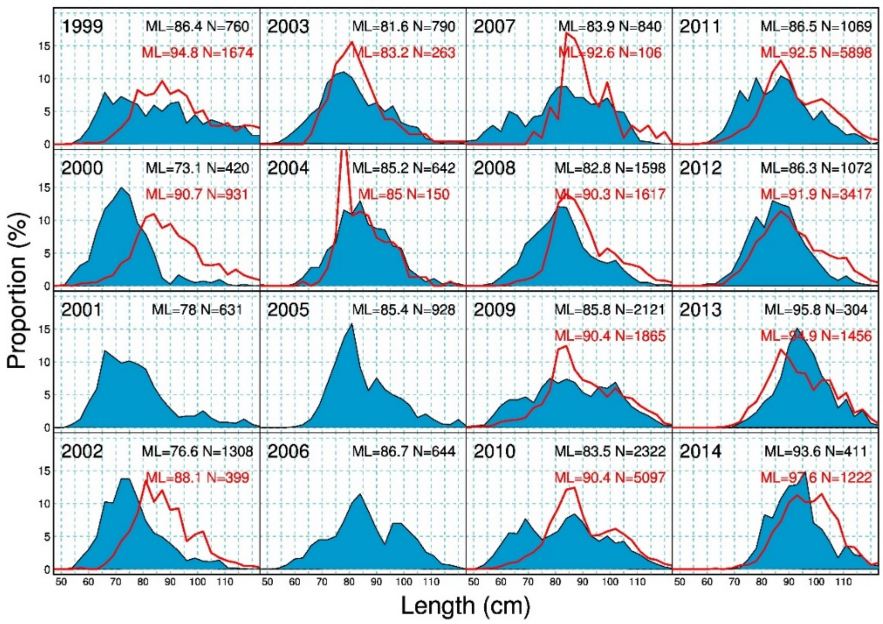

Figure 5.2.5. Blue ling in Va and XIV. Length distribution of blue ling from trawls (blue area) and longlines (red lines) of the Icelandic fleet in Va since 1999. The number of measured fish (N) and mean length (ML) is also given.

5.2.5.3 Age compositions

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

5.2.5.4 Weight-at-age

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

5.2.5.5 Maturity and natural mortality

Length at 50% maturity is estimated at roughly 77 cm and the range for 10–90% maturity is 65–90 cm.

No information is available on natural mortality (*M*).

5.2.5.6 Catch, effort and survey data

Effort and nominal cpue data from the Icelandic trawl and longline fleet are given in Figure 5.2.6. Due to changes in the fishery (expansion into new areas, fleet behaviour, etc) and technical innovations cpue is not considered a reliable index of biomass abundance of blue ling in Va and therefore no attempt has been made to standardize the series. However looking at fluctuations in cpue and effort may be informative in regards to the development of the fishery. Cpue from longlines has remained high since 2008. No marked changes are observed from trawls since 2000.

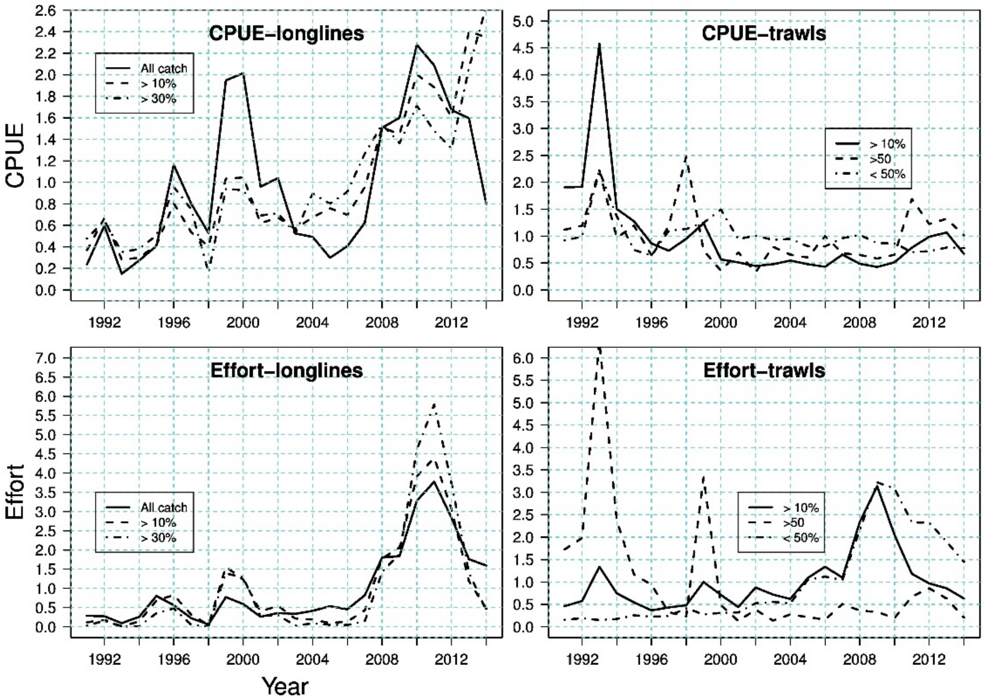

Figure 5.2.6. Blue ling in Va and XIV. Nominal cpue and effort from longlines and trawls in Va based on logbook data where blue ling was either recorded in catches or above certain level.

Time-series stratified abundance and biomass indices from the spring and autumn trawl surveys are shown in Figure 5.2.7 and length distributions from the autumn survey and its spatial distribution in Figures 5.2.8 and 5.2.9. Due to industrial action in 2011 the autumn survey was cancelled after about one week of survey time. Therefore no estimates are presented for 2011.

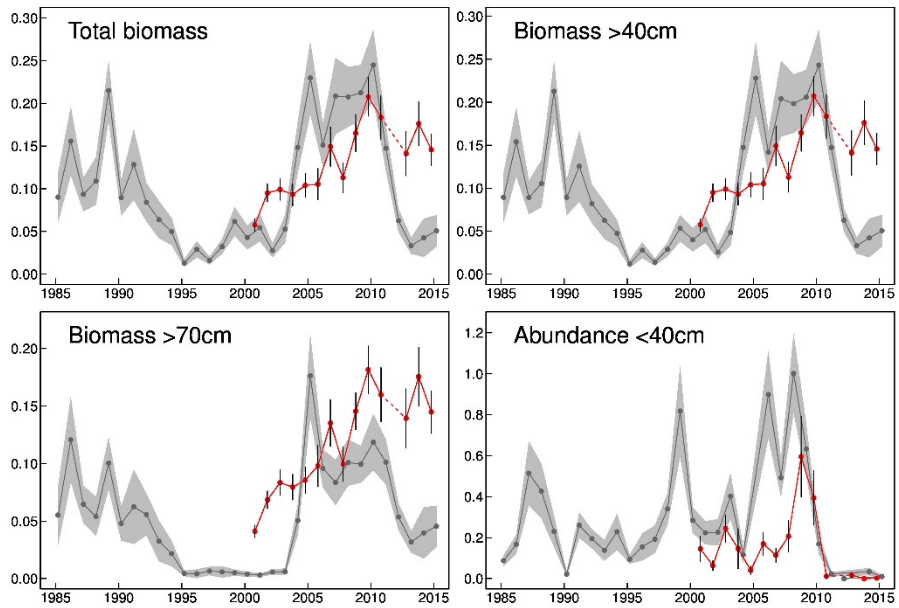

Figure 5.2.7. Blue ling in Va and XIV. Abundance indices for blue ling in the Icelandic spring survey since 1985 (line and shaded area) and the autumn survey since 2000 (red points and vertical lines). A) total biomass index, b) biomass of 40 cm and larger c) biomass of 70 cm and larger, d) abundance index of <40 cm. The shaded area and the vertical bar show +/- standard error of the estimate.

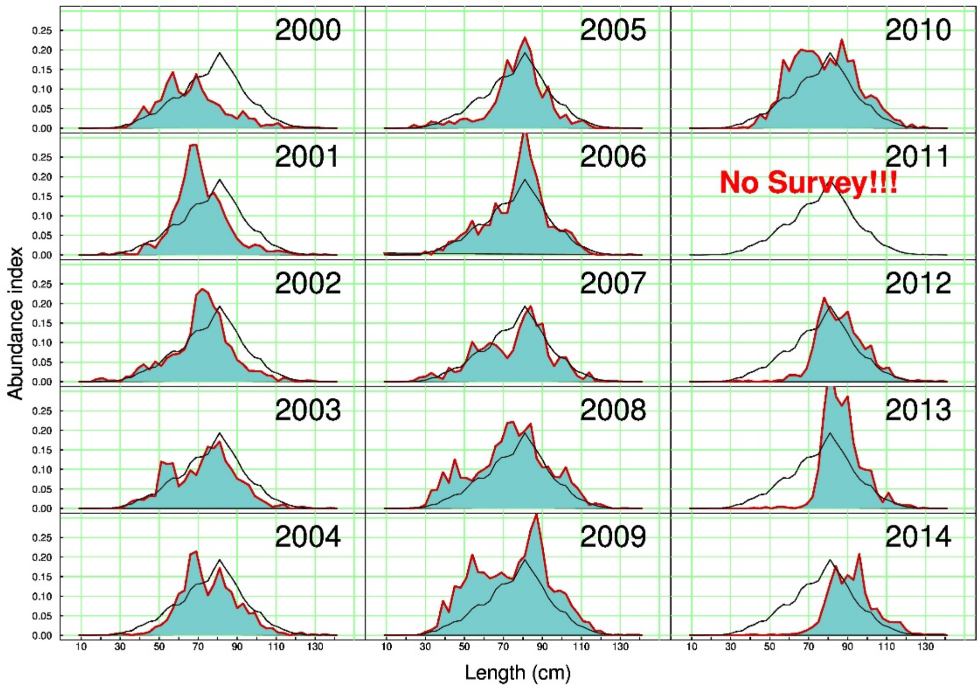

Figure 5.2.8. Blue ling in Va and XIV. Length distributions from the Icelandic autumn survey since 2000. Black line is the average by length over the whole survey period.

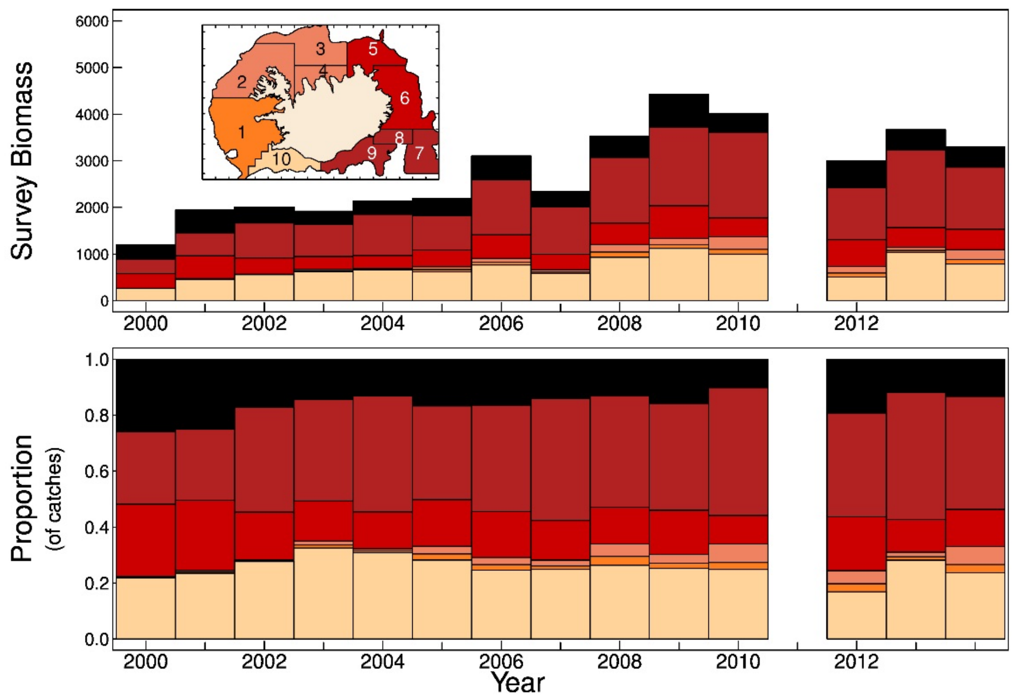

Figure 5.2.9. Blue ling in Va and XIV. Spatial distribution from the Icelandic autumn survey.

5.2.6 Data analyses

Landings and sampling

Catches from the Icelandic longline fleet increased rapidly from 2007 to 2010 resulting in a rapid expansion of the fishing area and change in the selectivity of the fishery even though there are now strong indications since 2012 that this may have reversed. This can be seen when looking at Table 5.2.3. In 2005 longliners caught 102 tonnes of blue ling when trawlers caught 1260 tonnes or 84% of the total catches (1505 tonnes). In 2011 trawlers caught 1618 tonnes, out of 5900 tonnes or 27%, but longliners 4138 tonnes or 70%. In 2013 the proportions caught by each gear were close to 1:1 and in 2014 catches are down to 1590 tonnes with the majority taken by trawlers (911 tonnes or 57% of the total catch).

As longliners take on average larger blue ling (Figure 5.2.5) this will have resulted in an overall change in the selection pattern since 2007. Total catches by the Icelandic fleet decreased between 2010 and 2013 and this decrease is mainly the result of decrease in trawls in 2011 but in longlines in 2012 and 2013. The expansion of the longline fleet to deeper waters (Figure 5.2.3) may be the result of decreased catch rates in shallower areas. However it may also be the result or wrong recording of depth by captains (metres vs. fathoms).

Cpue and effort

As stated above cpue indices from commercial catches are not considered a reliable index of stock abundance. Therefore the rapid increase in cpue from longlines should not be viewed as an increase in stock biomass but rather as the result of increased interest by the longline fleet and its expansion into deeper waters (Figure 5.2.6). In 2011 to 2012 there was a slight decrease in cpue from longline but the cpue increased again in 2013 to its highest value in the time-series. Cpue from trawling has remained at low levels while effort has been increasing.

Surveys

The spring survey covers only the shallower part of the depth distributional range of blue ling and shows high interannual variance (Figure 5.2.7). It is thus unknown to what extent the spring indices reflect actual changes in total blue ling biomass, given that it does not cover the depths were largest abundance of blue ling occur. It is however not driven by isolated large catches at a few survey stations.

The shorter autumn survey, which goes to greater depths and is therefore more likely to reflect the true biomass dynamics than the spring survey does indicate that there was an increase in blue ling biomass since 2007 (Figure 5.2.7). In 2010 to 2012 the index has decreased slightly. In 2014 then index is at similar level as in 2012 after a slight increase in 2013. A large increase of more than 200% in the recruitment index was observed in 2008 but in the 2010 to 2013 autumn survey it had decreased again to its lowest observed value (Figures 5.2.7 and 5.2.8). Due to industrial action only part of the autumn survey was conducted in 2011.

F_{proxy}

Relative fishing mortality (F_{proxy} = Yield/Survey biomass) derived from the autumn survey (+40 cm) and the combined catches from Va and XIV indicates that fishing mortality may have increased by more than 150% between 2007–2010 (Figure 5.2.10 and Table 5.2.4). Since then there are indications that it may have decreased by similar percentage between 2012 and 2014, to the same levels as observed in 2002 and 2009. The reason for the decrease is because of proportionally greater decrease in landings than in the survey index.

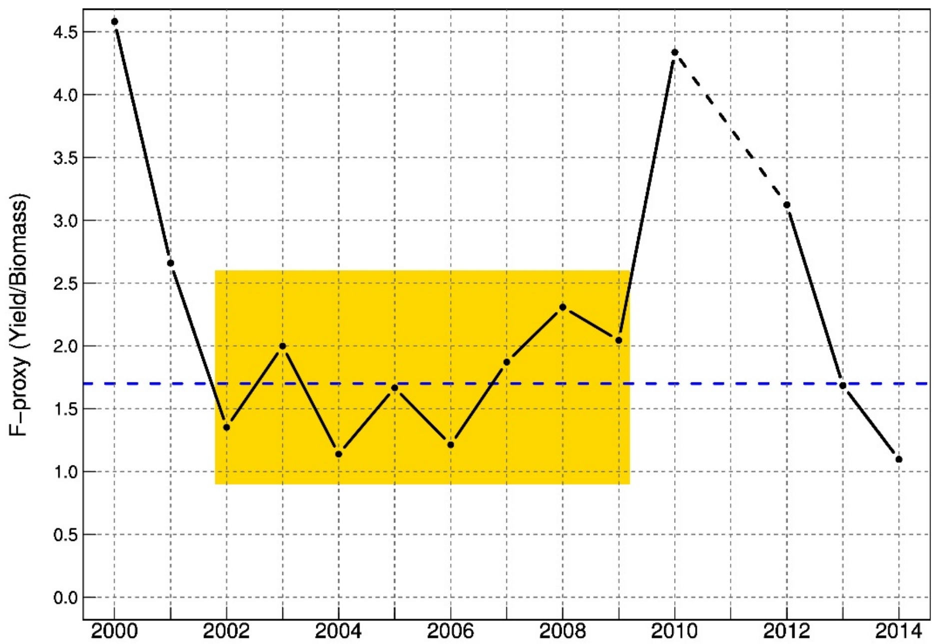

Figure 5.2.10. Blue ling in Va and XIV. Changes in relative fishing mortality (Yield/Survey biomass >39 cm). The yellow box highlights the reference period used by ICES as basis for the 2012 advice and the blue dotted line is the target F_{proxy} of 1.75 (Mean of 2002 to 2009).

Analytical assessment

Exploratory stock assessment on Blue ling in Va and XIVb using Gadget

An exploratory stock assessment of blue ling in Va using the Gadget model was presented at WGDEEP 2012. Updated results of the model were not presented at WGDEEP 2015.

5.2.7 Comments on the assessment

The assessment presented above is based on the ICES DLS approach for category 3 stocks and was proposed by the ADG in 2012. In the 2012 advice the target F_{proxy} was set at 1.7 or the average F_{proxy} in 2002 to 2009, however the landings from XIV were not correct and using the revised landings the target should be 1.75.

The autumn survey index in 2014 was 1455.8. Using the same procedure as last year would result in the advice for 2016 to set the TAC at 2548 t (1455,8 * 1,75).

5.2.8 Management considerations

Landings have decreased considerably in the last year and as blue ling in Va is now part of the ITQ system such a rapid increase in landings as observed between 2006 to 2011 is unlikely. Blue ling is caught in mixed fisheries by the trawler fleet, mainly targeting redfish and Greenland halibut. After the inclusion of blue ling in the ITQ system the longliners have shifted from a directed fishery to a more mixed fishery for the species. Because of the restrictions of the TAC the implications of low blue ling TAC for the trawlers can be considerable, even though the species is a low percentage in their catches.

Closure of known spawning areas in should be maintained and expanded where appropriate.

Table 5.2.1. Blue ling: Landing in ICES Division Va.

Year	Faroe	Germany	Iceland	Norway	UK	Total
1973	74	1678	548	6	61	2367
1974	34	1959	331	140	32	2496
1975	69	1418	434	366	89	2376
1976	29	1222	624	135	28	2038
1977	39	1253	700	317	0	2309
1978	38	0	1237	156	0	1431
1979	85	0	2019	98	0	2202
1980	183	0	8133	83	0	8399
1981	220	0	7952	229	0	8401
1982	224	0	5945	64	0	6233
1983	1195	0	5117	402	0	6714
1984	353	0	3122	31	0	3506
1985	59	0	1407	7	0	1473
1986	69	0	1774	8	0	1851
1987	75	0	1693	8	0	1776
1988	271	0	1093	7	0	1371
1989	403	0	2124	5	0	2532
1990	1029	0	1992	0	0	3021
1991	241	0	1582	0	0	1823
1992	321	0	2584	0	0	2905
1993	40	0	2193	0	0	2233
1994	89	1	1542	0	0	1632
1995	113	3	1519	0	0	1635
1996	36	3	1284	0	0	1323
1997	25	0	1319	0	0	1344
1998	59	9	1086	0	0	1154
1999	31	8	1525	8	11	1583
2000	0	7	1605	25	8	1645
2001	95	12	752	49	23	931
2002	28	4	1256	74	10	1372
2003	16	16	1098	6	24	1160
2004	38	9	1083	49	20	1199
2005	24	25	1497	20	26	1592
2006	63	22	1734	27	9	1855
2007	78	0	1999	4	10	2091
2008	88	0	3653	21	0	3763
2009	178	0	4132	5	0	4315
2010	515	0	6377	13	0	6905
2011	797	0	5903	2	0	6702
2012	312	0	4207	2	0	4521
2013	435	0	2769	2	0	3204
2014[1)]	71	0	1588	30	0	1689

[1)] **Provisional figures.**

Table 5.2.2. Blue ling: Landing in ICES Division XIV. Source: STATLANT database.

YEAR	FAROE	GERMANY	GREENLAND	ICELAND	NORWAY	RUSSIA	SPAIN	UK	DENMARK	TOTAL
1973	0	50	0	10	0	0	0	0	0	60
1974	0	90	0	6	0	0	0	0	0	96
1975	0	285	0	90	3	0	0	0	0	378
1976	0	65	0	21	0	0	0	13	0	99
1977	0	491	0	0	0	0	0	6	0	497
1978	0	933	0	0	4	0	0	0	0	937
1979	0	1026	0	0	0	0	0	0	0	1026
1980	0	746	0	0	0	0	0	0	0	746
1981	0	1206	0	0	0	0	0	0	0	1206
1982	0	1946	0	0	0	0	0	0	0	1946
1983	0	621	0	0	0	0	0	0	0	621
1984	0	537	0	0	0	0	0	0	0	537
1985	0	315	0	0	0	0	0	0	0	315
1986	214	149	0	0	0	0	0	0	0	363
1987	0	199	0	0	0	0	0	0	0	199
1988	21	218	3	0	0	0	0	0	0	242
1989	13	58	0	0	0	0	0	0	0	71
1990	0	64	5	0	0	0	0	10	0	79
1991	0	105	5	0	0	0	0	45	0	155
1992	0	27	2	0	50	0	0	32	0	111
1993	0	16	0	3124	103	0	0	22	0	3265
1994	1	15	0	300	11	0	0	57	0	384
1995	0	5	0	117	0	0	0	19	0	141
1996	0	12	0	0	0	0	0	2	0	14
1997	1	1	0	0	0	0	0	2	0	4
1998	48	1	0	0	1	0	0	6	0	56
1999	0	0	0	0	1	0	66	7	0	74
2000	0	1	0	4	0	0	889	2	0	896
2001	1	0	0	11	61	0	1631	6	0	1710
2002	0	0	0	11	1	0	0	0	0	12
2003	0	0	0	0	36	0	670	5	0	711
2004	0	0	0	0	1	0	0	7	0	8
2005	2	0	0	0	1	0	176	8	0	187
2006	0	0	0	0	3	1	0	0	0	4
2007	19	0	0	0	1	0	0	0	0	20
2008	1	0	0	0	2	0	381	0	1	385
2009	1	0	0	0	3	0	111	4	0	119
2010	1	0	0	0	9	0	34	0	3	47
2011	0	0	0	0	2	0	0	1	6	9
2012	0	0	0	367	9	0	0	0	3	379
2013	0	0	4	0	0	0	0	3	9	16
2014[1]	0	0	0	0	3	0	0	0	0	3

[1)] Provisional figures.

Table 5.2.3. Blue ling. Catches by gear type and numbers of boats participating in the blue ling fishery in Va.

Year	Longline	Trawl	Other gear	Total landings	Longliners		Trawlers	
	(tonnes)	(tonnes)	(tonnes)	(tonnes)	No boats	Hooks (mill.)	No. boats	Hrs (thous)
2000	804	797	25	1626	15	5.6	23	2.1
2001	129	576	51	756	15	2.3	26	1.6
2002	255	980	22	1257	12	2.8	30	3.1
2003	197	879	22	1098	9	1.4	37	2.7
2004	145	891	44	1080	10	2.1	39	2.8
2005	102	1260	143	1505	8	0.9	52	4.3
2006	151	1461	121	1733	12	1.5	53	4.9
2007	373	1537	81	1991	12	2.8	51	4.2
2008	1453	2111	88	3652	23	10.2	67	9.6
2009	1678	2245	208	4131	25	10.6	64	13.1
2010	3977	2184	213	6374	37	20.0	61	10.0
2011	4138	1618	144	5900	35	21.2	57	5.9
2012	2425	1306	476	4207	24	15.1	53	5.2
2013	1421	1293	53	2767	28	6.6	49	4.0
2014	622	911	54	1588	22	4.4	47	3.7

Table 5.2.4. Blue ling in Va and XIV. Catches in Va and XIV along with survey biomass index (larger than 40 cm) from the Icelandic Autumn survey and the calculated F_{proxy} (($C_{Va} + C_{XIV}$)/I).

Year	Va	XIV	Index	F_{proxy}
2000	1645	896	574.5	4.42
2001	931	1710	950.2	2.78
2002	1372	12	988.3	1.40
2003	1160	711	930.1	2.01
2004	1199	8	1039.7	1.16
2005	1592	187	1051.4	1.69
2006	1855	4	1492.9	1.25
2007	2091	20	1128.1	1.87
2008	3758	385	1645.2	2.52
2009	4233	119	2073.8	2.10
2010	6905	47	1836.8	3.78
2011	6702	9	*No survey*	
2012	4521	379	1411.5	3.47
2013	3082	16	1762.3	1.76
2014	1588	3	1455.8	1.09

5.3 Blue Ling (*Molva Dypterygia*) in Division Vb and Subareas VI and VII

5.3.1 The fishery

The main fisheries are those by Faroese trawlers in Vb and French trawlers in VI and, to a lesser extent, Vb. Total international landings from Subarea VII are small and are mostly bycatches in other fisheries, except in in ICES Division VII b and c where there are more fishing hauls directed to deep-water fish.

Landings by Faroese trawlers are mostly taken in the spawning season. Historically, this was also the case for French trawlers fishing in Vb and VI. However, in recent years blue ling has been taken round the year together with roundnose grenadier, black scabbardfish and deep-water sharks.

5.3.2 Landings trends

Total international landings from Division Vb (Table 5.3.1a–f and Figure 5.3.1) peaked in the late 1970s at around 21 000 t, stabilized in the 1980s at around 5000–10 000 t and have since declined to a stable low level of around 3000 t from 1995 to 2008 followed by a further reduction to around 1500 t in 2011–2014, mainly due to the absence of agreement between the Faroe Islands and the EU. The catch in 2013 was particularly low due to a lesser activity of Faroese trawlers, one single vessel made most of the catch.

The landings from Subarea VI peaked at about 18 000 t in 1973 and fluctuated throughout the 1980s within the range of 5000–10 000 t and have since gradually declined. In recent year reducing EU TACs have been the main driver of the catch level.

Landings from Subarea VII are comparatively small, mostly less than 500 t per annum in the whole time-series and have declined in recent years to <50 t.

5.3.3 ICES Advice

The ICES advices for 2015 and 2016 is "*Based on the ICES MSY approach ICES advises that annual catches should not be more than 5046 tonnes. All catches are assumed to be landed*".

5.3.4 Management

Prior to 2009, EU deep-water TACs were set on a biennial basis; however from 2009 onwards, annual TACs were applied for the components of this stock in EU waters of Vb and in VI and VII. From 2009 the EU TAC includes quota for Norway and the Faroe Islands. The Faroe Islands set a quota for some EU countries, including a significant ling and blue ling quota, from which a bycatch of roundnose grenadier was allowed, for French vessels. There was no such agreement between the Faroe Island and the EU in 2011 to 2013 but these were resumed in 2014.

The table below provides the EU TAC the TAC allocated to EU vessel in Faroese waters and the ICES estimate of international landings in recent years.

Year	Area	ICES advice	EU TAC	Quota included in EU TAC: EU	Norway	Faroe	EU quota in Vb (1) Faroese waters
2006	VI, VII	Biennial		3037	200	400	3065
2007	VI, VII	No direct fisheries		2510	160	200	3065
2008	VI, VII	Biennial		2009	150	200	3065
2009	Vb, VI, VII	No direct fisheries	2309	2009	150	150	3065
2010	Vb, VI, VII	Biennial	2032	1732	150	150	2700
2011	Vb, VI, VII	No direct fishery. Limit bycatch. Reduction in catches	2032	1717	150	0	0
2012	Vb, VI, VII	Same as 2011	2031	1882	150	0	0
2013	Vb, VI, VII	3900	2540	23905	150	0	0
2014	Vb, VI, VII	3900	2540	2210	150(2)	150(3)	1500
2015	Vb, VI,VII	5046	5046	4746	150(2)	150(3)	1500
2016	Vb, VI,VII	5046					

(1) TAC for ling and blue ling, against which a bycatch roundnose grenadier and black scabbard fish may be counted. Up to a limit of 500 t.

(2) To be fished in Union waters of IIa, IV, Vb, VI and VII (BLI/*24X7C).

(3) including bycatch of roundnose grenadier and black scabbardfish.

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

In Faroese waters, Faroese vessels are encouraged to land all fish, which is thought to be done for blue ling, owing to the species value. Faroese vessels are regulated by licences and fishing days.

In ICES Division VIb, areas closed to bottom fishing gears have been extended and these include some of the spawning areas identified by Large *et al*. (2009), see Figure 5.1.3b.

5.3.5 Data availability

5.3.5.1 Landings and discards

Landings data were updated. Landings in 2014 amounted to 2949 t, about the 2012 level and higher than the 2013 level (the lowest level since the development of the main fisheries in the early 1970s).

The proportion of blue ling discarded by year in the French deep-water trawl fishery in 2010–214 based upon French on-board observations carried out under the DCF was estimated to 0.01–0.3%, well below the 5% level where discards are considered negligible. This low discarding proportion comes from the absence of catch of small fish. However, the French industry reported low levels of discarding towards the end of 2009 when quotas were exhausted.

Similarly, Spanish observer onboard trawlers fishing in VIb reported that discards for this species are negligible, in the range of 0–0.5% of the catch.

Discards are presumed non-existent in Faroese waters.

Some blue ling discards were recorded in 2012 in the French bottom-trawl fishery for demersal fish in the Celtic Sea and West of Ireland. An estimated raised discards of 55 tonnes (95% confidence limit 18–117 t) was calculated for this fishery. Owing to the relatively southern distribution of this fishery, this discard is likely to comprise a high proportion of the Spanish ling (*Molva macrophthalma*), which is more abundant than blue ling at latitude south of 50–52°N and can be misidentified. Small Spanish ling are caught on the Celtic Sea outer shelf and upper slope.

Although discards may occur in other fleets fishing along the upper slope for demersal species, discards are considered minor compared to landings of deep-water fishing fleets.

5.3.5.2 Length compositions

Length composition of blue ling from Faroese trawlers in Division Vb are presented in Figure 5.3.2.

Length distribution of blue in Faroese spring and summer groundfish surveys are shown in Figures 5.3.3 and 5.3.4. A deep-water survey was initiated in 2014 in Faroese waters, the length of blue ling in this deeper survey is much larger than in the two other surveys (Figures 5.3.5).

In 2014, the mean length of French trawl landings by quarter was sampled from on-board observation and port sampling. Data before 2014 are all from port sampling and the mean length is shown in Figure 5.3.6. The mean length in 2014 was higher in both port samples and on-board observations. From 2015, length distribution data will be probably sampled from on-board observations, the comparison of the length distribution from on-board observation and port sampling suggest that there is no effect of the method (Figure 5.3.7) and that the larger mean size in 2014, compare to previous year come from that absence of smaller fish in both samples (Figure 5.3.7).

5.3.5.3 Age compositions

Otoliths were collected in 2014 but not read. In relation to the biennial frequency of advice, age estimation were organised to be done every second year for samples from two years.

5.3.5.4 Weight-at-age

Blue ling is landed gutted in France, the only EU country were landings of this species are sampled. Weight-at-age is calculated using the length-at-age and length–weight relationship. Weight and length data were provided by Faroe Island and the parameter estimates of the length–weight relationship from new data were similar to the previous estimates.

5.3.5.5 Maturity and natural mortality

No new data.

5.3.5.6 Catch, effort and RV data

The standardised cpue time-series from the Faroese trawler fleet was updated (Ofstad, 2015 WD) however, this time-series was not used in assessment.

The standardized cpue from haul-by-haul data provided by the French industry skipper tallybooks (see stock annex) was not updated.

From 2013, the Scottish deep-water research survey has been set to be biennial and was not carried out in 2014 (Figure 5.3.9).

No deep-water Irish survey was carried out since 2009.

Standardized time-series from the Faroese spring and summer surveys were updated (Table 5.3.2).

A new time-series of standardized abundance indices was calculated from the Norwegian longliner fleet operating in VIa (Table 5.3.3). The standardization was the same as that developed for ling (Helle *et al.*, 2015).

5.3.6 Data analyses

Length distribution of catches of Faroese fleets show that fish caught are mostly in the length range 70–120 cm (Figures 5.3.2). Recruitment inputs are visible in survey catches in some years, e.g. 2007–2009.

Mean length in French trawl landings (Figure 5.3.7) shows a strong decline until the mid-1990s followed by an increasing trend over 1995–2014, with some low levels in some years reflecting recruitment pulses, in particular in 2007 and a high mean in 2014 (Figure 5.3.7).

Surveys

The Faroese surveys show varying biomass since 1994 with high values in 2004, 2005 and since 2009. The depth range (<500 m) does not extend down to the core depth distribution of blue ling. The provided indices used all hauls and are stratified indices.

Multiyear catch curve (MYCC) model

The Multiyear catch curve (MYCC, Trenkel *et al.*, 2012, see stock annex) was not run in 2014 as no new age distribution was available. The 2014 results for M=0.11, used for advice, are shown in Figures 5.3.10 and 5.3.11.

Stock Reduction Analysis (SRA) using FL_{aspm}.

SRA estimates were made using the natural mortality ($M=0.11$) retained last year and a range of other input values of M. as required in the stock annex. This F value was chosen in 2014, because it resulted in the smallest difference in number-at-age estimated from the MYCC and SRA (Figure 5.3.14). This value is also similar to F=0.1 used for blue ling in Va and XIVb.

The new time-series of index from the Norwegian longline fleet was integrated in the modelling and the Irish index from the Irish deep-water survey, which was carried out in 2006–2009 only was left out. These changes had however only minor impact on the estimated biomass and exploitation rate over the whole time-series. The fit of each time-series of index to the stock biomass trajectory is shown in Figure 5.3.12.

At *M*=0.11, the initial biomass was estimated to about 300 000 t, temporal variations of the fishing mortality, showed the same pattern at all *M* assumptions but the overall level was lower at low *M*, as a low *M* implies a higher biomass. The time-series of the biomass and fishing mortality is given in Figure 5.3.13 for *M*=0.11and Table 5.3.5.

Natural mortality assumed in SRA runs and corresponding outputs for the initial (B_0) and current (B_{2015}, the estimated biomass at 01.01.2015) biomasses (thousand tonnes), Fishing mortality (*F*) and ratio $B_{CURRENT}$/ B_0 in the last year.

M	B_0	B_{2015}	F_{2014}	B_{2015}/B_0
0.1	293	101	0.03	0.34
0.11	275	95	0.03	0.35
0.13	245	88	0.04	0.36
0.15	223	83	0.04	0.37
0.19	189	83	0.04	0.44

SRA estimated fishing mortality in recent years were low for all the range of natural mortality. The estimated F in the past was five to ten times above the current level for 20 years from 1984 to 2003. The exploitable biomass in 2014 was estimated to 95 000 tonnes, corresponding to 35% of the exploitable biomass at the start of the time-series (1966), before the development of the main fisheries. The exploitable biomass was at its lowest historical level, 54 000 tonnes, in 2002–2003. In was then less than 20% of the initial biomass, i.e. close or below the precautionary approach B_{lim} level as expected, at the time, in assessment comments, although without quantification, at the time (ICES, 2002). For this stock the exploitable biomass and the spawning biomass (SSB) are equal because the fish recruit to the fishery and to the adult stock at the same time.

Projection

In order to improve reference points for this stock, the stock biomass and produced catch was projected forward for 200 years based on the Beverton–Holt stock–recruitment relationship catch derived from SRA under the assumed steepness of 0.75, a low value for a gadoid fish, so presumed conservative. All other settings (weight-at-age, maturity, selectivity y-at-age) of the SRA were used in the projection. A range of fishing mortalities from 0.03 to 0.3 was simulated. This range corresponds to the fishing mortality estimated from SRA in 2014 to ten times more. The simulations were fully deterministic.

The fishing mortality at which MSY was achieved was *F*=0.12, slightly over *M*=0.11 (Table 5.3.6). In these simulations, MSY is 8777 tonnes and SSB_{MSY}= 79 700 tonnes. This estimated SSB_{MSY} is smaller than the current SSB (95 000 tonnes) and, F_{MSY} is about four times F_{2014} (0.031). Nevertheless, almost the same yield is achieved at a smaller F of about 0.1 and the stock biomass is then 13% higher at 90 200 t (Table 5.3.6).

5.3.7 Comments on assessment

The assessment of blue ling in ICES Areas V, VI and VII is based on two models. A multiyear catch curve model (MYCC) is used to estimate the total annual mortality taking into account annual variations in recruitment, a stock reduction analysis (SRA) is used to predict the biomass dynamics of the stock. This year the MYCC was not updated as new age data were not available. SRA was updated, the results for the past are similar to that of the 2014. Owing to the low current fishing mortality, the stock goes on rebuilding. Simulations were carried out to estimate MSY and SSB_{MSY}. The estimated MSY is close to previous estimates from YPR or DCAC. From DCAC, MSY for this stock was estimated to 7000–10 000 tonnes (ICES, 2010, 2012). The current F=0.03 is estimated well below F_{MSY}=0.12 and the current SSB=95 000 t is estimated above SSB_{MSY}=80 000 t.

5.3.8 Management considerations

Blue ling is susceptible to sequential depletion of spawning aggregations. Maintaining the current closed areas will provide protection for the spawning aggregations. This may not be needed if the current TAC management regime is effective in limiting fishing mortalities as intended and if highly aggregated fisheries in these areas do not cause local depletion. In Faroese waters, from which roughly half the catch has been taken in recent years, the catch is mainly taken in the spawning season.

5.3.9 References

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Table 5.3.1a. Landings of blue ling in Subdivision Vb1.

Blue ling Vb1

YEAR	FAROES	FRANCE(1)	GERMANY(1)	NORWAY(2)	E & W(1)	IRELAND	RUSSIA(1)	TOTAL
1966		839		430				**1269**
1967			1006	238				**1244**
1968			1838	823				**2661**
1969			303	798				**1101**
1970			348	2718				**3066**
1971			1367	557				**1924**
1972			2730	1203				**3933**
1973	51	80	3009	4003	4			**7147**
1974	43	390	1808	1554	3			**3798**
1975	17	2147	1528	2492	1			**6185**
1976	42	10475	896	1482				**12 895**
1977	23	6977	870	858	4		12 500	**21 232**
1978	423	3369	744	237	35			**4808**
1979	1072	2683	691	331				**4777**
1980	1187	2427	5905	304				**9823**
1981	1481	371	2867	167				**4886**
1982	2761	843	2538	121				**6263**
1983	3933	668	222	256				**5079**
1984	6453	515	214	105				**7287**
1985	4038	1193	217	140				**5588**
1986	4830	2578	197	94				**7699**
1987	3361	3246	152	81				**6840**
1988	3487	3036	49	94				**6666**
1989	2468	1802	51	228				**4549**
1990	946	3073	71	450				**4540**
1991	1573	1013	36	196	1			**2819**
1992	1918	407	21	390	4			**2740**
1993	2088	192	24	218	19			**2541**
1994	1065	147	3	173				**1388**
1995	1606	588	2	38	4			**2238**
1996	1100	301	3	82				**1486**
1997	778	1656		65	11			**2510**
1998	1026	1411	0	24	1			**2462**
1999	1730	1067	4	38	4			**2843**
2000	1677	575	1	163	33		1	**2450**
2001	1193	430	4	130	11	2		**1770**
2002	685	578		274	8			**1545**
2003	1079	1133		12	1			**2225**
2004	751	1132		20			13	**1916**
2005	1028	781		15	1			**1825**
2006	1276	839		21	1		16	**2153**

Year	Faroes	France(1)	Germany(1)	Norway(2)	E & W(1)	Ireland	Russia(1)	Total
2007	1220	1166		212	8		36	**2642**
2008	642	865		35			110	**1652**
2009	523	325					0	**848**
2010	840	464		49		0	0	**1353**
2011	838	312		0		0	0	**1150**
2012	799	424		8		0	5	**1236**
2013	440	423		0		0	3	**1085**
2014	730	609		29				**1368**

***Preliminary. (1) Includes Vb2; (2) includes Vb2 up to 1974.**

Table 5.3.1b. Landings of Blue ling in Subdivision Vb2.

Year	Faroes	Norway	Scotland	Total
1966				0
1967				0
1968				0
1969				0
1970				0
1971				0
1972				0
1973				0
1974				0
1975	1			1
1976	6	37		43
1977		86		86
1978	7	83		90
1979	14	87		101
1980	36	159	1	196
1981	48	93		141
1982	128	66		194
1983	463	182		645
1984	757	50		807
1985	396	70		466
1986	81	41		122
1987	209	90		299
1988	2788	72		2860
1989	622	95		717
1990	68	191		259
1991	71	51	21	143
1992	1705	256	1	1962
1993	182	22	91	295
1994	239	16	1	256
1995	162	36	4	202
1996	42	62	12	116
1997	229	48	11	288
1998	64	29	29	122
1999	15	49	24	88
2000	0	37	37	74
2001	212	69	63	344
2002	318	21	140	479
2003	1386	84	120	1590
2004	710	6	68	784
2005	609	14	68	691
2006	647	34	16	697
2007	632	6	16	654
2008	317	0	91	408

Year	Faroes	Norway	Scotland	Total
2009	444	8	161	613
2010	656	10	225	891
2011	319	0	0	319
2012	211	0		211
2013	133	0	2	135
2014	150	6	2	158

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

Table 5.3.1c. Landings of blue ling in Division VIa.

Year	Faroes	France	Germany	Ireland	Norway	Spain(1)	E & W	Scotland	Lithuania(2)	Total
1966					20					20
1967			37		35					72
1968					126					126
1969			6		112					118
1970					176					176
1971					15					15
1972		696			14					710
1973		18 000			25					18 025
1974	33	15 000	1218		362		164			16 777
1975		5000	2941		20		8			7969
1976		5462	818		10		1			6291
1977		7940	470		16		556			8982
1978		5495	2498		19		21			8033
1979		3064	993		2		279			4338
1980		2124	773		10					2907
1981		3338	335		11			1		3685
1982		3430	79		16		99			3624
1983		5233	11		118		13			5375
1984		3653	183		45		5			3886
1985	56	5670	5		75		2			5808
1986		8254	7		47		2	1		8311
1987		9389	45		51		1			9486
1988	14	6645	2		29		2	1		6693
1989	6	7797	2		143					7948
1990		6114	44		54			1		6213
1991	8	6165	18		63		1	35		6290
1992	4	7742	4		129			24		7903
1993		6793	48	3	27		13	42		6926
1994		3363	24	73	90	433	1	91		4075
1995	0	3073		11	96	392	34	738		4344
1996	0	4116	4		50	681	9	1407		6267
1997	0	4053		1	29	190	789	1021		6083
1998	0	4735	3	1	21	142	11	1416		6329
1999	0	3731		10	55	119	5	1105		5025
2000		4544	94	9	102	108	24	1300		6181
2001		2877	6	179	117	797	116	2136	16	6244
2002		2172		125	61	285	16	2027	28	4714
2003	7	2010		2	106	3	3	428	29	2588
2004	10	2264		1	24	4	1	482	38	2824
2005	17	2019		2	33	88		390	1	2550
2006	13	1794		1	49	87	3	433	2	2382
2007	13	1814			31	47		113	1	2019
2008	14	1579			73	10		112	2	1790
2009	11	2202			74	165		178		2630

YEAR	FAROES	FRANCE	GERMANY	IRELAND	NORWAY	SPAIN[1]	E & W	SCOTLAND	LITHUANIA[2]	TOTAL
2010	43	1937			86	223		134		2423
2011	10	1136			93	10		74		1323
2012	5	1178			86	6		47		1322
2013	2	1168			132	11		203		1516
2014		1094			18			278		1390

. (1) Includes VIb; (2) Includes VIb for all countries up to (and including) 1974.

Table 5.3.1d. Landings of blue ling in DivisionVIb.

Year	Poland	Russia	Faroes	France	Germany	Norway	E & W	Scotland	Iceland	Ireland	Estonia	Spain	Total
1975			1			37							38
1976			13			6							19
1977			6	36		7							49
1978			3	58		8							69
1979			4	652	187	28							871
1980				3827	5526	8							9361
1981				534	3944	5							4483
1982				263	554	13		1					831
1983				243	38	50		2					333
1984			133	3281		43							3457
1985			11	7263	31	38							7343
1986			1845	2928	39	66	7	1					4886
1987			350	10	356	76	3	10					805
1988			2000	499	37	42	9	14					2601
1989			1292	61	22	217		16					1608
1990			360	703		127		2					1192
1991			111	2482	6	102	5	15					2721
1992			231	348	2	50	2	14					647
1993			51	373	109	50	66	57					706
1994			5	89	104	33	3	25					259
1995			1	305	189	12	11	38					556
1996			0	87	92	7	37	74					297

Year	Poland	Russia	Faroes	France	Germany	Norway	E & W	Scotland	Iceland	Ireland	Estonia	Spain	Total
1997			138	331		6	65	562	1				**1103**
1998			76	469		13	190	287	122	11			**1168**
1999			204	654		9	168	2411	610	4			**4060**
2000				514		184	500	966		7			**2171**
2001			238	210	1	256	337	1803		4	85		**2934**
2002		3	79	345		273	141	497		1			**1339**
2003	4	2		510		102	14	113			5		**750**
2004	1	5	4	514		2	10	96			3		**635**
2005		15	1	235		1	9	80					**341**
2006			3	313		2	4	29					**351**
2007		1	15	112		4	7	30					**169**
2008		12	2	29		2	2	9		0			**56**
2009		1		10		1		7		0			**19**
2010		0	0	39		15		1		0			**55**
2011		0	0	9		11		0					**20**
2012				3		3						1	**217(2)**
2013				5				0				3	**39(2)**
2014								3					**4(2)**

(1) included in VIa. (2) includes unallocated catch

Table 5.3.1e. Landings of blue ling in Subarea VII.

Year	France	Germany	Spain	Norway	E & W	Scotland	Ireland	Total
1988	21	1	0	0	0	0	0	22
1989	292	0	0	2	0	0	0	294
1990	223	0	0	0	0	0	0	223
1991	211	0	0	0	0	1	0	212
1992	398	0	0	3	0	6	0	407
1993	273	0	0	2	16	30	0	321
1994	298	0	4	1	9	26	1	339
1995	155	0	13	0	43	16	3	230
1996	189	0	21	1	57	97	0	365
1997	179	8	0	2	170	15	9	383
1998	252	3	22	1	283	30	10	601
1999	115	2	59	1	168	18	27	390
2000	91	2	65	5	31	17	73	284
2001	84	2	64	5	29	17	634	835
2002	45	4	42	0	77	55	453	676
2003	27	1	42	0	8	16	28	122
2004	23	1	15	0	4	1	19	63
2005	37	0	25	0	1	0	11	74
2006	30	0	31	0	2	0	4	67
2007	121	0	38	0	2	1	2	164
2008	28	0	6	0	0	0	0	34
2009	10	0	1	0	0	0	0	11
2010	13	0	24	0	0	0	0	37
2011	23	0	26	0	0	0	0	49
2012	19	0	21	5	0	0	0	45
2013	32	0	0	0	0	0	0	32
2014	24				3	2		29

*** Preliminary.**

Table 5.3.1f. Blue ling landings in Division Vb and Subareas VI and VII.

Year	Vb	VI	VII	Total
1966	1269	20		1289
1967	1244	72		1316
1968	2661	126		2787
1969	1101	118		1219
1970	3066	176		3242
1971	1924	15		1939
1972	3933	710		4643
1973	7147	18 025		25 172
1974	3798	16 777		20 575
1975	6186	8007		14 193
1976	12 938	6310		19 248
1977	21 318	9031		30 349
1978	4898	8102		13 000
1979	4878	5209		10 087
1980	10 019	12 268		22 287
1981	5027	8168		13 195
1982	6457	4455		10 912
1983	5724	5708		11 432
1984	8094	7343		15 437
1985	6054	13 151		19 205
1986	7821	13 197		21 018
1987	7139	10 291		17 430
1988	9526	9294	22	18 842
1989	5266	9556	294	15 116
1990	4799	7405	223	12 427
1991	2962	9011	212	12 185
1992	4702	8550	407	13 659
1993	2836	7632	321	10 789
1994	1644	4334	339	6317
1995	2440	4900	230	7570
1996	1602	6564	365	8531
1997	2798	7186	383	10 367
1998	2584	7497	601	10 682
1999	2931	9085	390	12 406
2000	2524	8352	284	11 160
2001	2114	9178	835	12 127
2002	2024	6053	676	8753
2003	3815	3338	122	7275
2004	2700	3459	63	6222
2005	2516	2891	74	5481
2006	2850	2733	67	5650
2007	3296	2188	164	5648
2008	2060	1846	34	3940

2009	1461	2649	11	4121
2010	2244	2478	37	4759
2011	1469	1343	49	2861
2012	1447	1539	45	3031
2013	1001	1555	32	2588
2014	1526	1394	29	2949

Table 5.3.2. Standardised biomass indices (kg/h) of blue ling in the annual demersal trawl spring and summer survey on the Faroe Plateau.

Year	Spring survey		Summer survey	
	Index	SE	Index	SE
1994	1.66	0.98		
1995	1.38	0.95		
1996	1.39	0.78	4.93	2.03
1997	3.46	2.10	1.31	0.67
1998	1.60	0.97	3.26	1.34
1999	0.10	0.06	1.85	0.81
2000	0.63	0.58	1.28	0.57
2001	1.38	0.83	1.87	0.96
2002	0.68	0.58	0.80	0.40
2003	2.31	1.76	0.90	0.57
2004	1.51	1.12	5.46	2.47
2005	1.13	0.90	4.87	1.84
2006	2.18	1.68	2.06	0.80
2007	2.30	1.74	1.64	0.76
2008	0.90	0.55	1.11	0.48
2009	4.39	2.35	3.04	1.48
2010	4.27	2.58	4.01	1.80
2011	2.92	1.79	3.41	1.55
2012	4.52	3.05	4.04	1.41
2013	2.99	2.04	3.84	1.61
2014	1.36	1.01	3.63	1.97

Table 5.3.3. Standardised cpue index (kg/1000 hooks) from the Norwegian longliners in ICES Division VIa.

YEAR	LOWER LIMIT	MEAN INDEX	UPPER LIMIT
2000	5.41501	8.66806	11.9211
2001	1.19139	5.06467	8.93795
2002	6.18003	10.6336	15.0873
2003	1.06198	4.23394	7.40591
2004	-0.880454	2.64624	6.17293
2005	1.51271	4.58405	7.65539
2006	7.65685	10.5885	13.5202
2007	4.45571	7.89304	11.3304
2008	12.1859	15.9015	19.6172
2009	8.68421	13.0095	17.3349
2010			
2011	11.463	14.0427	16.6223
2012	15.1387	17.9744	20.81
2013	17.6359	20.1458	22.6557
2014	8.04928	11.2419	14.4345

Table 5.3.4. Total and fishing mortality, stock number and recruitment estimates from the MYCC model under the assumption M=0.1. (2014 assessment).

Year	Z	Z standard dev.	Recruitment number (millions)	Recruit. Standard dev.	Total Numbers ages 9+ (millions)	Number age 9+ Sd	F
1995	0.23	0.01	3.35	0.32	16.04	1.74	0.12
1996	0.24	0.01	3.36	0.33	16.12	1.52	0.13
1997	0.28	0.02	3.39	0.33	16.13	1.33	0.17
1998	0.28	0.01	3.35	0.32	15.56	1.20	0.17
1999	0.33	0.02	3.42	0.34	15.17	1.10	0.22
2000	0.33	0.02	3.40	0.32	14.32	1.06	0.22
2001	0.35	0.02	3.37	0.30	13.63	1.04	0.24
2002	0.29	0.02	3.19	0.36	12.76	1.06	0.18
2003	0.27	0.02	3.23	0.33	12.75	1.12	0.16
2004	0.23	0.01	3.30	0.31	13.05	1.18	0.12
2005	0.22	0.01	3.46	0.32	13.82	1.20	0.11
2006	0.22	0.01	3.54	0.36	14.64	1.26	0.11
2007	0.21	0.01	3.46	0.32	15.17	1.34	0.10
2008	0.18	0.01	3.53	0.35	15.79	1.44	0.07
2009	0.18	0.01	3.21	0.33	16.36	1.50	0.07
2010	0.19	0.01	3.25	0.33	16.90	1.56	0.08
2011	0.16	0.00	3.13	0.39	17.12	1.65	0.05
2012	0.16	0.00	3.20	0.36	17.84	1.74	0.05
2013	0.15	0.00	3.42	0.34	18.68	1.78	0.04
2014			3.32	0.34	19.39	1.82	

Table 5.3.5. Time-series 1966–2014 of exploitable biomass, fishing mortality (*F*) and Spawning–Stock Biomass relative to the Spawning–Stock Biomass in the first year (*SSB/SBB0*) from the stock reduction analysis (SRA), with *M*=0.11.

Year	Exploitable biomass	F	SSB/(SSB0)	Year	Exploitable biomass	F	SSB/(SSB0)
1966	275	0	1.00	1991	69	0.2	0.25
1967	274	0.01	1.00	1992	67	0.24	0.24
1968	273	0.01	0.99	1993	63	0.2	0.23
1969	270	0	0.98	1994	62	0.11	0.23
1970	269	0.01	0.98	1995	66	0.13	0.24
1971	266	0.01	0.97	1996	68	0.14	0.25
1972	265	0.02	0.96	1997	68	0.17	0.25
1973	261	0.11	0.95	1998	67	0.19	0.24
1974	236	0.1	0.86	1999	64	0.23	0.23
1975	217	0.07	0.79	2000	60	0.22	0.22
1976	206	0.1	0.75	2001	57	0.25	0.21
1977	190	0.18	0.69	2002	54	0.19	0.20
1978	165	0.09	0.60	2003	54	0.15	0.20
1979	157	0.07	0.57	2004	56	0.13	0.20
1980	154	0.17	0.56	2005	59	0.1	0.21
1981	138	0.11	0.50	2006	62	0.1	0.23
1982	133	0.09	0.48	2007	65	0.1	0.24
1983	130	0.1	0.47	2008	68	0.06	0.25
1984	127	0.14	0.46	2009	72	0.06	0.26
1985	119	0.19	0.43	2010	76	0.07	0.28
1986	108	0.23	0.39	2011	80	0.04	0.29
1987	96	0.21	0.35	2012	85	0.04	0.31
1988	87	0.26	0.32	2013	90	0.03	0.33
1989	78	0.23	0.28	2014	95	0.03	0.35
1990	72	0.2	0.26				

Table 5.3.6. Estimated SSB and yield in the long term (after stabilization) of the stock of blue ling in VB, VI and VII under a range of fishing mortality. Projection initiated from the stock number-at-age in 2014 and run for 200 years, with a range of F value from the current F to ten times more.

F	SSB (tonnes)	Yield (tonnes)
0.031	188 088	5414
0.046	158 906	6810
0.062	135 982	7712
0.077	117 597	8274
0.093	102 593	8598
0.108	90 163	8750
0.111	87 932	8764
0.114	85 777	8774
0.123	79 731	8778
0.139	70 875	8713
0.154	63 280	8580
0.17	56 710	8396
0.185	50 979	8174
0.201	45 945	7922
0.216	41 493	7649
0.231	37 534	7359
0.247	33 992	7058
0.262	30 810	6748
0.278	27 936	6432
0.293	25 331	6112
0.309	22 960	5789

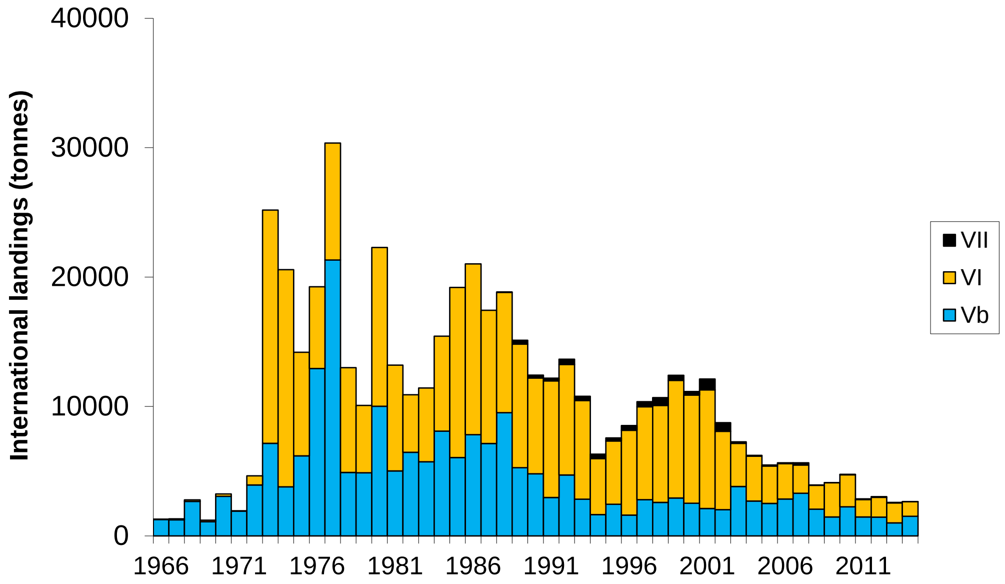


Figure 5.3.1. Trends in total international landings for blue ling in Vb, VI and VII.

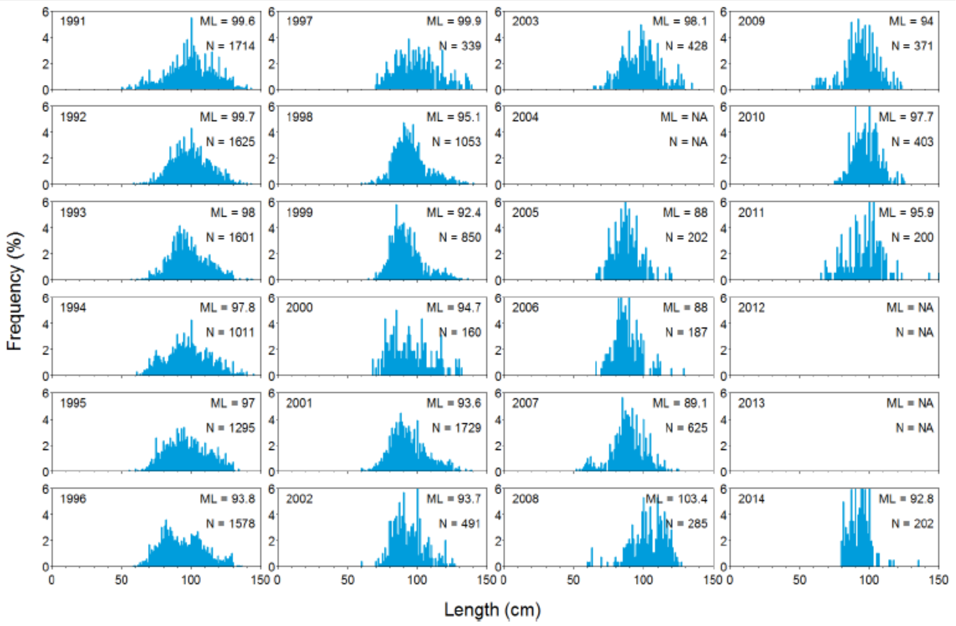


Figure 5.3.2. Blue ling in Vb (Faroes). Length distribution in the landings from Faroese otter-board trawlers >1000 HP.

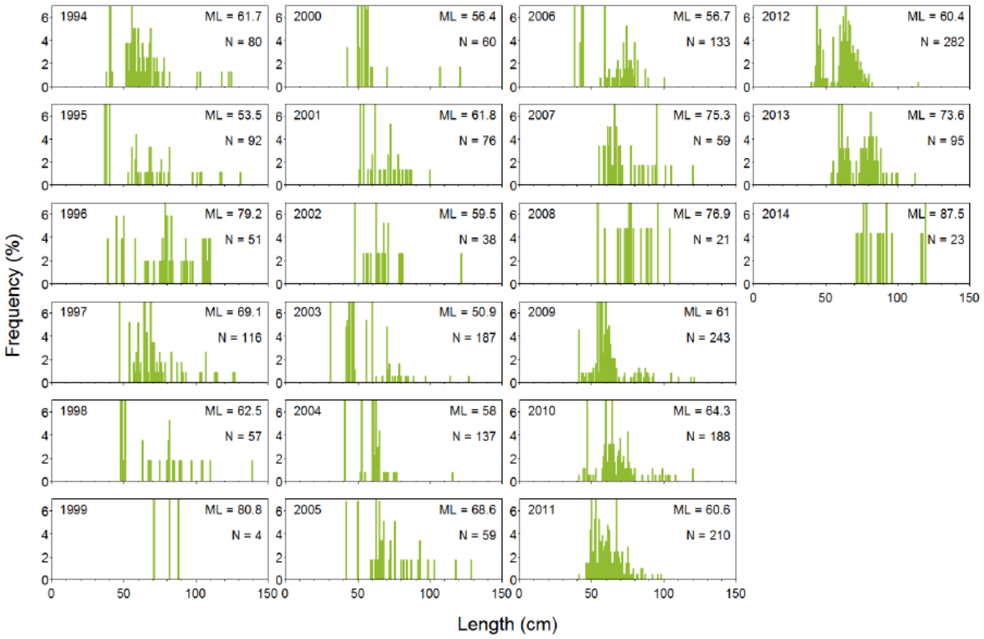


Figure 5.3.3. Length distribution of blue ling in the spring groundfish Faroese survey on the Faroe Plateau.

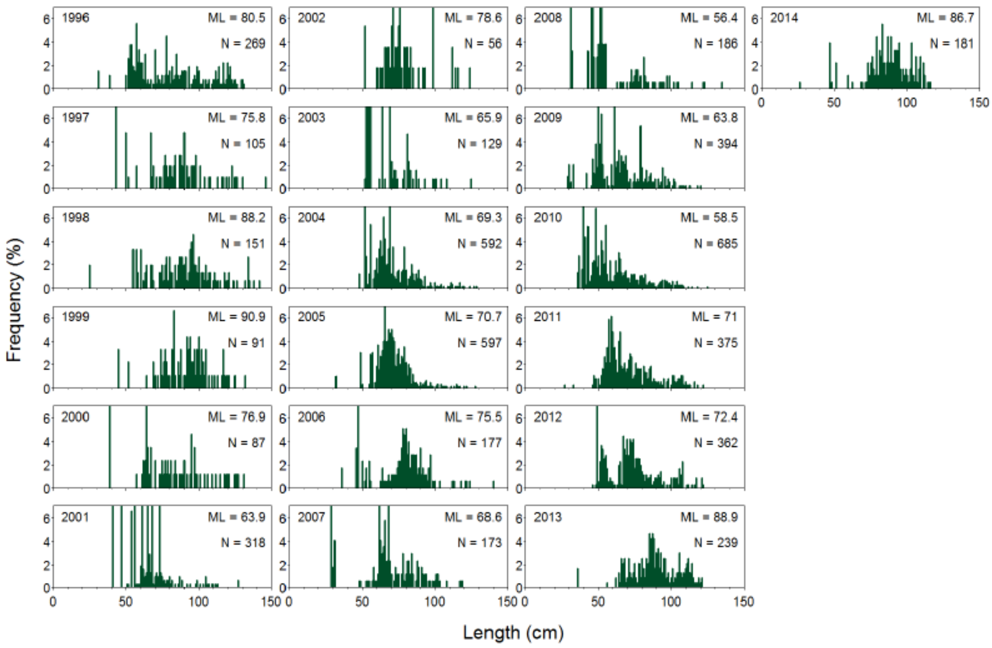


Figure 5.3.4. Length distribution of blue ling in the summer groundfish Faroese survey on the Faroe Plateau.

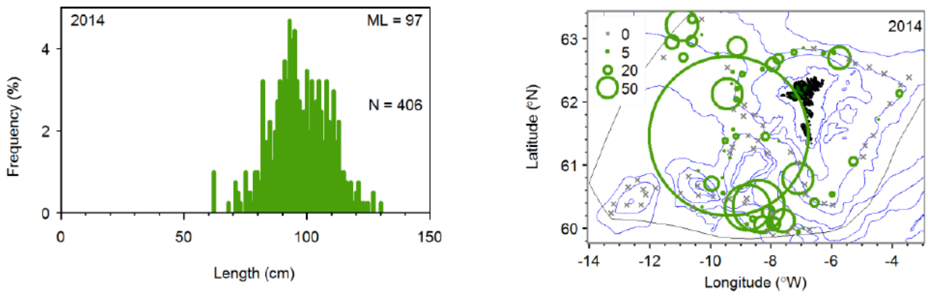


Figure 5.3.5. Length distribution of blue ling in the 2014 deep-water survey in Faroese waters.

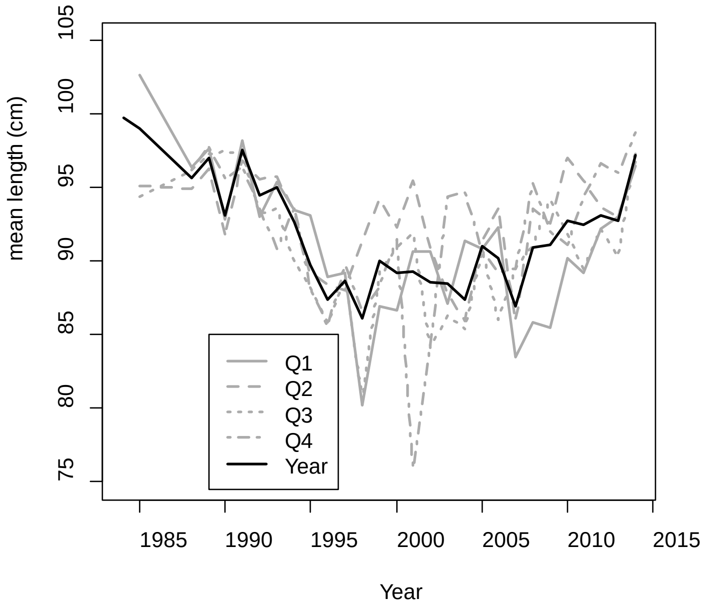


Figure 5.3.6. Quarterly mean length in French trawl landings, 1984–2014, from port sampling.

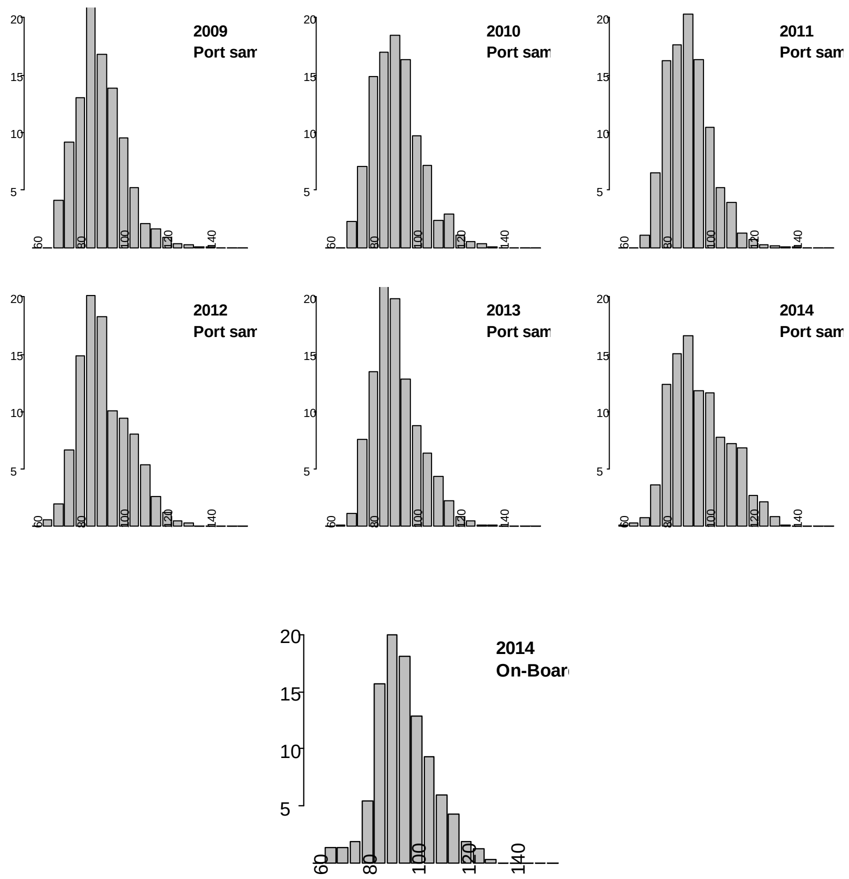


Figure 5.3.7. Length distribution 2009–2014 of the landings of blue ling from the French trawl fishery from port sampling in 2009–2014 and from on-board observations in 2014.

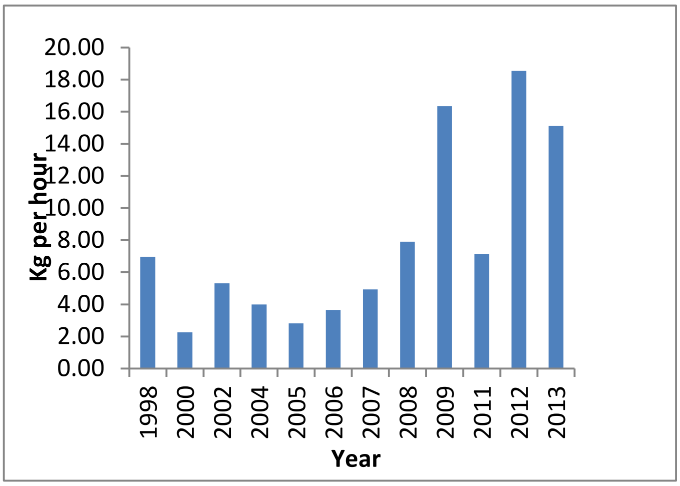


Figure 5. 3.9. Biomass index in the Scottish deep-water survey, based on haul carried out from 400 to 1600 m.

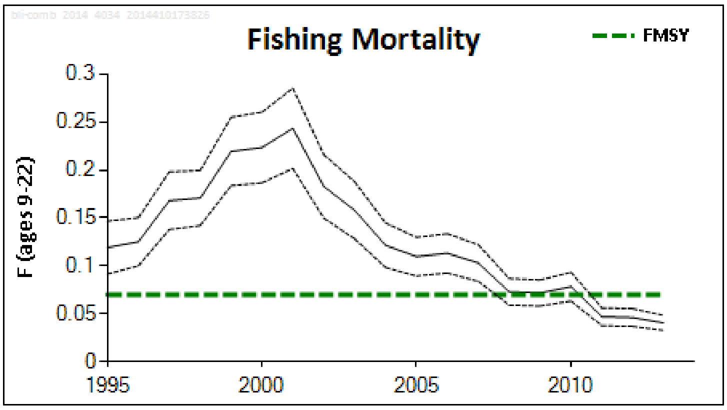


Figure 5.3.10. Estimated fishing mortality from the MYCC.

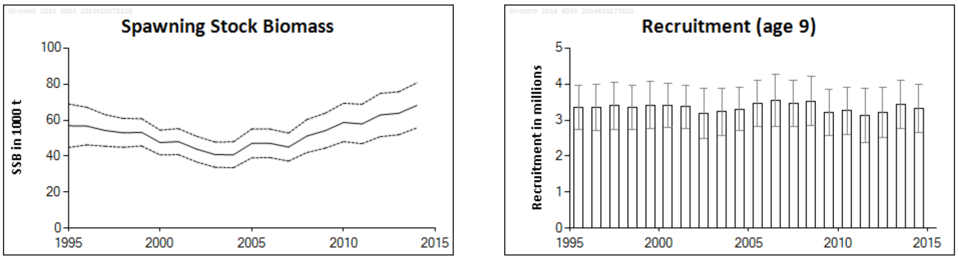


Figure 5.3.11. Estimated biomass of age 9+ and recruitment numbers (at age 9) from the MYCC.

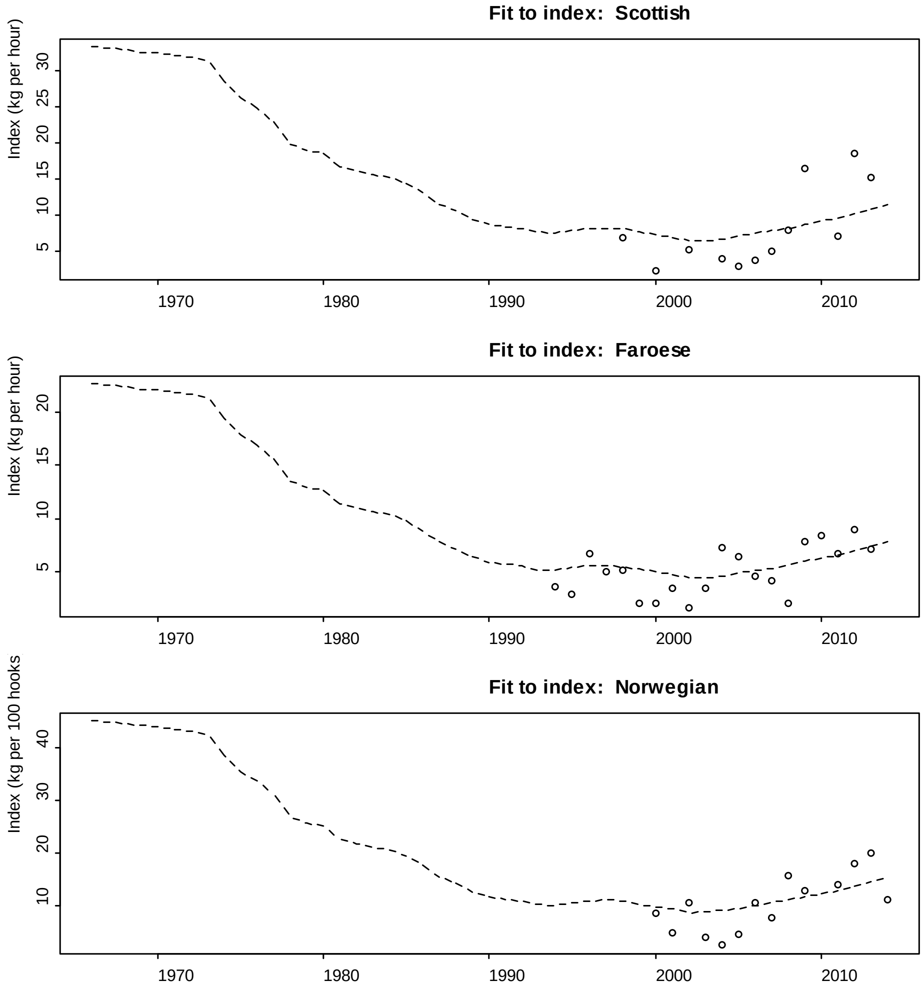


Figure 5.3.12. Fit of biomass indices to the estimated stock biomass: (top) Marine Scotland deep-water research survey, (centre) combined Faroese survey for haul deeper than 200 m, (bottom) Norwegian longliner fleet cpue.

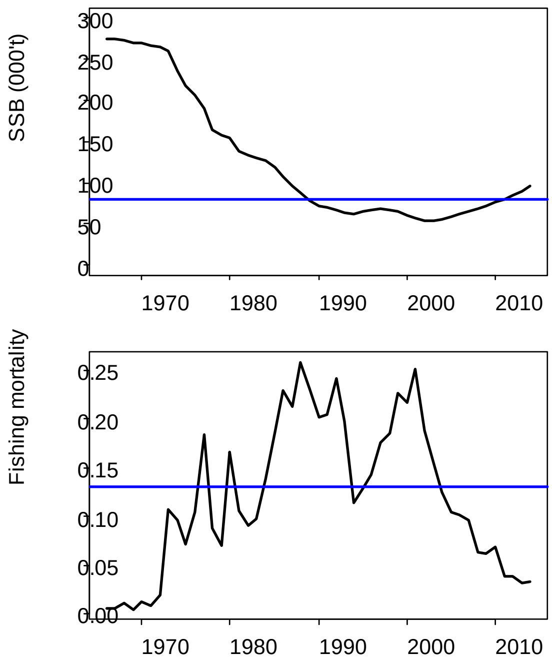


Figure 5.3.13. Spawning–stock biomass (SSB, thousand tonnes, top panel) and fishing mortality(bottom panel) from 1966 (onset of the fishery) to 2014. The blue lines represent B_{MSY} and F_{MSY}.

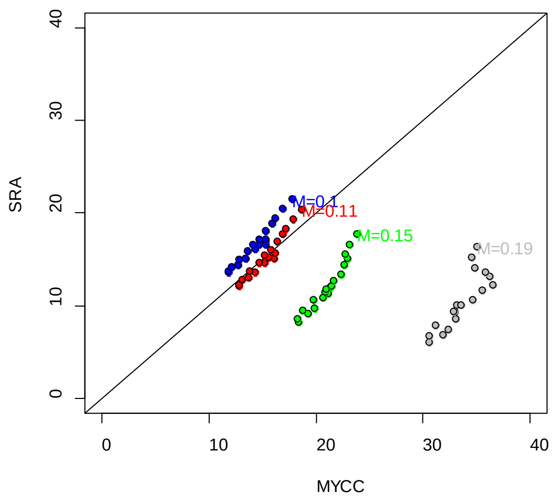


Figure 5.3.14. Comparison of stock numbers of age groups 9+ estimated by SRA and MYCC for M=0.1, 0.11, 0.15 and 0.15.

5.4 Blue ling (*Molva dypterygia*) in I, II, IIIa, IV, and XII

5.4.1 The fishery

The directed fisheries on spawning aggregations for blue ling on Hatton Bank (Division XIIb) and Division IIa (Storegga) are no longer conducted. Blue ling is now only taken as bycatch of other fisheries taking place in these areas.

In Hatton Bank (Division XIIb) blue ling represents a significant bycatch of trawl fisheries for mixed deep-water species. In Division IIa there is also a bycatch from the longline and gillnet fisheries.

In other ICES subareas blue ling is taken in minor quantities. Small reported landings in Subareas VIII, IX and X are now ascribed to the closely related Spanish ling (*Molva macropthalma*) since the species is not known to occur in any significant numbers in these subareas.

5.4.2 Landings trends

Landing data are presented in Tables 5.4.0a–f. There are also historical landings from the Norwegian fishery, mainly from Division IIa, back from 1896 (Figure 5.4.1). During the whole time-series, around 90% or more of the total landings were taken in Subareas II, IV and XII combined. Landings from other areas are presently at a low level. Recently, most of the landings come from Subarea II and XII.

For all areas except Subarea XII, a continuous decline on landings has been observed after the higher landing levels in the 1988–1993 period. In Subarea XII landings have been around 500 t since 1988, with a few higher levels in 1991, 1993, 1999, 2002 and 2003. Landings from individual subareas and divisions have recently been below 500 tonnes but apparently still declining.

5.4.3 ICES Advice

The ICES advice for 2015 was:

“No directed fisheries for blue ling, and a reduction in catches should be considered until such time there is sufficient scientific information to prove the fishery is sustainable:

- Measures should be implemented to minimize the bycatch;
- Closed areas to protect spawning aggregations should be maintained and expanded where appropriate.”

5.4.4 Management

A 2015 precautionary TAC for EU vessels in international waters of XII was set to 558 tonnes. TACs for vessels in EU waters and international waters of Vb, VI and VII were set to 5046 tonnes; of this a quota for Norwegian vessels was set to 150 tonnes to be fished in Union waters of IIa, IV, Vb, VI and VII. In Union and international waters of II and IV, a precautionary TAC for EU vessels was set to 53 tonnes.

5.4.5 Data availability

5.4.5.1 Landings and discards

Landings data are presented in Table 5.4.0a–f. No discard data are available.

5.4.5.2 Length compositions

No length data are available.

5.4.5.3 Age compositions

No age data are available.

5.4.5.4 Weight-at-age

No weight-at-age data are available.

5.4.5.5 Maturity and natural mortality

No data were available.

5.4.5.6 Catch, effort and research vessel data

No data are available.

5.4.6 Data analyses

The assessment for this stock is based on landing trends. The landings have declined and for all areas are now less than 10% of the mean landings from the years 1988–1993 (the period with stable landings) (Figures 5.4.2–5.4.4).

The historical Norwegian landings, mainly in IIa show that landings reached almost 6000 tons in 1980. Since then landings have decreased. In 2010, there was an increase in landings from Subarea II as a result of an increase in Faroese landings. From 2013 onwards, landings are at the same low levels as seen in the early 2000s.

In Subarea XII and after relative high levels for the period 2001–2005 landings have declined. This decline is likely to be due to reductions in Spanish fishing activity in this area.

In Subarea IV an increase on French and Norwegian landings were registered in 2010 and 2011. Recently, landing levels are back to the low levels seen in mid-2000s.

The increase of landings in Division IIIa in 2005 (2.5 times increase from 2004–2005) is likely to be associated to the increase of Danish roundnose grenadier fishery. This fishery stopped in 2006 and the landings of blue ling have since been insignificant.

5.4.6.1 Biological reference points

WKLIFE has not yet suggested methods to estimate biological reference points for stocks which have only landing data or are bycatch species in other fisheries. Therefore, no attempt was made to propose reference points for this stock.

5.4.7 Comments on assessment

Not applicable.

5.4.8 Management considerations

Trends in landings suggest serious depletion in Subarea II. Landings have also declined strongly in Subarea XII from 2002 onwards. Landings in other subareas and divisions are minor but there is some evidence of a persistent decline.

The advice given in 2014 remains appropriate "No directed fisheries for blue ling, and a reduction in catches should be considered until such time there is sufficient scientific information to prove the fishery is sustainable".

Measures should be implemented to minimize the bycatch.

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

Blue ling specimens caught in Subarea XIIb probably belong to the same stock that is exploited in Subarea VI. Management of Subarea XIIb should be consistent with the Advice for ICES Subarea Vb and for Divisions VI and VII.

The bulk of current bycatches of blue ling from subareas and divisions treated in this section are taken within EEZs. The exception is the XIIb catches from the Hatton Bank within the NEAFC Regulatory Area. In accordance with the interim guidelines from NEAFC established in 2014, the blue ling for the entire set of subareas and divisions considered would fall into Category 2. The only measure NEAFC can contribute, i.e. complementing measures within EEZs, is to further reduce bycatches in XIIb.

Table 5.4.0a. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Sub-area I. (* preliminary).

Year	Iceland	Norway	France	Faroes	Total
1988					
1989					
1990					
1991					
1992					
1993					
1994		3			3
1995		5			5
1996					0
1997		1			1
1998		1			1
1999					0
2000		1			1
2000		3			3
2001		1			1
2002		1			1
2003					0
2004		1			1
2005		1			1
2006					0
2007					0
2008					0
2009		1			1
2010		1			1
2011			3		3
2012			1		1
2013					0
2014*				4	4

Table 5.4.0b. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Divisions IIa and b. (* preliminary).

Year	Faroes	France	Germany	Greenland	Norway	E & W	Scotland	Sweden	Russia	Total
1988	77	37	5		3416	2				3537
1989	126	42	5		1883	2				2058
1990	228	48	4		1128	4				1412
1991	47	23	1		1408					1479
1992	28	19		3	987	2				1039
1993		12	2	3	1003					1020
1994		9	2		399	9				419
1995	0	12	2	2	342	1				359
1996	0	8	1		254	2	2			267
1997	0	10	1		280					291
1998	0	3			272		3			278
1999	0	1	1		287		2			291
2000		2	4		240	1	2			249
2001	8	7			190	1	2			208
2002	1	1			129	1	17			149
2003	30				115		1	1		147
2004	28	1			144				1	174
2005	47	3			144	1			2	197
2006	49	4			149					202
2007	102	3			154		3			262
2008	105	9			208		11			329
2009	56	1			219		9			285
2010	183	1			234		4			422
2011	312	7			167					434
2012	188	7			142		1			338
2013	79	16			107					202
2014*	29	16			73		9			127

Table 5.4.0c. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Sub-area III. (* preliminary).

Year	Denmark	Norway	Sweden	Total
1988	10	11	1	22
1989	7	15	1	23
1990	8	12	1	21
1991	9	9	3	21
1992	29	8	1	38
1993	16	6	1	23
1994	14	4		18
1995	16	4		20
1996	9	3		12
1997	14	5	2	21
1998	4	2		6
1999	5	1		6
2000	13	1		14
2001	20	4		24
2002	8	1		9
2003	18	1		19
2004	18	1		19
2005	48	1		49
2006	42			42
2007				0
2008		2		2
2009		+		0
2010		+		0
2011				0
2012				0
2013		1		1
2014*				0

Table 5.4.0d. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Division IVa. (* preliminary).

Year	Denmark	Faroes	France (IV)	Germany	Norway	E & W	Scotland	Ireland	Total
1988	1	13	223	6	116	2	2		363
1989	1		244	4	196	12			457
1990			321	8	162	4			495
1991	1	31	369	7	178	2	32		620
1992	1		236	9	263	8	36		553
1993	2	101	76	2	186	1	44		412
1994			144	3	241	14	19		421
1995		2	73		201	8	193		477
1996		0	52	4	67	4	52		179
1997		0	36		61	0	172		269
1998		1	31		55	2	191		280
1999	2		21		94	25	120	2	264
2000	2		15	1	53	10	46	2	129
2001	7		9		75	7	145	9	252
2002	6		11		58	4	292	5	376
2003	8		8		49	2	25		92
2004	7		17		45		14		83
2005	6		7		51		2		66
2006	6		6		82				94
2007	5		2		55				62
2008	2		9		63		+		74
2009	1		12		69		7		89
2010	1		24		109		21		155
2011			129		47		1		177
2012			96		70				166
2013			8		38				46
2014*			4		34		12		50

Table 5.4.0e. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Subarea XII. (* preliminary).

YEAR	FAROES	FRANCE	GERMANY	SPAIN	E & W	SCOTLAND	NORWAY	ICELAND	POLAND	LITHUANIA	RUSSIA	UNALLOCATED	TOTAL
1988		263											263
1989		70											70
1990		5											5
1991		1147											1147
1992		971											971
1993	654	2591	90			unallocated							3335
1994	382	345	25										752
1995	514	47			12								573
1996	445	60		264		19							788
1997	1	1		411	4								417
1998	36	26		375	1								438
1999	156	17		943	8	43		186					1353
2000	89	23		406	18	23	21	14					594
2001	6	26		415	32	91	103	2					675
2002	19			1234	8		9						1270
2003		7		1096		2	40		12	37			1194
2004		27		861							7		895
2005		10		657						8			675
2006		61		436							4		501
2007	1			353									354
2008				564									564

YEAR	FAROES	FRANCE	GERMANY	SPAIN	E & W	SCOTLAND	NORWAY	ICELAND	POLAND	LITHUANIA	RUSSIA	UNALLOCATED	TOTAL
2009		+		312							+		312
2010				50									50
2011				55									55
2012				205								427	633
2013				178								76	254
2014*				80									80

Table 5.4.0f. Blue ling (*Molva dypterygia*). Total landings by Subarea/Division (From 2010 landings from Areas VIII, IX and X given in previous reports are now considered to represent *Molva macropthalma*). (* preliminary data).

Year	I	II	III	IV	XII	Total
1988		3537	22	363	263	4185
1989		2058	23	459	70	2610
1990		1412	21	501	5	1939
1991		1479	21	627	1147	3274
1992		1039	38	554	971	2602
1993		1020	23	415	3335	4793
1994	3	419	18	424	752	1616
1995	5	359	20	483	573	1440
1996	0	267	12	190	788	1257
1997	1	291	21	270	417	1000
1998	1	278	6	286	438	1009
1999	0	291	6	265	1353	1915
2000	1	249	14	130	594	988
2001	3	208	24	252	675	1162
2002	1	149	9	377	1270	1806
2003	1	147	19	101	1194	1462
2004	0	174	19	83	895	1171
2005	1	171	49	70	675	966
2006	0	202	42	94	501	839
2007	0	263	0	62	354	679
2008	0	329	2	74	564	969
2009	1	285	0	89	312	687
2010	1	422	0	155	92	670
2011	0	434	0	50	50	534
2012	1	336	0	166	633	1136
2013	0	159	1	46	254	460
2014*	4	118	0	38	80	240

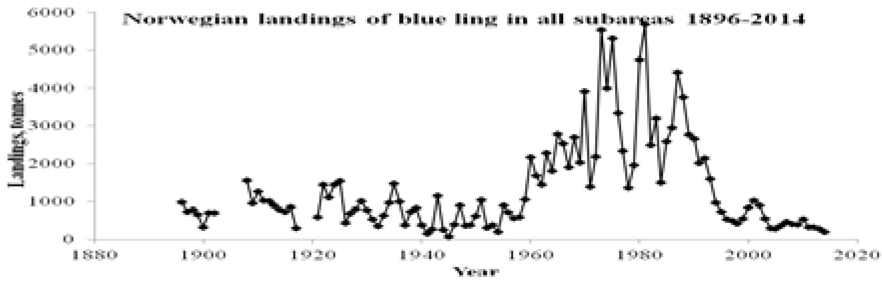


Figure 5.4.1. Reported Norwegian landings on blue ling from 1896–2014.

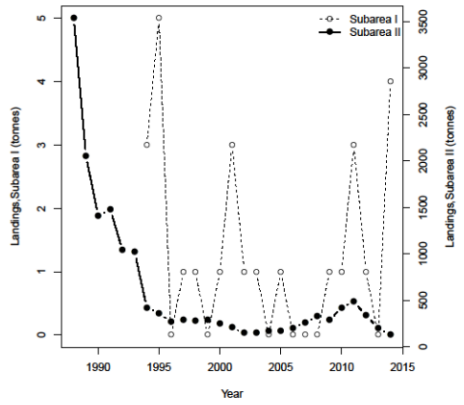


Figure 5.4.2. Landings of blue ling in Subareas I and II.

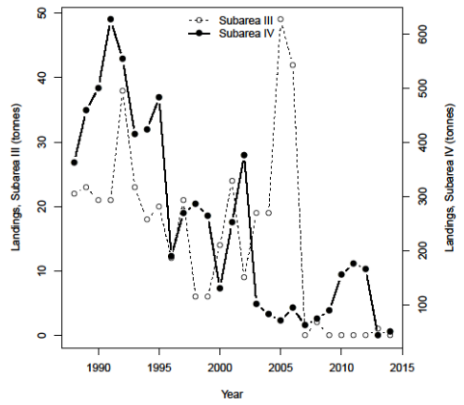


Figure 5.4.3. Landings of blue ling in Subareas III and IV.

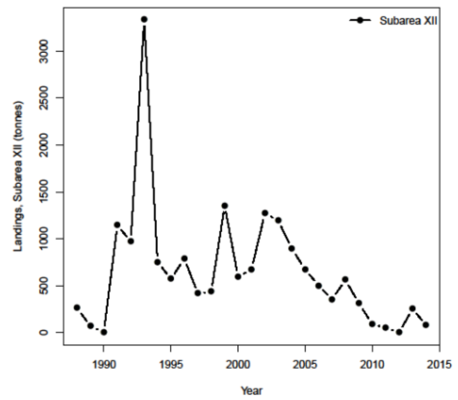


Figure 5.4.4. Landings of blue ling in Subarea XII.

6 Tusk

6.1 Stock description and management units

In 2007, WGDEEP examined the available evidence of stock discrimination in this species. Based ong enetic investigations (references), the group suggested the following stock units:

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

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

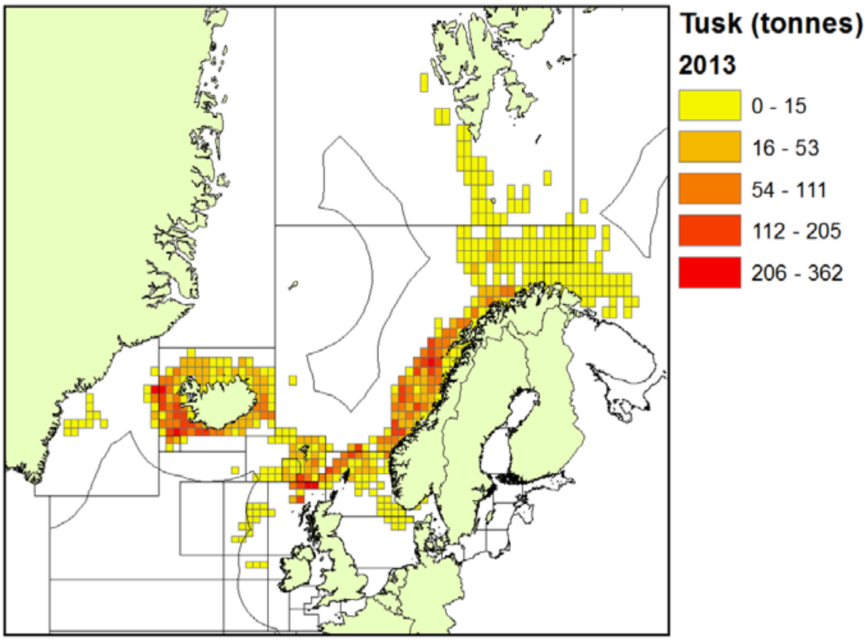


Figure 6.1. Reported landings of tusk in the ICES area by statistical rectangle, 2013. Data from Norway, Faroes, Iceland, France, UK (England and Wales) and Spain. Landings shown in this figure account for 99% of all reported landings in the ICES area.

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

6.2.1 The fishery

Tusk in Va is caught in a mixed longline fishery, conducted in order of importance by Icelandic, Faroese and Norwegian boats. Between 150–240 Icelandic longliners report catches of tusk, but much fewer gillnetters and trawlers. The number of longliners reporting tusk catches in 2014 decreased to 135 from 173 the previous year (Table 6.2.1). Most of tusk in Va is caught on longlines or around 97% of catches in tonnes and this has been relatively stable proportion since 1992 (Table 6.2.1).

Table 6.2.1. Tusk in Va. Number of Icelandic boats reporting catches and their landings from logbooks.

Year	Number of boats			Catches (Tonnes)			
	Longliners	Gillnetters	Trawlers	Longline	Trawl	Other	Sum
2000	244	20	13	4536	91	80	4707
2001	230	36	7	3210	72	98	3380
2002	194	18	11	3703	75	126	3904
2003	202	8	9	3902	55	60	4017
2004	192	6	10	2996	84	44	3124
2005	231	7	17	3324	164	46	3534
2006	228	11	12	4908	92	54	5054
2007	205	8	17	5834	95	57	5986
2008	170	16	30	6756	113	60	6929
2009	158	20	38	6754	107	91	6952
2010	165	25	34	6760	93	66	6919
2011	165	18	36	5744	67	34	5845
2012	173	22	37	6255	59	27	6341
2013	173	16	36	4873	73	27	4973
2014	135	19	37	4878	88	28	4994

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

Most of the tusk caught in Va by Icelandic longliners is caught at depths less than 300 meters (Figure 6.2.1). The main fishing grounds for tusk in Va as observed from logbooks are on the south, southwestern and western part of the Icelandic shelf (Figures 6.2.2 and 6.2.3).

The main trend in the spatial distribution of tusk catches in Va according to logbook entries is the decreased proportion of catches caught in the southeast and increased catches on the western part of the shelf. Around 50 to 60% of tusk is caught on the south and western part of the shelf (Figure 6.2.3).

Tusk in XIV is caught mainly as a bycatch by longliners and trawlers. The main area where tusk is caught in XIV is 63°–66°N and 32°–40°W, well away from the Icelandic EEZ.

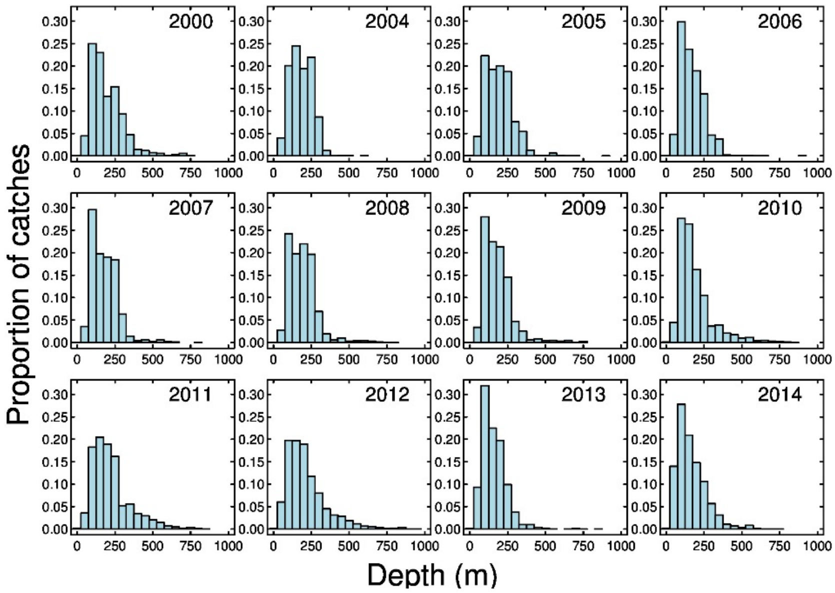


Figure 6.2.1. Tusk in Va and XIV. Depth distribution of longline catches in Va according to logbooks.

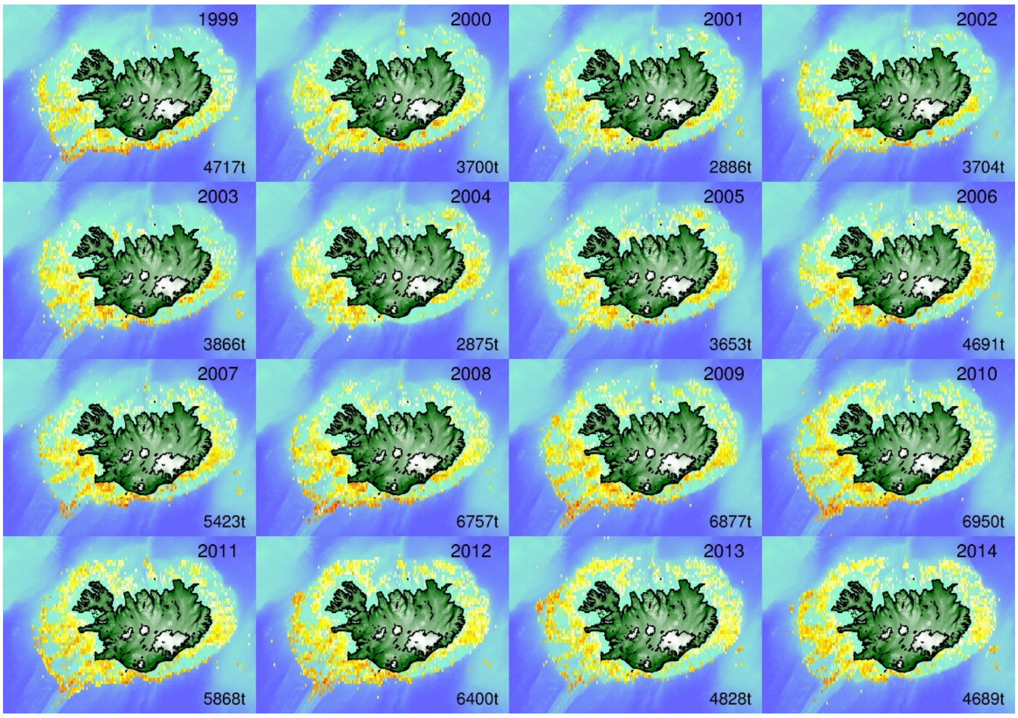


Figure 6.2.2. Tusk in Va and XIV. Geographical distribution of the Icelandic fishery since 1999 as reported in logbooks. All gears combined.

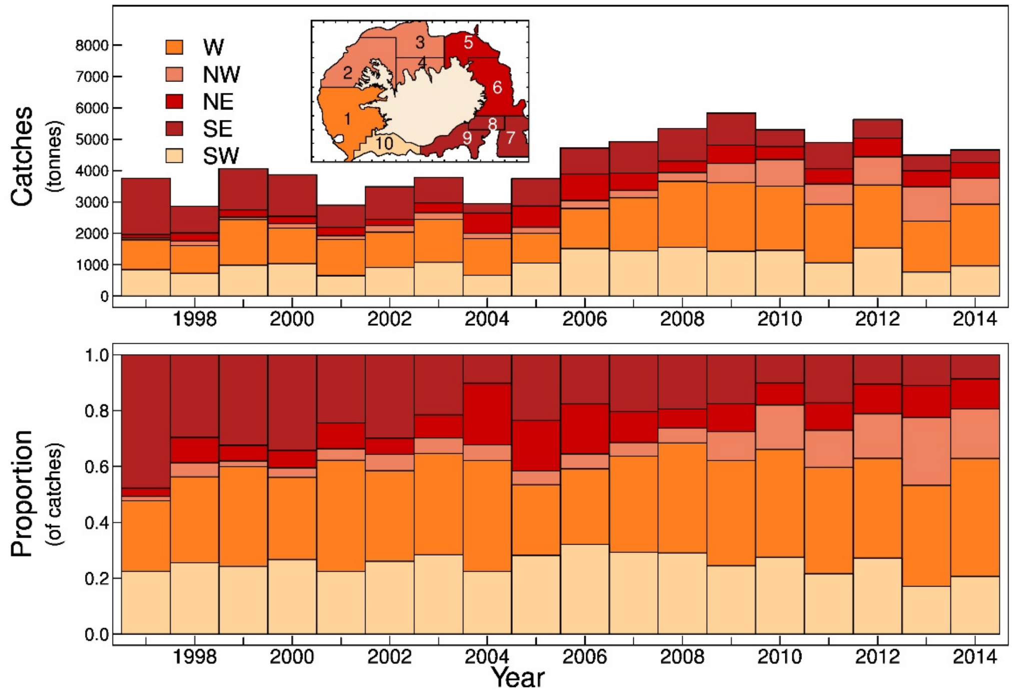


Figure 6.2.3. Tusk in Va and XIV. Changes in spatial distribution of the Icelandic fishery in 1996–2012 as reported in logbooks. All gears combined.

6.2.1.1 Landings trends

The total annual landings from ICES Division Va were around 6300 tonnes in 2013 (Table 6.2.6). Thus, landings in past years indicate decreasing trend following a decade of gradually increasing trend that peaked in 2010 with landings of 9000 tonnes. (Figure 6.2.4).

The foreign catch (mostly from the Faroe Islands, but also from Norway) of tusk in Icelandic waters has always been considerable. Until 1990, between 40–70% of the total annual catch from ICES Division Va was caught by foreign vessels but has since then been between 15–25%, mainly from the Faroe Islands (Table 6.2.6).

Landings in XIV have always been low compared to Va, rarely exceeding 100 t. (Table 6.2.7).

6.2.1.2 ICES Advice

The latest Advice from ICES in May 2014 states: ICES advises that, based on the MSY approach, catches should be no more than 3950 t.

This was the first year ICES used $F_{MSY} = 0.2$, previously the advice was based on $F_{MAX} = 0.24$ that was used as a F_{MSY} proxy.

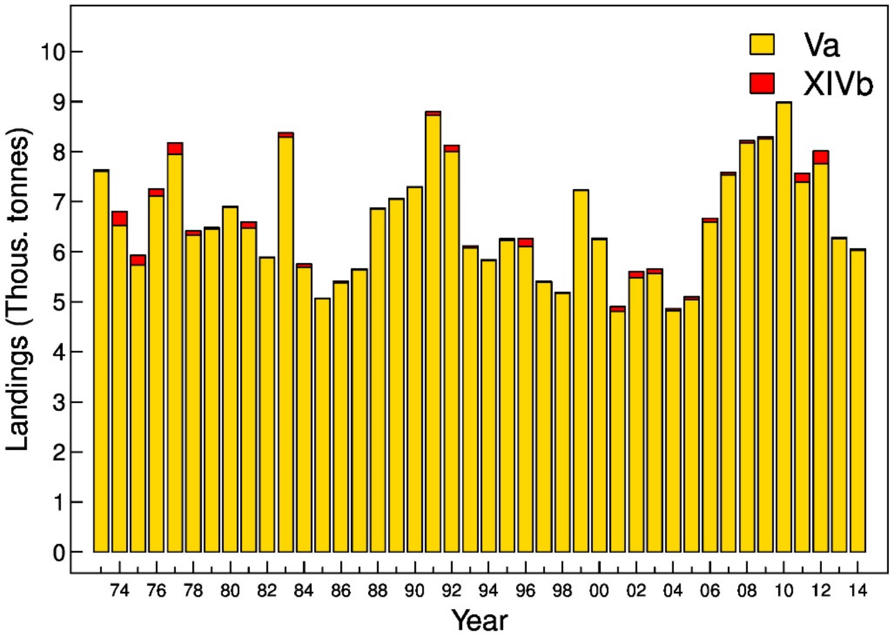


Figure 6.2.4. Tusk in Va and XIV. Landings in Va and XIV (source STATLANT).

6.2.1.3 Management

The Icelandic Ministry of Industries and Innovation (MII) is responsible for management of the Icelandic fisheries and implementation of legislation. Tusk was included in the ITQ system in the 2001/2002 quota year and as such subjected to TAC limitations. In the beginning the TAC was set as recommended by MRI but has often been set higher than advice. One reason is that no formal harvest rule exists for this stock. The landings, by quota year, have always exceeded the advised and set TAC but the overshot in landings has decreased from 30–40%. However since the 2011/12 fishing year the overshoot in landings has decreased and in 2013/14 fishing year the landings were equal to the set TAC (Table 6.2.2).

The reasons for the large difference between annual landings and both advised and set TACs are threefold:

1) It is possible to transfer unfished quota between fishing years;

2) It is possible to convert quota shares in one species to another;

3) The national TAC is only allocated to Icelandic vessels. All foreign catches are therefore outside of the quota system.

However for the last three fishing years, managers have to some extend taken into account the foreign catches (see below). The tusk advice given by MRI and ICES for each quota year is, however, for all catches, including foreign catches. Figure 6.2.5 shows the net transfers in the Icelandic ITQ-system. During the 2005/06 to 2010/11 fishing years there was a net transfer of other species quota being converted to tusk quota, this has however reversed during the last three fishing years.

Table 6.2.2. Tusk in Va and XIV. TAC recommended for tusk in Va by the Marine Research Institute, national TAC and total landings from the quota year 2001/2002.

Fishing year	MRI advice	National TAC	Landings
2001/02		4500	4876
2002/03	3500	3500	5046
2003/04	3500	3500	4958
2004/05	3500	3500	4901
2005/06	3500	3500	5928
2006/07	5000	5000	7942
2007/08	5000	5500	7279
2008/09	5000	5500	8162
2009/10	5000	5500	8382
2010/11	6000	6000	7777
2011/12	6900	7000	7401
2012/13	6700	6400	6833
2013/14	6200	5900	5881
2014/15	4000	3700	

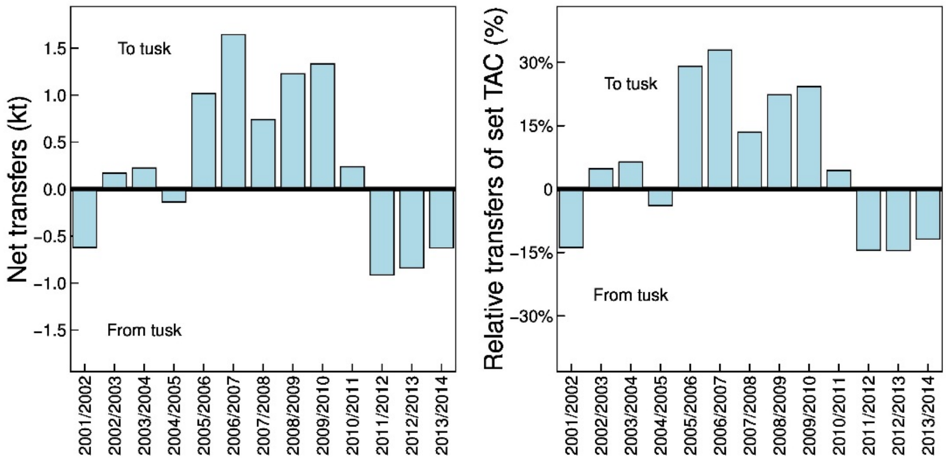


Figure 6.2.5. Tusk in Va and XIV. Net transfers of tusk quota to other species in the Icelandic ITQ system by fishing year. Positive values indicate that other species are being changed to tusk but negative mean that tusk quota is being converted to other species.

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

6.2.2 Data available

In general sampling is considered good from commercial catches from the main gear (longlines). The sampling does seem to cover the spatial distribution of catches for longlines and trawls but less so for gillnets. Similarly sampling does seem to follow the temporal distribution of catches (WGDEEP, 2012).

6.2.2.1 Landings and discards

Landings by Icelandic vessels are given by the Icelandic Directorate of Fisheries. Landings of Norwegian and Faroese vessels are given by the Icelandic Coast Guard. Discarding is banned by law in the Icelandic demersal fishery. Based on limited data, discard rates in the Icelandic longline fishery for tusk are estimated very low (<1% in either numbers or weight) (WGDEEP, 2011:WD02). Measures in the management system such as converting quota share from one species to another are used by the fleet to a large extent and this is thought to discourage discards in mixed fisheries. A description of the management system is given in the Stock Annex for tusk in Va and XIV.

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

6.2.2.2 Length compositions

An overview of available length measurements from Va is given in Table 6.2.3. Most of the measurements are from longlines, number of available length measurements increased in 2007 from around 2500 to around 4000 and have been close to that since.

Length distributions from the longline fishery are shown in Figures 6.2.6 (abundance) and 6.2.7 (biomass). In the figures the length distributions are multiplied with a maturity ogive to get estimates of the proportion of catches mature.

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

Table 6.2.3. Tusk in Va and XIV. Number of available length measurements from Icelandic (Va) commercial catches.

YEAR	LONGLINE		GILLNETS		TRAWLS	
	Samples	Measured	Samples	Measured	Samples	Measured
2000	17	2532	0	0	0	0
2001	17	2513	0	0	1	151
2002	17	2453	0	0	0	0
2003	18	2661	0	0	0	0
2004	10	1472	0	0	1	150
2005	12	1775	0	0	0	0
2006	15	2225	0	0	3	450
2007	22	3154	2	167	1	150
2008	32	4722	0	0	0	0
2009	27	3945	0	0	0	0
2010	29	4354	0	0	0	0
2011	28	4141	0	0	0	0
2012	35	5105	0	0	1	150
2013	22	3278	0	0	0	0
2014	28	3384	0	0	0	0

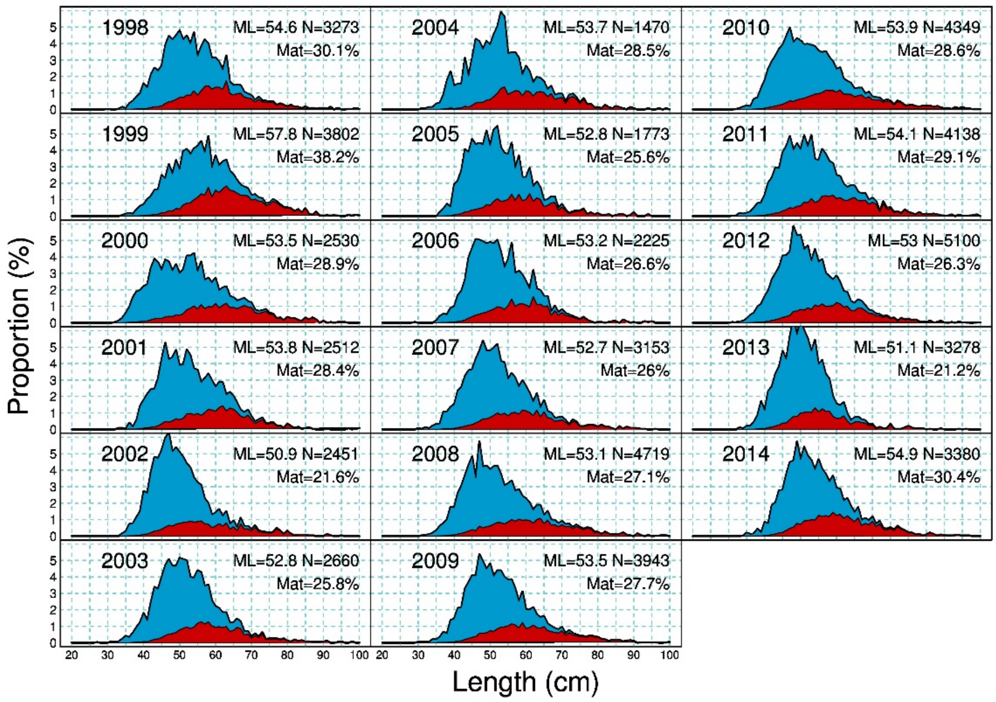


Figure 6.2.6. Tusk in Va and XIV. Length distributions from Icelandic commercial longline catches in abundance. Blue areas are immature tusk and red represent mature tusk. Small numbers to the right refer to mean length (ML), number of samples (N) and percentage of mature individuals (Mat).

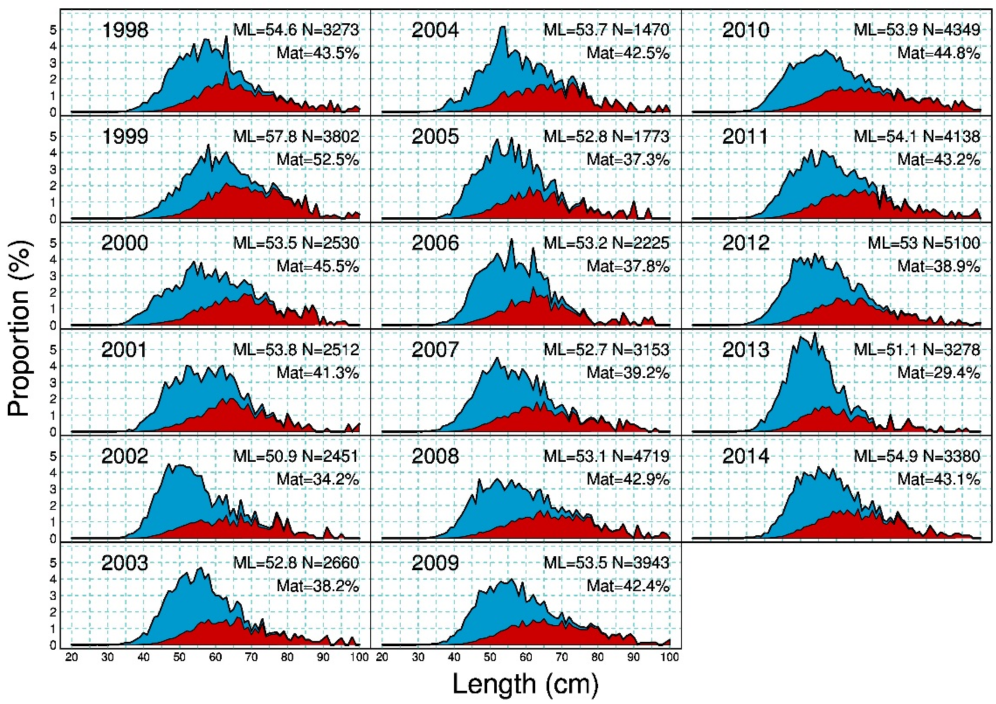


Figure 6.2.7. Tusk in Va and XIV. Length distributions from Icelandic commercial longline catches in biomass. Blue areas are immature tusk and red represent mature tusk. Small numbers to the right refer to mean length (ML), number of samples (N) and percentage of mature individuals (Mat).

6.2.2.3 Age compositions

Table 6.2.4 gives an overview of otolith sampling intensity by gear types from 2000 to 2013 in Va. Since 2010 considerable effort has been put into ageing tusk otoliths, so now aged otoliths are available from 1984, 1995, 2004–2014. The ageing are used as input data for the Gadget assessment (Figures 6.2.7–6.2.8). It is expected that the effort in ageing of tusk will continue.

No data are available from XIV.

Table 6.2.4. Tusk in Va and XIV. Number of available otoliths from Icelandic (Va) commercial catches and the Icelandic Spring survey and the number of aged otoliths.

Year	Longline			Survey		
	Samples	Otoliths	Aged	Samples	Otoliths	Aged
2000	17	849	0	229	321	0
2001	17	849	0	208	282	0
2002	17	851	0	207	303	0
2003	18	900	0	229	343	0
2004	10	500	0	225	422	399
2005	12	600	0	263	488	148
2006	15	750	0	281	499	457
2007	22	1100	0	290	483	381
2008	32	1600	600	282	489	475
2009	27	1350	1090	277	453	434
2010	29	1449	1373	241	378	363
2011	28	1400	1306	270	738	728
2012	34	1700	1112	285	771	750
2013	22	1100	490	275	744	517
2014	28	620	587	241	585	560

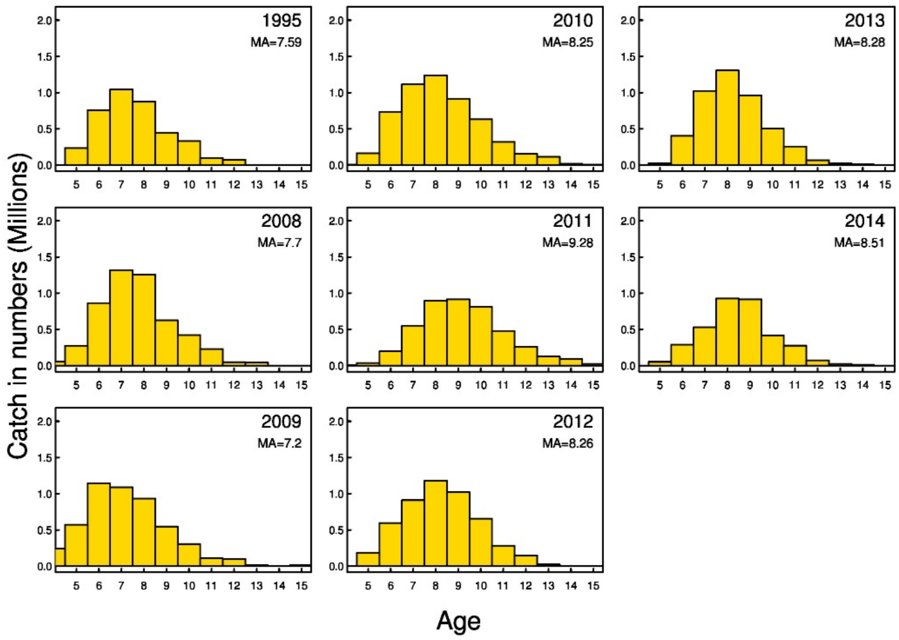


Figure 6.2.8. Tusk in Va and XIV. Catch in numbers in Va (From longlines).

6.2.2.4 Weight-at-age

Weight-at-age data from Va are limited to 2008–2014 (Figure 6.2.9).

No data are available from XIV.

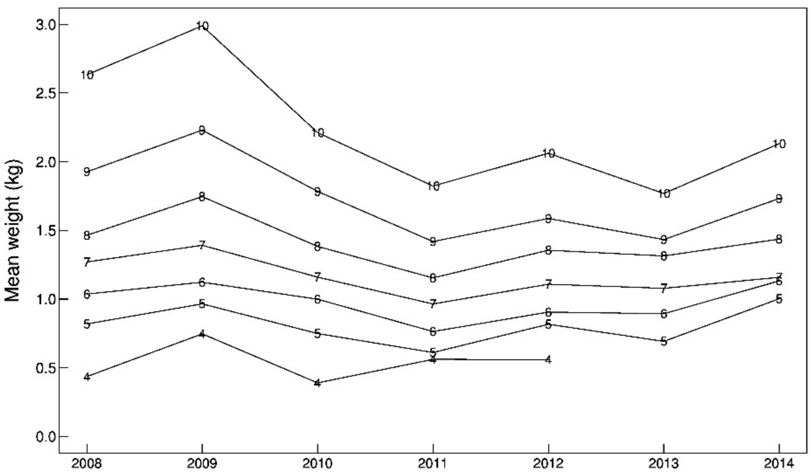


Figure 6.2.9. Tusk in Va and XIV. Changes in mean weight-at-age from commercial catches in Va.

6.2.2.5 Maturity and natural mortality

At 54 cm around 25% of tusk in Va is mature, at 62 cm 50% of tusk is mature and at 70 cm 75% of tusk is mature based on the spring survey data.

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

No data are available for XIV.

6.2.2.6 Catch, effort and research vessel data

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

Figure 6.2.10 shows nominal catch per unit of effort (cpue) and effort in the Icelandic longline fishery. The cpue is calculated using all longline data where catches of the species were registered, with no standardization attempted. The cpue estimates of tusk in Va are not considered representative of stock abundance.

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

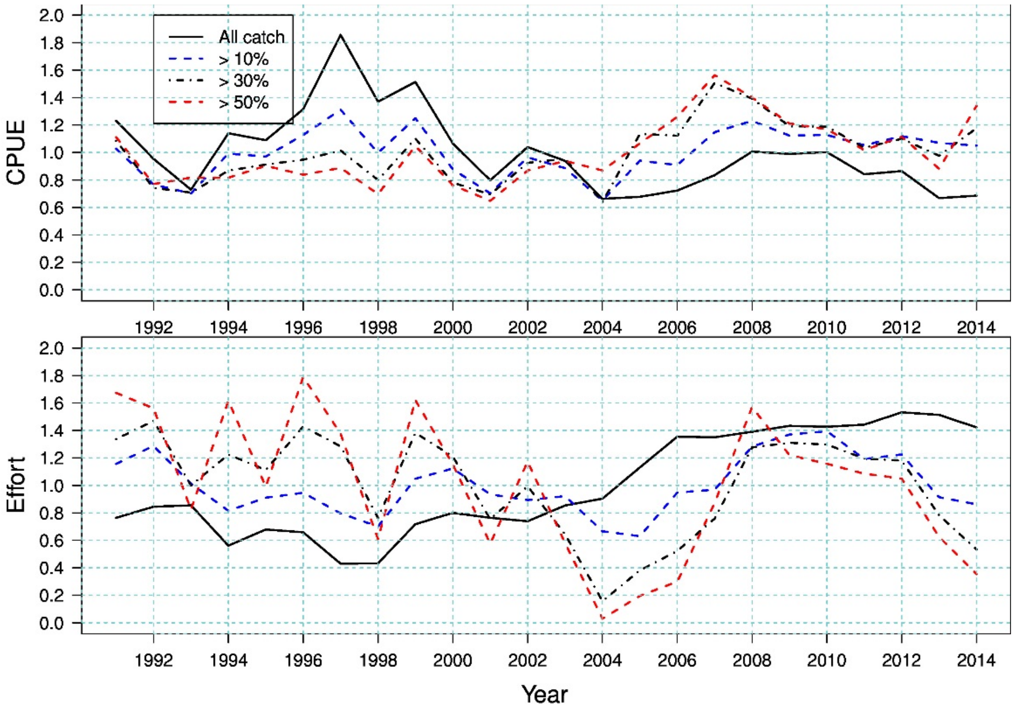


Figure 6.2.10. Nominal cpue and effort from the Icelandic longline fishery for catches where tusk composed different percentages of the total catch in each set.

Icelandic survey data (Va)

Indices: The Icelandic spring groundfish survey, which has been conducted annually in March since 1985, covers the most important distribution area of the tusk fishery. Detailed description of the spring groundfish survey is given in the Stock Annex for tusk in Va.

In 2011 the 'Faroe Ridge' survey area was included into the estimation of survey indices. This topic was mentioned at the WKDEEP 2010 meeting but not acted upon (see: WD 01 to the 2010 ICES WKDEEP). One of the problems when calculating spring survey indices for tusk in Icelandic waters is whether to use stations from the Iceland-Faroe Ridge. 24 stations on the Iceland-Faroe Ridge were omitted in 1996 from the survey. It was not until 2004 that nine of the stations were included again in the survey and all of the 24 stations in 2005. Inclusion of the Iceland-Faroe Ridge has some impact on the total survey index for the years when this area was surveyed.

In addition, the autumn survey was commenced in 1996 and expanded in 2000 however a full autumn survey was not conducted in 2011 and therefore the results for 2011 are not presented. A detailed description of the Icelandic spring and autumn groundfish surveys is given in the Stock Annex. Figure 6.2.11 shows both a recruitment index and the trends in various biomass indices. Survey length distributions are shown in Figure 6.2.12 (abundance) and changes in spatial distribution in Figures 6.2.13 and 6.2.14.

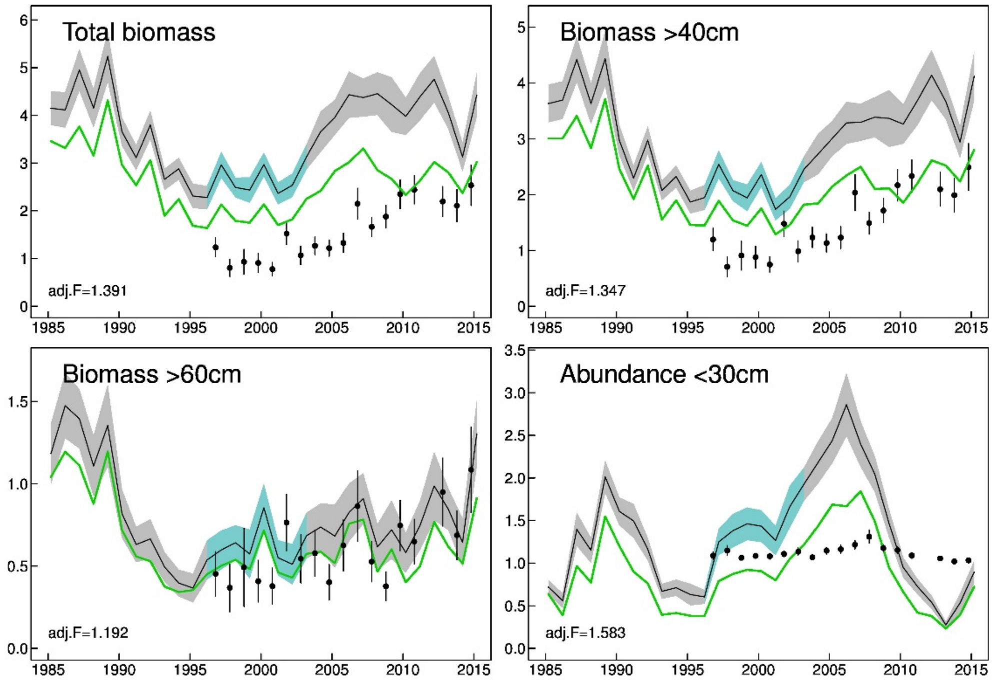


Figure 6.2.11. Tusk in Va and XIV. Indices in the Spring Survey (March) 1985 and onwards (line shaded area) and the autumn survey (October) 1996 and onwards (No autumn survey in 2011). Green line is the index excluding the Faroe-Iceland Ridge.

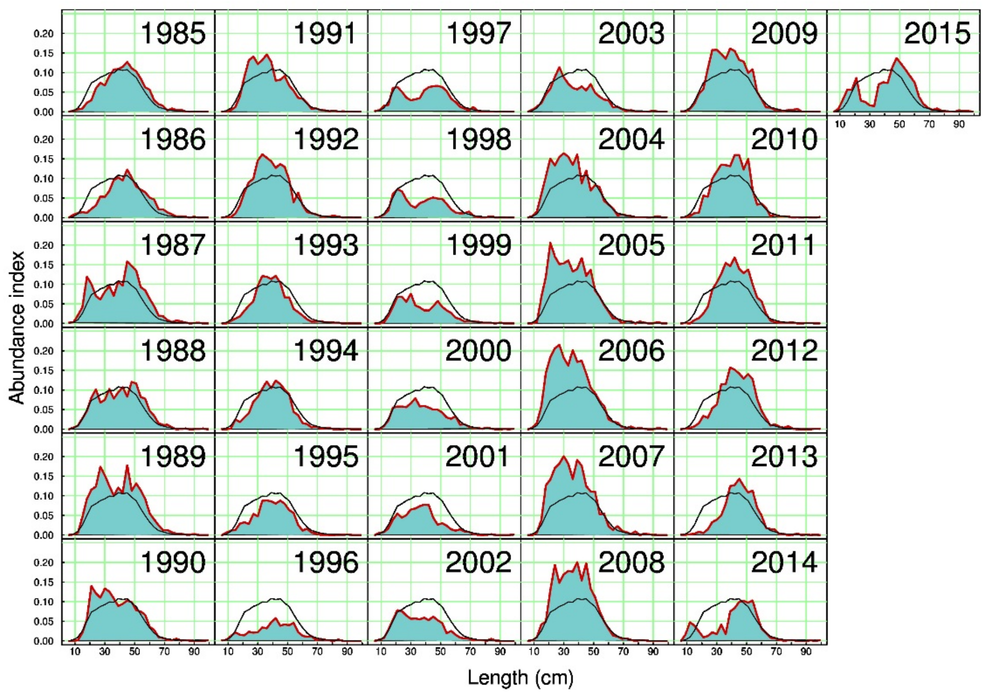


Figure 6.2.12. Tusk in Va and XIV. Length disaggregated abundance indices from the spring survey (March) 1985 and onwards. Black line is the average over the whole period.

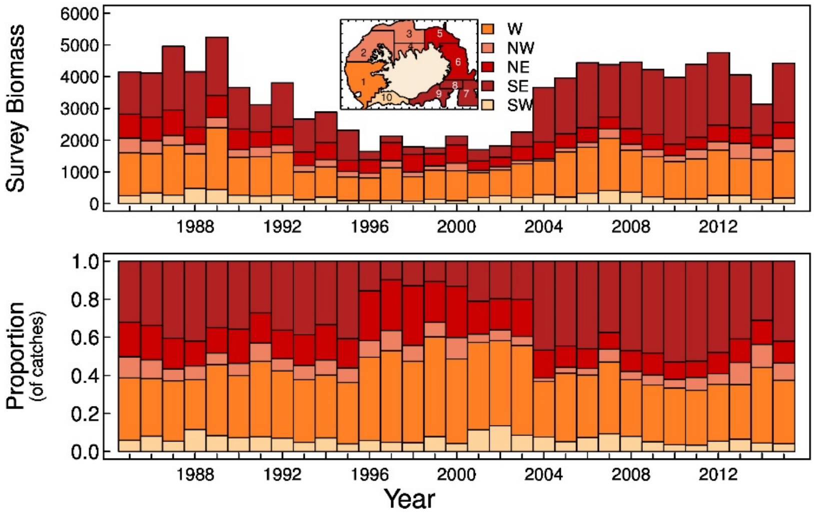


Figure 6.2.13. Tusk in Va and XIV. Estimated survey biomass in the spring survey (March) by year from different parts of the continental shelf (upper panel) and as a proportion of the total (lower panel).

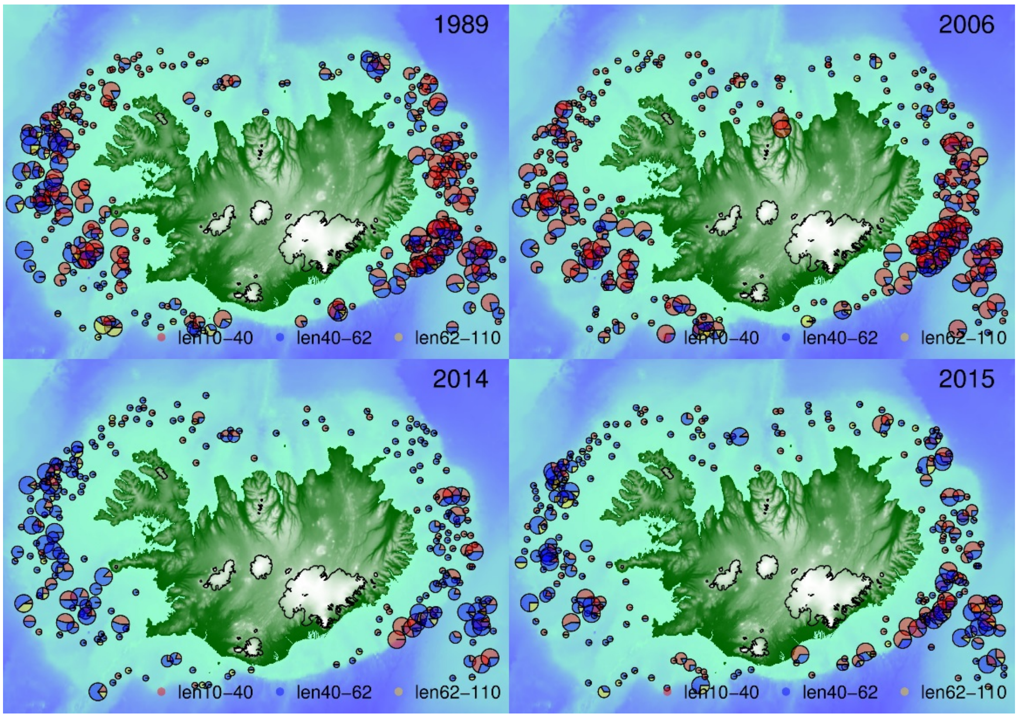


Figure 6.2.14. Tusk in Va and XIV. Changes in spatial distribution divided by size. Size of pie is indicative of numbers of specimens caught at the tow-station.

German survey data (XIV)

Indices: The German groundfish survey was started in 1982 and is conducted in the autumn. It is primarily designed for cod but covers the entire groundfish fauna down to 400 m. The survey is designed as a stratified random survey; the hauls are allocated to strata off West and East Greenland both according to the area and the mean historical cod abundance at equal weights. Towing time is 30 min at 4.5 kn. (Ratz, 1999).

Data from the German survey in XIV were not available at the meeting. The trend in the German survey catches, presented at the WGDEEP 2010, was similar to those observed in surveys in Va.

6.2.3 Data analyses

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

There have been no marked changes in the number of boats nor the composition of the fleet participating in the tusk fishery in Va (Table 6.2.1). Catches decreased from around 9000 tonnes in 2010 to 6029 tonnes in 2014. This decrease is mainly because of reductions in landings by the Icelandic longline fleet and to a lesser extend Faroese and Norwegian landings (Table 6.2.6). This has resulted in less overshoot of landings relative to set TAC (Table 6.2.2) and species conversions in the ITQ system in the last three fishing years are different than in previous years in that tusk was converted to other species compared to other species being converted to tusk in previous fishing years.

There are no marked changes in the length compositions since 2004, mean length in the catches ranges between 52.7 and 54.1 (Figure 6.2.6). According to the available length distributions and information on maturity only around 29% of catches in abundance and 44% in biomass are mature (Figures 6.2.6 and 6.2.7). There does seem to be a shift in the age distribution from commercial catches between 2010 and 2011 where ages are higher. However the age distributions from 2012 and 2014 appear similar as observed in 2010 (Figure 6.2.8). The reason for this is unknown, but given they lack of distinctive cohort structure in the data the first explanation might be a lack of consistency in ageing. Reasons such as difference in sampling, temporal or spatial are highly unlikely.

Cpue is not considered a reliable stock indicator but may nevertheless be indicative of changes in fleet dynamics. Cpue and effort have remained more or less stable since 2008 (Figure 6.2.10).

At WGDEEP 2011 the Faroe-Iceland ridge was included in the survey index when presenting the results from the Icelandic spring survey for tusk in Va. That index is also used for tuning the Gadget model. Total biomass index and the biomass index for tusk larger than 40 cm (harvestable part of the stock) increased in 2015 compared to 2014 and are now at a similar level as in in 2011 (Figure 6.2.11). The same holds for the index of tusk larger than 60 cm (spawning–stock biomass index) but that index didn't increase by similar factors as the other two biomass indices. The index of juvenile abundance (<30 cm) decreased by a factor of 6 between the 2005 survey when it peaked and the 2013 survey when it was at its lowest observed value. Since 2013 juvenile index has increased year on year in the 2014 and 2015 survey. The index excluding the Faroe-Iceland Ridge shows similar trends as described above. The results from the shorter autumn survey are by and large similar to those observed from the spring survey except for the juvenile abundance index that is more or less at a constant level compared to the spring survey juvenile index. Due to industrial action the autumn survey did not take place in 2011.

When looking at the spatial distribution from the spring survey around half of the index is from the SE area (Figure 6.2.12). However only around 20 to 25% of the catches are caught in this area (Figures 6.2.2 and 6.2.3). The change in juvenile abundance between 2006 and 2015 can be clearly seen in Figures 6.2.12 and 6.2.14 where in 2006 juveniles (<40 cm) were all over the southern part of the shelf but can hardly be seen in 2014.

Stock assessment on Tusk in Va using Gadget

Since 2010 the Gadget model (**G**lobally applicable **A**rea **D**isaggregated **G**eneral **E**co-system **T**oolbox, see www.hafro.is/gadget) has been used for the assessment of tusk in Va (See stock annex for details). In 2012 the EG decided to lower the value of natural mortality used in the assessment from 0.2 to 0.15 (See discussion in WGDEEP-2012 report) and this was subsequently adopted by the RG, ADG and ACOM.

Data used and model settings

Data used for tuning are given in the stock annex.

Model settings used in the Gadget model for tusk in Va are described in more detail in the Stock Annex.

Diagnostics

Weights of likelihood components

Weights were assigned to likelihood components using the re-iterative procedure outlined in the Stock Annex. As in previous assessments the survey indices (si2039, si4069, si70110) were grouped together and similarly the length and age distributions from the survey (ldist.survey, alkeys.suvey) and from commercial catches (ldist.comm, alkeys.comm). The weights were similar to those assigned in 2012 except for si2039 component which is the juvenile index in the Gadget model. The overall likelihood score was 7995 of which the survey index components accounted for 3,72%, the age and length data from the survey for around 32,13% and the data from commercial catches for 64.15% (Table 6.2.5). It can therefore be stated that the model follows the survey data considerably better than the commercial catch data.

Table 6.2.5. Tusk in Va and XIV. Weights of likelihood components in the 2013 assessment and their individual likelihood score. For comparisons the weights of the 2012 assessments are also presented.

COMPONENT	*WEIGHT*	WEIGHT	LIKELIHOOD	% OF LIK.
	2013	**2014 and 2015**	**score**	**score**
bounds	10.00	10.00	0	0
understocking	1.00	1.00	0	0
si2039	48.11	37.24	90.91	1.26
si4069	21.29	21.88	114.09	1.58
si70110	3.18	3.34	63.58	0.88
ldist.catch	0.11	0.11	2599.78	35,99
ldist.survey	0.06	0.06	1067.19	14,78
alkeys.catch	0.34	0.24	2034.56	38,17
alkeys.survey	0.22	0.22	1252,81	17,35
Sum			7222.90	

Observed and predicted proportions by fleets: Overall the fit of the predicted proportional length distributions is close to the observed distributions (Figures 6.2.15 and 6.2.16). In general for the commercial catch distributions the fit is better at the end of the time-series (Figure 6.2.15). The reason for this is there is little data at the beginning of the time-series and the model may be constrained by the initial values.

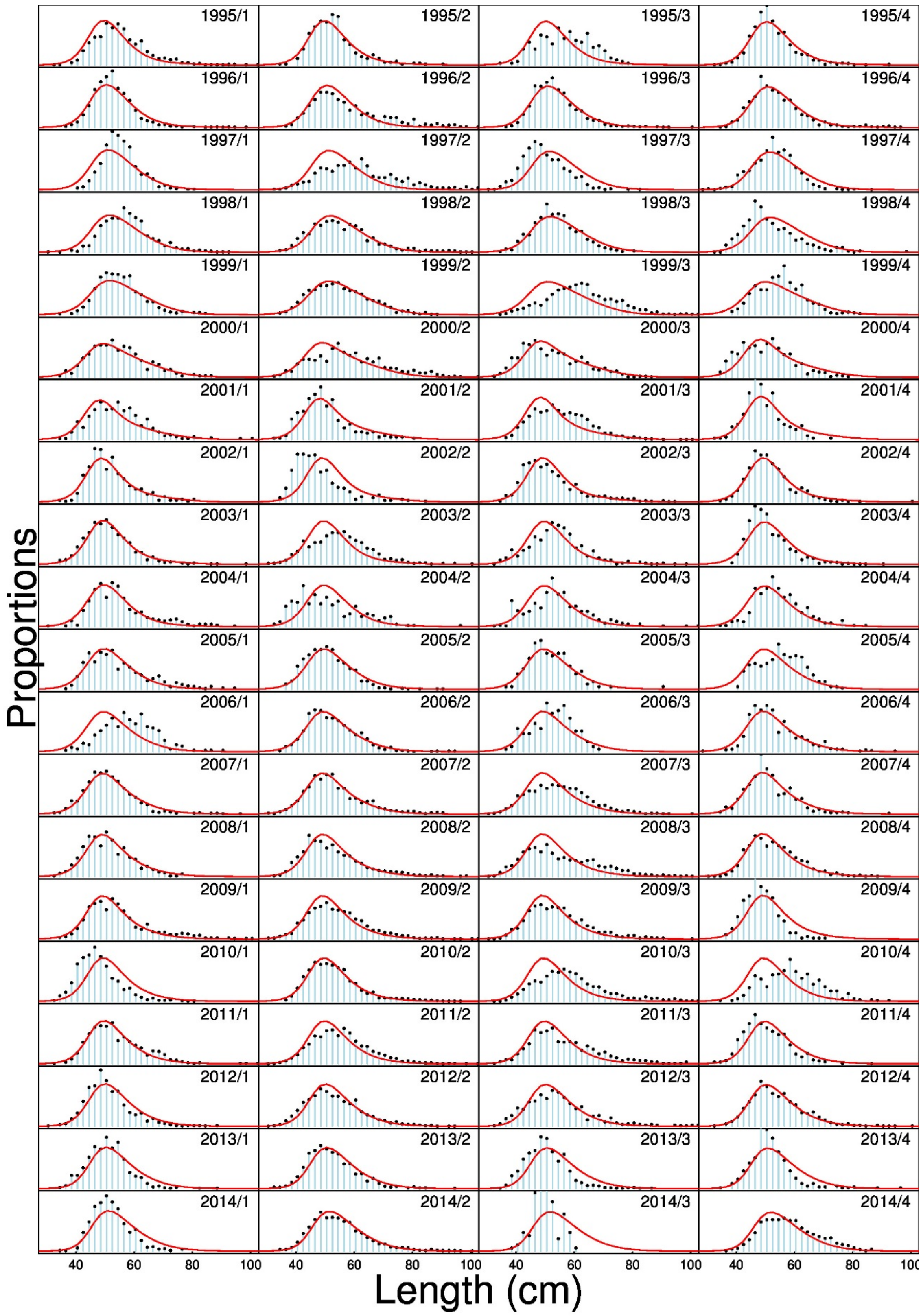


Figure 6.2.15. Tusk in Va and XIV. Proportional fit (red line) to observed length distributions (points and blue bars) from commercial catches (longlines) by year and quarter from Gadget.

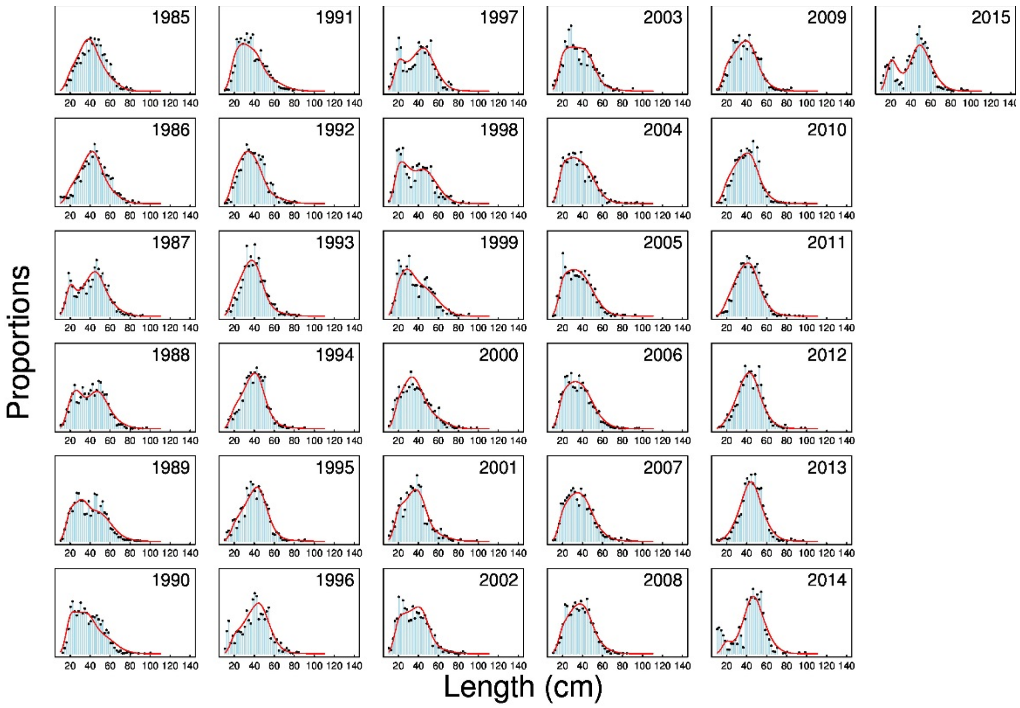


Figure 6.2.16. Tusk in Va and XIV Fit (red line) to observed length distributions (points and blue bars) from the Icelandic spring survey by year from Gadget.

Model fit: In Figure 6.2.17 the length disaggregated indices are plotted against the predicted numbers in the stock as a time-series. The correlation between observed and predicted is good for the first five length groups (20–29, 30–39, 40–49, 50–59 and 60–69) which the first three to four are the main length groups of tusk caught in the spring survey. In the two larger length groups the fit gets progressively worse. Overall fit, when the disaggregated abundance indices and predictions are converted to biomass and summed over the length intervals is good, however the model is predicting lower biomass than the survey indicates in the terminal year (Figure 6.2.17).

Retrospective analysis: Compared to last year's assessment there is a downward revision of SSB. Similarly fishing mortality was estimated at lower level in 2012 than now**.** Overall the perception of the stock does change considerably from last year (Figure 6.2.17). It should be noted that at the time of WGDEEP 2013 the results of the 2013 spring survey were not available. Results of an analytical retrospective analysis (omitting last year's data) give similar results though the bias is not as strong (Figure 6.2.18).

Retrospective analysis may be misleading for this model as data are being added each year into the time-series (ageing going back in time), not only at the end of the time-series. Therefore estimates may change considerably much farther back in time than in traditional age-based models. Additionally the steep drop in the tuning series (the spring survey) that the model is following results in lower biomass estimates and higher estimates of fishing mortality. This can be seen in the analytical retrospective fit to the survey indices in Figure 6.2.19. There is little retrospective bias in the smaller length groups but the peak in the indices in 2005 to 2011 is being down-graded, i.e. the model underestimates in that period with each additional year. For the larger length groups the model overestimated the indices (abundance) in the peak period in the first runs but in the later runs it is either in line with the indices or under them. This is a very traditional problem when there is a large interannual change in tuning series.

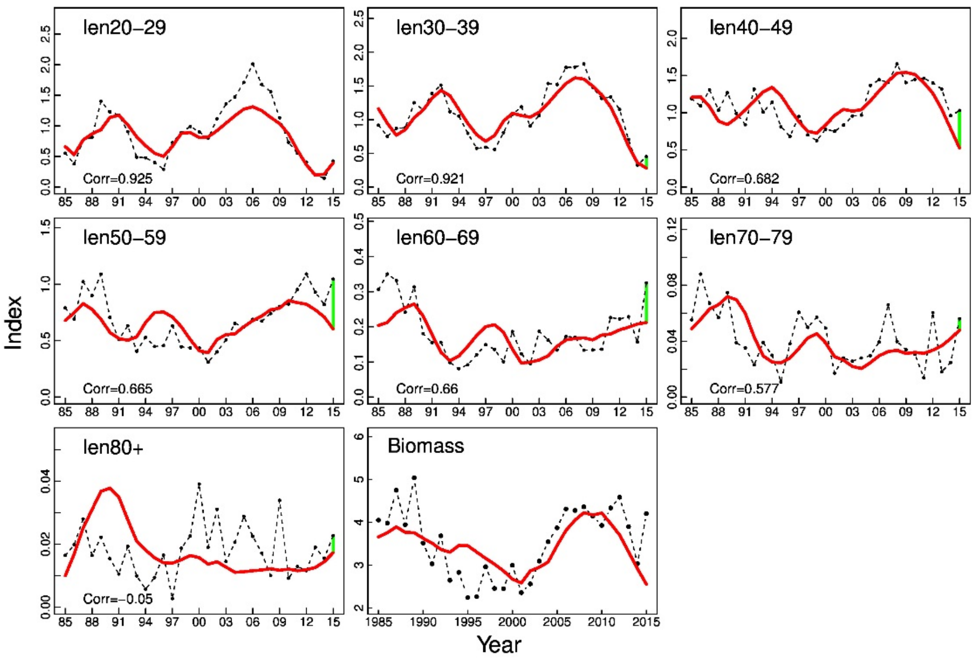


Figure 6.2.17. Tusk in Va and XIV. Gadget fit to indices from disaggregated abundance by length indices from the spring survey and to summed-up biomass.

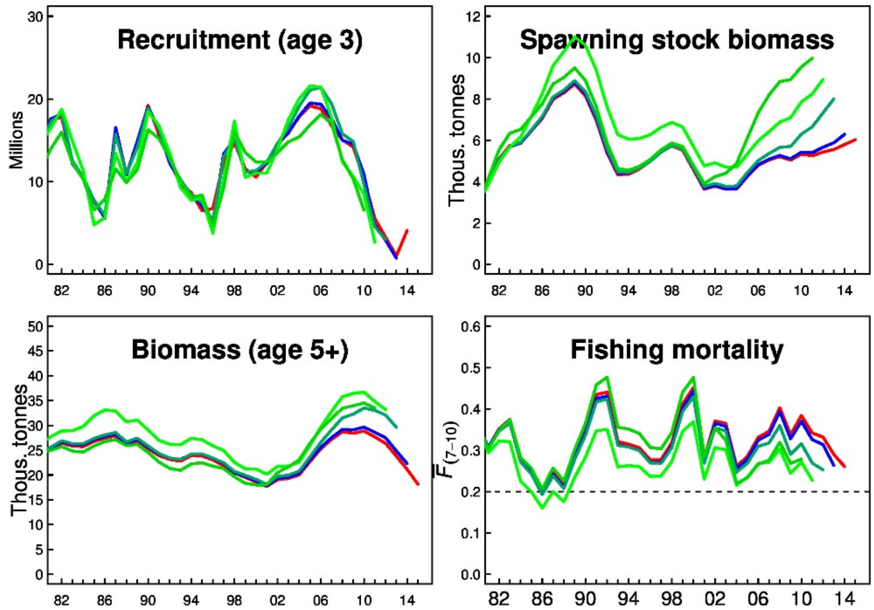


Figure 6.2.18. Tusk in Va and XIV. Historical retrospective analysis of the Gadget runs presented at WGDEEP 2011 to 2014.

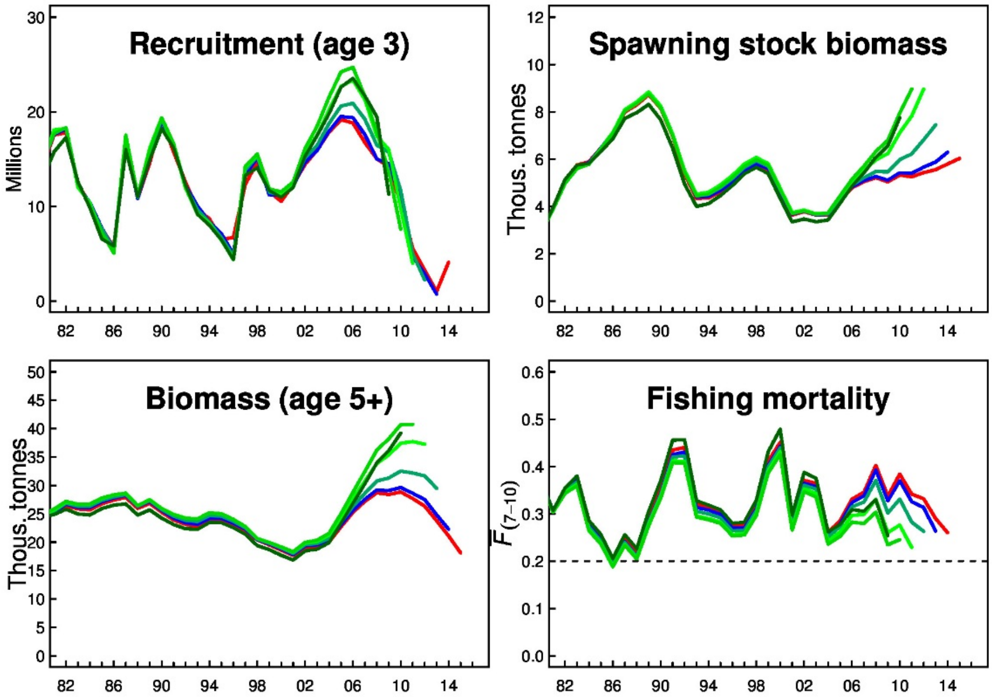


Figure 6.2.19. Tusk in Va and XIV. Analytical retrospective analysis of the Gadget runs presented.

Results

The results are presented in Table 6.2.8 and Figure 6.2.20. Recruitment peaked in 2005 to 2006 but has decreased and is estimated in 2013 to have been the lowest observed. Recruitment in 2014 and 2015 (not shown) is estimated to be considerably higher than in 2013. Spawning–stock biomass has increased slowly since 2005. Harvestable biomass is estimated at a fairly high level compared to the rest of the time-series. Fishing mortality for the main age groups in the fishery (F_{7-10}) has decreased from 0.39 in 2008 to 0.26 in 2014. Estimates of total biomass show a decrease since 2008. Estimates of selection curves are similar to those estimated last year (Figure 6.2.21).

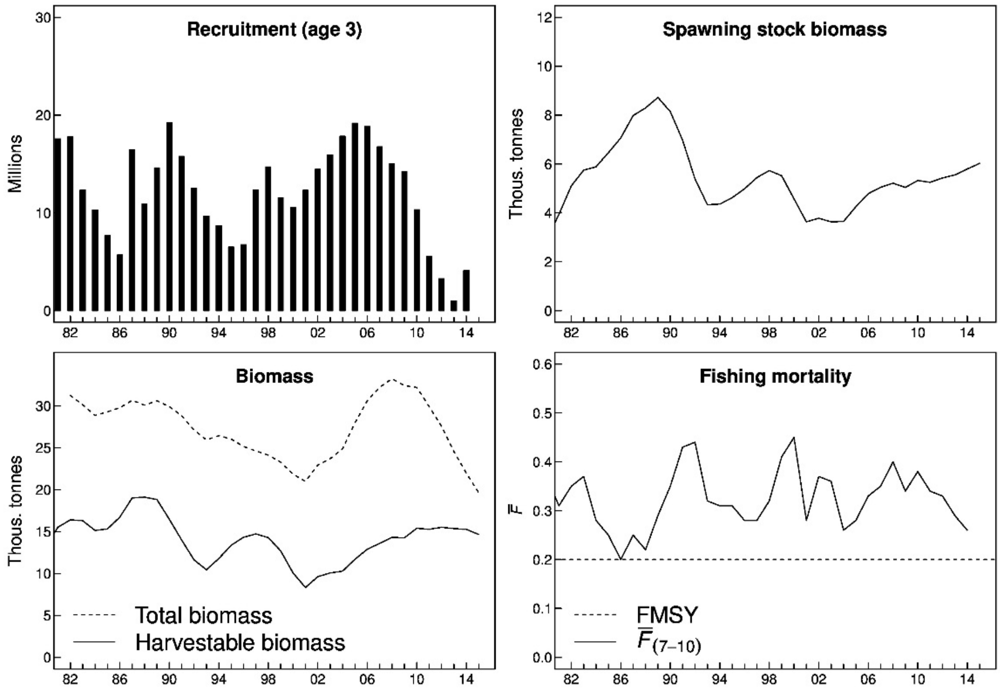


Figure 6.2.20. Tusk in Va and XIV. Estimates of recruitment, biomass, harvestable biomass and fishing mortality for tusk for the age groups most important in the fishery i.e. ages 7 to 10 (solid line).

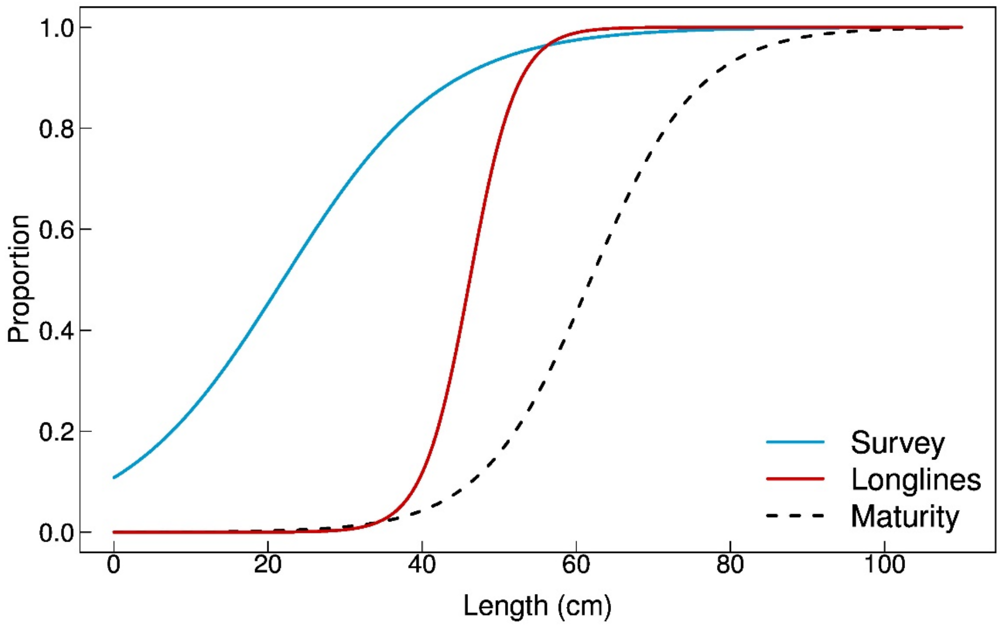


Figure 6.2.21. Tusk in Va and XIV. Estimated selection curves from Gadget and for comparison the maturity ogive (black broken line) used for estimation of SSB.

Reference points

In the past Yield per recruit based reference points estimated as described in the stock annex have been used as proxies for F_{MSY}. F_{MAX} from a Y/R analysis is 0.24 and $F_{0.1}$ is 0.15 (Figure 6.2.22). As F_{MAX} is well defined and that there are no obvious limitations in the model in terms of fit to the data WGDEEP proposed in 2012 that F_{MAX} be adopted as proxy for F_{MSY}, ACOM subsequently used F_{MAX} as an proxy MSY reference point for the advice in 2012. Running the analysis for F for the fully recruited age groups in the fishery (age 13 to 16) results in slightly higher estimates of F_{MAX}=0.3 as is to be expected (Figure 6.2.22). According to bootstrap results presented in WGDEEP 2013 the estimated CV for F_{MAX} is 3% indicating that the 95% confidence interval of F_{MAX} are between 0.226 and 0.255.

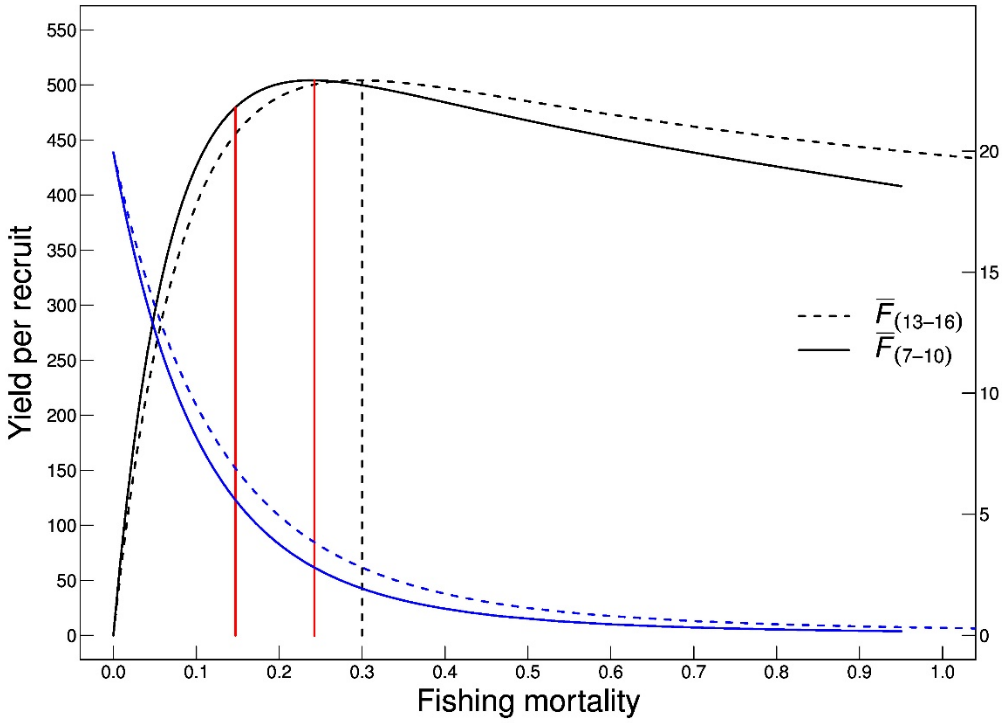


Figure 6.2.22. Tusk in Va and XIV. Estimates of yield per recruit and S/R analysis using Gadget. The results are presented for the main age groups in the fishery (7 to 10) and for historical comparison for ages 13–16 or fully recruited to the fishery.

Stochastic simulations using the auto-correlation in recruitment (AR-1 model) were run until the year 2115 under fishing mortality ranging from 0 to 0.6. From these simulations an estimate of F_{MSY} of 0.20 is obtained. The equilibrium catch curve is rather flat at F_{MSY} indicating that the value is uncertain however using the F_{MSY} estimate would result in considerably larger biomass of the stock compared to fishing at F_{MAX} (Figure 6.2.23). The confidence intervals for the F_{MSY} were 0.13 (5%), 0.16 (25%), 0.26 (75%) and finally 0.48 (95%).

WGDEEP 2014 recommended using F_{MSY}=0.2 as the target fishing mortality rather than F_{MAX}. This was subsequently used as the basis for the advice in 2014 by ICES.

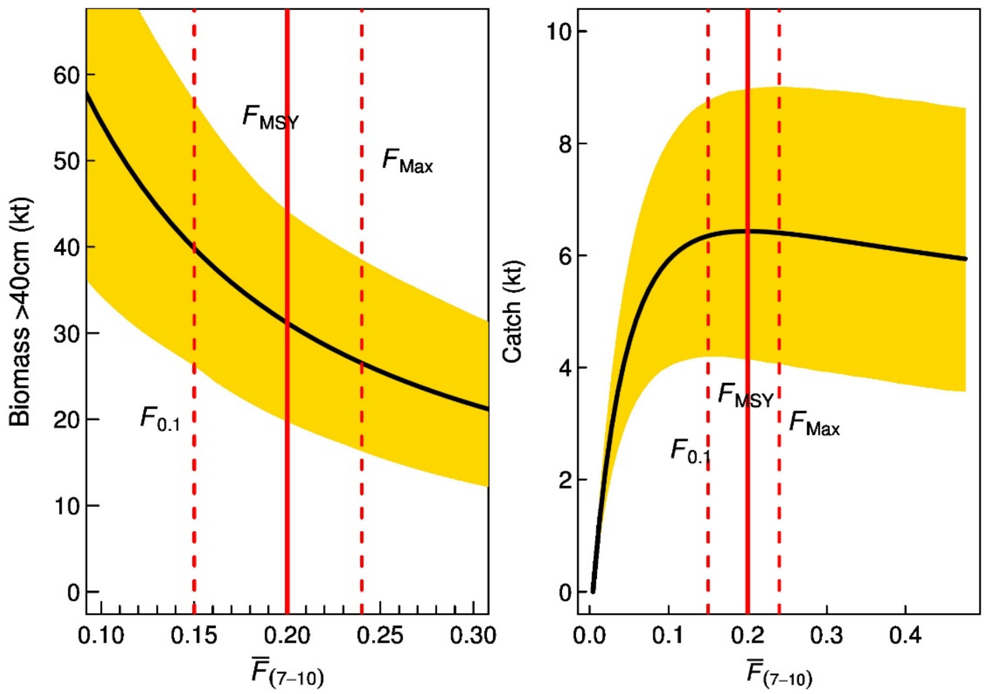


Figure 6.2.23. Tusk in Va and XIV. Equilibrium stock biomass and catch from stochastic simulations.

Projections

Forward projections were conducted using Gadget. The main assumptions were:

- Recruitment (age3) set as equal to mean recruitment in 2012 to 2014. Does not affect the projected catch level in 2015 to 2016.
- Catches in quarter 1 in 2015 are known and catches in quarters 2 and 3 are set as the reminder of the TAC for the 2014/15 fishing year.

The projections were run to 2019 for F_{MSY} = 0.2 (Table 6.2.8). According to the projections SSB will peak in 2017, however total biomass and harvestable biomass have already started to decrease. Catch levels decrease after 2015 from 4.65 kt to 2.8 kt in 2019. For comparison, projections were also run, using the same assumptions for F_{MAX} and $F_{0.1}$ (Table 6.2.19).

6.2.4 Comments on the assessment

In line with the recommendations of WKROUND 2010 and WKDEEP 2010 the group stresses the need for flexibility on ICES part when it comes to updating model settings for assessments such as the tusk assessment which are based on complicated statistical theory and are computationally intensive.

This assessment was conducted in the same way as last year. The results of this year's assessment are on par with last year's assessment.

6.2.5 Management considerations

The signs from commercial catch data and surveys indicate that the biomass of tusk in Va and XIV is either stable or decreasing. This is confirmed in the Gadget assessment and can be attributed to the continuous decrease in recruitment between 2008 and 2013. Recruitment may be on the increase again after a low in 2013.

Due to the selectivity of the longline fleet catching tusk in Va a large proportion of the catches is immature (60% in biomass, 70% in abundance). The spatial distribution of the fishery in relation to the spatial distribution of tusk in Va as observed in the Icelandic spring survey may result in decreased catch rates and local depletions of tusk in the main fishing areas.

Tusk is a slow growing late maturing species, therefore closures of known spawning areas should be maintained and expanded if needed. Similarly closed areas to longline fishing where there is high juvenile abundance should be maintained and expanded if needed.

Table 6.2.6. Tusk in Va and XIV. Nominal landings by nations in Va.

Year	Faroe	Denmark	Germany	Iceland	Norway	UK	Total
1973	3363	0	576	2366	911	391	7607
1974	3172	0	375	1857	893	230	6527
1975	2445	0	384	1673	975	254	5731
1976	2397	0	334	2935	1352	94	7112
1977	2818	0	212	3122	1796	0	7948
1978	2168	0	0	3352	812	0	6332
1979	2050	0	0	3558	845	0	6453
1980	2873	0	0	3089	928	0	6890
1981	2624	0	0	2827	1025	0	6476
1982	2410	0	0	2804	666	0	5880
1983	4046	0	0	3469	772	0	8287
1984	2008	0	0	3430	254	0	5692
1985	1885	0	0	3068	111	0	5064
1986	2811	0	0	2549	21	0	5381
1987	2638	0	0	2984	19	0	5641
1988	3757	0	0	3078	20	0	6855
1989	3908	0	0	3131	10	0	7049
1990	2475	0	0	4813	0	0	7288
1991	2286	0	0	6439	0	0	8725
1992	1567	0	0	6437	0	0	8004
1993	1329	0	0	4746	0	0	6075
1994	1212	0	0	4612	0	0	5824
1995	979	0	1	5245	0	0	6225
1996	872	0	1	5226	3	0	6102
1997	575	0	0	4819	0	0	5394
1998	1052	0	1	4118	0	0	5171
1999	1035	0	2	5794	391	2	7224
2000	1154	0	0	4714	374	2	6244
2001	1125	0	1	3392	285	5	4808
2002	1269	0	0	3840	372	2	5483
2003	1163	0	1	4028	373	2	5567
2004	1478	0	1	3126	214	2	4821
2005	1157	0	3	3539	303	41	5043
2006	1239	0	2	5054	299	2	6596
2007	1250	0	0	5984	300	1	7535
2008	959	0	0	6932	284	0	8175
2009	997	0	0	6955	300	0	8252
2010	1794	0	0	6919	263	0	8976
2011	1347	0	0	5845	198	0	7390
2012	1203	0	0	6341	217	0	7761
2013	1092	0.12	0	4973	192	0	6257
2014	728	0	0	4995	306	0	6029

Table 6.2.7. Tusk in Va and XIV. Nominal landings by nations in XIV.

YEAR	FAROE	DENMARK	GREENLAND	GERMANY	ICELAND	NORWAY	RUSSIA	SPAIN	UK	TOTAL
1973	16	0	0	9	0	0	0	0	2	27
1974	259	0	0	2	15	0	0	0	1	277
1975	29	0	0	17	13	138	0	0	0	197
1976	0	0	0	5	89	47	0	0	1	142
1977	167	0	0	16	0	40	0	0	1	224
1978	0	0	0	47	0	38	0	0	0	85
1979	0	0	0	27	0	0	0	0	0	27
1980	0	0	0	13	0	0	0	0	0	13
1981	110	0	0	10	0	0	0	0	0	120
1982	0	0	0	10	0	0	0	0	0	10
1983	74	0	0	11	0	0	0	0	0	85
1984	0	0	0	5	0	58	0	0	0	63
1985	0	0	0	4	0	0	0	0	0	4
1986	33	0	0	2	0	0	0	0	0	35
1987	13	0	0	2	0	0	0	0	0	15
1988	19	0	0	2	0	0	0	0	0	21
1989	13	0	0	1	0	0	0	0	0	14
1990	0	0	0	2	0	7	0	0	0	9
1991	0	0	0	2	0	68	0	0	1	71
1992	0	0	0	0	3	120	0	0	0	123
1993	0	0	0	0	1	39	0	0	0	40
1994	0	0	0	0	0	16	0	0	0	16
1995	0	0	0	0	0	30	0	0	0	30
1996	0	0	0	0	0	157	0	0	0	157
1997	0	0	0	0	10	9	0	0	0	19
1998	0	0	0	0	0	12	0	0	0	12
1999	0	0	0	0	0	8	0	0	0	8
2000	0	0	0	0	11	11	0	3	0	25
2001	3	0	0	0	20	69	0	0	0	92
2002	4	0	0	0	86	30	0	0	0	120
2003	0	0	0	0	2	88	0	0	0	90
2004	0	0	0	0	0	40	0	0	0	40
2005	7	0	0	0	0	41	8	0	0	56
2006	3	0	0	0	0	19	51	0	0	73
2007	0	0	0	0	0	40	6	0	0	46
2008	0	0	33	0	0	7	0	0	0	40
2009	12	0	15	0	0	5	11	0	0	43
2010	7	0	0	0	0	5	0	0	0	12
2011	20	0	0	0	131	24	0	0	0	175
2012	33	0	0	0	174	46	0	0	0	253
2013	1.9	0.3	0	0	0	23.8	0	0	0	26
2014	2	0	0	0	0	26	0	0	0	28

Table 6.2.8. Tusk in Va and XIV. Estimates of biomass, harvestable biomass, spawning–stock biomass (SSB) in thousands of tonnes and recruitment (millions) and fishing mortality from Gadget. Projections for 2014 to 2018 are shown in italics.

Year	Biomass	Harvestable biomass	SSB	Recruitment (age 3)	Catch	$F_{(7-10)}$
1980	32.185	13.232	2.887	13.956	6.890	0.37
1981	31.302	15.525	3.938	17.564	6.476	0.31
1982	31.247	16.409	5.105	17.775	5.880	0.35
1983	30.147	16.299	5.747	12.331	8.287	0.37
1984	28.872	15.138	5.887	10.288	5.692	0.28
1985	29.304	15.325	6.462	7.665	5.065	0.25
1986	29.788	16.726	7.068	5.680	5.381	0.20
1987	30.674	19.024	7.984	16.428	5.645	0.25
1988	30.091	19.118	8.295	10.869	6.865	0.22
1989	30.620	18.824	8.723	14.591	7.077	0.29
1990	29.923	16.481	8.146	19.206	7.292	0.35
1991	28.835	13.987	6.968	15.760	8.733	0.43
1992	27.120	11.629	5.383	12.546	8.010	0.44
1993	25.959	10.449	4.333	9.677	6.059	0.32
1994	26.450	11.785	4.359	8.679	5.828	0.31
1995	26.049	13.369	4.620	6.484	6.231	0.31
1996	25.160	14.327	4.985	6.737	6.241	0.28
1997	24.629	14.725	5.445	12.341	5.759	0.28
1998	24.125	14.276	5.731	14.697	5.146	0.32
1999	23.290	12.704	5.520	11.545	7.290	0.41
2000	21.845	10.068	4.571	10.542	6.240	0.45
2001	21.002	8.324	3.634	12.304	4.526	0.28
2002	22.942	9.621	3.780	14.448	5.249	0.37
2003	23.701	10.066	3.633	15.940	5.315	0.36
2004	24.890	10.278	3.646	17.838	4.655	0.26
2005	27.968	11.694	4.254	19.157	4.820	0.28
2006	30.626	12.894	4.787	18.819	6.602	0.33
2007	32.237	13.598	5.046	16.749	7.594	0.35
2008	33.248	14.315	5.213	15.035	8.175	0.40
2009	32.427	14.260	5.041	14.200	8.253	0.34
2010	32.221	15.398	5.325	10.313	8.986	0.38
2011	29.930	15.280	5.251	5.558	7.391	0.34
2012	27.572	15.513	5.429	3.262	7.762	0.33
2013	24.562	15.364	5.552	1.011	6.258	0.29
2014	21.991	15.270	5.794	4.095	6.025	0.26
2015	19.661	14.665	6.027	*8.606*	*4.657*	*0.25*
2016	*17.568*	*13.211*	*6.070*	*2.789*	*3.437*	*0.20*
2017	*16.555*	*12.005*	*6.279*	*2.789*	*3.188*	*0.20*
2018	*15.561*	*10.783*	*6.208*	*2.789*	*2.980*	*0.20*
2019	*14.563*	*10.238*	*5.938*	*2.789*	*2.823*	*NA*

Table 6.2.9. Prognosis from the Gadget model fishing at $F_{0.1}$ and F_{MAX}.

F0.1 = 0.15

year	ssb	catch	Fbar
2014	5.794	6.025	0.26
2015	6.027	4.451	0.23
2016	6.264	2.739	0.15
2017	6.887	2.678	0.15
2018	7.211	2.616	0.15
2019	7.268	2.567	0.15

Fmax = 0.24

year	ssb	catch	Fbar
2014	5.794	6.025	0.26
2015	6.027	4.828	0.27
2016	5.911	3.978	0.24
2017	5.807	3.532	0.24
2018	5.473	3.184	0.24
2019	5.015	2.936	0.24

6.3 Tusk (*Brosme brosme*) on the Mid-Atlantic Ridge (Subdivisions XIIa1 and XIVb1)

6.3.1 The fishery

Tusk is a bycatch species in the gillnet and longline fisheries in Subdivisions XIIa1 and XIVb1. During the period 1996–1997 Norway also had a fishery in this area.

6.3.2 Landings trends

Landing statistics by nation in the period 1988–2014 are shown in Table 6.4.1.

The reported landings are generally very low in this area. Russia reported landings of tusk in 2005–2007 and 2009 and no landings were reported for 2010 and 2011. In 2012 Norway reported 17 tonnes in Area XIVb1 and the Faroe Islands, 1 tonn. No landings have been reported in 2013 and 2014.

6.3.3 ICES Advice

Advice for 2013 to 2015: ICES advises on the basis of the approach for data-limited stocks that catches should not be increased unless there is evidence that this is sustainable. Measures should be taken to limit occasional high levels of bycatch.

6.3.4 Management

NEAFC (Rec 03 2014) recommends that in 2014 the effort in areas beyond national jurisdiction shall not exceed 65 percent of the highest level for deep-water fishing in previous years.

6.3.5 Data available

6.3.5.1 Landings and discards

Landings were available for all the relevant fleets. No discard data were available.

6.3.5.2 Length compositions

No length compositions were available.

6.3.5.3 Age compositions

No age compositions were available.

6.3.5.4 Weight-at-age

No data were available.

6.3.5.5 Maturity and natural mortality

No data were available.

6.3.5.6 Catch, effort and research vessel data

No data were available.

6.3.6 Data analyses

There are insufficient data to assess this stock.

Biological reference points

WKLIFE has not yet suggested methods to estimate biological reference points for stocks which have only landings data or are bycatch species in other fisheries. Therefore, no attempt was made to propose reference points for this stock.

6.3.7 Comments on the assessment

No assessment was carried out this year.

6.3.8 Management considerations

As this is a bycatch species in fisheries for other species, advice should take account of advice for the targeted species in those fisheries. The life-history traits do not suggest it is particularly vulnerable.

Table 6.4.1. Tusk XII. WG estimate of landings.

Tusk XII

Year	Faroes	France	Iceland	Norway	Scotland	Russia	Total
1988		1					1
1989							0
1990							0
1991							0
1992							0
1993			+				0
1994			+				0
1995	8	-	10				18
1996	7	-	9	142			158
1997	11	-	+	19			30
1998				-			0
1999				+			0
2000							0
2001							0
2002							0
2003							0
2004						5	5
2005							0
2006						64	64
2007						19	19
2008						0	0
2009						2	2
2010						0	0
2011						0	0
2012	1						1
2013							0
2014*							0

***Preliminary.**

TUSK XIVb1

YEAR	FAROES	ICELAND	NORWAY	E & W	RUSSIA	TOTAL
2012			17			**17**
2013						**0**
2014*						**0**

Table 6.4.1. (Continued).Tusk, total landings by subareas or division.

YEAR	XII	XIVB1	ALL AREAS
1988	1		1
1989	0		0
1990	0		0
1991	0		0
1992	0		0
1993	0		0
1994	0		0
1995	18		18
1996	158		158
1997	30		30
1998	0		0
1999	0		0
2000	0		0
2001	0		0
2002	0		0
2003	0		0
2004	5		5
2005	0		0
2006	64		64
2007	19		19
2008	0		0
2009	2		2
2010	0		0
2011			
2012	1	17	18
2013			0
2014*			0

***Preliminary.**

6.4 Tusk (*Brosme brosme*) in VIb

6.4.1 The fishery

Tusk is a bycatch species in the trawl, gillnet and longline fisheries in Subarea VIb. Norway has traditionally landed the largest percentage of the total catch. Longliners catch about 90% of the Norwegian landings. Since January 2007 parts of the Rockall

Bank has been closed to fishing with bottom trawls, gillnets and longlines. The areas closed are traditional areas fished by the Norwegian longline fleet.

During the period 1988 to 2014 Norwegian vessels have report over 80 percent of the total landings, and in 2012 more than 90 percent of the landings were reported by Norwegian vessels. Small bycatches of tusk were also taken in the area by trawlers in the haddock fishery.

6.4.2 Landings trends

Landing statistics by nation in the period 1988–2014 are in Table 6.5.1.

Landings varied considerably between 1988–2000 and peaked at 2344 t in 2000, and since then have been low with a declining trend. In 2013 the catch was 38 tons an all-time low during this time period (Figure 6.5.1).

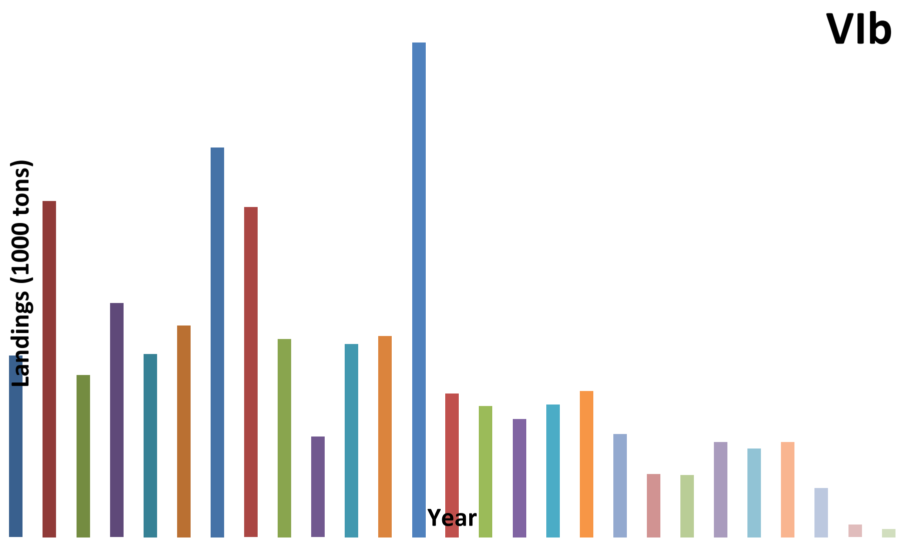


Figure 6.5.1.The international total landings of tusk from Subarea VIb.

6.4.3 ICES Advice

Advice for 2013 and 2014: Based on the ICES approach for data-limited stocks, ICES advises catches of no more than 350 t.

6.4.4 Management

Apart from the closed areas, there are no management measures that apply exclusively to this area.

Norway, which also has a licensing scheme, had a catch allocation in EU waters (Subareas V, VI and VIII). In 2015 the Norwegian quota in the EU zone is 2923 t (up to 2000 t are interchangeable with ling quota).

EU TACs cover Subarea V, VI, VII (EU and international waters) and in 2015 is set at 937 t.

NEAFC recommended in 2009 that the effort in the NEAFC regulatory area shall not exceed 65 percent of the highest level put into deep fishing in previous years.

6.4.5 Data available

6.4.5.1 Landings and discards

Landings were available for all relevant countries. No new discard data were available.

6.4.5.2 Length compositions

The length distribution of tusk based on data provided by the Norwegian reference fleet for the period 2003–2013 is presented in Figure 6.5.2. The average length during this period fluctuated without any obvious trend (no data were available for 2011).

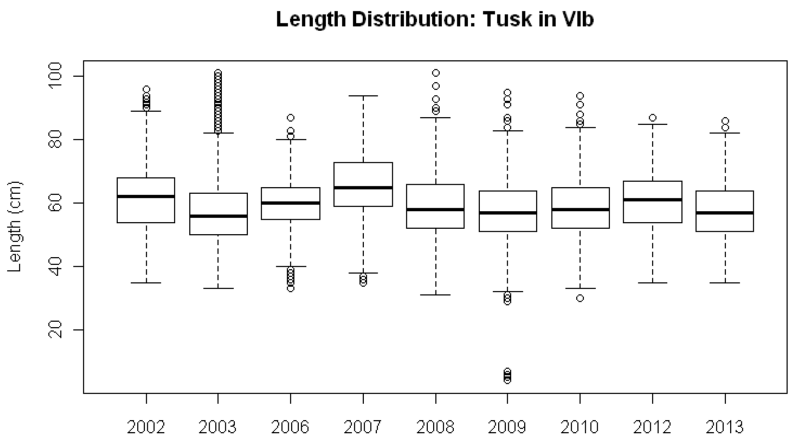


Figure 6.5.2. The length distribution of tusk based on data provided by the Norwegian reference fleet for the period 2003–2013 (no data were available for 2011 and 2014).

6.4.5.3 Age compositions

No new age composition data were available.

6.4.5.4 Weight-at-age

No new data were presented.

6.4.5.5 Maturity and natural mortality

No new data were presented.

6.4.5.6 Catch, effort and research vessel data

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2013. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 t in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day.

6.4.6 Data analyses

No analytical assessments were carried out.

One source of information on abundance trends was the cpue series based on the Norwegian longliners' data (see Helle and Pennington, WD 2015). The number of longliners has declined from 72 to 26 during the period 2000–2014. The number of fishing days with a tusk catch in Division VIb has remained very stable in the period 2000–2008 with an average between five and eight days per vessel, however in 2013 and 2015 this had declined to three (Helle and Pennington, WD 2015).

Table 6.5.2. Average number of days that each Norwegian longliner fished in an ICES subarea/division.

Tusk	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
VIb	4	6	8	5	5	8	7	6	5	2	4	4	4	3	3

The number of hooks set per day and the total set per year also remained stable during the period 2000–2008, however in 2009 and 2010 there was a large increase in Subarea VIb Figure 6.5. This increase in the number of hooks may be due to poor data quality as the vessels were changing from paper to electronic logbooks. From 2011, when the quality of the data was good, the number of hooks per day was at the same level as in the period (2000–2008) (Figure 6.5.3).

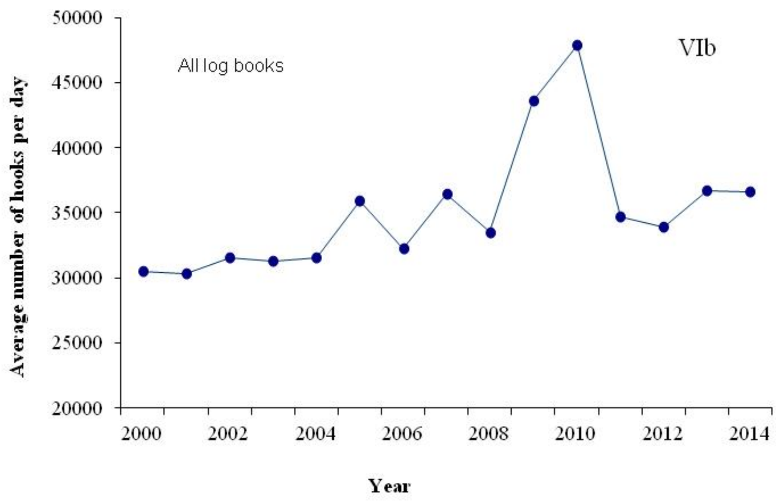


Figure 6.5.3. Average number of hooks the Norwegian longliner fleet used per day in each of the ICES Subarea VIb for the years 2000–2014 in the fishery for tusk, ling and blue ling.

The standardized cpue series shows a declining trend during the period 2000–2007, after 2007 cpue has been at a stable but low level (Figure 6.5.4).

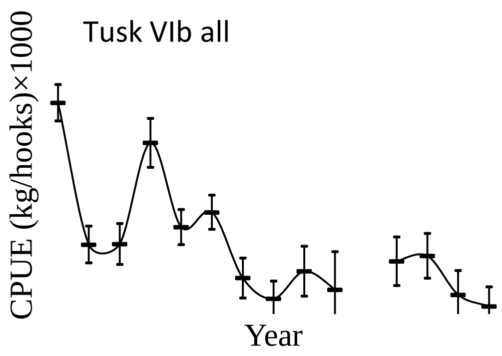


Figure 6.5.5. Estimated cpue (kg/1000 hooks) series for tusk in Subarea VIb based on skipper's log-books (during the period 2000–2014. The bars denote the 95% confidence intervals.

Biological reference points

Estimates of L_{MAX} and AFC were identified and made available to WKLIFE.

6.4.7 Comments on the assessment

The new and standardizes cpue show the same trend as the unstandardized cpue and the cpue series based on a super-population model presented in 2012.

6.4.8 Management considerations

The landings have since 2001 been low with a decreasing trend until 2008. The last three years the landings have remained stable at around 500 tonnes. The cpue also show a decreasing trend until 2007 after this it has been at a stable low level. The main fishing grounds traditionally exploited by the Norwegian fleet in this subarea were closed to bottom contacting gears in 2007 and this may have influenced recent estimates of cpue.

Table 6.5.1. Tusk VIb. WG estimate of landings.

Year	Faroes	France	Germany	Ireland	Iceland	Norway	E & W	N.I.	Scot.	Russia	Total
1988	217		-	-		601	8	-	34		860
1989	41	1	-	-		1537	2	-	12		1593
1990	6	3	-	-		738	2	+	19		768
1991	-	7	+	5		1068	3	-	25		1108
1992	63	2	+	5		763	3	1	30		867
1993	12	3	+	32		899	3	+	54		1003
1994	70	1	+	30		1673	6	-	66		1846
1995	79	1	+	33		1415	1		35		1564
1996	0	1		30		836	3		69		939
1997	1	1		23		359	2		90		476
1998		1		24	18	630	9		233		915
1999				26	-	591	5		331		953
2000		2		22		1933	14		372	1	2344
2001	1	1		31		476	10		157	6	681
2002		8		3		515	8		88		622
2003		7		18		452	11		72	1	561
2004		9		1		508	4		45	60	627
2005		5		9		503	5		33	137	692
2006	10	1		16		431	2		25	2	487
2007	4	0		8		231	1		30	25	299
2008	41	0		2		190	0		16	44	293
2009	70			4		358			17	3	452
2010	57			1		348			13		419
2011	3					433			14		450
2012	15					209			9		233
2013		1				46			11		57
2014*	6					26			6		38

***Preliminary.**

Table 6.5.1. (Continued).

Tusk, total landings in Subarea VIb.

Year	VIb	All areas
1988	860	860
1989	1593	1593
1990	768	768
1991	1108	1108
1992	867	867
1993	1003	1003
1994	1846	1846
1995	1564	1564
1996	939	939
1997	476	476
1998	915	915
1999	953	953
2000	2344	2344
2001	681	681
2002	622	622
2003	561	561
2004	627	627
2005	692	692
2006	487	487
2007	299	299
2008	293	293
2009	452	469
2010	419	419
2011	450	450
2012	233	233
2013	57	57
2014*	38	38

***Preliminary.**

6.5 Tusk (*Brosme brosme*) in Subareas I and II

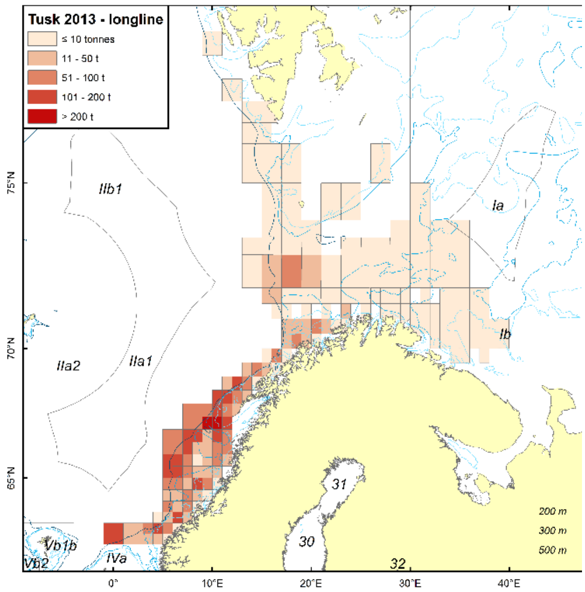
6.5.1 The fishery

Tusk is caught primarily as a bycatch in the ling and cod fisheries in Subareas I and II. Currently the major fisheries in Subareas I and II are the Norwegian longline and gill-net fisheries, but there are also bycatches by other gears, e.g., trawls and handlines. The Norwegian landings are taken usually by around 85% by longlines, 10% by gillnets and the remainder by a variety of other gears. Other nations catch tusk as a bycatch in trawl and longline fisheries. Figure 6.3.1 shows the spatial distribution of the total catch by the Norwegian longline fishery in 2013 and 2014. As can be seen, the fishery was more concentrated along the coast of Norway and didn’t extend as far south or north in 2014 as in 2013.

Russian landings (84 t) are from Subdivisions I, IIa and IIb in 2014 and were mainly taken as bycatch in longline fisheries.

The Norwegian longline fleet (vessels larger than 21 m) increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number decreased to 26 in 2014. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The average number of days that the longliners operated in ICES Subareas I and II has declined since the peak in 2011. During the period 1974 to 2014 the total number of hooks per year has varied considerably, but with a downward trend since 2002 (For more information see Helle and Pennington, WD 2015).

Since the total number of hooks per year takes into account; the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, it follows that it may be a suitable measure of changes in applied effort. Based on this gauge, it appears that the average effort for the years 2011–2014 is 43% less than the average effort during the years 2000–2003.



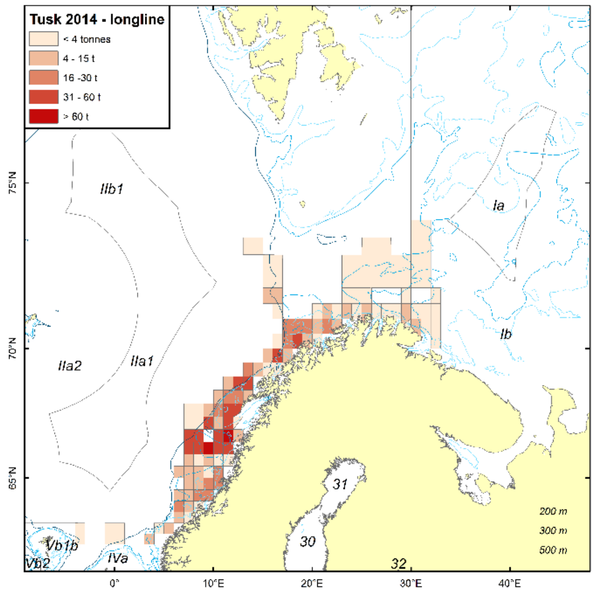


Figure 6.3.1. Distribution of catches for the Norwegian longline fishery in 2013 and 2014.

6.5.2 Landings trends

Landing statistics by nation in the period 1988–2014 are given in Table 6.3.1a–d. Landings declined from 1989 to 2005, afterwards the landings increased (Figures 6.3.2 and 6.3.3). The preliminary landings for 2014 are 8742 t.

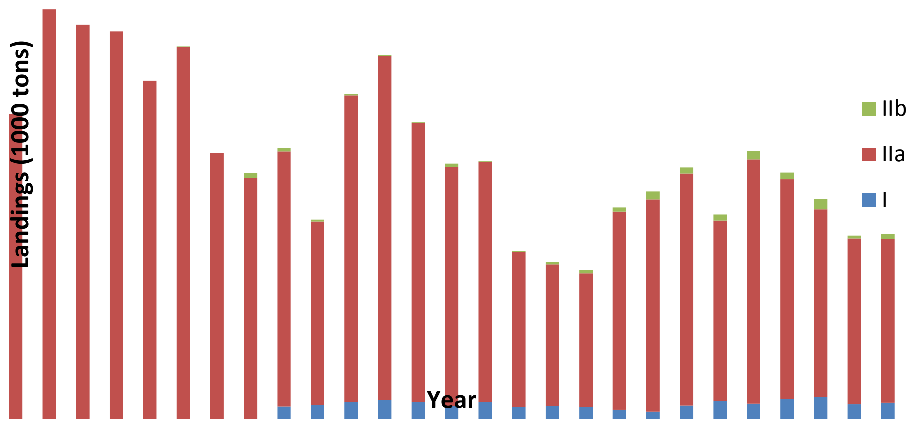


Figure 6.3.2. Total yearly landings of tusk in Areas I and II for the period 1988–2014.

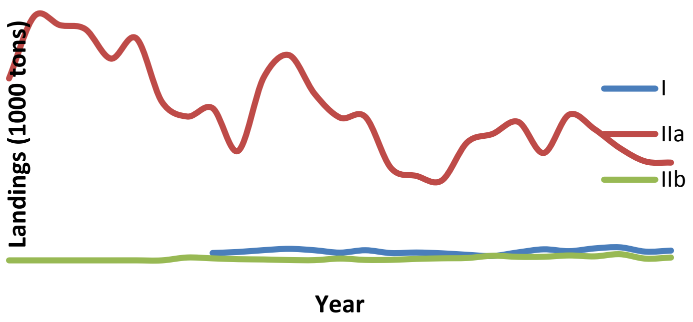


Figure 6.3.3. Total yearly landings of tusk in Areas I and II in each area for the period 1988–2014.

6.5.3 ICES Advice

Advice for 2013 to 2015: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 9040 t.

6.5.4 Management

There is no quota set for the Norwegian fishery for tusk but the vessels participating in the directed fishery for ling and tusk in Subareas I and II are required to have a licence for tusk. The quota for the EU in Areas I and II in the Norwegian zone for tusk is in 2015 set to 170 t. There is no minimum landing size in the Norwegian EEZ.

The EU TAC (for community vessels fishing in community waters and waters not under the sovereignty or jurisdiction of third countries in I, II and XIV) was set to 21 t in 2015.

6.5.5 Data available

6.5.5.1 Landings and discards

The amounts landed were available for all the relevant fleets. No estimates of the amount of tusk discards are available. But since the Norwegian fleets are not regulated by TACs and there is a ban on discarding, the incentive for illegal discarding is believed to be low. The landings statistics are, therefore, regarded as being adequate for assessment purposes.

6.5.5.2 Length compositions

Figure 6.3.4 shows the length distribution and Figure 6.3.5 shows the length–weight relationship of tusk based on data provided by the Norwegian reference fleet for the period 2001–2014. The length fluctuated without any obvious trend.

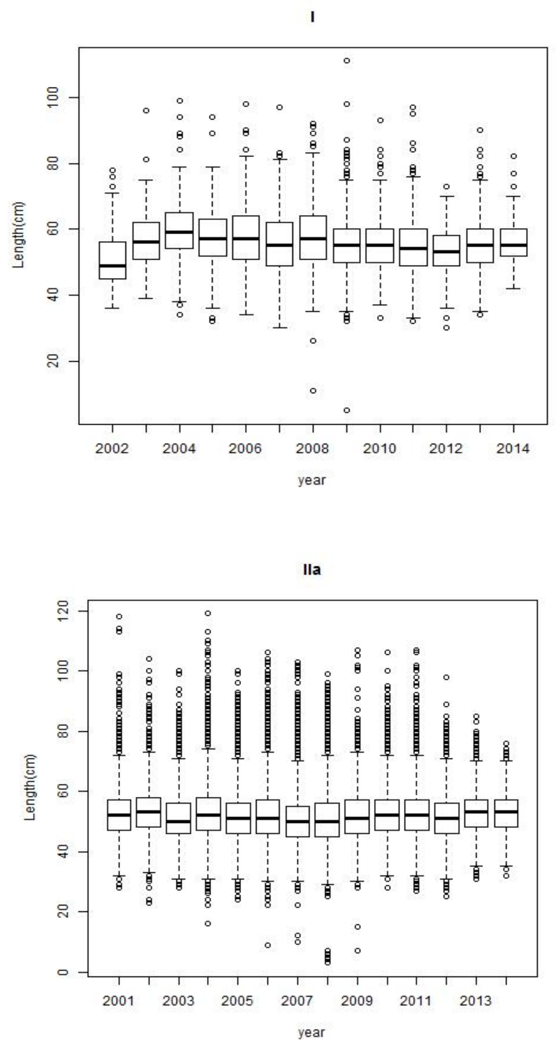


Figure 6.3.4. Box and whisker plots showing the length distribution of tusk. The data were provided by the Norwegian reference fleet for the period 2001–2014.

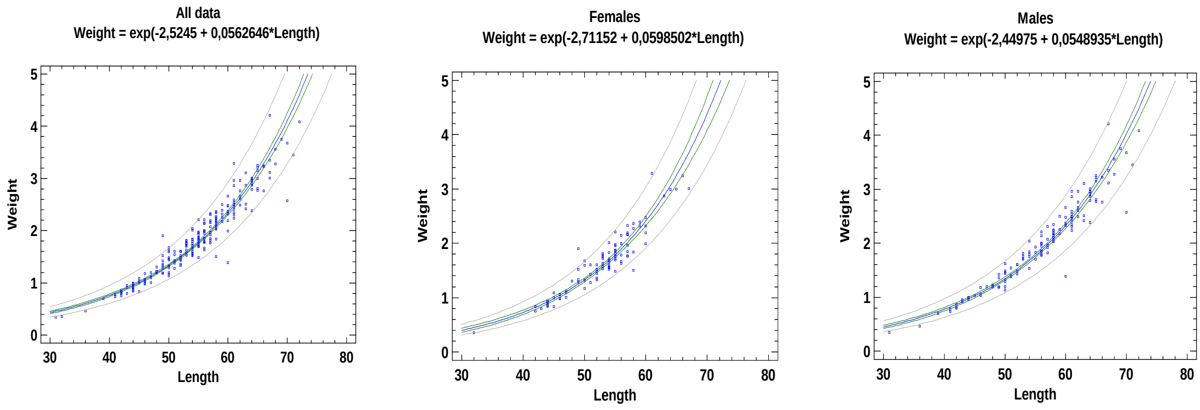


Figure 6.3.5. Length–weight relationship for tusk.

6.5.5.3 Age compositions

The age–length-weight relation is based on data from a small area off Lofoten. The data collected for the project CoralFish are shown in Figure 6.3.6. The average length-at-age and weight-at-age were slightly higher for males than for females. It should be noted that these samples may not be representative of the entire population.

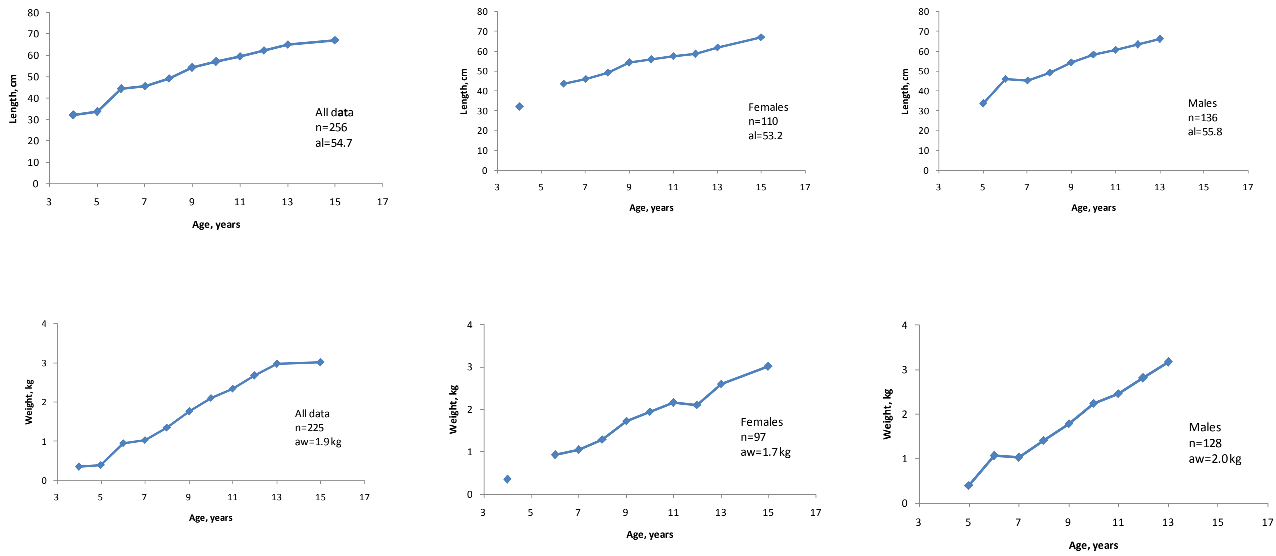


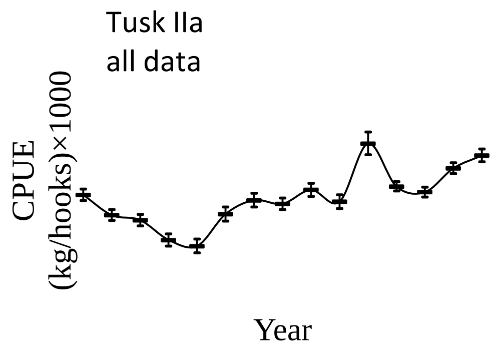
Figure 6.3.6. Weight and length-at-age for females and males combined.

6.5.5.4 Maturity and natural mortality

No data were presented.

6.5.5.5 Catch, effort and research vessel data

Two cpue series, one based on all data and one when tusk was targeted were presented (Figure 6.3.7). No research vessel data were available.



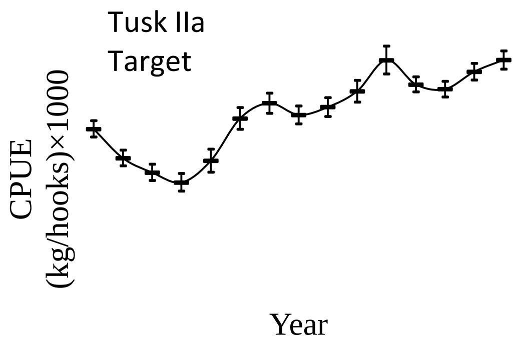


Figure 6.3.7. Estimates of cpue (kg/1000 hooks) of tusk based on skipper's logbook data for 2000–2014. The bars denote the 95% confidence interval.

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2014. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 t in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day.

The method for estimating cpue for tusk is given in Helle *et al.*, 2015. An analysis based on these data is in the WD Helle and Pennington, 2015.

6.5.6 Data analyses

No analytical assessments were possible due to lack of age-structured data and/or tuning series.

Graphs of two standardized GLM-based cpue series estimated from all data and from a subset of the data for which tusk made up more than 30% of the catches are shown in Figure 6.3.7. The cpue series starting in 2000 shows an upward trend for the period 2004–2006 and has remained stable at a high level since then. No further analyses were carried out.

Biological reference points

Estimates of L_{MAX} and AFC were identified and made available to WKLIFE.

6.5.7 Comments on the assessment

The two new standardized cpue series based on all data and when tusk was targeted show a stable and positive trend. The trends are similar to the previous cpue series based on a super-population model presented in 2012.

6.5.8 Management considerations

Catch levels since 2004 do not appear to have had a detrimental effect on the stock given that cpue continues to increase steadily. Current catch levels are considered to be appropriate. The size of the longline fleet fishing for tusk has decreased because of greater access to quotas for Arcto-Norwegian cod. Since the catches have been stable and the indicator series have been showing an increasing trend it is suggested not to apply the 20% buffer.

Table 6.3.1a. Tusk I. WG estimates of landings.

Year	Norway	Russia	Faroes	Iceland	Ireland	France	Total
1996	587						587
1997	665						665
1998	805						805
1999	907						907
2000	738	43	1	16			798
2001	595	6		13			614
2002	791	8	n/a	0			799
2003	571	5			5		581
2004	620	2			1		623
2005	562						562
2006	442	4					446
2007	355	2					357
2008	627	7					634
2009	869	1					870
2010	725	1				1	727
2011	941						941
2012	1024						1024
2013	692						692
2014*	766	5					771

***Preliminary.**

Table 6.3.1b. Tusk IIa. WG estimates of landings.

Year	Faroes	France	Germany	Greenland	Norway	E & W	Scotland	Russia	Ireland	Iceland	Total
1988	115	32	13	-	14 241	2	-				14 403
1989	75	55	10	-	19 206	4	-				19 350
1990	153	63	13	-	18 387	12	+				18 628
1991	38	32	6	-	18 227	3	+				18 306
1992	33	21	2	-	15 908	10	-				15 974
1993	-	23	2	11	17 545	3	+				17 584
1994	281	14	2	-	12 266	3	-				12 566
1995	77	16	3	20	11 271	1					11 388
1996	0	12	5		12 029	1					12 047
1997	1	21	1		8642	2	+				8667
1998		9	1		14 463	1	1	-			14 475
1999		7	+		16 213		2	28			16 250
2000		8	1		13 120	3	2	58			13 192
2001	11	15	+		11 200	1	3	66	5		11 301
2002		3			11 303	1	4	39	5		11 355
2003	6	2			7284		3	21			7316
2004	12	2			6607		1	61	1		6684
2005	29	6			6249			37	3		6324
2006	33	9			9246	1		51	11		9351
2007	54	7			9856	0	5	85	12		10 019
2008	52	6			10 848	1	3	56	0		10 966
2009	59	3			8354		1	82			8499
2010	39	6			11 445		1	49			11 540
2011	59	5			10 290		1	41			10 405
2012	54	7	1		8764	2		48		1	8877
2013	24	13	3		7729		7	52		2	7830
2014*	10	9	1		7680		7	38			7745

***Preliminary.**

(1)Includes IIb.

Table 6.3.1c. Tusk IIb. WG estimates of landings.

Year	Norway	E & W	Russia	Ireland	France	Total
1988		-				0
1989		-				0
1990		-				0
1991		-				0
1992		-				0
1993		1				1
1994		-				0
1995	229	-				229
1996	161					161
1997	92	2				94
1998	73	+	-			73
1999	26		4			26
2000	15	-	3			18
2001	141	-	5			146
2002	30	-	7			37
2003	43					43
2004	114		5			119
2005	148		16			164
2006	168		23			191
2007	350		17	1		368
2008	271		11	0		282
2009	249		39			288
2010	334		57			391
2011	299		20		5	324
2012	453		40			493
2013	121	3	16			140
2014*	185		41			226

Table 6.3.1d. Tusk I and II. WG estimates of total landings by subareas or divisions.

YEAR	I	IIA	IIB	ALL AREAS
1988		14 403	0	14 403
1989		19 350	0	19 350
1990		18 628	0	18 628
1991		18 306	0	18 306
1992		15 974	0	15 974
1993		17 584	1	17 585
1994		12 566	0	12 566
1995		11 388	229	11 617
1996	587	12 047	161	12 795
1997	665	8667	94	9426
1998	805	14 475	73	15 353
1999	907	16 250	26	17 183
2000	798	13 192	18	14 008
2001	614	11 301	146	12 061
2002	799	11 355	37	12 191
2003	581	7316	43	7940
2004	623	6684	119	7426
2005	562	6324	164	7050
2006	446	9351	191	9988
2007	357	10 019	368	10 744
2008	634	10 966	282	11 882
2009	870	8499	288	9657
2010	727	11 540	391	12 658
2011	941	10 386	319	11 646
2012	1024	8862	493	10 394
2013	692	7830	140	8662
2014*	771	7745	226	8742

***Preliminary.**

6.6 Tusk (*Brosme brosme*) in other areas (IIIa, IVa, Vb, VIa, VII, VIII, IX and other areas of XII)

6.6.1 The fishery

General descriptions of the fisheries in these areas are in the overview Sections 3.3., 3.4, 3.5 and 3.6.

Tusk is a bycatch species in the trawl, gillnet and longline fisheries in these subareas/divisions. Norway has traditionally landed the major proportion of the total landings. Around 90% of the Norwegian and Faroese landings are taken by longliners.

When landings from Areas III–IV and VIa–XII are pooled over the period 1988–2015, 36% of the landings have been in Area IV, 46% in Area Vb, and 16% in Area VIa.

In Area Vb, tusk was mainly fished by longliners (about 90% of the catch), and the rest of the catch was taken by large trawlers. The main fishing ground for tusk is on the slope around the Faroes Plateau and the Faroe Bank deeper than approximately 200 m. The Norwegian longliners were not allowed to fish inside the Faroese EEZ in the period 2011–2013, the Faroese longliners fish in the area where the Norwegian longliners used to fish. Since 2014 Norwegian longliners have been given quotas in this area.

6.6.2 Landings trends

Landing statistics by nation during the period 1988–2014 are in Table 6.6.1 and are shown by year in Figure 6.6.1.

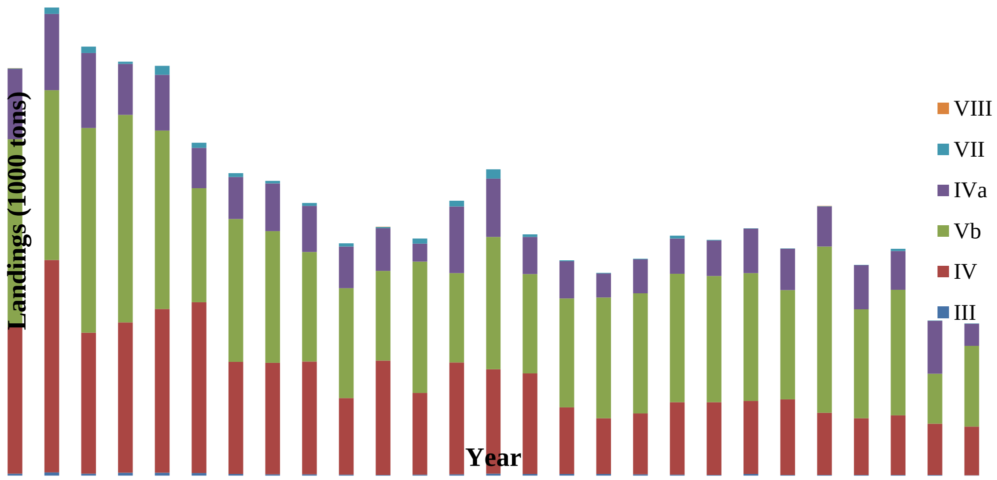


Figure 6.6.1. Landings of tusk per year for the period 1988–2014.

For all subareas/divisions, the catches were relatively stable during the period 2002 to 2012, afterwards there was a decline in catches, especially in Area Vb. The total catch was 4585 in 2014 (Figure 6.6.2).

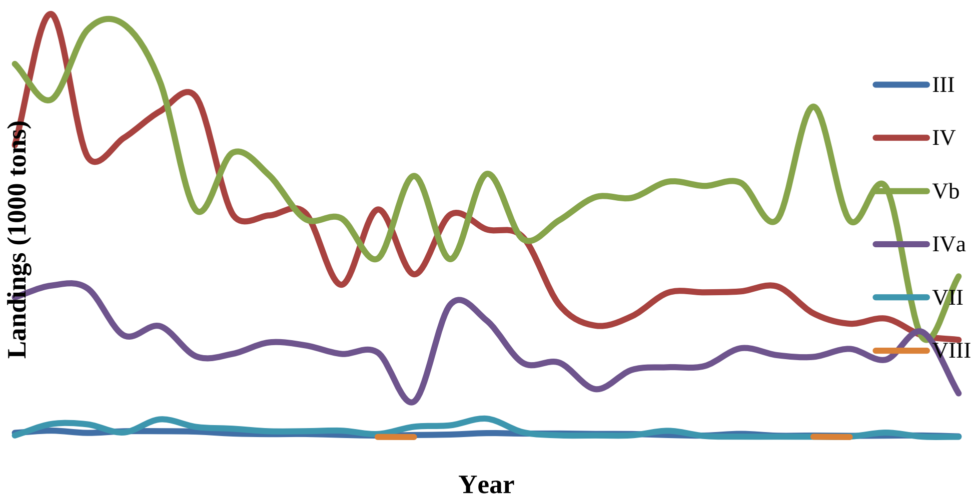


Figure 6.6.2. Landings of tusk in each area for the period 1988–2014.

6.6.3 ICES Advice

Advice for 2013 to 2015: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 8500 tonnes.

6.6.4 Management

There is a licensing scheme and effort limitation for Vb. The minimum landing length for tusk in Division Vb is 40 cm. Norway previously had a bilaterally agreed quota with the Faeroes in Vb, and the quota for 2010 was 1774 t. There were no quota agreements for the years 2011–2013. In 2014, Norway could catch 1250 tons ling/tusk and 1025 tons tusk, and in 2015 Norway can catch 1600 tons tusk. Norway also has a licensing scheme in EU waters, and in 2015 the Norwegian quota in the EC zone was 2923 t. The quota for the EU in the Norwegian zone (Area IV) is set at 170 t.

EU TACs for areas partially covered in this section are in 2015:

Subarea III:	29 t;
Subarea IV:	235t;
Subarea V, VI, VII (EU and international waters):	937t.

NEAFC recommends that in 2009 the effort in areas beyond national jurisdictions shall not exceed 65% of the highest level of effort for deep-water fishing applied in previous years.

6.6.5 Data available

6.6.5.1 Landings and discards

The amount of landings was available for all the relevant fleets. No estimates of the quantity of discards for tusk were available. The Norwegian and Faroese fleet are not allowed to discard tusk, and incentives for illegal discarding are believed to be low. The landings statistics and logbooks are therefore regarded as being adequate for assessment purposes.

No discards have been reported for 2014, while for 2013 Spain reported that discards were 40 tons and Ireland 12 tons.

6.6.5.2 Length compositions

Figure 6.6.3 show the estimated length distributions of tusk in Areas IVb, Vb and VIa based on data provided by the Norwegian reference fleet for the period 2001–2014.

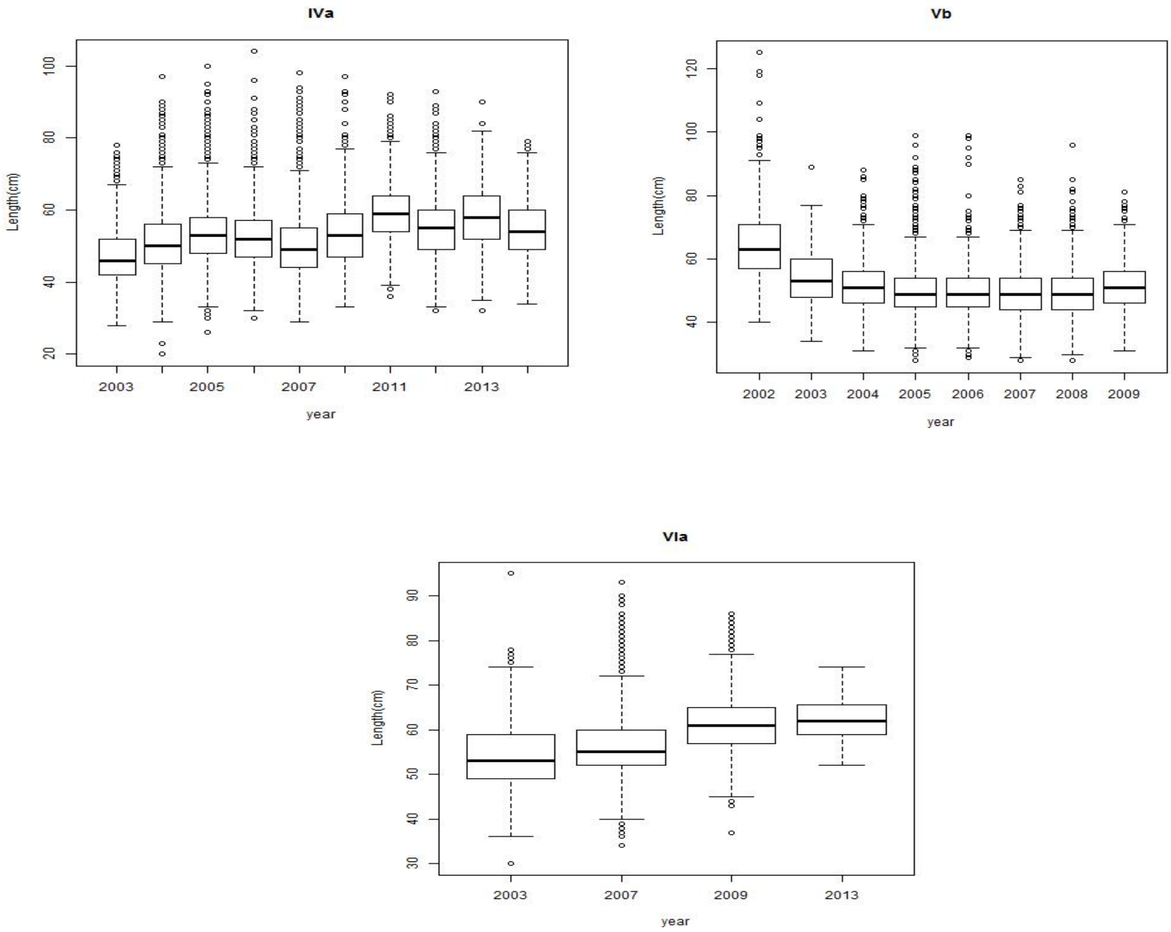


Figure 6.6.3.Plots of the length distribution in Areas IVa, Vb and VIa for the period 2001 to 2014. The graphs are based on length data from the Norwegian reference fleet.

The length distributions of the commercial catches by Faroese longliners were presented for the period 1994–present (Figure 6.6.4). The estimated mean lengths of the catch by the longliners varied from 46 to 56 cm, and there was no downward trend in mean lengths over time (Figure 6.6.4). The commercial longline catches had fish lengths mainly between 40 and 60 cm.

Length distributions of tusk are from four different trawl surveys conducted in Faroese waters: the annual Faroese spring (1994–present, Figure 6.6.5) and summer survey (1996–present, Figure 6.6.6), the annual Greenland halibut survey (1995–present, Figure 6.6.7) and a deep-water survey (2014, Figure 6.6.8).

Length distributions from the Russian investigations is in Aleksandrov and Vinnichenko, WD 2015.

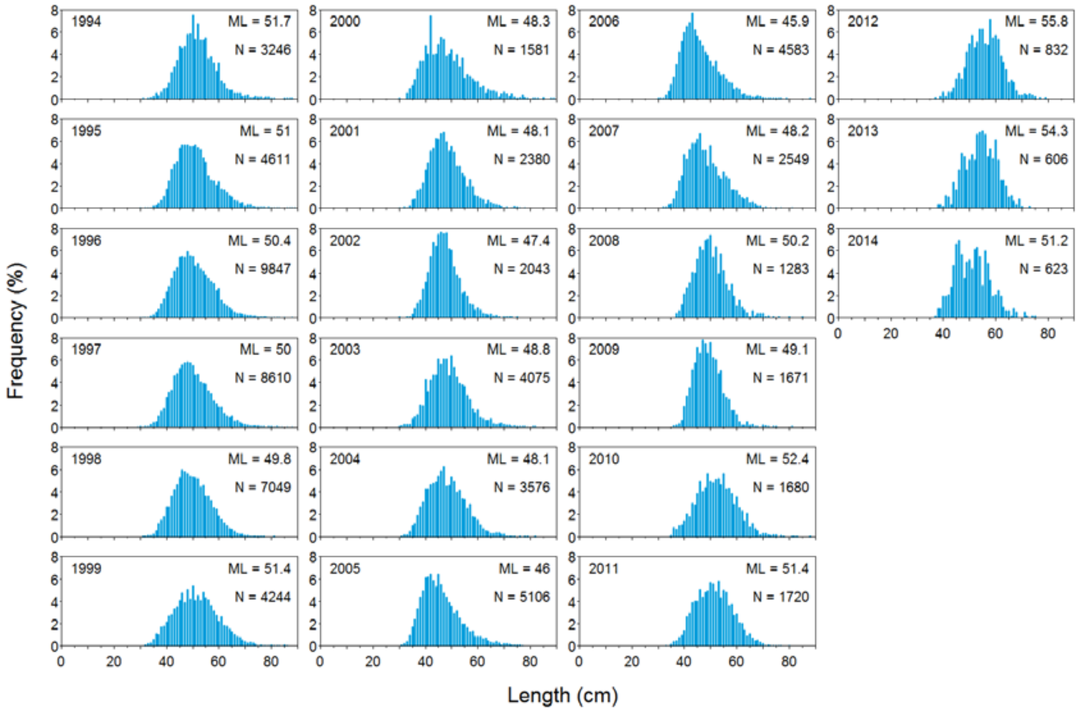


Figure 6.6.4. The estimated length distributions of the catch of tusk by longliners (>100 BRT) in Area Vb.

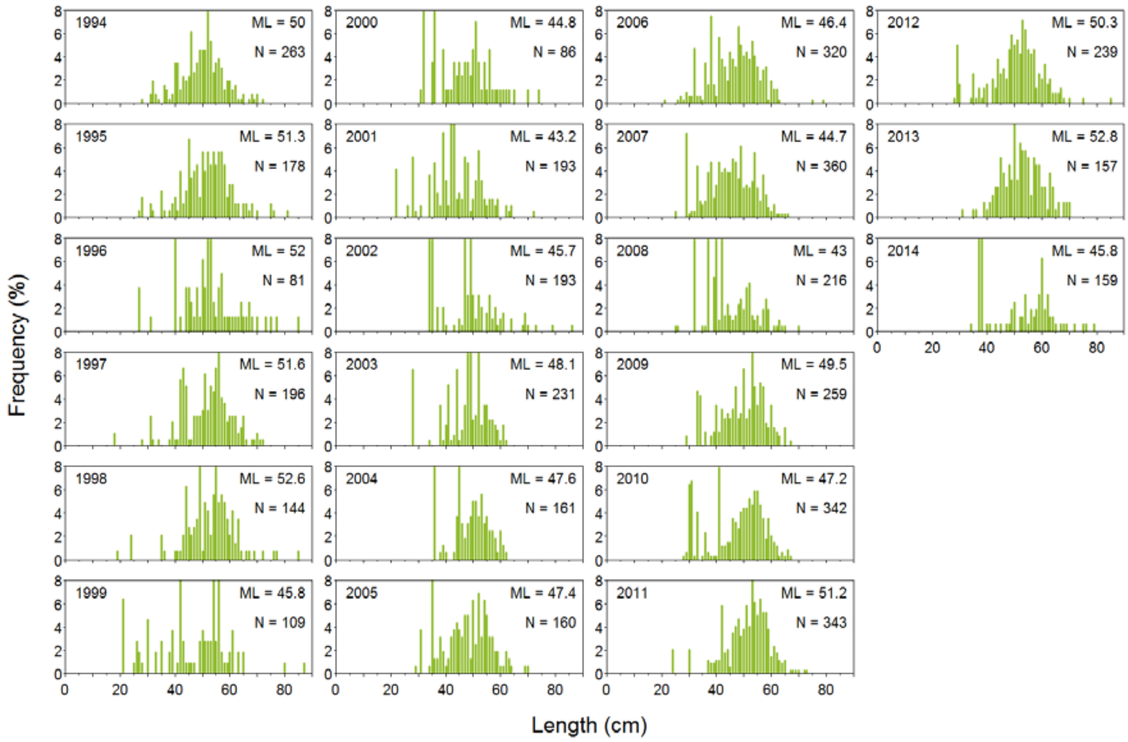


Figure 6.6.5. Estimated length distributions of tusk in Area Vb based on data from the spring groundfish surveys.

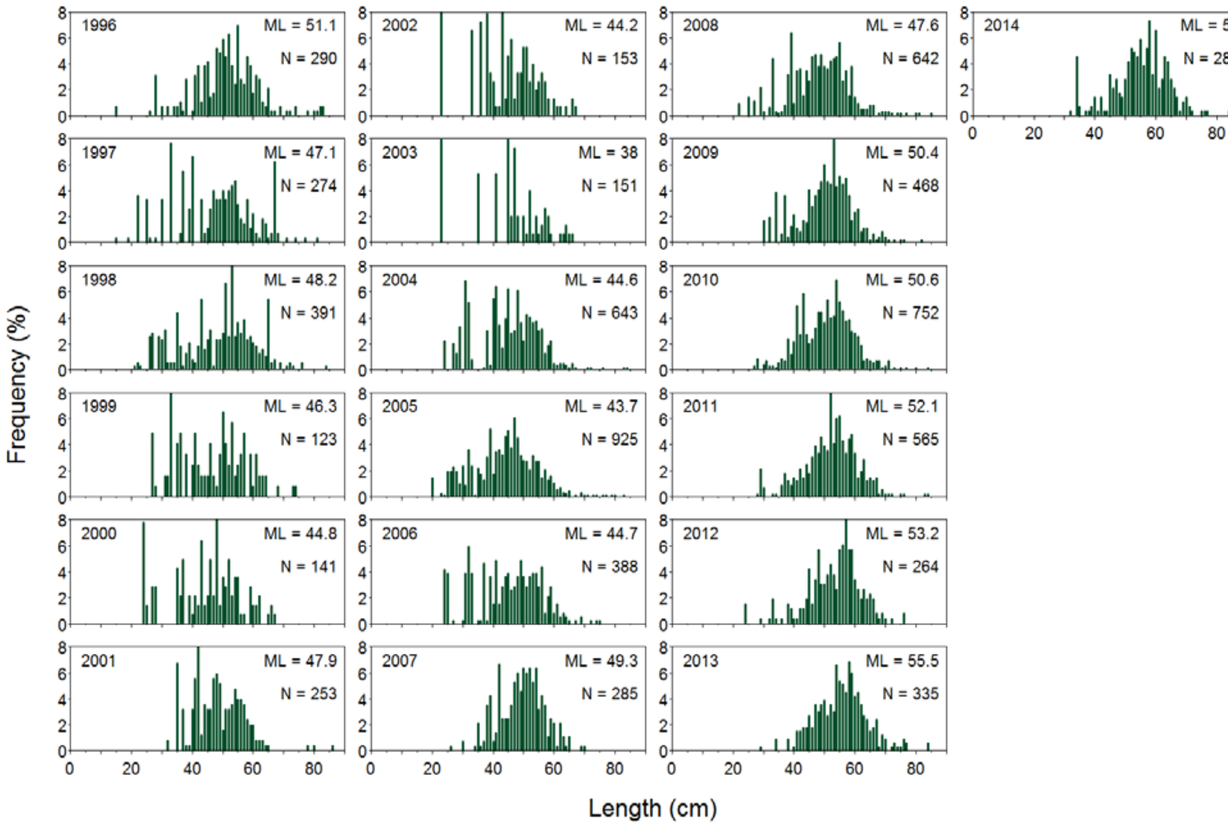


Figure 6.6.6. Estimated length distributions of tusk in Area Vb based on data from the summer groundfish surveys.

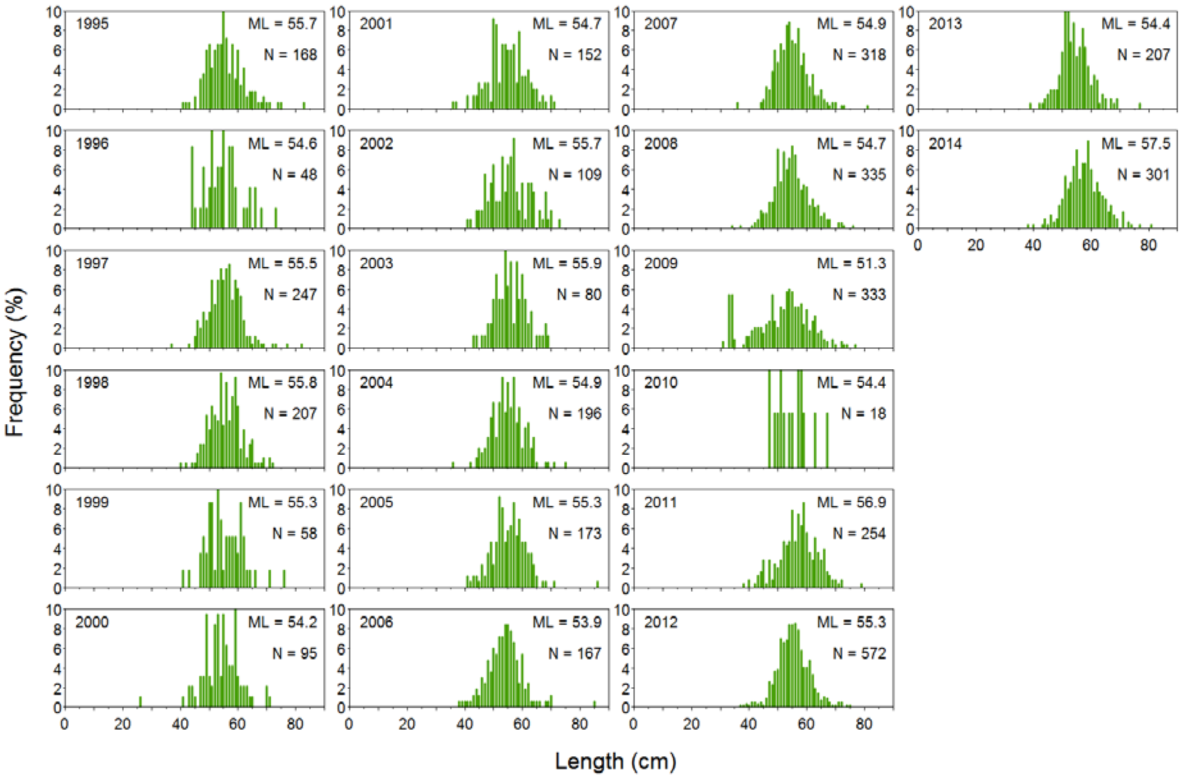


Figure 6.6.7. Tusk Vb. Length distributions from the annual Greenland halibut trawl survey.

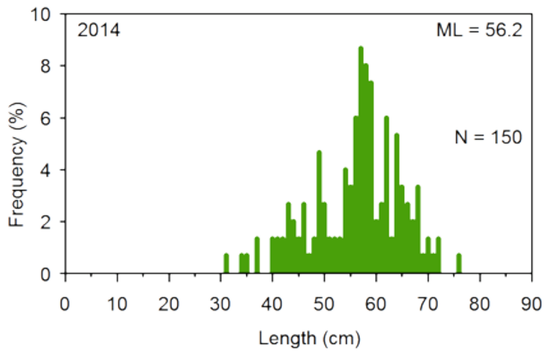


Figure 6.6.8. Tusk Vb. Length distribution in the deep-water survey in 2014.

6.6.5.3 Age compositions

A small-scale exchange of 50 tusk otolith images was conducted in 2013 (WKAMDEEP, 2013). The results of this experiment showed that the average coefficient of variation (CV) of the ten age readers of tusk was 16.9%, and the conclusion from this experiment was, because of the relatively large ageing errors, care should be taken when interpreting estimated year-class strength and population growth rates (WGDEEP, 2013).

A total of 840 tusk otoliths from various Faroese surveys in 2013–2014 were age read and the age–length key from these results were used to estimate the age composition of the catch by the longline fishery (Figure 6.6.9). These preliminary results indicate that the longline landings are largely composed of six to ten year old fish, and the mean age in the catch were around eight years (Figure 6.6.9).

The mean length at age and mean gutted weight-at-length of the tusk catch in Faroese waters are presented in Figure 6.6.10.

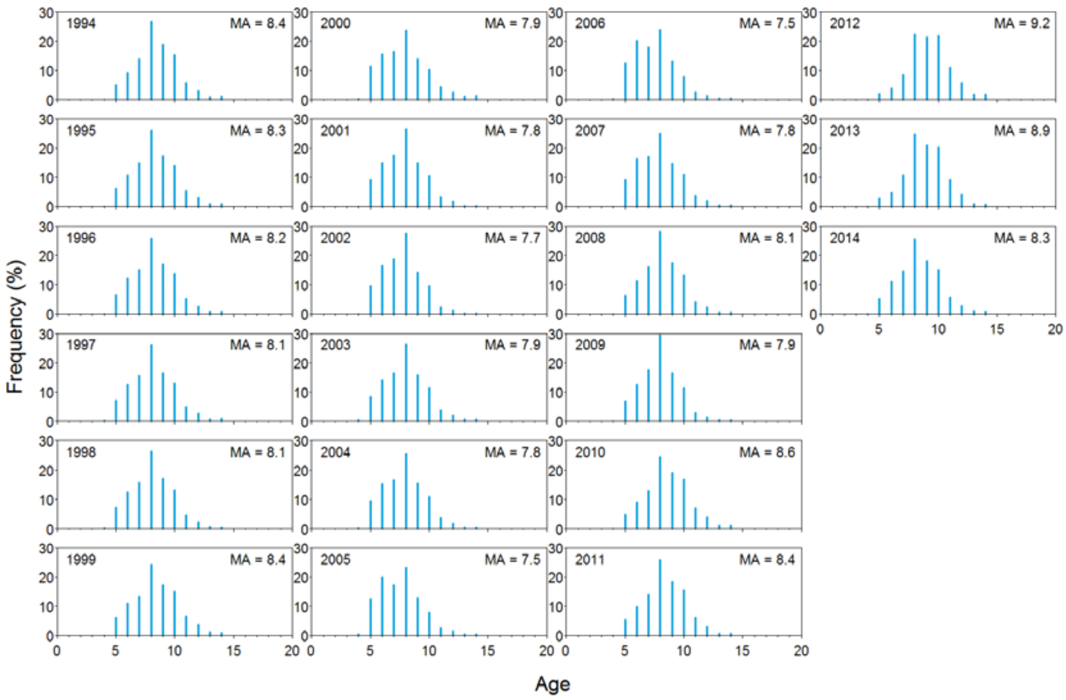


Figure 6.6.9. Tusk Vb. Age distribution of the catch by longline fishery.

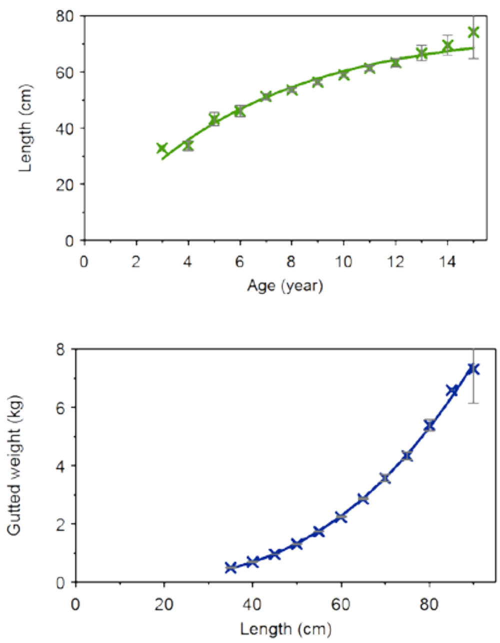


Figure 6.6.10. Tusk Vb. Mean length-at-age (left figure) and mean gutted weight-at-length (right figure).

6.6.5.4 Weight-at-age

Mean weight-at-age of tusk in the commercial catches in Faroese waters are presented in Figure 6.6.11. The mean weight-at-age was relative stable during the period from 1994 to 2014 with the highest individual weights-at-age in 2012 (Figure 6.6.11).

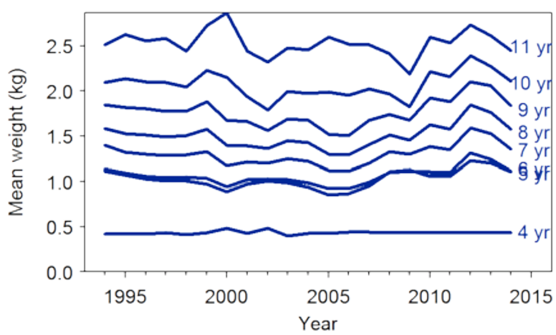


Figure 6.6.11. Tusk Vb. Mean weight-at-age in the landings.

6.6.5.5 Maturity and natural mortality

Data on maturity of tusk from various Faroese surveys in 2013 and 2014 indicated a L_{50} around 50–55 cm (N=840) and an A_{50} around 7–8 years (N=840) (Figure 6.6.12).

No information is available on natural mortality of tusk in Vb.

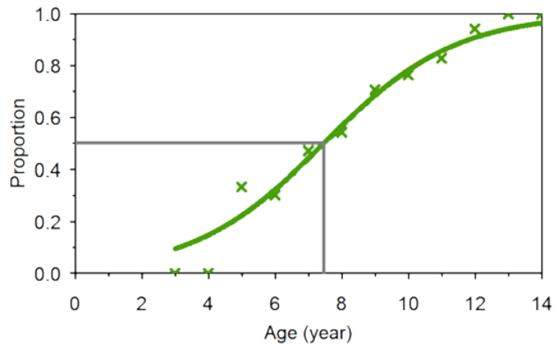


Figure 6.6.12. Tusk Vb. Maturity ogive.

6.6.5.6 Catch, effort and research vessel data

Catch and effort data for Norwegian and Faroese longliners were presented as were the cpue indices based on the Faroese groundfish surveys.

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2014. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 t in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day. The quality of the Norwegian logbook data is poor in 2010 due to changes from paper to electronic logbooks. Since 2011 data quality has improved considerably and data from the entire fleet were available.

A standardized cpue series for the period 2000–2014 is in Figure 6.6.13.

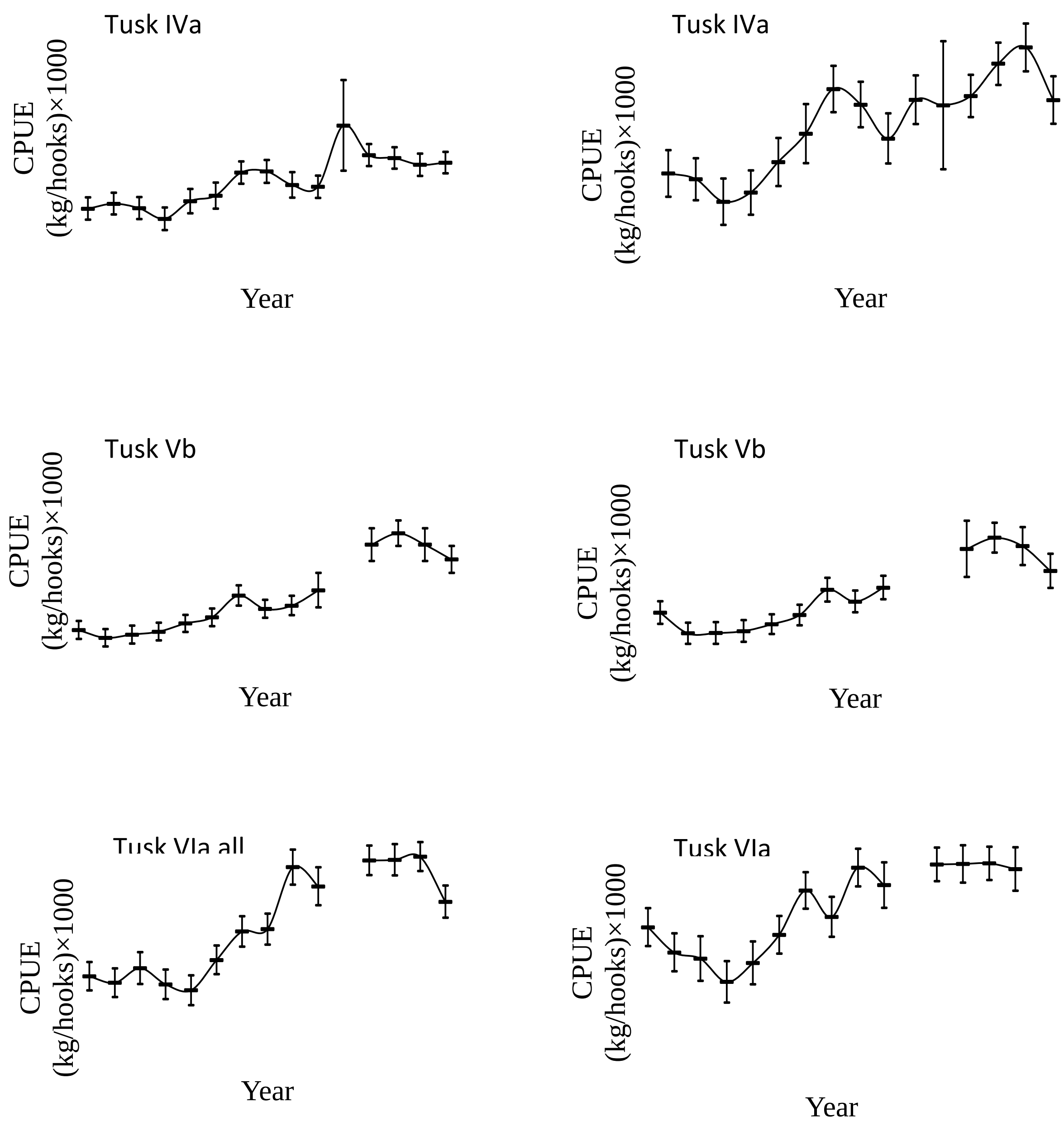


Figure 6.6.13. A cpue series for tusk for the period 2000–2014 based on all available data and when tusk appeared to be targeted. The bars denote the 95% confidence intervals.

A standardized commercial cpue series for longliners fishing in Faroese waters was presented (Figure 12). The background data were based mainly on data from the log-books of five longliners. The data selected were only from sets where tusk was in the catch, and tusk+ling was more than 60% of the total catch. An additional cpue series were constructed for comparison with the cpue series from Norwegian longliners where all the sets with tusk >30% of the total catch in the sets were used.

Abundance indices from different surveys were presented. A standardized cpue from the annual Faroese groundfish surveys in spring (1994–present) and summer (1996–

present) are in Figure 6.6.14. Also, cpue from the spring survey 1983–1993 were presented, and these data were not stratified (Figure 13). These surveys are only conducted down to 530 m, so these estimates are not covering the whole distribution area of tusk.

A cpue series for tusk caught as bycatch in the annual Greenland halibut trawl surveys is in Figure 13. The cpue series based on the Greenland halibut survey shows an overall increase since 1999 from around 1 kg/hour to 4 kg/hour in 2014 (Figure 15).

Abundance indices of tusk <40 cm caught in the Faroese groundfish surveys on the Plateau is in Figure 6.6.15. Indices of tusk <40 cm from the two surveys do not show the same trend and the level of the index in the last years were low (Figure 6.6.15).

Abundance indices of tusk caught in the Faroese 0-group survey on the Plateau indicate that the population was at a very low level in the period 1983–2011, while the level increased in 2012–2013, but decreased again in 2014 (Figure 6.6.16).

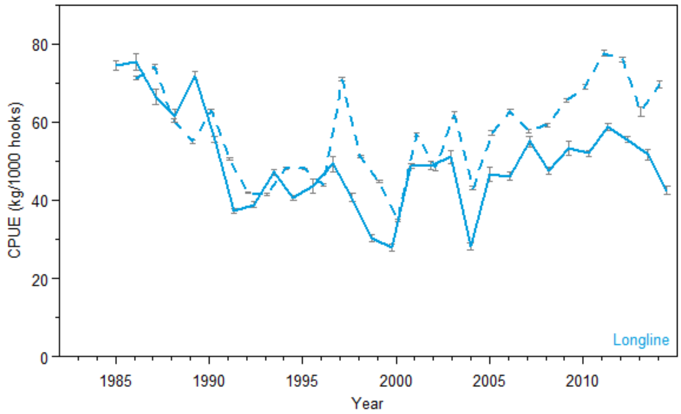
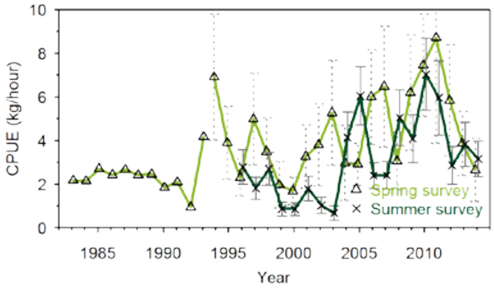


Figure 3.6.14. Tusk Vb. Standardized cpue for 4–5 longliners (<110 GRT) fishing in Faroese waters. The whole line is where tusk was in the catch and ling+tusk >60% of total catch in the sets and the stippled line is where tusk>30% of the total catch in the sets.



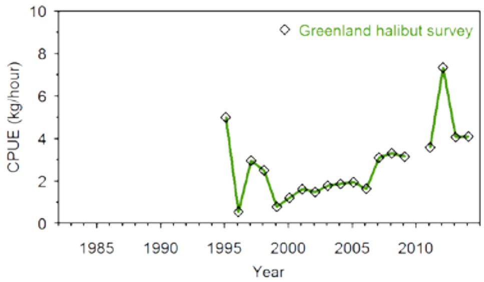


Figure 6.6.15. Tusk Vb. Cpue series based onthe annual trawl groundfish surveys (left figure) and based on the annual Greenland halibut survey (right figure). The spring survey data from 1983–1993 is not stratified.

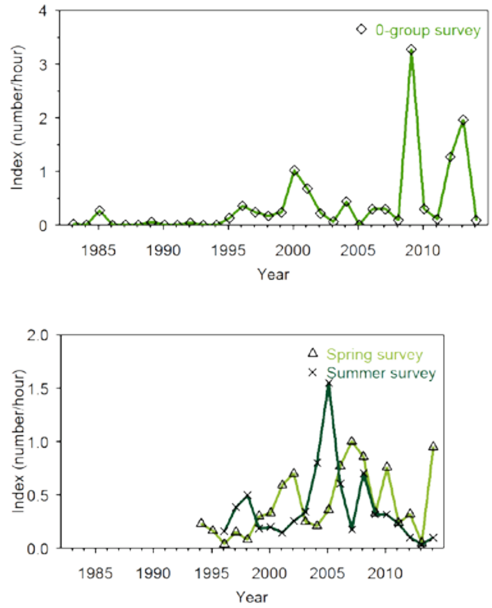


Figure 6.6.16 Tusk Vb. Abundance index of tusk (2–3 cm in length) (number/hour) on the Faroe Plateau from the 0-group survey (left figure) and abundance index of tusk <40 cm in the annual spring- and summer survey (right figure).

In order to produce one cpue series for all areas, all the data from the Norwegian longline fleet was combined (Areas IVa, IVb, Vb and VIa). Data from the targeted fishery was used (daily catches when tusk made up more than 30 % of the total catch) (Figure 6.6.17).

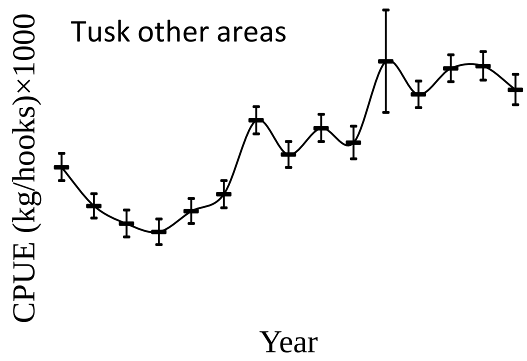


Figure 6.6.17. A combined cpue series for all "other tusk" areas for the period 2000–2014 based on data from the Norwegian longline fleet when tusk was targeted (>30% of total catch). The bars denote the 95% confidence intervals.

6.6.6 Data analyses

No analytical assessments were attempted this year.

Norwegian length distributions, based on data provided by the longline reference fleet from Areas IVb, Vb and VIa, have varied slightly with no obvious trend (Figure 6.6.3).

The mean length of the catch by the Faroese spring and summer groundfish surveys varied between 43 and 55 cm (Figures 6.6.5 and 6.6.6). The length distributions from these surveys are noisy and some lengths seem to be overestimated (especially small fish). The reason behind this is probably that small tusk, below the commercial landing size limit, are sampled as a subsample from the catch and thereafter raised to the total catch weight. Very few tusk smaller than 30 cm are caught in these surveys. The mean length of tusk in the Greenland halibut survey, which used a commercial trawl, was quite stable at around 55 cm (Figure 6.6.7).

The mean length of 150 tusk caught in the deep-water survey was 56 cm (Figure 6.6.8).

Cpue trends

IVa

Two cpue series for tusk in Area VIa based on Norwegian longline data were presented; one based on all the data, and one based on when tusk appeared to be the target species. The series based on all the data shows a stable and slightly increasing trend while the one based on the targeted fishery shows a clear and positive upward trend with a decline in 2014 (Figure 6.6.13).

Vb

A standardized commercial cpue series for longliners fishing in Faroese waters during the period 2005 to 2014 has been quite stable at around 50 kg/1000 hooks with a small decrease during the last three years to 40 kg/1000 hooks in 2014 (Figure 6.6.14). Changing the selection of sets to all sets where tusk was >30% of the total catch in the sets (for comparison with the cpue from Norwegian longliners) gave in general the same signal but at higher cpues in the latest years.

Both a standardized cpue series from the annual Faroese groundfish surveys in spring (1994–present) and summer (1996–present) and the cpue series from the annual groundfish surveys show a decrease during the last three years (Figure 6.6.15).

A cpue series from the Greenland halibut survey shows an overall increase since 1999 from around 1 kg/hour to 4 kg/hour in 2014 (Figure 6.6.15).

Abundance indices of tusk <40 cm caught in the Faroese groundfish surveys on the Plateau are in Figure 14. Indices of tusk <40 cm from the two surveys do not show the same trend and the level of the index during the last few years are low (Figure 6.6.16).

Abundance indices of tusk caught in the Faroese 0-group survey on the Plateau show a very low level in the period 1983–2011, the level increased in 2012–2013, but decreased again in 2014 (Figure 6.6.16).

The cpue series based on the Norwegian longline data shows a stable trend from 2000 to 2008, afterwards it increased until 2012 and then decreased (Figure 6.6.13).

VIa

In **VIa** a cpue series based on the Norwegian longline data shows a decrease in cpue from 2004 to 2008, after this it has remained at a high and stable level (Figure 6.6.13).

Combined cpue series for "Tusk other areas"

The combined Norwegian longline cpue series shows the same trend as that for the different areas and by the Faroese series, both the longline and grounfish series.

Biological reference points

Estimates of L_{MAX} and AFC were identified and made available to WKLIFE.

6.6.7 Comments on the assessment

The Norwegian longline cpue series based on the logbooks has now been standardized. However, it shows the same trend as the unstandardized cpue series, and the series based on a super-population model that was presented in 2012.

6.6.8 Management considerations

Landings in all subareas have been stable since 2002. The cpue series, for the Faroes longline fishery in Vb and for the Norwegian longline fisheries show a stable or positive trend since 2003 with a decrease during the last few years. In IVa and VIb the cpue series indicate a positive development of the stocks. Since the catches have been stable and the indicator series have been showing an increasing trend it is suggested not to apply the 20% buffer.

Table 6.6.1. Tusk IIIa, IV, Vb, VI, VII, VIII, IX. WG estimates of amount landed.

TUSK IIIa

Year	Denmark	Norway	Sweden	Total
1988	8	51	2	61
1989	18	71	4	93
1990	9	45	6	60
1991	14	43	27	84
1992	24	46	15	85
1993	19	48	12	79
1994	6	33	12	51
1995	4	33	5	42
1996	6	32	6	44
1997	3	25	3	31
1998	2	19		21
1999	4	25		29
2000	8	23	5	36
2001	10	41	6	57
2002	17	29	4	50
2003	15	32	4	51
2004	18	21	6	45
2005	9	30	5	44
2006	4	21	4	29
2007	1	19	1	21
2008	0	43	3	46
2009	1	17	1	19
2010	1	17	3	21
2011	1	14	3	17
2012	1	17	2	20
2013	1	20	1	22
2014*	1	7	1	9

***Preliminary.**

TUSK IVa

Year	Denmark	Faroes	France	Germany	Norway	Sweden[1]	E & W	N.I.	Scotland	Ireland	Total
1988	83	1	201	62	3,998	-	12	-	72		4,429
1989	86	1	148	53	6,050	+	18	+	62		6,418
1990	136	1	144	48	3,838	1	29	-	57		4,254
1991	142	12	212	47	4,008	1	26	-	89		4,537
1992	169	-	119	42	4,435	2	34	-	131		4,932
1993	102	4	82	29	4,768	+	9	-	147		5,141
1994	82	4	86	27	3,001	+	24	-	151		3,375
1995	81	6	68	24	2,988		10		171		3,348
1996	120	8	49	47	2,970		11		164		3,369
1997	189	0	47	19	1,763	+	16		238	-	2,272
1998	114	3	38	12	2,943		11		266	-	3,387
1999	165	7	44	10	1,983		12		213	1	2,435
2000	208	+	32	10	2,651	2	12		343	1	3,259
2001	258		30	8	2443	1	11		343	1	3095
2002	199		21		2438	1	8		294		2961
2003	217		19	6	1560		4		191		1997
2004	137	+	14	3	1370	+	2		140		1666
2005	123	17	11	4	1561	1	2		107		1826
2006	155	8	14	3	1854		5		120		2159
2007	95	0	22	4	1975	1	6		74	3	2180
2008	57	0	16	2	1975		3		85	1	2139
2009	48		8	1	2108	7	3		93		2268
2010	36		10	2	1734		8		71		1861
2011	52		24		1482	1	6		72		1636
2012	28		14	1	1635	1	3		67		1749
2013	42		11	3	1375		3		76		1510
2014*	21		13	3	1364		3		58		1462

(1) Includes IVb 1988–1993.

***Preliminary.**

Table 6.6.1. (Continued).

Tusk IVb

Year	Denmark	France	Norway	Germany	E & W	Scotland	Ireland	Sweden	Total
1988		n.a.		-	-				
1989		3		-	1				4
1990		5		-	-				5
1991		2		-	-				2
1992	10	1		-	1				12
1993	13	1		-	-				14
1994	4	1		-	2				7
1995	4	-	5	1	3	2			15
1996	4	-	21	4	3	1			33
1997	6	1	24	2	2	3			38
1998	4	0	55	1	3	3			66
1999	8	-	21	1	1	3			34
2000	8		106	+	-	2			116
2001	6		45[(1)]	1	1	3			56
2002	6		61	1	1	2			71
2003	2		5	1					8
2004	2		19	1		1			23
2005	2		4	1					7
2006	2		30						32
2007	1		6				8		15
2008	0		69			0	2		71
2009	1		3			0	0	13	17
2010	1		13						15
2011	1		95						96
2012	2		43					2	47
2013	3		28						31
2014*	2		10						12

[(1)] Includes IVc.

***Preliminary.**

TUSK Vb1

YEAR	DENMARK	FAROES[4]	FRANCE	GERMANY	NORWAY	E & W	SCOTLAND [1]	RUSSIA	TOTAL
1988	+	2827	81	8	1143	-			4059
1989	-	1828	64	2	1828	-			3722
1990	-	3065	66	26	2045	-			5202
1991	-	3829	19	1	1321	-			5170
1992	-	2796	11	2	1590	-			4399
1993	-	1647	9	2	1202	2			2862
1994	-	2649	8	1 [2]	747	2			3407
1995		3059	16	1 [2]	270	1			3347
1996		1636	8	1	1083				2728
1997		1849	11	+	869		13		2742
1998		1272	20	-	753	1	27		2073
1999		1956	27	1	1522		11[3]		3517
2000		1150	12	1	1191	1	11[3]		2367
2001		1916	16	1	1572	1	20		3526
2002		1033	10		1642	1	36		2722
2003		1200	11		1504	1	17		2733
2004		1705	13		1798	1	19		3536
2005		1838	12		1398		24		3272
2006		2736	21		778		24	1	3559
2007		2291	28		1108	2	2	37	3431
2008		2824	18		816	18	13	109	3689
2009		2553	14		499	4	31	34	3135
2010		3949	16		866		58		4889
2011		3288	3		1		1		3293
2012		3668	23		102				3793
2013		1464	36		0				1500
2014*		1764	32		511		3		2310

1) Included in Vb$_2$ until 1996.

(2) Includes Vb$_2$.

(3) Reported as Vb.

(4) 2000–2003 Vb1 and Vb2 combined.

*** Preliminary.**

Table 6.6.1. (Continued).

TUSK Vb2

YEAR	FAROE	NORWAY	E & W	SCOTLAND (1)	FRANCE	TOTAL
1988	545	1061	-	+		1606
1989	163	1237	-	+		1400
1990	128	851	-	+		979
1991	375	721	-	+		1096
1992	541	450	-	1		992
1993	292	285	-	+		577
1994	445	462	+	2		909
1995	225	404	-2	2		631
1996	46	536				582
1997	157	420				577
1998	107	530				637
1999	132	315				447
2000		333				333
2001		469				469
2002		281				281
2003		559				559
2004		107				107
2005		360				360
2006		317				317
2007		344				344
2008		61				61
2009		164				164
2010		127				127
2011		0				0
2012		0				0
2013					12	12
2014*		123			6	129

(1)Includes Vb1.

(2)See Vb1.

(3)Included in Vb1.

***Preliminary.**

TUSK VIa

Year	Denmark	Faroes	France (1)	Germany	Ireland	Norway	E & W	N.I.	Scot.	Spain	Total
1988	-	-	766	1	-	1310	30	-	13		2120
1989	+	6	694	3	2	1583	3	-	6		2297
1990	-	9	723	+	-	1506	7	+	11		2256
1991	-	5	514	+	-	998	9	+	17		1543
1992	-	-	532	+	-	1124	5	-	21		1682
1993	-	-	400	4	3	783	2	+	31		1223
1994	+		345	6	1	865	5	-	40		1262
1995		0	332	+	33	990	1		79		1435
1996		0	368	1	5	890	1		126		1391
1997		0	359	+	3	750	1		137	11	1261
1998			395	+		715	-		163	8	1281
1999			193	+	3	113	1		182	47	539
2000			267	+	20	1327	8		231	158	2011
2001			211	+	31	1201	8		279	37	1767
2002			137		8	636	5		274	64	1124
2003			112		4	905	3		104	0	1128
2004		1	140		22	470			93	0	726
2005		10	204		7	702			96	0	1019
2006		5	239		10	674	16		115	0	1059
2007		39	261		3	703	9		70	0	1085
2008		30	307		1	964	0		44	0	1346
2009		33	217		4	898	0		88	2	1242
2010		41	183		5	939			48		1216
2011		87	173		1	1060			25		1337
2012		106	166		1	860			41		1174
2013		46	191		1	1204			66	86	1594
2014*		0	193			393			60	16	662

Not allocated by divisions before 1993.

*** Preliminary.**

Table 6.6.1. (Continued).

TUSK VIIa

Year	France	E & W	Scotland	Total
1988	n.a.	-	+	+
1989	2	-	+	2
1990	4	+	+	4
1991	1	-	1	2
1992	1	+	2	3
1993	-	+	+	+
1994	-	-	+	+
1995	-	-	1	1
1996	-	-		
1997	-	-	1	1
1998	-	-	1	1
1999	-	-	+	+
2000		-	+	+
2001		-	1	1
2002	n/a	-	-	-
2003		-	-	-
2004				
2005				
2006				
2007				
2008				
2009				
2010				
2011				
2012				
2013				
2014*				

***Preliminary.**

TUSK VIIb,c

YEAR	FRANCE	IRELAND	NORWAY	E & W	N.I.	SCOTLAND	TOTAL
1988	n.a.	-	12	5	-	+	17
1989	17	-	91	-	-	-	108
1990	11	3	138	1	-	2	155
1991	11	7	30	2	1	1	52
1992	6	8	167	33	1	3	218
1993	6	15	70	17	+	12	120
1994	5	9	63	9	-	8	94
1995	3	20	18	6		1	48
1996	4	11	38	4		1	58
1997	4	8	61	1		1	75
1998	3		28	-		2	33
1999	-	16	130	-		1	147
2000	3	58	88	12		3	164
2001	4	54	177	4		25	263
2002	1	31	30	1		3	66
2003	1	19		1			21
2004	2	19					21
2005	4	18				1	23
2006	4	23	63			0	90
2007	2	4	7				13
2008	2	2	0				4
2009	0	4	0				4
2010		5					5
2011		1					1
2012			63				63
2013	3	1					4
2014*		1					1

***Preliminary.**

Table 6.6.1. (Continued).

TUSK VIIg–k

Year	France	Germany	Ireland	Norway	E & W	Scotland	Spain	Total
1988	n.a.		-	-	5	-		5
1989	3		-	82	1	-		86
1990	6		-	27	0	+		33
1991	4		-	-	8	2		14
1992	9		-	-	38	-		47
1993	5		17	-	7	3		32
1994	4		12	-	12	3		31
1995	3		8	-	18	8		37
1996	3		20	-	3	3		29
1997	4	4	11	-		+	0	19
1998	2	3	4	-		1	0	10
1999	2	1	-	-		+	6	8
2000	2		5	-	-	+	6	13
2001	3		-	9	-	+	2	14
2002	1				1		3	5
2003	1		1				1	3
2004	1						0	1
2005	1						1	2
2006	1		1				1	3
2007	1						1	1
2008	0						0	0
2009	0		0		0	0	0	0
2010	0							0
2011	0							0
2012	0					2		2
2013	0							0
2014*								0

***Preliminary.**

TUSK VIIIa

Year	E & W	France	Total
1988	1	n.a.	1
1989	-	-	-
1990	-	-	-
1991	-	-	-
1992	-	-	-
1993	-	-	-
1994	-	-	-
1995	-	-	-
1996	-	-	-
1997	+	+	+
1998	-	1	1
1999	-	-	0
2000	-		-
2001	-		-
2002	-	+	+
2003	-	-	-
2004		1	
2005			
2006			
2007			
2008			
2009			
2010		4	4
2011		0	0
2012			0
2013			0
2014*			0

***Preliminary.**

Table 6.6.1. (Continued).

Tusk, total landings by subareas or division.

Year	III	IVa	IVb	Vb1	Vb2	VIa	VIIa	VIIb,c	VIIg-k	VIIIa	All areas
1988	61	4429		4059	1606	2120		17	5	1	12 298
1989	93	6418	4	3722	1400	2297	2	108	86		14 130
1990	60	4254	5	5202	979	2256	4	155	33		12 948
1991	84	4537	2	5170	1096	1543	2	52	14		12 500
1992	85	4932	12	4399	992	1682	3	218	47		12 370
1993	79	5141	14	2862	577	1223		120	32		10 048
1994	51	3375	7	3407	909	1262		94	31		9136
1995	42	3348	15	3347	631	1435	1	48	37		8904
1996	44	3369	33	2728	582	1391		58	29		8234
1997	31	2272	38	2742	577	1261	1	75	19		7016
1998	21	3387	66	2073	637	1281	1	33	10	1	7510
1999	29	2435	34	3517	447	539		147	8	0	7156
2000	36	3260	116	2367	333	2011		164	13		8300
2001	57	3095	56	3526	469	1767	1	263	14		9248
2002	50	2961	71	2722	281	1124		66	5		7280
2003	51	1997	8	2733	559	1128		21	3		6500
2004	45	1666	23	3536	107	726		21	1		6125
2005	44	1826	7	3272	360	1019		23	2		6553
2006	29	2159	32	3560	317	1059		90	3		7249
2007	21	2180	15	3468	344	1077		13	1		7119
2008	46	2139	71	3798	61	1347		4	0		7466
2009	19	2268	17	3135	164	1242		4	0		6849
2010	21	1861	15	4889	127	1216		3	0	4	8136
2011	17	1623	96	3287	0	1337		5	0	0	6361
2012	20	1749	47	3793	0	1174		63	2		6848
2013	22	1510	31	1500	12	1594		4	0		4673
2014*	9	1462	12	2310	129	662		1			4585

***Preliminary.**

7 Greater silver smelt

7.1 Stock description and management units

At the WGDEEP 2014 it was suggested that unit arg-oth was split further into advicery units as fishing grounds are suffisiently isolated (WD, 2014). It was also suggested that further division may be adequate. This change was implemented at the WGDEEP meeting in 2015, which is an advisory year.

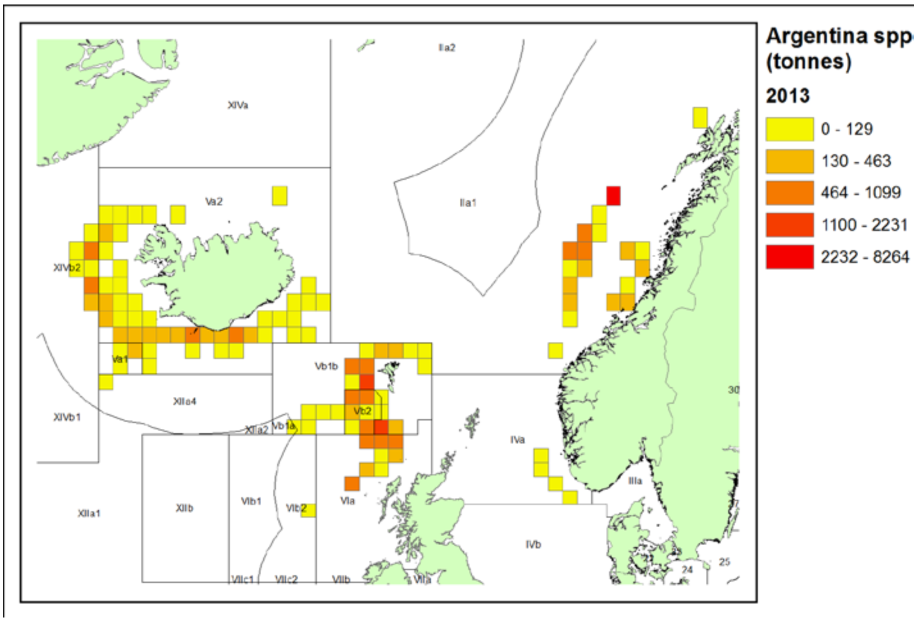


Figure 7.1.1. Catches of greater silver smelt by Iceland, Norway, Faroes and the Netherlands in 2013. Some catches of *A. Sphyraena* and *Argentina* unidentified may be included in the Norwegian and Dutch landings.

7.2 Greater silver smelt (*Argentina silus*) in I and II,

7.2.1 The fishery

Significant fisheries occur in Subareas IIa. Presently the main actors in direct fisheries are Norwegian fleets in IIa2. Landings in Area IIa were reduced in 2007 as a response to management to stabilise around 12 000 t and preliminary numbers for 2013 landings are at that level (Table 7.2.1).

7.2.2 Landing trends

Landings in Area IIa, mainly conducted by Norway, were reduced in 2007 as a response to management to stabilise around 12 000 t and preliminary numbers for 2014 landings are at that level.

7.2.3 ICES Advice

The 2012 advice was joint for a wide area (I, II, IIIa, IV, Vb, VI, VII, VIII, IX, X, XII, XIV), and based on the ICES approach for data-limited stocks ICES advised that catches should be no more than 31 300 tonnes. (see ICES, 2012). Advice for 2015 was; "The 2012 advice for this stock was biennial and valid for 2013–2014 (ICES, 2012). New data available do not change the perception of this stock. Therefore the advice for this fishery in 2015 is the same as in 2013: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 31 300 tonnes.

7.2.4 Management

For a period after 1983 a precautionary unilateral annual TAC applied in IIa, but the landings never exceeded the quota and this regulation was abandoned in 1992. In 2007 a 12 000 tonnes TAC was introduced as a precautionary measure to reduce an increase in the fishery. This TAC has been the same since 2007. In addition there is a licensing system that regulates the number of trawlers that can take part in the directed fishery, equipment restriction, bycatch restrictions, and an area- and time restriction.

The EU introduced TAC management in 2003. For 2013 the EU TAC for I+II =90 t.

7.2.5 Data available

7.2.5.1 Landings and discards

Landings data are presented by area and countries (Tables 7.2.1, Figure 7.2.1).

Discarding is banned in Norway and there is no available information on GSS discard in these areas.

7.2.5.2 Length compositions

There are length distributions of commercial catches from the Norwegian trawl fisheries in IIa from 2009–2013 (Figure 7.2.1b).

Data from the Norwegian slope survey in IIa in March 2009–2014 are shown in Figures 7.2.2.

7.2.5.3 Age compositions

Age compositions from Norwegian catches in IIa are presented in Figures 7.2.3.

Age distributions from the Norwegian slope survey in IIa in March 2012 are shown in Figures 7.2.4.

7.2.5.4 Weight-at-age

No new data on weight-at-age were presented.

7.2.5.5 Maturity and natural mortality

No new data on maturity and natural mortality were presented.

7.2.5.6 Catch, effort and research vessel data

A trawl-acoustic survey was conducted in 2014 along the continental slope in Norwegian EEZ from 62–74°N (Hallfredsson and Heggebakken, WD ICES WGDEEP 2015). This survey is run biennially, and 2014 was the third time the survey is carried out. Highest densities of greater silver smelt in 2014 were found in similar areas as in 2014 on the continental slope off central Norway (Figure 7.2.5). Total acoustic biomass estimates 2009, 2012 and 2014 surveys are shown in Table 7.2.2 and Figure 7.2.8.

Additionally Trawl surveys were conducted in 2003-2005, and a cpue series for available surveys in March 2003–2014 is presented (Figures 7.2.7 and Figure 7.2.8).

7.2.6 Data analyses

Length and age distributions

Norwegian size and age distributions from fisheries in IIa (Figures 7.2.1, 7.2.2 and 7.2.3) are similar in different key fishing areas and showed that catches continue to consist of rather younger fish than catches in the 1980s during the initial years of the target fisheries 1990s (Bergstad, 1993; Monstad and Johannessen, 2003; Johannessen and Monstad, 2003). There are no marked changes in the size and age composition in the recent 5–6 years. However length and age distributions in the Norwegian survey in the area show higher length and age, with proportion of old fish closer to what was found in the 1980s compared to what is found in the fisheries (Figures 7.2.2 and 7.2.4) This may indicate that the fisheries are conducted on shallow waters compared to the species distribution, as size of greater silver smelt increases with depth.

Commercial and survey cpue series

Preliminary analysis of trawl cpue indices for 2003–2014 and acoustic index for 2009–2014 were presented (Figure 7.2. 8). All indices show an upward trend.

Exploratory assessment

No exploratory assessment was presented.

7.2.7 Comments on the assessment

Advice is given every second year for this stock and this year's advice applies for 2015 and 2016.

7.2.8 Management considerations

Advice is given every second year for this stock and last year's advice applies for present year.

Population characteristics from Norwegian fisheries data are not showing negative trends in recent years. Population characteristics from Norwegian surveys show larger and older fish than samples from the fisheries in the same area. Acoustical biomass estimates in 2012 show some reduction compared to 2009, but marked upward trend again in 2014. Trawl cpue series show an upward trend since 2004.

Table 7.2.1. Greater Silver Smelt in I and II. WG estimates of landings in tonnes. *) landings in 2014 are preliminary.

Year	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Iceland	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				14369
2002			7405			2				7407
2003		575	8345		7	2	4	4		8937
2004		4235	11557		4					15796
2005			17063		16			14		17093
2006			21681		4					21685
2007			13272		1					13273
2008			11876							11876
2009			11929							11929
2010			11831			23				11854
2011			11476			0.4				11476
2012			12002				0.2	114	18	12134
2013			11978				0.3			11979
2014*			11747.33							11747

Table 7.2.2. GSS in IIa. Biomass estimates (t) for Greater silver smelt in Norwegian slope surveys Mars 2009, 2012 and 2014. For methods see Harbitz, WD ICES WKDEEP 2010.

	2009	2012	2014*
Latitude < 70°N, depth 300–500 m	92200	96400	110000
Latitude < 70°N, depth 500–750 m	105200	55200	211000
Latitude > 70°N, depth 300–500 m	1800	2400	
Latitude > 70°N, depth 500–750 m	1000	12800	7000
SUM	200200	166800	328000

***In 2014 the survey was conducted without pelagic trawl. This could increase the possibility of incorrect species determination in the upper water layers during the interpretation of the acoustic data which again leads to increased uncertainty in the estimates.**

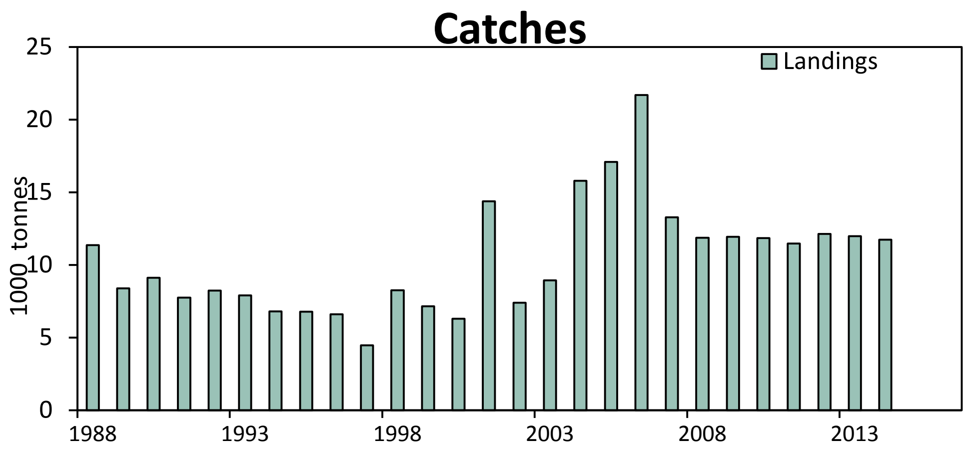


Figure 7.2.1. Total landings of greater silver smelt in I and II.

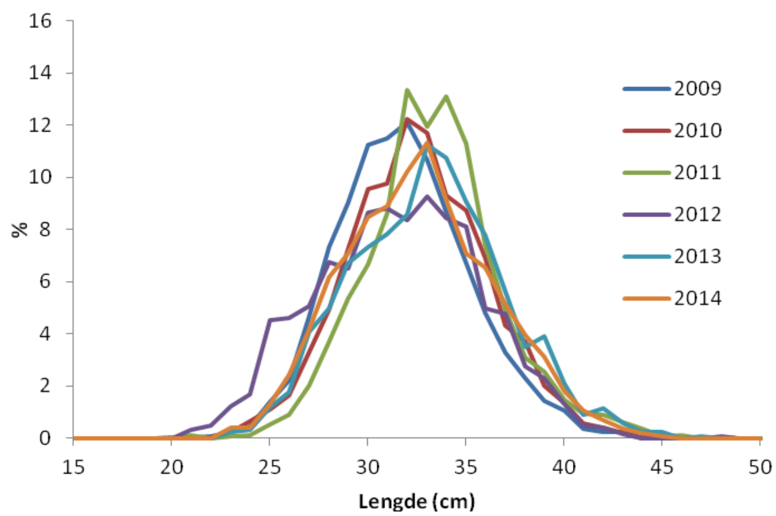


Figure 7.2.1b. Greater silver smelt in IIa. Length distributions from the fisheries in 2009–2014. Samples from all fishing fields summed up within a year. (Hallfredsson and Heggebakken, 2015 WD, WGDEEP).

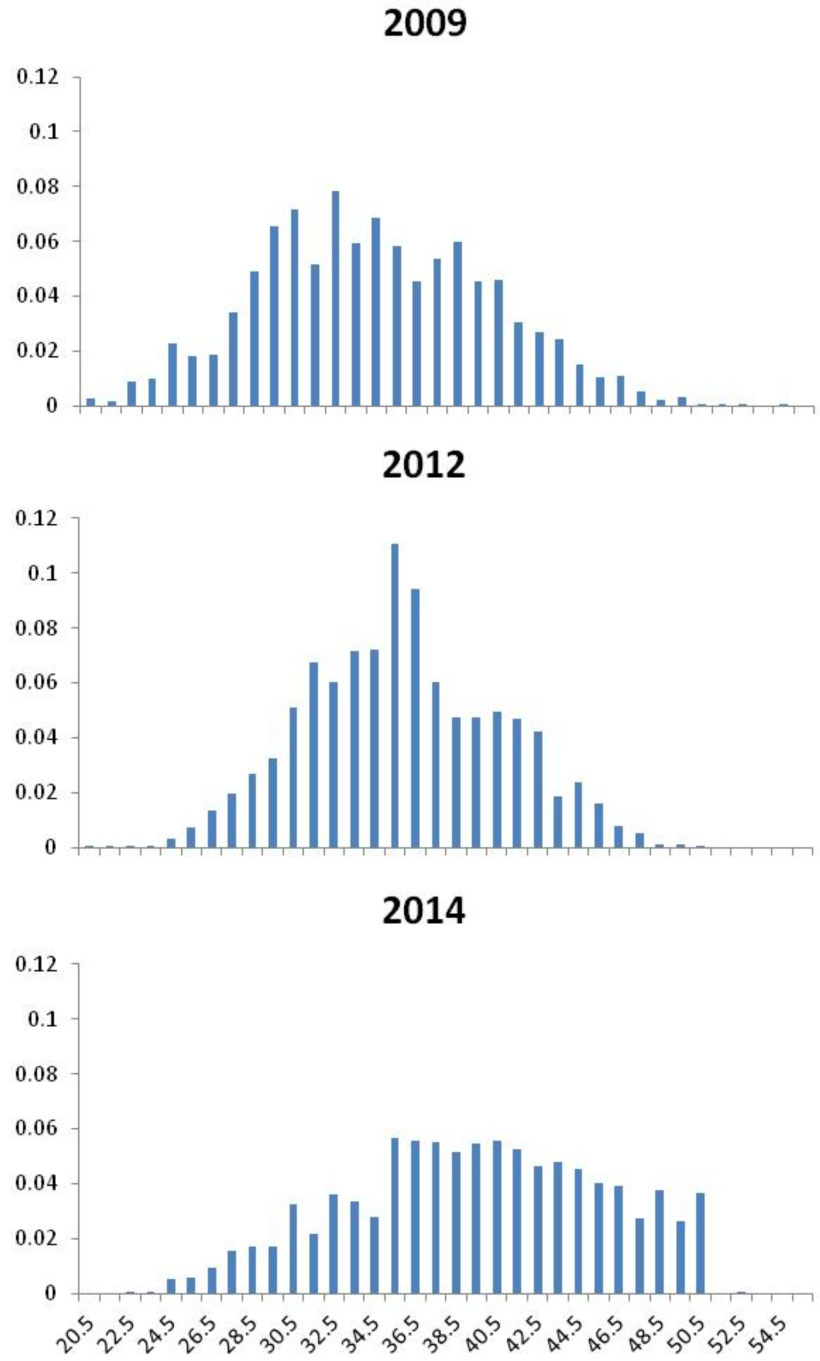


Figure 7.2.2. Greater silver smelt in IIa. Length distributions for greater silver smelt in the Norwegian slope surveys March 2009, 2012 and 2014.

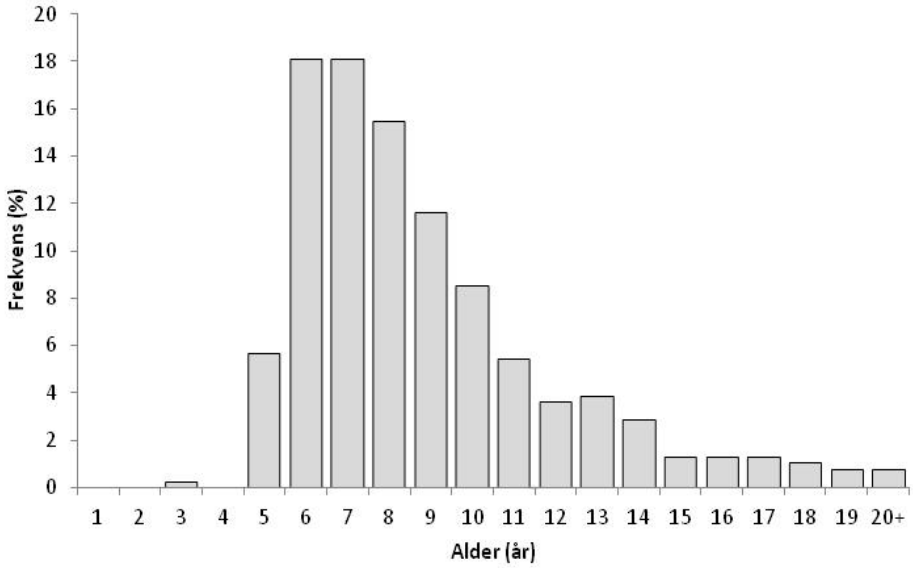


Figure 7.2.3. GSS in IIa. Age distributions of greater silver smelt from Division IIa fisheries in 2014. These are data from individual samples (denoted by IMR serial number). Fishing areas are given in brackets (Hallfredsson and Heggebakken, WD WGDEEP 2015).

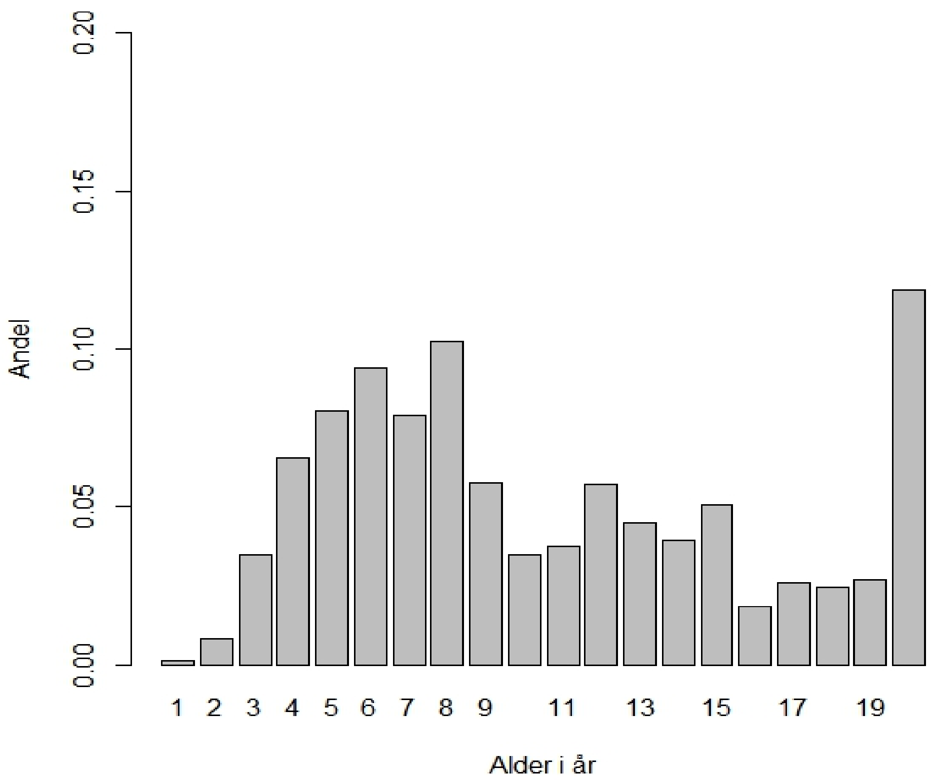


Figure 7.2.4. GSS in IIa. Age distribution for greater silver smelt in the Norwegian slope survey March 2015.

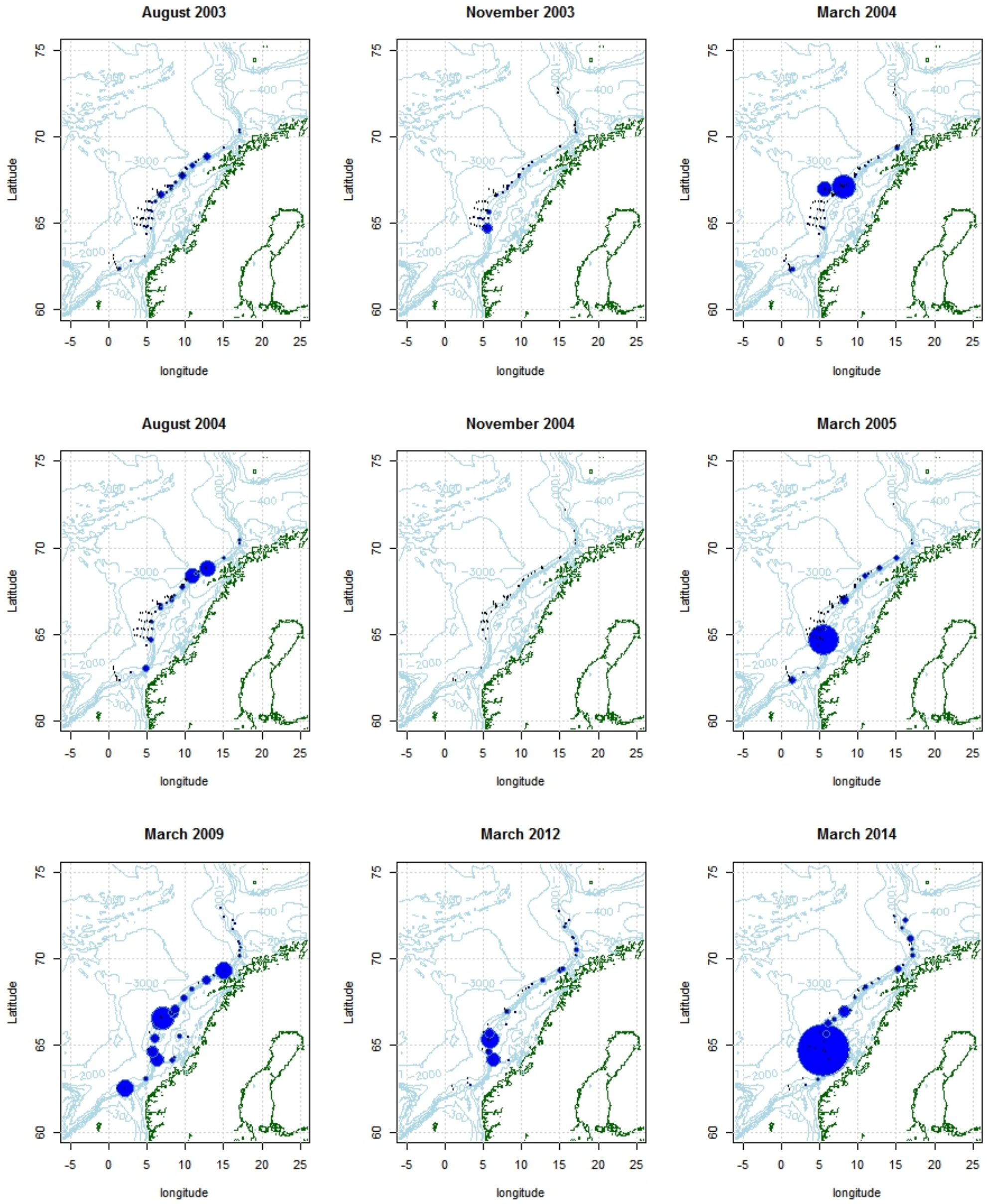


Figure 7.2.5. GSS in IIa. Trawl estimates for distribution of Greater silver smelt in the Norwegian slope survey in 2009, 2012 and 2014. Stations north from 73°N are omitted. Radius of blue dots is scaled by the catch in kg per nautical mile, and black dots show all stations.

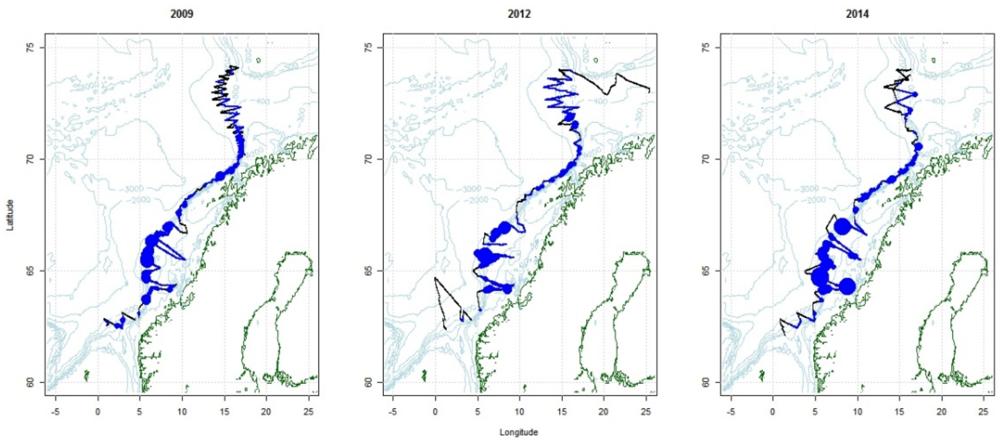


Figure 7.2.6. GSS in IIa. Acoustic estimates (S_A-values) for distribution of greater silver smelt in Norwegian continental slope surveys March/April 2009 and 2012.

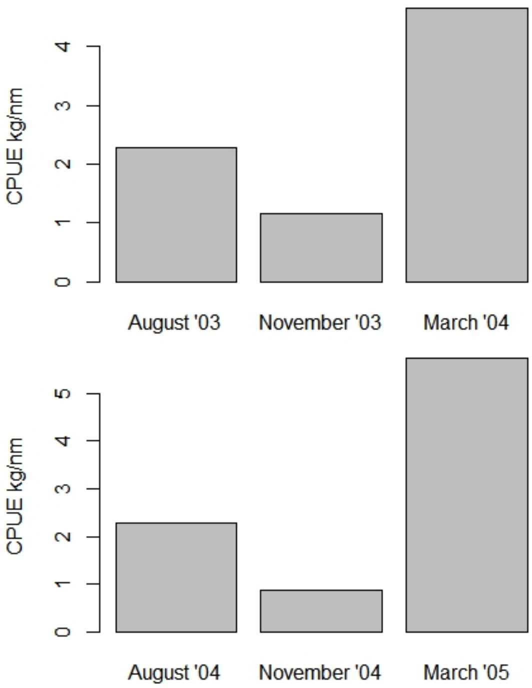


Figure 7.2.7. GSS in IIa. Trawl cpue by month in Norwegian slope surveys in 2003–2005.

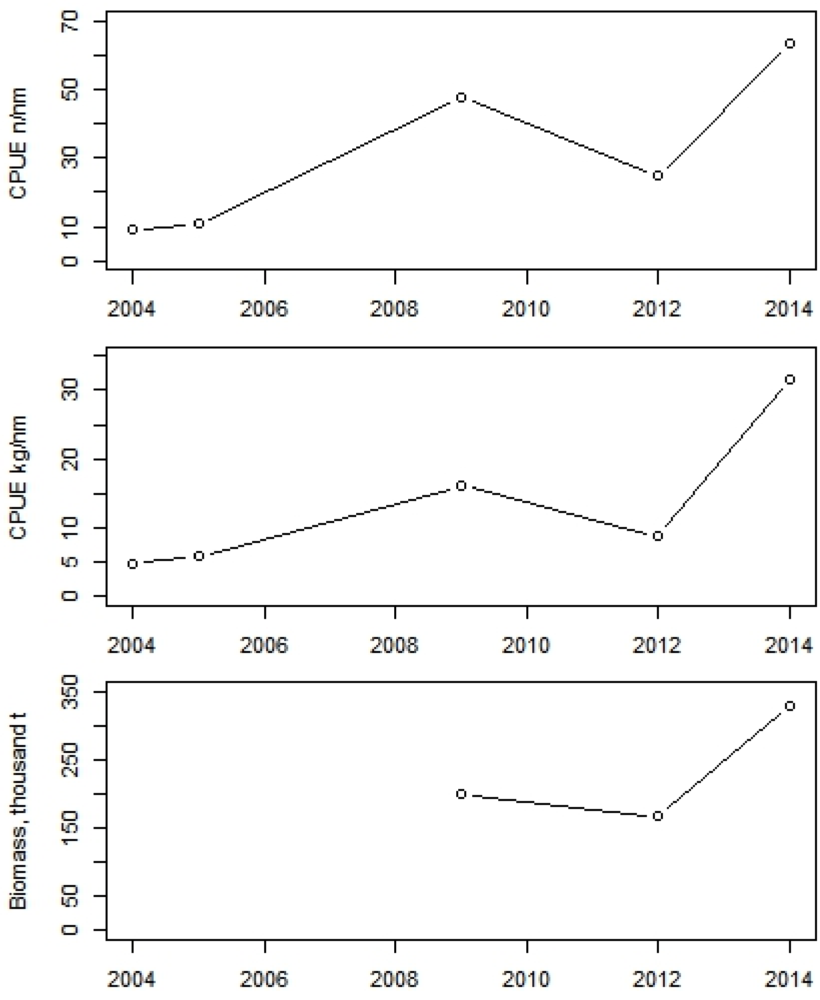


Figure 7.2.8. GSS in IIa. Abundance and biomass indices for greater silver smelt in Norwegian slope surveys in March/April 2004, 2005, 2009, 2012 and 2014. Radius of blue dots is scaled by the catch in kg per nautical mile, and black dots show all stations. The two uppermost panels are trawl cpue indices and the lowermost panel is acoustic biomass index.

7.3 Greater silver smelt (*Argentina silus*) in Division Va

7.3.1 The fishery

Greater silver smelt is mostly fished along the south and southwest coast of Iceland, at depths between 500 and 800 m. Greater silver smelt has been caught in bottom trawls for years as a bycatch in the redfish fishery. Only small amounts were reported prior to 1996 as most of the greater silver smelt was discarded. However discarding is not considered as significant because of the relatively large mesh size used in the redfish fishery. Since 1997, a directed fishery for greater silver smelt has been ongoing and the landings have increased significantly (Table. 7.3.1).

7.3.1.1 Fleets

Since 1996 between 20–39 trawlers have annually reported catches of greater silver smelt in Va (Table 7.3.1). The trawlers participating in the greater silver smelt fishery also target redfish (*Sebastes marinus* and *S. mentella*) and to lesser extent Greenland halibut and blue ling.

Number of hauls peaked in 2010, but the number of hauls have decreased since then in line with lower total catches. In most years between 70–90% of the greater silver smelt catches are taken in hauls were the species is more than 50% of the catch (Table 7.3.2).

Table 7.3.1. Greater silver smelt in Va. Information on the fleet reporting catches of greater silver smelt.

Year	Number Trawlers	Number Hauls	Reported catch	No. Hauls which GSS >50% of catch	Proportion of reported catch in hauls were GSS >50%
1997	26	854	2257	384	0,846
1998	39	2587	11132	1968	0,955
1999	24	1451	4456	824	0,865
2000	23	1263	3491	643	0,827
2001	26	767	1577	255	0,715
2002	32	1134	3127	504	0,777
2003	30	1127	1965	253	0,538
2004	27	1017	2688	340	0,705
2005	30	1368	3520	361	0,732
2006	31	1542	3725	395	0,715
2007	26	1259	3440	461	0,759
2008	31	3143	8428	863	0,663
2009	34	3434	10233	1010	0,694
2010	36	4724	16280	1836	0,740
2011	34	3244	10155	973	0,723
2012	31	3334	9732	985	0,713
2013	31	2704	7192	618	0,651
2014	24	2310	6148	487	0,615

7.3.1.2 Targeting and mixed fisheries issues in the Greater Silver Smelt fishery in Va

Mixed fisheries issues: species composition in the fishery

Redfish spp. (*Sebastus marinus* and *S. mentella*) are the main species when it comes to mixed fishery of greater silver smelt. Other species of lesser importance are Greenland halibut, blue ling and ling. Other species than these rarely exceed 10% of the bycatch in the greater silver smelt fishery in Va (Table 7.3.2).

Table 7.3.2. Greater silver smelt in Va. Proportional species composition where greater silver smelt was more than 50% of the total catch in a haul.

Year	Redfish		Greenland halibut	Ling	Blue ling	Other
	S. marinus	*S. mentella*				
1997	1,4	79	0,0	6,9	7,2	5,5
1998	5,3	77,9	0,0	3,6	6,4	6,8
1999	4	79,9	0,0	2,5	5,9	7,6
2000	4,8	71	0,2	0,3	9,7	14,1
2001	22,4	55,4	4,5	0,5	0,9	16,3
2002	16,9	74,2	0,4	1,2	4,0	3,2
2003	37,7	52	0,4	0,1	5,1	4,7
2004	25,1	68,4	0,7	0,1	0,9	4,8
2005	15,6	69,5	4,3	1,4	3,0	6,2
2006	28,8	59,8	1,4	0,9	1,0	8,1
2007	12,1	70,9	5,9	0,3	6,1	4,6
2008	26,7	60,8	2,8	1,2	5,0	3,4
2009	20,9	63,7	3,3	0,2	7,9	4,1
2010	16	63,7	2,0	0,9	6,4	11,1
2011	13,4	66,3	2,2	0,4	4,8	12,9
2012	8,9	67,5	1,3	0,2	7,5	14,5
2013	9,6	63,8	4,7	0,2	9	12,8
2014	2,4	78,3	2,8	0,3	5,5	10,7

Spatial distribution of catches through time

Spatial distribution of catches in 1996–2014 is presented in Figures 7.3.1 and 7.3.2. With the exception of 1996 most of the catches have been from the southern edge of the Icelandic shelf. However in recent years there has been a gradual increase in the proportion caught in the western area and even in the north western area. The reason for this is the fleet is focusing on redfish and Greenland halibut but then takes few hauls of greater silver smelt in the area (Figures 7.3.1 and 7.3.2).

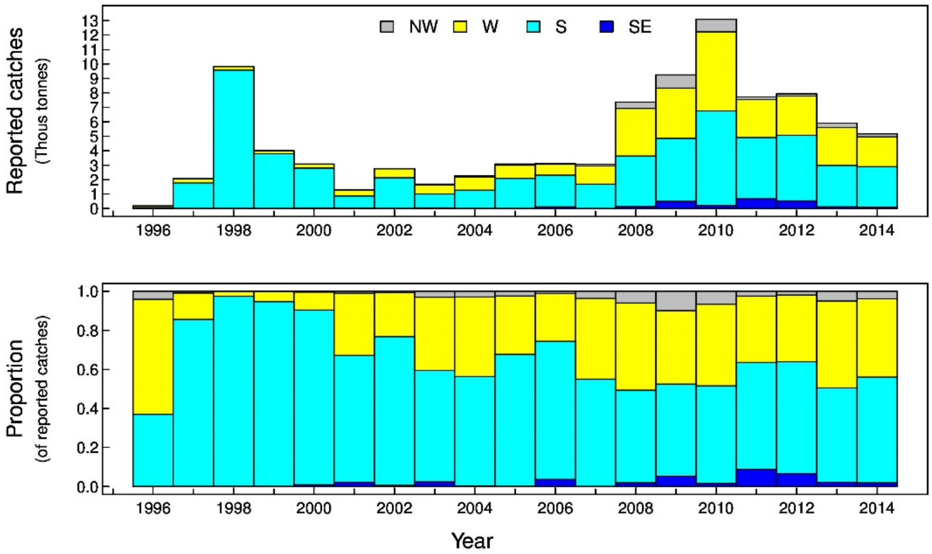


Figure 7.3.1. Greater silver smelt in Va. Catches defined by survey regions deeper than 400 m by year (See stock annex for details). Above are the catches on absolute scale and below in proportions.

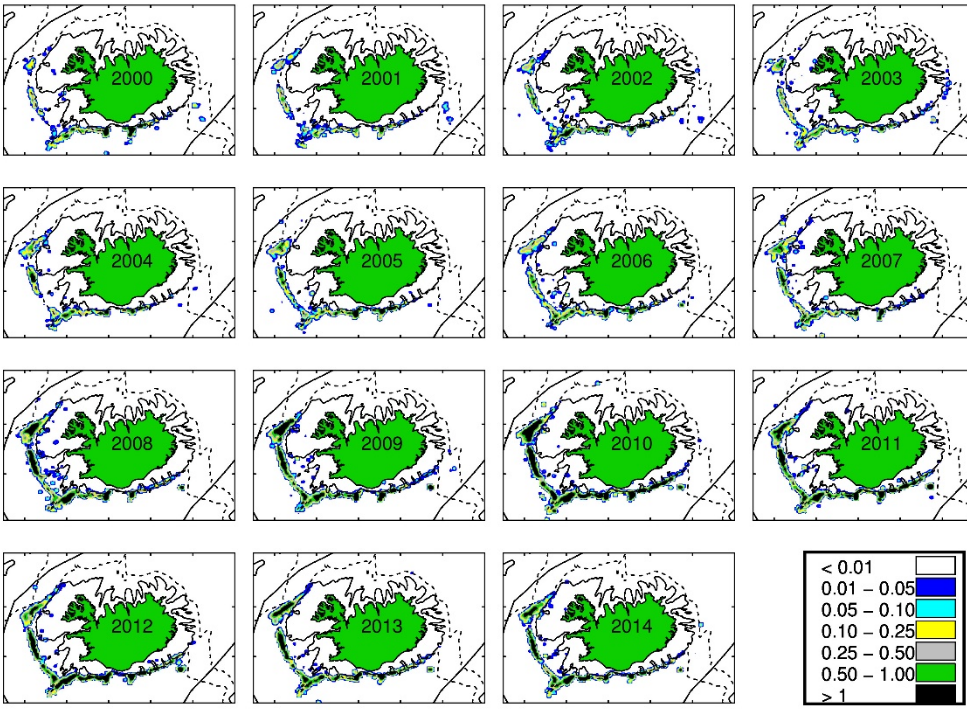


Figure 7.3.2. Greater silver smelt in Va. Spatial distribution of catches as reported in logbooks.

7.3.2 Landings trends

Landings of Greater Silver Smelt are presented in Table 7.3.1 and Figure 7.3.3. Since directed fishery started in 1997–1998, the landings increased from 800 t in 1996 to 13 000 t in 1998. Between 1999 and 2007 catches varied between 2600 to 6700 t. Since 2008 landings have increased substantially, from 4200 t in 2007 to almost 16 500 t in

2010. In 2011 and 2012 landings decreased due to closure of the fishery by managers and landings in 2014 amounted to approximately 7200 tonnes.

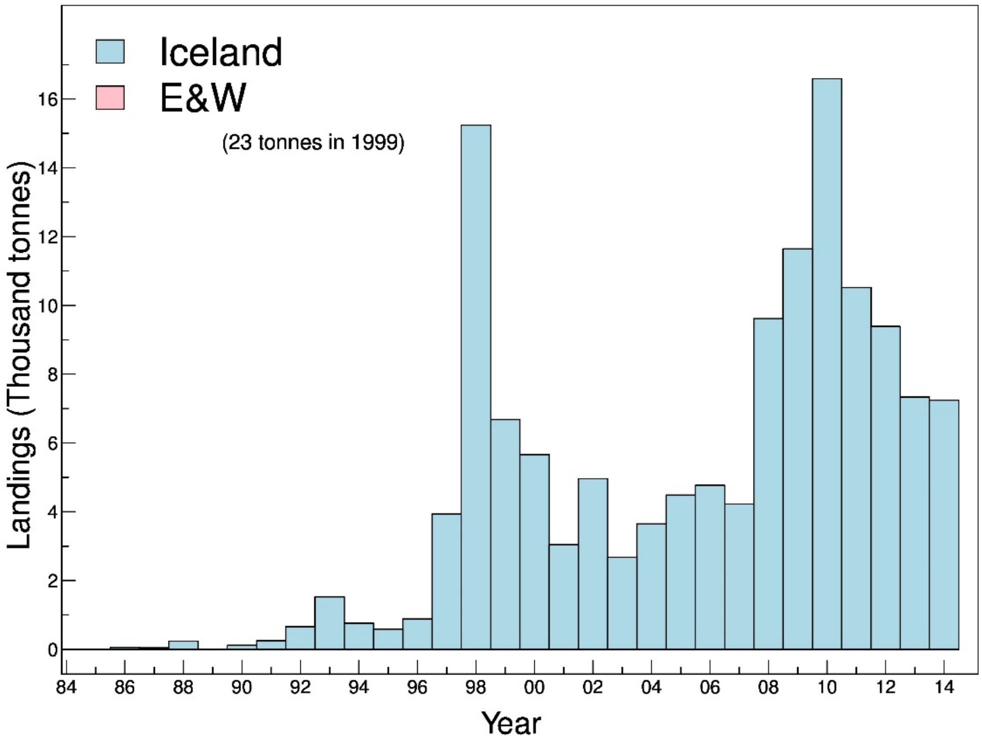


Figure 7.3.3. Greater silver smelt in Va. Nominal landings. 23 tonnes were landed by foreign vessels (England and Wales) in 1999, which is the only year of reported by foreign vessels.

7.3.3 ICES Advice

The ICES advice for 2015 is: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 4033 tonnes.

The basis for the advice was the following: For data-limited stocks with reliable abundance information from fisheries-independent data and a target F_{proxy}, where abundance is considered above MSY $B_{trigger}$, ICES uses a harvest control rule that calculates catches based on the F_{proxy} target multiplied by the most recent survey biomass estimates.

For this stock the F_{proxy} of 0.151 is applied, with an additional uncertainty cap of 20%, as a factor to the 2013 biomass estimate, resulting in catch advice of no more than 4033 t. ICES does not implement the default rule as used for other data-limited stocks because the fishing mortality has increased significantly in the last two years.

7.3.4 Management

Before the 2013/2014 fishing year the Icelandic fishery was managed as an exploratory fishery subject to licensing since 1997. Detailed description of regulations on the fishery of greater silver smelt in Va is given in the Stock Annex.

On the 7th of June 2010 the Ministry of Fisheries and Agriculture redrew licences for the remaining time of that fishing year (2009/2010). Licences were similarly redrawn on the 7th of March 2011 (for 2010/2011), 2nd of December 2011 (for 2011/2012) and on the 18th of March 2013 (for (2012/2013).

As of the 2013/2014 fishing year, greater silver smelt is regulated by the ITQ system (regulation 662/2013) used for many other Icelandic stocks such as cod, haddock, tusk and ling. The TAC for the 2013/2014 fishing year was set at 8000 based on the recommendations of MRI using a preliminary Gadget model and the 2014/2015 fishing year the recommendation was to maintain the catches at 8000 t.

7.3.5 Data available

7.3.5.1 Landings and discards

Landings by Icelandic vessels are given by the Icelandic Directorate of Fisheries. Discarding is banned in Icelandic waters and currently there is no available information on greater silver smelt discards. It is however likely that unknown quantities of greater silver smelt were discarded prior to 1996.

7.3.5.2 Length compositions

Table 7.3.3 gives the number of samples and measurements available for calculations of catch in numbers of Greater Silver Smelt in Va. Length distributions are presented in Figure 7.3.4.

7.3.5.3 Age compositions

Table 7.3.3 gives the number of samples and measurements available for calculations of catch in numbers of greater silver smelt in Va. Estimates of catch in numbers are given in Figure 7.3.5.

Table 7.3.3. Greater silver smelt in Va. Summary of sampling intensity and overview of available data for estimation of catch in numbers.

Year	No. length samples	No. length measurements	No. otolith samples	No. otoliths	No. aged otoliths
1997	45	4863	28	1319	985
1998	141	14911	102	6018	890
1999	58	4163	44	2180	82
2000	27	2967	18	1011	113
2001	10	489	6	245	17
2002	21	2270	10	360	127
2003	63	5095	13	425	0
2004	34	996	7	225	84
2005	49	3708	14	772	0
2006	29	4186	13	616	465
2007	14	2158	8	285	272
2008	44	3726	39	1768	1387
2009	53	5701	36	1746	1387
2010	134	16351	68	3370	3120
2011	63	6866	40	1953	1774
2012	35	3891	23	1094	405
2013	47	4925	34	710	704
2014	32	4255	9	210	200

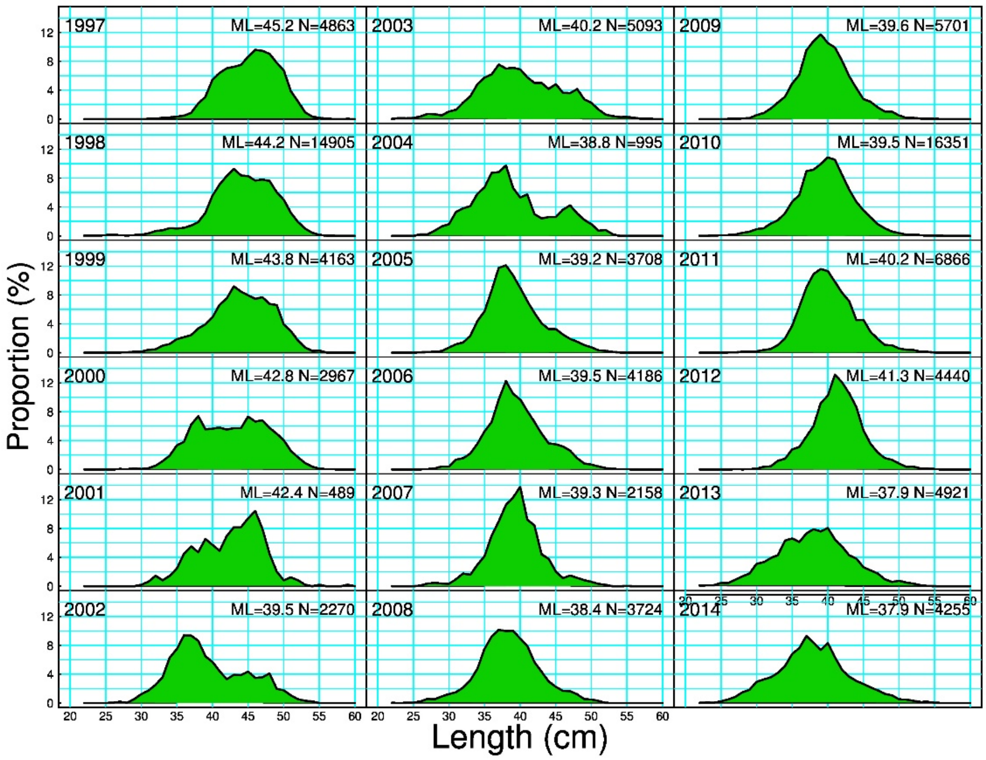


Figure 7.3.4. Greater silver smelt in Va. Length distributions from commercial catches.

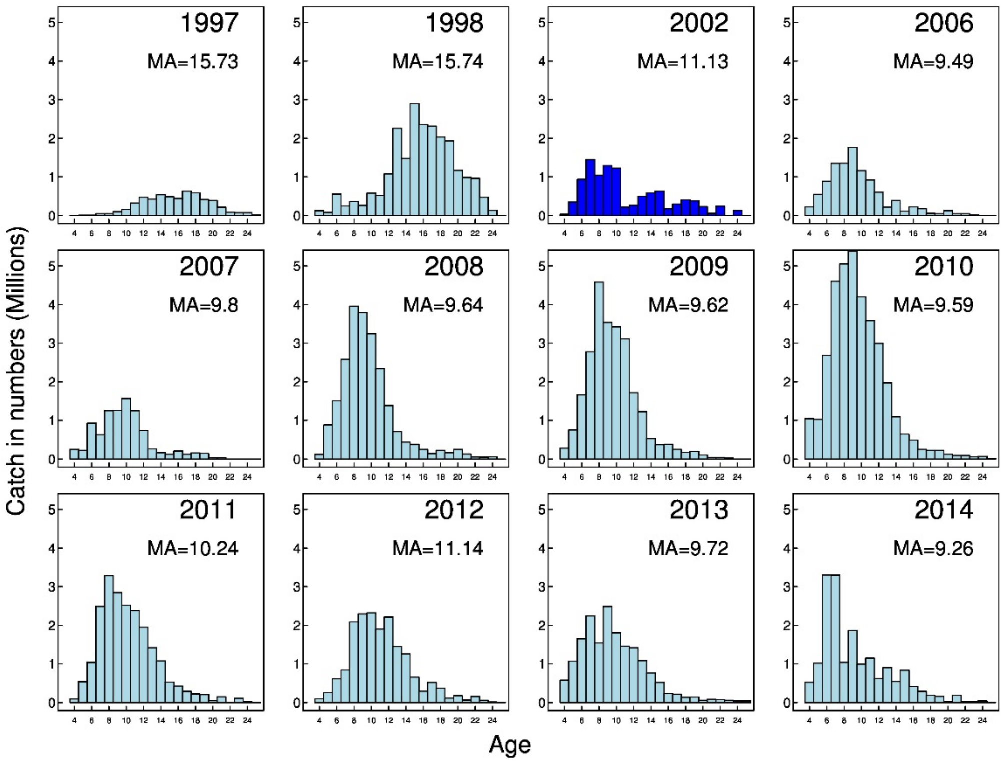


Figure. 7.3.5. Greater silver smelt in Va. Catch in numbers. Estimates for 2002 are based on limited number of aged otoliths (See Table 7.3.3).

7.3.5.4 Weight-at-age

No marked changes can be observed in mean weight-at-age from commercial catches between 1997–1998 and 2006–2013.

7.3.5.5 Maturity and natural mortality

Estimates of maturity ogives of greater silver smelt in Va were presented at the WKDEEP 2010 meeting for both age and length (WKDEEP 2010, GSS-04) using data collected in the Icelandic autumn survey (See stock annex for details). Males tend on average to mature at a slightly higher age or at 6.5 compared to 5.6 for females but at a similar length as females 35.3 cm. Most of the greater silver smelt caught in commercial catches in Va are mature.

No information exists on natural mortality of greater silver smelt in Va.

7.3.5.6 Catch, effort and research vessel data

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

At WKDEEP 2010 a glm cpue series was presented (WKDEEP 2010, GSS-05), however because of strong residual patterns the group concluded that the glm-cpue series was not suitable to use as an indicator of stock trends.

The cpue is not considered to represent changes in stock abundance as the fishery is mostly controlled by market factors, oil prices and quota status in other species, mainly redfish.

Icelandic survey data

Indices

The Icelandic spring ground-fish survey, which has been conducted annually in March since 1985, gives trends on fishable biomass of many exploited stocks on the Icelandic fishing grounds. In total, about 550 stations are taken annually at depths down to 500 m. The survey area does not cover the most important distribution area of the greater silver smelt fishery in Va and is therefore not considered representative of stock biomass. However the survey may be indicative of recruitment but the data have not been explored in sufficient detail. In addition, the autumn survey was commenced in 1996 and expanded in 2000. A detailed description of the autumn groundfish survey is given in the stock annex for greater silver smelt in Va. The survey is considered representative of stock biomass of greater silver smelt since it was expanded in 2000. Figure 7.3.6 gives trend in biomass and juvenile abundance for the spring survey in 1985 to 2015 and for the autumn survey in 2000 to 2014. Due to industrial action in 2011 the autumn survey was cancelled after about one week of survey time. Greater Silver Smelt is among the most difficult demersal fish stocks to get reliable information on from bottom-trawl surveys. This is in large part due to the fact that most of the greater silver smelt caught in the survey is taken in few but relatively large hauls. This can result in very high indices with large variances particularly if the tow-station in question happens to be in a large stratum with relatively few tow-stations. At the Benchmark for greater silver smelt in Va (WKDEEP-2010) it was concluded that the assessment of the unit should be based on trends in the Icelandic Autumn survey, both standard calculated index and a Winsorized version of the index of GSS, at depths greater than 400 meters.

At WGDEEP 2010 three versions of indices from the autumn survey were presented:

1) Index using the original stratification scheme for the spring and autumn survey (See stock annex for details).

2) A Winsorized index using the same stratification scheme as in 1 (See stock annex for details).

3) Index using a revised stratification scheme, specially designed for the autumn survey.

The group considered the revised indices (3) a step forward and that the data from the Icelandic autumn survey should in the future be processed using the revised stratification scheme. The index for greater silver smelt at depths greater than 400 meters, based on the revised stratification scheme was then used by ACOM in the advisory process in 2014. The index for depth greater than 400 meters was assumed to be the best available indicator of the available biomass to the fishery (Figure 7.3.7). However at WGDEEP 2015 this biomass index is seen to be highly variable, with the estimate for 2014 being roughly five times higher that of the previous year whilst not being significantly different. Therefore at WGDEEP 2015 presented the fourth alternative:

4) A Winsorized index using the revised stratification scheme from 3).

A comparison of indices derived using approaches (3) and (4) are shown in Figure 7.3.7. The group considered the revised indices (4) to be an improvement when compared to the previous approach (3) and thus recommended it for further use.

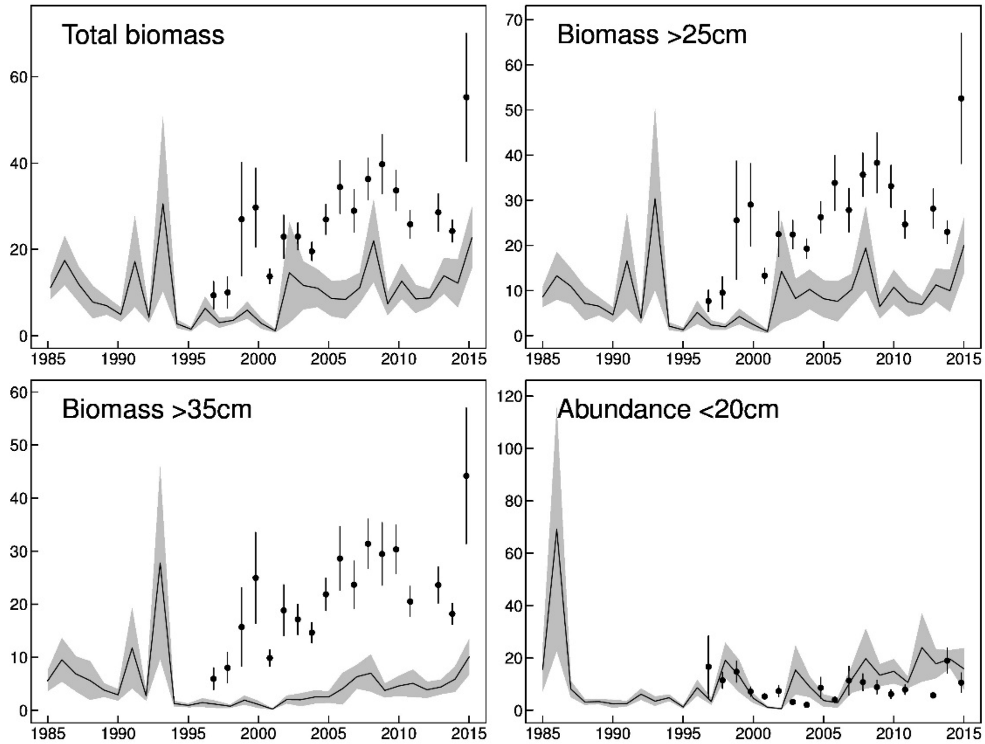


Figure 7.3.6. Greater silver smelt in Va. Indices from the Icelandic spring survey (black lines and shaded area) and from the autumn survey (dots and vertical lines). Vertical lines and shaded area represent +/- 1 standard error.

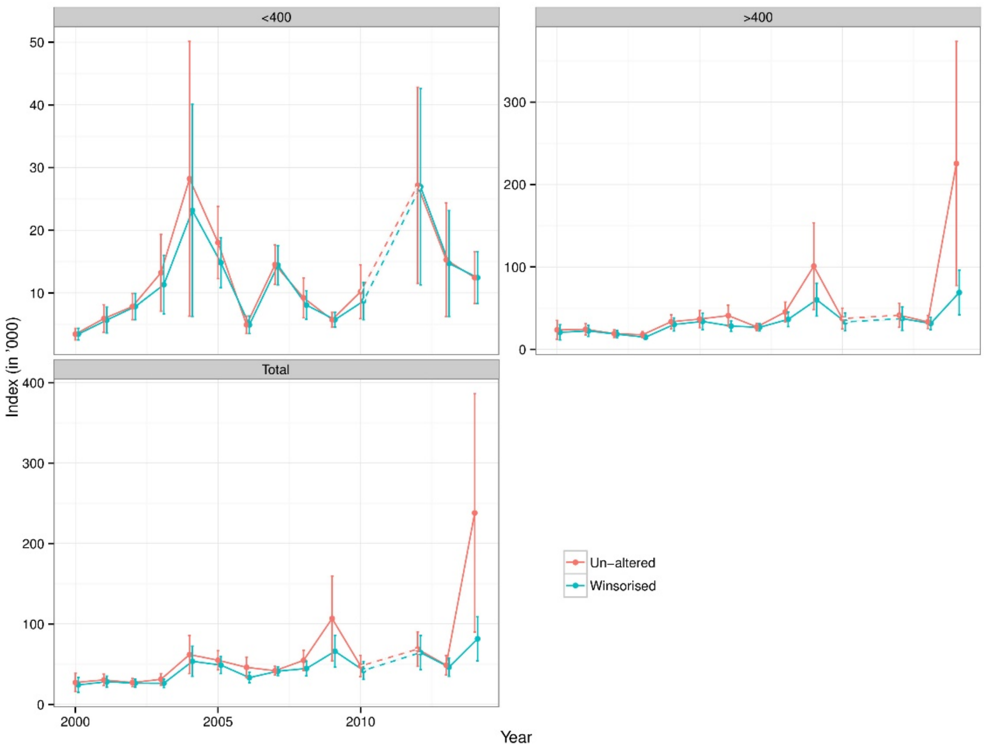


Figure 7.3.7. Greater silver smelt in Va. Index from the Icelandic autumn survey, divided by depth. The line colour indicates the biomass index used, either un-altered or Winsorized (see text for further details).

7.3.6 Data analyses

Landings and sampling

Spatial distribution of catches did not change markedly between 2013 and 2014 and fishing for greater silver smelt in the NW area seems to have stopped (Figures 7.3.1 and 7.3.2). Landings of greater silver smelt increased rapidly from 2007 to 2010 when they peaked at around 16 000 tonnes, since then they have decreased to around 7000 tonnes in 2014 (Figure 7.3.3 and Table 7.3.4). The decrease in catches is the result of increased vigilance by the managers to constrain catches to those advised. At the same time mean length in catches decreased from around 44 cm in 1998 to 38–40 in 2008 to 2011 however there is a slight increase in mean length in 2012 but that increase was not present in 2014 (Figure 7.3.4). A similar continuous downward trend in mean age in the commercial catches is also observed. Mean age in the fishery has decreased since the late nineties from around 16 to around 10 in 2006 to 2011 but as for mean length, mean age in catches in 2012 increased and is estimated at 11.5 years in 2012 compared to 10.3 in 2011 and 9.7 in 2013 (Figure 7.3.5). The reason for this change is not known as there is no marked difference in the spatial distribution of the fishery.

Surveys

As mentioned above greater silver smelt is a difficult species to survey in trawl surveys and the indices derived from the both the spring and autumn surveys have high CVs. Occasional spikes in the indices without any clear trend characterize the spring survey biomass indices. The only thing that can be derived from the spring survey is that the biomass indices (total and >25 cm), in 1985–1993 and again from 2002 to 2015 at a slightly higher level than in 1994–2001. The juvenile index has a very high peak in 1986 but then hardly any juveniles are detected in the survey in 1987 to 1995. Since 1998 there have been several small spikes in the recruitment index with the 2015 estimate at the highest level since 1993 (Figure 7.3.6).

The observed trends in the biomass indices from the autumn survey have a considerably different trends than those observed in the spring survey (Figure 7.3.6). According to the autumn survey biomass increased more or less year on year from 2000 to 2008 but then decreased in 2009 and 2010. The total biomass index in the autumn survey showed slight variations until 2015 when the index increased to the highest value observed.

There is a clear gradient in mean length of greater silver smelt with depth, larger fish being in deeper water. Also fishing for greater silver smelt in Va is banned at depths less than 400 meters. The autumn survey index for depth greater than 400 meters is therefore considered the best indicator of available biomass to the fishery. As noted in the section above the Winsorized index appears to be less sensitive to the few large hauls in the 2009 and 2014 survey years (Figure 7.3.7).

F_{proxy}

Changes in relative fishing mortality (F_{proxy} = Yield / Survey biomass at depths greater than 400 m) are presented in Figure 7.3.8 and Table 7.3.5 using either the unaltered or winsorized index. According to the graph, F_{proxy} was relatively stable in 2004 to 2006 but then increased slowly from 2006 to 2008. This was mainly driven by increases in catches. The decrease in 2009 is the result of a very high value of the index in that year but the decrease between 2010 and 2012 is due to decrease in catches as the index was at similar levels between the two years (Figure 7.3.7).

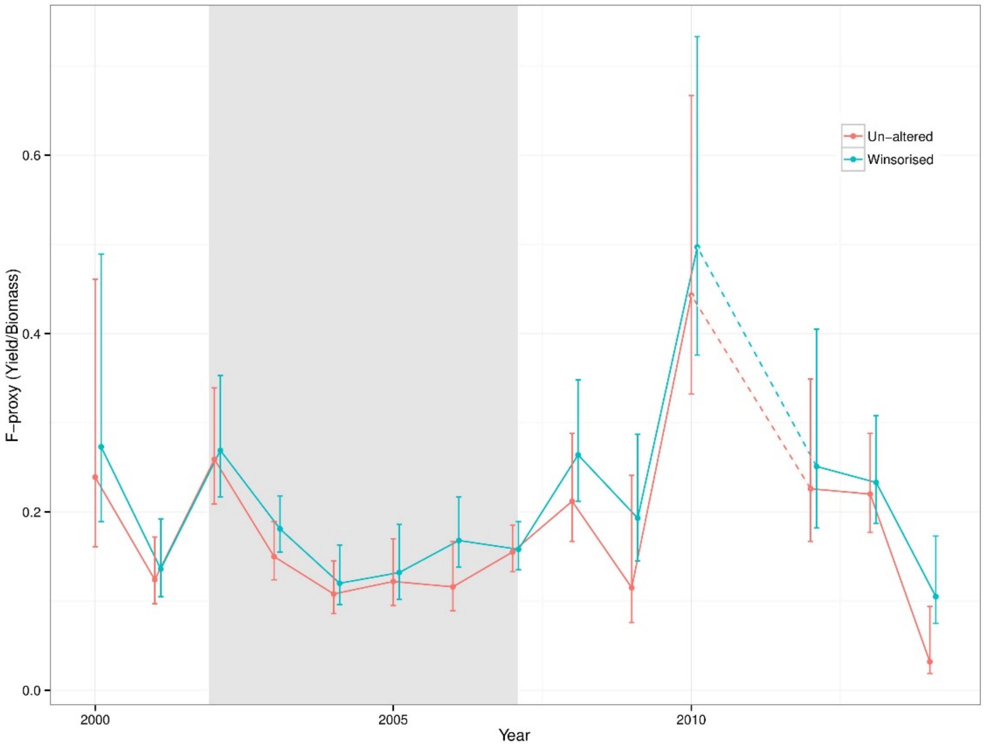


Figure 7.3.8. Greater silver smelt in Va. Changes in relative fishing mortality (F_{proxy}). The index used is the >400 m index from the Icelandic autumn survey. The line colour indicates the biomass index used, either un-altered or Winsorized (see text for further details).

Analytical assessment

No analytical assessment presented this year.

7.3.7 Comments on the assessment

The assessment presented above is based on the ICES DLS approach for category 3 stocks and was proposed by the ADG in 2012.

- In the 2012 advice the target F_{proxy} calculated using the total biomass index as the average F_{proxy} in 2002 to 2007.
- In 2013 WGDEEP re-iterated the conclusions of WKDEEP-2010 that the biomass index from the autumn survey at depths greater than 400 m was a more appropriate measure of the biomass available to the fishery.
- In 2014 the basis for the advice was the index from depths greater than 400 meters using a revised stratification, the same reference period was chosen for the target F_{proxy} (2002 to 2007). Additionally a 20% uncertainty buffer was applied to the target F_{proxy}.
- This year the index has been recalculated using the same winsorization procedure as recommended by WKDEEP-2010 and the revised stratification presented in 2010.

Using the same approach to advice on catch levels with this new biomass index the F_{proxy} target is then 0.171, applying the uncertainty buffer will reduce the target to 0.137. Using this target in the same way as in 2014 will then result in catches of 9467 tonnes (0.137*69 072.8) (Table 7.3.5). Using the average of the last three years of the index would result in catches of no more than 6304 tonnes ((37 413+31 504+69 073)/3*0.137).

7.3.8 Management considerations

Exploitation of greater silver smelt has been reduced in recent years, coming down from a relatively high level in 2010, to levels lower than the average exploitation rate in the reference time period.

Table 7.3.4. Greater silver smelt in Va. Nominal landings in 1988–2014.

Year	Catches
1988	206
1989	8
1990	112
1991	247
1992	657
1993	1.255
1994	613
1995	492
1996	808
1997	3.367
1998	13.387
1999	6.704
2000	5.657
2001	3.043
2002	4.960
2003	2.686
2004	3.637
2005	4.481
2006	4.775
2007	4.226
2008	8.778
2009	10.829
2010	16.428
2011	10.515
2012	9.290
2013	7.154
2014	7.241

Table 7.3.5. Greater silver smelt in Va. Landings and survey biomass from the Icelandic autumn survey (greater than 400 m, winsorised) and F_{proxy} (Yield/Survey biomass). The mean of the F_{proxy} values in italic is used as an F_{proxy} target.

Year	Landings	Index	CV Index	F_{proxy}
2000	5657	20764,4	0,443	0.272
2001	3043	22425,5	0,294	0.136
2002	4960	18464,8	0,24	*0.269*
2003	2686	14826,1	0,17	*0.181*
2004	3637	30289,1	0,26	*0.120*
2005	4481	33955,8	0,289	*0.132*
2006	4775	28317,1	0,224	*0.169*
2007	4226	26832,4	0,165	*0.157*
2008	8778	36458	0,242	0.241
2009	10 829	60277,8	0,328	0.180
2010	16 428	33383,1	0,322	0.492
2011	10 515	No survey		
2012	9290	37413	0,38	0.248
2013	7154	31504,4	0,243	0.227
2014	7241	69072,8	0,393	0.105

7.4 Greater silver smelt (*Argentina silus*) in Vb and VIa

At the WGDEEP 2014 it was suggested that unit arg-oth was split further into advicery units as fishing grounds are suffisiently isolated (WD, 2014). It was also suggested that further division may be adequate. This change was implemented at the WGDEEP meeting in 2015, which is an advisory year.

7.4.1 The fishery

It is mainly Faroese and Dutch trawlers that are the main actors in direct fisheries of greater silver smelt in the advisory unit of Vb and VIa. In 2014, the Faroese trawlers caught 96% of the catches in Vb and 27% of the catches in VIa and the Dutch caught 43% of the catches in VIa.

Historically, greater silver smelt were only taken as bycatch in shelf-edge deep-water fisheries and either discarded or landed in small quantities. Targeted fishery for greater silver smelt in Faroese waters did not develop until the mid-1990s. In 2014 the preliminary landings in Faroese waters, from mainly three pairs of pair trawlers, were 11 252 t GSS (9747 t in Vb and 1495 t in VIa) (Figure 7.4.1). The decrease in catch during the last three years (2012–2014) might be because the Faroese trawlers also participated in the mackerel fishery.

The greater silver smelt fishing grounds in Faroese waters from mid 1990s to 2007 were located north and west on the Faroe Plateau and around Faroe Bank/Lousy Bank at depths between 300 and 700 meters. Since 2008, the Faroese fishery has extended the fishing grounds to include the area around the Wyville-Thomson Ridge south of the Islands. Since 2012 around 50% of the Faroese trawler catches were fished on the Wyville-Thomson Ridge (in Vb and VIa) (Figure 7.4.2).

7.4.2 Landing trends

Landings in Vb, mainly from Faroese directed fisheries, increased rapidly from 2004 (5300 t) to 2006 (12 400 t) and further increased with landings in 2011 being 15 586 t. Since then landings have been around 10 thousand tons, in 2014 the preliminary catch was 9747 tons. The recent reduction in greater silver smelt catches in Vb is due to a targeting of mackerel and a shift in fishing area to include areas in VIa inside the Faroese 200 EEZ boarder.

Landings in VIa mainly come from Faroese (27%) and Dutch fisheries (43%). The landings in VIa increased and had maximum of 19 049 t in 2001; then decreased again and have been between 5000 and 7500 since 2004. Preliminary landings in 2014 are 5446 tons.

7.4.3 ICES Advice

The unit arg-oth was splitted into advicery units at the WGDEEP meeting in 2015, which is an advisory year. So the advice for 2016 and 2017 will be for greater silver smelt in Vb and VIa.

ICES advice in 2010 was: "The fishery should not be allowed to expand, and a reduction in catches should be considered, in light of survey data indicating a recent decline."

The 2012 advice for this stock is biennial and valid for 2013, 2014 and 2015 (see ICES, 2012): Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 31 300 tonnes.

7.4.4 Management

The EU introduced TAC management in 2003. For 2013 and 2014 the EU TAC was set to 4316 tons in area V, VI, VII. For 2015 and 2016 the EU TAC was set to the same as in previous years (V, VI, VII = 4316 tons).

In 2014, the Faroese authorities set a law of species-specific management of greater silver smelt for Faroese area. The TAC in 2014 was 16 000 tons and six trawlers had licences to direct fishery of greater silver smelt. There were also limitations in e.g. bycatch, mesh size and fishing area. The TAC for 2015 is 14 400 tons (http://logir.fo/Kunngerd/16-fra-23-03-2015-um-skipan-av-fiskiskapinum-eftir-gulllaksi-a-foroysku-landleidunum-i-2015).

In the period from 2010–2013, the Faroese greater silver smelt fishery was managed by an agreement between the Faroese fleet that were licensed to direct greater silver smelt fishery and the Faroese authorities, guided by the stock assessment and scientific advice of Faroe Marine Research Institute. The agreement was that total annual landings should not exceed 18 thousand tons in Faroese waters.

7.4.5 Data available

7.4.5.1 Landings and discards

Landings data are presented by area and countries (Tables 7.4.1 and 7.4.2, Figure 7.4.1).

Discarding is banned in Faroese waters and there is no available information on greater silver smelt discard in Faroese waters.

Argentina silus can be a very significant discard of the trawl fisheries of the continental slope of Subareas VI and VII particularly at depths 300–700 m (e.g. Girard and Biseau, WD 2004). Information available on discards in 2009 and 2012 in Basque country and Spanish fisheries in Subareas VI–VII, and Divisions VIIIabcd and northern IXa (Table 7.3.3). These estimates have been in the range 1000–4000 t since 2003. In 2010 and 2011 they were around 2000 t. New calculation of the estimates for 2012 and 2013 reduce strongly the discards reported by Spain, so in 2014 there is no Spanish discards for this species in VI (only in VII). Based upon on-board observations from DCF sampling, the catch composition of the French mixed trawl fisheries in Vb, VI and VII include 5.3% of greater silver smelt, based upon data for year 2011 (Dubé *et al.*, 2012). This species is discarded in that fishery; it represents 25.3% of the discards. Raised to the total landings from that fishery an estimated 280 t of discarded greater silver smelt was estimated for 2011. Based upon similar level of the fishery in 2010–2012 this figure applies to recent years. The discards in 2014 were from French fishery in VIa (808 tons) and from German fishery (120 tons).

7.4.5.2 Length compositions

There are length distributions of commercial catches from Faroese commercial trawl catches in Vb (Figure 7.3.3) and from the Russian commercial bottom trawl catches in the Faroese Fishing Zone (Figures 7.4.4 and 7.4.5). In addition, there exist length measurements from the Netherlands fishery in VIa.

Length distribution data of greater silver smelt from Faroese waters are available from various sources. Length distributions from the Faroese spring- and groundfish survey on the Faroe Plateau in Vb are showed in Figures 7.4.6 and 7.4.7.

7.4.5.3 Age compositions

Age compositions from Faroese landings in Faroese waters are presented in Figure 7.4.8. In addition, there exist age data from the Netherlands fishery in VIa.

There also exist age data of greater silver smelt from the Faroese groundfish surveys in Vb.

7.4.5.4 Weight-at-age

Weight-at-age data of greater silver smelt from the Faroese commercial trawl fisheries are presented in Figure 7.4.9.

7.4.5.5 Maturity and natural mortality

Maturity of greater silver smelt from Russian commercial bottom-trawl catches in the Faroese FZ in April–May 2015 are shown in Figures 7.4.10 and 7.4.11.

No new data on natural mortality were presented. Natural mortality was set to 0.1 in the exploratory assessment.

7.4.5.6 Catch, effort and research vessel data

One standardized cpue series from commercial trawlers targeting greater silver smelt in Faroese waters (Vb) is shown in Figure 7.4.12 (Ofstad, 2015 WD WGDEEP).

Cpue indices for greater silver smelt from the annual Faroese groundfish surveys for cod, haddock and saithe in Vb are shown in Figure 7.4.13. Density and distribution from the same survey is shown in Figure 7.4.14 (Ofstad, WD WGDEEP 2015). It has to be noted that these surveys have very few stations (<5) deeper than 500 m and are therefore only likely to cover the juveniles adequately. The adult part of the population is not fully covered by these surveys and they may not necessarily give a correct time development of the biomass of the fishable stock.

7.4.6 Data analyses

Landings have increased from the whole stock area since 1994 but have been stable at level between 15 000 and 22 000 tonnes since 2007 in Vb and VIa. Size and age in catches have decreased but seem to have been stable since 1999. Trends in landings during this period may therefore not be indicative of stock abundance.

Length and age distributions

Mean length and age in the Faroese landings decreased from 1994 to 2000 and have been stable since then (Figures 7.4.3 and 7.4.8), probably because the fishery started on a virgin stock (Ofstad, WD WKDEEP 2010). The variation in mean length from the latest years could be due to sampling from different depths in the various areas, as the size of greater silver smelt is increasing with depth.

Commercial and survey cpue series

The Faroese commercial cpue (Faroese waters) increased until 2010 and has decreased slightly since then (Figure 7.4.12). The period from 1995 to 1997 is believed to be a "learning" period, i.e. the cpue is not believed to be proportional to abundance in those years.

The Faroese summer survey biomass index did not show any distinctive time trend between 1996 and 2014 (Figure 7.4.13), although there were fluctuations. The survey cpue fluctuates. Given the low turnover rate (high turnover time) in this species one would not expect to see large changes in abundance by year, indicating that short-term fluctuations may be caused by random events. The shallow depth range covered by the survey (very few stations deeper than 500 m) covers the juveniles adequately but not necessarily the adults since large individuals are generally found at greater depths.

Exploratory assessment

An exploratory age-based stock assessment of greater silver smelt in Faroese waters was presented to the group: catches as input to the stock assessment only include Faroese catches in Vb and VIa but not Dutch catches in VIa. Besides, this year, the catch number-at-age used in the assessment was expanded from 14+ to 21+ and the summer survey was also used as tuning series in addition with the pair trawler series (Ofstad, WD WGDEEP 2015). The retrospective bias in the model has improved over the years. A modest residual pattern is observed in the summer survey.

Although the exploratory age-based stock assessment has not been benchmarked it seems to indicate the absolute level of stock size and fishing mortality and seems that could give a good indication of the time trend of the stock. The exploratory age-based assessment can easily be expanded to include all landings from VIa and include Dutch data.

The age-based assessment will likely improve its performance in the future because the time-series becomes longer and the assessment more stable.

7.4.7 Comments on the assessment

Advice is given every second year for this stock, so the advice for 2016 also applies for 2017. The advice for 2016–2017 is, for the first time, given for the new advisory unit (Vb and VIa). The advice is based on trends in the cpue (kg/hour) from the Faroese summer survey on the Faroe Plateau (DLS method 3.2).

7.4.8 Management considerations

The greater silver smelt fishery in Faroese waters is managed by Faroese authorities and the quota is set at the F_{01} catch from the age based assessment. The quota has been reduced from 16 000 t (for 2014) to 14 400 t (for 2015) in recent years. The decrease in the biomass index in 2014 indicates further reductions in the TAC.

The fact that the possibility to find new fishing areas within Faroese waters seems to be limited during the next few years will show whether or not the stock is able to sustain the current level of the TAC.

Table 7.4.1. Greater Silver Smelt Vb and VIa. WG estimates of landings in tonnes. *) landings in 2014 are preliminary.

Greater silver smelt (*Argentina silus*) Vb

Year	Faroes	Russia/USSR	UK (Scot)	UK(EWN)	Ireland	France	Netherlands	Norway	Germany	TOTAL
1988	287									287
1989	111	116								227
1990	2885	3								2888
1991	59		1							60
1992	1439	4								1443
1993	1063									1063
1994	960									960
1995	5534	6752								12 286
1996	9495		3							9498
1997	8433									8433
1998	17 570									17 570
1999	8186		15	23		5				8229
2000	3713	1185	247			64				5209
2001	9572	414	94		1					10 081
2002	7058	264	144				5			7471
2003	6261	245	1				51			6558
2004	3441	702	42				1125			5310
2005	6939	59					15			7013
2006	12 524	35								12 559
2007	14 085	8					0.4	32		14 126
2008	14 930	19						3		14 952
2009	14 200	28								14 228
2010	15 567	2	40							15 609
2011	15 071	8								15 079
2012	9744	110								9854
2013	11 109	114								11 223
2014*	9747	339							110	10 196

Table 7.4.1. (Continued).

Greater silver smelt (*Argentina silus*) VIa

Year	Denmark	Faroes	France	Germany	Ireland	Netherlands	Norway	E&W	Scotland	Russia	Spain	TOTAL
1988					3040		4884					7924
1989		188			1325	3715	11984		3369			20581
1990		689		14	110	5870			112			6795
1991			7			4709			10			4726
1992			1		100	4964			466			5531
1993						663			406			1069
1994				43		6217			1375			7635
1995		483		284		3706			465			4938
1996				1384	295	3953						5632
1997				1496	1089	4684						7269
1998				464	405	4687						5556
1999				24	168	8026		5				8223
2000			19	403	3178	3389						6989
2001			7	189	5838	3655			4777			14466
2002			1	150	3035	4020		424	4136			11766
2003				126	1	1932			80			2039
2004			147	652	46	3707			507			5059
2005		103	10	125	18	5317			61			5634
2006		53		213		4628			3		1	4897
2007		254		589		6969	3				2	7817
2008		991		10		4156	3					5160
2009		3923		115	0.5	2488	83		6	36		6651
2010		3060				3143	7		20	11		6241
2011		3655			0.1	3050		2	2			6709
2012		2781	2	538	0.2	1785		5	5	1		5115
2013	125	3197		417	0.1	1430				13	0.2	5182
2014*	711	1495		908		2332						5446

Table 7.4.2. Greater silver smelt (*Argentina silus*) (Vb and VIa).

Year	Vb	VIa	Total
1988	287	7924	8211
1989	227	20581	20808
1990	2888	6795	9683
1991	60	4726	4786
1992	1443	5531	6974
1993	1063	1069	2132
1994	960	7635	8595
1995	12286	4938	17224
1996	9498	5632	15130
1997	8433	7269	15702
1998	17570	5556	23126
1999	8229	8223	16452
2000	5209	6989	12198
2001	10081	14466	24547
2002	7471	11766	19237
2003	6558	2039	8597
2004	5310	5059	10369
2005	7013	5634	12647
2006	12559	4897	17456
2007	14126	7817	21943
2008	14952	5160	20112
2009	14228	6651	20879
2010	15609	6241	21850
2011	15586	6709	22295
2012	9854	5115	14969
2013	11223	5182	16405
2014*	10196	5446	15642

Table 7.4.3. Greater silver smelt in VIb. Discard of greter silver smelt in Basque country (AZTI) and Spanish fisheries (IEO).

Species	ICES area/division	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Argentina silus	VI	298	89	31	57	194	68	81	127	2	*	*
IEO												
Species	ICES area/division	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Argentina silus	Subareas VI–VII	2211	2978	2149	1147	1823	2988	4028	1878	2048	177	90
cv		*64*	*44*	*62*	*40*	*55*	*34*	*36*	*36*	*90*		

***Included in IEO Discards.**

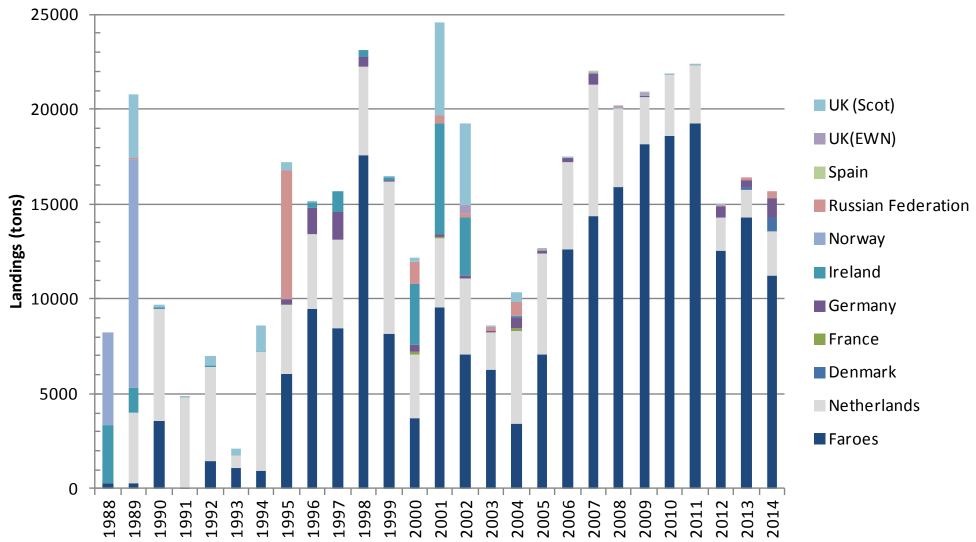


Figure 7.4.1. Greater silver smelt in Vb and VIa. Total landings of greater silver smelt in Vb and VIa by countries.

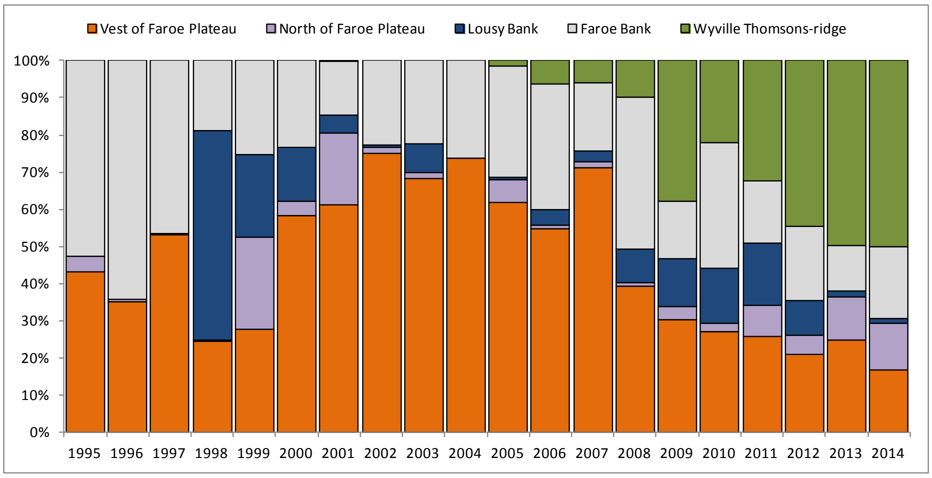


Figure 7.4.2. Greater silver smelt in Vb. Distribution of the greater silver smelt catch divided into five main areas in Faroese waters.

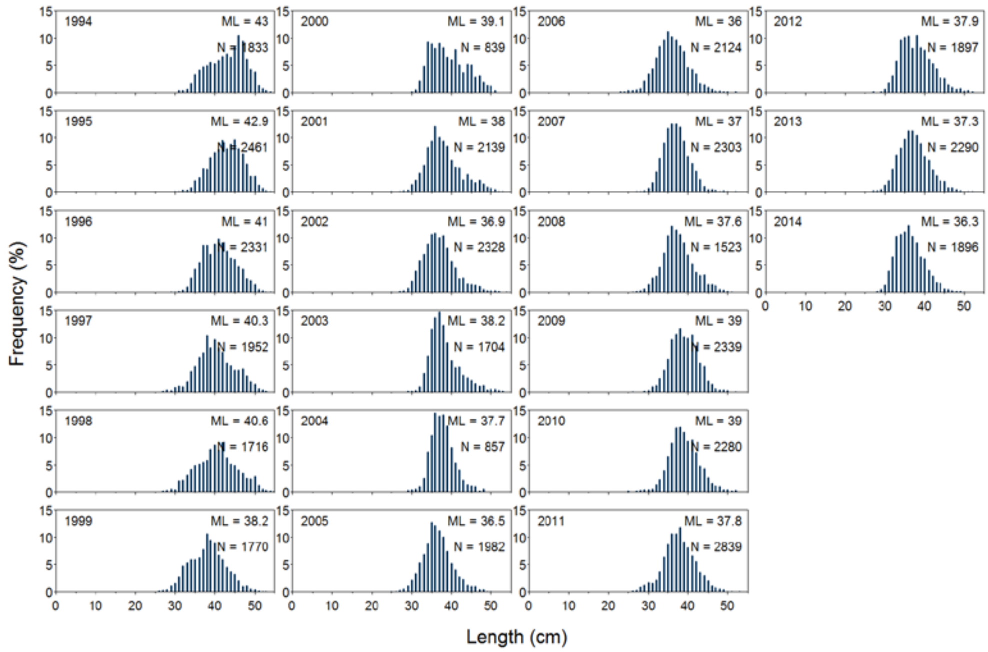


Figure 7.4.3. Grater silver smelt in Vb. Length distributions of greater silver smelt in the Faroese landings (Ofstad, WD WGEEP 2015).

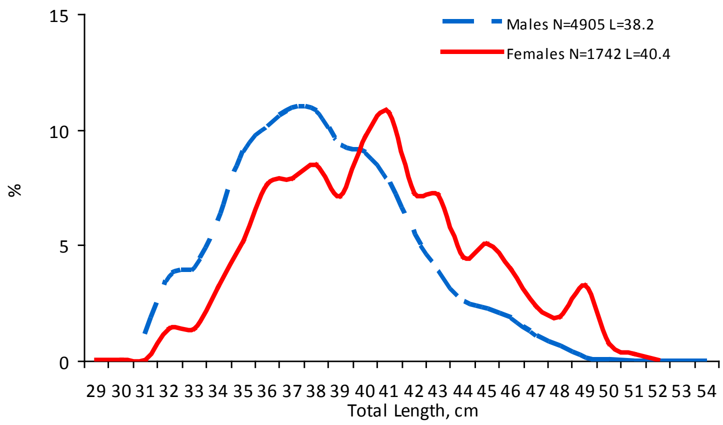


Figure 7.4.4. Greater silver smelt in Vb. Length composition of greater silver smelt from Russian commercial bottom-trawl catches in the Faroese FZ in May–June 2014 (Aleksandrov and Vinnichenko, WD WGDEEP 2015).

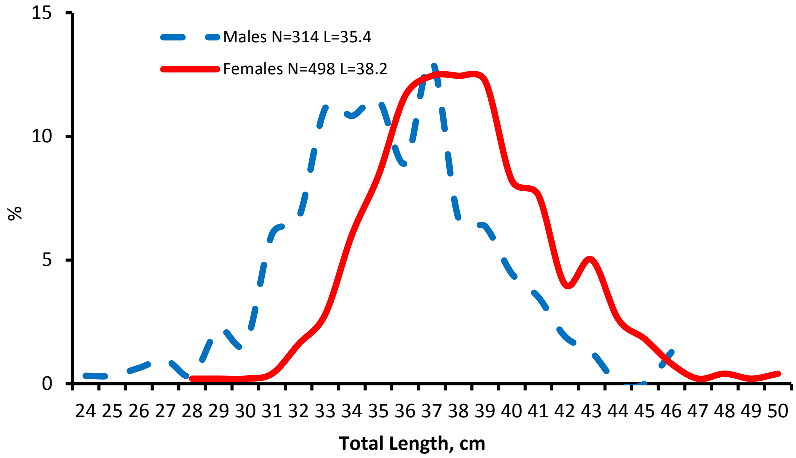


Figure 7.4.5. Greater silver smelt in Vb. Length composition of greater silver smelt from Russian commercial pelagic trawl catches in the Faroese FZ in May–June 2014 (Aleksandrov and Vinnichenko, WD WGDEEP 2015).

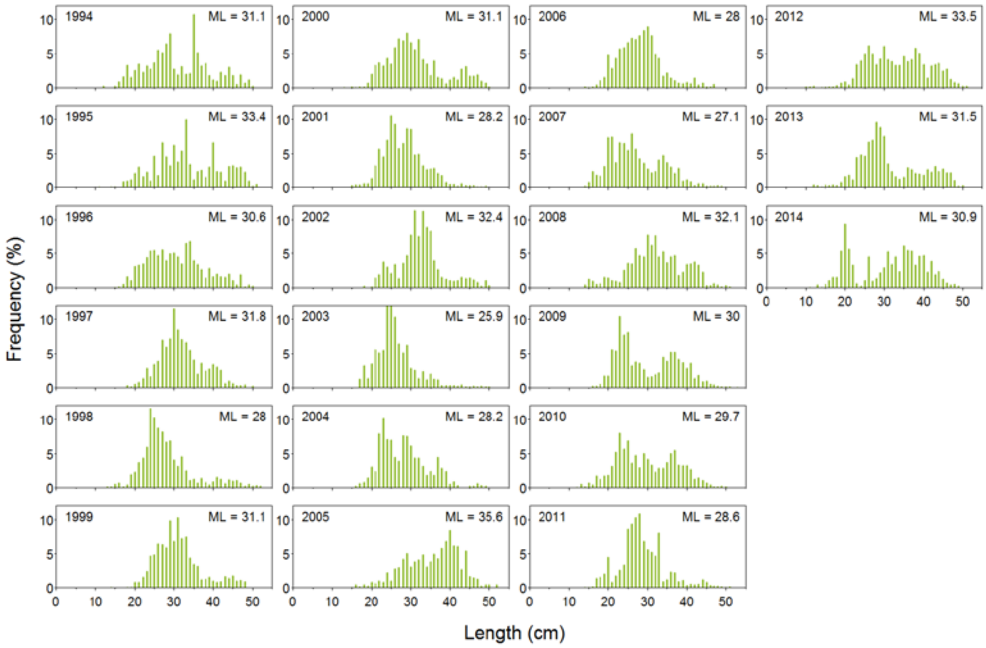


Figure 7.4.6. Greater silver smelt in Vb. Length distribution from the Faroese spring survey with mean length (ML) and number of calculated length measures (N). Greater silver smelt is sampled from a subsample of the total catch, so the values are multiplied to total catch.

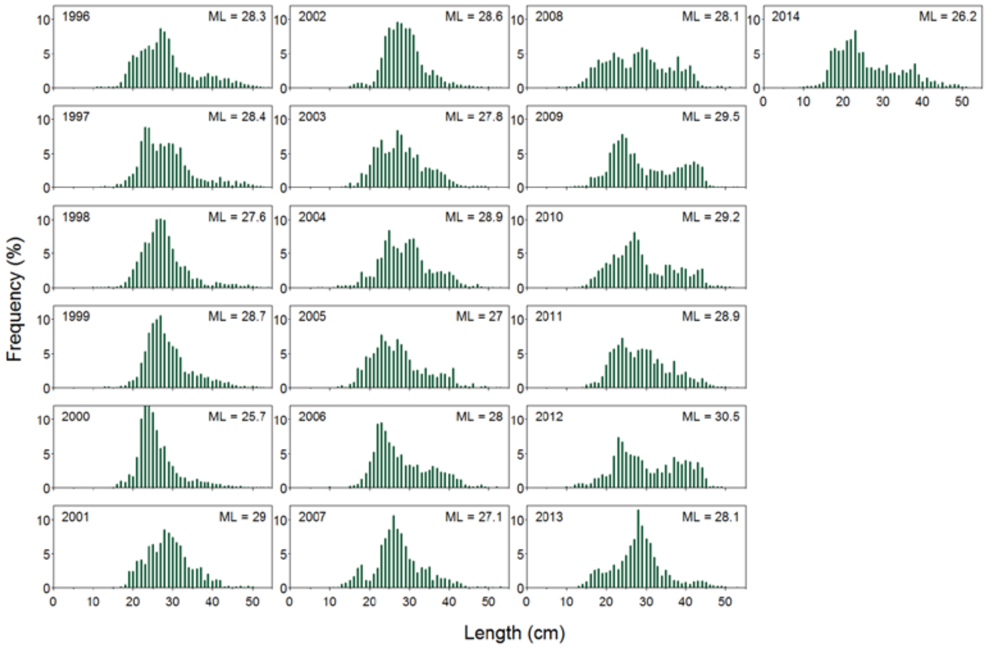


Figure 7.4.7. Greater silver smelt in Vb. Length distribution from Faroese summer survey with mean length (ML) and number of calculated length measures (N). GSS is sampled from a sub-sample of the total catch, so the values are multiplied to total catch.

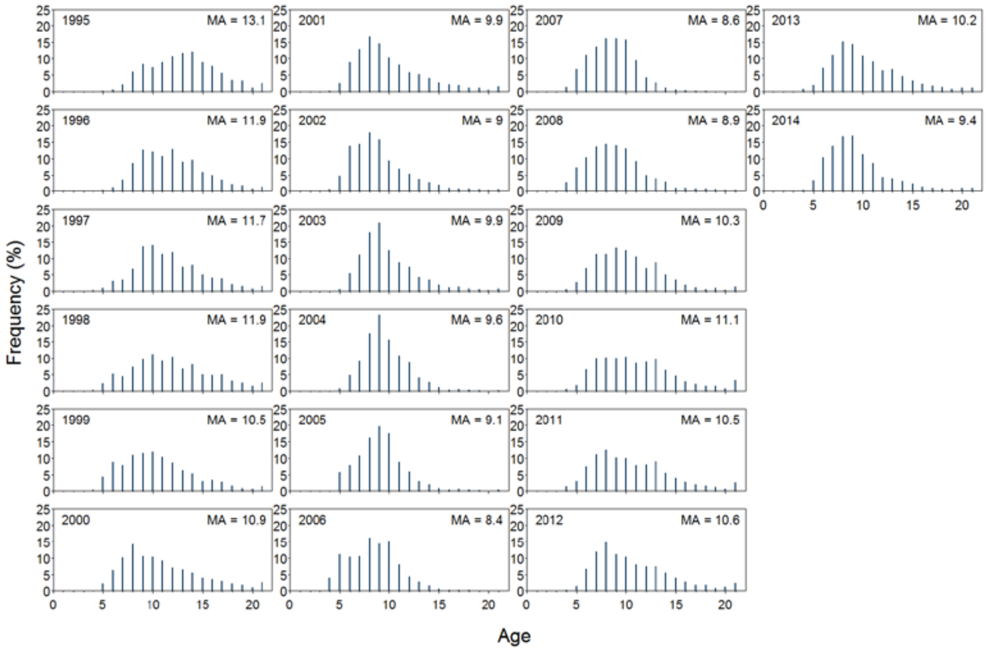


Figure 7.4.8. Greater silver smelt in Vb. Age distribution used in the exploratory assessment in Vb from commercial pair trawlers with mean age (MA) 1995–2014 (Ofstad, WD, WGDEEP 2015).

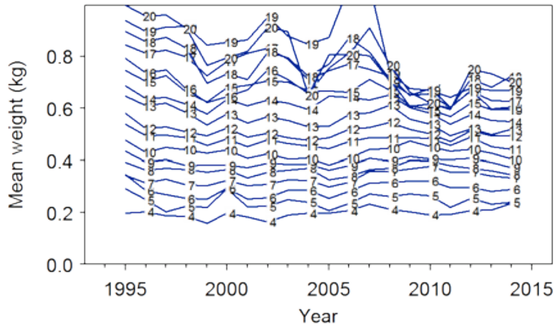


Figure 7.4.9. Greater silver smelt Vb. Mean weight-at-ages 4–21+ of greater silver smelt in the commercial catch.

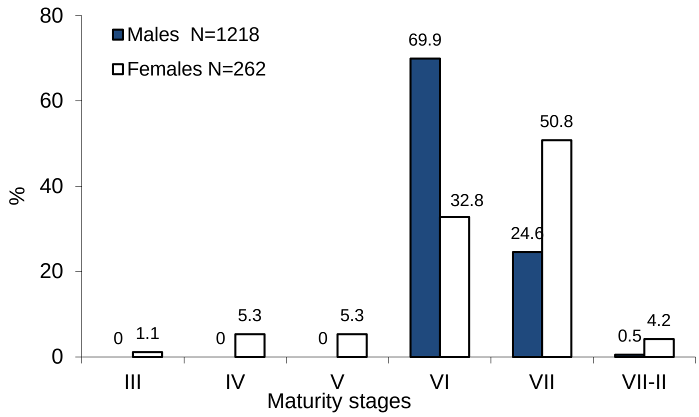


Figure 7.4.10. Greater silver smelt in Vb. Maturity of Greater silver smelt from commercial bottom-trawl catches in the Faroese EEZ in May–June 2014 (Aleksandrov and Vinnichenko, WD WGDEEP 2015).

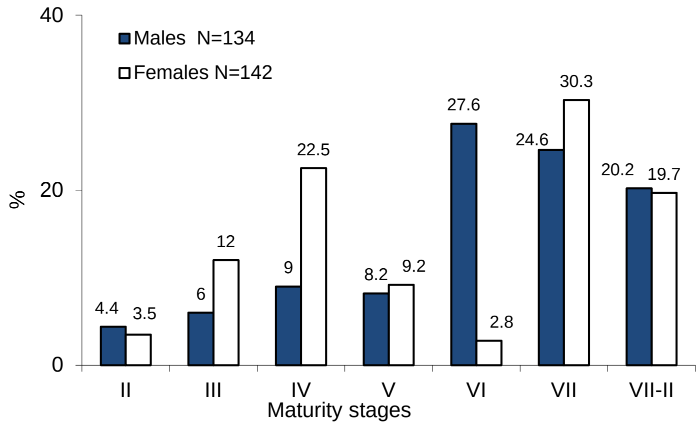


Figure 7.4.11. Greater silver smelt in Vb. Maturity of Greater silver smelt from commercial pelagic1 trawl catches in the Faroese EEZ in May–June 2014 (Aleksandrov and Vinnichenko, WD WGDEEP 2015).

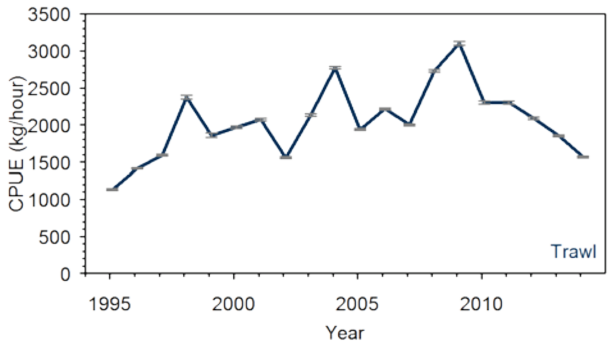


Figure 7.4.12. Greater silver smelt in Vb. Standardized cpue from pair trawlers fishing greater silver smelt where catch of greater silver smelt is more than 50% of total catch in each haul (Ofstad, WD WGEEP 2015).

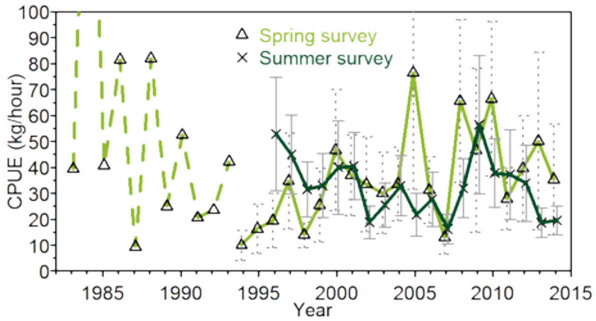


Figure 7.4.13. Greater silver smelt in Vb. Standardized cpue from Faroese groundfish surveys on the Faroe Plateau. Arrows +- SE and the data from 1983–1993 was not standardized. (Ofstad, WD WGEEP 2015).

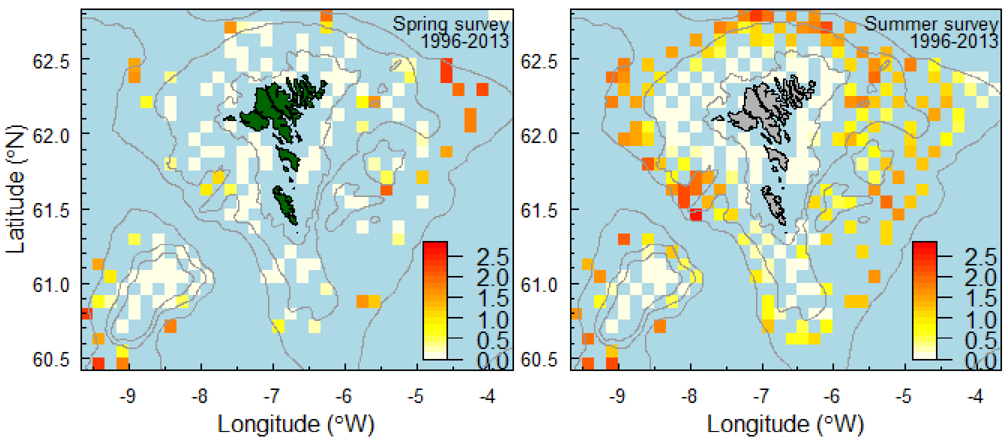


Figure 7.4.14. Greater silver smelt in Vb. Density and distribution of greater silver smelt in the annual spring- and summer groundfish surveys on the Faroe Plateau and the Faroe Bank as average log(kg/hour+1). Depth contour line is for 100, 200 and 500 m.

7.5 Greater silver smelt (*Argentina silus*) in IIIa, IV, VIb, VII, VIII, IX, X and XII

The distribution and biology of the species in the Norwegian Deep was described in Bergstad (1990; 1993), and occurrence of eggs and larvae in the Skagerrak by Bergstad and Gordon (1994). Bergstad (1993) showed how the species dispersed into wider areas as juveniles and during the summer and autumn. Studies from the 1980s showed that in deeper parts of the IIIa (depth >300 m), *Argentina silus* dominated the fish community together with roundnose grenadier (*Coryphaenoides rupestris)* (Bergstad 1990; Bergstad *et al*., 2003).

7.5.1 The fishery

From the1970s onwards greater silver smelt was targeted in a trawl fishery in the Skagerrak (IIIa) (Thorsen 1979; Anon. 1991; ICES, 2014). The target fishery that developed in the 1970s harvested what appeared as spring spawning concentrations in ICES Division IIIa. Thorsen (1979) refers to Norwegian catches of 1000–1200 tonnes/year in the 1970s. In addition, the species was always a bycatch in the industrial fisheries for Norway pout and blue whiting along the western and southern slope of the Norwegian Deep in IVa and to a lesser extent IIIa, as well as in *Pandalus borealis* fishery in the same area (Lahn-Johannessen *et al*., 1978; ICES, 2007; 2014).

In the period after 1988 when the WGDEEP collated statistics, estimated landings by Denmark and Norway were in the range 2000–5000 tonnes/year, and this continued into the early 2000s (Figure 7.5.1). This included the usually minor quantities of bycatches in the small-mesh trawl fisheries for reduction, primarily in IVa. The Danish landings declined to very low levels from around 2005 onwards, and the targeted fishery in IIIa ceased (ICES, 2007). Norwegian landings from Subareas III and IV declined in the mid-1990s, reflecting the decreasing target fishery in IIIa, but then increased sharply in 2006–2007. The latter increase was, however, attributed to target fisheries in northern parts of IVa, not a restart of the target fishery in IIIa (ICES, 2007). For 2014 Norway reported 1.7 tonnes from IIIa, and 2717 tonnes from IVa (Official statistics reported to WGDEEP, but data remain preliminary).

Other areas have minor fisheries, and no direct fisheries.

7.5.2 Landing trends

Landings in the targeted fishery in IIIa declined in the early 2000s and have been at zero since 2007. Landings in IVa have increased in recent years. In other areas, landings are sporadic but generally low and are believed to represent bycatch in fisheries for other species.

7.5.3 ICES Advice

The 2012 advice was joint for a wide area (I, II, IIIa, IV, Vb, VI, VII, VIII, IX, X, XII, XIV), and based on the ICES approach for data-limited stocks ICES advised that catches should be no more than 31 300 tonnes. The advice was biennial and valid for 2013 and 2014 (see ICES, 2012).

7.5.4 Management

Norway has a regulation prohibiting directed fisheries in IV and IIIa, with a bycatch allowance for other fisheries.

The EU introduced TAC management in 2003. For 2015 the EU TAC in Subareas III and IV is set to 1028 t and in Subareas V, VI and VII, 4316 tonnes.

7.5.5 Data available

7.5.5.1 Landings and discards

Landings data are presented by area and countries (Tables 7.5.1–7.5.9).

Argentina silus can be a very significant discard of the trawl fisheries of the continental slope of Subareas VI and VII particularly at depths 300–700 m (e.g. Girard and Biseau, WD 2004). Information available on discards in 2009 and 2012 in Basque country and Spanish fisheries in Subareas VI–VII, and Divisions VIIIabcd and northern IXa (Table 7.5.3). These estimates have been in the range 1000–4000 t since 2003. In 2010 and 2011 they were around 2000 t. New calculation of the estimates for 2012 and 2013 reduce strongly the discards reported by Spain. Based upon on-board observations from DCF sampling, the catch composition of the French mixed trawl fisheries in Vb, VI and VII include 5.3% of greater silver smelt, based upon data for year 2011 (Dubé *et al.*, 2012). This species is discarded in that fishery; it represents 25.3% of the discards. Raised to the total landings from that fishery an estimated 280 t of discarded greater silver smelt was estimated for 2011. Based upon similar level of the fishery in 2010–2012 this figure applies to recent years.

7.5.5.2 Length compositions

Length information is available from a Norwegian survey in III–IV.

The size compositions of *Argentinas* spp. from Porcupine survey since 2001 is presented in Figure 7.5.12 (Velasco *et al.*, WD WGDEEP 2015).

7.5.5.3 Age compositions

No new data on age composition were presented.

7.5.5.4 Weight-at-age

No new data on weight-at-age were presented.

7.5.5.5 Maturity and natural mortality

No new data on maturity and natural mortality were presented.

7.5.5.6 Catch, effort and research vessel data

The Norwegian *Pandalus* survey samples the full depth range of *Argentina silus*, i.e. from 150 m on the upper slopes to the deepest parts of the Norwegian Deep in IIIa. All relevant parts of ICES Division IIIa are well sampled, but in Division IVa the survey excluded subareas north of about 59°30’N where the species is known to occur. Despite this uncertainty, the *Pandalus* survey nonetheless provides significant information on the temporal variation within the southernmost parts, and especially the Skagerrak (IIIa). The species has a stable distribution pattern within this area, with an interesting exception suggesting a decline in the easternmost areas (IIIa) in the period 2004–2010. Indices for greater silver smelt were presented to the meeting (Bergstad *et al.*, WD WGDEEP 2015).

Spanish bottom-trawl surveys have been carried out in Area VII (Porcupine) since 2001. Recent investigations have revealed that survey catches from the Spanish Porcupine survey contain both *A. Silus* and *A. Sphyraena* (Figures 7.5.2, 7.5.3 and 7.5.4).

Abundance and biomass indices from survey catches of mixed *A. silus* and *A. sphyraena* is presented in Figure 7.5.22. As with the Faroese surveys the Spanish survey only goes to 400 m and is unlikely to cover the depth range of greater silver smelt.

7.5.6 Data analyses

Length and age distributions

The time-series of individual weight and size distributions in the Norwegian *Pandalus* survey suggest structural changes during the period after 1985. An overall decline in mean weight and length of the survey catches were observed. It appears as if the fraction of fish larger than about 30 cm had almost disappeared. This is not so unusual in IVa where juveniles are predominant throughout the year (Bergstad, 1993), but in IIIa the near absence of large fish contrasts strongly with data from the 1980s when large fish were abundant (Bergstad, 1993; this study). In the 2007 survey, no individuals older than 15 years occurred in IIIa and the finding was considered unexpected (Bergstad *et al*., 2008), contrasting with several observations in the 1980s of catches in research trawls being dominated by age 20+ specimens. Bergstad (1993) reported proportions of 20+ in individual catches ranging from 40 to 80% (research vessel catches) and on average around 65% in commercial catches. Monstad and Johannessen (2003) found similar figures.

The size compositions from Porcupine Bank in area VII have no obvious trend towards smaller fish but these data may by disturbed by the relative species composition *A. silus* and *A. sphyreana* (Figure 7.5.12).

Commercial and survey cpue series

The catch rates in terms of numbers and weight from the Norwegian *Pandalus* survey suggest pronounced variation and trends (Figure 7.5.2). The survey catch rates first declined steadily and then rather abruptly to unprecedented low levels in 2005. Since 2005, indices have increased steadily and they are now at similar levels to the start of the series in 1985. The decline in abundance until 2005 was also reflected in a decrease in incidence.

The low survey abundance in the period 2005–2010 and the particular decline in eastern areas is in line with the observations in a dedicated deep-sea fish survey conducted in the spring of 2007 (Bergstad *et al*., 2008). In the 2007 survey only 51 individuals were captured in nine bottom trawls from relevant subareas and depths of the Skagerrak (IIIa). In contrast, Bergstad (1993) reported bottom trawl catches of 100 kg/h or more over wide areas in all seasons in mid-1980s.

Of particular interest is the apparently abrupt decline to low levels in 2005–2006. There is no obvious reason for such an abrupt drop, but it should be noted that this coincides with a strong pulse in the landings from target fisheries for roundnose grenadier (*Coryphaenoides rupestris*) in Division IIIa (Bergstad *et al*., 2013). Landings of grenadier rose to unprecedented quantities in 2004–2005, and the target fishery was stopped in mid-2006. Roundnose grenadier and greater silver smelt co-occur in the Skagerrak (Bergstad, 1990; Bergstad *et al*., 2003) and it may be reasonable to assume that bycatch levels of the latter increased in the period of high grenadier landings. Such bycatches, probably landed for reduction, may not be fully reflected in the landings statistics given in Figure 7.5.1.

For Subarea VII, abundances and biomass indices from the Spanish porcupine survey have been showed a decreasing trend from 2002 until 2011 but have been rising since then (Figure 7.5.22). However the survey is unlikely to cover all the exploitable biomass of the stock as it only goes down to 400 meters.

Exploratory assessment

No exploratory assessment was presented.

7.5.7 Comments on the assessment

Advice is given every second year for this stock and this year's advice applies for 2015 and 2016.

It should be noted that lesser silver smelt (*Argentina sphyraena*) may in some southerly areas have been included in the landing figures. According to research on the Spanish Porcupine survey where both species appear lesser silver smelt are smaller and occupies shallower areas than greater silver smelt (Figures 7.5.2, 7.5.3 and 7.5.4). The proportion of lesser silver smelt in the fisheries is not believed to be large but further investigations should be undertaken.

For Area III and IV ddirected fisheries are inadvisable pending more information, hence the formulation used for several other species i.e. 'No directed fishery', might be an option for an area specific advice.

7.5.8 Management considerations

The trends in Porcupine bank survey abundance indices have since 2011 gone from downward to upward trends.

The target fishery that developed in IIIa in the 1970s ceased in the same period in the 1990s that the survey abundance declined to low levels, and at the end of that decade the relevant fishing fleets probably regarded the concentration in IIIa as "commercially extinct". Whether the situation is the same today is uncertain, but target fisheries never restarted. In IVa bycatches occur but the targeted midwater fishery in the northern parts (ICES, 2007) ceased.

Table 7.5.1. Greater Silver Smelt in III. WG estimates of landings in tonnes. *) landings in 2014 are preliminary.

YEAR	DENMARK	GERMANY	NORWAY	SWEDEN	TOTAL
1966			156		156
1967			3		3
1968					
1969					
1970			106		106
1971			26		26
1972					
1973		20			20
1974					
1975			496		496
1976			1034		1034
1977			273		273
1978		25	1435		1460
1979			640		640
1980			156		156
1981			173		173
1982	4376		140		4516
1983	7733		221		7954
1984	5588		317		5905
1985	10		281		291
1986			676		676
1987	190		768		958
1988	1062		27		1089
1989	938		236		1174
1990	732		1150		1882
1991	1421		800		2221
1992	3564		634		4198
1993	2343		487		2830
1994	1108				1108
1995	1061				1061
1996	1389		159		1548
1997	1455		703	542	2700
1998	748		413	428	1589
1999	1420		2		1422
2000	1039		4	273	1316
2001	907			1011	1918
2002	614			484	1098
2003	918			42	960
2004	910		1		911
2005	470				470
2006	324				324
2007					0

Year	Denmark	Germany	Norway	Sweden	TOTAL
2008					0
2009					0
2010					0
2011					0
2012					0
2013					0
2014*					0

Table 7.5.2. Greater Silver Smelt in IV. WG estimates of landings in tonnes. * landings in 2014 are preliminary.

YEAR	DENMARK	FRANCE	GERMANY	NETHERLANDS	NORWAY	SCOTLAND	IRELAND	TOTAL
1970					233			233
1971					90			90
1972					77			77
1973			1		110			111
1974								
1975					4			4
1976								
1977					205			343
1978			403		65			493
1979			64					64
1980			22					22
1981			18		10			28
1982	278				470			748
1983	806				450			1256
1984	705				125			830
1985	986				789			1775
1986					86			86
1987			2		373			375
1988			1		1655			1656
1989	384			335	1892	1		2612
1990	5		13		421			439
1991		1		3	323	6		333
1992			1	70	64	101		236
1993	10			298	81	56		445
1994	10				4	24		38
1995					1	20		21
1996	57				54			111
1997			1		1			2
1998			129	277	21			427
1999				7	4			11
2000		7			28		10	45
2001		28			3	228	3	262
2002					1	162	4	167
2003			4	42	6	20		72
2004			4	42	16	12	36	110
2005			1	28	3			32
2006	11		6		3468	2		3487
2007					3101			3101
2008					1548			1548
2009					1566			1566
2010					1034	10		1044
2011		4			584			588

Year	Denmark	France	Germany	Netherlands	Norway	Scotland	Ireland	TOTAL
2012		1			350			351
2013		2			1249			1251
2014*	40	1	204	345	2719			3310

Table 7.5.3. Greater Silver Smelt in VIb. WG estimates of landings in tonnes. * landings in 2014 are preliminary.

Year	Faroes	Germany	Ireland	Netherlands	Scotland	Russia	Spain	TOTAL
1979								
1980		13						13
1981		525						525
1982								
1983		4						4
1984								
1985								
1986								
1987								
1988								
1989								
1990			300					300
1991				5				5
1992			220		1			221
1993					3			3
1994					20			20
1995	1114							1114
1996								
1997								
1998								
1999			178					178
2000			1355			29		1384
2001					62	68		130
2002					1	29		30
2003					6	120		126
2004				11		12		23
2005						4		4
2006								
2007								
2008						1	8	9
2009								
2010								
2011								
2012								
2013								
2014*						20.5		20.5

Table 7.5.4. Greater Silver Smelt in VII. WG estimates of landings in tonnes. * landings in 2014 are preliminary.

Year	France	Germany	Ireland	Netherlands	Scotland	Norway	Poland	Spain	UK E/W	TOTAL
1972										
1973	40									103
1974							63			
1975										
1976										
1977			1							1
1978		404					5			409
1979		103								103
1980										
1981										
1982						666				666
1983						595				595
1984						163				163
1985										
1986						258				258
1987						50				50
1988						100				100
1989						200				200
1990		23		1						24
1991				9						9
1992				254						254
1993				505						505
1994				39						39
1995		73	6	431						510
1996		10								10
1997				12						12
1998										
1999			50							50
2000		79	166	244				34		523
2001	5		1592	2	2782			34		4415
2002			4433		2			2		4437
2003			95	19				5		119
2004				13	19			15		47
2005		26	1		14			17		58
2006								40		40
2007								35		35
2008										
2009	13		1					6		20
2010	10			8				2	3	23
2011		4			8					12
2012		2			1					3
2013				1						1
2014*				1						1

Table 7.5.5. Greater Silver Smelt in VIII. WG estimates of landings in tonnes. *landings in 2014 are preliminary.

YEAR	NETHERLANDS	SPAIN	TOTAL
2002	195		194.61
2003	43		42.525
2004	23		22.722
2005	202		202.29
2006			0
2007			0
2008		10	10
2009			0
2010			0
2011	1		1
2012			0
2013			0
2014*	1.1		1.1

Table 7.5.6. Greater Silver Smelt IX . WG estimates of landings in tonnes. *)andings in 2014 are preliminary.

YEAR	NETHERLANDS	PORTUGAL	TOTAL
2006			0
2007	1		1
2008		0.5	0.5
2009		1.9	1.9
2010		1.9	1.9
2011		0.9	0.9
2012		1.9	1.9
2013*			0
2014*			0

Table 7.5.7. Greater Silver Smelt XII. WG estimates of landings in tonnes. * landings in 2014 are preliminary.

YEAR	FAROES	ICELAND	RUSSIA	NETHERLANDS	TOTAL
1988					0
1989					0
1990					0
1991					0
1992					0
1993	6				6
1994					0
1995					0
1996	1				1
1997					0
1998					0
1999					0
2000		2			2
2001					0
2002					0
2003					0
2004			4	625	629
2005				362	362
2006					0
2007					0
2008					0
2009					0
2010					0
2011					0
2012		31			31
2013*					0
2014*					0

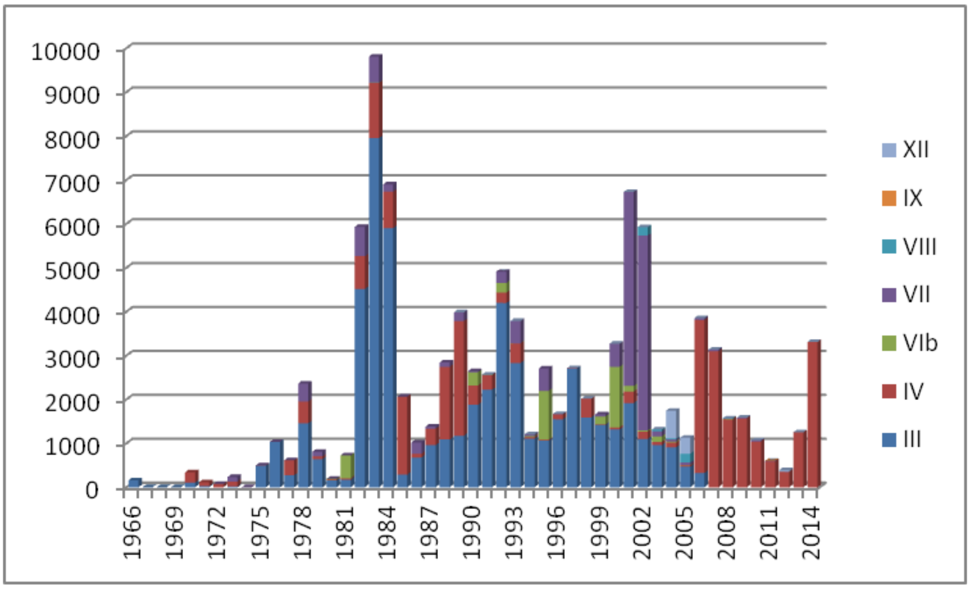


Figure 7.5.1. Total landings of greater silver smelt in IIIa, IV, VIb, VII, VIII, IX, X, XII and XIV.

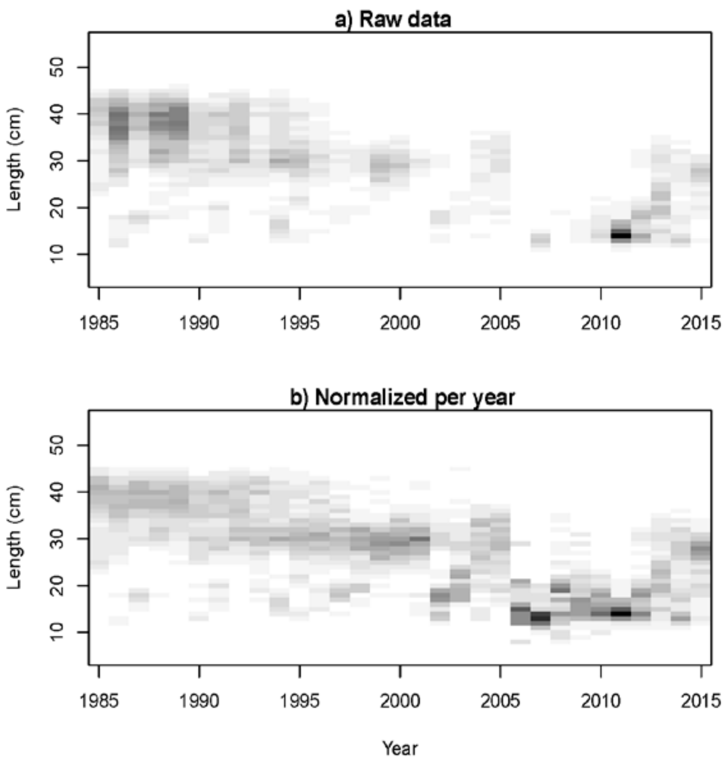


Figure 7.5.1b. Length distributions of *Argentina silus* in the annual *Pandalus borealis* shrimp survey in the ICES Subareas IIIa and IVa. The upper panel shows length distributions in the raw data. Year-to-year fluctuations reflect partly changes in sampling effort. In the lower panel, sampled distributions are normalized to the same total abundance each year (thus ignoring true changes in overall abundance).

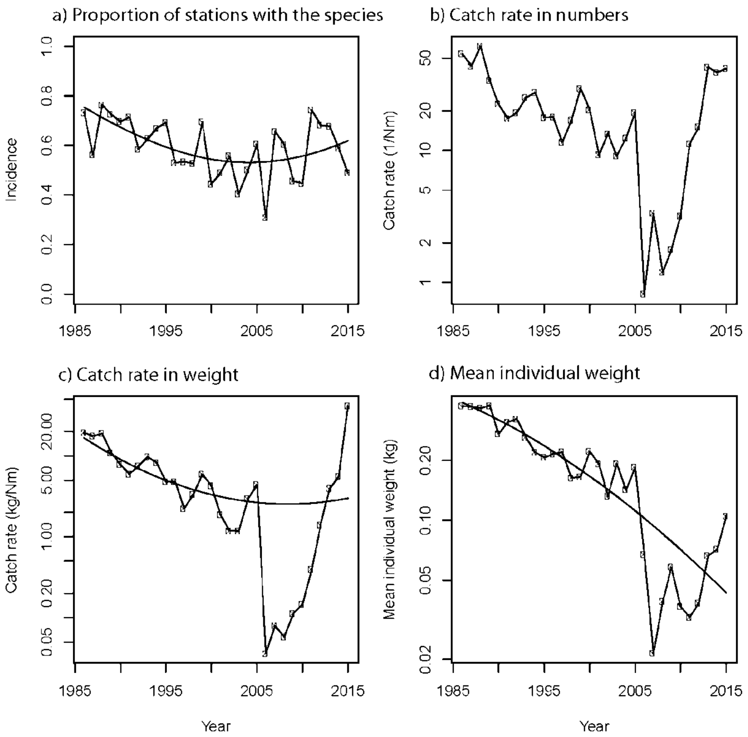


Figure 7.5.2. Dynamics of abundance and mean size of *Argentina silus* in the annual *Pandalus borealis* shrimp survey in the ICES Subareas IIIa and IVa. Panel a) shows the proportion of stations where *Argentina silus* was present. Panels b) and c) show changes in abundance indices, and panel d) in mean size of caught fish. Notice that the y-axis has logarithmic scale in panel b) to d). Trend lines, allowing for linear and quadratic effects, are shown when statistically significant.

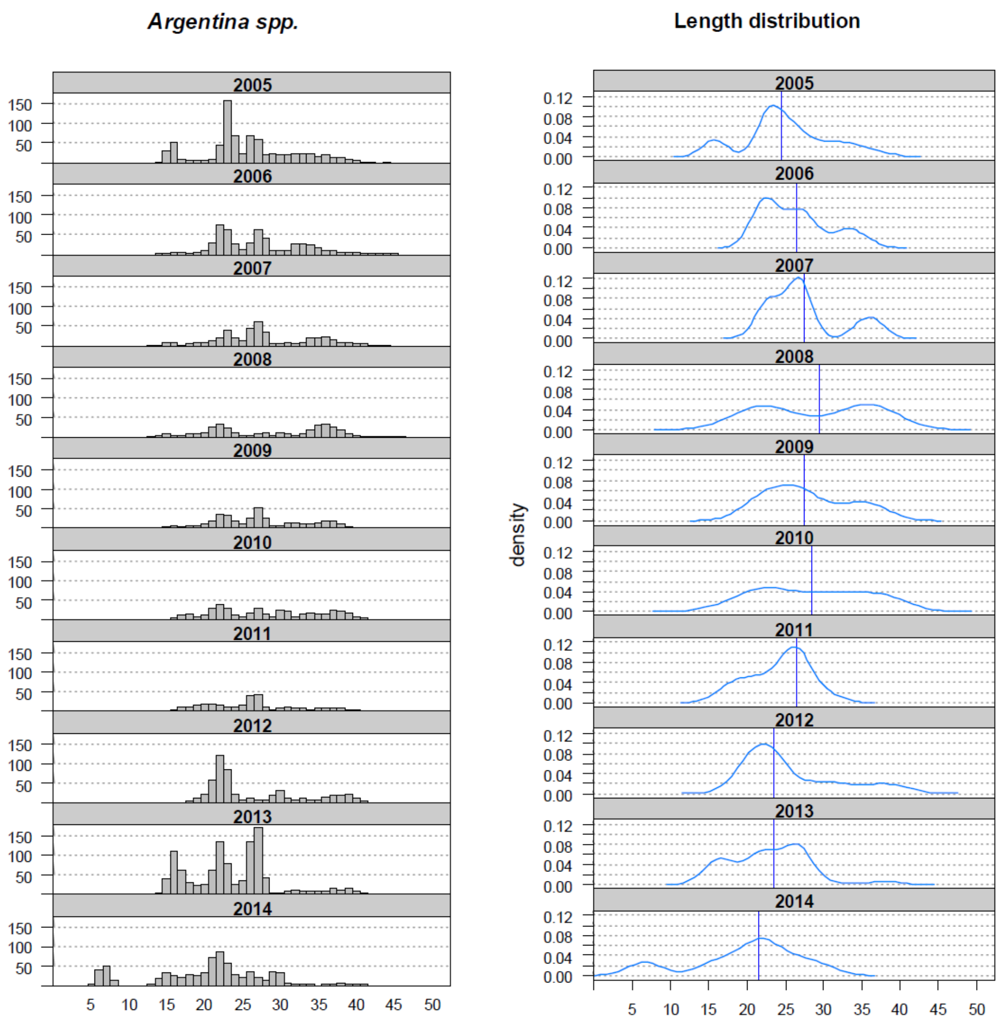


Figure 7.5.3. GSS in VII. Mean stratified length distributions of *Argentina* spp. in Spanish Porcupine surveys.

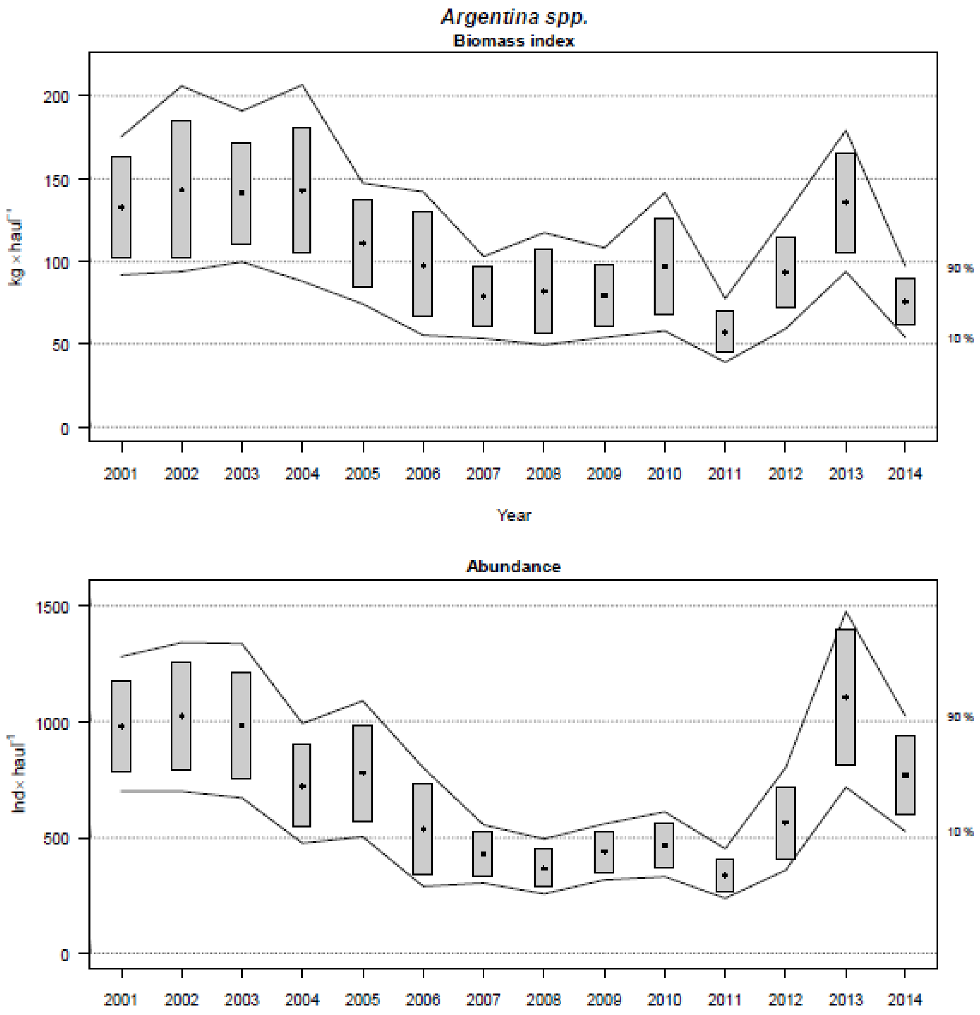


Figure 7.5.4. Greater silver smelt in VII. Changes in *Argentina* spp. (mainly *Argentina silus*) biomass and abundance indices during Porcupine Survey time-series. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

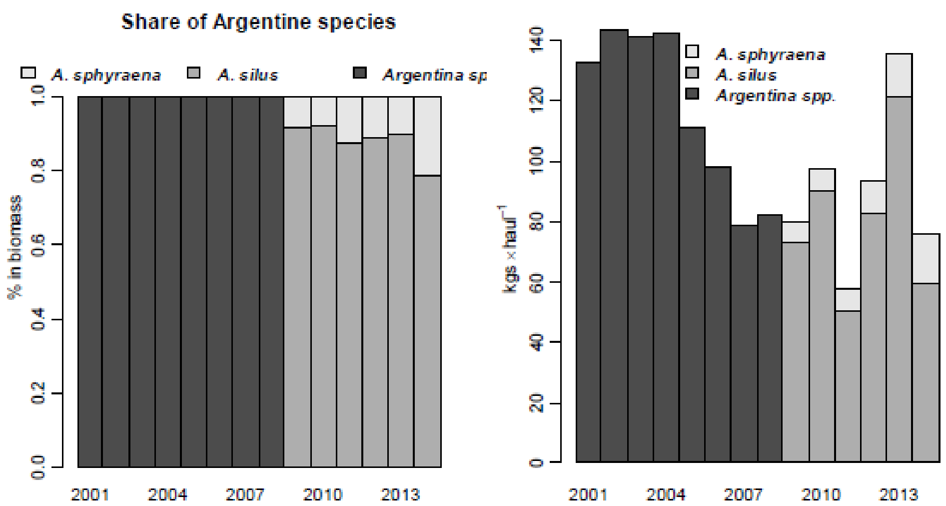


Figure 7.5.5. Share and abundance of Argentine species in Porcupine Bank surveys (2001–2014).

8 Orange roughy (*Hoplostethus atlanticus*) in the Northeast Atlantic

8.1 Stock description and management units

There is no information to determine the existence of separate populations of orange roughy in the North Atlantic.

The current ICES practice is to assume three assessment units:

- Subarea VI;
- Subarea VII;
- Orange roughy in all other areas.

Given the scarcity of spatial fisheries data and genetics data, etc. WGDEEP saw no reason to change this.

Orange roughy is an aggregating species and the spatial scale of current management units would not prevent sequential depletion of local aggregations. ICES recommended that where the small-scale distribution is known, this be used to define smaller and more meaningful management units.

Figure 8.1.1 shows the accumulated catch of orange roughy in the NEA in the different ICES areas for catches from 1991 to 2014.

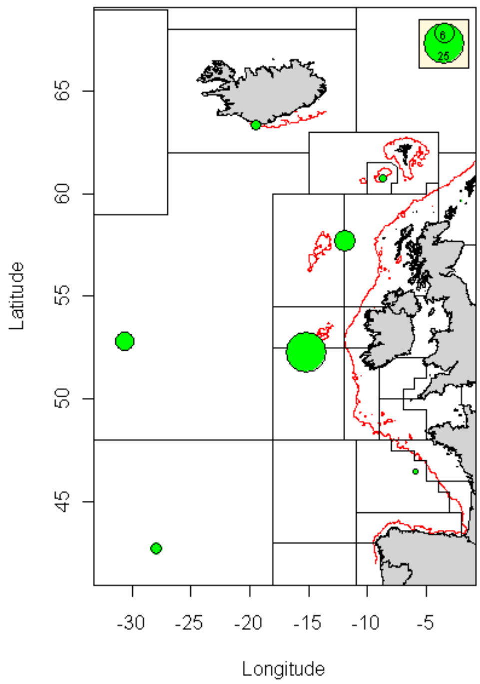


Figure 8.1.1. Fisheries for orange roughy by ICES areas in Northeast Atlantic. Size of circles reflects historic accumulated catch 1991–2013 in thousand tons.

8.2 Orange roughy (*Hoplostethus Atlanticus*) in Subarea VI

8.2.1 The fishery

There was a French target fishery, centred on spawning aggregations around the Hebrides Terrace Seamount. Irish vessels fished there for two years starting in 2001, but directed fisheries had ceased by 2006.

8.2.2 Landings trends

Table 8.2.0 and Figure 8.2.1 show the landings data for orange roughy for ICES Sub-area VI as reported to ICES or as reported to the Working Group. There were no landings of orange roughy in Area VI recorded in 2013. The cumulative landings in Area VI until 2013 was 7187 tons.

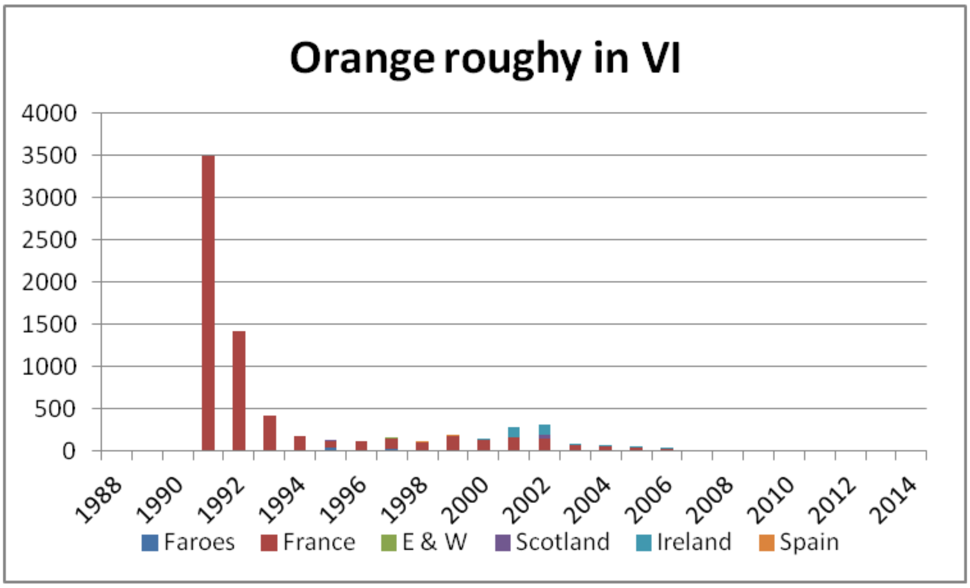


Figure 8.2.1. Time-series of orange roughy landings by country in ICES Area VI.

8.2.3 ICES Advice

The ICES advice for 2015 and 2016 is: on the basis of precautionary considerations that there should be no directed fishery and bycatch should be minimized. Due to its very low productivity, orange roughy can only sustain very low rates of exploitation. Based on the current information, it is not possible to manage a sustainable fishery for this species.

8.2.4 Management

In 2003 a TAC was introduced for orange roughy in VI, this TAC remained at 88 tons until 2006. In order to align the TAC with landings, the TAC for EC vessels in Area VI was reduced annually between 2007 and 2009. A zero TAC has been set for orange roughy in VI since 2010.

Landings in relation to TAC are displayed in Table 8.2.1.

Table 8.2.1. EU TACs and landings in EU and international waters of VI.

		Landing (t)	
Year	TAC (t)	EC vessels	Total
2003	88	81	81
2004	88	56	56
2005	88	45	45
2006	88	33	33
2007	51	12	12
2008	34	5	5
2009	17	2	2
2010	0	0	0
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0		

8.2.5 Data available

8.2.5.1 Landings and discards

Landings are in Table 8.2.0.

The raising of the observed bycatch from on-board observers to the fleet level for the French deep-water trawl fishery to the West of the British Isles gave an estimated discard of 1 tonnes (confidence limits 0-1t) at the fleet level. A total of 85 kg were recorded in French observer sampling in 2014. Raised discard weights were not available for 2014.

8.2.5.2 Length compositions

Length distributions are available from historical observer programmes and current deep-water surveys. Available information can be found in the stock annex.

8.2.5.3 Age compositions

No new information. Available information can be found in the stock annex.

8.2.5.4 Weight-at-age

No information.

8.2.5.5 Maturity and natural mortality

No new information. Available information can be found in the stock annex.

8.2.5.6 Catch, effort and research vessel data

No new information. Available information can be found in the stock annex.

8.2.6 Data analyses

No new analysis was performed in 2015.

8.2.7 Management considerations

The fisheries for orange roughy in Subareas VI and VII have now ceased and a zero TAC has been implemented since 2010. A zero TAC without allowing a bycatch can potentially lead to discarding if existing fisheries overlap with the distribution of orange roughy. Examination of French observer data suggests that bycatch and discarding of orange roughy is currently not significant (<1 tonne).

Due to the closure of the fishery in VI and VII there are limited fishery-dependant data to evaluate the status of the stocks. Also, current fisheries limited monitoring programmes are insufficient to monitor the recovery of the stocks in VI and VII.

Assessment of the susceptibility of orange roughy populations in VI and VII to recent and current deep-water trawl fisheries (see WGDEEP 2014, Section 8.3) has shown a strong reduction in risk over time when fisheries stopped directed targeting practices and continued with mixed deep-water trawl fisheries. Some spatial overlap between the species and current fisheries remains, such as on the ”flat” fishing grounds in VI on the continental slope to the northwest of Ireland extending to the west of Scotland. The overlap between orange roughy distribution and current fishery seems to generate small bycatch. Owing to previous estimates of sustainable catch of a few hundred tonnes per year in VI and VII, the impact of current fisheries are considered sustainable.

Table 8.2.0. Orange roughy catch in Subarea VI.

Year	Faroes	France	E & W	Scotland	Ireland	Spain	Total
1988	-	-	-	-	-	-	0
1989	-	5	-	-	-	-	5
1990	-	15	-	-	-	-	15
1991	-	3,502	-	-	-	-	3502
1992	-	1,422	-	-	-	-	1422
1993	-	429	-	-	-	-	429
1994	-	179	-	-	-	-	179
1995	40	74	-	2	-	-	116
1996	0	116	-	0	-	-	116
1997	29	116	1	-	-	-	146
1998	-	100	-	-	-	2	102
1999	-	175	-	-	0	1	176
2000	-	136	-	-	2	-	138
2001	-	159	-	11	110	-	280
2002	n/a	152	-	41	130	-	323
2003	-	79	-	-	2	-	81
2004	-	54	-	-	2	-	56
2005	-	41	-	-	6	-	47
2006		32			1		33
2007		12					12
2008		5					5
2009		3					3
2010		0					0
2011		0					0
2012		0					0
2013		1(1)					3**
2014		0					0

*** Preliminary. (1) discards only; including 2 tonnes unallocated**

8.3 Orange roughy (*Hoplostethus Atlanticus*) in Subarea VII

8.3.1 The fishery

After the collapse of the fishery in Subarea VI, the main fishery for orange roughy in the northern hemisphere moved to this subarea. This fishery peaked in 2002 and rapidly declined thereafter. Some targeted fishing from a few or even one single 20–24 m trawlers was carried out until 2008 while the remaining catches were a bycatch from the mixed deep-water trawl fishery operating on the slopes.

8.3.2 Landings trends

Table 8.3.1 and Figure 8.3.1 show the landings data for orange roughy as reported to ICES or as reported to the Working Group. There have been no landings of orange roughy reported in VII since 2010.

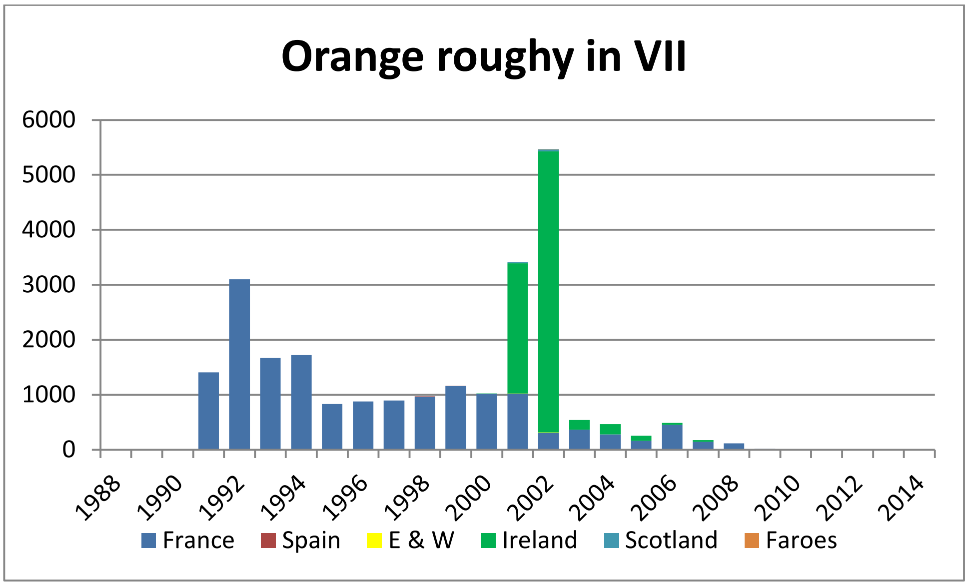


Figure 8.3.1. Time-series of orange roughy landings by country in ICES Subarea VII.

8.3.3 ICES Advice

The ICES advice for 2015 and 2016 is: on the basis of precautionary considerations that there should be no directed fishery and bycatch should be minimized. Due to its very low productivity, orange roughy can only sustain very low rates of exploitation. Based on the current information, it is not possible to manage a sustainable fishery for this species.

8.3.4 Management

A TAC for orange roughy in Area VII was first introduced in 2003. Landings in relation to TAC are displayed in the table below:

Table 8.3.1. EU TACs and landings in EU and international waters of VII

		Landing (t)	
Year	TAC (t)	EC vessels	Total
2003	1349	541	541
2004	1349	467	467
2005	1149	255	255
2006	1149	489	489
2007	193	172	172
2008	130	118	118
2009	65	15	15
2010	0	0	0
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0		

The TAC for orange roughy in VII is set to 0 t for 2015 and 2016.

8.3.5 Data available

8.3.5.1 Landings and discards

Landings are shown are in Table 8.3.0.

Discards of Orange roughy from the French mixed deep-water fishery in Subareas VI and VII were estimated from observer data. In recent years, discards estimated at fleet level have been calculated for total discards and by species. In 2012, the estimated discards of orange roughy was 400 kg. These data suggest that the bycatch of orange roughy in the mixed deep-water trawl fishery is low.

8.3.5.2 Length compositions

No new information available. Historic information can be found in the stock annex.

8.3.5.3 Age compositions

No new information available. Historic information can be found in the stock annex.

8.3.5.4 Weight-at-age

No data.

8.3.5.5 Maturity and natural mortality

No new information available. Historic information can be found in the stock annex.

8.3.5.6 Catch, effort and research vessel data

No new information. Available information can be found in the stock annex.

8.3.6 No new analysis was performed in 2015

8.3.7 Management considerations

The fisheries for orange roughy in Subareas VI and VII have now ceased and a zero TAC has been implemented since 2010. A zero TAC without allowing a bycatch can potentially lead to discarding if existing fisheries overlap with the distribution of orange roughy. Examination of French observer data suggests that bycatch and discarding of orange roughy is currently not significant (<1 tonne). Due to the closure of the fishery in VI and VII there are limited fishery-dependant data to evaluate the status of the stocks. Also, current fisheries-independent monitoring programmes are insufficient to monitor the recovery of the stocks in VI and VII.

PSA Assessment of the susceptibility of orange roughy populations in VI and VII to recent and current deep-water trawl fisheries has shown a strong reduction in risk over time when fisheries stopped directed targeting practices and continued with mixed deep-water trawl fisheries. Some spatial overlap between the species and current fisheries remains, such as the northern slope of the Porcupine Bank. Fishing effort had ceased in this location in 2009 but returned from 2010 onwards. In the same area, scientific trawl surveys have confirmed the presence of orange roughy including juveniles (see ICES, 2012). The overlap between orange roughy distribution and current fishery seems to generate small bycatch. Owing to previous estimates of sustainable catch of a few hundred tonnes per year in VI and VII, the impact of current fisheries are considered sustainable.

Table 8.3.0. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus,* by nation in Subarea VII.

Year	France	Spain	E & W	Ireland	Scotland	Faroes	Total
1988	-	-	-	-	-	-	0
1989	3	-	-	-	-	-	3
1990	2	-	-	-	-	-	2
1991	1406	-	-	-	-	-	1406
1992	3101	-	-	-	-	-	3101
1993	1668	-	-	-	-	-	1668
1994	1722	-	-	-	-	-	1722
1995	831	-	-	-	-	-	831
1996	879	-	-	-	-	-	879
1997	893	-	-	-	-	-	893
1998	963	6	-	-	-	-	969
1999	1157	4	-	-	-	-	1161
2000	1019	-	-	1		-	1020
2001	1022	-	1	2367	22	-	3412
2002	300		14	5114	33	4	5465
2003	369			172			541
2004	279			188			467
2005	165			90			255
2006	451			37			489
2007	145			28			164
2008	118						118
2009	15						15
2010							0
2011							0
2012	2						0
2013							0
2014*							0

***Preliminary.0**

8.4 Orange Roughy (*Hoplostethus atlanticus*) IN I, II, IIIa, IV, V, VIII, IX, X, XII, XIV

8.4.1 The fishery

Fisheries have been conducted in Subareas Va, Vb, VIII, X, and XII. Most started in the early 1990s, the exception being Subarea X which started in 1996. In the last seven years, fisheries are mainly occurring in X and XII, with sporadic catches in Va, Vb and IX. In 2014, one Faroese vessel operated a small directed fishery in ICES Subareas X and XII. Information on this fishery is presented in WD Ofstad 2015.

8.4.2 Landing trends

Table 8.4.0 and Figure 8.4.1 show the landings data for orange roughy for the ICES areas as reported to ICES or as reported to the Working Group.

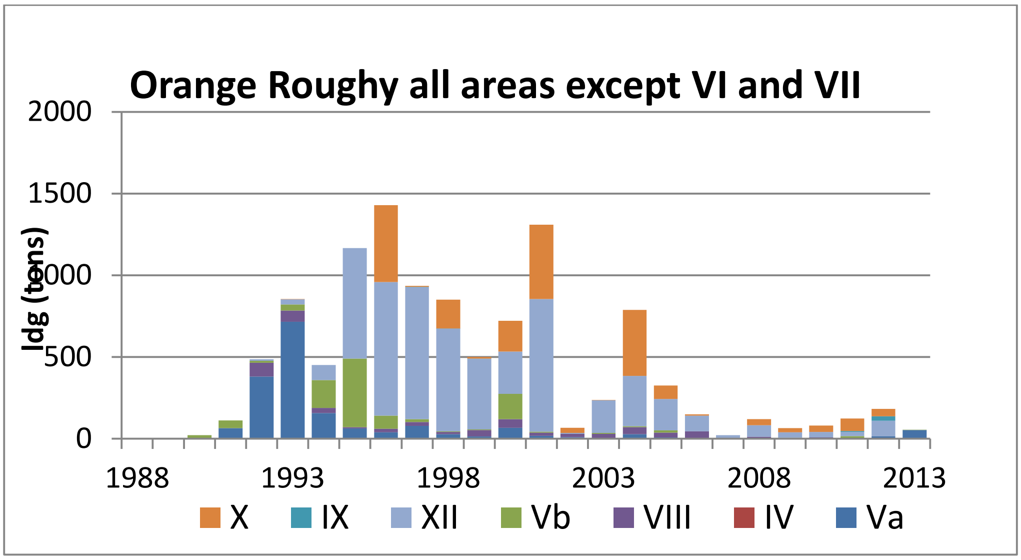


Figure 8.4.1. Time-series of orange roughy landings by in all areas (except VI and VII).

8.4.3 ICES Advice

The ICES advice for 2015 and 2016 is: on the basis of precautionary considerations that there should be no directed fishery and bycatch should be minimized. Due to its very low productivity, orange roughy can only sustain very low rates of exploitation. Based on the current information, it is not possible to manage a sustainable fishery for this species.

8.4.4 Management measures

The EU TAC is set for 0 for 2015 and 2016. The TAC applies to Community waters and EC vessels in international waters. Landings in relation to EU TAC are shown in Table 8.4.1.

In the NEAFC area, there are no targeted fisheries for orange roughy permitted in those parts of the NEAFC Regulatory Area that fall within ICES Subareas V, VI and VII. In other areas, directed fishery for orange roughy is limited to a total annual catch of 150 tons for any contracting party and is restricted to vessels of contracting parties having participated in fishery for orange roughy in the NEAFC Regulatory Area in areas other than V, VI and VII prior to 2005 (Recommendation 6: 2013).

In addition there are a number of management measures that are currently in place in the NEAFC regulatory area in relation to bottom trawling in known VMEs and outside existing fishing areas.

Table 8.4.1. EU TACs and landings in Community waters and waters not under the sovereignty or jurisdiction of third countries of I, II, III, IV, V, VIII, IX, X, XI, XII and XIV.

		Landing (t)	
Year	TAC (t)	EC vessels	Total
2005	102	71	278
2006	102	58	149
2007	44	16	36
2008	30	8	112
2009	15	5	62
2010	0	<1	83
2011	0	4	124
2012	0	28	167
2013	0	0	57
2014	0	0	58
2015	0		

8.4.5 Data available

8.4.5.1 Landings and discards

Landings are in Table 8.4.0.

8.4.5.2 Length composition

Sampling of lengths, weight and gender of orange roughy was carried out by trained crew members on board the single Faroese fishing vessel operating in this fishery. Samples were taken randomly from the catch. Approximately 5% of the Faroese landings of 58 tons in 2014 were sampled (753 individuals). The length distribution of the catch is between 50–70 cm total length (Figure 8.4.2), which is the same as in the Faroese experimental fishery in the nineties (Thomsen, 1998). The average length and weight of orange roughy females and males were around the same in 2011–2014 compared with the results from the experimental fishery in 1992–1998 (Thomsen, 1998) (Table 8.4.2).

Table 8.4.2. Mean length and weight by sex. From sampling by trained crew members onboard the single Faroese fishing vessel targeting orange roughy.

Year	Area	Average length (cm)		Average weight (kg)		
		Female	Male	Female	Male	
1992–1998	Faroe Islands	61.4	58.6	4.4	3.7	Thomsen, 1998
	Hatton Bank	64.6	62.8	4.9	4.3	Thomsen, 1998
	Reykjanes ridge	58.9	56.4	3.6	3	Thomsen, 1998
	North of Azores	60.6	59.7	3.9	3.7	Thomsen, 1998
2011		61.4	60.5	3.5	3.2	
2012		61.4	60.8	3.5	3.2	
2013		60.9	57.7	4.3	3.8	
2014		62.1	58.4	4.2	3.7	

8.4.5.3 Age composition

No data.

8.4.5.4 Weight-at-age

No data.

8.4.5.5 Maturity and natural mortality

No data.

8.4.5.6 Catch, effort and research vessel data

Catch and effort data were collected on a haul-by-haul basis in the Faroese fishery.

8.4.6 Data analysis

No data analysis was carried out in 2015.

8.4.7 Management considerations

The advice for the fishery given in 2008/2010 is still appropriate: "Due to its very low productivity, orange roughy can only sustain very low rates of exploitation. Currently, it is not possible to manage a sustainable fishery for this species. ICES recommends no directed fisheries for this species. Bycatches in mixed fisheries should be as low as possible."

Table 8.4.0a. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Division Va.

Year	Iceland	Total
1988	-	0
1989	-	0
1990	-	0
1991	65	65
1992	382	382
1993	717	717
1994	158	158
1995	64	64
1996	40	40
1997	79	79
1998	28	28
1999	14	14
2000	68	68
2001	19	19
2002	10	10
2003	0	0
2004	28	28
2005	9	9
2006	2	2
2007	0	0
2008	4	4
2009	<1	<1
2010	<1	<1
2011	4	4
2012	16	16
2013	54	54
2014*	0	0

Table 8.4.0b. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Division Vb.

Year	Faroes	France	Total
1988	-	-	0
1989	-	-	0
1990	-	22	22
1991	-	48	48
1992	1	12	13
1993	36	1	37
1994	170	+	170
1995	419	1	420
1996	77	2	79
1997	17	1	18
1998	-	3	3
1999	4	1	5
2000	155	0	155
2001	1	4	5
2002	1	0	1
2003	2	3	5
2004		7	7
2005	3	10	13
2006	0	0	0
2007	0	1	1
2008	0	<1	<1
2009	<1	2	2
2010	<1	<1	<1
2011	0	0	0
2012	0	0	0
2013	1		1
2014*	0		0

Table 8.4.0c. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea VIII.

Year	France	Spain VIII and IX	E & W	Total
1988	-	-	-	0
1989	0	-	-	0
1990	0	-	-	0
1991	0	-	-	0
1992	83	-	-	83
1993	68	-	-	68
1994	31	-	-	31
1995	7	-	-	7
1996	22	-	-	22
1997	1	22	-	23
1998	4	10	-	14
1999	33	6	-	39
2000	47	-	5	52
2001	20	-	-	20
2002	20	-	-	20
2003	31			31
2004	43			43
2005	29			29
2006	43			43
2007	1			1
2008	8			8
2009	13			13
2010	8			8
2011	0			0
2012	0			0
2013	0			0
2014				0

Table 8.4.0d. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea IX.

Year	Portugal	Spain	Total
1990	0	-	0
1991	0	-	0
1992	0	-	0
1993	0	-	0
1994	0	-	0
1995	0	-	0
1996	0	-	0
1997	0	1	1
1998	0	1	1
1999	0	1	1
2000	0	0	0
2001	0	0	0
2002	0	0	0
2003	0	0	0
2004	0	0	0
2005	0	0	0
2006	0	0	0
2007	0	0	0
2008	0	0	0
2009	0	0	0
2010	0	0	0
2011	4	0	4
2012	28		28
2013	0		0
2014			0

Table 8.4.0e. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea X.

Year	Faroes	France	Norway	E & W	Portugal	Ireland	Total
1989	-	-	-	-	-		0
1990	-	-	-	-	-		0
1991	-	-	-	-	-		0
1992	-	-	-	-	-		0
1993	-	-	1	-	-		1
1994	-	-	-	-	-		0
1995	-	-	-	-	-		0
1996	470	1	-	-	-		471
1997	6	-	-	-	-		6
1998	177	-	-	-	-		177
1999	-	10	-	-	-		10
2000	-	3	-	28	157		188
2001	84	-	-	28	343		455
2002	30	-	-	-	-		30
2003		1					1
2004	384					19	403
2005	128	2					130
2006	8						8
2007	0						0
2008	37						37
2009	26						26
2010	39						39
2011	77						77
2012	45						45
2013	0						0
2014	47						47

Table 8.4.0f. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea XII.

Year	Faroes	France	Iceland	Spain	E & W	Ireland	New Zealand	Russia	Total
1989	-	0	-	-	-			-	0
1990	-	0	-	-	-			-	0
1991	-	0	-	-	-			-	0
1992	-	8	-	-	-			-	8
1993	24	8	-	-	-			-	32
1994	89	4	-	-	-			-	93
1995	580	96	-	-	-			-	676
1996	779	36	3	-	-			-	818
1997	802	6	-	-	-			-	808
1998	570	59	-	-	-			-	629
1999	345	43	-	43	-			-	431
2000	224	21	-	-	2			12	259
2001	345	14	-	-	2		450	-	811
2002	+	6	-	-	-		0	-	6
2003		64				136	0	-	200
2004	176	131					0		307
2005	158	36					0		193
2006	81	15							96
2007	20								20
2008	71								71
2009	34								34
2010	35								35
2011	27								27
2012	94								94
2013	2								2
2014	11								11

Table 8.4.0g. Orange roughy total international landings in the ICES area, excluding VI and VII.

Year	IV	Va	Vb	VIII	IX	X	XII	All areas
1988		0	0	0	0	0	0	0
1989		0	0	0	0	0	0	0
1990		0	22	0	0	0	0	22
1991		65	48	0	0	0	0	113
1992		382	13	83	0	0	8	486
1993		717	37	68	0	1	32	855
1994		158	170	31	0	0	93	452
1995		64	420	7	0	0	676	1167
1996		40	79	22	0	471	818	1430
1997		79	18	23	1	6	808	935
1998		28	3	14	1	177	629	852
1999		14	5	39	1	10	431	500
2000		68	155	52	0	188	259	722
2001		19	5	20	0	455	811	1310
2002		10	1	20	0	30	6	67
2003		+	5	31	0	1	200	237
2004		28	7	43	0	403	307	788
2005		9	13	29	0	83	193	327
2006		2	0	43	0	8	96	149
2007	14		1	1	0	0	20	36
2008	7	4	<1	8	0	37	71	127
2009	0	1	2	3	0	26	34	66
2010	0	<1	<1	8	0	39	35	82
2011	0	4	0	0	<1	77	27	108
2012		16	0	0	28	45	94	183
2013		54	1	0	0	0	2	57
2014						47	11	58
Total	21	1762	1005	545	31	2104	5661	11129

***Preliminary.**

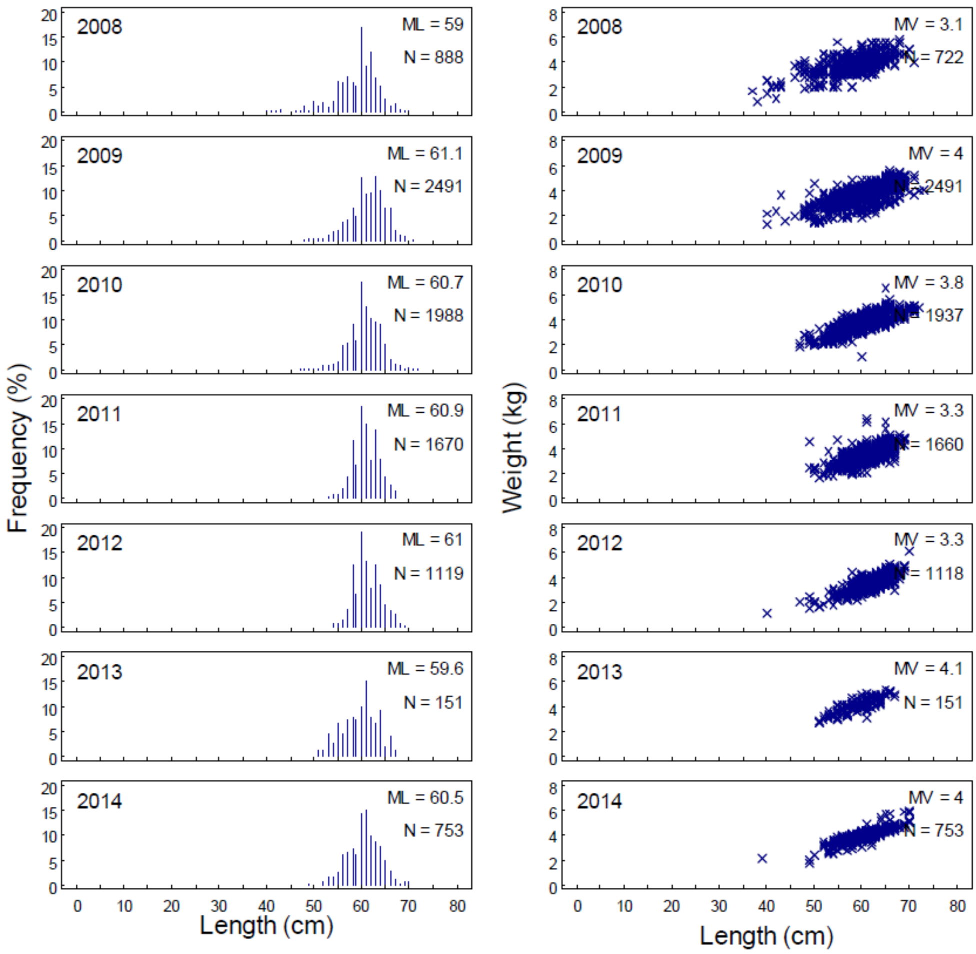


Figure 8.4.1. Length distribution of orange roughy in Faroese catches 2008 to 2014.

9 Roundnose grenadier (*Coryphaenoides rupestris*)

9.1 Stock description and management units

ICES WGDEEP has in the past proposed four assessment units of roundnose grenadier in the NE Atlantic (Figure A.1):

- Skagerrak (IIIa);
- The Faroe-Hatton area, Celtic sea (Divisions Vb and XIIb, Subareas VI, VII);
- the Mid-Atlantic Ridge 'MAR' (Divisions Xb, XIIc, Subdivisions Va1, XIIa1, XIVb1);
- All other areas (Subareas I, II, IV, VIII, IX, Division XIVa, Subdivisions Va2, XIVb2).

This current perception is based on what are believed to be natural restrictions to the dispersal of all life stages. The Wyville-Thomson Ridge may separate populations further south on the banks and slopes off the British Isles and Europe from those distributed to the north along Norway and in the Skagerrak. Considering the general water circulation in the North Atlantic, populations from the Icelandic slope may be separated from those distributed to the west of the British Isles. It has been postulated that a single population occurs in all the areas south of the Faroese slopes, including also the slopes around the Rockall Trough and the Rockall and Hatton Banks but the biological basis for this remains hypothetical.

In 2007, WGDEEP examined the available evidence of stock discrimination in this species but, on the available evidence, was not able to make further progress in discriminating stocks. On this basis WGDEEP concluded there was no basis on which to change current practice.

Recent genetic analyses have brought forward new information regarding the issue of stock discrimination in the roundnose grenadier. White *et al*. (2010), investigating a limited geographic area in the central and eastern North Atlantic, found evidence for population substructure and local adaptation to depth. A study by Knutsen *et al*. (in press and summarised by Bergstad (WGDEEP 2012, WD 03)), covered a larger geographic range and significant genetic structure was observed. Parts of this structure, notably in peripheral (Canada) and bathymetrically isolated basins (Skaggerak and Trondheimsleia (off Norway)), obviously represent distinct biological populations with limited present connectivity. In other areas, off the British Isles (Irish slope, Rockall, and Rosemary Bank), the magnitude of genetic structure is weaker and less clearly defined. This lack of definition could reflect that samples from this area represent a single, widespread population. On the other hand, a recent study of coastal Atlantic cod (Knutsen *et al*., 2011) reported highly restricted connectivity (less than 0.5% adult fish exchanged per year) among two populations that were only weakly differentiated at microsatellite loci. This level is similar to that found between Greenland, Mid-Atlantic Ridge, Rockall, and Rosemary Bank, and the possibility that some of these sites represent distinct biological populations cannot be excluded.

9.2 Roundnose Grenadier (*Coryphaenoidesrupestris*) in Division Vb and XIIb, Subareas VI and VII

9.2.1 The fishery

The majority of landings of roundnose grenadier from this area are taken by bottom trawlers. To the west of the British Isles, in Divisions Vb, VIa, VIb2 and Subareas VII, French trawlers catch roundnose grenadier in a multispecies deep-water fishery. The Spanish trawling fleet operates further offshore along the western slope of the Hatton Bank in ICES Divisions VIb1 and XIIb.

9.2.2 Landings trends

Official French landings have been revised for 2013 and are preliminary for 2014.

Evidences of substantial mismatches between observer and official Spanish data of landings in Subarea VI and Division XIIb were presented at WGDEEP in 2010. This has raised some concerns regarding possible misreporting between the different species of grenadiers (*Coryphaenoides rupestris*, *Macrourus berglax* and *Trachyrincus scabrus*). This issue is still present for XIIb and VIb landings but according to official Spanish catch data it concerns a much smaller proportion of grenadier catch. Catches of *Macrourus berglax* and *Trachyrincus scabrus* were almost absent from the catches over the 2009–2011 period. In 2012, 6 t of *Trachyrincus scabrus* were reported in VI, 188 t in XIIb. Provisional 2013 landings data show around 179 t and 195 t of *Macrourus berglax* reported in VIb and XIIb respectively. No landings were reported for *Trachyrincus scabrus* in the preliminary 2013 data.

Over the past two decades, landings from Division Vb, have reached more than 3800 t in 1991 and more than 2000 t in 2001. Between these two periods, the landings were low (less than 700 t in 1994). After 2001, landings decreased to about 1000 t in 2002 but increased further to about 1840 t in 2005 and then decreased to 74 t in 2011. In 2014, the provisional landings in Vb are 77 t. These landings are exclusively from French and Faroese trawlers (Table 9.2.0a–f).

In Subarea VI, the highest landings were observed in 2001 (close to 15 000 t) and have decreased to around 1423 t in 2013. Provisional landings are 1059 t in 2014. Most of these landings are caught by French and Spanish trawlers.

In Subarea VII, landings close to 2000 t were recorded in 1993–1994, recent annual landings are much lower (from 200 to 400 t/year in 2005–2007, 34 t in 2011). In 2014, provisional landings are 11 t and only from France.

In ICES Division XIIb, the recent fishery is exclusively from Spanish trawlers. After a peak to more than 12 200 t in 2004, reported landings have decreased to about 5335 t in 2009, 1580 t in 2011 and 796 t in 2013. Provisional landings were 832 t in 2014. There were significant Faroese landings in the mid-1990s, but this fishery disappeared in the 2000s and only now amounts for a few tons each year. French Fisheries have landed up to 1700 t in 2004 but have since strongly decreased. There were no French and Faroese landings in Division XIIb for 2007–2013.

The landings data are considered uncertain in Division XIIb, because of the possibility of unreported landings in international waters, which is a serious issue for assessment. In addition to this, none of the national landings data were reported by new ICES divisions and some landings were allocated to divisions according to working group knowledge of the fisheries.

9.2.3 ICES Advice

The ICES advice for 2015 and 2016 is:"*On the basis of the MSY approach that catches should be no more than 4595 t in 2015 and 4673 t in 2016 for Division Vb and Subareas VI and VII. If discard rates do not change from the average of the last three years (2011–2013), this implies landings of no more than 3952 t in 2015 and 4019 t in 2016.*

Following the precautionary approach ICES advises annual catches of no more than 838 tonnes in 2015 and 2016 for Division XIIb. If discard rates do not change this implies annual landings of no more than landings in 2013 (796 t)".

9.2.4 Management

TACs for EU vessels for deep-water species have been set since year 2003. These TACs are revised every second year. The EU TAC and national quotas from member countries apply to all vessels in EU EEZ and to EU vessels in international waters.

For Division Vb and Subareas VI and VII, a TAC was set at 4010 t for 2015 and 4078 t for 2016. This TAC since EC regulation 1367/2014 is a combined value for roundnose grenadier and roughhead grenadier (*Macrourus berglax*). According to this regulation, "as regards the four stocks of roundnose grenadier, scientific advice and recent discussions in the North East Atlantic Fisheries Commission (NEAFC) indicate that catches of this species may be misreported as catches of roughhead grenadier. In this context, it is appropriate to establish a TAC covering both species while enabling a separate reporting for each of them."

Additionally, a maximum of 10% of each quota may be fished in Union and international waters of VIII, IX, X, XII and XIV. The quota is exclusively for bycatches with no directed fisheries are permitted. Landings of roundnose grenadier shall not exceed 95% of each Member State quota.

In Subareas VIII, IX, X, XII and XIV the TAC was set at 3644 t in 2015 and 3279 t for 2016. This TAC covers areas with minor roundnose grenadier catches (VIII, IX and X), part of this assessment area (Division XIIb, the western slope of the Hatton bank) and the Mid-Atlantic Ridge (Divisions XIIa,c and Subarea XIV). The main countries having quotas allocations under this TAC are Spain and Poland. Therefore these quota allocations are based upon historical landings in XIIb for Spain and in XIIa,c (Mid-Atlantic Ridge) for Poland.

The table below summarizes the TACs in the two management areas and landings in the assessment area.

	Vb, VI, VII		VIII, IX, X, XII, XIV		Total international Landings Vb, VI, VII, XIIb
	EU TAC	EU Landings	EU TAC	EU Landings XIIb	
2005	5253	5777	7190	8782	14558
2006	5253	4676	7190	4361	9037
2007	4600	3778	6114	4258	8036
2008	4600	3102	6114	2432	5534
2009	3910	4046	5197	5335	9381
2010	3324	3461	5197	2759	6220
2011	2924	1577	4573	1578	3155
2012	2546	1440	3979	666	9103
2013	4297	1523	3581	782	3841

	Vb, VI, VII		VIII, IX, X, XII, XIV		Total international Landings Vb, VI, VII, XIIb
	EU TAC	EU Landings	EU TAC	EU Landings XIIb	
2014	4297	1147*	3223	924*	2071*
2015**	4010		3644		
2016**	4078		3279		

***: provisional.**

****: combined TAC for roundnose grenadier and roughhead grenadier**

[1]: official + unallocated catches

After the introduction of TACs in 2003 and 2005, the reported landings have decreased. However, the observed decrease may be confounded by problems related to species reporting particularly in XIIb.

In addition to TACs, further management measures applicable to EU fleets are a licensing system, fishing effort limits, the obligation to land the fish in designated harbours and a regulation for on-board observations according to Council Regulation (EC) No 2347/2002 of 16 December 2002. In the Faroes waters, the catch of roundnosegrenadier is subject to a minimum size of 40 cm total length, other regulations that may apply to roundnose grenadier are detailed in the overview section.

9.2.5 Data available

9.2.5.1 Landings and discards

Landings time-series data per ICES areas are presented in Table 9.2.0.

Landings data by new ICES areas were available from France, Norway and UK (England and Wales and Scotland) from 2005. No other country provided data by new ICES area. Catch in Subarea XII were allocated to Division XIIb (western Hatton bank) or XIIa,c (Mid-Atlantic Ridge) according to knowledge of the fisheries from WG members.

Catch and discards by haul were available from observer programmes from France and Spain.

French observer program: Discards data are available routinely from France since 2008 through the Obsmer (observers at sea) program. The length distributions of discards from all these observations has been consistent and stable for the period 2004–2010 with about 30% of the weight and 50% of the number of roundnose grenadier caught being discarded, because of small size. This figure is higher than from previous sampling programme where the discarding rate in the French fisheries was estimated slightly above 20% in 1997–1998 (Allain *et al.*, 2003). These differences may have come from a combination of changes in the depth distribution of the fishing effort and a decrease in the abundance of larger fish as visible in the landings. Since then, the discard rate has been reduced to 12% of the weight of the catch (29% in number of individuals) in 2011 and 6% in weight in 2012 (24% in number)s. In 2013, discards accounts for 15% of the catch in weight and 32% in number. In 2014, discards accounts for 6% of the catch in weight and 16% in number.

The reduction of discards is related to:

1) a change of depth of the French fleet towards shallower waters; and

2) attempts to avoid areas where discards are high.

Spanish Observer programme (Hatton Bank): discard data are available from the Spanish Observer Programme. For the period 2004–2014, observers have covered on average 15±10% (range 3–39%) of the fleet fishing days in division VIb, and 12±8% (range 2–33%) in Division XIIb. Although occasionally the discards reached 26% of the total observed weight catch in the period 1996–2014, they are negligible in most sampled months. Annual average discards are 7% (range 0 to 21%) in weight in both Divisions VIb and XIIb (range 0 to 26%). These discards, however, correspond to undersized individuals. Discards data for 2011 were not presented as they are considered to be inaccurate but provided again for 2012 and onwards.

9.2.5.2 Length composition of the landings and discards

Length composition of landings and discards were available from France and Spain covering different periods and areas (Figures 9.2.1–9.2.3).

9.2.5.3 Age composition

No new data.

9.2.5.4 Weight-at-age

No new data.

9.2.5.5 Maturity and natural mortality

No new data.

9.2.5.6 Research vessel survey and cpue

Research vessel survey

Data were available from the Marine Scotland deep-water survey since the years 1998 to 2013 and from stats squares 41E0 through 45E0. This survey operates now on a biannual basis therefore no survey was carried out in 2014.

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

Haul by haul data from French skipper's personal tallybooks were not updated this year due to time constraints. Discards are not available from those datasets therefore only lpues are calculated and provided for roundnose grenadier. Owing to the decreasing of quotas in recent years, the fishery now operates on a smaller area. Further, in 2012 data for only two vessels were available at the time of the working group. As a result, the data only covered two of the five small areas previously considered for this lpue series. The time-series should then be interpreted with caution. The observed lpue is unlikely to represent properly the trend in the stock because the change in abundance in unfished areas are not considered.

Lpue from the Faeroese commercial fleet

The commercial cpue series is from trawlers, where the criteria were that grenadier contributed more than 30% of the total catch.

Logbook data for the period 1985–2009 have been quality controlled. The cpue are from a subset of the commercial ships: all available logbooks from 6–8 otterboard trawlers mainly fishing in deep water, 4–8 pair trawlers fishing on the slope from about 150 m and 4–5 longliners (GRT >110). The data for 2010–present are selected directly from the database at the Faroese Coastal Guard and all available logbooks have been available. For comparison the same ships were selected as used previously in the WG.

A general linear model (GLM) was used to standardize all the cpue(kg/h) series for the commercial fleet where the independent variables were the following: vessel (actually the pair ID for the pair trawlers, otterboard trawlers or longliners), month (January–April, May–August, September–December), fishing area (Vb1, Vb2) and year. The dependent variable was the log-transformed kg per hour measure for each trawl haul/setting, which was back-transformed prior to use. The reason for this selection of hauls was to try to get a series that represents changes in stock abundance.

Roundnose grenadier is only fished by large trawlers and the main fishing area is on the slope around the Faroe Bank.

The cpue data were available in 2014 but the figure is not accurate because of a very low number of hauls with more than 30% of grenadier since 2011 (1 in 2014).

Lpue from the Spanish commercial fleet in XIIb

Some basic lpue indices were estimated for the Spanish fleet in order to include the XIIb landings into the assessment. The level of aggregation (month by month total landings and horsepower units) did not permit to estimate a proper standard deviation.

9.2.6 Data analyses

9.2.6.1 Benchmark assessments

Trends from length distribution and individual weight

For France, the modal discarded length has remained constant (Figures 9.2.1–9.2.2) at around 12cm while the average pre-anal length of the individuals in the landings has decreased from 20.8 cm in 1990 to 16 cm in 2014 (Figure 9.2.4).

Size–frequency data provided by Spain for the period 2002–2014 in VI and XIIb shows the modal length (PAFL) of landings to be closely similar between divisions with female being larger than male by around 2 cm (Figure 9.2.5). The modal length of discards is around 9.5cm. Over the period 2002–2014, there is no apparent trend in size of discards. However for landed individuals, both the average size for male and female have decreased by 1cm (from 15.5 cm to 14cm for females and 13.5 to 12.4 cm for males) until 2009. Over the period 2009–2014, in both VI and XIIb, the mean length in landings has increased by two centimetres for both males and females in 2010–2011. Few discards data were available by the time of the working group. No new information is available on Spanish discards.

The difference of modes of the length distributions of landed catch between the Spanish fleet in Divisions VI and XIIb and the French fleet is possibly because of different sorting habits in relation to different markets.

It is therefore important that length distribution of the landings and discards are provided to the working group by all fleets exploiting the stock.

Time-series of mean individual weight from the Marine Scotland Deepwater Science survey shows no clear trends because of big confidence intervals. Average weight is around 0.42 kg (Figure 9.2.6).

Trends in abundance indices

Marine Scotland Deep-water Science survey

The working group was provided this year with an update of the survey indices. There is an increasing trend of abundance over the period 2011-2013. The confidence intervals are however large (Figure 9.2.7).

Lpue from the Faeroese commercial fleet

The cpue is stable for the period 2009–2010 although it is above average in 2011. After that period, the low number of hauls carrying more than 30% of grenadier makes cpue estimates highly inaccurate (Figure 9.2.8).

Lpue from the Spanish commercial fleet in XIIb

The lpue has declined over the time-series stable with a peak in 2003 followed by a decline until 2005. A second peak occurred in 2008. The lpue has been declining since then (Figure 9.2.9).

Lpue from the French tallybooks

The overall trend in abundance (Figure 9.2.10–9.2.11) shows a decline from 2000 to 2003 and has been stable since until 2013 where the abundance index is substantially higher. This series has not been updated this year.

Multi-Year Catch Curves (MYCC)

MYCC this year could not be updated because age data are not available for recent years.

Bayesian surplus production model

A Bayesian surplus production model is used for this stock and results are used as indicators of trends (see stock annex).

Based upon what is believed to be natural restrictions to the dispersal of all life stages, the area of this stock is considered to include Division Vb and XIIb and Subareas VI and VII but due to uncertainties in the catch in Division XIIb, assessment has been restrained to Vb, VI, VII in 2008 and 2009. The WKDEEP benchmark agreed in 2010 that *"landings and effort data in Division XIIb should be included into the assessment if they become reliable. A separate assessment for Division XIIb should be carried out separately from the one for Division Vb, and Subareas VI, VII."* The reference assessment ("Ref") is therefore restrained to Vb, VI, VII while a full exploratory assessment including XIIb is presented further in this section.

The following datasets were used for the benchmark assessment:

- Landings in Vb, VI, VII (1988–2014);
- Overall standardized abundances indices from the French tallybooks (2000–2013) based on rectangles (edge6, other6);
- Life-history parameters to provide initial estimates for the model (Figure 9.2.12).

The various time-series used for those benchmark and exploratory runs are listed in Table 9.2.1.The summary of each assessment output is on Table 9.2.2.

Diagnostics plot are available on Figures 9.2.13–9.2.14 and indicates a relatively good fit of the model except for the last year due to the strong change in the abundance index. Overall model fit, while being acceptable, was harder to achieve most likely because of the lack of last year abundance indices. The impact of the missing last year was not clearly quantified on model outputs therefore caution is advised when considering the absolute levels in comparison to previous run.

Outputs of the assessments are presented on Figure 9.2.15.

Harvest rate H_y can be seen as a proxy of fishing mortality as it is the ratio between landings and stock biomass B_y on year *y*. The surplus production model provides also B_{MSY} and H_{MSY} indicators. B_{MSY} is assumed by the model to be half of K, the carrying capacity, considered here by the model to be equal to stock biomass estimates in 1988. H_{MSY} is the ratio between a sustainable catch C_{MSY} and B_{MSY}. C_{MSY} is equal to r*K/4, *r* being the intrinsic growth rate of the population. For this particular value of catch, the stock biomass is expected to reach a theoretical equilibrium.

The shape of the harvest rates is driven by the shape of the landings time-series and has been over H_{MSY} since 1992 until 2007, peaking over the period 2000–2004 at around 0.25. Since then, the median of the harvest rate distribution has been close or below H_{MSY} which is around 0.08+/-0.01. Stock biomass has been continuously below B_{MSY} since 2002.

Virgin biomass was estimated to be around 130 kt (+/-1kt). The magnitude of this number is in line with estimates from previous working groups. Stock biomass in 2014 is around 50 kt (+/-15 kt). B_{MSY} is estimated to be 65 kt (+/-1 kt). MSY $B_{trigger}$ is set at 32 kt (B_{loss} value for 2006).

In 2014, the probability of this stock (Vb, VI, VII) to be above MSY $B_{trigger}$ is 86%, 3% to be above B_{MSY}, 99% to be below H_{MSY} (Table 9.2.2). Model outputs suggest that any TAC set below C_{MSY} (5085 t +/- 382 t) is likely to allow the increase of stock biomass. Some projections are developed further in this section for different management options.

This assessment does not change the perception that biomass is recovering slowly after a low historical level in 2006–2008. The exploitation rate appears to be below MSY limits and biomass estimates show a slight upwards trend.

9.2.6.2 Exploratory assessments

The benchmarked assessment methodology uses data only from Vb, VI and VII.

- This year, an additional exploratory assessment was carried out to take account of landings in XIIb. Run "Vb-VI-VII-XIIb" is the standard run using XIIb landings data. French and Spanish standardized lpues are combined with a weighting corresponding to the amount of landings in XIIb and Vb, VI, VII.

- An additional assessment "Vb-VI-VII-DS" was carried out using the Marine Scotland Deepwater Science Survey indices. The rationale for using this survey is the reduction of the number of vessels being part of the French tallybook indices. This survey indices provides also some fishery independent information.

Short-term forecast are added for Vb, VI, VII runs.

Exploratory run in Vb, VI, VII and XIIb (Vb-VI-VII-XIIb run)

The inclusion of landings of XIIb requires a combined abundance indices from the landings and efforts of the Spanish fleet XIIb and the indices from the French tally-books (Figure 9.2.16). The weighting between indices relies on proportion of landings between the Vb,VI,VII regions and XIIb (Table 9.2.1).

Figure 9.2.17 shows the estimates of biomass and harvest rates. Harvest rates have been over H_{MSY} since 1999 with a peak in 2004 before declining to levels slightly above H_{MSY} since 2008. Harvest rates were below H_{MSY} in 2011 and 2013.

Biomass has been continuously below B_{MSY} since 2003 and is currently stable at low level.

The carrying capacity was estimated to be around 215 kt+/-1 kt. Stock biomass in 2014 is 73 kt (+/-18 kt). B_{MSY} is estimated to be 107 kt +/- 0.7 kt. From this run, the probability of this stock to be above MSY $B_{trigger}$ (69 kt) is 69%, 5% to be above B_{MSY} and 100% to be below H_{MSY}. Median C_{MSY} is estimated to be 8581 t +/- 794 t. Any catch below this level should lead to an increase of stock biomass.

It is important to note that the confidence over this assessment including XIIb is lower than for the one restricted to Vb, VI, VII because of the uncertainty of the landings in XIIb linked to species reporting and evidence of reporting from other areas. Landings in XIIb contributes strongly therefore it should be emphasized that Member States should provide accurate landings and effort information regarding the fishing activity in XIIb as uncertainties associated with the high level of landings in XIIb strongly impact any assessment.

Exploratory run in Vb, VI, VII using the Marine Scotland Deepwater Science Survey ("Vb-VI-VII-DS" run)

The fit of the model on the survey indices is good (Figure 9.2.18 in blue) and shows a steady increase after 2003. The fit captures the overall trend of the median of the survey indices. Outputs of the assessments are presented on Figure 9.2.19. A comparison of biomass and harvest rates trajectories between this run and the reference run is presented on Figure 9.2.20.

Overall, the biomass time-series has the same trends than the reference run with an initial decrease of biomass followed by a stronger decrease from 2001 to 2006 and then a period of recovery. Biomass estimates in 1988 is the same for both runs (134 kt +/-2.5 kt). B_{MSY} and H_{MSY} indicators are also close to reference run respectively 67 kt +/-1 kt and 0.09 +/- 0.01.

However, biomass estimates, MSY Btrigger and C_{MSY} strongly differs as the recovery dynamics is more vigorous using those indices. Biomass in 2014 is estimated to be 38 kt +/- 14 kt (68% more than the reference run), MSY Btrigger at 44 kt +/- 7 kt (39% increase) and C_{MSY} at 6 kt +/- 0.5 kt (15%).

This is mainly because the dynamics of the survey indices and commercial indices are not the same. The first one shows a continuous increase through time past 2001 while the commercial indices are in comparison at their lowest from 2002 to 2006 and then increase slowly.

This assessment does not change, as the others, the perception that biomass is increasing slowly after a low historical level in 2006. The exploitation rate appears to be below MSY limits as the other runs.

However the stock recovers at a faster rate than the reference run but with wider confidence intervals. Probabilities to be above MSYBtrigger (1.00) and to reach B_{MSY} are therefore much higher (0.42 against 0.03) in comparison to the reference run.

Short-term forecast have been made for this run are also compared with those for the reference run below.

Short-term forecasts

Exploratory short-term forecasts in Vb, VI, VII (run 1 to 6)

The Bayesian context allows introducing the notion of risk into the assessment through catch options and probabilities to be above or below limits such as MSY indicators. Several stocks at ICES provide probabilities with catch options (e.g. Bay of Biscay anchovy, Greenland halibut).

With this stock potentially on a rebuilt trajectory, several catch options were tested to provide projections of the potential catches in the next years and the probability to reach B_{MSY}.

Several runs were considered forecasting the period 2015–2025. For 2015 and 2016, the landings were considered to be equal to the current TAC in Vb, VI, VII. For the following years, several catch options were considered (Figure 9.2.21):

- Run 1: *Status quo* catch: TAC_y remains constant over time according to the TAC set by EU for 2015 and 2016. TAC in 2016 is then used each following years.
- Run 2: TAC_y gradually decreases every two years by 15%.
- Run 3: TAC_y follows the ICES WKFRAME3 approach.
- Run 4: Closure of the fishery (TAC_y=0).
- Run 5: TAC so that harvest rate stays at H_{MSY} levels.
- Additionnal runs for a range of constant TAC between 500 t to 8000 t.

Run 3 is based on the ICES WKFRAME3 approach. The following rules are applied:

- If B_y is below B_{MSY},

$$H_y = H_{MSY} \cdot \frac{B_{y-1}}{B_{MSY}}$$

As catch level C_y is simply H_y*B_y, recommended TAC_y would be expected to be:

$$TAC_y = H_{MSY} \cdot \frac{{B_{y-1}}^2}{B_{MSY}}$$

- If B_y is above or equal to B_{MSY},

$$TAC_y = H_{MSY} \cdot B_{y-1}$$

Run 6 has constant harvest rates set at HMSY. In order to keep H at HMSY, it is necessary to project the available biomass $B_y$the upcoming year using the surplus production model equation. This gives the following harvest control rule:

$$TAC_y = H_{MSY} \cdot \frac{B_{y-1} + r \cdot B_{y-1} \cdot \left(\frac{1-B_{y-1}}{K}\right)}{1 + H_{MSY}}$$

The corresponding TACs are shown in the table below. Runs 3 and 5 (WKFRAME approach and H_{MSY}) are the only scenarios where TAC is increasing.

RUN	CURRENT TAC #1	85% TAC #2	WKFRAME#3	CLOSURE #4	HMSY TAC #5
TAC2015	4010	4010	4010	4010	4010
TAC2016	4078	3409	5589	0	5716
TAC2017	4078	3409	5635	0	5728
TAC2018	4078	2897	5666	0	5739
TAC2019	4078	2897	5698	0	5750
TAC2020	4078	2463	5711	0	5759
TAC2021	4078	2463	5731	0	5763
TAC2022	4078	2093	5751	0	5766
TAC2023	4078	2093	5768	0	5770
TAC2024	4078	1779	5786	0	5773
TAC2025	4078	1779	5800	0	5776

WKFRAME (Run 3), H_{MSY} TACs (Run 5) have TACs between 5500 and 5800 t which is at least 1.5 kt more than the current TACs. Apart from a fishery closure (Run 4), 85% TAC (Run 2) is the only run where TAC decreases year after year.

In regards to reference points, the results of the different scenarios are discussed below for both reference and survey based runs. Results are expressed as probabilities to reach a given threshold (B_{MSY}, MSY $B_{trigger}$, H_{MSY}).

Results have to be considered carefully especially considering the EU TAC because this value is a combined TAC with roughhead grenadier. Current landings of grenadier are much lower than this TAC.

Probability of being above MSY Btrigger

In most cases, biomass will stay above MSY Btrigger and increase year after year except. There are a few exceptions. For the reference run, keeping the current TAC will lower the probability as well as constant TAC avec above 4000 t. For the survey-based run, the probability to stay above MSY Btrigger will decrease with time using the WKFRAME option as well as when TAC is above 4000 t.

P(B > MSY Btrigger)

Model run	Scenario	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Reference run	current TAC	0.86	0.82	0.78	0.75	0.73	0.70	0.69	0.67	0.65	0.64	0.63	0.62
	85%TAC	0.86	0.82	0.81	0.80	0.81	0.83	0.84	0.86	0.87	0.88	0.90	0.91
	WKFRAME3	0.86	0.82	0.87	0.90	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	Closure	0.86	0.82	0.92	0.96	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00
	TAC=500t	0.86	0.82	0.91	0.94	0.98	0.99	0.99	0.99	0.99	1.00	1.00	1.00
	TAC=1000t	0.86	0.82	0.89	0.93	0.96	0.98	0.99	0.99	0.99	0.99	0.99	0.99
	TAC=2000t	0.86	0.82	0.86	0.89	0.91	0.92	0.93	0.94	0.95	0.96	0.96	0.97
	TAC=3000t	0.86	0.82	0.84	0.84	0.84	0.85	0.85	0.85	0.86	0.86	0.86	0.86
	TAC=4000t	0.86	0.82	0.79	0.76	0.74	0.72	0.70	0.68	0.67	0.66	0.65	0.64
	TAC=5000t	0.86	0.82	0.74	0.68	0.62	0.58	0.54	0.51	0.49	0.47	0.45	0.43
	TAC=6000t	0.86	0.82	0.70	0.59	0.52	0.46	0.41	0.35	0.31	0.29	0.25	0.23
	TAC=7000t	0.86	0.82	0.65	0.52	0.42	0.33	0.27	0.22	0.18	0.15	0.13	0.12
	TAC=8000t	0.86	0.82	0.61	0.45	0.32	0.22	0.17	0.13	0.09	0.07	0.05	0.04
	Hmsy TAC	0.86	0.82	0.86	0.90	0.92	0.94	0.96	0.98	0.98	0.99	0.99	0.99
Survey based run	current TAC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99
	85%TAC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	WKFRAME3	1.00	1.00	1.00	0.99	0.98	0.98	0.97	0.96	0.94	0.93	0.92	0.90
	Closure	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=500t	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=1000t	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2000t	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=3000t	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=4000t	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99
	TAC=5000t	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98	0.97	0.97	0.97	0.96
	TAC=6000t	1.00	1.00	1.00	0.99	0.98	0.97	0.95	0.93	0.92	0.90	0.88	0.86
	TAC=7000t	1.00	1.00	0.99	0.98	0.96	0.93	0.89	0.84	0.81	0.77	0.73	0.70
	TAC=8000t	1.00	1.00	0.99	0.97	0.92	0.86	0.78	0.72	0.65	0.57	0.51	0.46
	Hmsy TAC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Probability of being above B_{MSY}

Except the H_{MSY} run, any scenario might theoretically bring the stock biomass to MSY levels at some point in the future. The faster way to reach BMSY is to close the fishery or applying an 85% TAC (Run 2) because in both cases TAC will decrease. With the H_{MSY} run, the probability stays constant. This is likely to be linked to the way the TAC is calculated and may not be a realistic indicator here. Median biomass still increases but the confidence intervals decrease at the same pace. Both effects compensate leaving the false impression of biomass not increasing to B_{MSY}.

For the reference run, the low biomass estimates put lots of contrast between scenarios and it takes in each case a longer time to reach B_{MSY}. With the closure of the fishery, the "fastest scenario", median biomass would reach B_{MSY} by 2021. On the opposite, with the survey based run, in most situations, biomass will reach that level by 2016 as long as the TAC is lower than 6000t each year. This cap is also noticed for the reference run as biomass keeps increasing under that threshold and then decreases.

Overall, the survey based run has a higher probability to stay above B_{MSY} because of absolute biomass estimates.

P(B > BMSY)

Model run	Scenario	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	current TAC	0.03	0.04	0.05	0.06	0.07	0.08	0.10	0.12	0.13	0.14	0.15	0.16
	85% TAC	0.03	0.04	0.05	0.07	0.09	0.12	0.15	0.18	0.22	0.28	0.33	0.39
	WKFRAME3	0.03	0.04	0.06	0.10	0.13	0.17	0.20	0.24	0.28	0.30	0.33	0.36
Reference run	Closure	0.03	0.04	0.07	0.13	0.21	0.30	0.41	0.52	0.62	0.72	0.81	0.87
	TAC=500t	0.03	0.04	0.07	0.12	0.18	0.26	0.35	0.46	0.54	0.63	0.71	0.79
	TAC=1000t	0.03	0.04	0.07	0.12	0.16	0.22	0.30	0.39	0.47	0.54	0.62	0.69
	TAC=2000t	0.03	0.04	0.06	0.09	0.13	0.17	0.21	0.27	0.32	0.39	0.44	0.50
	TAC=3000t	0.03	0.04	0.05	0.07	0.10	0.13	0.15	0.18	0.21	0.24	0.28	0.31
	TAC=4000t	0.03	0.04	0.05	0.06	0.07	0.09	0.10	0.12	0.13	0.14	0.16	0.17
	TAC=5000t	0.03	0.04	0.04	0.05	0.05	0.05	0.06	0.07	0.07	0.07	0.08	0.09
	TAC=6000t	0.03	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
	TAC=7000t	0.03	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
	TAC=8000t	0.03	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00
	Hm sy TAC	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	current TAC	0.43	0.48	0.51	0.56	0.61	0.65	0.68	0.71	0.73	0.75	0.77	0.78
	85% TAC	0.43	0.48	0.53	0.60	0.67	0.72	0.77	0.82	0.86	0.90	0.92	0.94
	WKFRAME3	0.43	0.48	0.48	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
	Closure	0.43	0.48	0.63	0.75	0.84	0.92	0.96	0.98	0.99	1.00	1.00	1.00
	TAC=500t	0.43	0.48	0.61	0.73	0.82	0.89	0.94	0.97	0.98	0.99	1.00	1.00
	TAC=1000t	0.43	0.48	0.60	0.71	0.78	0.86	0.92	0.94	0.97	0.98	0.99	1.00
Survey based run	TAC=2000t	0.43	0.48	0.56	0.67	0.75	0.80	0.85	0.89	0.92	0.94	0.97	0.97
	TAC=3000t	0.43	0.48	0.55	0.62	0.69	0.73	0.77	0.82	0.84	0.87	0.90	0.92
	TAC=4000t	0.43	0.48	0.52	0.56	0.61	0.65	0.69	0.71	0.74	0.76	0.78	0.80
	TAC=5000t	0.43	0.48	0.49	0.51	0.54	0.55	0.57	0.58	0.60	0.63	0.64	0.65
	TAC=6000t	0.43	0.48	0.48	0.47	0.47	0.47	0.47	0.47	0.46	0.46	0.46	0.45
	TAC=7000t	0.43	0.48	0.45	0.42	0.40	0.38	0.37	0.35	0.33	0.31	0.29	0.27
	TAC=8000t	0.43	0.48	0.42	0.38	0.34	0.30	0.25	0.23	0.20	0.18	0.15	0.13
	Hm sy TAC	0.43	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48

Probability of being below H_{MSY}

The probability of being below H_{MSY} increases after 2016 except for Run 3 (WKFRAME) which decreases from 0.92 in 2016 to 0.63 in 2025 and also, for the survey based run when the TAC is set at 6000 t or above. Run 5 (H_{MSY}) stays constants at H_{MSY}, which validates the TAC formula used for this scenario. The higher biomass estimates from the survey-based run led to a higher probability of being below H_{MSY}.

P(H< HMSY)

Model run	Scenario	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Reference run	current TAC	0.99	0.22	0.22	0.24	0.25	0.28	0.29	0.30	0.32	0.35	0.39	0.42
	85%TAC	0.99	0.22	0.39	0.42	0.57	0.60	0.74	0.76	0.86	0.87	0.92	0.93
	WKFRAME3	0.99	0.22	0.92	0.89	0.86	0.82	0.78	0.74	0.71	0.68	0.66	0.63
	Closure	0.99	0.22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=500t	0.99	0.22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=1000t	0.99	0.22	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2000t	0.99	0.22	0.86	0.88	0.89	0.91	0.92	0.92	0.93	0.93	0.95	0.96
	TAC=3000t	0.99	0.22	0.51	0.53	0.55	0.58	0.61	0.63	0.65	0.67	0.69	0.71
	TAC=4000t	0.99	0.22	0.24	0.26	0.28	0.29	0.31	0.32	0.34	0.37	0.41	0.43
	TAC=5000t	0.99	0.22	0.10	0.11	0.12	0.13	0.14	0.16	0.20	0.23	0.27	0.33
	TAC=6000t	0.99	0.22	0.03	0.03	0.04	0.05	0.09	0.13	0.20	0.27	0.35	0.41
	TAC=7000t	0.99	0.22	0.01	0.01	0.02	0.06	0.12	0.21	0.32	0.41	0.49	0.55
	TAC=8000t	0.99	0.22	0.00	0.01	0.03	0.09	0.21	0.34	0.46	0.55	0.64	0.71
	HmsyTAC	0.99	0.22	0.21	0.22	0.22	0.21	0.21	0.20	0.21	0.21	0.19	0.21
Survey based run	current TAC	1.00	0.86	0.86	0.87	0.88	0.89	0.90	0.91	0.92	0.92	0.92	0.93
	85%TAC	1.00	0.86	0.95	0.96	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00
	WKFRAME3	1.00	0.86	0.54	0.53	0.52	0.51	0.51	0.51	0.51	0.51	0.51	0.50
	Closure	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=500t	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=1000t	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2000t	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=3000t	1.00	0.86	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	1.00	1.00
	TAC=4000t	1.00	0.86	0.87	0.88	0.89	0.90	0.91	0.92	0.92	0.93	0.93	0.93
	TAC=5000t	1.00	0.86	0.69	0.70	0.71	0.71	0.71	0.71	0.72	0.73	0.73	0.75
	TAC=6000t	1.00	0.86	0.45	0.45	0.45	0.44	0.44	0.43	0.43	0.43	0.43	0.43
	TAC=7000t	1.00	0.86	0.25	0.24	0.23	0.22	0.21	0.21	0.20	0.20	0.21	0.21
	TAC=8000t	1.00	0.86	0.12	0.11	0.09	0.08	0.08	0.07	0.07	0.08	0.10	0.12
	HmsyTAC	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Conclusions

Overall, the resulting distributions of total biomass have increasing probabilities of being above B_{MSY} and MSY $B_{trigger}$ over time.

By 2020, a closure of the fishery would give a probability of 45% of being above B_{MSY} for the reference run and 100% for the survey based run. Overall, the survey-based run is more optimistic in most cases than the runs derived from the tallybook indices. This phenomena is directly linked to the steady increasing trends on the survey indices in comparison to the relatively flat indices from the tallybook. Some investigations are needed to understand the differences between the indices. In any cases, the slow increase of biomass towards MSY suggests that any management plan, forecast should probably span over a decade which is the same conclusion than last year.

9.2.7 Management considerations

The harvest rate for roundnose grenadier appears to be below H_{MSY} in Vb, VI, VII and also for runs in XIIb. SSB is below B_{MSY} in all regions and at low levels. For Vb, VI, VII, the assessment suggests a slow recovery of the stock while the inclusion of XIIb landings suggests a more stable situation.

Table 9.2.0a. Working Group estimates of landings of roundnose grenadier from Division Vb.

YEAR	FAROES	FRANCE	NORWAY	GERMANY	RUSSIA/USSR	UK (E+W)	UK (SCOT)	TOTAL
1988				1				1
1989	20	181		5	52			258
1990	75	1470		4				1549
1991	22	2281	7	1				2311
1992	551	3259	1	6				3817
1993	339	1328		14				1681
1994	286	381		1				668
1995	405	818						1223
1996	93	983		2				1078
1997	53	1059						1112
1998	50	1617						1667
1999	104	1861	2			29		1996
2000	48	1699		1		43		1791
2001	84	1932						2016
2002	176	774				81		1031
2003	490	1032				10		1532
2004	508	985	0	0	6	0	76	1575
2005	903	884	1	0	1	0	48	1837
2006	900	875	0	0	0	0	0	1775
2007	838	862	0	0	0	0	0	1700
2008	665	447	0	0	0	0	0	1112
2009	322	122	0	0	0	0	2	446
2010	229	381	0	0	0	0	1	611
2011	63	11	0	0	0	0	0	74
2012	16	28	0	0	0	0	0	44
2013	24	36	0	0	0	0	0	60
2014*	33	44	0	0	0	0	0	77

*** Provisional.**

Table 9.2.0b. Working Group estimates of landings of roundnose grenadier from Subarea VI.

YEAR	ESTONIA	FAROES	FRANCE	GERMANY	IRELAND	LITHUANIA	NORWAY	POLAND	RUSSIA	SPAIN	UK (E+W)	UK (SCOT)	TOTAL
1988		27		4							1		32
1989		2	2211	3								2	2218
1990		29	5484	2									5515
1991			7297	7									7304
1992		99	6422	142			5				2	112	6782
1993		263	7940	1								1	8205
1994			5898	15	14							11	5938
1995			6329	2	59							82	6472
1996			5888									156	6044
1997		15	5795		4							218	6032
1998		13	5170				21			3			5207
1999			5637	3	1					1			5642
2000			7478		41		1			1002	1	433	8956
2001	680	11	5897	6	31	137	32	58	3	6942	21	955	14773
2002	821		7209		12	1817		932			6	741	11538
2003	52	32	4924		11	939		452	3			185	6598
2004	26	12	4574	0	8	961	0	13	72	1991	0	72	7729
2005	80	24	2897	0	17	92	1	0	71	467	0	44	3694
2006	34	25	1931	0	5	112	0	0	0	393	0	15	2515
2007	0	10	1552	0	2	31	0	0	0	252	0	4	1851
2008	0	6	1433	0	0	23	0	0	16	458	0	27	1963

Year	Estonia	Faroes	France	Germany	Ireland	Lithuania	Norway	Poland	Russia	Spain	UK (E+W)	UK (Scot)	TOTAL
2009	0	6	1090	0	0	0	0	0	0	1900	0.3	15	3012
2010	0	13	1271	0	0	0	2	0	0	1498	1.2	23	2809
2011	0	4	1112	0	0	0	0	0	0	345	0	8	1469
2012	0	0	1088	0	0	0	0	0	0	258	2	0	1348
2013	0	0	934	0	0	0	0	0	0	482	6.2032	0	1423
2014*	0	0	630	0	0	0	0	0	0	428.61	0	0	1059

*** Provisional.**

Table 9.2.0c. Working Group estimates of landings of roundnose grenadier from Subarea VII.

Year	Faroes	France	Ireland	Spain	UK (Scot)	TOTAL
1988						0
1989		222				222
1990		215				215
1991		489				489
1992		1556				1556
1993		1916				1916
1994		1922				1922
1995		1295				1295
1996		1051				1051
1997		1033		5		1038
1998		1146		11		1157
1999		892		4		896
2000		859				859
2001		938	416			1354
2002	1	449	605		3	1058
2003		373	213		1	587
2004	0	248	320	0	0	568
2005	0	191	55	0	0	246
2006		248	138	0	0	386
2007		207	20	0	0	227
2008		27				27
2009		59				59
2010		41				41
2011		34				34
2012		48				48
2013		40				40
2014*		11				11

*** Provisional.**

Table 9.2.0d. Working Group estimates of landings of roundnose grenadier from Subarea XIIb.

Year	Estonia	Faroes	France**	Germany	Iceland	Ireland	Lithuania	Spain	USSR/Russia	UK (E+W)	UK (Scotl.)	Norway	Total
1988													0
1989			0						52				52
1990			0										0
1991			14						158				172
1992			13										13
1993		263	26	39									328
1994		457	20	9									486
1995		359	285										644
1996		136	179		77			1136					1528
1997		138	111					1800					2049
1998		19	116					4262					4397
1999		29	287					8251	6				8573
2000		6	374	9				5791		9	6		6195
2001		2	159			3		5922			7	1	6094
2002			14				18	10045		1	2		10080
2003			539			1	31	11663			1		12235
2004		8	1 693				120	10880	91		4		12796
2005	20	5	508				13	7804	81		350		8782
2006	27	1	85				6	4242					4361
2007	140	2	0				8	4108					4258
2008		0	0				3	2416	13				2432

Year	Estonia	Faroes	France**	Germany	Iceland	Ireland	Lithuania	Spain	USSR/Russia	UK (E+W)	UK (Scotl.)	Norway	Total
2009								5335					5335
2010			1					2758					2759
2011		3						1575					1578
2012		9						657					666
2013								796					796
2014*		3.6						828.72					832

*** Preliminary.**

**** French landings reported in former ICES Subarea XII allocated to XIIb.**

Table 9.2.0e. Working Group estimates of landings of roundnose grenadier unallocated landings in Vb VI and VII.

Year	Unallocated
1988	
1989	
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	
2000	
2001	208
2002	504
2003	952
2004	0
2005	0
2006	0
2007	0
2008	0
2009	
2010	
2011	
2012	6997.0
2013	1522.0
2014*	92.0

*** Provisional.**

Table 9.2.0f. Working Group estimates of landings of roundnose grenadier Vb, VI, VI and XIIb.

Year	Vb	VI	VII	XIIb	Unallocated	Vb,VI,VII	Overall total
1988	1	32	0	0	0	33	33
1989	258	2218	222	52	0	2698	2750
1990	1549	5515	215	0	0	7279	7279
1991	2311	7304	489	172	0	10104	10276
1992	3817	6782	1556	13	0	12155	12168
1993	1681	8205	1916	328	0	11802	12130
1994	668	5938	1922	486	0	8528	9014
1995	1223	6472	1295	644	0	8990	9634
1996	1078	6044	1051	1528	0	8173	9701
1997	1112	6032	1038	2049	0	8182	10231
1998	1667	5207	1157	4397	0	8031	12428
1999	1996	5642	896	8573	0	8534	17107
2000	1791	8956	859	6195	0	11606	17801
2001	2016	14773	1354	6094	208	18143	24445
2002	1031	11538	1058	10080	504	13627	24210
2003	1532	6598	587	12235	952	8717	21904
2004	1575	7729	568	12796	0	9872	22668
2005	1837	3694	246	8782	0	5777	14558
2006	1775	2515	386	4361	0	4676	9037
2007	1700	1851	227	4258	0	3778	8036
2008	1112	1963	27	2432	0	3102	5534
2009	446	3012	59	5335	0	4046	9381
2010	611	2809	41	2759	0	3461	6220
2011	74	1469	34	1578	0	1577	3155
2012	44	1348	48	666	6997	1440	9103
2013	60	1423	40	796	1522	1523	3841
2014*	77	1059	11	832	92	1147	2071

*** Preliminary.**

Table 9.2.1. Time-series of landings and lpues used for the reference and exploratory assessments.

	LANDINGS 1988–2014		ABUNDANCE INDICES		
Simulations	Reference, VB-VI-VII-DS survey	Vb-VI-VII-XIIb	Reference	Mar. Scot.	Vb, VI, VII, XIIb
				survey indices	
1988	33	33	-	-	-
1989	2698	2750	-	-	-
1990	7279	7279	-	-	-
1991	10104	10276	-	-	-
1992	12155	12168	-	-	-
1993	11802	12130	-	-	-
1994	8528	9014	-	-	-
1995	8990	9634	-	-	-
1996	8173	9701	-	-	-
1997	8182	10231	-	-	-
1998	8031	12428	-	-	-
1999	8534	17107	-	-	-
2000	11606	17801	1.000	1.000	1.000
2001	18143	24445	1.078	1.135*	1.078
2002	13627	24210	1.757	1.269	1.757
2003	8717	21904	0.460	1.258*	1.239
2004	9872	22668	0.465	1.247	0.970
2005	5777	14558	0.434	1.140	0.948
2006	4676	9037	0.361	0.887	0.808
2007	3778	8036	0.502	1.251	0.875
2008	3102	5534	0.593	1.471	0.904
2009	4046	9381	0.548	1.288	0.846
2010	3461	6220	0.473	1.260	0.682
2011	1577	3155	0.448	1.233	0.718
2012	1440	9103	0.527	1.612	0.651
2013	1523	3841	0.858	1.798	0.651
2014*	1147	2071	-	-	-

Table 9.2.2. Summary of results from the exploratory assessments.

			SIMULATIONS								
	Simulation	Year	Area Vb-VI-VII			Area Vb-VI-VII - DS			Area Vb-VI-VII-XIIb		
			Reference run			survey run			SALY exploratory run		
	Median biomass	1988	130857	+/-	1176	133714	+/-	2543	214567	+/-	1400
	+/- std dev	2014	37951	+/-	12047	63758	+/-	13802	73446	+/-	18121
	(tons)										
Standard	Average biomass	1988	130953			133905			214715		
outputs	(tons)	2014	39372			64824			74301		
	Med. Harvest rate	1988	0	+/-	0	0	+/-	0	0	+/-	0
	+/- std dev	2014	0.03	+/-	0.01	0.02	+/-	0	0.03	+/-	0.01
	Median Bmsy	all	65428	+/-	588	66857	+/-	1271	107283	+/-	700
	(tons)										
MSY	MSY Btrigger	2006	31653.5	+/-	5244	43980	+/-	7119	68474	+/-	7588
reference	(tons)										
points	Median Hmsy	all	0.08	+/-	0.01	0.09	+/-	0.01	0.08	+/-	0.01
	Target Cmsy	all	5085	+/-	382	5827	+/-	561	8581	+/-	794
	(tons)										
	P(B>Bmsy)	2014	0.03			0.42			0.05		
Risks	P(H<Hmsy)	2014	0.99			1.00			1.00		
	P(B>Btrig)	2014	0.86			1.00			0.69		

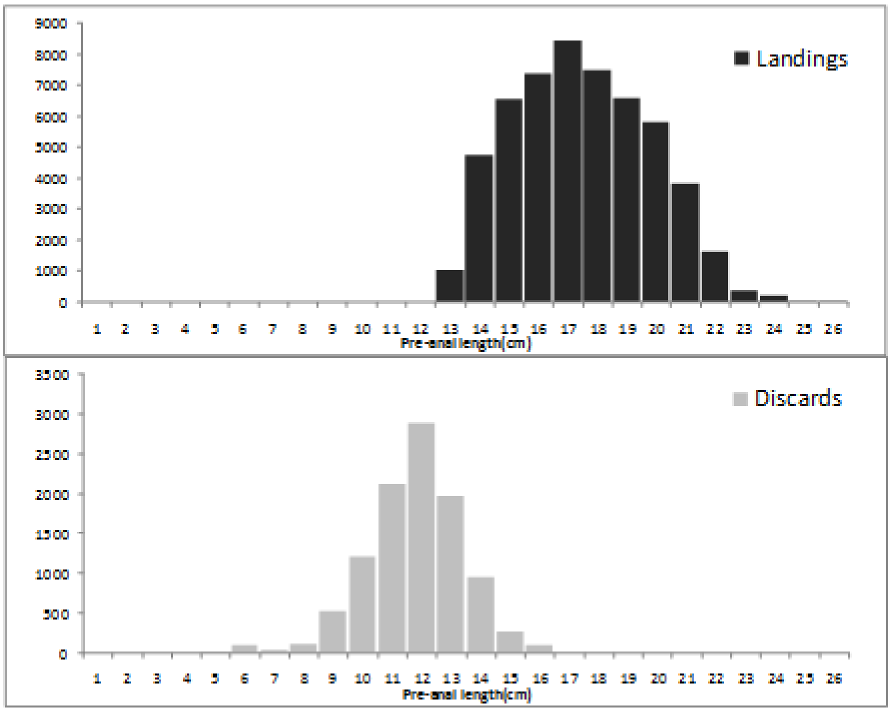


Figure 9.2.1. Length distribution of the landings and discards of the French fleet in Division Vb, VI, VII, XIIb based from on-board observations in 2014.

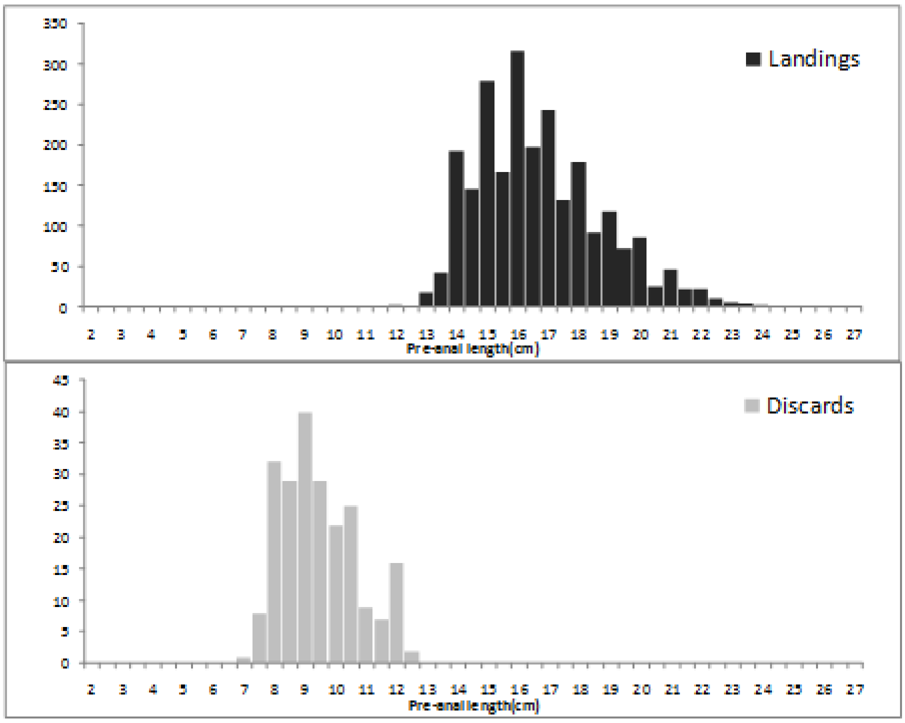


Figure 9.2.2. Length distribution of the landings by sex and discards of the Spanish fleet in Division VIb based from on-board observations in 2014.

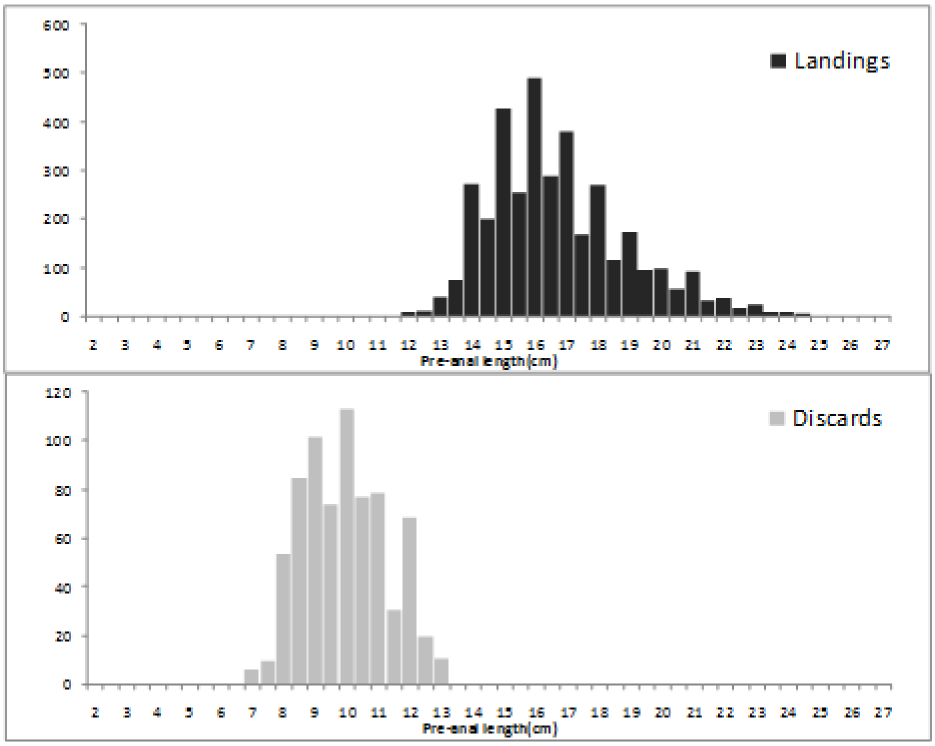


Figure 9.2.3. Length distribution of the landings by sex and discards of the Spanish fleet in Division XIIb based from on-board observations in 2014.

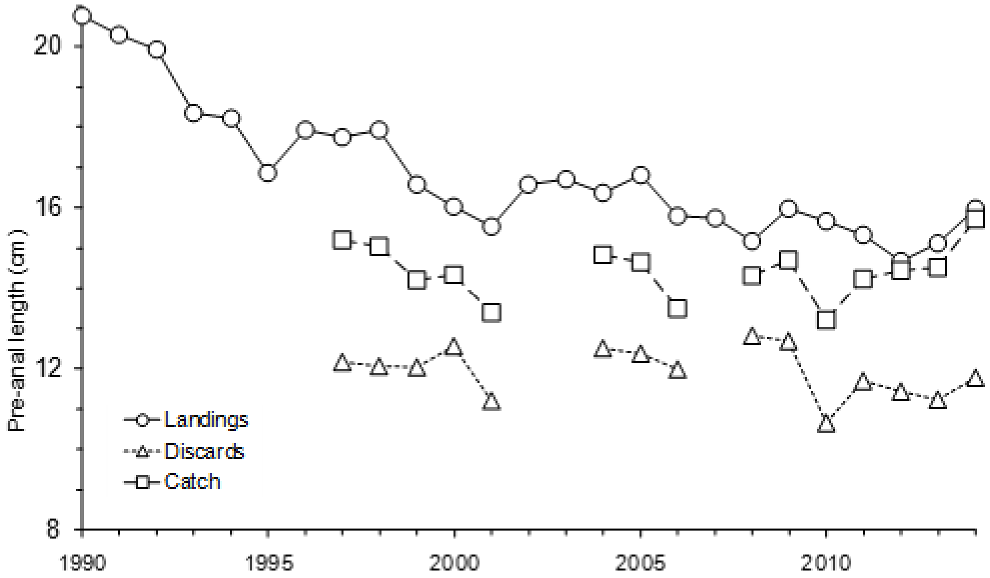


Figure 9.2.4. Evolution of the pre-anal length of roundnose grenadier in the French landings, catch and discards, 1990–2014.

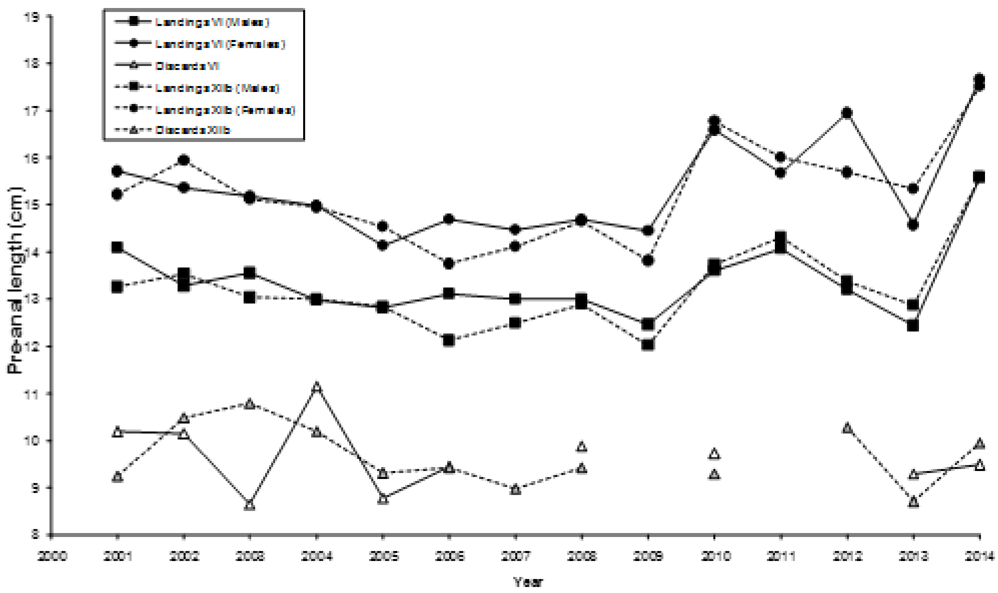


Figure 9.2.5.Evolution of the pre-anal length of roundnose grenadier in the Spanish landings and discards in Divisions VIb and XIIb, 2001–2014.

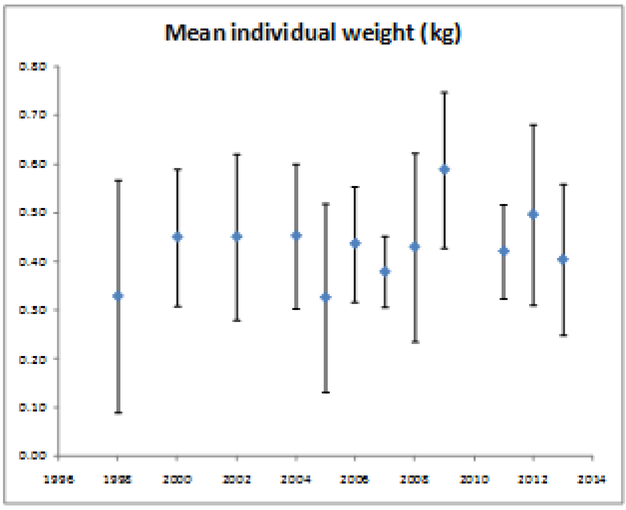


Figure 9.2.6. Mean individual weight of roundnose grenadier according to Marine Scotland deep-water survey in VIa.

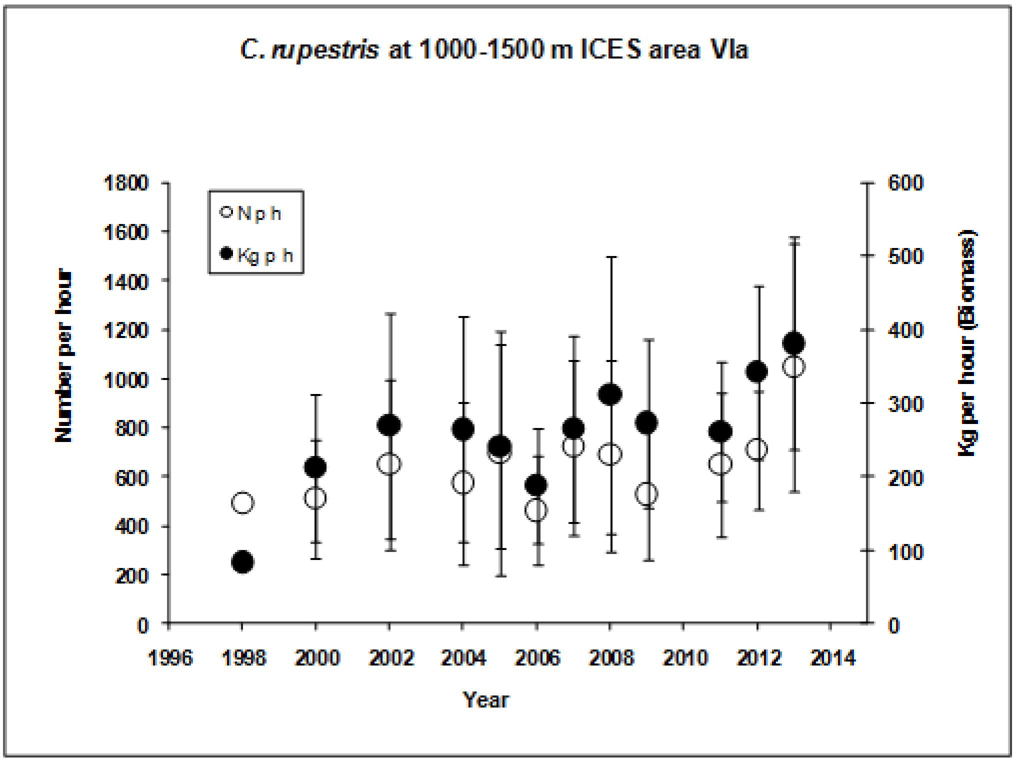


Figure 9.2.7. Abundance indices of roundnose grenadier according to Marine Scotland deep-water survey in VIa.

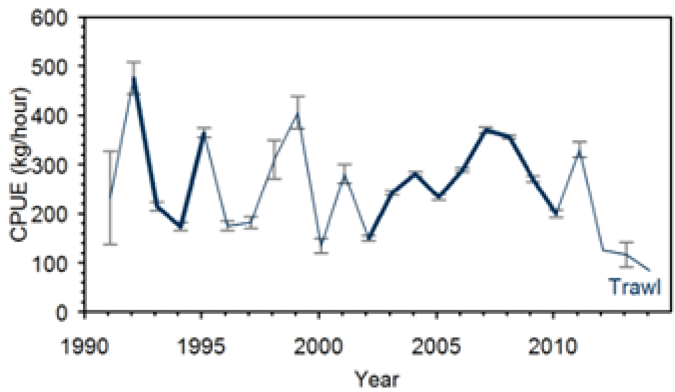


Figure 9.2.8. Roundnose grenadier in Vb. Cpue from otter-board trawlers. Criteria: >30% of roundnose grenadier in the catch.

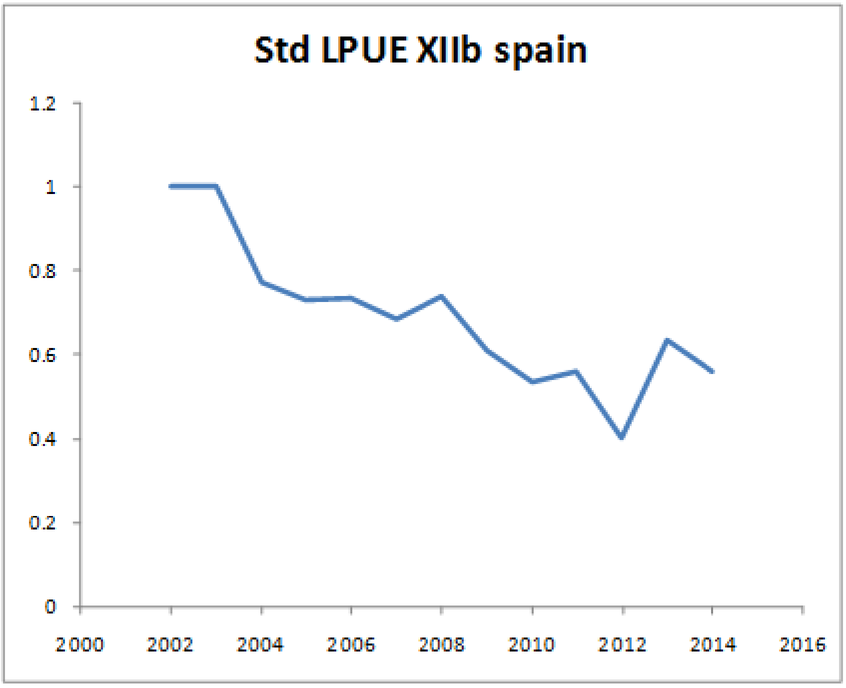


Figure 9.2.9. Lpue from the Spanish commercial fleet operating in XIIb.

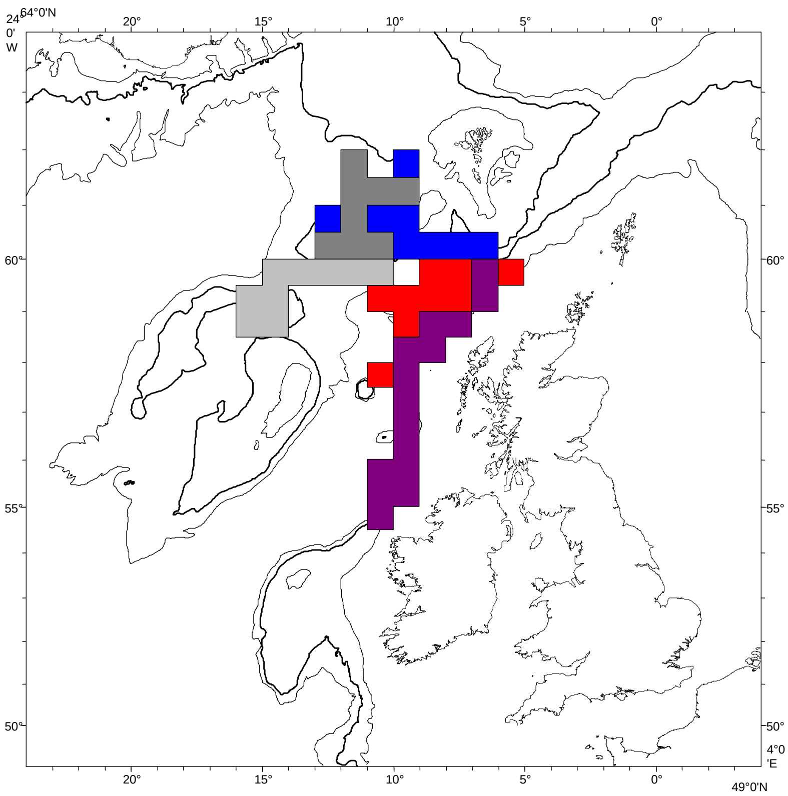


Figure 9.2.10. Reference areas (set of statistical rectangles) used to calculate French lpues (brown: New grounds in V (new5), grey new grounds in VI (new6); red: others in VI (other6); purple: edge in VI (edge6); blue: all grounds in VII (ref7). Depth contours are 200, 1000 and 2000 m.

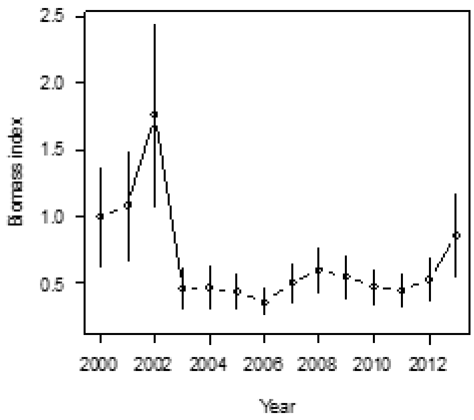


Figure 9.2.11. Time-series of abundance indices (calculated based upon the tallybook data). The grenadier abundance was predicted for the mean length of all tow carried out in every rectangle of the two small areas (edge6, other6) and averaged across rectangle.

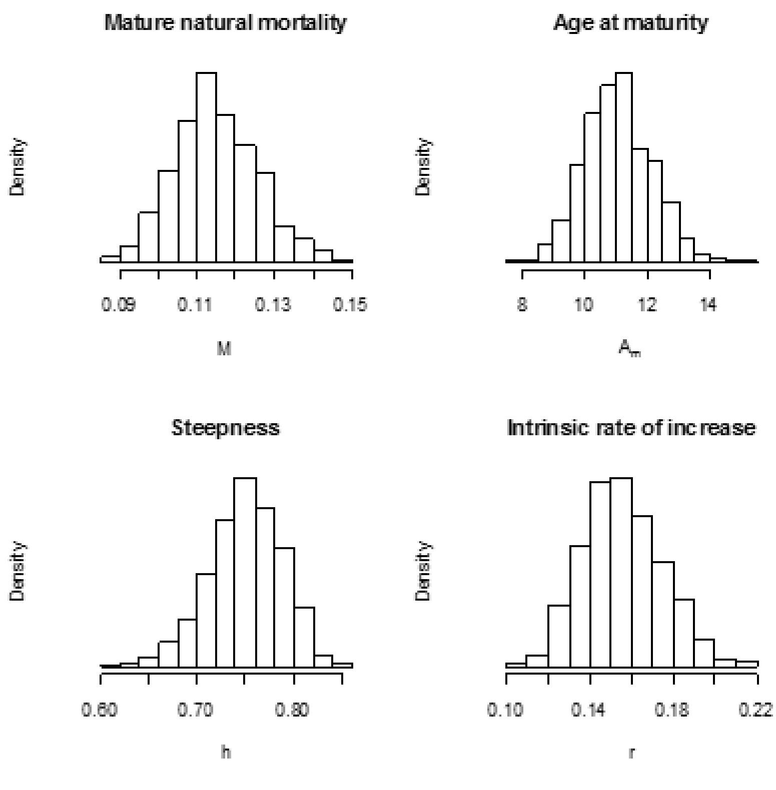


Figure 9.2.12. Distribution of initial life-history parameters used in the surplus production model.

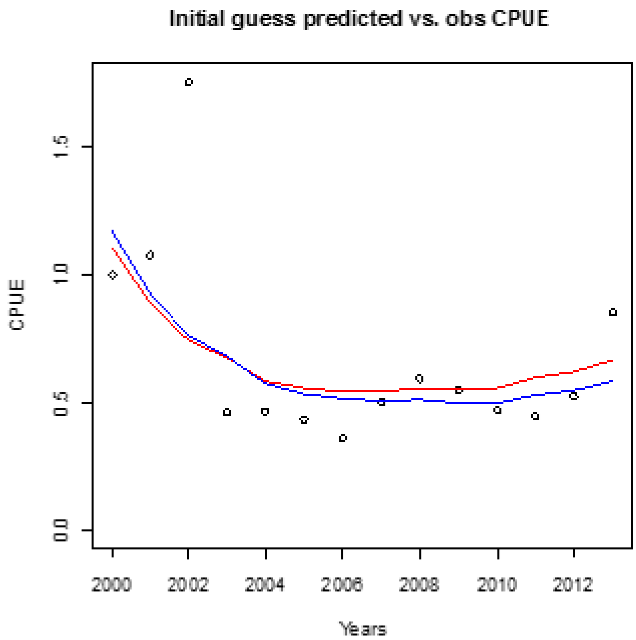


Figure 9.2.13. Predicted vs initial guess vs estimates of lpue for roundnose grenadier in Vb, VI, VII, based on commercial data.

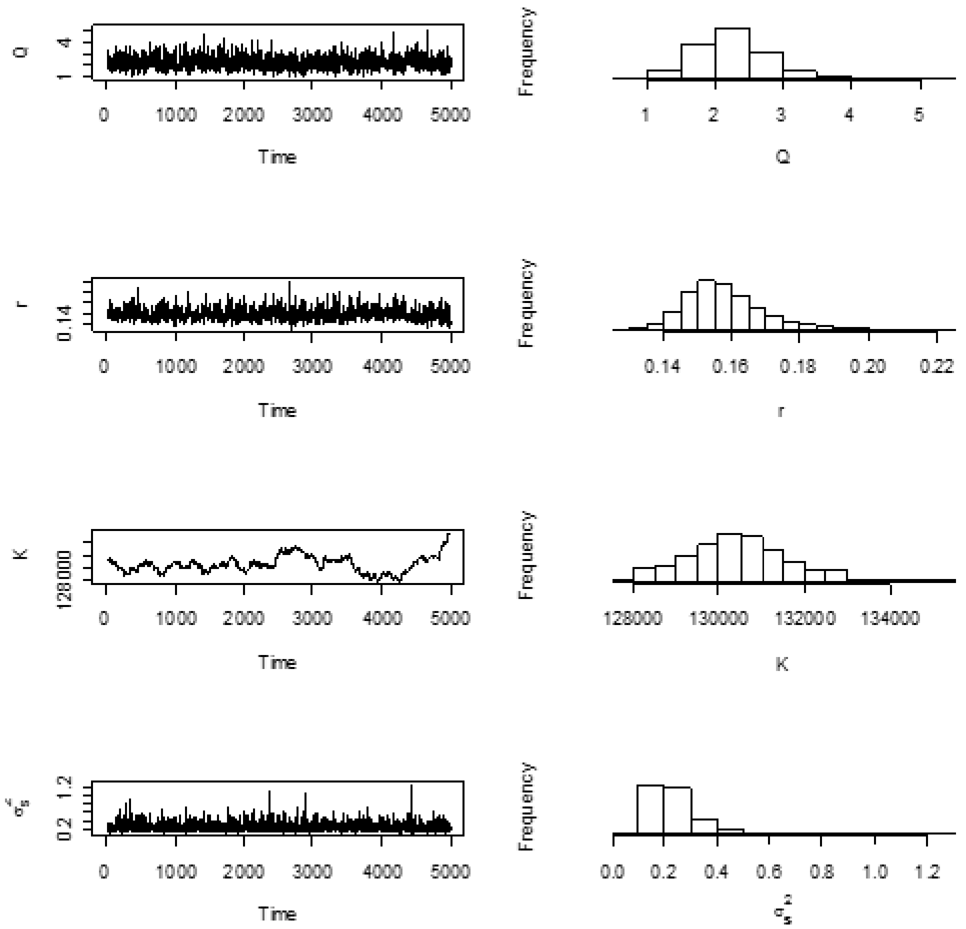


Figure 9.2.14. Diagnostic plots of the reference assessment on roundnose grenadier in Vb, VI, VII.

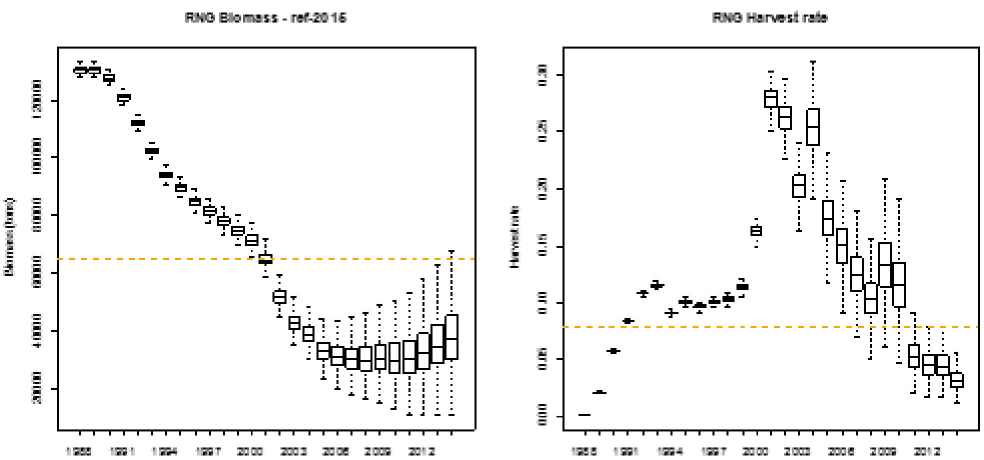


Figure 9.2.15. Estimated biomass and harvest rates from the reference simulation (Vb, VI, VII). Dotted lines are respectively B_{MSY} (left panel) and H_{MSY} levels (right panels).

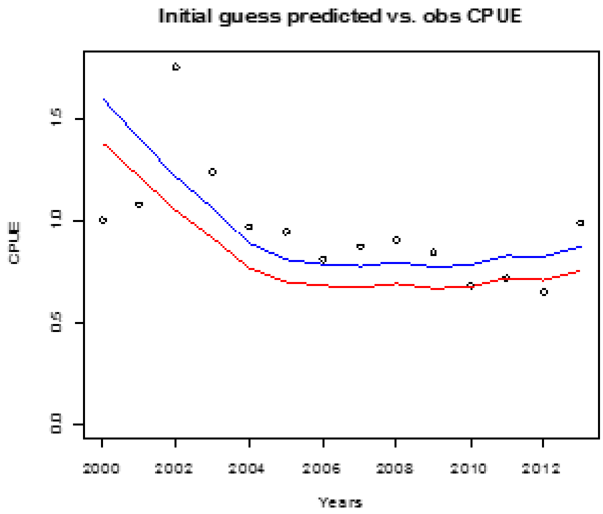


Figure 9.2.16. Predicted vs initial guess vs. estimates of lpue for roundnose grenadier in Vb, VI, VII, XIIb based on commercial data.

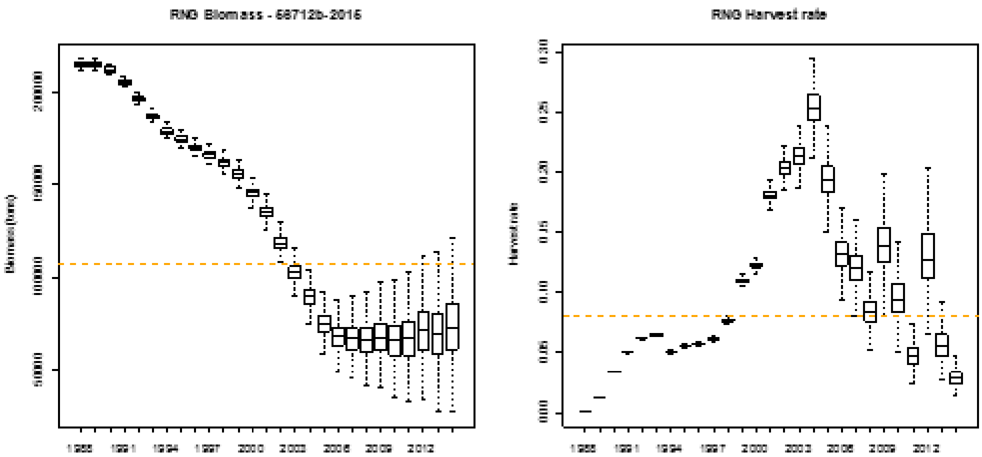


Figure 9.2.17. Estimated biomass and harvest rates using landings in Vb, VI, VII and XIIb.

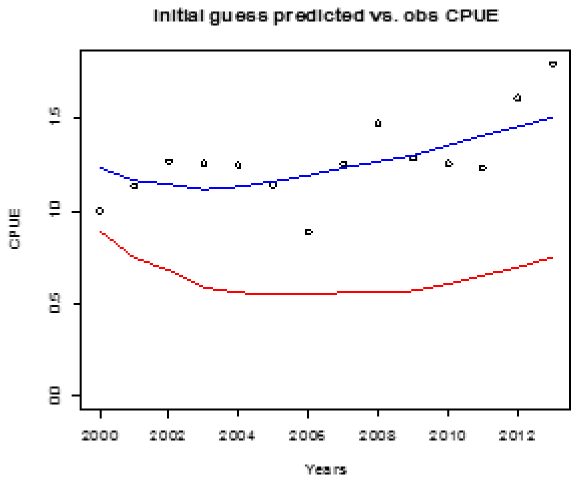


Figure 9.2.18. Predicted vs initial guess vs. estimates of lpue for roundnose grenadier in Vb, VI, VII, based on the Marine Scotland Deepwater science survey indices.

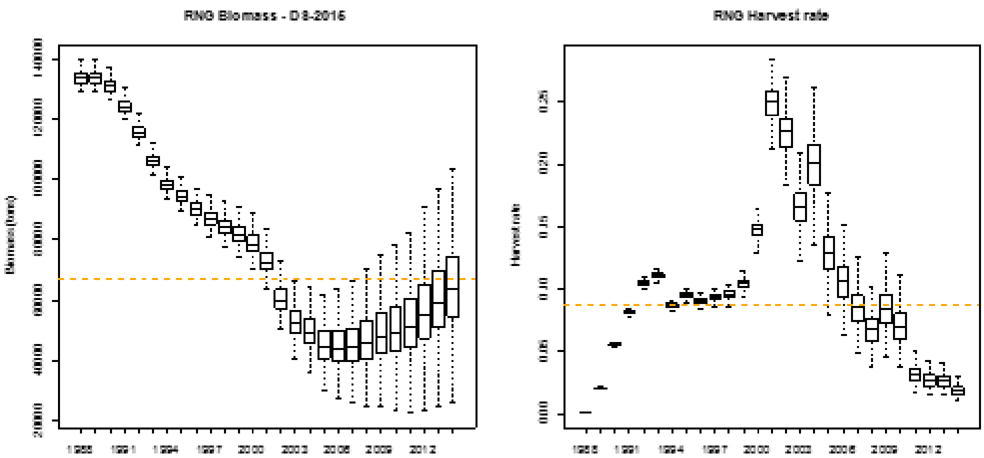


Figure 9.2.19. Estimated biomass and harvest rates using landings in Vb, VI, VII, based on the Marine Scotland Deepwater science survey indices.

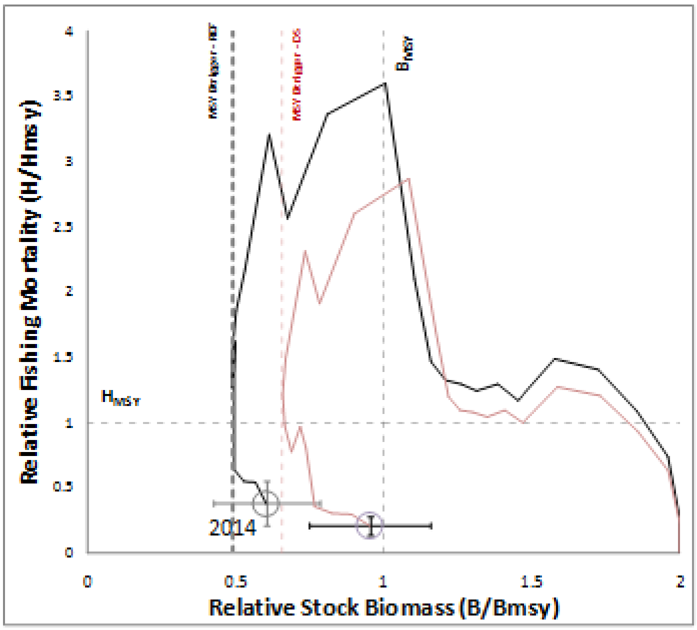


Figure 9.2.20. Comparative estimates of biomass between reference run (black line) in and survey based run (red line) in Vb, VI, VII.

9.3 Roundnose Grenadier (*Coryphaenoides rupestris*) in Division IIIa

9.3.1 The fishery

From the late 1980s until 2006 a Danish directed fishery for roundnose grenadier was conducted in the deeper part of Division IIIa. Until 2003 landings increased gradually, from around 1000 t to 4000 t with fluctuations. In 2004 and 2005 exceptionally high catches were reported; reaching almost 12 000 tonnes in 2005. This directed fishery stopped in 2006 due to implementation of new agreed regulations between EU and Norway.

At present, there are no directed fisheries for roundnose grenadier in Division IIIa.

9.3.2 Landings trends

The total landings by all countries from 1988–2014 are shown in Table 9.3.0 and Figure 9.3.0.

The landings from the directed fishery ceased in 2007 and the total landings have since been minor (<2 tonnes). The landings are now bycatches from other fisheries.

9.3.3 ICES Advice

The Advice for 2015 and 2016 is: "ICES advises on the basis of the precautionary considerations that there should be no directed fishery and bycatch should be minimized".

9.3.4 Management

There has been no directed fishery for roundnose grenadier since 2006. However, should a new fishery begin this would be subject to management regulations agreed at the consultative meeting in Oslo 31 January 2006 between the EU and Norway.

In Council Regulation (EU) No 1367/2014, fixing for 2015 and 2016 the fishing opportunities for EU vessels for fish stocks of certain deep-sea fish species, a TAC was set to 435 and 348 tonnes, respectively for EU vessels in EU waters and international waters of Subarea III.

9.3.5 Data available

9.3.5.1 Length compositions

Since the directed fishery has stopped there is no new information on size compositions from commercial catches other than the data given for the period 1996–2006 in the Stock Annex.

Updated information on size distribution from the Norwegian shrimp survey is given (Figure 9.3.1).

9.3.5.2 Age composition

No new age data are available.

Age data from survey catches in the Skagerrak in 1987 and 2007-2013 are available in Bergstad *et al.*, 2014.

9.3.5.3 Bycatch effort and cpue

There is updated information on estimated bycatch of roundnose grenadier in Norwegian shrimp fishery in ICES Division IVa and IIIa (Figure 9.3.2). These bycatch estimates were not obtained by sampling of the commercial catches but derived using the mean annual Norwegian shrimp-trawl survey catches of grenadier a depths <400 m and annual effort in the shrimp trawl fishery. The shrimp fishery in this area is mainly conducted shallower than the primary depth range of roundnose grenadier. It should be noted that commercial vessels fishing in the relevant areas use sorting grids to reduce bycatch, a device not used in the survey, hence survey-based estimates are likely to be overestimates.

9.3.5.4 Survey indices

The Norwegian annual shrimp survey conducted since 1984 samples deeper parts of the Skagerrak and northeastern North Sea (IIIa and IVa), including the depth range where the roundnose grenadier occurs (mainly 300–600 m). The minor area >600 m is an ammunition and warship dumping ground with warning against fishing).

9.3.6 Data analyses

A recent study analysed the time-series of abundance of roundose grenadier through the time-series (Bergstad *et al.*, 2014). Catch rates in terms of biomass (kg/h) and abundance (nos/h) were calculated for stations 300 m and deeper (Figure 9.3.3). Stations with zero catches were included, and the catches at non-zero stations were standardized by tow duration. The published analysis also includes a time-series of small grenadier, i.e. <5 cm PAFL, illustrating variation in recruitment.

9.3.6.1 Trends in landings, effort and estimated bycatches

Collated information on landings and survey-based estimates of bycatch suggest that the removals of roundnose grenadier are now at low levels in Division IVa and IIIa.

There is no longer a directed fishery for grenadier in this area and data on effort and cpue is therefore not available from the commercial catches. The earlier evaluation of the Danish cpue data were presented in ICES (2007) but these cpue data do not provide any clear indications of stock development and status for the time of the directed fishery which ceased in mid-2006.

Landings are now insignificant and represent bycatches from other fisheries. The estimated bycatch of roundnose grenadier from the Norwegian shrimp fishery is shown to be at low levels (less than 100 tonnes /year).

9.3.6.2 Size compositions

The recent length distributions from the Norwegian survey data contrasts with the 1991–2004 distributions by their low proportions of small fish (Bergstad *et al*., 2014). The pulse of juveniles appearing in the early 1990s appears to have represented the only major recruitment event through the time-series 1984–present. Recently some small juveniles appear every year in the survey, but there is no indication of a pronounced recruitment pulse as observed in the early 1990s.

The Danish and Norwegian length distributions, sampled from commercial landings and survey catches, respectively, agree well for those years covered by samples from both countries (1987 and 2004–2006) (See Stock Annex for information on the Danish length distributions from the directed fishery). Note that both in 1987 and 2004 there appear to be two clearly distinguishable components in the Danish length compositions. In the Norwegian data, several years show two modes and it is possible to follow the more abundant occurrence of juveniles<5 cm (PAL) through several years.

9.3.6.3 Biomass and abundances indices from survey

The survey catch rates in terms of biomass (kg/h) and abundance (nos/h) varied strongly through the time-series, but elevated levels were observed from 1998 to 2005. The indices have declined since 2004 with both biomass and abundance being lowest on record in 2015, also below the level observed in the period prior to the exploitation pulse in 2003–2005. Since the fishery is stopped and the bycatches are expected to be low, it is uncertain on why the survey catches still declines.

9.3.6.4 Age data

The age distribution from recent years contrasts with distributions from the 1980s (Bergstad, 1990b) in terms of proportions of old fish (e.g. >20 years) (Figure 9.3.4). After the exploitation pulse in 2003–2005, the proportion of old fish has declined to very low levels (Bergstad *et al*., 2014). In recent years, i.e. after 2006 the mean age in the catches has increased somewhat, but the proportion of fish >20 years remains low.

Analyses of size distributions and the time-series of survey abundance of small juveniles by Bergstad *et al*. (2014) suggested that only a single very abundant recruitment event occurred during the time period 1985–2015, perhaps only a single major year class. This event rejuvenated the stock and enhanced abundance in subsequent years.

Biological reference points

No biological reference points for category 6 or 7 stocks.

9.3.7 Comments on assessment

No analytical assessment was carried out. The abundance indices from the Norwegian survey, derived from the relevant depth range of the species in this area, provides currently the only source of abundance information.

9.3.8 Management considerations

The decline in abundance after 2005–2006 suggested by the Norwegian shrimp survey catch rates probably reflect the combined effect of the enhanced targeted exploitation in 2003–2005 and low recruitment in the years following the single recruitment pulse in the early 1990s. The percentage of fish >15 cm is at a lower level as in the late 1980s and early 1990s, and there is no suggestion of a new recruitment pulse as seen in the 1990s. Recent age distributions almost lack the >20 year old component which was prominent in the 1980s.

Since the targeted fishery has stopped and the bycatch in the shrimp fishery seems low and probably decreasing, the potential for recovery of the roundnose grenadier in Skagerrak may be good. However, current abundance levels appear the lowest recorded during the survey time period 1984–2015 and rejuvenation and growth of the population would at present seem unlikely due to low recruitment during the recent decade.

Table 9.3.0. Roundnose grenadier in Division IIIa. WG estimates of landings.

Year	Denmark	Norway	Sweden	TOTAL
1988	612		5	617
1989	884		1	885
1990	785	280	2	1067
1991	1214	304	10	1528
1992	1362	211	755	2328
1993	1455	55		1510
1994	1591		42	1633
1995	2080		1	2081
1996	2213			2213
1997	1356	124	42	1522
1998	1490	329		1819
1999	3113	13		3126
2000	2400	4		2404
2001	3067	35		3102
2002	4196	24		4220
2003	4302			4302
2004	9874	16		9890
2005	11 922			11 922
2006	2261	4		2265
2007	+	1		1
2008	+	+		+
2009	2	+	+	2
2010	1	+	+	1
2011		0		0
2012	1	0		1
2013	1	0		1
2014*	0,6	0	0,4	1

*** Preliminary data.**

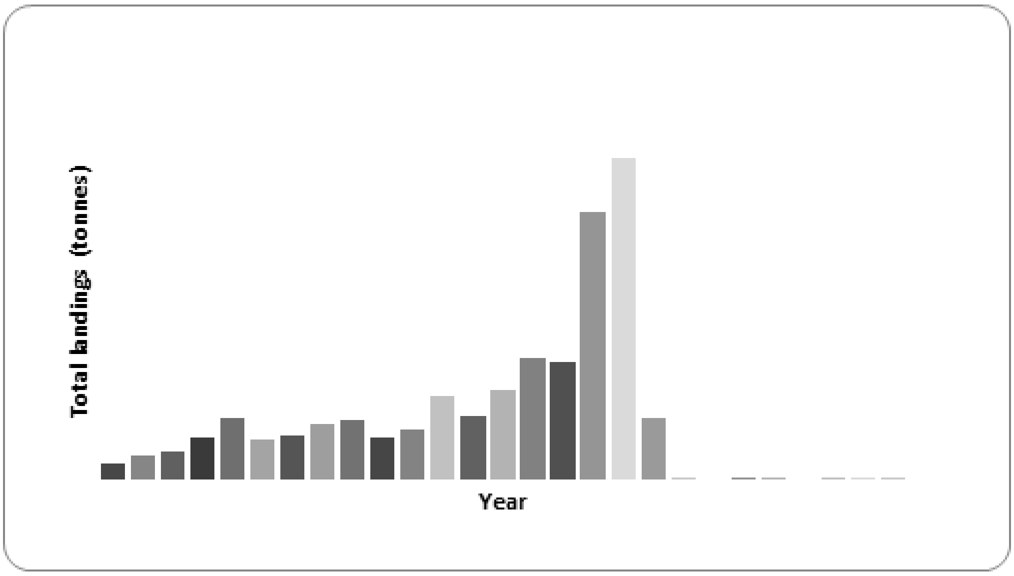


Figure 9.3.0. Landings of roundnose grenadier from Division IIIa. Landings from 2007–2014 are insignificant.

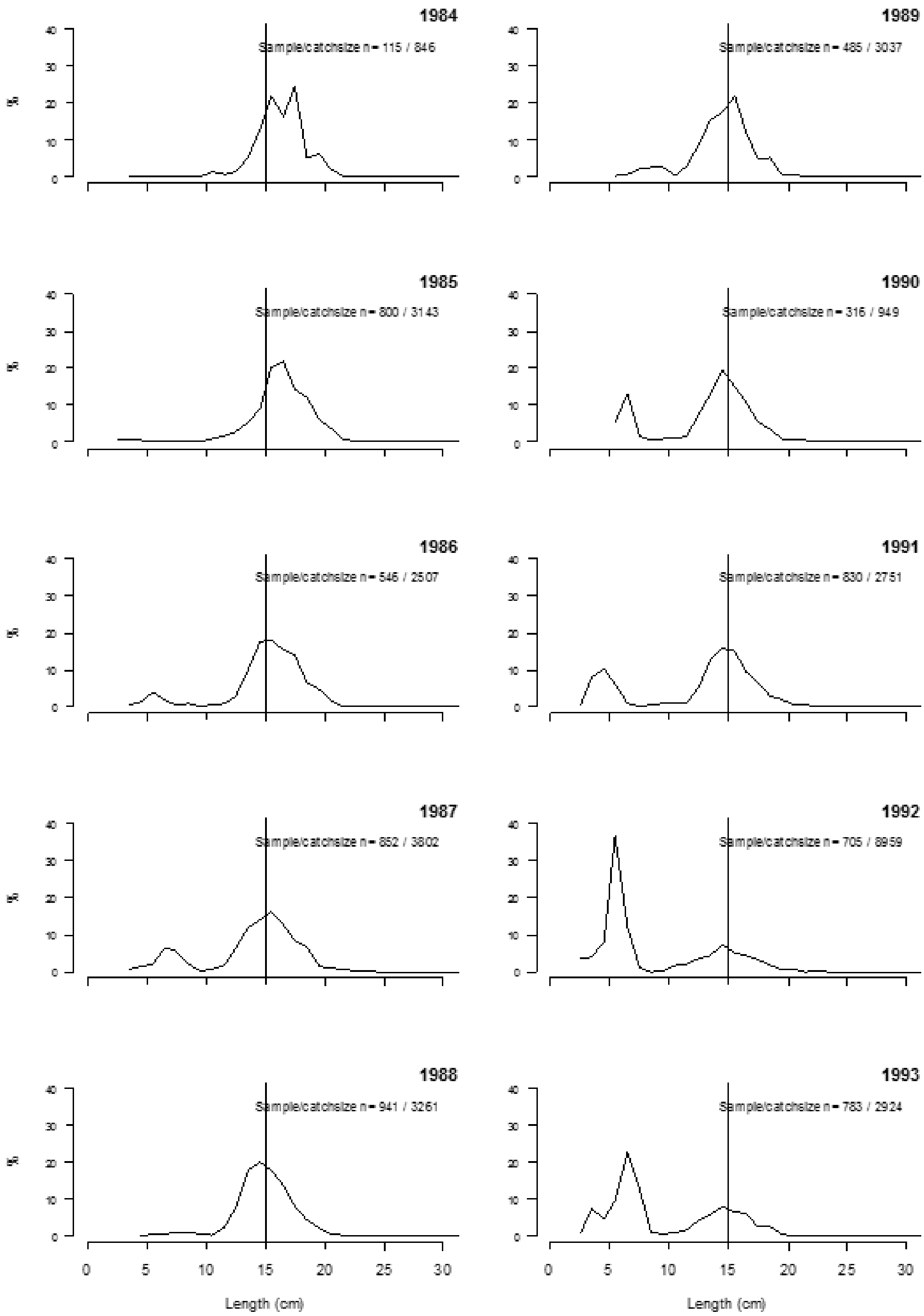


Figure 9.3.1. Length–frequency distributions for roundnose grenadier, 1984–2015. Data from Norwegian shrimp survey, all catches deeper than 300 m. Length is measured as pre-anal fin length in cm. The distributions are calculated as percent number of fish in each cm length interval standardized to total catch number and trawling distance for each station each year.

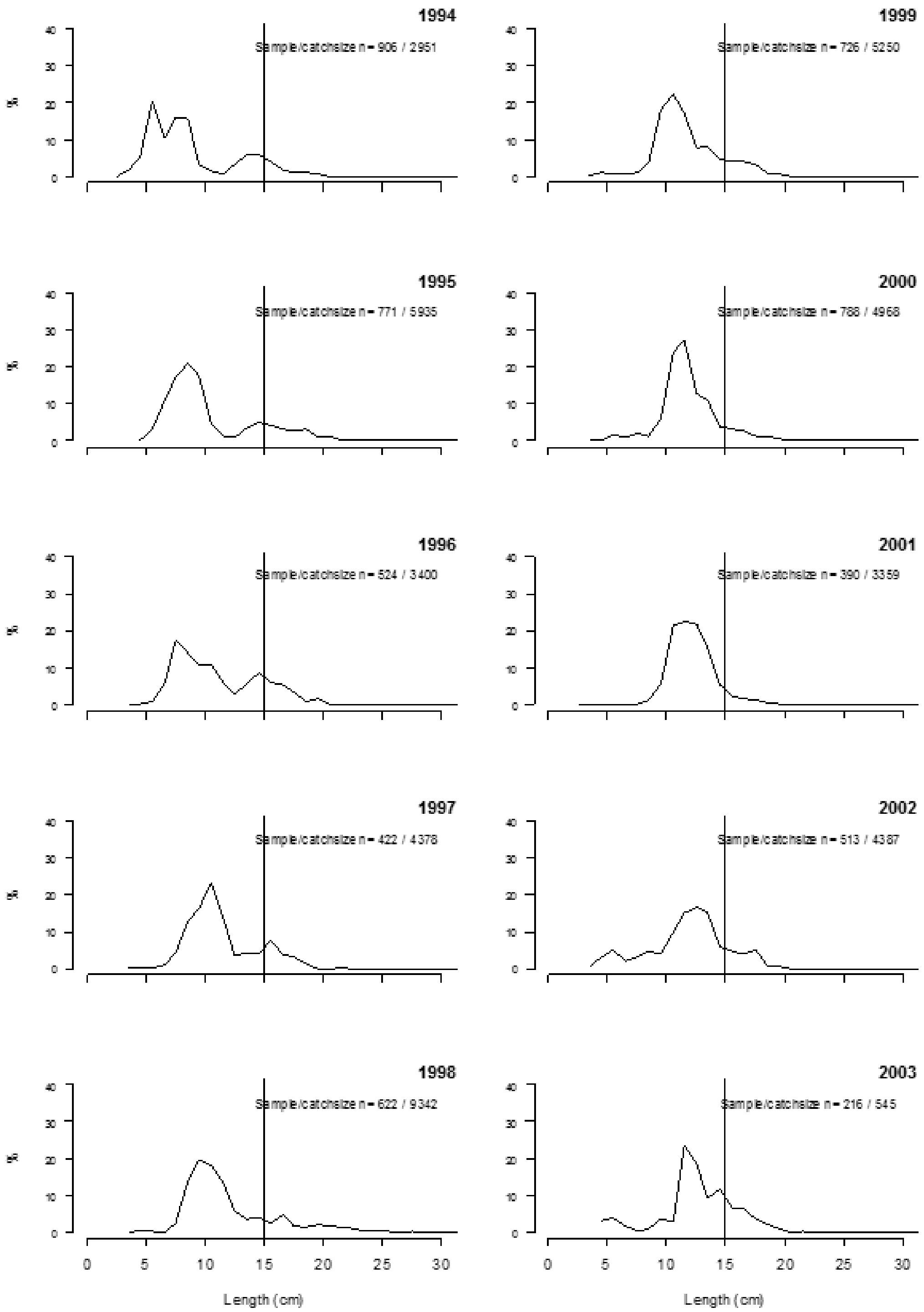


Figure 9.3.1. (Con't).

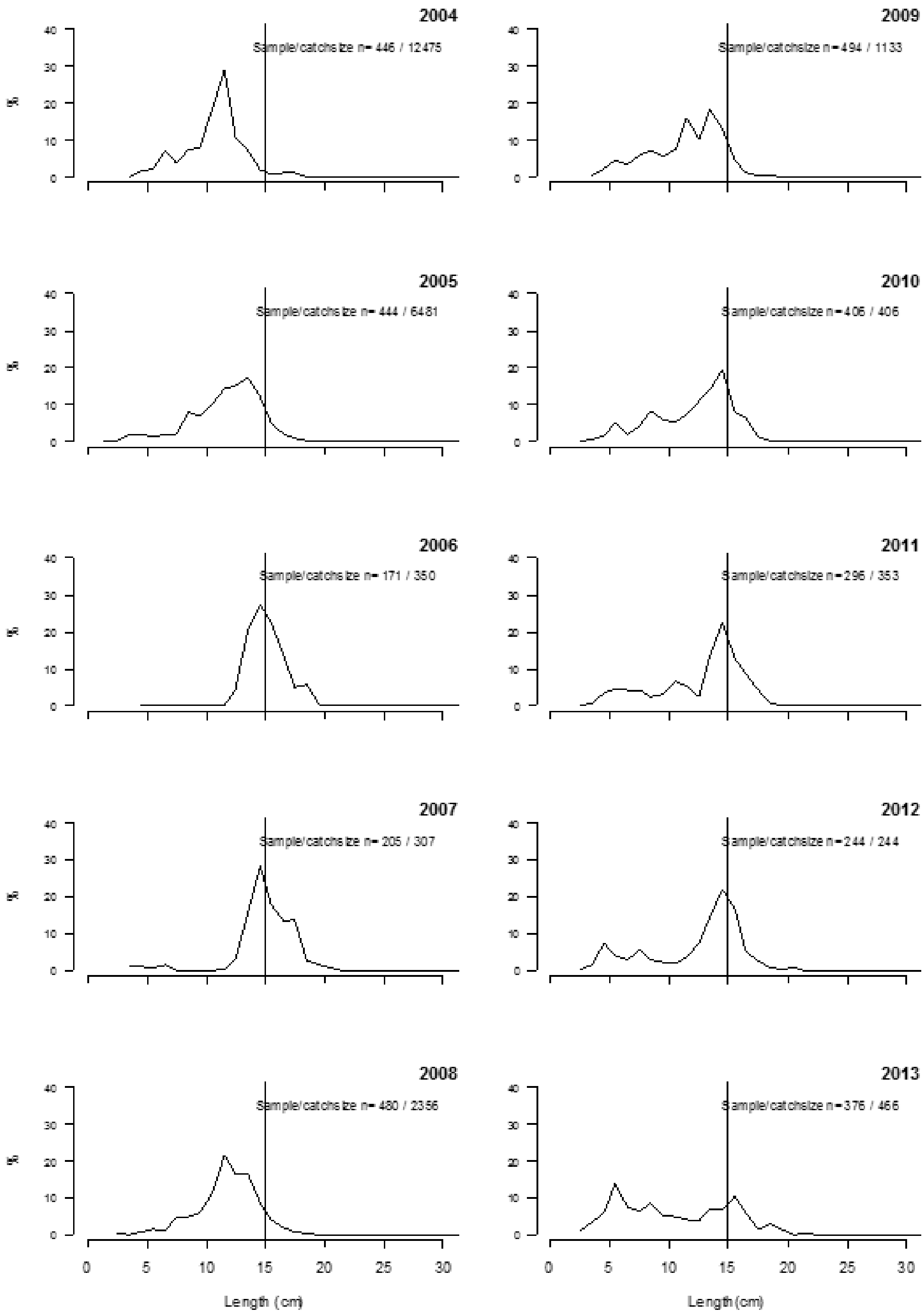


Figure 9.3.1. (Con't).

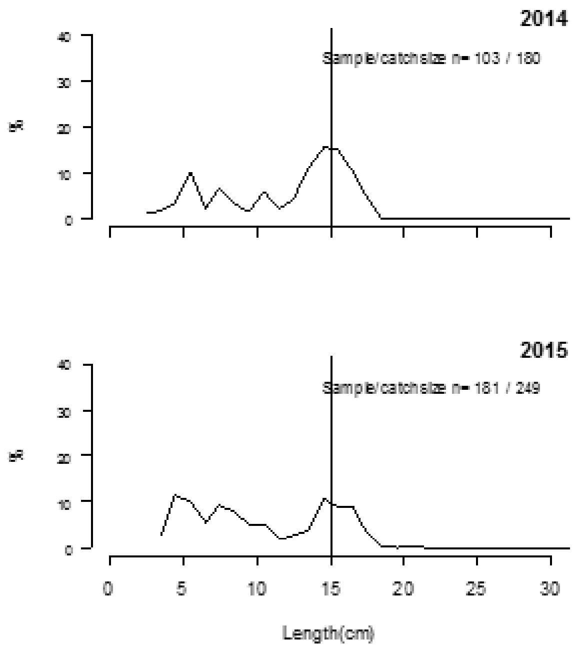


Figure 9.3.1. (Con't).

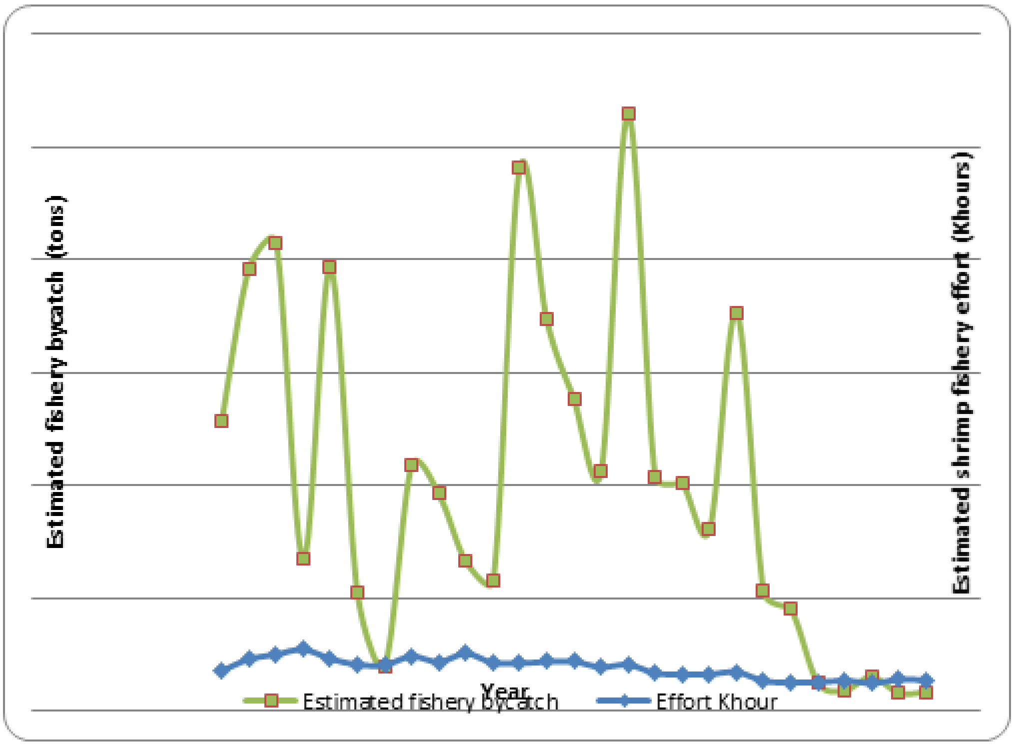


Figure 9.3.2. Estimated bycatch of roundnose grenadier in the Norwegian shrimp fishery in ICES Division IVa and IIIa, and the estimated commercial shrimp fishery effort in the same area. See text for explanation.

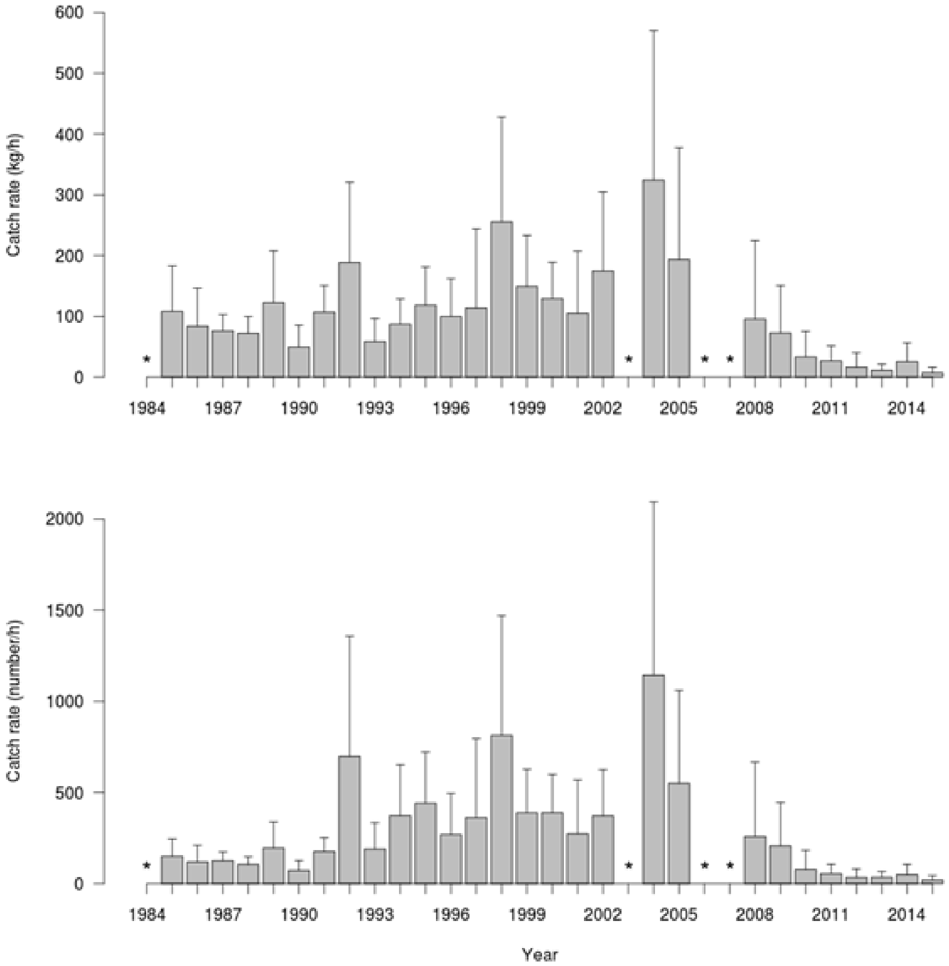


Figure 9.3.3. Survey catch rates in biomass (kg/h) and abundance (nos/h) of grenadier 1984–2015. Note: in 1984, 2003, 2006, and 2007 only a single or no trawls were made deeper than 400 m, thus the primary grenadier habitat was not sampled. Lines indicate estimates of 2SE (Updated from Bergstad *et al.*, 2013).

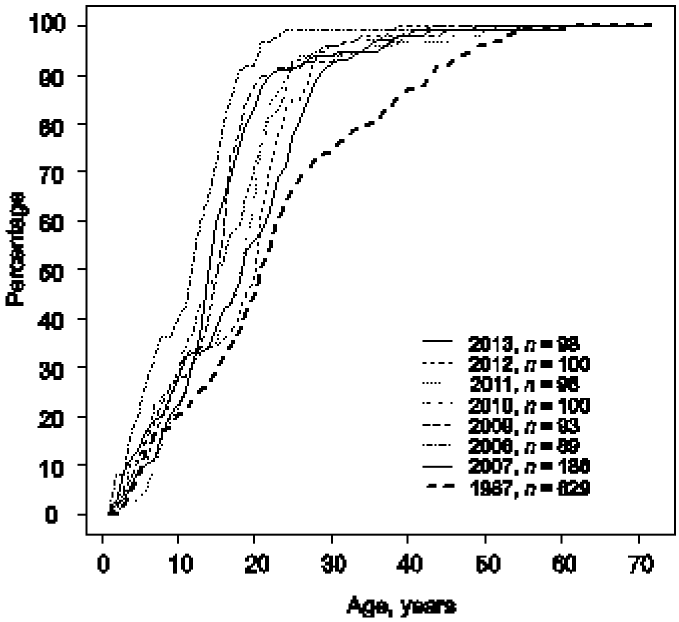


Figure 9.3.4. Cumulative age distributions of roundnose grenadier in the Skagerrak. Data from survey catches in the Skagerrak in 1987 and 2007–2013. The distribution from 1987 was modified from Bergstad (1990). Data from 2007 were collected on the deep-water fish survey in April.

9.3.9 References

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9.4 Roundnose Grenadier (*Coryphaenoides rupestris*) in Divisions Xb, XIIc and Subdivisions Va1, XIIa1, XIVb1

9.4.1 The fishery

The fishery on the Northern Mid-Atlantic Ridge (MAR) started in 1973, when dense concentrations of roundnose grenadier were discovered by USSR exploratory trawlers. Roundnose grenadier aggregations may have occurred on 70 seamount peaks between 46–62°N but only 30 of them were commercially important and subsequently exploited. Since the early nineties fisheries on MAR have been sporadic and much smaller in scale. The main nations participating in the fishery are Spain (since 2010) and Russia (since 2000).

9.4.1.1 Landings trends

The greatest annual catch (almost 30 000 t) was taken by the Soviet Union in 1975 (Tables 9.4.1–9.4.4, Figure 9.4.1) and in subsequent years the Soviet catch varied from 2800 to 22 800 t. The fishery for grenadier declined after the dissolution of the Soviet Union in 1992. In the last 15 years, there has been a sporadic fishery by vessels from Russia (annual catch estimated at 200–3200 t), Poland (500–6700 t), Latvia (700–4300 t) and Lithuania (data on catch are not available). Grenadier has also been taken as bycatch in the Faroese orange roughy fishery and Spanish demersal multispecific fishery.

There is no information about target fishery of roundnose grenadier on the MAR in 2006 and 2007. In 2008 and 2009 Russian trawlers made attempts at fishing with pelagic and bottom trawls in the southern part of the Division XIIc. Total catches were 30 t and 12 t respectively including 13 t and 5 t of roundnose grenadier. In 2010, Russian trawler caught 73 t roundnose grenadier during a short-term fishery (two days) in the southern part of the Division Xb.

Also in 2010, the Spanish fleet targeting redfish on the MAR reported catches of roundnose grenadier in XIVb totalling 242 tones. The following year, roundnose grenadier became a target species, with catches increasing to 2440 t in XIVb, according to official statistics. In subsequent years a total estimated catch consisted of 2952 and 1789 t in 2012 and 2013 respectively. The preliminary official catch for 2014 is 2079 t, including Spanish catch in XIVb1 and negligible Faroese and French bycatches in Xa, XIIa and XIVb. The discards on Spanish target fishery estimated by scientific observers was at level of 386 t.

To these figures an unallocated catch in XIVb1 of 1015 t must be added. Therefore total estimated preliminary catch in 2014 consists of 3481 t.

9.4.1.2 ICES Advice

ICES advice for 2013 and 2014 was:

“catches should decrease by 20% compared to the average catch of the last three years, corresponding to catches of no more than 1350 t in 2013 and subsequent years”.

In 2014 the allowable catch was recalculated to 717 t in according the revision catch statistic. Thereby ICES advice for 2015 was: "the advice for this fishery in 2015 is the same as the advice for 2013–2014. However, ICES notes that catches for the period 2010–2011 have been revised substantially downwards and mean catch for 2009–2011 is now 896 t (compared to the previous estimates of 1687 t). Applying the same 20% reduction to the revised catches gives catch advice of 717 t. Based on ICES approach to data-limited stocks," ICES advises that catches should be no more than 717 t."

9.4.1.3 Management

There is TAC-based species-specific management of the roundnose grenadier fisheries in Subareas VIII, IX, X, XII, XIV for European Community vessels (See Section 9.1.2). On the 33th Annual session of NEAFC was adopted TAC of 717 t for roundnose grenadier in the international waters of Divisions Xb and XIIc, Subdivisions XIIa1 and XIVb1. In addition, the measure of regulations of efforts in the fisheries for deep-water species was adopted again (in the same redaction, as earlier). These measures are in force until 31 December2015.

9.4.2 Data available

9.4.2.1 Landings and discards

Landings are given in Tables 9.4.1–9.4.4. There were no discards of roundnose grenadier on Russian trawlers where smallest fish and waste were used for fish meal processing. There are discards data by Spanish research observers from Spanish commercial vessels in 2014.

9.4.2.2 Length compositions

According to last Russian research data (October 2010) large mature specimens of grenadier of 60–85 cm in total length prevailed in catches taken on the MAR between 46–50°N (Figure 9.4.2). The retrospective data analysis demonstrates that the length of fish caught in 2003–2010 in the surveyed area decreased as compared to 1980s. The length distributions in 2003 and 2010 are generally similar, however, in 2010 the number of small immature grenadier up to 50 cm in length was lower.

The pelagic trawl Spanish fishery in 2012–2014 caught individuals from 6 to 23 cm pre-anal length. The length compositions of landings and discards of this fishery are presented in Figure 9.4.3.

In 2013 juvenile individuals were occasionally caught by pelagic trawl during Redfish survey in the Irminger Sea at a depth 500–900 m. Total length of 28 specimens varied from 7 to 32 cm.

9.4.2.3 Age compositions

No new data on age compositions were presented.

9.4.2.4 Weight-at-age

No new weight-at-age data are available.

9.4.2.5 Maturity and natural mortality

No new data on natural mortality are available. According to Russian research data in October 2010, gonads of roundnose grenadier were mostly at the stage of maturation. The total proportion of females at pre-spawning and spawning states constituted 25%, which is comparable with the results observed in May–June 2003 (21%). In the both cases a small number of juvenile specimens were observed in catches (2.3% and 3.4%respectively).

9.4.2.6 Catch, effort and research vessel data

Catch and cpue data are given in Tables 9.4.1–9.4.5 and Figures 9.4.1 and 9.4.4. There are gaps in the cpue time-series due to lack of catch statistics for 1973 and 1982 and absence of target fishery in 1994–1995 and 2006–2009 (data for some years cannot be used owing to short fishing periods). Effort data separated by subareas and divisions are available for Russian fleet in 2003–2005 (Table 9.4.5). The Spanish official effort data are 60 and 141 days for XIIa and XIVb, in 2012; and 18 and 108 days for XIIa and XIVbin 2013. In 2014 Spanish fleet worked in XIVb1 during 112 days. Thus mean catch per fishing day was from 12.6 to 18.5 t (Figure 9.4.5).

9.4.3 Data analyses

The only source of information on abundance trends was the cpue series from the Soviet/Russian official data (Table 9.4.5, Figure 9.4.4). The cpue varied strongly, but generally declined in the 1970s, then the level appears to have remained comparatively stable till to 1990. Further decline occurred in 1991–1993 and 1998–2000. There is some increasing of cpue in 2004–2005 but it remained at a low level, almost half that observed in the early 1970s when a virgin stock was exploited. These data must be treated with caution because the fishery on MAR is very difficult and its effectiveness depends on many factors (distribution of pelagic concentrations, experience of vessel crew, environmental conditions, etc.) that could not be taken in account during current analysis of cpue dynamics.

From 2012 the official Spanish cpue and effort data are available. The current effort is low compared to the effort developed by USSR vessels in the 1970s and the cpue seems also low, long-term comparison is however undermined by the absence of standardisation of fleet and vessel type.

The most recent trawl acoustic survey was carried out by Russian RV "Atlantida" in October 2010 in the southern part of fishing area (44–50°N), where 17 seamounts were surveyed (Figure 9.4.5). The typical echo-indications of grenadier were obtained over 13 seamounts located to the north of 46°N. Similar to 2003, considerable increase of the grenadier distribution depths (mainly 1200–1350 m, sometimes up to 1500 m) was observed (Figure 9.4.6) as compared to 1970s–1980s, when it was mainly from 600 to 1200 m (Chuksin and Sirotin, 1975). The biomass of the pelagic component of the grenadier on the 13 seamounts amounted to about 59 400 t. In 2003 the biomass was estimated 35 100 t on the nine seamounts of this area. The biomass values were higher in 2010 than in 2003 at the most seamounts (Table 9.4.6). The average biomass per one seamount increased from 3900 t in 2003 to 4600 t in 2010. Some increasing of biomass, stable length composition and limited fishery scale of grenadier give grounds to make a preliminary conclusion on the stable state of its stock during several last years.

9.4.4 Biological reference points

No attempt was made to propose reference points for this stock.

9.4.5 Comments on the assessment

No analytical assessments were carried out.

9.4.6 Management considerations

The fishery was resumed in recent years after the long break. The landings series is too short now. In fact, active fishery started in 2011. WGDEEP considers that the latest approach for management is applicable for this stock; the TAC in average catch for three recent years.

Table 9.4.1. Working group estimates of catch of roundnose grenadier from Subdivision Va1.

YEAR	USSR/ RUSSIA	TOTAL
1973	820	820
1974	12561	12561

Table 9.4.2. Working group estimates of catch of roundnose grenadier from Subarea Xb.

YEAR	USSR/ RUSSIA	FAROES[1]	TOTAL
1976	170		170
1993		249	249
1994			
1995			
1996		3	3
1997		1	1
1998		1	1
1999		3	3
2000			
2001			
2002			
2003			
2004		1	1
2005	799		799
2006			
2007			
2008			
2009			

Table 9.4.3.Working group estimates of catch of roundnose grenadier from Subareas XIIa1 and XIIc.

Year	USSR/ Russia	Poland[2]	Latvia[2]	Faroes[2]	Spain	Total
1973	226					226
1974	5874					5874
1975	29894					29894
1976	4545					4545
1977	9347					9347
1978	12310					12310
1979	6145					6145
1980	17 419					17419
1981	2954					2954
1982	12472					12472
1983	10300					10300
1984	6637					6637
1985	5793					5793
1986	22842					22842
1987	10893					10893
1988	10606					10606
1989	9495					9495
1990	2838					2838
1991	3214[1]		4296			7510[1]
1992	295		1684			1979
1993	473		2176	263		2912
1994			675	457		1132
1995				359		359
1996	208			136		344
1997	705	5867		138		6710
1998	812	6769		19		7600
1999	576	546		29		1151
2000	2325					2325
2001	1714			2		1716
2002	737					737
2003	510					510
2004	436			8		444
2005	600					600
2006				1		1
2007				2		2
2008	13					13
2009	5					5
2010						
2011						
2012					864	
2013					118	
2014[3]						

[1]–revised catch data [2]– official ICES data [3]– preliminary data.

Table 9.4.4. Working group estimates of catch of roundnosegenadier from Subdivision XIVb1.

Year	USSR/ Russia	Spain	Unallocated	Discards	Total
1976	11				11
1982	153				153
1997	3361				3361
1998					
1999					
2000	5				5
2001	69				69
2002	4	235[2]			239
2003		272[2]			272
2004	201				201
2005					
2006					
2007					
2008					
2009					
2010		242[1]			242[2]
2011		2440[1]			2440[1]
2012		1860	1098		2958
2013		1789			1789
2014[3]		2075	1015	386	3477

[1]–revised catch data [2]– official ICES data [3]—preliminary statistics

Table 9.4.5. Soviet/Russian efforts and cpue on roundnose grenadier fishery by the MAR area.

Year	ICES Subarea and Division	Number of fishing days	Catch per fishing day, t
1974	XIIa1+XIIc, Va1		35.2
1975	XIIa1+XIIc		36.6
1976	XIIa1+XIIc, XIVb1, Xb		24.0
1977	XIIa1+XIIc		17.3
1978	XIIa1+XIIc		17.0
1979	XIIa1+XIIc		19.6
1980	XIIa1+XIIc		17.3
1981	XIIa1+XIIc		18.4
1982	XIIa1+XIIc		
1983	XIIa1+XIIc		17.3
1984	XIIa1+XIIc		18
1985	XIIa1+XIIc		18.5
1986	XIIa1+XIIc		21
1987	XIIa1+XIIc		17.3
1988	XIIa1+XIIc		21.8
1989	XIIa1+XIIc		15.6
1990	XIIa1+XIIc		18.4
1991	XIIa1+XIIc		14.5
1992	XIIa1+XIIc		12.9
1993	XIIa1+XIIc, Xb		10.7
1994	XIIa1+XIIc, XIVb1, Xb		
1995	XIIa1+XIIc, XIVb1, Xb		
1996	XIIa1+XIIc, Xb		22.2
1997	XIIa1+XIIc, XIVb1, Xb		20.3
1998	XIIa1+XIIc, Xb		6.8
1999	XIIa1+XIIc, Xb		8.8
2000	XIIa1+XIIc, XIVb1		9.1
2001	XIIa1+XIIc		15.8
	XIVb1		
2002	XIIa1+XIIc		13.2
	XIVb1		
2003	XIIa1+XIIc	51	10.1
2004	XIIa1+XIIc	25	16.1
2005	XIIa1+XIIc	42	17.7
	Xb	37	
2006	XIIa1+XIIc, XIVb1, Xb		
2007	XIIa1+XIIc, XIVb1, Xb		
2008	XIIc	7	
2009	XIIc	1	

Table 9.4.6. Biomass of roundnose grenadier (t) according results of the Russian acoustic surveys on the MAR in 2003 and 2010.

Seamount number	2003	2010
462	Not surveyed	2188
473-A	1662	10 259
473-B	7016	6417
476-A	3159	4357
485-A	971	6350
485-B	Not surveyed	2097
491-B	3228	2203
493-A	Fish records are weak	1828
494-A	18 086*	12 274
494-B		8227
495	977	1350
495-B	Not surveyed	241
496-A	Fish records are weak	1573
TOTAL	35 099	59 364

*** – total for two seamounts.**

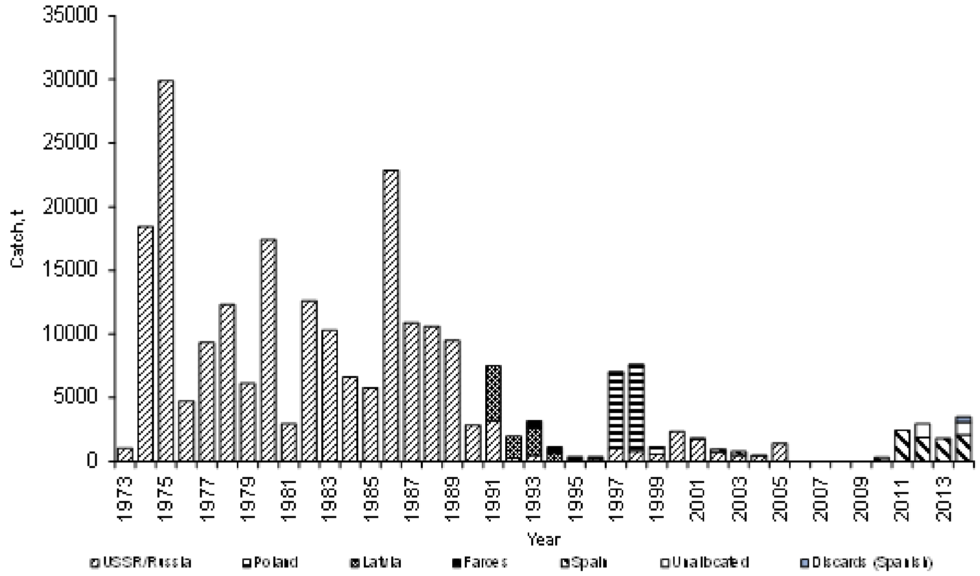


Figure 9.4.1. International catch of roundnose grenadier on the MAR in 1973–2014.

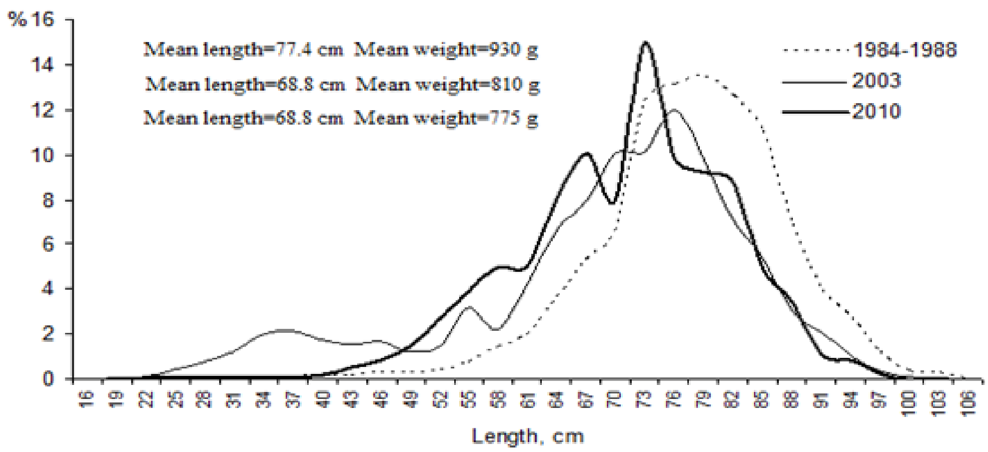


Figure 9.4.2. Total length composition of roundnose grenadier on the MAR in 1984–1988 (47–51°N), in 2003 (47–51°N) and in 2010 (47–50°N).

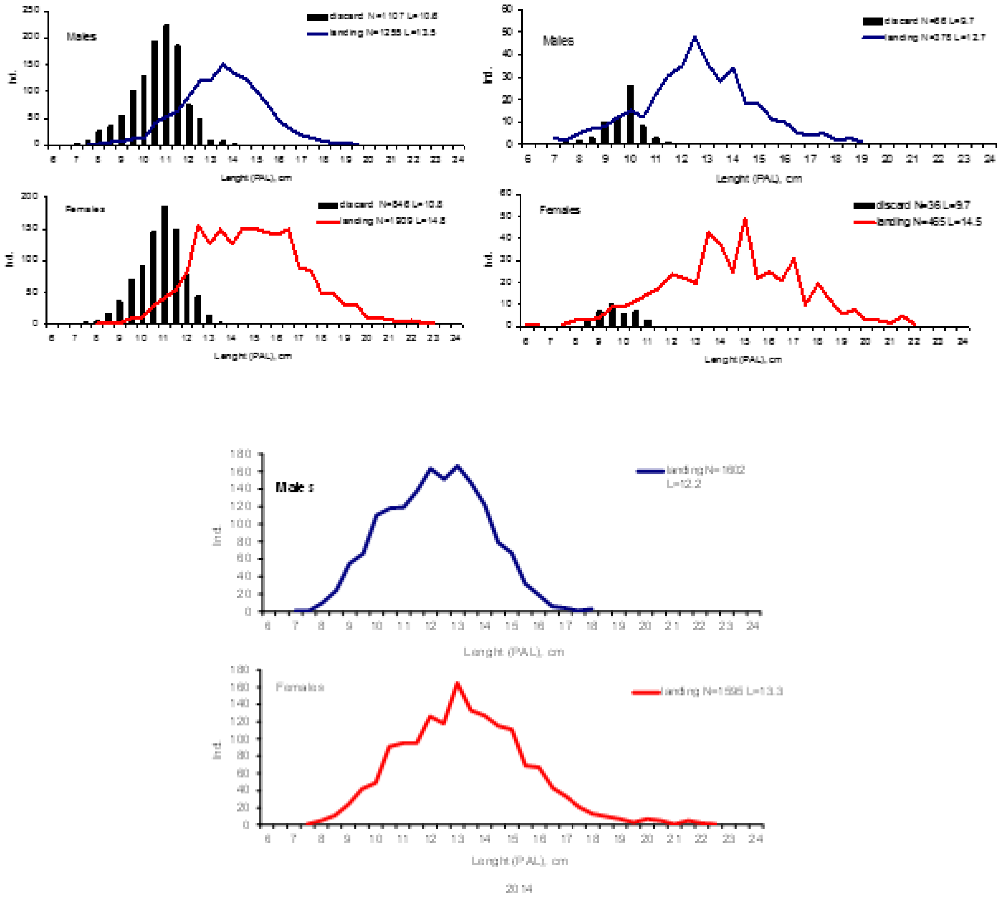


Figure 9.4.3. Length composition (PAL) of landings and discards of roundnose grenadier on Spanish commercial trawl fishery.

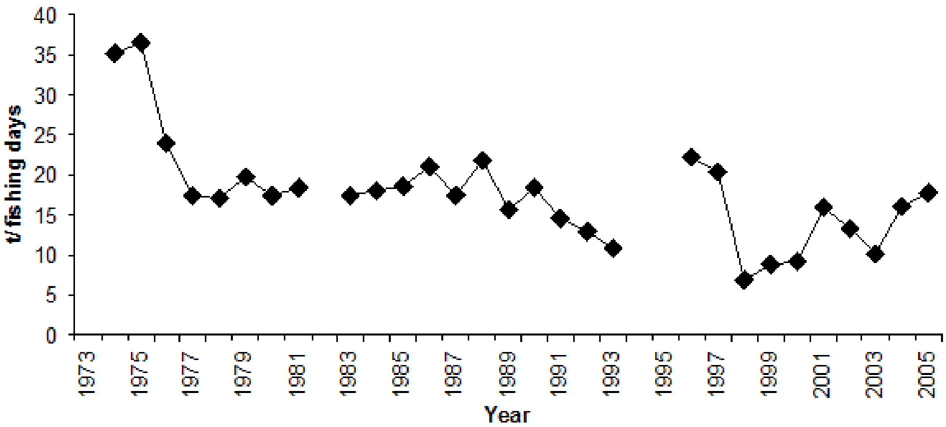


Figure 9.4.4. Soviet/Russian cpue of roundnose grenadier on the MAR in 1973–2005.

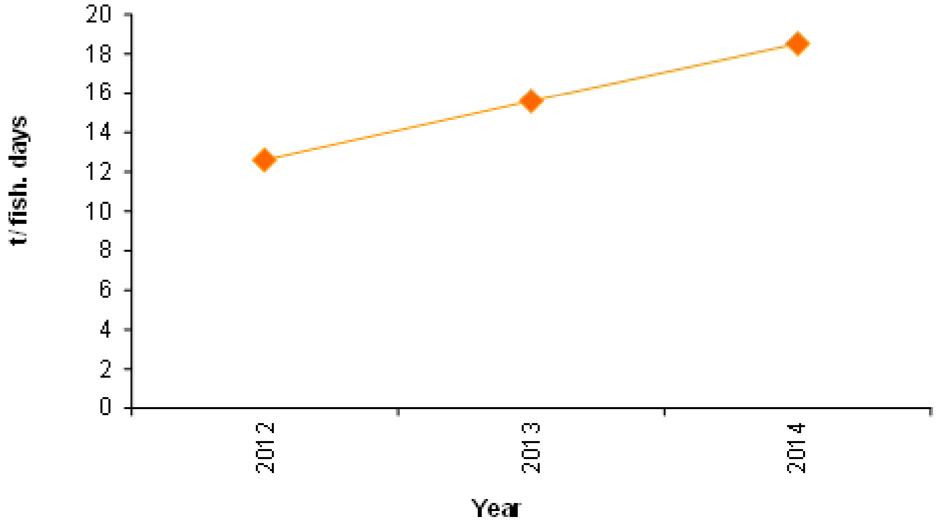


Figure 9.4.5.Spanish cpue of roundnose grenadier on the MAR in 2012–2014.

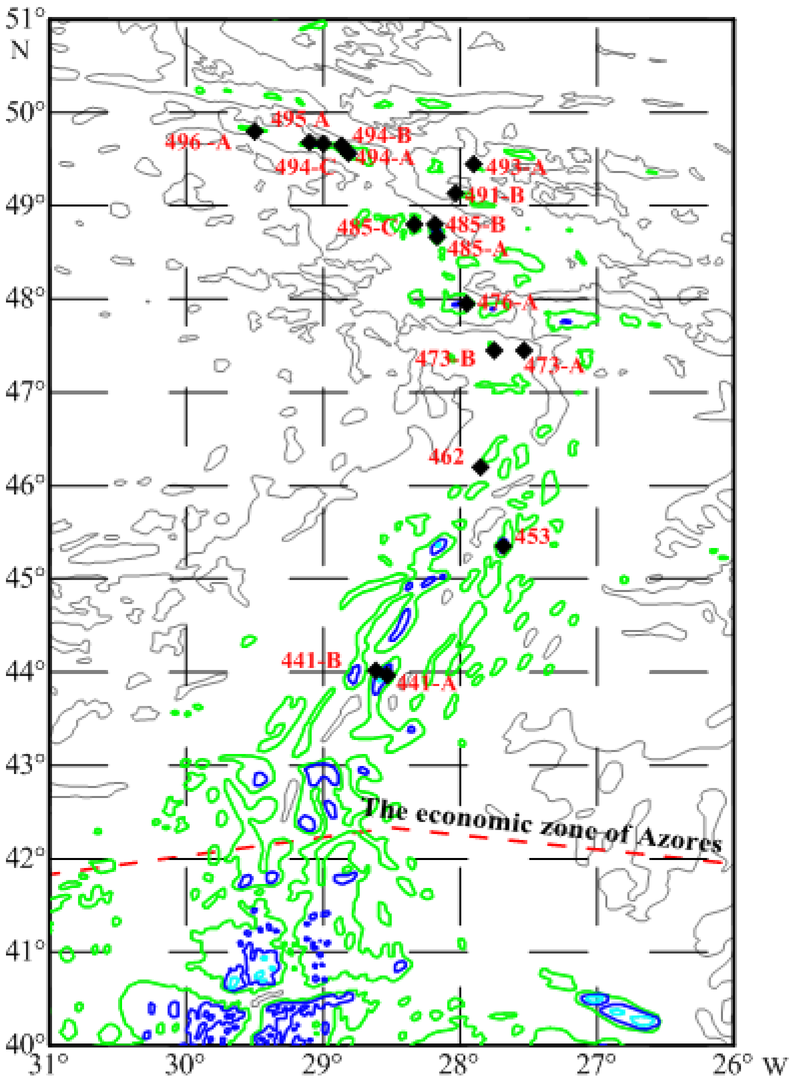


Figure 9.4.5. Location of seamounts surveyed at RV "Atlantida" on the MAR in October 2010.

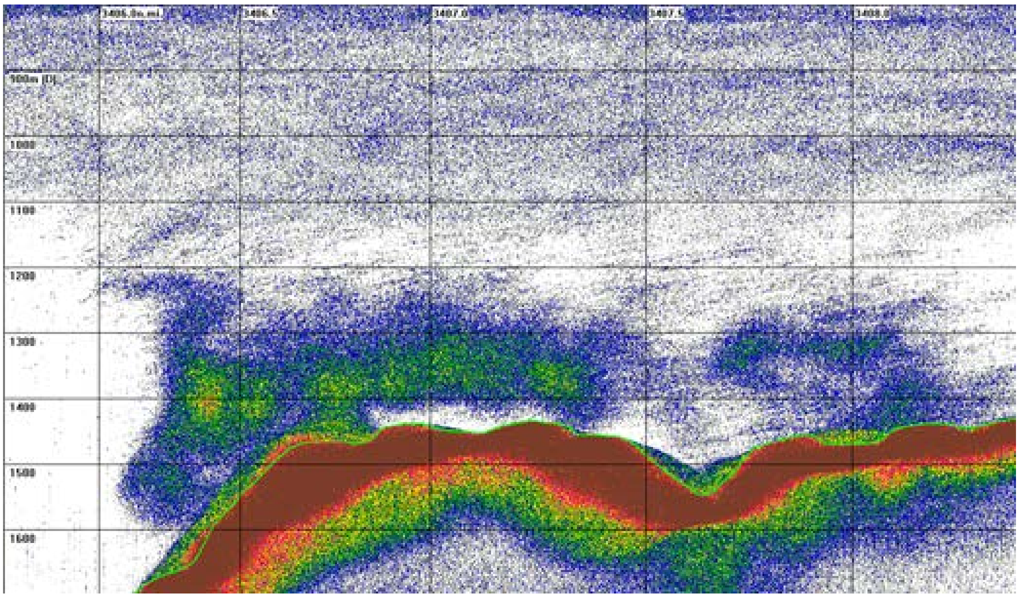


Figure 9.4.6. Echo-records of roundnose grenadier at the MAR seamount 494-A in October 2010.

9.5 Roundnose grenadier (*Coryphaenoides rupestris*) in other areas (I, II, IV, Va2, VIII, IX, XIVa, XIVb2)

9.5.1 The fishery

Outside of the main fisheries covered in other sections, landings of roundnose grenadier were insignificant.

9.5.1.1 Landings trends

Landing statistics by nations in the period 1990–2014 are presented in Tables 9.5.1–9.5.5.

In the Subareas I and II the catch of roundnose grenadier in 2014 is 4 t and was taken as bycatch by Norwegian fleet. From 1990 landings varied from 0 to 101 t (Figure 9.5.1). The major contribution to the total catch was made by Norway. Roundnose grenadier was partly taken in mixed deep-water fisheries; directed local fisheries in Norwegian fjords for this species also exist. Earlier French landings, that reached 41 t, were assigned to this species however a recent revision of the data indicates that previous landings are more likely to correspond to roughhead grenadier, so there is no French landings for roundnose grenadier in Subareas I and II.

In Subarea IV, the catch of roundnose grenadier in 2014 comprised 4 t which was taken by the Norwegian fleet. During 1990–2012 total landings in this area varied between 0 and 372 t (Figure 9.5.2). The main contribution to the total catch was made by the Danish fleet in 2004. Roundnose grenadier is caught as incidental bycatch in this area by Scottish and Norwegian vessels in insignificant amount as well. As detected for French landings of this species in Subareas I and II, earlier landings of roundnose grenadier in Subarea IV are likely to correspond to roughhead grenadier but 2014 landings are well assigned. Four tons in 2014 may correspond to catch of roundnose close to the Norwegian deep or to misreported roughhead along the slope of the northern North Sea.

During 1990–2014, the landings of roundnose grenadier within Icelandic waters (Division Va) varied 2 to 398 t and were made by Iceland (Figure 9.5.3). Maximum landings were registered in 1992–1997 when 198–398 t were caught annually as bycatch in mixed deep-water fisheries, but it should be noted that it can include other grenadier species till 1990 (Table 9.5.3). In recent years, roundnose grenadier landings from 16 to 81 t were taken in Icelandic waters as bycatch in trawl fisheries for Greenland halibut and redfish. In 2014 catch in Va amounted 36 t.

Roundnose grenadier landings in Subareas VIII and IX during 1990–2013 were minor and amounted 0 to 28 t annually (Figure 9.5.4). The main contribution to the total catch was made by France (Table 9.5.4). In 2014 landings from the subareas comprised less than 1 t.

Total catch in Greenland waters (Subdivision XIVb2) in 1990–2014amounted 2126 t (Figure 9.5.5). There is no directed fishery for roundnose grenadier in these areas. The majority of landings is taken as bycatch by Greenland, Germany and Norway during Greenland halibut bottom-trawl fisheries (Table 9.5.5). In 2014 catch was 7 t that mainly was taken by Norway.

In the period 2003–2005 the unallocated landings were assigned to Subareas I, II, IV. VIII, IX and Division Va2 and XIVb2 and the values were 208, 504, and 952 t respectively (Table 9.5.6).

9.5.1.2 ICES advice

ICES advice for2013, 2014and 2015was: "Based on the ICES approach for data-limited stocks, ICES advises that fisheries should not be allowed to expand from 120 t until there is evidence that this is sustainable."

9.5.1.3 Management

There is a TAC management of the roundnose grenadier fisheries in Subareas I, II, IV, VIII, IX, Division Va and Subdivision XIVb1 for European Community vessels. In international waters there are NEAFC regulation of efforts in the fisheries for deep-water species.

9.5.2 Data available

9.5.2.1 Landings and discards

Landings are given in Table 9.5.1–9.5.5. Estimated discards owing to bycatch in Spanish fisheries for demersal fish in VIII and IX did not exceed 2 t in 2012, 1 t in 2013 and 0.5 t in 2014.

9.5.2.2 Length compositions

No data.

9.5.2.3 Age compositions

No data.

9.5.2.4 Weight-at-age

No data.

9.5.2.5 Maturity and natural mortality

No data.

9.5.2.6 Catch, effort and research vessel data

No data.

9.5.3 Data analyses

No assessment was carried out for this stock in 2015.

Biological reference points

WKLIFE has not yet suggested methods to estimate biological reference points for stocks which have only landings data or are bycatch species in other fisheries. Therefore, no attempt was made to propose reference points for this stock.

9.5.4 Comments on the assessment

No assessment was carried out for this stock in 2015.

9.5.5 Management considerations

This is a bycatch fishery and advice should take into account advice for other stocks.

Table 9.5.1. Working group estimates of landings of roundnose grenadier from Subareas I and II.

Year	Faroes	Denmark	Germany	Norway	Russia/USSR	Germany	UK (E+W)	UK (Scot)	TOTAL
1990			2		12	3			17
1991			3	28					31
1992		1		29					30
1993				2					2
1994			12						12
1995									0
1996									0
1997	1			100					101
1998				87	13				100
1999				44	2				46
2000									0
2001							2		2
2002				11	1				12
2003				4					4
2004				27					27
2005				12					12
2006				6	2				8
2007				11	1				12
2008				10					10
2009				8					8
2010				17	6				23
2011				16					16
2012				5					5
2013				17					17
2014*				4					4

*** Preliminary data.**

Table 9.5.2. Working group estimates of landings of roundnose grenadier from Subarea IV.

YEAR	GERMANY	NORWAY	UK (SCOT)	DENMARK	FRANCE	TOTAL
1990	2					2
1991	4					4
1992			4	1		5
1993	4					4
1994	2			25		27
1995	1		15			16
1996			5	7		12
1997			10			10
1998						0
1999		5				5
2000						0
2001				17		17
2002		1	26			27
2003		1	11			12
2004			1	371		372
2005		2				2
2006		4				4
2007		1				1
2008						0
2009						0
2010		2	0			2
2011		0	0			0
2012		1				1
2013						0
2014*					3	3

***Preliminary data.**

Table 9.5.3. Working group estimates of landings of roundnose grenadier from Division Va.

YEAR	FAROES	ICELAND**	NORWAY	UK (E+W)	TOTAL
1990		7			7
1991		48			48
1992		210			210
1993		276			276
1994		210			210
1995		398			398
1996	1	139			140
1997		198			198
1998		120			120
1999		129			129
2000		54			54
2001		40			40
2002		60			60
2003		57			57
2004		181			181
2005		76			76
2006		62			62
2007	1	13	2		16
2008		29			29
2009		46			46
2010		59			59
2011		62			62
2012	0	80			81
2013		84			84
2014*		36			36

*** Preliminary data. ** includes other grenadiers from 1990 to 1996.**

Table 9.5.4. Working group estimates of landings of roundnose grenadier from Subareas VIII and IX.

Year	France	Spain	TOTAL
1990	5		5
1991	1		1
1992	12		12
1993	18		18
1994	5		5
1995			0
1996	1		1
1997			0
1998	1	19	20
1999	9	7	16
2000	4		4
2001	7		7
2002	3		3
2003	2		2
2004	2		2
2005	8		8
2006	27	1	28
2007	10		10
2008	8		8
2009	1		1
2010	1		1
2011	1		1
2012	0		0
2013	0		0
2014*	0		0

*** Preliminary data.**

Table 9.5.5. Working group estimates of landings of roundnose grenadier from Division XIVb2.

Year	Faroes	Germany	Greenland	Iceland	Norway	UK (E+ W)	UK (Scot)	Russia	TOTAL
1990		45	1			1			47
1991		23	4			2			29
1992		19	1	4	6		1		31
1993		4	18	4					26
1994		10	5						15
1995		13	14						27
1996		6	19						25
1997	6	34	12		7				59
1998	1	116	3		6				126
1999		105	0		19				124
2000		41	11		5				57
2001		11	5		7	2	72		97
2002		25	5		15	1	1		47
2003			15		5	1			21
2004		27	3						30
2005			7		6	1			14
2006		35	0		17				53
2007	1				1				2
2008								12	12
2009					2				2
2010		33			7				40
2011		32			4				36
2012					1				1
2013					2				2
2014*	0				7				7

*** Preliminary data.**

Table 9.5.6. Working group estimates of landings of roundnose grenadier from I, II, IV, Va2, VIII, IX, XIVb2.

YEAR	I+II	IV	VA	VIII+IX	XIVB2	UNALLOCATED	TOTAL
1990	17	2	7	5	47	0	78
1991	31	4	48	1	29	0	113
1992	30	5	210	12	31	0	288
1993	2	4	276	18	26	0	326
1994	12	27	210	5	15	0	269
1995	0	16	398	0	27	0	441
1996	0	12	140	1	25	0	178
1997	101	10	198	0	57	0	366
1998	100	0	120	20	126	0	366
1999	46	5	129	16	124	0	320
2000	0	0	54	5	57	0	116
2001	2	17	40	7	97	208	163
2002	12	27	60	3	47	504	149
2003	4	12	57	2	21	952	96
2004	27	372	181	2	30	0	612
2005	12	2	76	7	14	0	111
2006	8	4	62	28	53	0	155
2007	12	1	16	10	2	0	41
2008	10	0	29	8	12	0	59
2009	8	0	46	1	2		57
2010	23	2	59	1	40		125
2011	16	0	62	1	36		115
2012	5	1	81	1	1		89
2013	17	0	84	0	2		103
2014*	4	4	36	0	7		51

*** Preliminary data.**

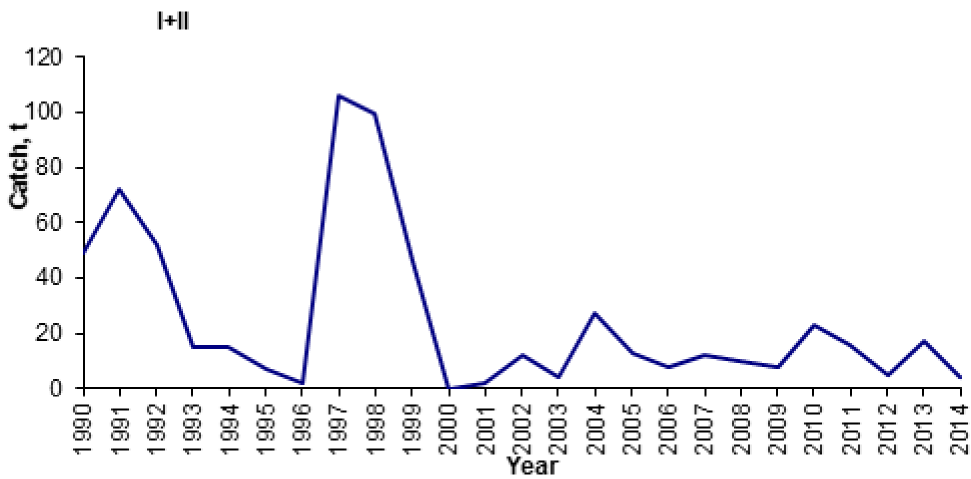


Figure 9.5.1. Roundnose grenadier landings in Subareas I and II, 1990–2014 (data for 2014 are preliminary).

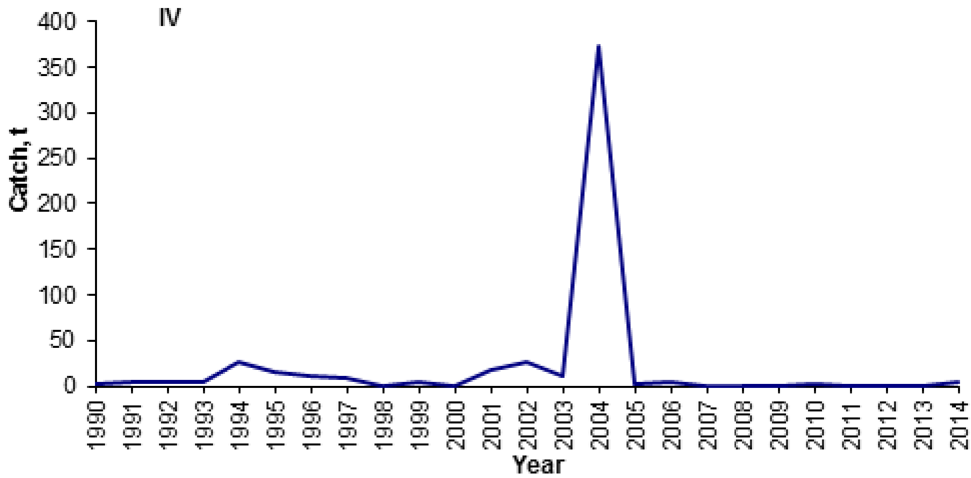


Figure 9.5.2. Roundnose grenadier landings in Subareas IV, 1990–2014 (data for 2014 are preliminary).

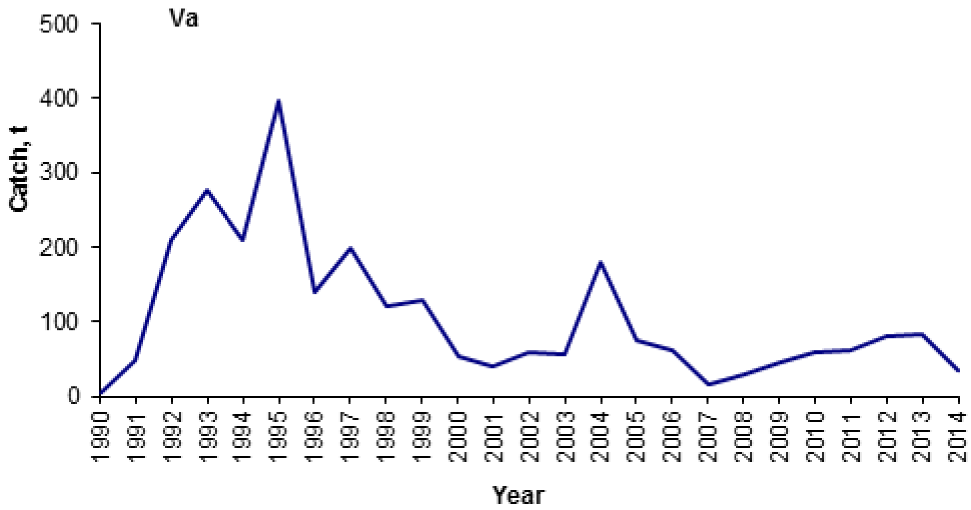


Figure 9.5.3. Roundnose grenadier landings in Division Va, 1990–2014 (data for 2014 are preliminary).

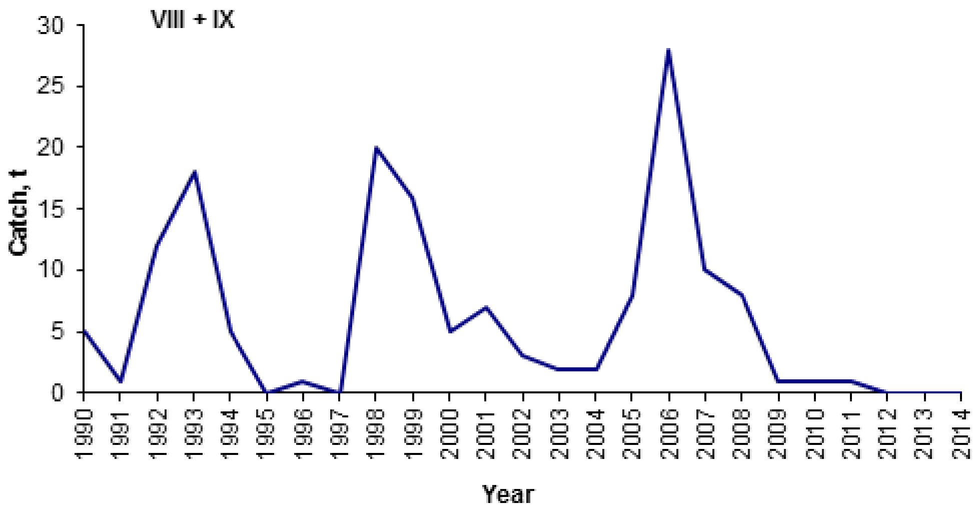


Figure 9.5.4. Roundnose grenadier landings in Subareas VIII–IX, 1990–2014 (data for 2014 are preliminary).

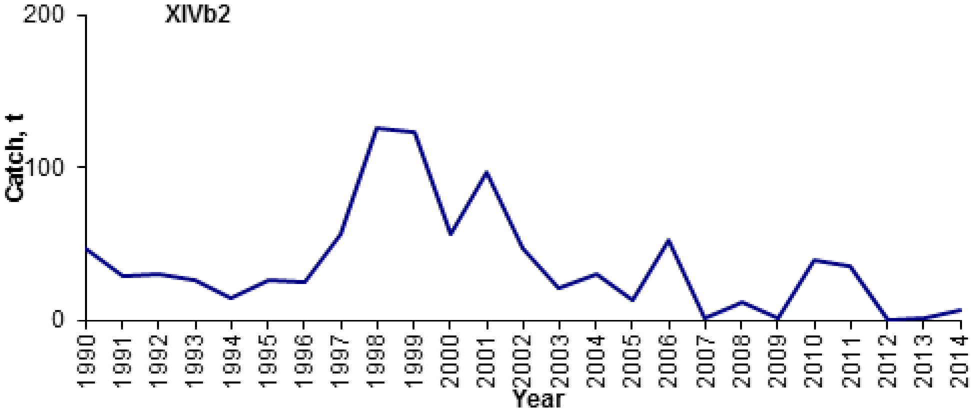


Figure 9.5.5. Roundnose grenadier landings in Subarea XIVb2, 1990–2014 (data for 2014 are preliminary).

10 Black scabbardfish (*Aphanopus carbo*) in the Northeast Atlantic

10.1 Stock description and management units

The species is distributed on both sides of the North Atlantic and on seamounts and ridges south to about 30°N. It only occurs sporadically north of the Scotland-Iceland-Greenland ridges. Juveniles are mesopelagic and adults are bentho-pelagic. The life cycle of the species is not completed in just one area and either small or large scale migrations occur seasonally.

The stock structure in the whole northeast Atlantic is still uncertain. All available information supports the assumption of a single stock from Faroese waters and the west of the British Isles down to Portugal (Farias *et al.*, 2013). The links with other areas (mainly Iceland and the Azores) is less clear.

Recent studies on Azorean specimens indicate that two species of *Aphanopus* coexist in ICES Division Xa, *A.carbo* and *A. intermedius* (Besugo *et al.*, 2014 WD). In 2013 the Azorean Government supported a scientific study that aimed to obtain estimates of the proportion of occurrence of each species within Azorean EEZ. The overall proportion of *A. intermedius* in relation to the overall catches of *Aphanopus* species is about 0.75. However the proportion can vary accordingly to the sampling location (Figure 10.4.1).

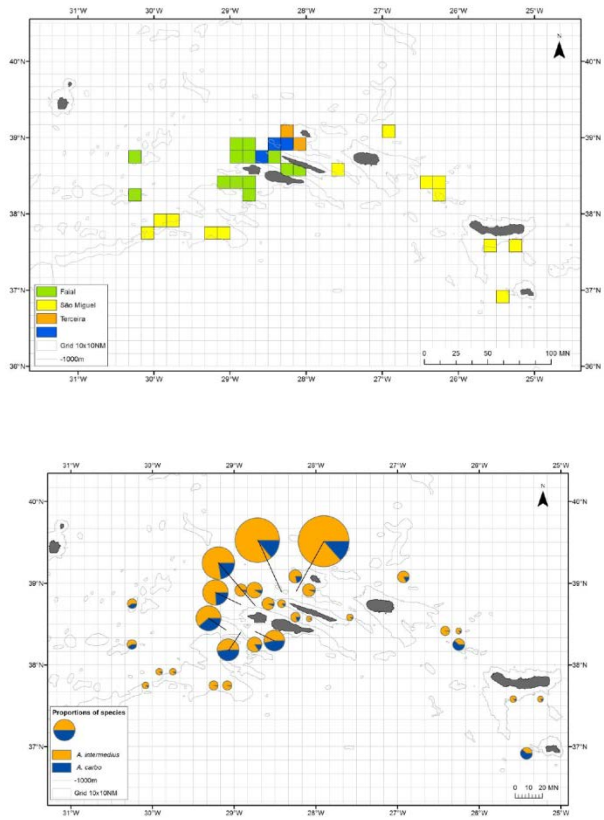


Figure 10.1.1. Map of the sampling locations (upper) and estimates of the proportion of each *A. carbo* and *A. intermedius* at different sampling points.

Prior to the 2014 benchmark meeting (WKDEEP, 2014), WGDEEP has considered three assessment units for black scabbardfish (ICES, 2011):

1) Northern (Divisions Vb and XIIb and Subareas VI and VII);
2) Southern (Subareas VIII and IX);
3) Other areas (Divisions IIIa and Va Subareas I, II, IV, X, and XIV).

The northern component comprises fish exploited mainly by trawl fisheries while the southern component by a longline fishery in Subarea IXa. In other areas the species is exploited by both longliners and trawlers, but the overall landings are much lower than at the other two management units.

Based upon the linkage between the northern and southern management units, WKDEEP 2014 concluded that the status for all areas should be considered as whole when management advice is given for each component. However, given the presumed sequential nature of the exploitation pattern, management should also take into consideration trends occurring in the separate areas.

The different exploitation regimes (different fishing gears and exploited size ranges of the species) between the northern and southern components justifies keeping them distinct for management purposes. However, as all evidence suggest one single stock doing a clockwise migration between these areas, a dynamics population model was fitted to data from the northern and southern component, this model was benchmarked at 2014 WKDEEP. The link between the northern and southern components and other areas (mainly Iceland and the Azores) is less clear and these areas were smaller fisheries occur were treated separately. The report will be structured maintaining the initial separation between units, except for topics related with assessment and advice.

10.2 Black scabbardfish in Divisions Vb and XIIb and Subareas VI and VII

In this section fisheries, landings trends, management applicable are presented for Divisions Vb and XIIb and Subareas VI and VII, but the data analyses and management considerations apply to these areas combined to ICES Subareas VIII and Division IXa.

10.2.1 The fishery

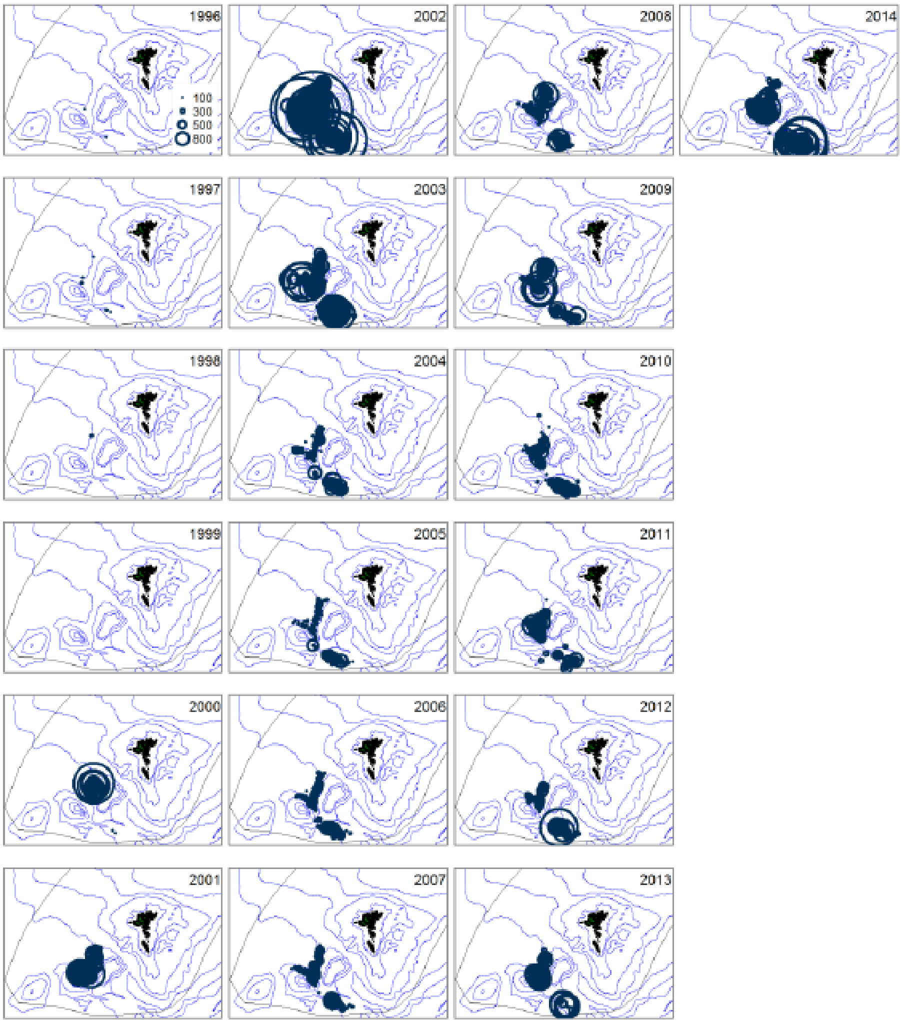


Figure10.2.1. Black scabbardfish Vb. Spatial distribution of biomass index (kg/hour) from the commercial trawl fishery (only hauls with more than 30% black scabbardfish of the total catch were included).

In Subarea Vb black scabbardfish is fished by large Faroese trawlers (Ofstad, 2015) and the main fishing areas are located on the slope around the Faroe Bank and on the Wyville Thomsen ridge (Figure 10.2.1).

In 2015, there was no updated information on the fisheries taking place in Subareas XIIb and Divisions VI and VII.

10.2.2 Landings trends

The historic landings trends on the northern component are described in the stock annex.

Total landings from the ICES Division Vb and Subareas VI, VII and XII showed a markedly increasing trend from 1999 to 2002 followed by a decrease (Figure 10.2.2). In 2006 there was a peak of landings and then landings decreased till 2009, mainly in ICES Divisions VI and VII, probably driving by TAC management regulation (Figure

10.2.2). From 2010 onwards landings fluctuated around 2400 tonnes, although in 2012 there was a marked increase in ICES Subarea XII.

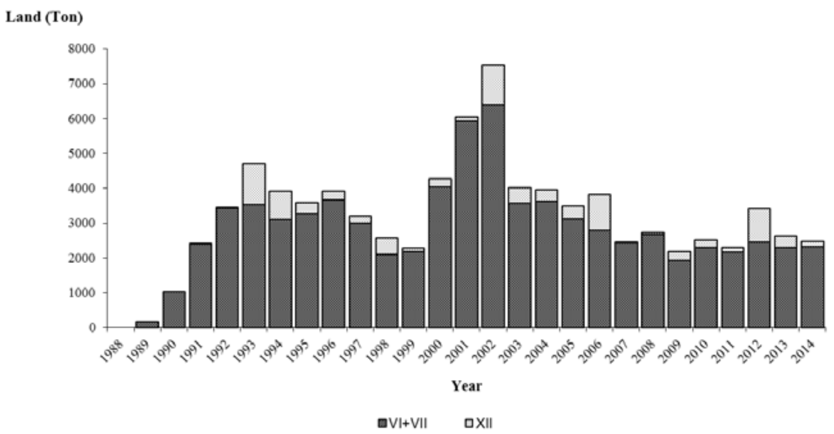


Figure10.2.2. Time-series of annual landings for ICES Division Vb and Subareas VI+VII and XII (2014 provisional data).

In earlier years of the time-series French landings represented more than 75% of the northern component total landings. After 2001 and till 2010 French landing represent about 60%. During that period both Faroese and Spanish landings increase their relative contribution (Figure 10.2.3). In recent years, 2011 onwards, French landings represent nearly 70% of the total landings. French landings are mainly derived from ICES Subarea VI.

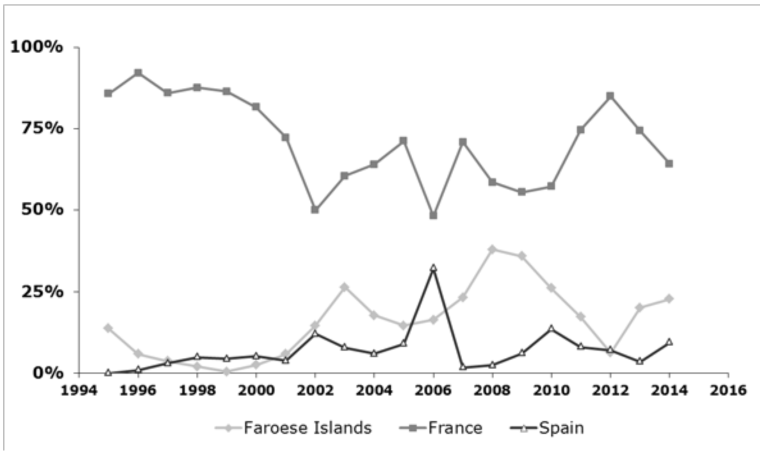


Figure 10.2.3. French, Spanish and Faroese relative contribution to the annual landings for northern component.

10.2.2.1 ICES Advice

The latest ICES advice for 2014 and 2015, based on the ICES approach for data-limited stocks was: "annual catches of no more than 2802 t in Subareas VI, VII, and Divisions Vb, IXIIb".

10.2.3 Management

Since 2003, management of black scabbardfish by EU vessels fishing in EU and international waters includes a combination of TAC and licensing system. Both TACS and EU total landings in Subareas V, VI, VII and XII from 2006 to 2013 are presented in the table below. The difference between the TAC and landings may not necessarily be regarded as TAC overshoot as some catches occur in waters under the jurisdiction of third countries and are therefore not covered by the TAC.

Year	EU TAC V, VI, VII & XII	EU Landinds Vb, VI, VII and XII
2006	3042	7455
2007	3042	4885
2008	3042	3722
2009	2738	3082
2010	2547	2582
2011	2356	2350
2012	2179	2155
2013	3051	2772
2014*	3966	2471

*** 2014 Preliminary landings.**

10.2.4 Data available

10.2.4.1 Landings and discards

Updated landing data were made available for the major fishing countries operating in the ICES Subareas Vb, VI, VII and XII (Table 10.2.1). Spanish landing data from 2006 and 2013 were thoroughly scrutinized during the 2014 WGDEEP meeting because some of the values were considered unreliable.

As in previous years, the 2014 discard rates of black scabbardfish derived from French bottom trawl fleet were low (less than 1% in all the quarters of the year).

Estimates of deep-sea discards from Spanish bottom fleet operating in the Northeast Atlantic ICES Subareas VI and VII and in Divisions VIIIc, North IXa for the period 2007–2011 are presented in Table 10.2.0. Excluding 2007 in ICES Subareas VI and VII, the annual discards of black scabbardfish were low. In 2014 the average discard rate were 0.27 and 0.11 in Divisions VIb and XIIb respectively.

Table 10.2.0. Raised discards estimates (tonnes) for the Spanish "fresh" fleet in ICES areas (these data do not include the Basque country fleet nor the Spanish freezer fleet of Hatton Bank). The coefficient of variation (CV) of the estimate is presented in brackets.

ICES	2003	2004	2005	2006	2007	2008	2009	2010	2011
Subareas VI–VII	0.0	0.0	69.5	0.0	125.2	1.8	0.0	12.2	6.5
(CV)	-	-	(99.7)	-	(99.7)	(99.4)	-	(95.2)	(99.7)
Division VIIIc. IXa	4.5	0.0	0.0	2.9	10.2	0.2	1.1	6.7	0
(CV)	(99.8)	-		(99.4)	(59.6)	(111.4)	(69.4)	(69.9)	

As a consequence of Spanish and French discard results it is concluded that discards of black scabbardfish are negligible

10.2.4.2 Length compositions

In WGDEEP 2014, length–frequency distributions available from the French trawlers observers were used to separate the number of specimens fished in the northern component into the two length classes. These two length classes are used as inputs in the assessment model adopted by the WKDEEP 2014(C2 from 70 to 103 cm TL (total length) and C3> 130 cm TL).

In 2015 and since this is not an advice year for the stock, the length data available were not further used to convert monthly catches, which are given in weight, into numbers.

The length–frequency distributions derived from length data obtained by on-board observers in Spanish and French trawlers fisheries were determined (Figures 10.2.4 and 10.2.5). For the two fisheries the recent length distributions did not differ from former years.

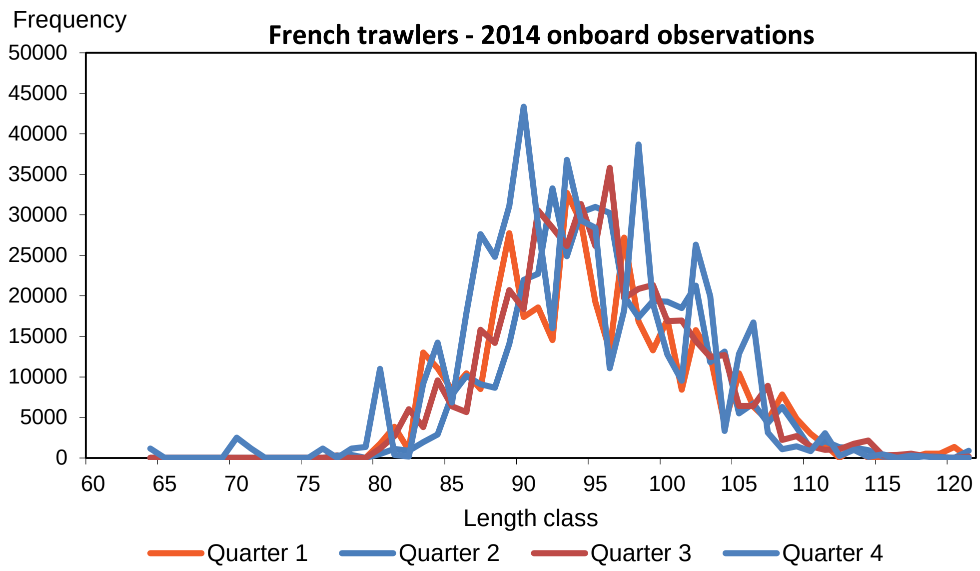
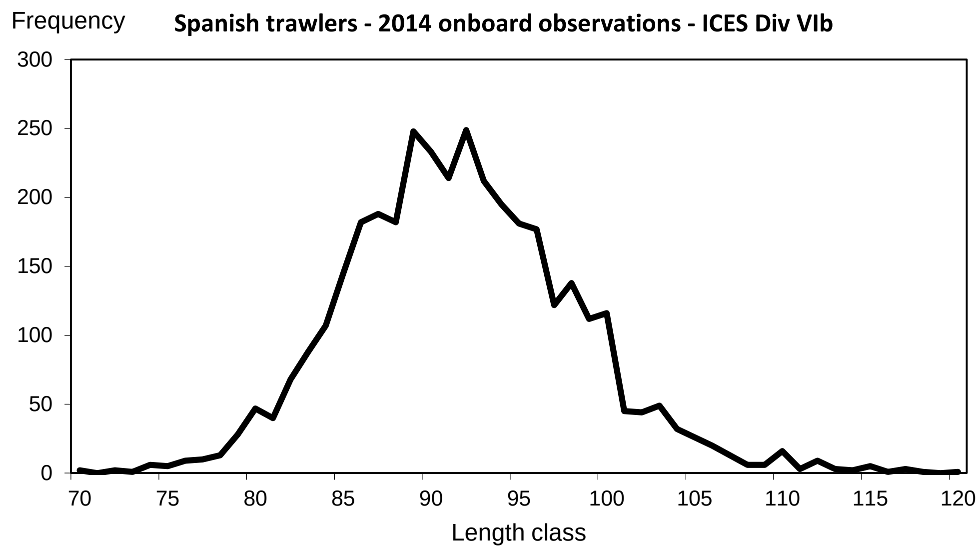


Figure 10.2.4. French fishery. Quarterly length–frequency distributions of black scabbardfish derived from on-board observations (frequencies were raised to the total catch).



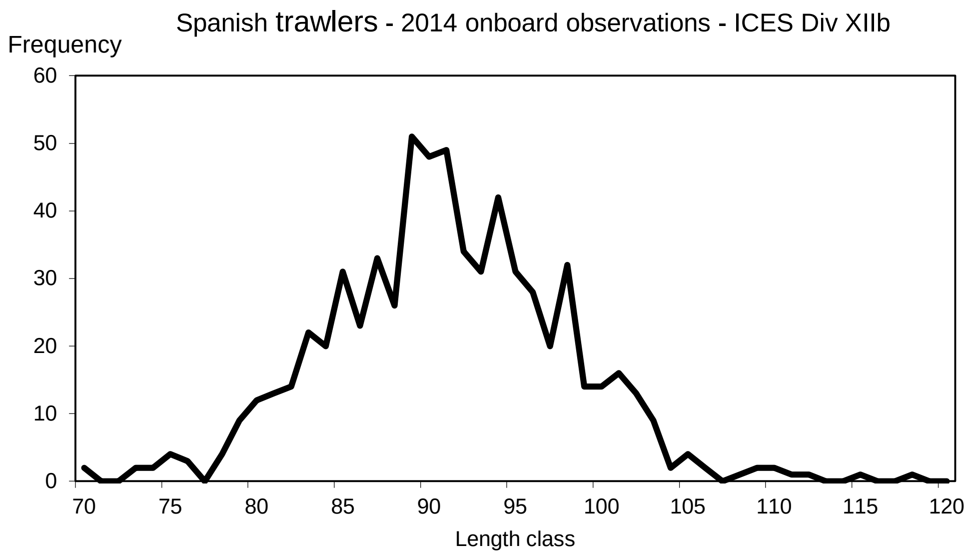


Figure 10.2.5. Spanish fishery. Annual lengthfrequency distributions of black scabbardfish in Divisions VIb (a) and XIIb (b) derived from on-board observation (frequencies were not raised to the total catch).

The length–frequency distributions derived from length data obtained from specimens caught during the Faroese deep-water survey are presented in Figure 10.2.6. The species was mainly caught on the Wyville-Thomsen ridge and on the slope north of the Faroe Bank (Figure 10.2.6). During the survey, a total of 4477 specimens were measured and 150 were sampled for sex, maturity and otolith extraction. The estimated mean length was 94 cm and all the sampled individuals were immature.

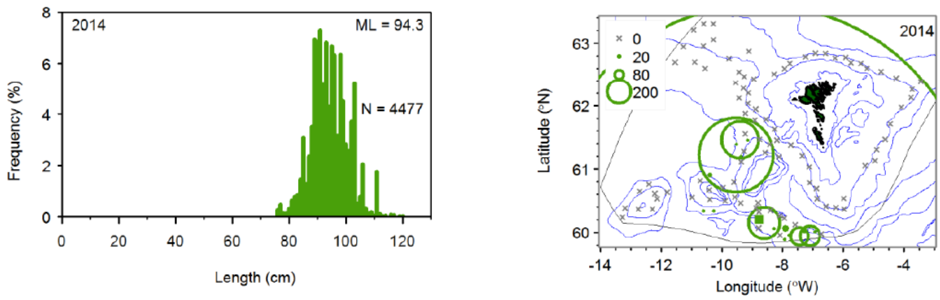


Figure 10.2.6. Black scabbardfish Vb. Length distribution (left) and spatial distribution (right) in the deep-water survey 2014.

10.2.4.3 Age compositions

Age compositions are not required as input data for the assessment model adopted for the stock. Growth parameters are, however, used to construct the prior distribution for the probability for specimen to transit from the C2 to the C3 length class during one semester (for further details see the Stock Annex).

10.2.4.4 Weight-at-age

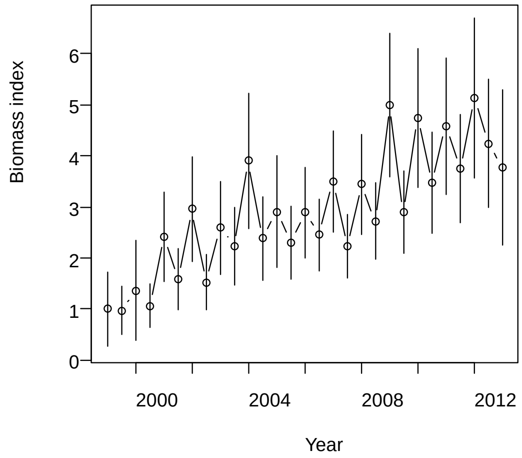
No data on weight-at-age are available.

10.2.4.5 Maturity and natural mortality

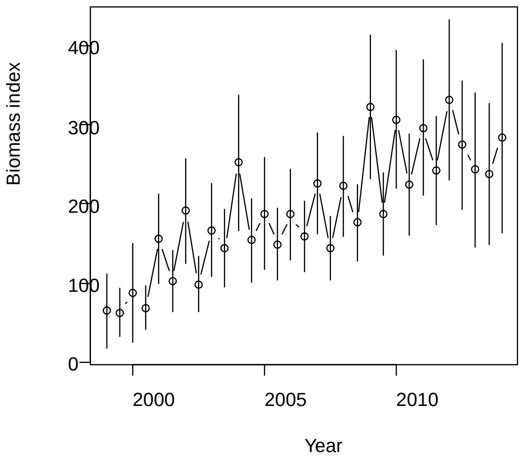
The information available for ICES Subareas Vb, VI, VII and XII consistently points out to the exclusive occurrence of small and immature specimens in the area.

10.2.4.6 Catch, effort and research vessel data

In 2014 standardized French cpue series covering the period 1998–2013 were presented (Figure 10.2.6). Estimates were made for one vessel in each rectangle, for the mean fishing depth by rectangle, and estimates by area were obtained by averaging over rectangles by area. Cpue was estimated by semester (Figure 10.2.4a) and by six month time period as: Sem1= months 3–8 of the year, Sem 2=month 9–12 of the year, plus months 1 and 2 of the next year. The use of an index by semester instead of a yearly index was driven by a clear seasonal pattern in cpue with higher catch rates in autumn–winter.



a)



b)

Figure 10.2.6. Cpue by semester: a) time-series provided for WKDEEP 2014 a) and b) new time-series by new semesters, i.e. Semester1= months 3–8 of the year and Semester 2=month 9–12 of the year, plus months 1 and 2 of the next year. Data for Semester 2 in 2013 is incomplete as month 1 and 2 of 2014 were not available.

The second cpue series was used to estimate the standardized fishing effort (more details in the stock annex) and applied to define initial prior for the catchability parameter.

Scottish research survey data have been provided to 2014 WGDEEP. The biomass and abundance indices estimates obtained for the depth stratum deeper than 1000 m (depth stratum considered as the core of the species distribution in the surveyed area) are presented in Figure 10.2.7. No new data were provided in 2015 because Scottish survey is biannual.

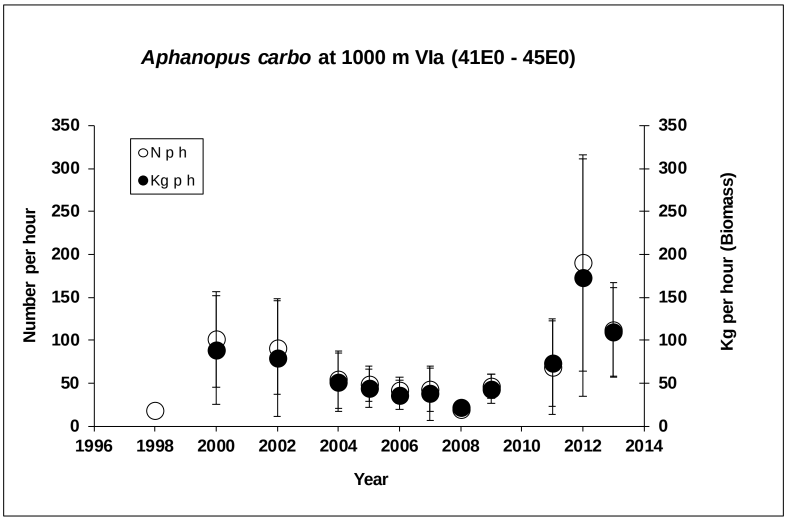


Figure 10.2.7. Abundance (left axis) and biomass indices of black scabbardfish in ICES Division VIa from the Scottish deep-water survey.

A new series of cpue data (in Kg/hour) for Subarea Va was presented (Figure 10.2.6). This series was based on fishery data from Faroese trawlers, particularly from fishing hauls where black scabbardfish represented more than 30% of the total catch. For the years earlier than 2000 the number of fishing hauls was reduced. In 2009–2010 cpue were at same level as average cpue for the whole period, but in 2014 there was a sharp increase (Figure 10.2.8).

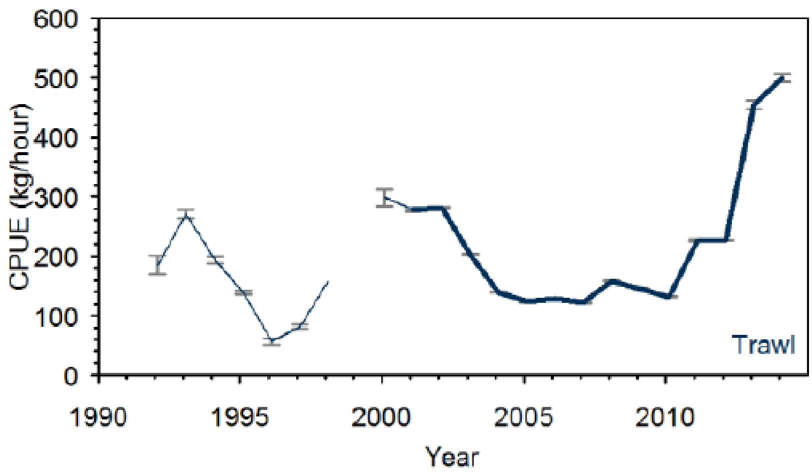


Figure 10.2.8. Black scabbardfish Vb. cpue from otter-board trawlers (>1000 HK). Criteria: black scabbardfish >30% of total catch per haul.

10.2.5 Data analyses

Since this is not an advice year for black scabbardfish stock, no data analyses were carried out.

Reference points

At the WKDEEP 2014 and in view of the probable linkage between the northern and southern fishery components, it is agreed that the status of the stock as a whole should be considered when giving management advice for either fishery component. However, given the presumed sequential nature of the exploitation pattern, management should also take into consideration trends occurring in the separate areas.

WKDEEP 2104 proposed that the harvest control rule should adjust catches in both areas according to recent trends in total abundance for the two components combined as estimated by the state–space model (estimated by a regression fitted to the posterior median estimates of abundance of the most recent five years). This would be applied in combination with a simple harvest control rule that specifies that catch advice should only increase when the abundance trends for both fishery components are increasing. If the abundance in either component is stable or decreasing, the advised catch for both areas should be adjusted according to the rate of change in the area showing the decrease.

10.2.6 Management considerations

Available information does not unequivocally support the assumption of a single stock for the whole NE Atlantic area although most available evidences do support it. In face of this evidence, WGDEEP 2014 recommended that ICES Division Va be included in the northern component.

ICES did not assessed fisheries in Madeira which are outside the ICES area. It is believed that the incorporation CECAF data would allow for more accurate estimation of the dynamics of the whole stock.

In 2014 the management advice was given based on the harvest control rule proposed by WKDEEP 2014 (see the stock annex for further details).

Table 10.2.1a. Landings of black scabbardfish from Division Vb. Working group estimates.

Year	Faroese Islands			France	Germany*		Scotland	E&W&NI	Russia	Total
	Vb 1	Vb 2	Vb	Vb	Vb1	Vb				
1988					.	.	-	-	-	
1989	-	-		170	.	.	-	-	-	**170**
1990	2	10		415	.	.	-	-	-	**427**
1991	-	1		134	-	-	-	-	-	**135**
1992	1	3		101	-	-	-	-	-	**105**
1993	202	-		75	9	-	-	-	-	**286**
1994	114	-		45	-	1	-	-	-	**160**
1995	164	85		175	-	-	-	-	-	**424**
1996	56	1		129	-	-	-	-	-	**186**
1997	15	3		50	-	-	-	-	-	**68**
1998	36	-		144	-	-	-	-	-	**180**
1999	13	-		135	-	-	6	-	-	**154**
2000			116	186	-	-	9	-	-	**311**
2001	122	281		457	-	-	20	-	-	**880**
2002	222	1138		304	-	-	80	-	-	**1744**
2003	222	1230		172	-	-	11	-	-	**1635**
2004	80	625		94	-	-	70	-	-	**869**
2005	65	363		106	-	-	20	-	-	**553**
2006	54	637		93	-	-	-	-	-	**784**
2007	78	596		116	-	-	-	-	-	**790**
2008	94	787	828	159	.	.	-	-	-	**1868**
2009	117	852	-	96	.	.	1	-	-	**1067**
2010	102	715	-	142	.	.	31	-	-	**990**
2011	67	371		115	-	-	-	-	-	**553**
2012	84	43		115	-	-	-	-	-	**242**
2013	38	379	159	160						**735**
2014	400	181	143				0		1	**725**

Table 10.2.1b. Landings of black scabbardfish from Division XII. Working group estimates.

Year	France	Spain	Scotland	Russia(XIIc)**	Poland*	Unallocated	Total
1988				.	-		**0**
1989	0			.	-		**0**
1990	0			.	-		**0**
1991	2			.	-		**2**
1992	7			.	-		**7**
1993	24			.	-		**24**
1994	9			.	-		**9**
1995	8			.	-		**8**
1996	7	41		.	-		**48**
1997	1	98		.	-		**99**
1998	324	134		.	-		**458**
1999	1	109	0	.	-		**109**
2000	5	237		.	-		**242**
2001	3	115		.	-		**118**
2002	0	1117	1	.	-		**1119**
2003	7	444		.	1		**452**
2004	10	230	1	.	-		**242**
2005	14	239		.	-		**253**
2006	0	1009		.	-		**1009**
2007	-	9	0	.	-		**9**
2008	-	53	0	4	.		**57**
2009	-	103		-	.		**103**
2010	1	180	-	-	.		**181**
2011	1	113	-	-			**114**
2012	-	47	-	-		**907**	**954**
2013	-	50	-			**289**	**339**
2014	-	149	-				**149**

***STATLAND data.**

***STATLAND data from 1988 to 2011.**

Table 10.2.1b. Continued.

Year	Faroes	Germany	Ireland	E&W&NI	Iceland*	Lituania*	Estonia	Total
1988		.				.	.	**0**
1989		.				.	.	**0**
1990		.				.	.	**0**
1991		-				.	-	**0**
1992		-				-	-	**0**
1993	1051	93				-	-	**1144**
1994	779	45				-	-	**824**
1995	301	-				-	-	**301**
1996	187	-			0	-	-	**187**
1997	102	-				-	-	**102**
1998	20	-				-	-	**20**
1999		-				-	-	**0**
2000	1	-				-	-	**1**
2001		-				-	-	**0**
2002		-		0		-	-	**0**
2003		-	1			1	-	**2**
2004	95	-				1	-	**96**
2005	127	-	0			-	1	**128**
2006	8	-				-	2	**10**
2007	0	-	0			-	7	**7**
2008	1	.	0			-	.	**1**
2009	156	-	0	0		.	.	**156**
2010	27	-	0	0			.	**27**
2011	24	-	-	-			.	**24**
2012								**0**
2013	1	-	-	-			.	**1**
2014				-				**0**

* **STATLAND data.**

Table 10.2.1c. Landings of black scabbardfish from subarea VI. Working group estimates.

YEAR	FRANCE			FAROES		GERMANY*		IRELAND	SCOTLAND		NETHERLANDS *		LITUANIA*	ESTONIA *	POLAND*	RUSSIA*	SPAIN	UNALLOCATED	TOTAL
	VI	VIA	VIB	VIA	VIB	VIA	VI B	VIA	VIA	VIB	VIA	VIB	VIA	VIB	VIB	VIB			
1988						.	.				-	-	.	.		.			
1989		138	0	46		.	.		-	-	-	-	.	.	-	.			**184**
1990		971	53			.	.		-	-	-	-	.	.	-	.			**1023**
1991		2244	62			-	-		-	-	-	-	.	-	-	-			**2307**
1992		2998	113	3		-	-		-	-	-	-	-	-	-	-			**3113**
1993		2857	87		62	48	-		-	-	-	-	-	-	-	-			**3054**
1994		2331	55			30	15		2	-	-	-	-	-	-	-			**2433**
1995		2598	15			-	3		14	4	-	-	-	-	-	-			**2634**
1996		2980	1			-	2		36	<0.5	-	-	-	-	-	-			**3019**
1997		2278	16		3	-	-		147	88	-	-	-	-	-	-	0		**2533**
1998		1553	7			-	-		142	6	-	-	-	-	-	-	1		**1709**
1999	-	1610	8			-	-		133	58	11	-	-	-	-	-	0		**1820**
2000	-	2971	27			-	-		333	41	7	-	-	-	-	-	1		**3380**
2001	-	3791	29		3	-	-		486	145	-	-	3	225	-	226	150		**5058**
2002	-	3833	156	2		-	-		603	300	21	2	9	-	2	-			**4928**
2003	-	2934	67	45		-	-		78	9	-	2	12	7	2	7			**3162**
2004	-	2637	99	59		-	-		100	24	-	-	85	5	-	5	62		**3075**
2005	3	2533	59	38		-	-		18	62	-	-	5	11	-	11	126		**2867**
2006	-	1713	36	59		-	-	1	63	0	-	-	1	3	-	3	475		**2353**
2007	-	1991	4	44	37	-	-	0	53	0	-	-	-	-	-	-	50		**2179**
2008	-	2348	0	37	0	.	.	0	26	0	14	.	-	.	.	1	60		**2487**
2009	15	1609	1	39	0	.	.	0	80	0	.	.	.	.	.	-	95		**1840**
2010	-	1778	1	72		.	.	0	73	0	.	.			.	-	297		**2220**
2011	5	1791	3	31		-	-		1	0	.	.				-	116		**1946**
2012	-	1509	0	3		-	-	.	34	0						-	68	690	**2304**
2013		1799	9	6	-			-	57	.							44	189	**2104**
2014		1902	0	4	2			-	110	.	3						154		**2175**

Table 10.2.1d. Landings of black scabbardfish from Division VII. Working group estimates.

YEAR	FRANCE								IRELAND			SCOTLAND	E&W&NI	SPAIN	
	VII	VIIA	VIIB	VIIC	VIID-G	VIIH	VIIJ	VIIK	VIIB,J	VIIC	VIIK	VIIB,C,J,K	VIIJ,K	VII	TOTAL
1988															
1989		0	-	-	-		-	-				-			**0**
1990		0	2	8	0		0	-				-			**10**
1991		0	14	17	7		7	49				-			**94**
1992		0	9	69	11		49	183				-			**322**
1993		0	24	149	16		170	109				-			**468**
1994		0	32	165	8		120	336				-			**662**
1995		0	52	121	9		74	385				-			**641**
1996		0	104	130	2		60	360				-			**658**
1997		0	24	200	1		33	202				-		1	**462**
1998		0	15	104	6		52	211				-		2	**390**
1999	-	-	7	97	0	2	70	177				-		0	**355**
2000	-	-	25	173	1	4	100	253				3		0	**559**
2001	-	-	40	237	0	3	180	267				41		0	**768**
2002	-	0	33	105	2	7	138	49				53			**386**
2003	-	-	15	29	1	3	159	36				1			**245**
2004	-	-	31	28	8	9	115	63				0			**253**
2005	0	5	6	11	1	17	105	23				-			**169**
2006	-	-	3	10	1	24	315	20	1	32	37	0	2		**445**
2007	-	-	2	7	0	4	168	7	0	52	17	-	-		**257**
2008	-	-	2	19	0	6	148	4	-	-	-	0	-		**179**
2009	-	-	-	29	1	2	53	4	-	-	-	-	-		**90**
2010	-	-	2	40	0	2	36	-	-	-	-	-	-	-	**81**
2011	-	-	0	81	0	2	129	-	-	-	-	-	-		**212**

Year	France								Ireland			Scotland	E&W&NI	Spain	
	VII	**VIIa**	**VIIb**	**VIIc**	**VIId-g**	**VIIh**	**VIIj**	**VIIk**	**VIIb,j**	**VIIc**	**VIIk**	**VIIb,c,j,k**	**VIIj,k**	**VII**	**Total**
2012	-	-	13	36	2	9	63	6	-	-	-	-	-	31	**160**
2013		0	21	86	1	12	67	1				-	-	9	**196**
2014		0	14	79	0	9	50	0				.	.	-	**153**

Table 10.2.1e. Landings of black scabbardfish from Division VI and VII. Working group estimates.

YEAR	IRELAND	E&W&NI	TOTAL
1988			
1989			**0**
1990			**0**
1991			**0**
1992			**0**
1993	8		**8**
1994	3		**3**
1995			**0**
1996		1	**1**
1997	0	2	**2**
1998	0	1	**1**
1999	1	1	**2**
2000	59	40	**99**
2001	68	37	**105**
2002	1050	43	**1093**
2003	159	5	**164**
2004	293	2	**295**
2005	79	-	**79**
2006	-	-	**0**
2007	-	-	**0**
2008	-	-	**0**
2009	-	-	**0**
2010	-	-	**0**
2011	-	-	**0**
2012	-	-	**0**
2013	-	-	**0**
2014	-	-	**0**

10.3 Black scabbardfish in Subareas VIII, IX

10.3.1 The fishery

The main fishery taking place in these subareas is derived from the Portuguese longliners. This fishery was described in 2007 report (Bordalo_Machado and Figueiredo, 2007 WD) and updated later (Bordalo_Machado and Figueiredo, 2009).

The French bottom trawlers operating mainly in Subareas VI and VII had a small marginal activity in Subarea VIII. For the whole time period Spanish catches of the species have been negligible.

10.3.2 Landings trends

Landings in Subareas VIII and IX are almost all from the Portuguese longline fishery that takes place in Subarea IXa, representing more than 99% of the total landings (Figure 10.3.1).

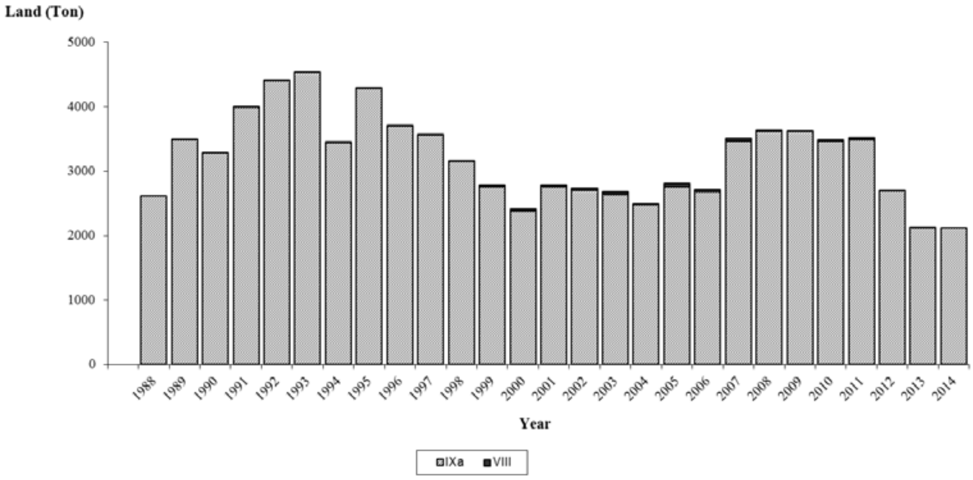


Figure 10.3.1. Annual landings for ICES Subareas VIII and Division IXa (2014 provisional data).

10.3.3 ICES Advice

The latest ICES advice for 2013 and 2014, based on the ICES approach for data-limited stocks was: "annual catches of no more than 2726 t in Subarea VIII and Division IXa".

10.3.4 Management

Since 2003, management of black scabbardfish by EU vessels fishing in EU and international waters includes a combination of TAC and licensing system. The TAC adopted from 2006 till 2013, as well as, the total landings in Subareas VIII, IX and X are next presented.

YEAR	EU TAC VIII, IX AND X	EU LANDINDS IN VIII AND IX	EU LANDINDS IN X
2006	**3042**	**2791**	**65**
2007	**4000**	**3556**	
2008	**4000**	**3719**	**75**
2009	**3600**	**3601**	**162**
2010	**3348**	**3453**	**102**
2011	**3348**	**3476**	**139**
2012	**3348**	**2726**	**458**
2013	**3 700**	**2147**	**206**
2014*	**3700**	**2128**	**30**

*** 2014 landing estimates are preliminary.**

10.3.5 Data available

10.3.5.1 Landings and discards

No new information on the discards of deep-water species produced by the Portuguese on-board sampling programme (EU DCR/NP) was made available. However there is no evidence for the existence of changes from the estimates calculated for the period 2004–2013(Prista and Fernandes, 2014 WD). Sampling levels attained by on-board sampling programme in the deep-water set longlines that target black scabbardfish (LLS_DWS) between 2005 and 2013 are presented in Table 10.3.0.

Table 10.3.0. Discards (in number per set) of WGDEEP 2014 species in the LLS_DWS fishery (2005–2013); ___ indicates no occurrence. (a) BSF data include fish whose good parts (i.e., parts not affected by predation marks) may have been marketed.

	BSF			GFB			RNG		
Year	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
2005 (a)	98.0	10.0	88-108	1.7	2.9	0-5	0.3	0.6	0-1
2006 (a)	114.4	79.3	8-195	—	—	—	—	—	—
2007 (a)	70.0	103.3	4-189	—	—	—	—	—	—
2008	52.8	36.5	23-99	0.8	1.5	0-3	—	—	—
2009	29.3	12.5	13-48	0.2	0.4	0-1	—	—	—
2010	49.7	26.9	13-96	0.2	0.4	0-1	—	—	—
2011	30.5	28.6	0-78	0.5	0.8	0-2	—	—	—
2012	40.3	28.9	5-96	0.2	0.7	0-2	—	—	—
2013	40.5	6.4	36-45	0.5	0.7	0-1	—	—	—

Discards of most WGDEEP 2014 species carried out by Portuguese vessels operating deep-water set longlines (targeting black scabbardfish) within the Portuguese ICES Division IXa were not quantified at fleet level. However, the low frequency of occurrence (and number of specimens) registered in the sampled hauls and sets indicate discards of black scabbardfish can be assumed null or negligible for assessment purposes. The black scabbardfish discard mortality is mainly caused by shark and cetacean predation on hooked black scabbardfish and is relatively low when compared to landings. Consequently discards are not likely to play a significant role in the assessment of black scabbardfish (Prista and Fernandes, 2014 WD).

10.3.5.2 Length compositions

In WGDEEP 2014 length data of the black scabbardfish landed at Sesimbra port (ICES IXa) by the Portuguese longline fleet and collected under the DCF/EU landing sampling programme were used to separate the southern component into the two length classes (TL (total length): 70 cm C2 <103 and C3>130 cm) considered in the assessment approach adopted for the stock.

In 2015 and since this is not an advice year for the stock, the length data available will not be used to convert monthly catches, which are given in weight, into numbers. Length–frequency distribution derived from length data collected in 2014 under DCF/EU programme is presented in Figure 10.3.1.

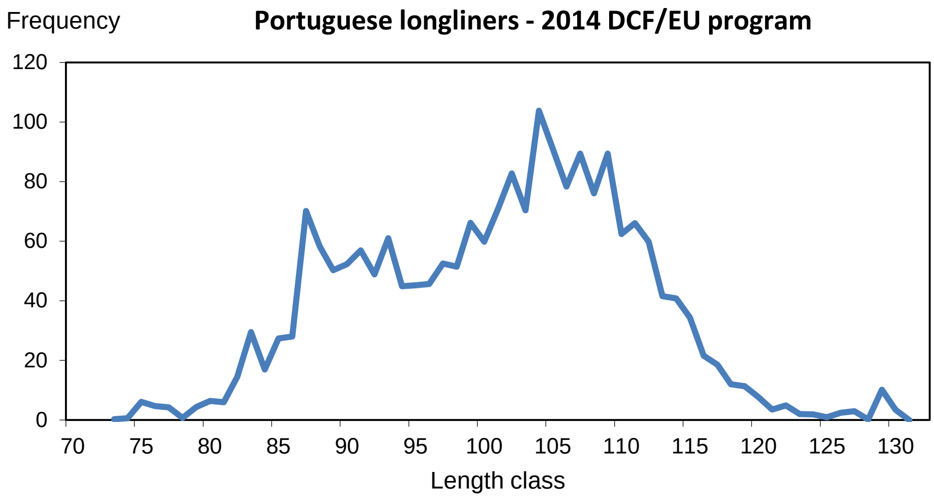


Figure 10.3.2. Portuguese longliners. 2014 annual length–frequency distribution (EU/DCF).

10.3.5.3 Age compositions

Age data are not required as input for the assessment model adopted for the stock. Growth parameters are, however, used to construct the prior distribution for the probability for specimen to transit from the C2 to the C3 length class during one semester (for further details see the Stock Annex).

10.3.5.4 Weight-at-age

No new information on age was presented.

10.3.5.5 Maturity and natural mortality

In ICES Subarea IXa only immature and early developing specimens have been observed (Figueiredo, 2009, WGDEEP WD). Mature individuals have been just registered in Madeira (Figueiredo *et al.*, 2003) and, in Canary Islands (Pajuelo *et al.*, 2008) and the northwest coast of Africa.

Black scabbardfish has a determinate fecundity strategy. Estimates of relative fecundity ranged from 73 to 373 oocytes/female weight (g). It is further admitted that skipped spawning may occur. During the spawning season, the percentage of non-reproductive large females varied between 21% and 37% (Vieira *et al.*, 2009).

10.3.5.6 Catch, effort and research vessel data

In 2015, a new standardized Portuguese monthly cpue series covering the period 1998–2014 is presented (Figure 10.3.2) Estimates of cpue obtained through the adjustment of a GLM model, in which monthly cpue is the response variable and Year, Month and Vessel are the factors. The monthly cpue was calculated for each vessel as the ratio of the total landed weight (Kg) and the number of fishing trips. Only vessels having total annual landings ≥1000 Kg and more than one year of landings were considered.

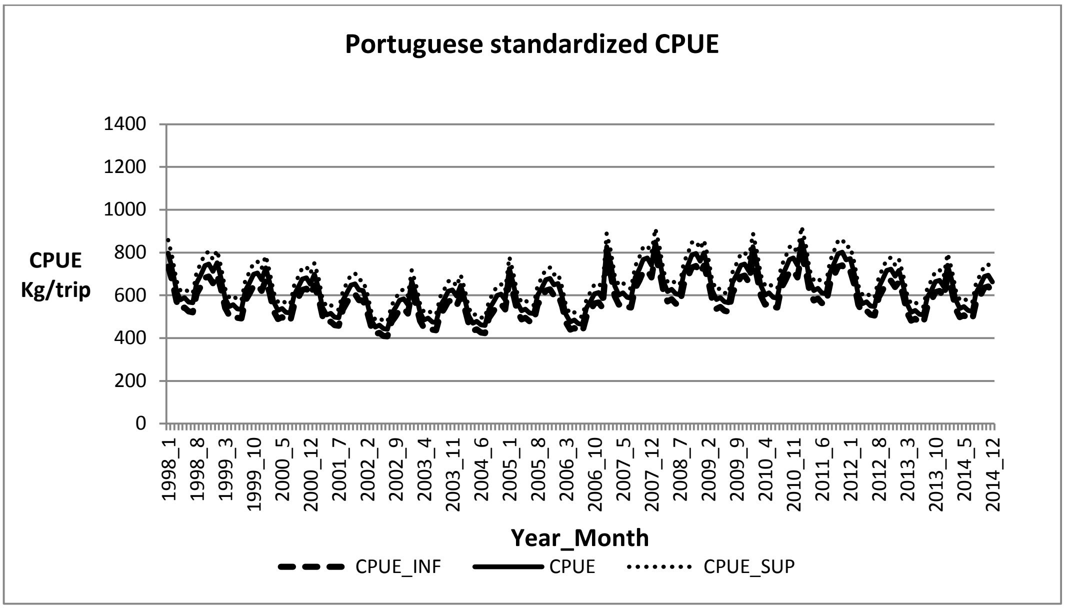


Figure 10.3.2. Portuguese cpue by semester time-series based on Portuguese longliner fleet operating in Subdivision IXa.

10.3.6 Data analyses

Since this is not an advice year for black scabbardfish stock, no data analyses were carried out.

10.3.7 Management considerations

Management considerations are described in Section 10.1.6.

Table 10.3.1a. Black scabbardfish from Subarea IX; Working group estimates of landings.

YEAR	PORTUGAL	FRANCE	SPAIN	TOTAL
1988	2602			**2602**
1989	3473			**3473**
1990	3274			**3274**
1991	3978			**3978**
1992	4389			**4389**
1993	4513			**4513**
1994	3429			**3429**
1995	4272			**4272**
1996	3686			**3686**
1997	3553		0	**3553**
1998	3147		0	**3147**
1999	2741	-	0	**2741**
2000	2371	-	0	**2371**
2001	2744	-	0	**2744**
2002	2692	-		**2692**
2003	2630	0		**2630**
2004	2463	-		**2463**
2005	2746	-		**2746**
2006	2674	-		**2674**
2007	3453	-		**3453**
2008	3602	-		**3602**
2009	3601	-		**3601**
2010	3453	-	0	**3453**
2011	3476	-		**3476**
2012	2668	-	12	**2680**
2013	2130	-	-	**2130**
2014*	2109	-	-	**2109**

*** 2014 landing estimates are preliminary.**

Table 10.3.1b. Black scabbardfish from Subarea VIII; Working group estimates of landings.

YEAR	FRANCE						SPAIN	
	VIII	VIIIa	VIIIb	VIIIc	VIIId	VIIIe		Total
1988								**0**
1989		-	-		-			**0**
1990		-	-		0			**0**
1991		1	-		0			**1**
1992		4	-		4			**9**
1993		5	-		7			**11**
1994		3	-		2			**5**
1995		0	-		-			**0**
1996		0	-		0		3	**3**
1997		1	-		0		1	**2**
1998		2	-		0		3	**6**
1999	-	7	-	-	4	-	0	**12**
2000	-	15	0	-	20	0	1	**36**
2001	-	16	0	-	12	0	1	**29**
2002	-	17	2	-	16	-	1	**36**
2003	-	25	-	-	8	-	1	**34**
2004	0	25	0	-	14	-	1	**40**
2005	-	19	0	-	6	-	1	**26**
2006	-	30	2	0	19	-	0	**52**
2007	-	14	1	-	13	-	1	**29**
2008	-	10	0	-	35	-	1	**45**
2009	-	15	1	0	3	-	1	**19**
2010	0	13	1	0	3	-	-	**17**
2011	-	4	0	0	14	-	-	**18**
2012	-	10	0	-	3	-	18	**32**
2013		5	0	0	2	-	3	**10**
2014*		7	0	0	3	-	-	**9**

*** 2014 landing estimates are preliminary.**

10.4 Black scabbardfish other areas (I, II, IIIa, IV, X, Va, XIV)

10.4.1 The fishery

In past, fisheries in ICES Divisions I, II, IIIa, IV, X and XIV and Subarea Va occurred sporadically or at very low levels.

In Divisions in I–IV and XIV the low levels of landings may just indicate that the species has a low occurrence in the area. On the contrary, landings from other areas, particularly in Division X and Subarea Va, indicate that the level of abundance of species appears to be significant.

In Subarea X, the commercial interest of the Portuguese longliner fleet for the exploitation of the species has increased in recent years. Some Faroese trawl exploratory surveys targeting orange roughy took also place in Subarea X. In those surveys black scabbardfish is caught as a bycatch.

Since 2010 in ICES Subarea Va the Icelandic trawl fishery regularly catches the species.

10.4.2 Landings trends

In ICES Division X in former years landings have been quite variable, but in recent ones they are higher and less sporadic. For the period 2009–2013 landings averaged 200 tonnes. However this landing figure is likely to include *A. intermedius*, a species with a similar morphological appearance with *A. carbo* that also occurs in ICES Division Xa.

Since 2010 Icelandic landings in ICES Subarea Va have significantly increased, reaching 358 tonnes in 2014.

The 111 tonnes reported in 2010 in ICES Division XIV is considered to be misreported.

10.4.3 ICES Advice

The ICES advice for 2014 and 2015 was: "annual catches of no more than 366 t in the adjacent areas (Subareas I, II, IV, X, and XIV, and Divisions IIIa and Va".

10.4.4 Management

Since 2003, management of black scabbardfish by EU vessels fishing in EU and international waters includes a combination of TAC and licensing system. The TAC adopted from 2007 to 2013 by subarea are presented next.

In 2010 the TACs have been exceeded. More information is needed in order to track the situation.

YEAR	EU AND INTERNATIONAL WATERS OF I, II, III AND IV	EU LANDINGS
2007	15	1
2008	15	0
2009	12	5
2010	12	15
2011	12	1
2012	9	1
2013	9	0
2014*	9	0

*** 2014 landing estimates are preliminary. TACs and landings for Subarea X are included in Table 10.3.4**

10.4.5 Data available

10.4.5.1 Landings and discards

Landings are given in Tables 10.4.1a–e and in Figure 10.4.1. In Subareas II, IV and XIV reported landings are considered to be misreported although the extent of this is unknown.

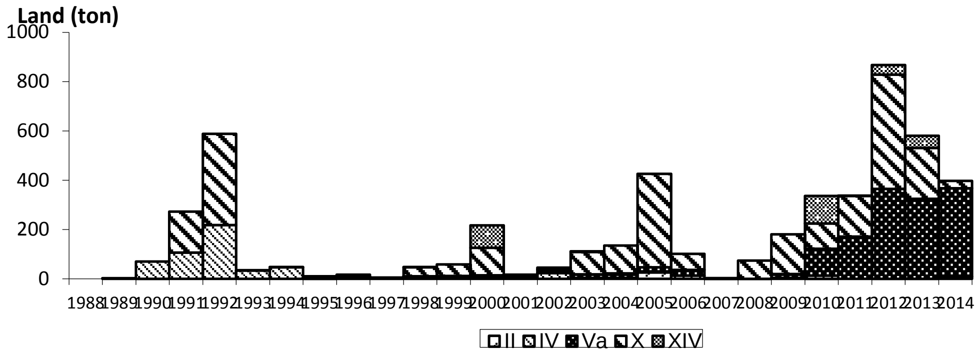


Figure 10.4.1. Annual landings for black scabbardfish by ICES Subareas II, IV, V, X and XIV.

10.4.5.2 Length compositions

In Subarea X, the commercial interest for the species has increased over time, but apart from the data presented for Faroese exploratory survey in 2008, the data available are only landings.

For Division Va length–frequency distributions based on the Icelandic Autumn surveys for the period 2000–2014 are presented in Figure 10.4.2. There are slight changes along the time-series considered; in former years smaller specimens (TL<70 cm) were more frequently caught. A deeper analysis of the data will be carried on intersessionally.

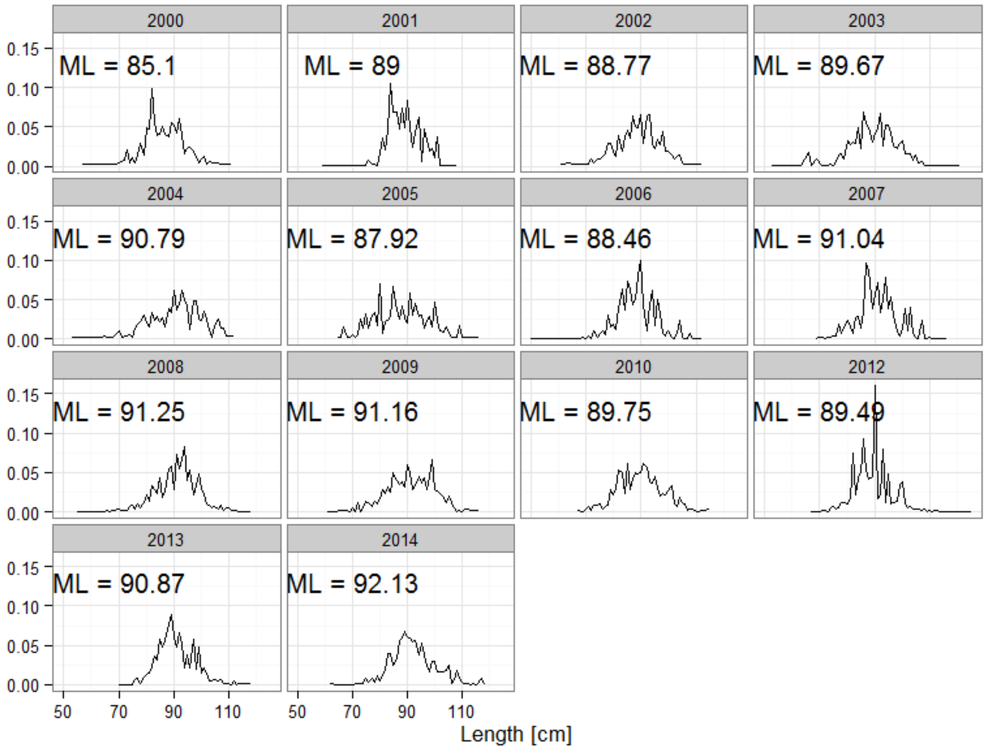


Figure 10.4.2. Black scabbardfish in Va: length distribution from the Icelandic Autumn survey, 2000 to 2014.

10.4.5.3 Age compositions

No data were available.

10.4.5.4 Weight-at-age

No data were available.

10.4.5.5 Maturity and natural mortality

For ICES Division Xa there are some indications of the existence of spawners in the area. On the contrary for Subarea Va available information consistently points out to the exclusive occurrence of small and immature specimens in the area.

10.4.5.6 Catch, effort and research vessel data

New series of biomass indices for all sizes (Total biomass) and for specimens larger than 90 cm and 110 cm are shown along with abundance of black scabbardfish smaller than 80 cm from the Icelandic Autumn survey were provided by Iceland (Figure 10.4.3).

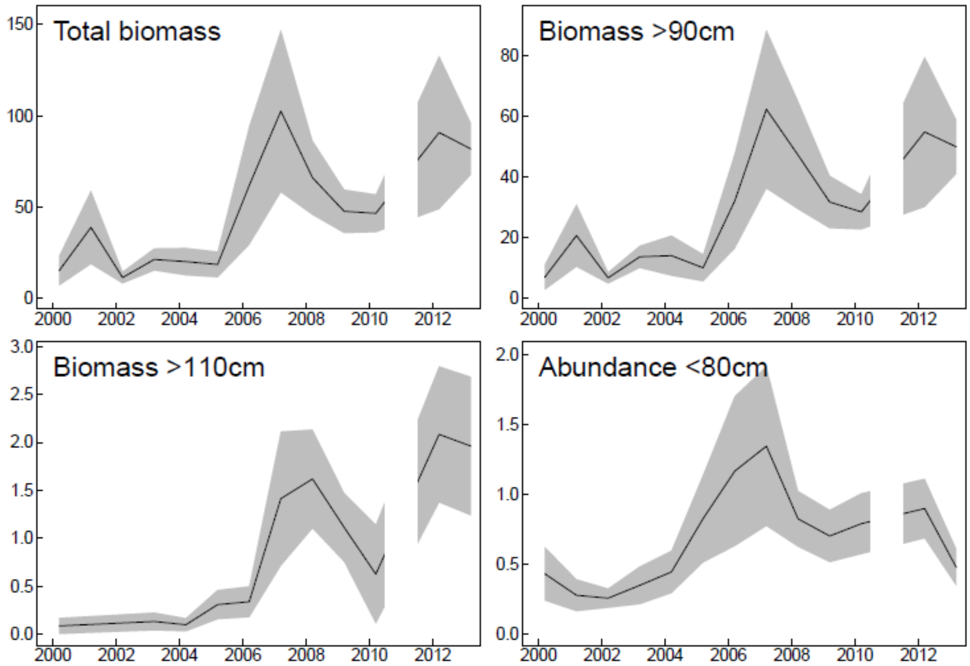


Figure 10.4.3. Abundance and biomass indices from the Icelandic autumn survey.

Total biomass and Abundance estimates and their coefficient of variation are presented in Table 10.4.2. In recent years, biomass indices show consistent increasing trends for all the length ranges considered. On the contrary, abundance indices for small individuals (<80 cm) have been consistently decreasing in recent years.

Table 10.4.2. Black scabbardfish in Va: Trends in indices from the Icelandic Autumn survey in 2000 to 2014. NEED TO BE UPDATED

Year	Biomass index	CV	Abundance index	CV
2000	14898.6	0.551	2288.9	0.528
2001	38587.4	0.523	5388.5	0.522
2002	11022.1	0.294	1544.2	0.291
2003	20965.9	0.291	2817.5	0.302
2004	19778.2	0.382	2591.6	0.339
2005	18222.5	0.390	2644.8	0.380
2006	61616.1	0.529	8806.2	0.532
2007	102484.0	0.435	13710.2	0.445
2008	65885.9	0.310	8474.7	0.300
2009	47421.2	0.252	6209.6	0.254
2010	46311.8	0.225	6282.2	0.233
2012	90725.5	0.464	12330.0	0.474
2013	81727.3	0.175	10669.9	0.179

10.4.6 Data analyses

Since this is not an advice year for black scabbardfish stock, no data analyses were carried out.

10.4.7 Comments on the assessment

Since this is not an advice year for the stock no assessment was carried out.

10.4.8 Management considerations

The information available do not unequivocally supports the assumption of a single stock for the whole NE Atlantic area however most of the evidence available does support it. In face of this evidence it is recommended that ICES Division Va be included in the northern component.

Future advices on this stock need to take into consideration the co-occurence of two different species *A. carbo* and *A. intermedius* in ICES Area X.

Table 10.4.1a. Black scabbardfish other Areas II. Working group estimates of landings.

YEAR	FRANCE	FAROES	TOTAL
		II a	
1988			**0**
1989	0		**0**
1990	1		**1**
1991	0		**0**
1992	0		**0**
1993	0		**0**
1994	0		**0**
1995	1		**1**
1996	0		**0**
1997	0		**0**
1998	0		**0**
1999	-		**0**
2000	-		**0**
2001	-		**0**
2002	-		**0**
2003	-		**0**
2004	-		**0**
2005	0	27	**27**
2006	-	-	**0**
2007	-	0	**0**
2008	-	-	**0**
2009	-	-	**0**
2010	0	-	**0**
2011	-	-	**0**
2012			**0**
2013	-	-	**0**
2014*	**-**	**-**	**0**

*** 2014 landing estimates are preliminary.**

Table 10.4.1b. Black scabbardfish other Areas IV. Working group estimates of landings.

Year	France				Scotland			Germany *	E&W&NI	Total
		IVa	IVb	IVc	IVa	IVb	IVc	IVa	IVa	
1988					-			.	-	**0**
1989	3				-			.	-	**3**
1990	70				-			.	-	**70**
1991	107				-			-	-	**107**
1992	219				-			-	-	**219**
1993	34				-			-	-	**34**
1994	45				-			3	-	**48**
1995	6				2			-	-	**8**
1996	6				1			-	-	**7**
1997	0				2			-	-	**2**
1998	2				9			-	-	**11**
1999		4			3			-	-	**7**
2000		2			3			-	-	**5**
2001		1			10			-	1	**12**
2002		0			24			-		**24**
2003		0			4			-		**4**
2004		4	1		0			-		**5**
2005		1	1		0			-		**2**
2006		13			0	0	0	-		**13**
2007		1	0		-			-		**1**
2008		0			0			-		**0**
2009		5	0		-	-	-	-	-	**5**
2010		13	2		-	-	-	-	-	**15**
2011		-	1		-	-	-	-	-	**1**
2012		0			-	-	-	-	-	**0**
2013		1	0	0	-	-	-			**1**
2014*		10	0	0						**10**

*** 2014 landing estimates are preliminary.**

Table 10.4.1c. Black scabbardfish other Areas Va. Working group estimates of landings.

Year	Iceland	Faroes	Total
1988	-		**0**
1989	-		**0**
1990	-		**0**
1991	-		**0**
1992	-		**0**
1993	0		**0**
1994	1		**1**
1995	+		**0**
1996	0		**0**
1997	1		**1**
1998	0		**0**
1999	6		**6**
2000	10		**10**
2001	5		**5**
2002	13		**13**
2003	14		**14**
2004	19		**19**
2005	19		**19**
2006	23		**23**
2007	1		**1**
2008	0		**0**
2009	15		**15**
2010	109		**109**
2011	172		**172**
2012	365		**365**
2013	324	0	**324**
2014*	358	-	**358**

*** 2014 landing estimates are preliminary.**

Table 10.4.1d. Black scabbardfish other Areas X. Working group estimates of landings.

YEAR	FAROES	PORTUGAL	FRANCE	IRELAND	TOTAL
1988	-	-			**0**
1989	-	-	0		**0**
1990	-	-	0		**0**
1991	-	166	0		**166**
1992	370	-	0		**370**
1993	-	2	0		**2**
1994	-	-	0		**0**
1995	-	3	0		**3**
1996	11	0	0		**11**
1997	3	0	0		**3**
1998	31	5	0		**36**
1999	-	46	-		**46**
2000	-	112	-		**112**
2001	-	+	-		**0**
2002	2	+	-		**2**
2003		91	0		**91**
2004	111	2	-		**113**
2005	56	323	-	0	**379**
2006	10	55	-		**65**
2007	0	0	-	0	**0**
2008	75	0	-	0	**75**
2009	157	5	-	0	**162**
2010	53	49	-	0	**102**
2011	25	139	-		**164**
2012	4	458	-	-	**462**
2013		206	-		**206**
2014*	30	-	-		**30**

*** 2014 landing estimates are preliminary.**

Table 10.4.1f. Black scabbardfish other Areas XIV. Working group estimates of landings.

Year	Faroes	Spain	Unallocated	Total
	XIVb			
1988	-	-		**0**
1989	-	-		**0**
1990	-	-		**0**
1991	-	-		**0**
1992	-	-		**0**
1993	-	-		**0**
1994	-	-		**0**
1995	-	-		**0**
1996	-	-		**0**
1997	-			**0**
1998	2			**2**
1999	-			**0**
2000	-	90		**90**
2001	-	0		**0**
2002		8		**8**
2003		2		**2**
2004				**0**
2005	0			**0**
2006	-			**0**
2007	0			**0**
2008	0			**0**
2009	0			**0**
2010		111		**111**
2011	0	-		**0**
2012	-	39	49	**88**
2013		50	40	**90**
2014				**0**

*** 2014 landing estimates are preliminary.**

10.5 References

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11 Greater forkbeard (*Phycis blennoides*) in all ecoregions

11.1 The fishery

Greater forkbeard is as a bycatch species in the traditional demersal longline and trawl mixed fisheries targeting species such as hake, megrim, monkfish, ling, and blue ling in Subareas VI, VII, VIII and IX.

Since 1988, 77% of landings have come from Subareas VI and VII. Spanish, French, Norwegian and UK trawl and longline are the main fleets involved in this fishery. The Irish mixed deep-water fishery around Porcupine Bank historically landed important quantities of this species but since 2006 the landings of this country have been reduced strongly. Russian fisheries in the Northeast Atlantic land small quantities of greater forkbeard as bycatch of the trawler fleet targeting roundnose grenadier, tusk and ling on Hatton and Rockall Banks.

A further 13% of landings in this period come from the French and Spanish trawl and longline fleets in Subareas VIII and IX (mainly from VIII). In Subarea IX since 2001 small amounts of *Phycis* spp (probably *Phycis phycis*) have been landed in ports of the Strait of Gibraltar by the longliner fleet targeting scabbardfish in Algeciras, Barbate and Conil. Portuguese landings of *P. blennoides* are scarce, but important amounts of *Phycis* spp and *Phycis phycis* species are reported every year in Subarea IX.

Minor quantities of *Phycis blennoides* are landed by Portugal in Subarea X and by Norwegian and in recent years Faroese vessels in Divisions Va and Vb. The Azores deep-water fishery is a multispecies and multigear fishery dominated by the main target species *Pagellus bogaraveo*. Target species can change seasonally according to abundance and market prices, but *P. blennoides*, representing less than 0.5% of total deep-water landings in the last five years, can be considered as bycatch.

11.2 Landings trends

Tables 11.0a–h and Figure 11.1 show landings of greater forkbeard by country and subarea.

In Subareas I, II, III and IV only Norwegian landings are significant reaching 310 t in these combined subareas. The Norwegian longliners which fish in these areas catch *P. blennoides* as a bycatch in the ling fishery. The quantity of this bycatch depends on market price. After eight years without *P. blennoides* records, in 2002 the Norwegian fleet reported 315 t in Subareas I and II and 561 t in Subareas III and IV, since then the landings of this country have been very variable and have reduced to 96 t and 210 t respectively in 2014.

In Vb landings historically come from France and Norway. However in 2011 and 2012 the landings reached the highest values because Faroes reported 310 t and 145 t respectively. After this the landings dropped to similar levels as before 2011–2012 because the Faroese fleet did not report landings in 2013 and only 0.2 t in 2014.

Traditionally the most important landings in the Northeast Atlantic are recorded in VI and VII from Spain, Norway, UK (Scotland), Ireland and France. Historical landings decreased since the peak of 4967 t in 2000 and they are especially low in 2009 and 2010 due to the low landings reported by Spain.

The main landings from Subareas VIII and IX come from Spanish fleets. The average landings in the last ten years is 304 t with a peak of 556 t in 2007. In 2010 landings were the lowest of the series mainly due to the reduction of landings reported by Spain.

In Subarea X landings come only from Portugal and peaked to 136 t in 1994 and 91 t in 2000. Since this year landings have continuously decreased with the lowest landing recorded in 2012 (6 t). In 2014 for first time France reported 0.2 t in this Subarea.

Although since 1991 many countries were involved in the fishery, landings in Subarea XII are negligible, except in the period from 2002 to 2009 in which Spain reported significant landings. Since 2010 only 0.5 t have been landed by France.

11.3 ICES Advice

For 2015 ICES advised; ICES advises on "the basis of the data-limited stock approach that landings should be no more than 2628 tonnes".

11.4 Management

Biannual EU TACs since 2013 and landings in 2013 and 2014 by ICES subarea are shown below. Landings in Subareas I, II, III and IV include Norwegian landings while only EU TACs are shown, resulting in the landings exceeding the TAC. Total landings were lower than the EU TAC, however in I, II, III and IV landings were well above of the TAC in both years.

PHYCIS BLENNOIDES	EU TAC		TOTAL INTERNATIONAL LANDINGS	
Subarea	2013–2014	2015–2016	2013	2014
I, II, III, IV	31	37	262	311
V, VI, VII	2028	2434	1598	1586
VIII, IX	267	320	275	360
X, XII	54	65	8	9
Total	2380	2856	2143	2265

11.5 Stock identity

ICES currently considers greater forkbeard as a single stock for the entire ICES area. It is considered probable that the stocks structure is more complex; however further study would be required to justify change to the current assumption.

11.6 Data available

11.6.1 Landings and discard

Landings are presented in Table 11.0a–h. This year national landings in 2012 and 2013 have been revised and updated. Landings by fishing gear in 2013 and 2014 are shown in the Table 11.1.

Discard estimates in 2104 could be considered underestimated because only five countries fishing in subareas VI, VII, VIII and IX have been reported this information (Table 11.2a). The discards estimates in 2013 and 2014 accounted 36% and 34% of the total catches respectively. The discards in the rest of subareas remain unknown.

11.6.2 Length compositions

Figure 11.2, 11.3 and 11.4 present the length–frequency distributions from 2001 to 2014 of Spanish Groundfish Survey in the Porcupine bank, Northern Spanish Shelf bottom-trawl survey and Scottish Western Coast Groundfish IBTS surveys.

11.6.3 Age compositions

No new data available.

11.6.4 Weight–at–age

No new data available.

11.6.5 Maturity and natural mortality

No new data available.

11.6.6 Catch, effort and research vessel data

In 2015 six different surveys were used to derive biomass and mean length indices. These surveys cover the Subareas, III, IV, VI, VII and VIII (Figure 11.5).

- Spanish Groundfish Survey in the Porcupine bank (SP-PorcGFS) in Divisions VIIc and VIIk. Biomass and abundance of greater forkbeard from 2001 to 2014 are presented in Figure 11.6.
- French EVHOE IBTS (FR-EVHOE) in Divisions VIIf,g,h,j; and VIIIa,b,d). Data of abundance and biomass raised to the total subarea have been provided for a series from 1987 to 2013. Data of 2014 were not available for the WG (Figures 11.7a and 11.7b).
- Irish Groundfish survey (IGFS) in Divisions VIa South and VIIb. Abundance and biomass Indices (nº per hour and kg per hour) from the period 2005 to 2014. This survey provides abundance indices for the total catches and for individuals <32 cm by shelf and slope strata (Figure 11.8).
- Northern Spanish Shelf bottom-trawl survey (SP-NGFS) in Divisions IXa and VIIIc. Biomass and abundance (kg/30 min tow and No/30 min tow) of greater forkbeard in the Cantabrian Sea from 1990 to 2014 are presented in Figure 11.9.
- North Sea IBTS survey (NS-IBTS) in Divisions IVa, IVb, IVc, IIIa and IIIc. Abundance in number per hour from 1975 to 2015 is presented in Figure 11.10.
- Scottish Western Coast Groundfish IBTS survey (SWC-IBTS) in Divisions Vb, VIa, VIb, VIIa, VIIb. Abundance in number per hour from 1986 to 2014 is presented in Figure 11.11.

Effort data (kWd) of the Spanish, Swedish and Irish fleets (OTB, LLS and GTR) have been provide by subarea (Table 11.3).

11.7 Data analyses

In the Porcupine bank survey, greater forkbeard keeps increasing in biomass terms, being 2014 the highest catch of the time-series, nevertheless a decrease in abundance in numbers has been recorded after the increasing trend in the previous three years, which reached in 2013 the peak of the time-series (Figure 11.6). This difference in the trends between biomass and abundance is due to the evolution of 2012 cohort that in 2013 produced the distinctive mode in 26–29 cm with more than 40 individuals per haul. In 2014 the main mode was between 37–40 cm with ca. 22 individuals per haul (Figure 11.2). In 2014 there were almost no traces of recruits, with only 0.13 individuals smaller than 18 cm per haul, showing two years of poor recruitment (0.42 in 2013, while in 2012 there were ca. eight recruits per haul. The geographical distribution of *Phycis blennoides* catches (Figure 11.12) shows that greater forkbeard is distributed almost uniformly along the bank. In 2014 higher abundances seem to occur in the northeastern part of the area.

The EVHOE IBTS survey in Divisons VII f,g,h,j and VIII a,b,d combined indicates a clear increase in biomass and abundance since 1996, although the biomass has decreased in 2012 and 2013 since the most important peak in 2011 (Figure 11.7a). The trend in the Divisions VIII a,b,d is very similar (Figure 11.7b).

Iris GFS indicates a decrease in the abundance in VIa and VIIb to 0.3 individuals per hour and in biomass to 1.7 kg per hour after the two peaks in the series in 2012 and 2013 (Figure 11.8).

The biomass in Divisions IXa and VIIIc by the SP-NGFS drops to 0.46 kg/h after the highest indices recorded since 2010. The abundance series shows continuous peaks and valleys and 2014 shows one of the lowest values with only 1.93 individuals/h (Figure 11.9). The spatial distribution in 2014 is similar to previous years with the more important catches taking place in the central and western areas of the Division VIIIc (Figure 11.13).

The NS-IBTS recorded in 2011 and 2012 the most important abundance years of the series (24.5 and 40.2 individuals/h respectively), but dropped strongly to a 4.2 individuals/h in 2014 (Figure 11.10).

Although the abundance levels recorded in the SWC-IBTS series are considerably lower than in NS-IBTS, the same trend is observed in the last years since the abundance showed an important increase in 2011 and 2012 and decreased to 0.71 individuals/h in 2104 (Figure 11.11).

WGDEEP reiterates its previous view that although the data provided by the surveys have increased the area covered in the ecoregion neither the available surveys nor discard data cover yet the entire distributional stock, especially in Subareas I, II and IXa.

11.7.1 Exploratory assessment

No analytical assessment was presented in WGDEEP 2014.

11.7.2 Comments on the assessment

No analytical assessment was presented in WGDEEP 2014.

11.8 Management considerations

As this is a bycatch species in both deep-water and shelf fisheries, advice should take account of advice for the targeted species in those fisheries. The life-history traits do not suggest it is particularly vulnerable.

The working group realised that for a particular year the landings data considered as preliminary can change significantly when these data are revised the following year. After revision of these data in 2015 landings in in 2013 increased from 1836 t to 2143 t.

These differences between the preliminary and definitive data for a given year could lead to misinterpretation of the analysis of the landings trend, affecting also the assessment of the stock and therefore the biannual advice.

After the peaks in 2012 and 2013 all survey indices in Subareas VI, and VII indicate a decrease in the abundance in 2104. Biomass showed also a decrease in 2014 except in the area covered by the Porcupine survey. The trend in Subarea VIII is not clear showing an increase in biomass and abundance in Divisions VIIIabde until 2013 and a decrease in 2104 in VIIIc (and IXa). In subareas III and IV the abundance in 2014 dropped strongly since the peak in 2012, although the index in 2014 is however above the long-term mean since 1976.

On the other hand, landings in all ecoregions remain stable in last four years between 2100–2600 t. As greater forkbeard is a bycatch of the traditional demersal trawl and longline mixed fisheries, discards of this species are considered high. According to the information available, discards represented 51% and 55% of the annual landings in 2013 and 2104 respectively.

Table 11.0a. Greater forkbeard (*Phycis blennoides*) in the Northeast Atlantic. Working group estimates of landings.

YEAR	I+II	III+IV	VB	VI+VII	VIII+IX	X	XII	TOTAL
1988	0	15	2	1898	533	29	0	2477
1989	0	12	1	1815	663	42	0	2533
1990	23	115	38	1921	814	50	0	2961
1991	39	181	53	1574	681	68	0	2596
1992	33	145	49	1640	702	91	1	2661
1993	1	34	27	1462	828	115	1	2468
1994	0	12	4	1571	742	136	3	2468
1995	0	3	9	2138	747	71	4	2972
1996	0	18	7	3590	814	45	2	4476
1997	0	7	7	2335	753	30	2	3134
1998	0	12	8	3040	1081	38	1	4180
1999	0	31	34	3455	673	41	0	4234
2000	0	11	32	4967	724	91	6	5831
2001	8	27	102	4405	727	83	8	5360
2002	318	585	149	3417	715	57	81	5321
2003	155	233	73	3287	661	45	82	4536
2004	75	143	50	2606	720	37	54	3685
2005	51	83	46	2290	519	22	77	3087
2006	49	139	39	2081	560	15	42	2925
2007	47	239	56	1995	586	17	37	2978
2008	117	245	45	1418	446	18	17	2307
2009	82	149	22	796	203	13	44	1309
2010	132	186	61	824	69	14	0	1287
2011	113	179	319	1257	321	11	0	2201
2012	98	1	169	1802	366	6	0	2443
2013	83	179	11	1588	275	8	0	2143
2014	97	214	24	1562	360	9	0	2265

***preliminary.**

Table 11.0b. Greater forkbeard *(Phycis blennoides)* in Subareas I and II. Working group estimates of landings.

YEAR	NORWAY	FRANCE	RUSSIA	UK (SCOT)	GERMANY	UK (EWNI)	FAROE ISLANDS	IRELAND	TOTAL
1988	0								0
1989	0								0
1990	23								23
1991	39								39
1992	33								33
1993	1								1
1994	0								0
1995	0								0
1996	0								0
1997	0								0
1998	0								0
1999	0	0							0
2000	0	0							0
2001	0	1	7						8
2002	315	0		1		2			318
2003	153	0				2			155
2004	72	0	3	0					75
2005	51	0							51
2006	46	0	3						49
2007	41	0	5	1	0				47
2008	112	0	4	1			0		117
2009	76	0	6	0					82
2010	127	4							132
2011	107	6							113
2012	98	0.4							98
2013	83	0.1		0					83
2014	96	0.4							97

***preliminary.**

Table 11.0c. Greater forkbeard (*Phycis blennoides*) in Subareas III and IV. Working group estimates of landings.

YEAR	FRANCE	NORWAY	UK (EWNI)	UK (SCOT)[1]	GERMANY	TOTAL
1988	12	0	3	0		15
1989	12	0	0	0		12
1990	18	92	5	0		115
1991	20	161	0	0		181
1992	13	130	0	2		145
1993	6	28	0	0		34
1994	11			1		12
1995	2			1		3
1996	2	10		6		18
1997	2			5		7
1998	1		0	11		12
1999	3		5	23		31
2000	4		0	7		11
2001	6		1	19	2	27
2002	2	561	1	21	0	585
2003	1	225	0	7		233
2004	2	138		3		143
2005	2	81	0	1		83
2006	1	134	3			139
2007	1	236	0	2		239
2008	0	244		1		245
2009	4	142		3		149
2010	3	182		1		186
2011	17	160		1		179
2012	1	198				199
2013*	1	178	0	0		179
2014	1	210		3		214

***preliminary.**

[1] Includes Moridae, in 2005 only data from January to June.

Table 11.0d. Greater forkbeard (*Phycis blennoides*) in Division Vb. Working group estimates of landings.

YEAR	FRANCE	NORWAY	UK(SCOT)[1]	UK(EWNI)	FAROEISLANDS	RUSSIA	ICELAND	TOTAL
1988	2	0						2
1989	1	0						1
1990	10	28						38
1991	9	44						53
1992	16	33						49
1993	5	22						27
1994	4							4
1995	9							9
1996	7							7
1997	7	0						7
1998	4	4						8
1999	6	28	0					34
2000	4	26	1	0				32
2001	9	92	1	0				102
2002	10	133	5	0				149
2003	11	55	7	0				73
2004	9	37	2	2				50
2005	7	39		0,3				46
2006	8	26			6			39
2007	11	34	0	0	9	2	0	58
2008	10	20	0		4	11	1	46
2009	0	13	3		3	2	0	24
2010	2	45	3	1	11		2	62
2011	7				310		1	319
2012	6	5			145	7	7	169
2013	7	3	0				0	11
2014	7	14	0		0		2	24

[1] Includes Moridae in 2005 only data from January to June.

***preliminary.**

Table 11.0e. Greater forkbeard (*Phycis blennoides*) in Subareas VI and VII. Working group estimates of landings.

YEAR	FRANCE	IRELAND	NORWAY	SPAIN(1)	UK (EWNI)	UK (SCOT) (2)	GERMANY	RUSSIA	FAROE ISLANDS	TOTAL
1988	252	0	0	1584	62	0				1898
1989	342	14	0	1446	13	0				1815
1990	454	0	88	1372	6	1				1921
1991	476	1	126	953	13	5				1574
1992	646	4	244	745	0	1				1640
1993	582	0	53	824	0	3				1462
1994	451	111		1002	0	7				1571
1995	430	163		722	808	15				2138
1996	519	154		1428	1434	55				3590
1997	512	131	5	46	1460	181				2335
1998	357	530	162	530	1364	97				3040
1999	314	686	183	824	929	518	1			3455
2000	671	743	380	1613	731	820	8	2		4967
2001	683	663	536	1332	538	640	10	4		4405
2002	613	481	300	1049	421	545	9	0		3417
2003	469	319	492	1100	245	661	1	1		3287
2004	441	183	165	1131	288	397		1		2606
2005	598	237	128	979	179	164		5		2290
2006	625	68	162	1075	148			2	0	2081
2007	578	56	188	875	117	179		2		1995
2008	711	43	174	236	31	196		27	0	1418
2009	304	7	222	48	31	184		1		796
2010	383	8	219	23	14	173		3	1	824
2011	378	6	309	326	27	210				1257
2012	381	9	225	992	1	194				1802
2013*	451	16	289	583	3.4	246		0		1588
2014	468	25	159	769	6	135				1562

(1) landings of *Phycis* spp Included from 1988 to 2012.

(2)Includes Moridae in 2005 only data from January to June.

*** Preliminary.**

Table 11.0f. Greater forkbeard *(Phycis blennoides)* in Subareas VIII and IX. Working group estimates of landings.

YEAR	FRANCE	PORTUGAL	SPAIN[1]	UK(EWNI)	IRELAND	UK (SCOT)	TOTAL
1988	7	29	74				110
1989	7	42	138				187
1990	16	50	218				284
1991	18	68	108				194
1992	9	91	162				262
1993	0	115	387				502
1994		136	320				456
1995	54	71	330				455
1996	25	45	429				499
1997	4	30	356				390
1998	3	38	656				697
1999	8	41	361				410
2000	36	91	375				502
2001	36	83	453				573
2002	67	57	418				542
2003	28	45	387				461
2004	44	37	446				527
2005	58	22	312	0			392
2006	54	10	257				321
2007	32	14	510	0			556
2008	41	13	123				178
2009	8	13	183	0			203
2010	10	12	48			0	69
2011	13	13	295				321
2012	46	5	315				366
2013	31	8	234	2			275
2014	38	6	315			0	360

***Preliminary.**

(1) **Landings of *Phycis spp* Included from 1988 to 2012.**

Table 11.0g. Greater forkbeard *(Phycis blennoides*) in Subarea X. Working group estimates of landings.

YEAR	PORTUGAL	FRANCE	TOTAL
1988	29		29
1989	42		42
1990	50		50
1991	68		68
1992	91		91
1993	115		115
1994	136		136
1995	71		71
1996	45		45
1997	30		30
1998	38		38
1999	41		41
2000	91		91
2001	83		83
2002	57		57
2003	45		45
2004	37		37
2005	22		22
2006	15		15
2007	17		17
2008	18		18
2009	13		13
2010	14		14
2011	11		11
2012	6		6
2013	8		8
2014	9	0	9

***Preliminary.**

Table 11.0h. Greater forkbeard (*Phycis blennoides*) in Subarea XII. Working group estimates of landings.

YEAR	FRANCE	UK(SCOT)[1]	NORWAY	UK(EWNI)	SPAIN[2]	RUSSIA	TOTAL
1988							0
1989							0
1990							0
1991							0
1992	1						1
1993	1						1
1994	3						3
1995	4						4
1996	2						2
1997	2						2
1998	1						1
1999	0	0					0
2000	2	4					6
2001	0	1	6	1			8
2002	0		2	4	74		81
2003	3		8	0	71		82
2004	3		6		44		54
2005	1	0	0		75		77
2006					42		42
2007					37		37
2008	0				17		17
2009	1		0		37	6	44
2010	0						0
2011	0						0
2012	0						0
2013							0
2014	0						0

***Preliminary.**

[1]Includes Moridae in 2005 only data from January to June.

[2] Landings of *Phycis spp* Included from 1988 to 2012.

Table 11.1. *Phycis* spp. European landings (t) by metier in 2013 and 2014.

Landings (t)	2013	2014
Iceland		
LLS_DEF	0	n.a.
Ireland		
OTB_CRU	3	n.a.
OTB_DEF	13	n.a.
Portugal		
LLS_DWS	0	0
MIS_MIS_0_0_0	8	6
OTB	0	0
Russia		
Longline	0	
Spain		
LLS_DEF_0_0_0	509	770
MIS_MIS_0_0_0_HC	168	42
OTB_DEF	141	272
UK (England)		
LLS_DWS	3	1
BEAM TRAWL		0
GILL NET (NOT 52 OR 53)		0
GILL NET (TANGLE)		0
GILL NET (TRAMMEL)		0
Unspecified Gear		4
UNSPECIFIED GILL NET		0
UK (Scotland)		
GNS_DEF_>=220_0_0_all	20	4
LLS_DEF_0_0_0_all	126	46
MIS_MIS_0_0_0_HC	2	7
OTB_DEF_>=120_0_0_all	100	81

Table 11.2a. Reported discards (ton) of *P. blennoides* in 2013 and 2014.

TON	2013	2014
DISCARDS	1185	1166
LANDINGS	2143	2265
CATCHES	3328	3431

Table 11.3. Effort (kWd) of *P. blennoides*, *P. Phycis* and *Phycis* spp by the Spanish, Swedish and Irish fleets in 2014.

	III	IV	V	VI	VII	VIII	IX	XII
Spain				500409	534570	4676906	1330671	
Sweden	6908723	1666360						
Ireland		1019		754232	9955488	619		1756

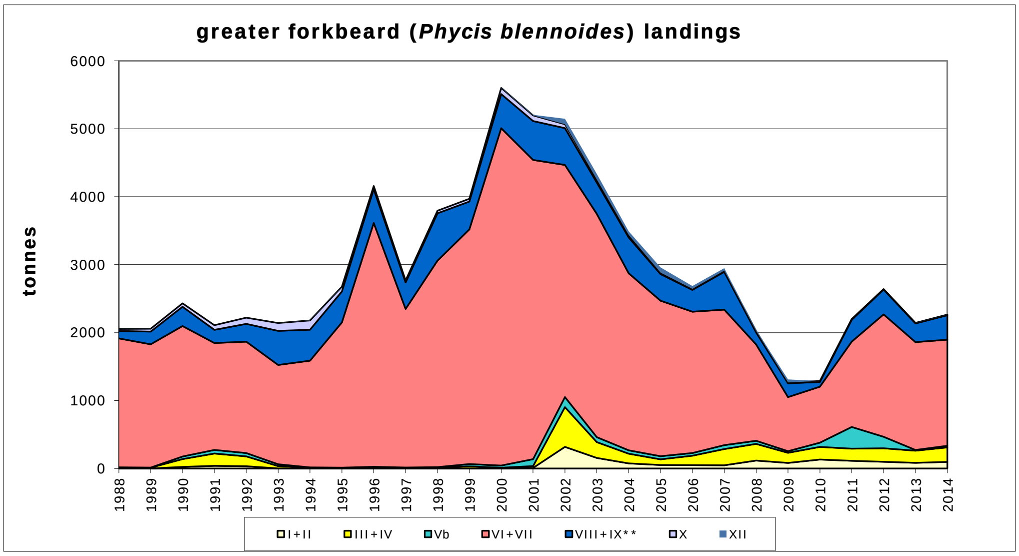


Figure 11.1. Greater forkbeard landing trends in all ICES subareas since 1988.

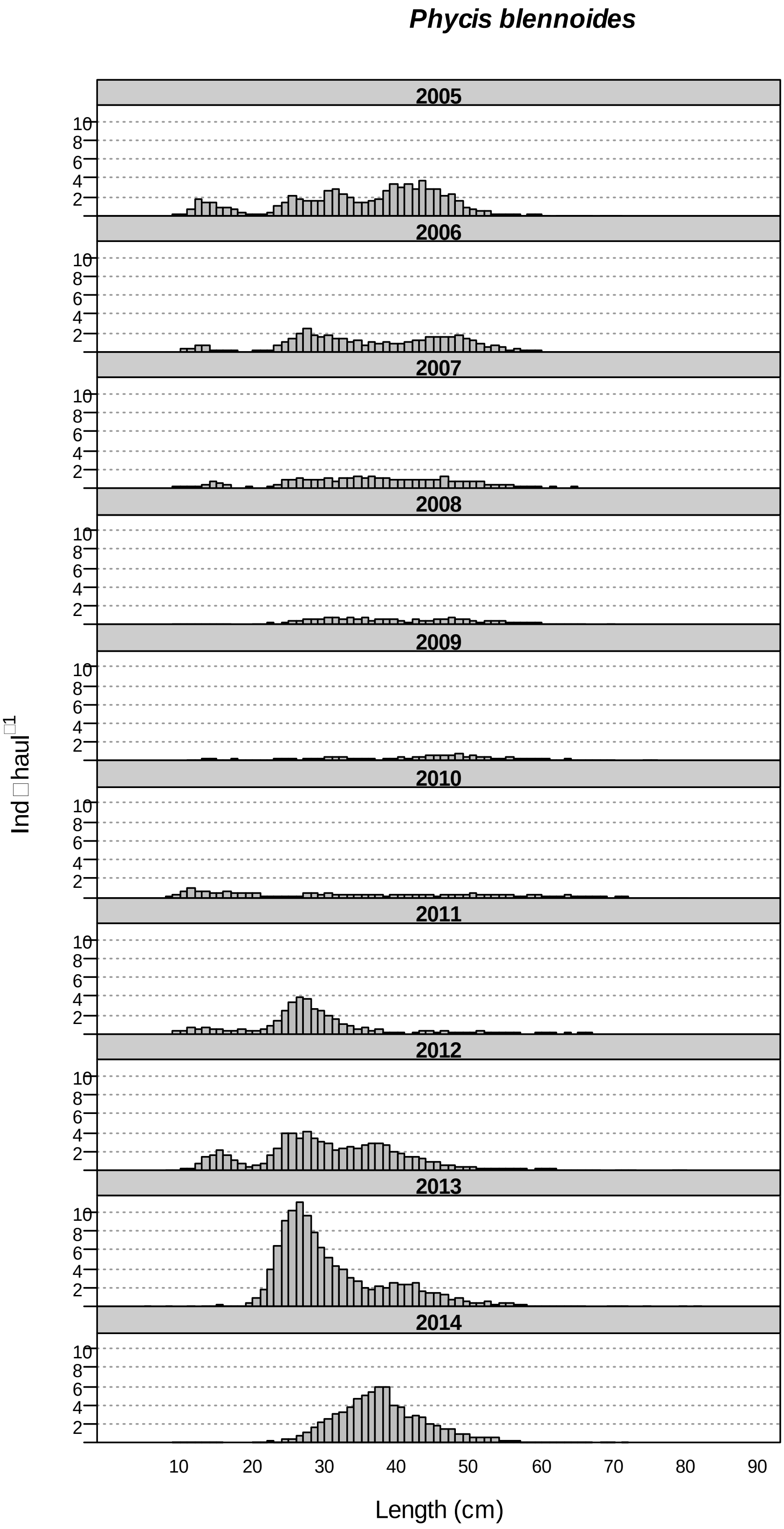


Figure 11.2. Mean stratified length distributions of *Phycis blennoides* in Spanish Porcupine surveys (2005–2014).

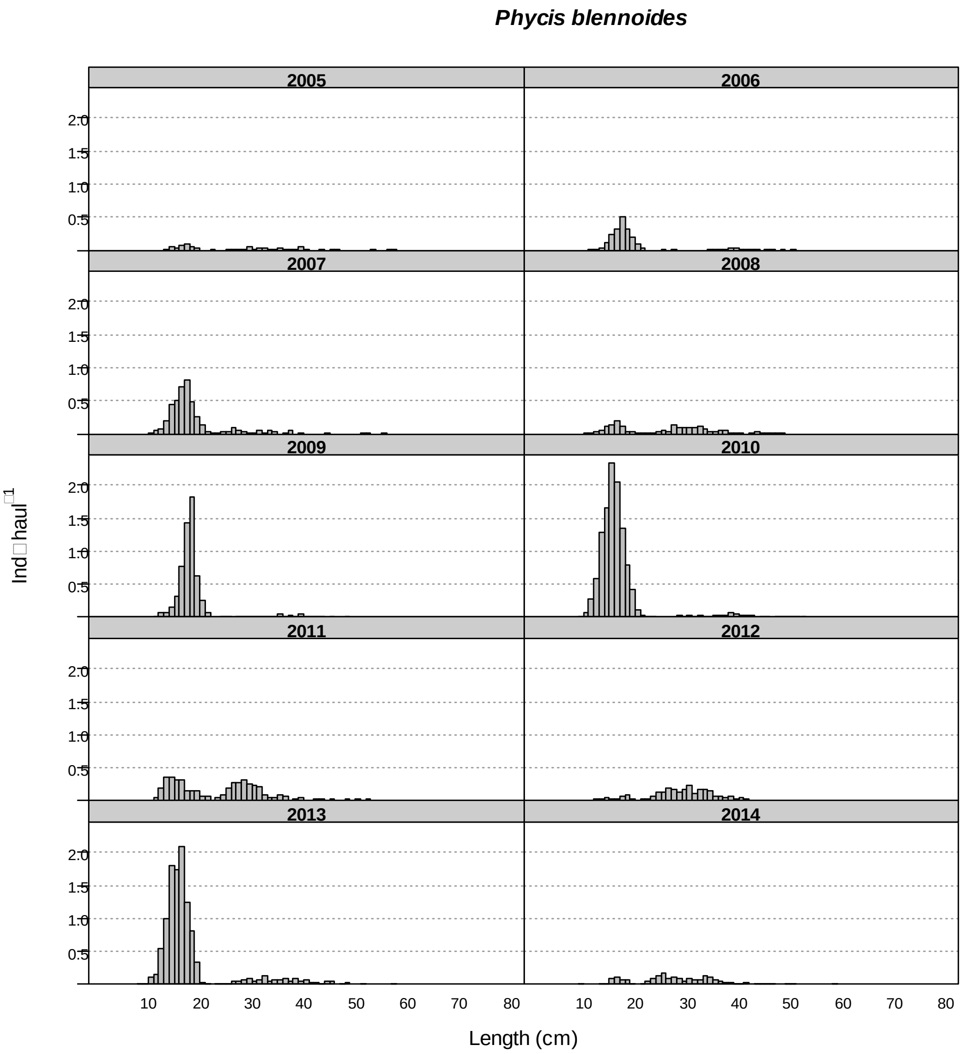


Figure 11.3. Mean stratified length distributions of greater forkbeard (*P. blennoides*) in Northern Spanish Shelf surveys (2005–2014).

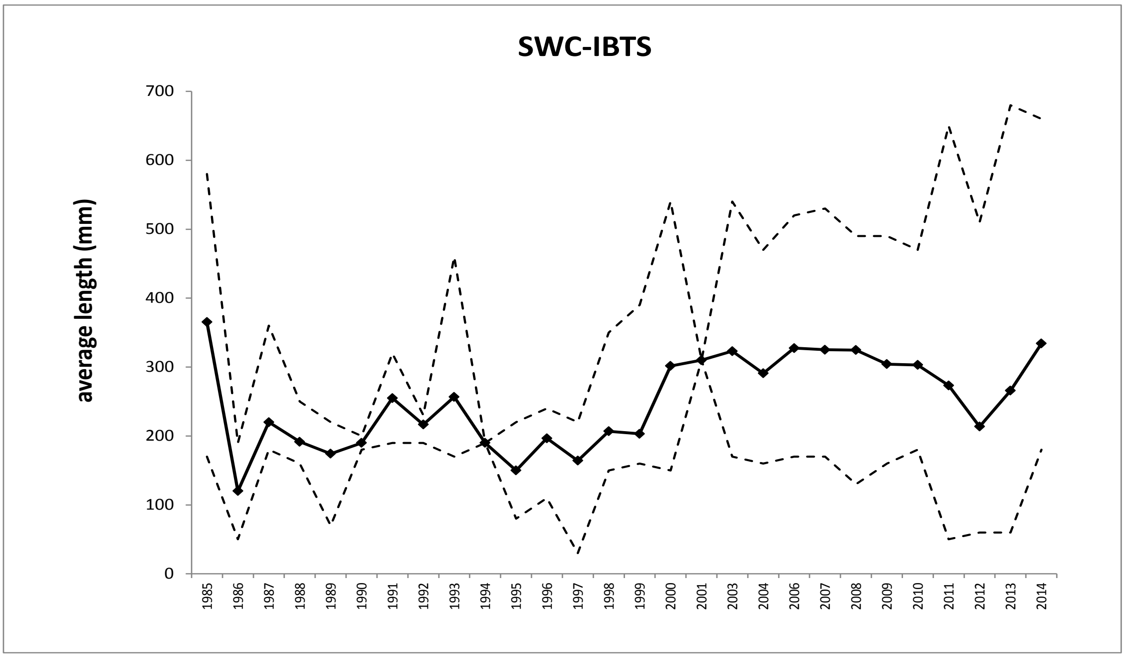


Figure 11.4. Average length (mm) by year of the greater forkbeard catched in the of the Scottish Western Coast Groundfish IBTS survey (SWC-IBTS) until 2014. Dashed line indicates maximum and minimum length of the catches.

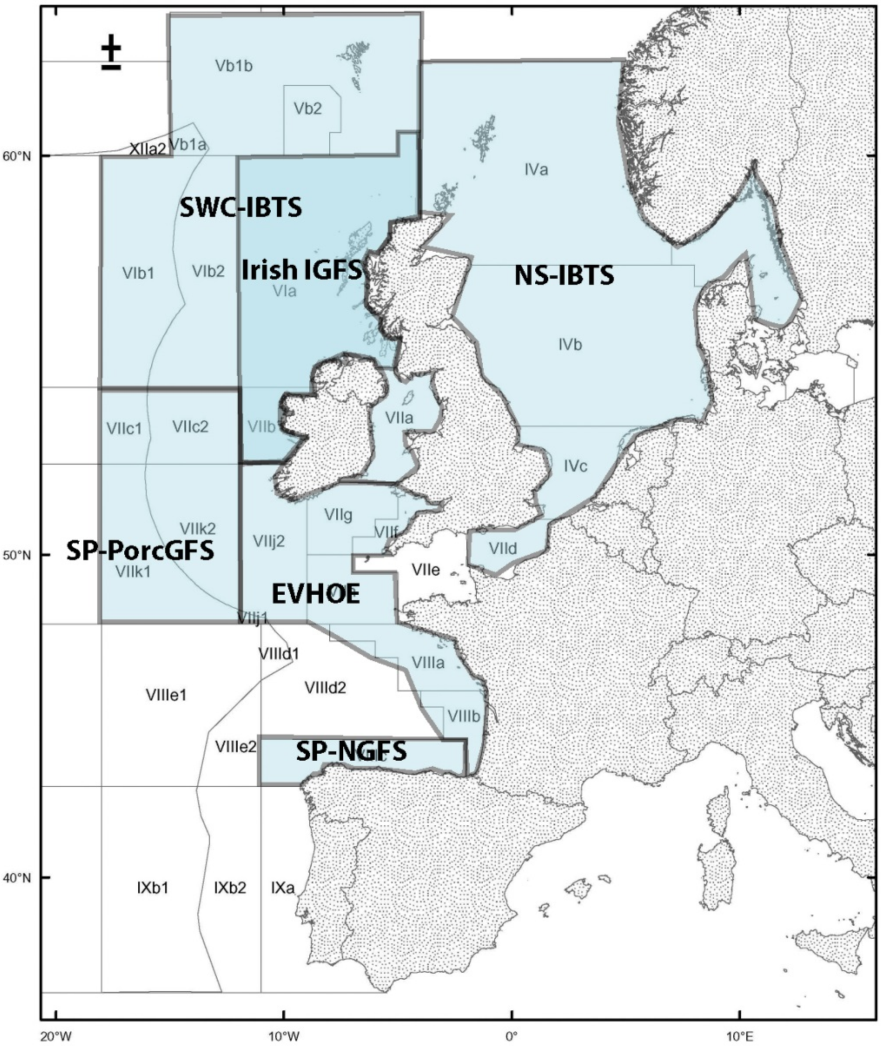


Figure 11.5. Map of the Divisions covered by the surveys used in the trend analysis of abundance and biomass of GFB.

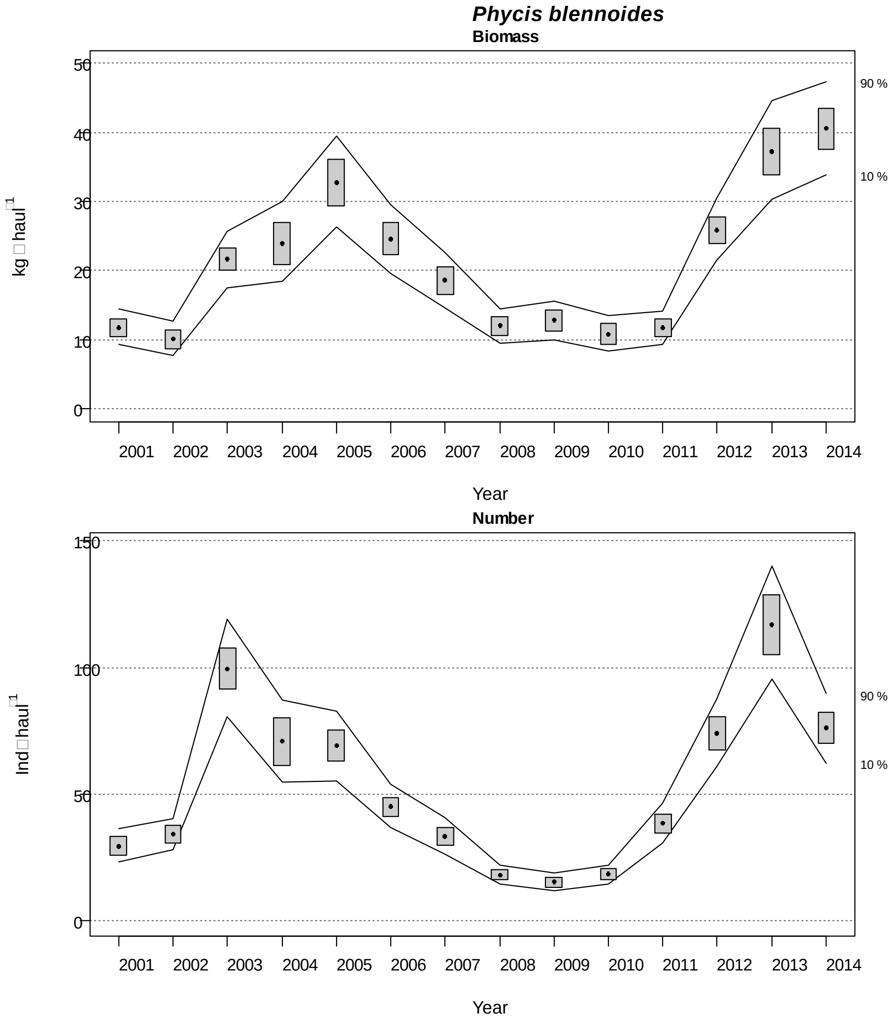
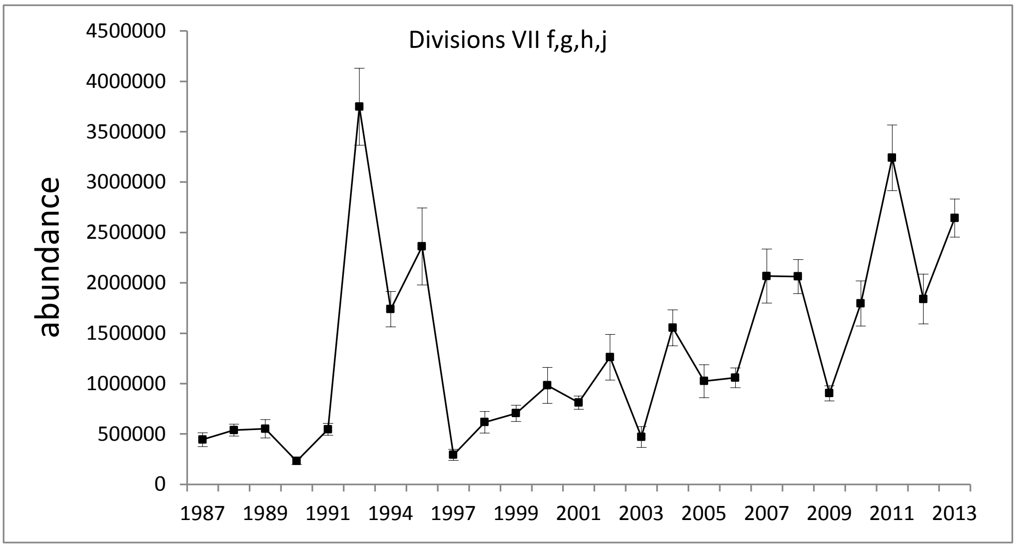


Figure 11.6. Time-series in *Phycis blennoides* biomass (top) and abundance (bottom) indices in the Porcupine survey (2001–2014). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (☐ = 0.80, bootstrap iter
pers. comm.).



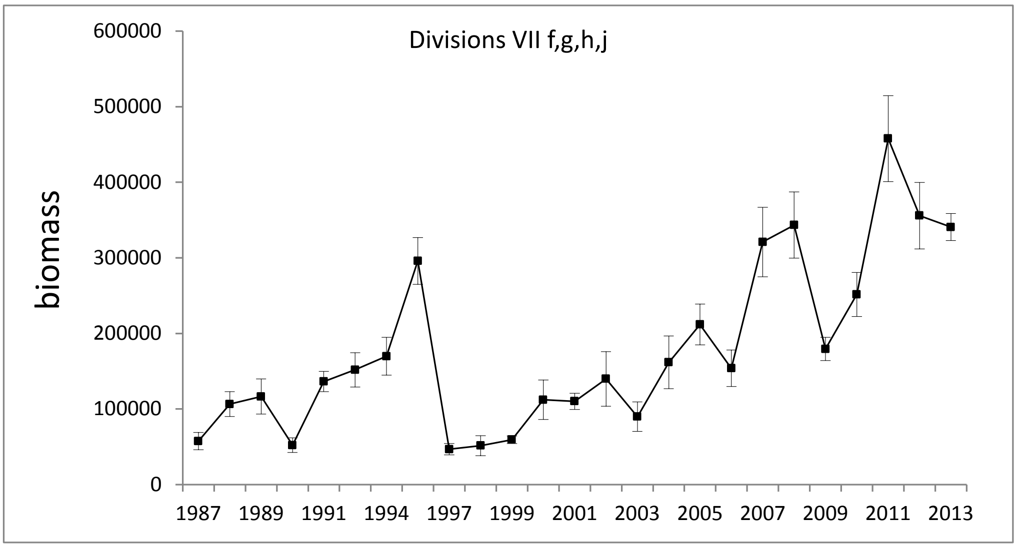


Figure 11.7a. Greater forkbeard series of abundance and biomass of the French IBTS survey in the Divisions VII f,g,h,j and VIIIa,b,d combined until 2013.

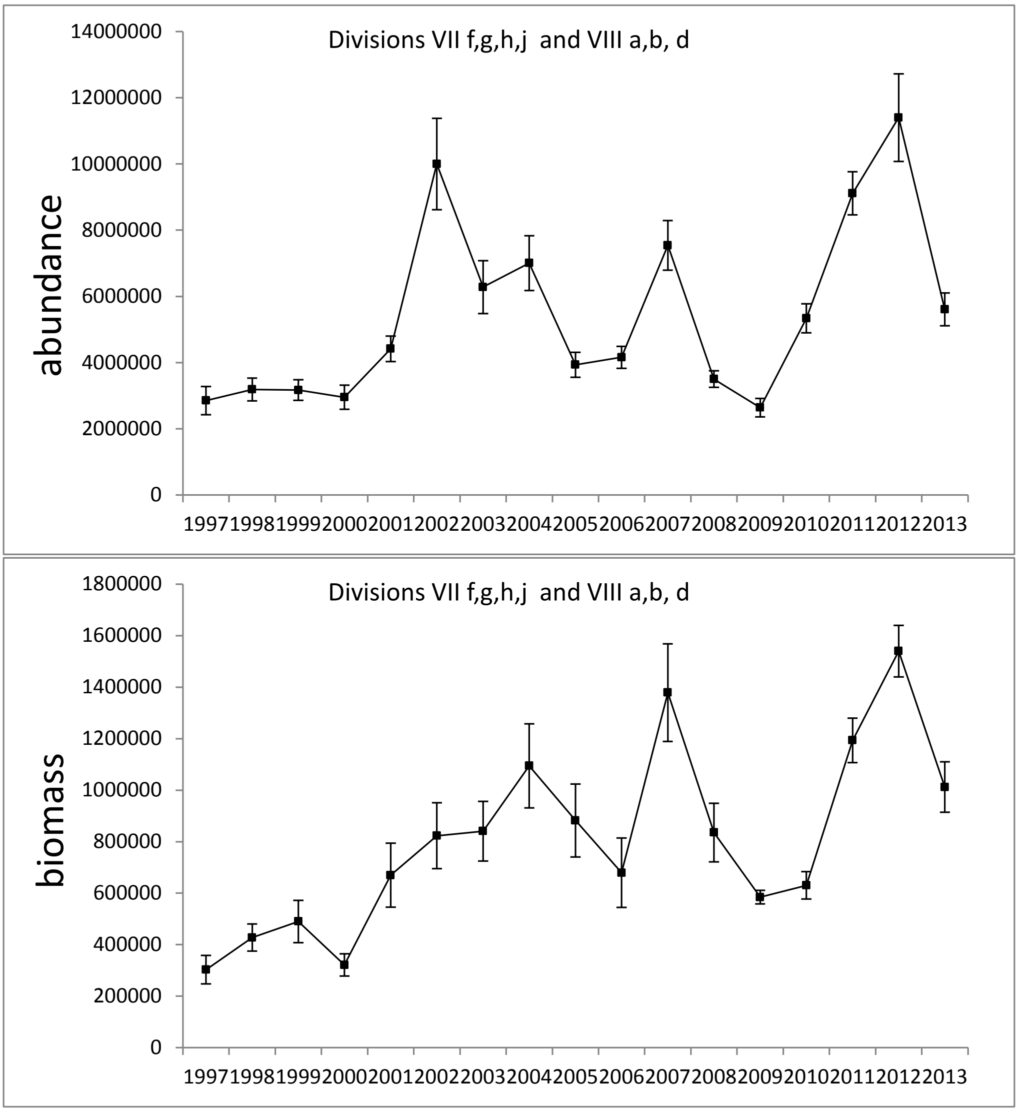


Figure 11.7b. Greater forkbeard series of abundance and biomass of the French IBTS survey in the Divisions VIIIa,b,d until 2013.

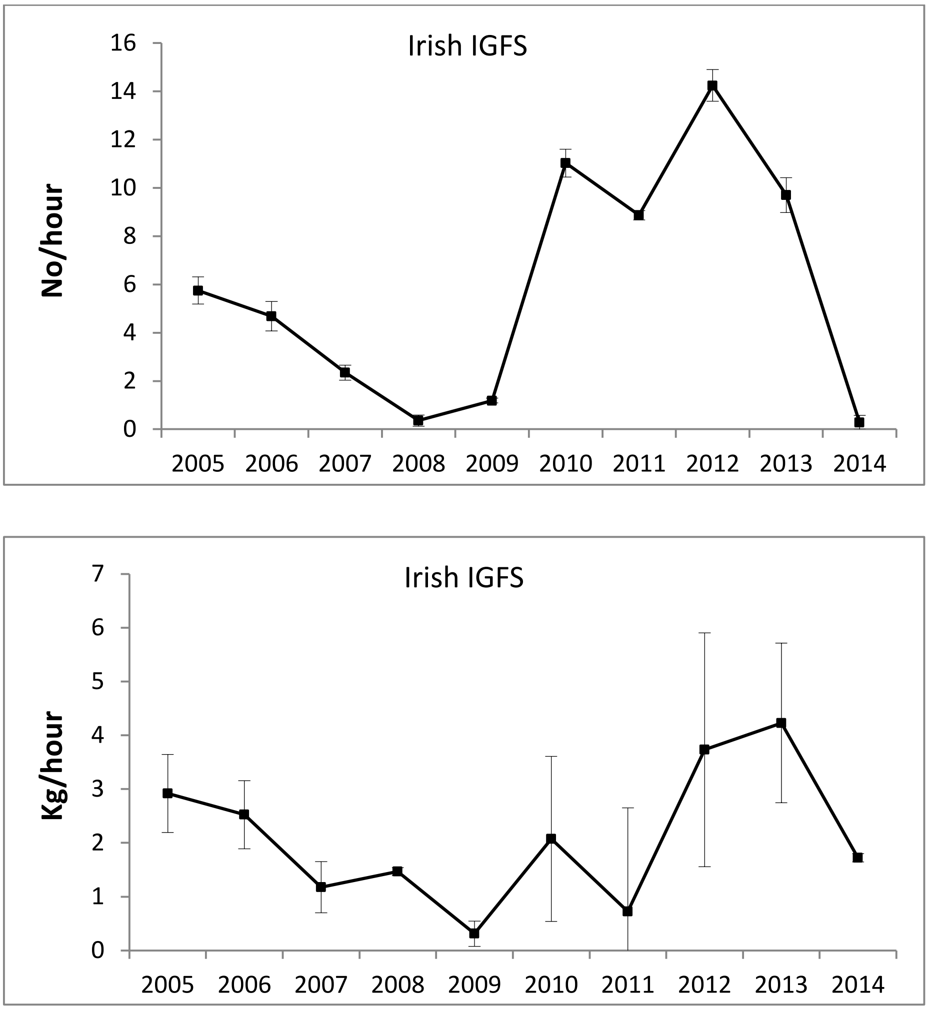


Figure 11.8. Abundance and biomass Indices (nº per hour and kg per hour) of total catches and for individuals <32 cm of the Irish IGFS Survey in the slope and shelf strata, from 2005 to 2014.

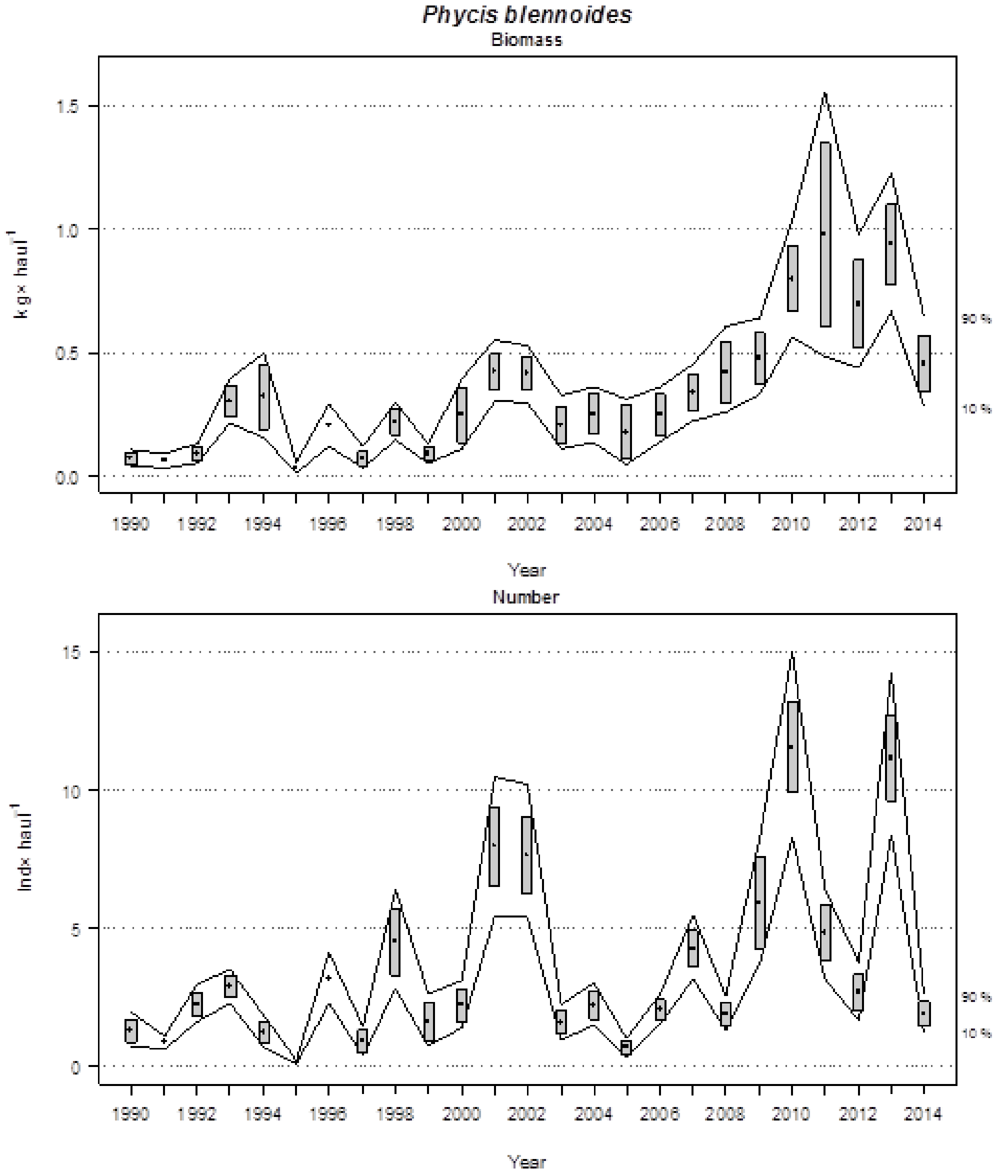


Figure 11.9. Changes in *Phycis blennoides* abundance index (kg/tow and No/tow) during northern Spanish Shelf bottom-trawl survey time-series (1990–2014) in (Divisions IXa and VIIIc).

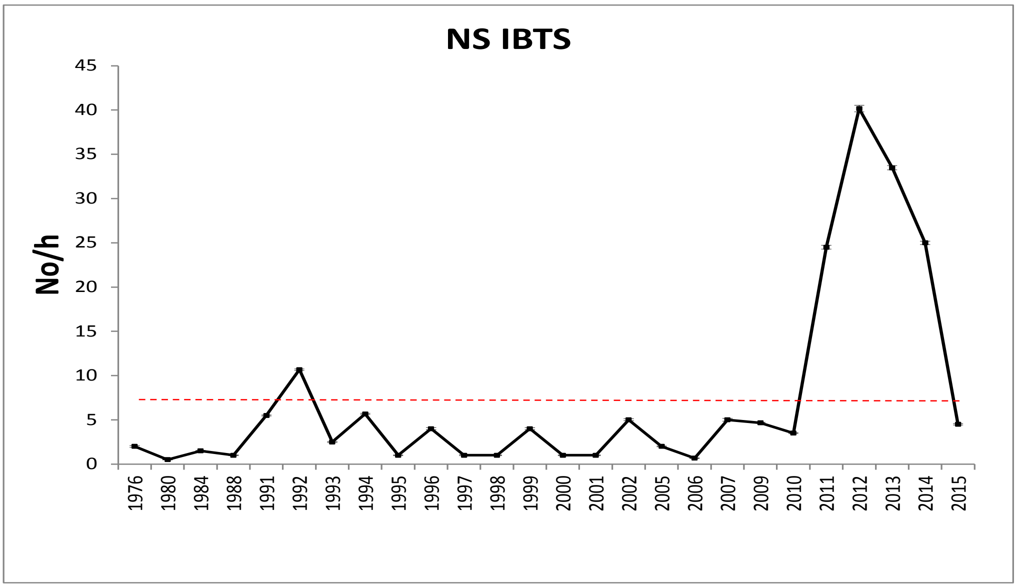


Figure 11.10. Greater forkbeard series of abundance (No/hour of the North Sea IBTS survey (NS-IBTS) until 2015. Red dashed line indicates the average of the series.

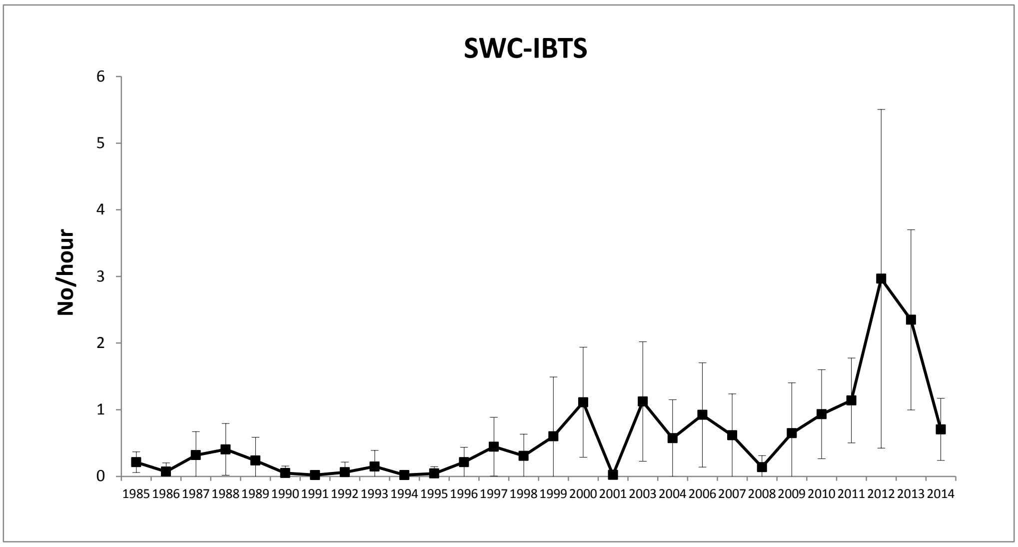


Figure 11.11. Greater forkbeard series of abundance (No/hour) of the Scottish Western Coast Groundfish IBTS survey (SWC-IBTS) until 2014.

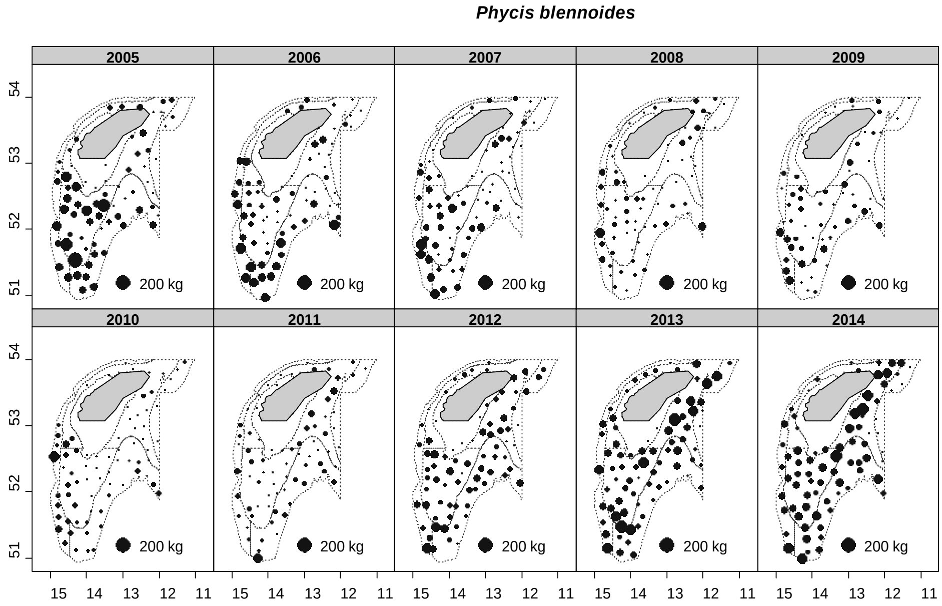


Figure 11.12. Geographic distribution of *Phycis blennoides* catches (kg/30 min haul) in Porcupine surveys between 2001 and 2014.

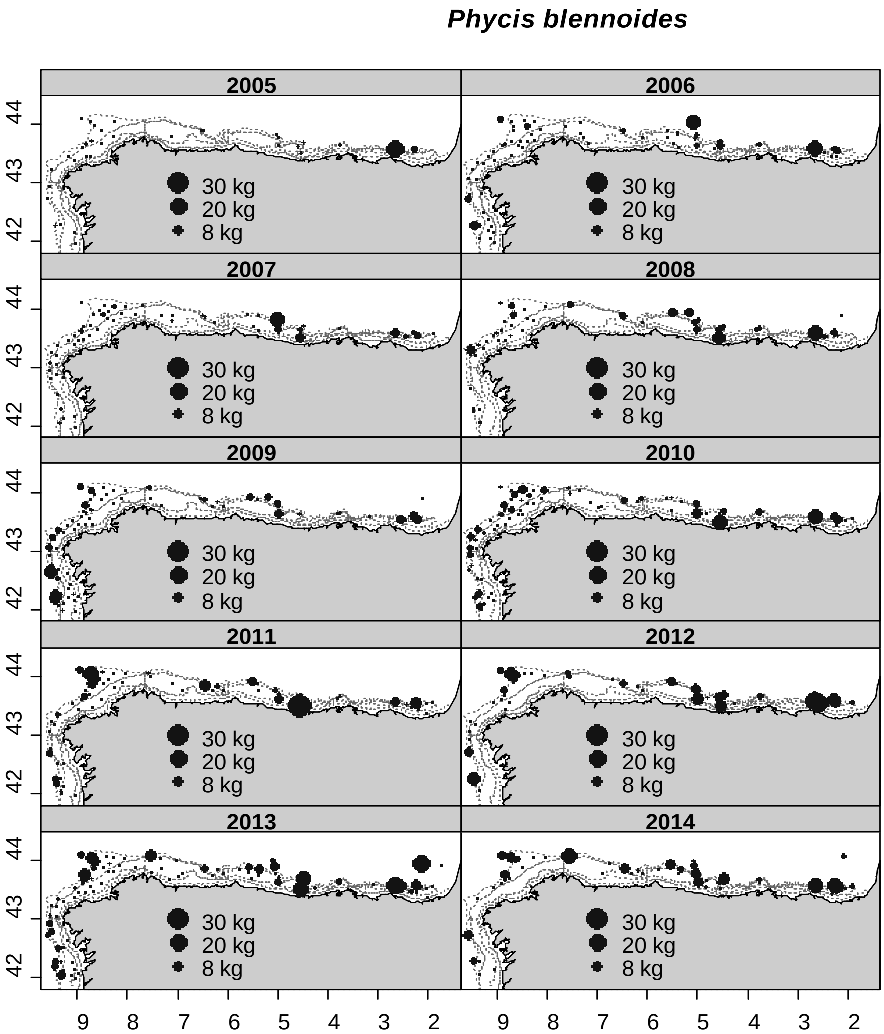


Figure 11.13. Catches in biomass of greater forkbeard on the Northern Spanish Shelf bottom trawl surveys during the last decade: 2005–2014.

12 Alfonsinos/Golden eye perch (*Beryx* spp.) in all ecoregions

12.1 The fishery

Alfonsinos, *Beryx splendens* and *Beryx decadactylus*, are generally considered as bycatch species in the demersal trawl and longline mixed fisheries targeting deep-water species. For most of the fisheries, the catches of alfonsinos are reported under a single category, as *Beryx* spp.

The proportions of each species in the catches are not well known. Detailed landings data by species are available only for the Portuguese (Azores) hook and line fishery in Division Xa, where the landings of *B. decadactylus* averaged 20% of the catches of both species in the last ten years, and for the Russian trawl fishery that targeted *B. splendens*.

Portuguese, Spanish and French trawlers and longliners are the main fleets involved in this fishery.

There were landings from a targeted fishery by Russian vessels in the NEAFC area (Xb) between 1993 and 2000 and some minor landings as bycatch in fisheries targeting other species since 2000. There are no target fisheries presently occurring in Mid-Atlantic Ridge (NEAFC) area since 2000 (see Section 4). Currently landings are reported from bycatch fisheries occurring in the EEZ of Portugal (IX), Spain (VI, VII, VIII and IX), France (VI, VII and VIII) and a small-scale target fishery in the Azores (X) (See Table 12.1e).

12.2 Landings trends

The available landings data for Alfonsinos, (*Beryx* spp), by ICES subareas/divisions as officially reported to ICES or to the working group, are presented in Tables 12.1(a–g), 12.2 and 12.3 and Figures 12.1–12.5. Total landings are stabilized since 2005, due to management measures introduced (TAC/quotas), being around 400 t between 2005 and 2013, with high landings during 2012 (600 t), and around 277 t during the last two years.

12.3 ICES Advice

Based on ICES approach to data-limited stocks, ICES advises that annual catches should be no more than 280 tonnes. All catches are assumed to be landed.

12.4 Management

Fishing with trawl gears is forbidden in the Azores region (EC. Reg. 1568/2005). A box of 100 miles limiting the deep-water fishing to vessels registered in the Azores was created in 2003 under the management of fishing effort of the CFP for deep-water species (EC. Reg. 1954/2003). An EU TAC of 328 t for EC vessels is in force since 2005, being reduced to 312 t during 2013 and to 296 t thereafter.

Technical measures have been introduced in the Azores since 1998. During 2009 new measures were introduced, particularly to control the effort of longliners through restrictions on fishing area, minimum length, gear and effort. A seamount (Condor) is closed to the fishery until 2016.

There are NEAFC regulations of effort in the fisheries for deep-water species and closed areas to protect vulnerable habitats. (http://neafc.org/managing_fisheries/measures/current).

REGULATION	SPECIES	YEAR	ICES AREA	TAC	LANDINGS
Reg 2270/2004	*Beryx sp*	2005	III, IV, V, VI, VII, VIII, IX, X, XII	328	422
	Beryx sp	2006	III, IV, V, VI, VII, VIII, IX, X, XII	328	367
Reg 2015/2006	*Beryx sp*	2007	III, IV, V, VI, VII, VIII, IX, X, XII	328	396
	Beryx sp	2008	III, IV, V, VI, VII, VIII, IX, X, XII	328	407
Reg 1359/2008	*Beryx sp*	2009	III, IV, V, VI, VII, VIII, IX, X, XII	328	383
	Beryx sp	2010	III, IV, V, VI, VII, VIII, IX, X, XII	328	291
Reg 1225/2010	*Beryx sp*	2011	III, IV, V, VI, VII, VIII, IX, X, XII	328	340
	Beryx sp	2012	III, IV, V, VI, VII, VIII, IX, X, XII	328	605
Reg 1262/22012	*Beryx sp*	2013	III, IV, V, VI, VII, VIII, IX, X, XII	312	272
	Beryx sp	2014	III, IV, V, VI, VII, VIII, IX, X, XII	296	282
Reg. 1367/2014	*Beryx sp*	2015	III, IV, V, VI, VII, VIII, IX, X, XII	296	
	Beryx sp	2016	III, IV, V, VI, VII, VIII, IX, X, XII	296	

12.5 Stock identity

No new information.

12.6 Data available

12.6.1 Landings and discards

Tables 12.1a–g, describe the alfonsinos landings by subarea and country. Discards results for the Azorean longliners were updated during 2014 (WD, Pinho, 2014). Annual longline discard estimates by year for the sampled trip vessels with alfonsinos catches during the period 2004–2011 range from 0,8% to 8.6% for *B splendens* and 0.07% to 10.2% for the *B. decadactylus* (Table 12.4). These discards are mostly a result of the management measures such as TAC and minimum length.

12.6.2 Length compositions

Fishery length compositions from the Azores were updated (WD Pinho *et al.*, 2015). These are summarised for both species in Figures 12.6 and 12.7 for the period 1991–2013.

Azorean survey length compositions were not updated since there was no survey during 2014. Available information for both species and are presented in Figures 12.8 and 12.9.

Annual mean length from the Azorean fishery was updated but not for the survey. Available information for both species are presented in Figures 12.10 to 12.13.

12.6.3 Age compositions

No new information about age compositions of *Beryx* species was available during the WGDEEP meeting. This information was already reported to the working group but there are not relevant changes on the growth of the species.

12.6.4 Weight-at-age

No new information.

12.6.5 Maturity, sex-ratio, length-weight and natural mortality

No new information was available to the working group. This DCF information was summarized in the 2010 report and there are no relevant changes on the biology of the species.

12.6.6 Catch, effort and research vessel data

No new information on the abundance indices from the fishery as data for recent years are not yet standardised.

Abundance indices from the Azorean longline survey were updated and are presented for the alfonsino (*Beryx splendens*) (Figure 12.14) and golden eye perch (*Beryx decadactylus*) (Figure 12.15).

12.7 Data analyses

Total landings declined in the late 1990s and have since stabilised at about 376 tonnes (for the two species combined), with a peak of 605 t in 2012 due to the landings reported by Spain for Areas VI–VII. Species-specific landings trends in the Azores fishery showed similar trends for both species (Figure 12.5).

A reduction on the small fish (<20 cm) is observed on the landings for *B splendens* since 2005 due to the minimum length regulations. Length compositions present in general a mode around 30 cm with the exception of the period 2004–2007 (Figure 12.6). Considering a length of first maturity around 35 cm fork length (FL) it appears that the Azorean fishery have caught mainly immature fish. However, this may be a selective effect of the hook and line fisheries.

Fishery length compositions for *B decadatylus* show a bimodal or trimodal distribution. A well-defined mode is observed annually around 24 cm. The other two modes vary annually being centred around 32 cm and 42 cm during the last five years (Figure 12.7).

Survey length compositions for *B splendens* and *B decadactylus* show that relatively low numbers of individuals of this species are caught on the survey on the sampled depth strata (50–600 m) (Figures 12.8 and 12.9).

Fishery mean length of *B. splendens* presents a slight decrease along time (Figure 12.10) and for *B. decadactylus* is stable around 35 cm (Figure 12.11).

Survey mean length for *B splendens*, shows an increase from 1995 (27 cm) to 1997 (32 cm) and maintained since 1999 around 27 cm fork length (Figure 12.12). For *B decadactylus* a decrease is observed from 1995 (37 cm) to 1997 (34 cm), with a peak in 1996 (39 cm) and maintained since 1999 around 35 cm (Figure 12.13).

Survey abundance index for *B splendens*, declined significantly between 1995 and 1997 and has since remained at very low levels until 2007. An increasing trend on the abundance has been observed during the last four years (Figure 12.14). For *B. decadactylus* a decrease is observed from 1995 to 1996, maintained thereafter until 2003 at low levels. It increased then from 2003 to 2007 and maintained thereafter at high levels, suggesting an overall increase of the abundance on the recent years (Figure 12.15).

The working group express concerns on the reliability of these indices as an indicator of abundance index due to the relatively low numbers of individuals caught each year.

The survey may not be designed for these high mobile and aggregative species particularly for *B decadactylus*. Therefore the working group thinks the approach taken in 2012, i.e. to base advice on catch history to be appropriate.

12.8 Comments on the assessment

No analytical assessment was carried out last year.

12.9 Management considerations

As a consequence of their spatial distribution associated with seamounts, their life history and their aggregating behaviour, alfonsinos are considered to be easily overexploited by trawl fishing; they can only sustain low rates of exploitation. Population dynamics are uncertain with recent estimates suggesting high longevity (>50 years), while other estimates suggest a longevity of ~15 years. Fisheries on such species should not be allowed to expand above current levels unless it can be demonstrated that such expansion is sustainable. To prevent wiping out entire subpopulations that have not yet been mapped and assessed the exploitation of new seamounts should not be allowed.

Table 12.1a. Landings (tonnes) of *Beryx* spp. IV.

Year	France	TOTAL
1988	0	0
1989	0	0
1990	1	1
1991	0	0
1992	2	2
1993	0	0
1994	0	0
1995	0	0
1996	0	0
1997	0	0
1998	0	0
1999	0	0
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009	0	0
2010	0	0
2011	0	0
2012	0	0
2013	0	0
2014	0	0

***Preliminary.**

Table 12.1b. Alfonsinos (*Beryx* spp.) Vb.

YEAR	FAROES	FRANCE	TOTAL
988			0
1989			0
1990		5	5
1991		0	0
1992		4	4
1993		0	0
1994		0	0
1995	1	0	1
1996	0	0	0
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	0	0
2001	0	0	0
2002	0	0	0
2003	0	0	0
2004	0	0	0
2005	0	0	0
2006	0	0	0
2007	0	0	0
2008	0	0	0
2009	0	0	0
2010	0	0	0
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0

***Preliminary.**

Table 12.1c. Alfonsinos (*Beryx* spp.) VI and VII.

	France	E & W	Spain	Ireland	Scotland	TOTAL
1988						0
1989	12					12
1990	8					8
1991						0
1992	3					3
1993	0		1			1
1994	0		5			5
1995	0		3			3
1996	0		178			178
1997	17	4	5			26
1998	10	0	71			81
1999	55	0	20			75
2000	31	2	100			133
2001	51	13	116			180
2002	35	15	45			95
2003	20	5	55	4		84
2004	15	3	46			64
2005	15	0	55	0		70
2006	27	0	51	0		78
2007	17	1	47	0		65
2008	22	0	32	0		54
2009	9	0	0	0	1	10
2010	4	0	0	0	1	5
2011	7	0	33	0	0	40
2012	4	0	337	0	0	341
2013	14	1	33	0	0	77
2014	10	0	68	0	0	49

***Preliminary.**

Table 12.1d. Alfonsinos (*Beryx* spp.) VIII and IX.

Year	France	Portugal	Spain	E & W	TOTAL
1988					0
1989					0
1990	1				1
1991					0
1992	1				1
1993	0				0
1994	0		2		2
1995	0	75	7		82
1996	0	43	45		88
1997	69	35	31		135
1998	1	9	258		268
1999	11	29	161		201
2000	7	40	117	4	168
2001	6	43	179	0	228
2002	13	60	151	14	238
2003	10	0	95	0	105
2004	21	53	209	0	283
2005	9	45	141	0	195
2006	8	20	64	3	97
2007	8	45	67	0	120
2008	5	42	54	0	101
2009	1	42	18	0	61
2010	12	27	1	0	41
2011	4	21	40	0	65
2012	4	11	27	0	42
2013	5	17	4	0	26
2014	3	18	81	0	102

*** Preliminary.**

Table 12.1e. Alfonsinos (*Beryx* spp.) X.

	XA	XB				
Year	Portugal	Faroes	Norway	Russia**	E & W	TOTAL
1988	225					225
1989	260					260
1990	338					338
1991	371					371
1992	450					450
1993	533		195			728
1994	644		0	837		1481
1995	529	0	0	200		729
1996	550	0	0	960		1510
1997	379	5	0			384
1998	229	0	0			229
1999	175	0	0	550		725
2000	203	0	0	266	15	484
2001	199	0	0	0	0	199
2002	243	0	0	0	0	243
2003	172	0	0	0	0	172
2004	139	0	0	0	0	139
2005	157	0	0	0	0	157
2006	192	0	0	0	0	192
2007	211	0	0	0	0	211
2008	250	2	0	0	0	252
2009	311	1	0	0	0	312
2010	240	0	0	5	0	245
2011	226	4	0	5	0	235
2012	213	10	0	0	0	222
2013	168	0	0	0	0	168
2014	131	0	0	0	0	131

*** Preliminary.**

**** Not official data from ICES Area Xb.**

Table 12.1f. Alfonsinos (*Beryx* spp.) XII.

Year	Faroes	TOTAL
1988		
1989		
1990		
1991		
1992		
1993		
1994		
1995	2	2
1996	0	0
1997	0	0
1998	0	0
1999	0	0
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009	0	0
2010	0	0
2011	2	2
2012	0	0
2013	0	0
2014	0	0

*** Preliminary.**

Table 12.1g. Alfonsinos (*Beryx* spp.) in Madeira (Portugal) outside the ICES area.

YEAR	PORTUGAL	TOTAL
1988		0
1989		0
1990		0
1991		0
1992		0
1993		0
1994		0
1995	1	1
1996	11	11
1997	4	4
1998	3	3
1999	2	2
2000*		
2001*		
2002*		
2003*		
2004*		
2005*		
2006*		
2007*		
2008*		
2009*		
2010*		
2011*		
2012*		
2013*		
2014*		

*** No information.**

Table 12.2. Reported landings for the alfonsinos, (*Beryx* spp), by ICES subareas/divisions.

YEAR	IV	VB	VI+VII	VIII+IX	XA	XB	XII	TOTAL
1988			0	0	225	0		225
1989			12	0	260	0		272
1990	1	5	8	1	338	0		353
1991			0	0	371	0		371
1992	2	4	3	1	450	0		460
1993			1	0	533	195		729
1994			5	2	644	837		1488
1995		1	3	82	529	200	2	817
1996			178	88	550	960	0	1776
1997			26	135	379	5	0	545
1998			81	268	229	0	0	579
1999			75	201	175	550	0	1001
2000			133	168	203	281	0	785
2001			180	228	199	0	0	607
2002			95	238	243	0	0	577
2003			84	105	172	0	0	361
2004			64	283	139	0	0	485
2005			70	195	157	0	0	422
2006			78	97	192	0	0	367
2007			65	120	211	0	0	396
2008	0	0	54	101	250	2	0	407
2009	0	0	10	61	311	1	0	383
2010	0	0	5	41	240	5	0	291
2011	0	0	40	65	226	9	2	342
2012	0	0	341	42	213	10	0	605
2013	0	0	77	26	168	0	0	282
2014	0	0	39	102	131	0	0	272

***Preliminary.**

Table 12.3. Reported landings of *Beryx splendens* and *B. decadactylus* in the Azores (ICES Division Xa).

YEAR	*B. SPLENDENS*	*B. DECADACTYLUS*	TOTAL
1988	122	103	225
1989	113	147	260
1990	137	201	338
1991	203	168	371
1992	274	176	450
1993	316	217	533
1994	410	234	644
1995	335	194	529
1996	379	171	550
1997	268	111	379
1998	161	68	229
1999	119	56	175
2000	168	35	203
2001	182	17	199
2002	223	20	243
2003	150	22	172
2004	110	29	139
2005	134	23	157
2006	152	40	192
2007	165	46	211
2008	187	63	250
2009	243	68	311
2010	189	51	240
2011	179	47	226
2012	175	37	213
2013	140	28	168
2014	109	22	131

***Preliminary.**

Table 12.4. Annual percentage of *Beryx* spp. discarded by year in the Azores (ICES Division Xa) from the sampled trip vessels that caught and discard alfonsinos.

SPECIES	2004	2005	2006	2007	2008	2009	2010	2011
Beryx splendens	1,79	1,87	1,55	1,02	1,19	8,64	4,69	0,76
Beryx decadactylus	0,37	0,07	1,31	0,14	0,57	10,18	2,36	0,95

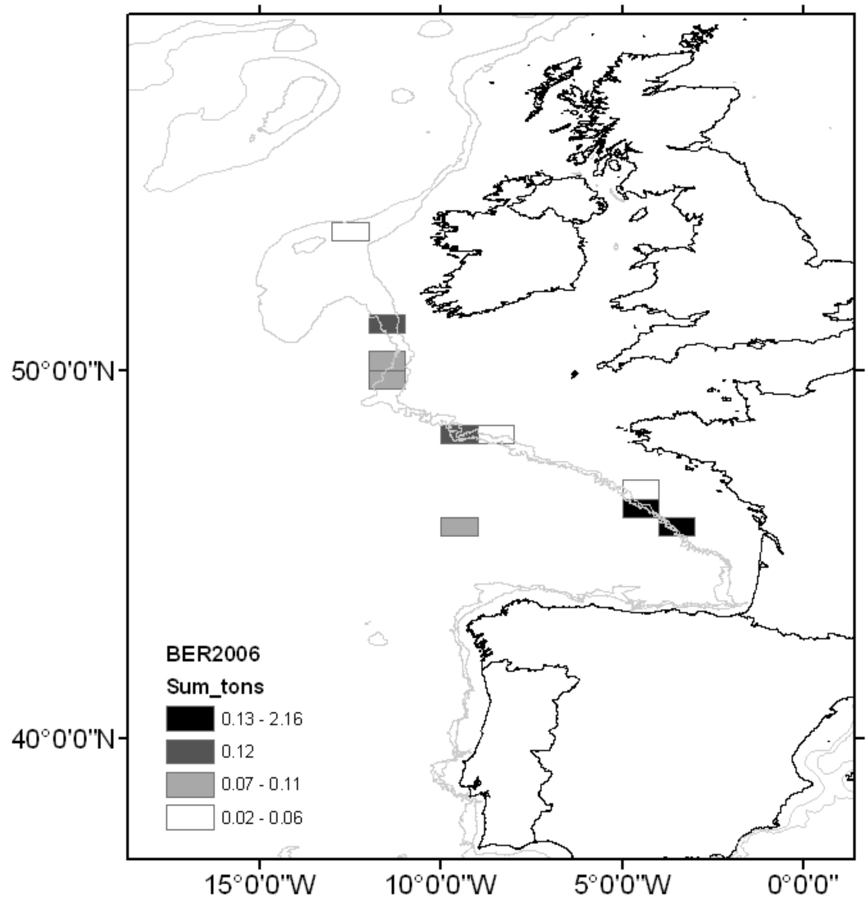


Figure 12.1. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2006.

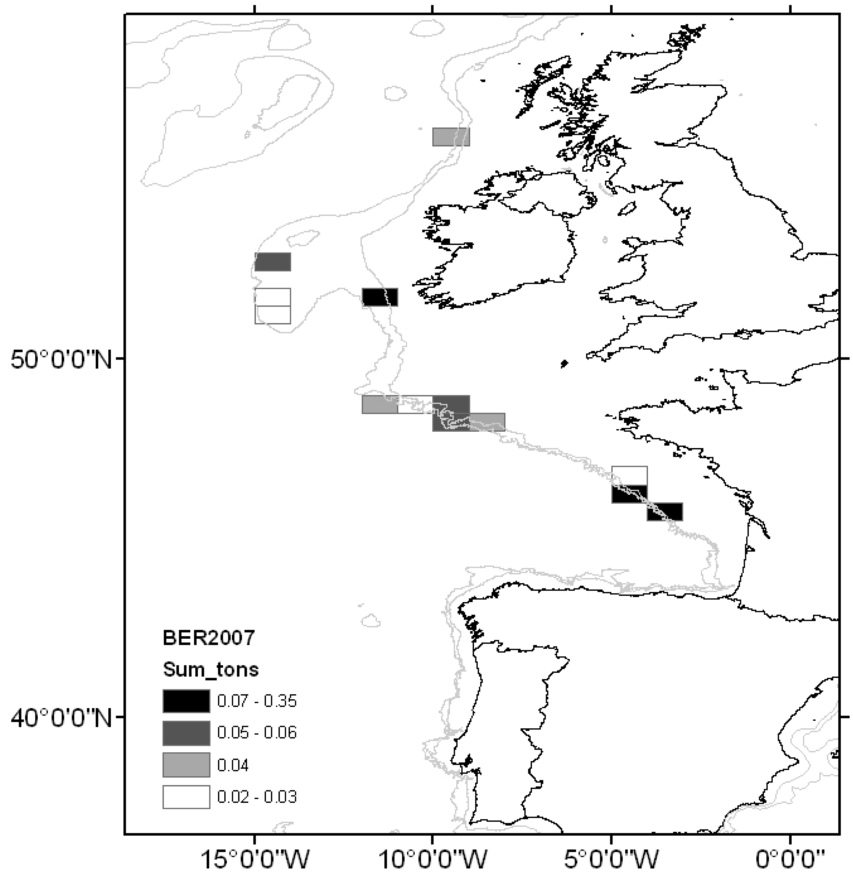


Figure 12.2. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2007.

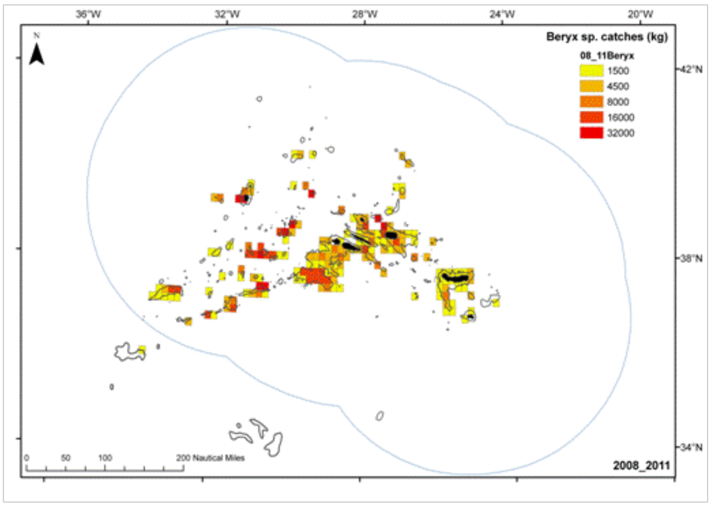


Figure 12.3. Catches of alfonsinos by Azores vessels, 2008–2011 (ICES, Xa2).

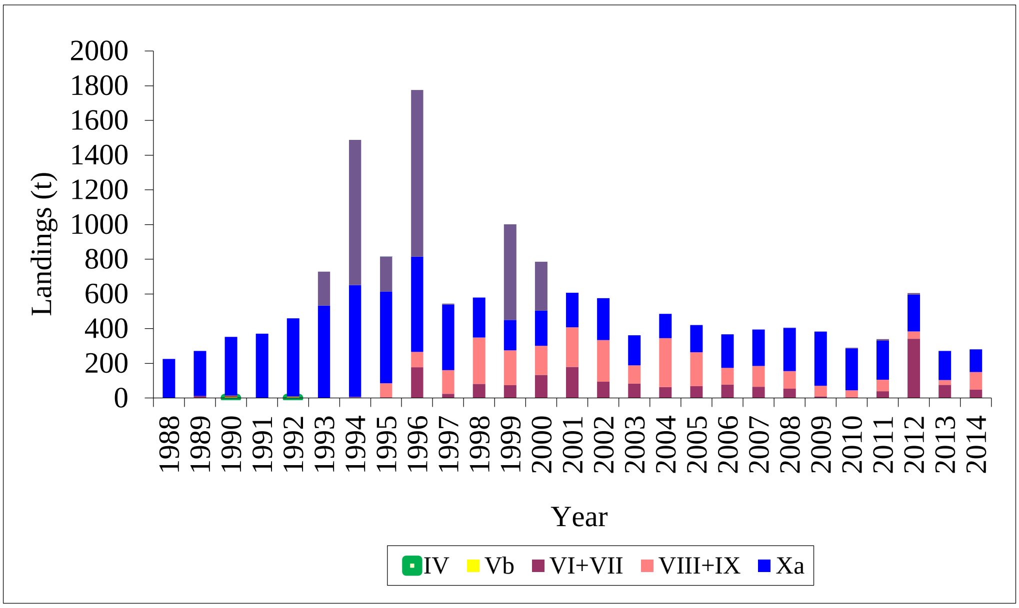


Figure 12.4. Reported landings for the alfonsinos, (*Beryx* spp), by ICES subareas/divisions.

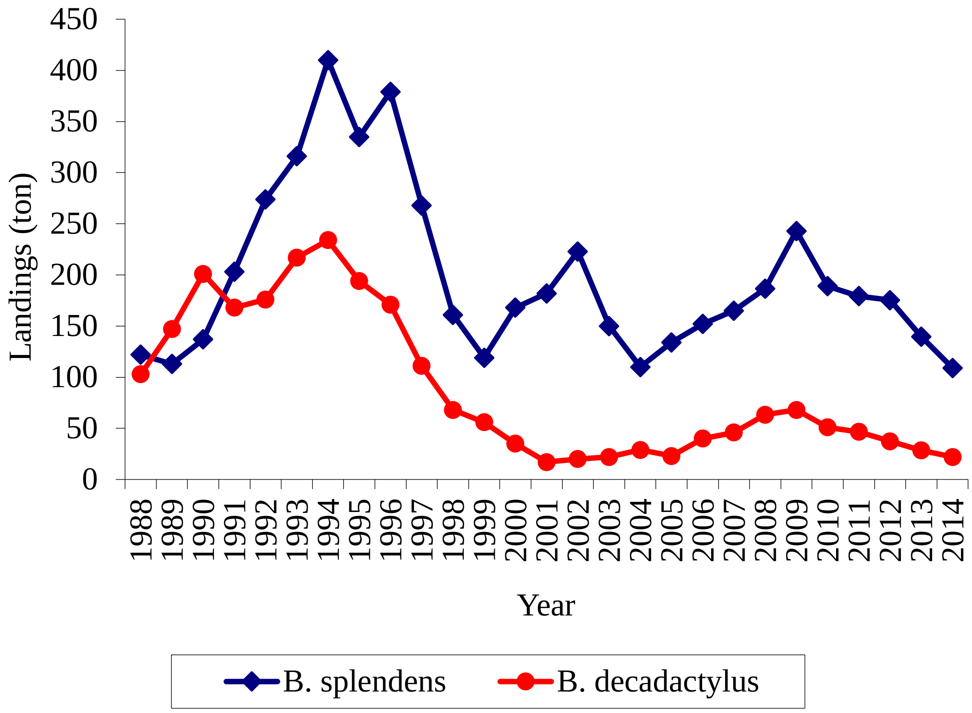


Figure 12.5. Landings of *Beryx splendens* and *B. decadactylus* in Azores (ICES Subarea X).

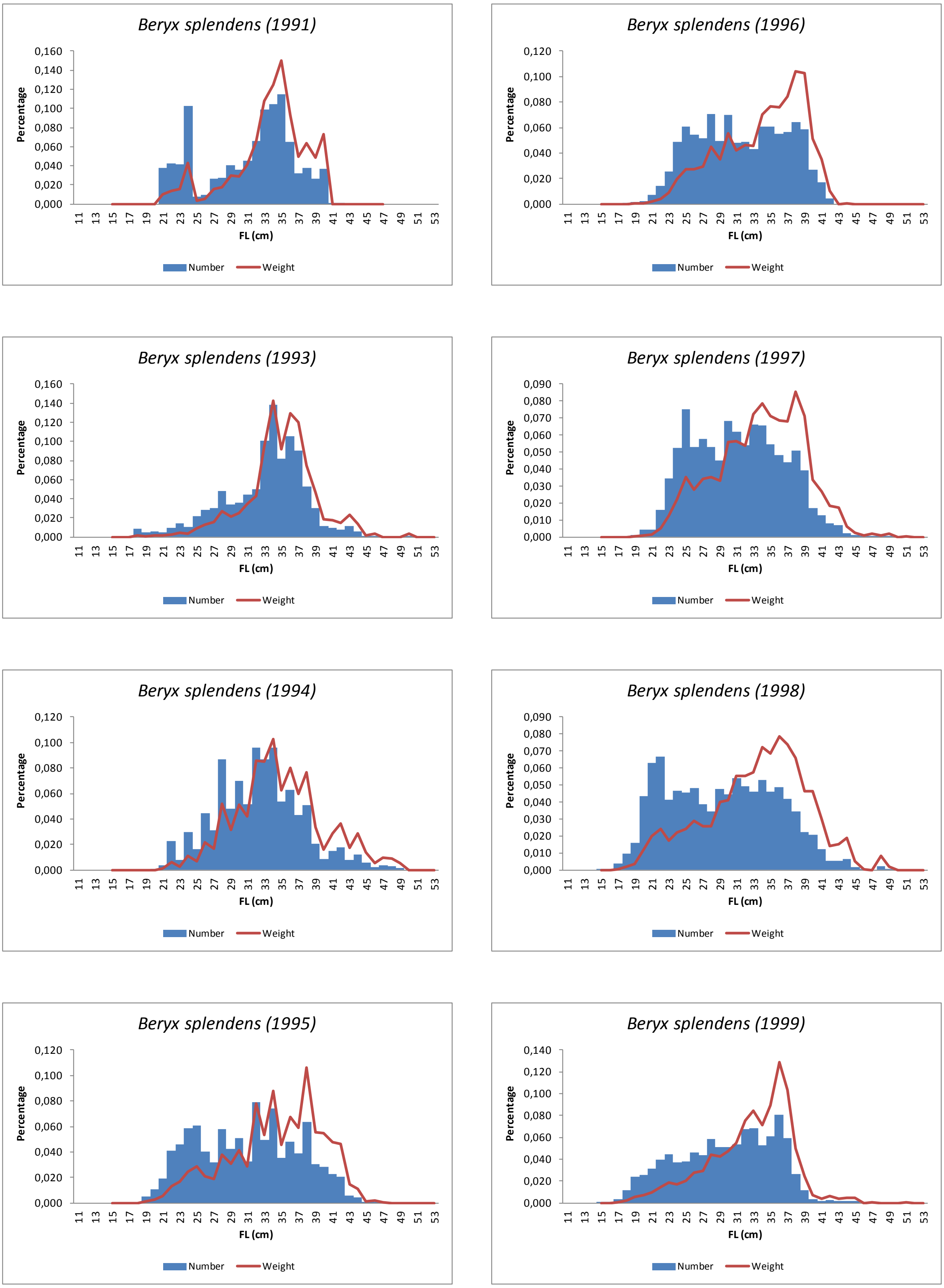


Figure 12.6. ***Beryx splendens*** **Length distribution of the catch from the Azores (ICES Subarea X). Bars represent the proportion in number of every size class and the red line represents the proportion in weight.**

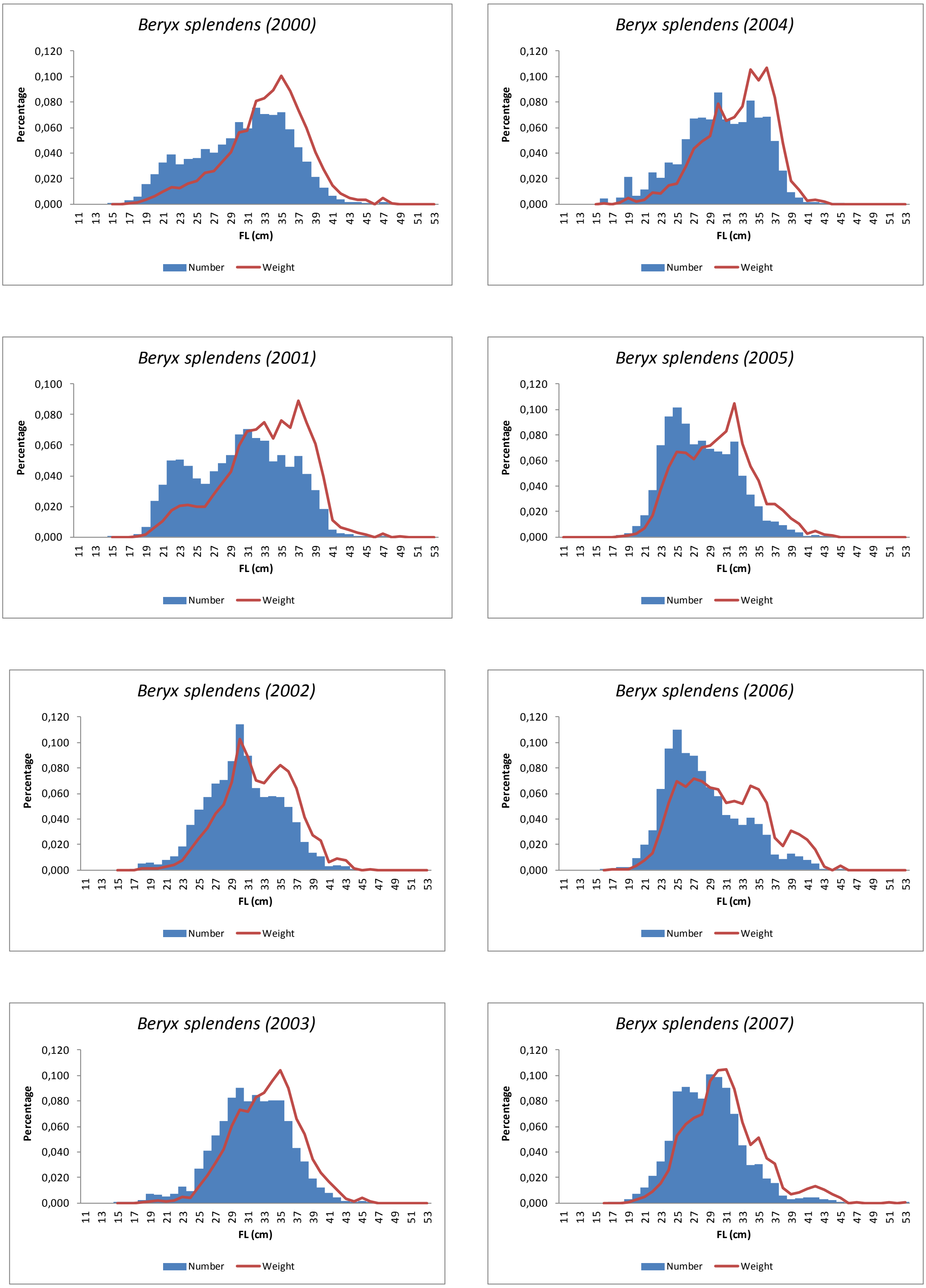


Figure 12.6. ***Beryx splendens*** **Length distribution of the catch from the Azores (ICES Subarea X). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.**

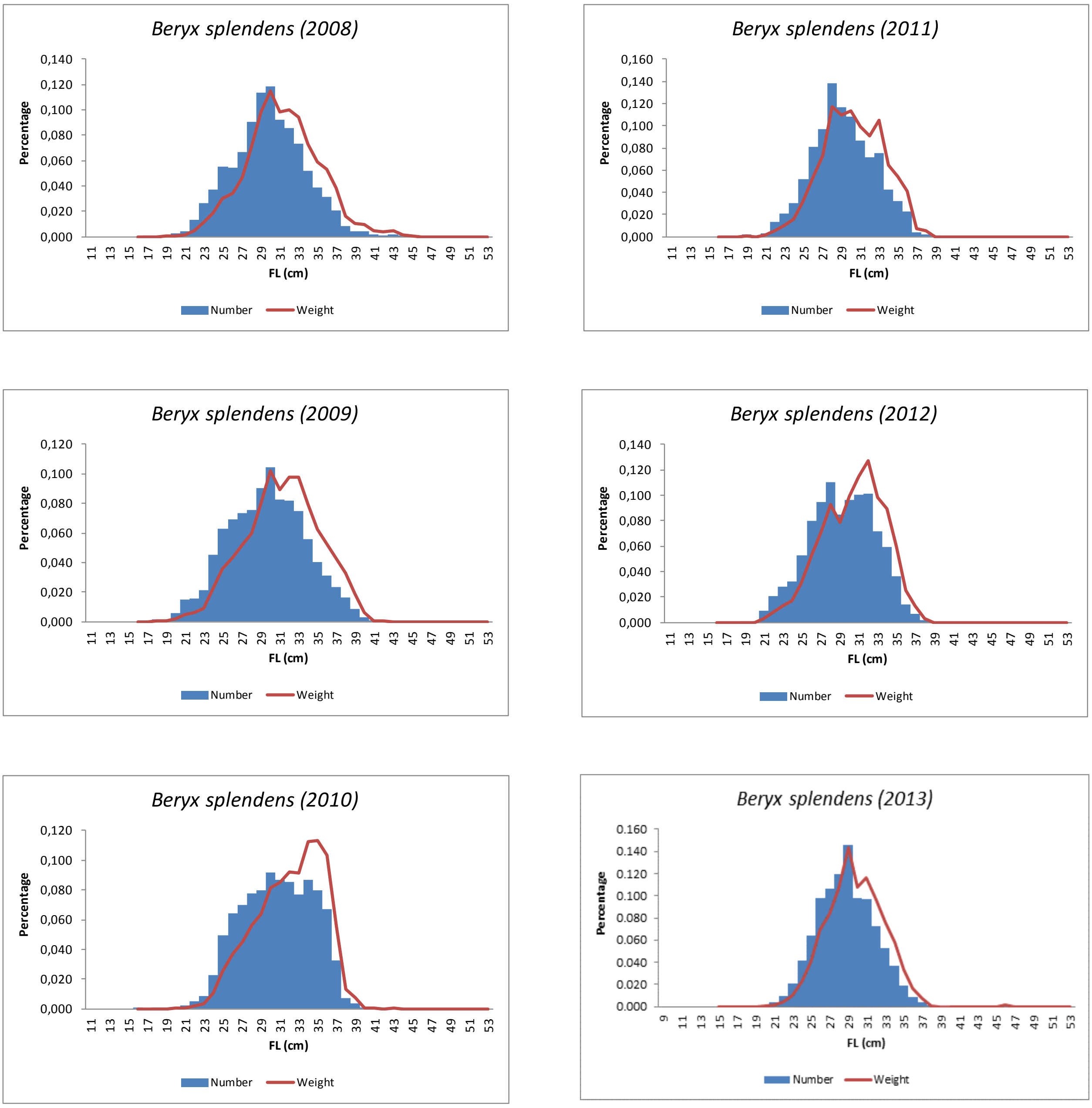


Figure 12.6. ***Beryx splendens*** **Length distribution of the catch from the Azores (ICES Subarea X). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.**

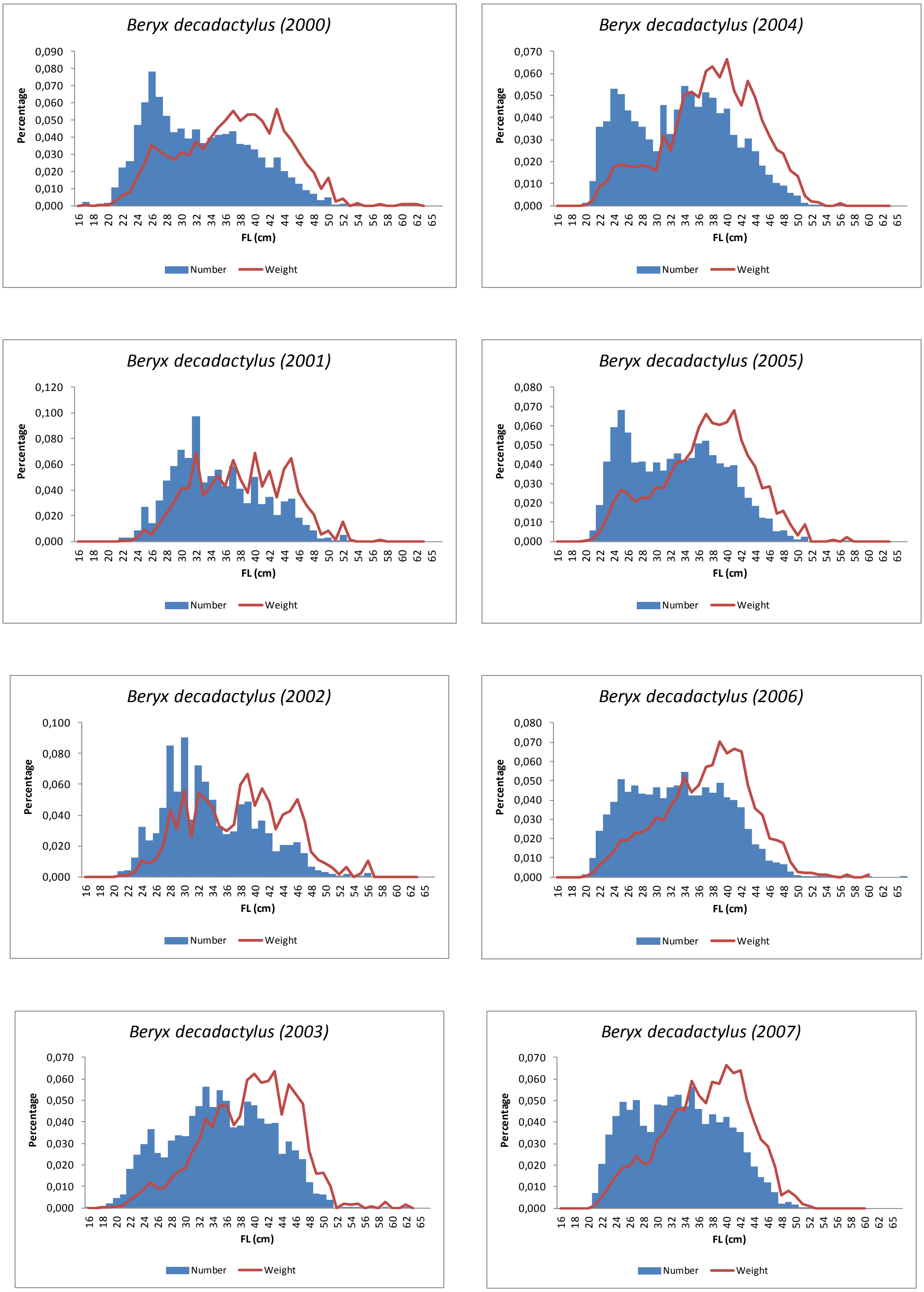


Figure 12.7. ***Beryx decadactylus*** **Length distribution of the catch from the Azores (ICES Subarea X). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.**

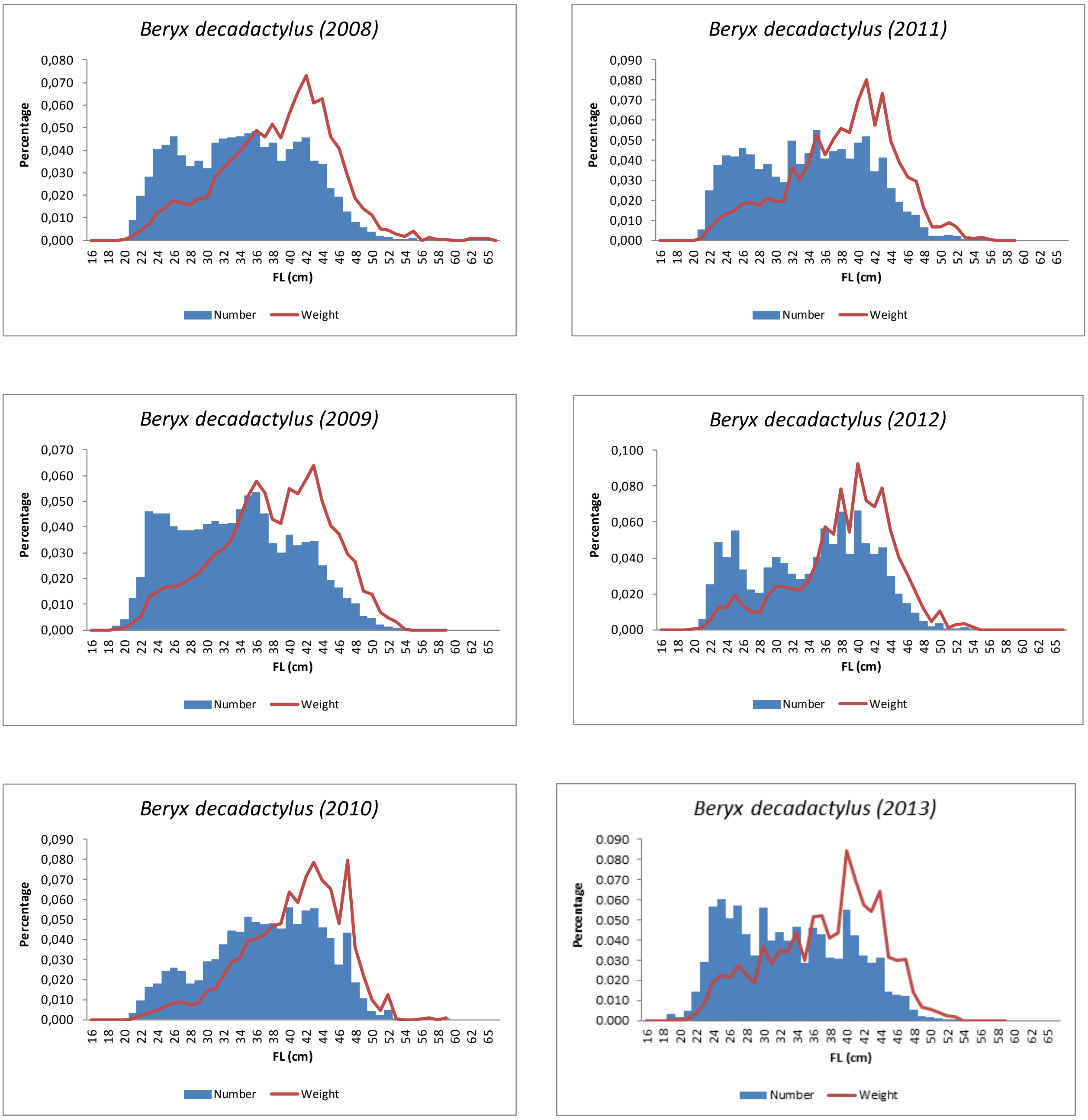


Figure 12.7. ***Beryx decadactylus*** **Length distribution of the catch from the Azores (ICES Subarea X). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.**

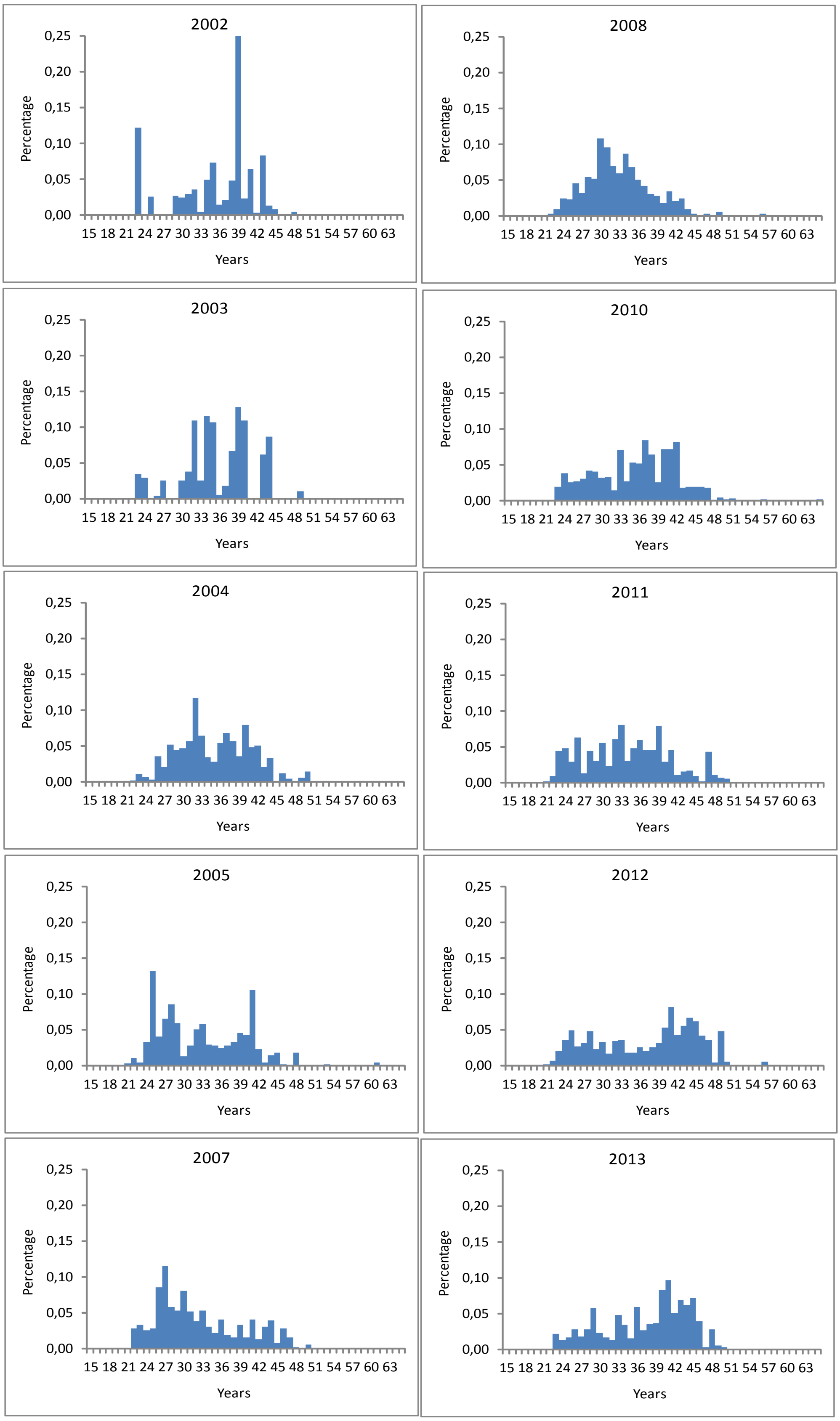


Figure 12.8. ***Beryx decadactylus*** **survey length compositions by year from the Azores (ICES Subarea X).**

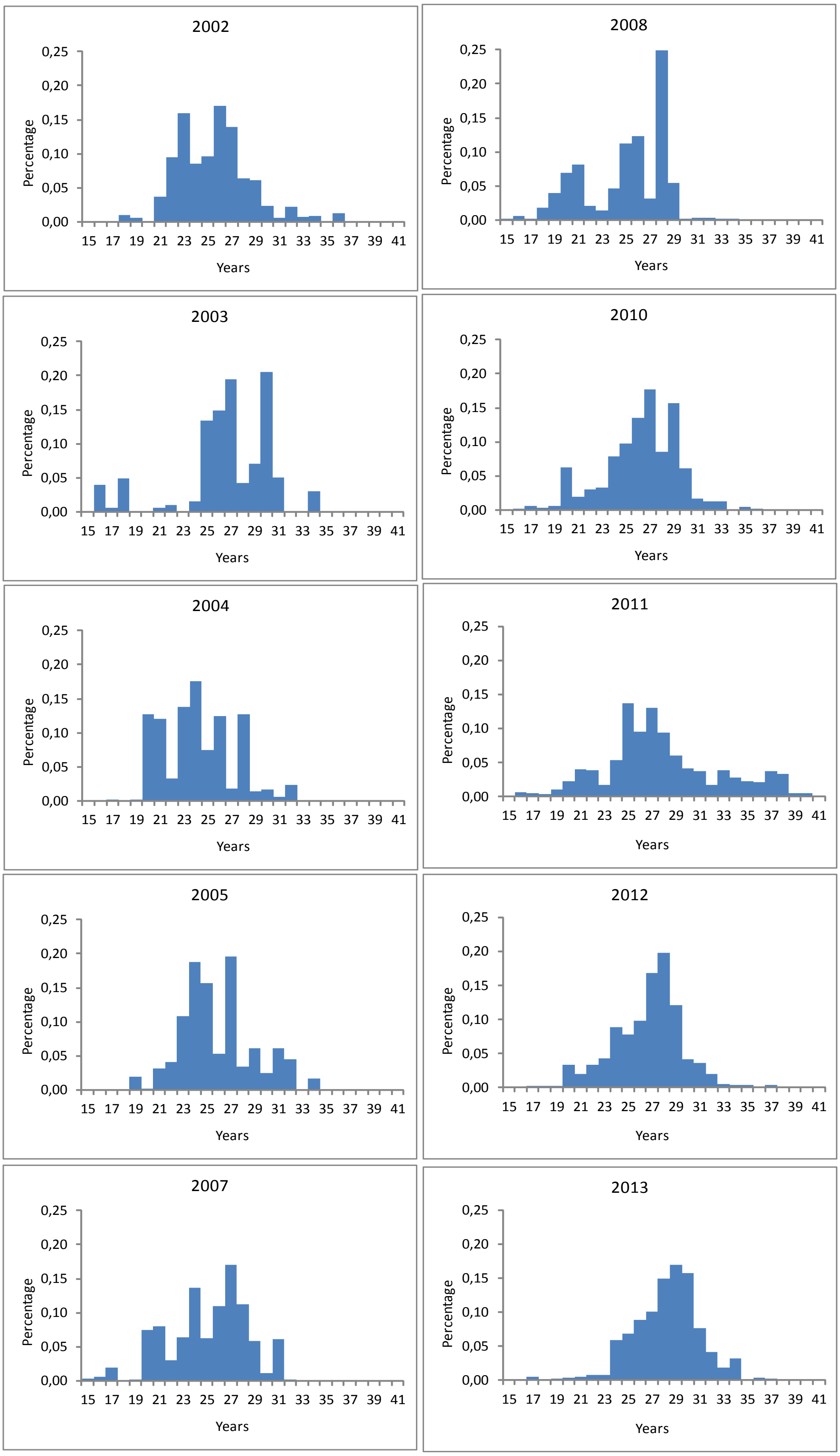


Figure 12.9. ***Beryx splendens*** **survey length compositions, by year from the Azores (ICES Subarea X).**

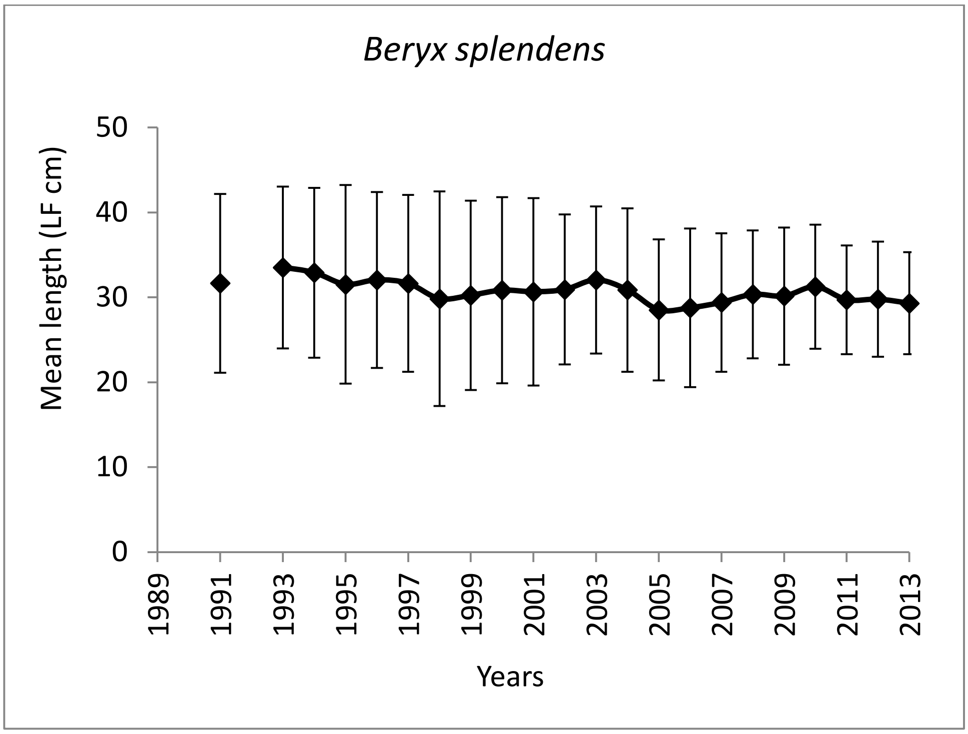


Figure 12.10. Annual mean length of *Beryx splendens* from the Azorean fishery (ICES Subarea X).Bars are 95% confidence interval.

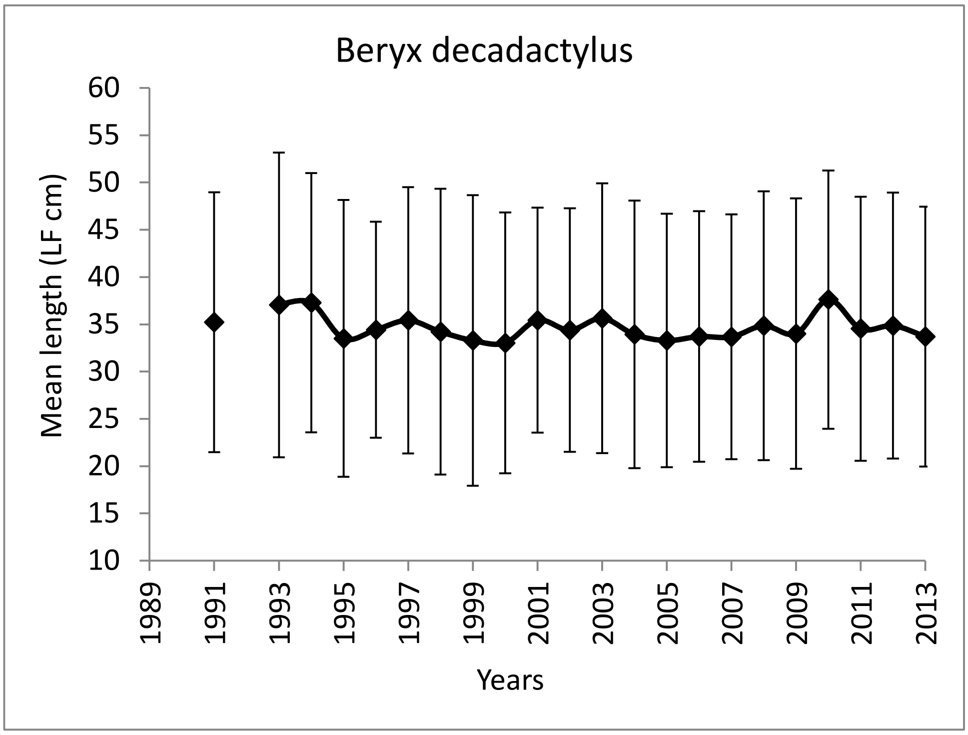


Figure 12.11. Annual mean length of *Beryx decadactylus* from the Azorean fishery (ICES Subarea X).Bars are 95% confidence interval.

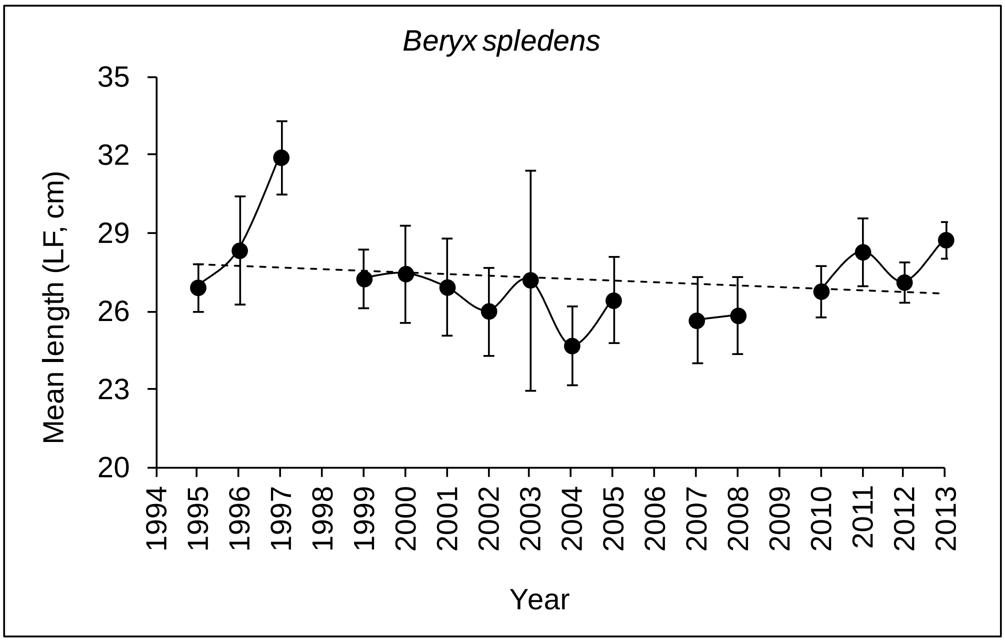


Figure 12.12. Annual mean length of *Beryx splendens* from the bottom longline survey (ICES Subarea X).Bars are 95% confidence interval.

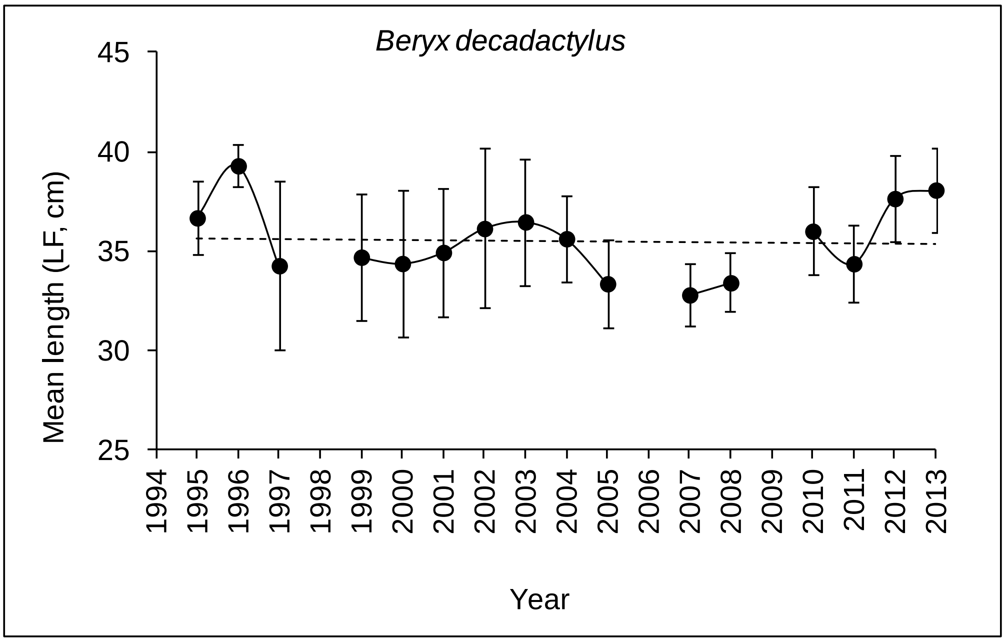


Figure 12.13. Annual mean length of *Beryx decadactylus* from the bottom longline survey (ICES Subarea X).Bars are 95% confidence interval.

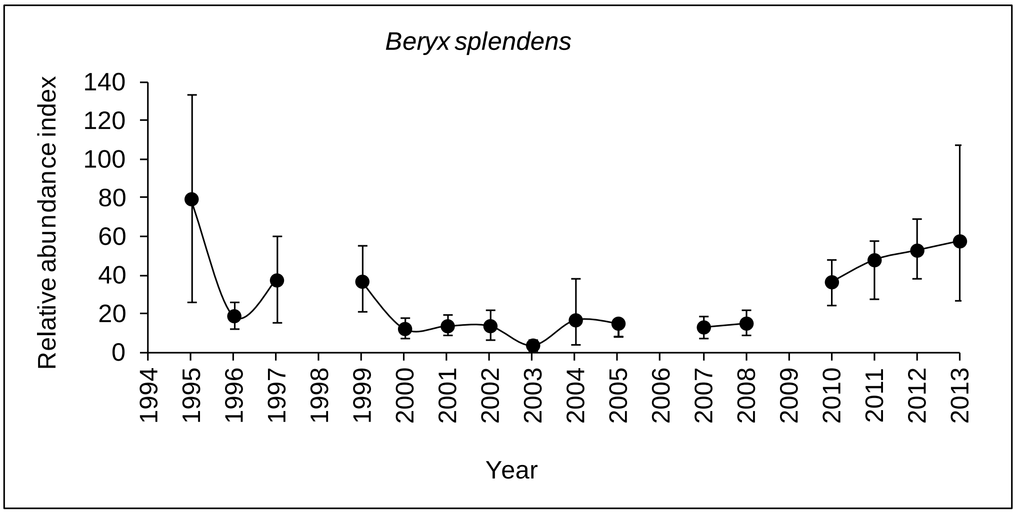


Figure 12.14. Annual bottom longline survey abundance index in number available for the alfonsinos (*Beryx splendens*) from the Azorean deep-water species surveys (ICES Subarea X).

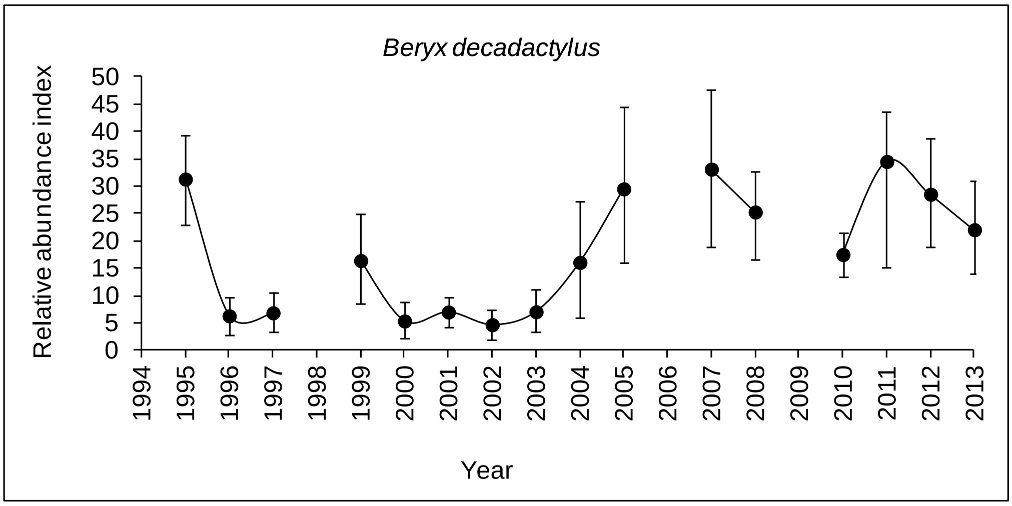


Figure 12.15. Annual bottom longline survey abundance index in number available for the golden eye perch (*B. decadactylus*) from the Azorean deep-water species surveys (ICES Subarea X).

13 Red (black spot) sea bream (*Pagellus bogaraveo*)

13.1 Current ICES stock structure

ICES considered three different components for this species: a) Areas VI, VII, and VIII; b) Area IX, and c) Area X (Azores region), (ICES, 1996; 1998a).

The interrelationships of the blackspot sea bream from Areas VI, VII, and VIII, and the northern part of Area IXa, and their migratory movements within these areas have been observed by tagging methods (Gueguen, 1974). However, there is no evidence of movement to the southern part of IXa where the main current fishery currently occurs.

Studies show that there are no genetic differences between populations from different ecosystems within the Azores region (east, central and west group of Islands, and Princesa Alice Bank) but there are genetic differences between Azores (ICES Area Xa2) and mainland Portugal (ICES Area IXa) (Stockley *et al*., 2005). These results, combined with the known distribution of the species by depth, suggest that Area X component of this stock can effectively be considered as a separate assessment unit.

Available information, particularly genetics and tagging, seems to support the current assumption of three assessment units (VI–VIII, IX and X).

13.2 Red (blackspot) sea bream in Subareas VI, VII & VIII

13.2.1 The fishery

From the 1950s to the 1970s, the blackspot sea bream was exploited mainly by French and Spanish bottom offshore trawlers, by artisanal pelagic trawlers in the eastern Bay of Biscay (ICES Divisions VIIIa,b), and by Spanish longliners in the Cantabrian Sea (ICES Division VIIIc), with smaller contributions from other fisheries (Lorance, 2011). Currently, EU Regulations state that no directed fisheries are permitted under the quota, therefore catches should be only bycatches.

In the period considered (1988–2014), most of the estimated landings from the Subareas VI, VII and VIII were taken by Spain (68%), followed by France (18%), UK (11%) and Ireland (2%).

The fishery in Subareas VI, VII and VIII strongly declined in the mid-1970s, and the stock is seriously depleted. Since the 1980s, it has been mainly a bycatch of otter trawl, longline and gillnet fleets and only a few small-scale handliners have been targeting the species. Since 1988 the landings from Subarea VIII represent 66% and VI and VII 34% of total accumulated landings. At present the blackspot sea bream catches in these areas are almost all bycatches of longline and otter trawl fleets from France, Ireland and Spain.

13.2.2 Landings trends

Landings data by ICES Subareas reported to the working group are shown in Table 13.2.1a–c. Figure 13.2.1a presents an overview of the historical series of landings in Subareas VI, VII and VIII since the middle of the last century. Figure 13.2.1b shows, in greater detail, landings of the same subareas since 1988. In 2014 UK (Scotland) reported landings for first time in VIIj. This ICES Division area is however part of the historical area of distribution of the species (Olivier, 1928; Desbrosses, 1932).

For these three subareas combined, landings decreased from 461 t in 1989 to 52 t in 1996, increased again to a peak in 2007 (322 t) and then decreased in following years to 256 t in 2014.

13.2.3 ICES Advice

ICES advices for the period 2015 and 2016 that on the basis of the precautionary considerations, that there should be no directed fishery and bycatch should be minimized.

13.2.4 Management

The EU TAC for the Subareas VI, VII and VIII was 196 t for 2012 and 178 t for 2013. Landings in 2013 and 2014 were above the TAC. A minimum landing size of 35 cm was applied from 2010 to 2012. In 2015 and 2016 TAC has been reduced to 169 t and 160 t respectively.

Pagellus bogaraveo	TAC				Landings	
Subarea	2013	2014	2015	2016	2013	2014
VI, VII, VIII	196	178	169	160	295	256

13.2.5 Data available

13.2.5.1 Landings and discards

The Spanish, French and UK extended landing-series of *P. bogaraveo* in Northeast Atlantic were updated since 2012 (Figure 13.2.1).

Historically, discards are considered negligible. However, in 2014 Spain reported 2.4 t of discards in the trammelnet fleet in the VIIIc that constitutes 0.9% of the catches in the year. As the blackspot sea bream is very a highly valued species in Spain, it is likely that these reported discards are carcasses in bad condition recovered from the nets or a misidentification of the species.

Other countries involved in this fishery also reported 0 discards this year.

13.2.5.2 Length compositions

No length data were available to the working group.

13.2.5.3 Age compositions

No age data were available to the working group.

13.2.5.4 Weight-at-age

Mean size and weight-at-age (Table 13.2.2) derived from Guéguen (1969) and Krug (1998) were used by Lorance (2011) in a yield-per-recruit model to simulate the effect of fishing mortality on the blackspot sea bream stock of Bay of Biscay.

13.2.5.5 Maturity and natural mortality

Natural mortality of 0.2 was estimated by Lorance (2011). M was derived from the presumed longevity in the population according the rule M ¼ 4.22/t max, where t is the maximum age in the population derived from data from many populations (Hewitt and Hoenig (2005)).

13.2.5.6 Catch, effort and research vessel data

At the current level of abundance, the black spot sea bream is rarely caught in the northern surveys by French IBTS (Divisions VIIf,g,h,j; VIIIa,b, and VIId) and Irish IGFS (Divisions VIa South and VIIb). In 2014 for first time in last three years the Northern Spanish Shelf bottom-trawl survey (SP-NGFS) reported catches of only 0.02 kg/hour (juveniles from 21 cm to 24 cm) in Divisions IXa and VIIIc. (Figures 13.2.2, 3 and 4).

In French surveys, similar to the current western IBTS, from early 1980s when the stocks were already low it was still in 40 to 60% of the hauls. This proportion dropped to close to zero by 1985 (Lorance, 2011). This observation indicates that the current survey is appropriate to detect and monitor a recovery of the stock if ever it happens.

13.2.6 Data analyses

2014 was the second year with a new vessel, the R/V *Miguel Oliver*, carrying the demersal groundfish survey on the northern Spanish Shelf. Data from the 2013 survey indicated differences in the catchability of some species, specially the benthic ones and an additional intercalibration experiment between R/V *Cornide de Saavedra* and the new vessel was carried out. A problem with the sweeps used in 2013 survey was detected, and the data from 2014 seem more coherent with the previous time-series. Nevertheless, as stated in 2014, the possible effect of species with a more “pelagic” behaviour such as blackspot sea bream are not clear, but given the variability and the fact that this species appears mainly in the shallower hauls not considered within the stratified abundance indices reduces the importance of this change for this species.

Landings since 1988 are well below those recorded in the period from 1960 to 1986 in which landings ranged from 2000 t to up to 13 000 t (Figure 13.2.1a). Catches recorded in the surveys are very scarce and are mainly juveniles smaller than 30 cm.

13.2.7 Biological reference points

WKLIFE has not yet suggested methods to estimate biological reference points for stocks which have only landings data or are bycatch species in other fisheries. Therefore, no attempt was made to propose reference points for this stock.

13.2.8 Management considerations

This stock is collapsed and the advice is to reduce mortality by all means to allow the stock to rebuild.

Measures should include protection for areas where juveniles occur. Recreational fisheries may be a significant proportion of the mortality of those juveniles owing to their coastal distribution. This was confirmed for the stock in Subarea X (Pinho *et al.*, 2015).

The TAC was exceeded in 2007, 2010, 2012, 2013 and 2014.

13.2.9 References

Desbrosses, P. 1932. La dorade commune (*Pagellus centrodontus* Delaroche) et sa pêche. Revue des Travaux de l'Office des Pêches Maritimes 5:167–222.

Olivier, R. 1928. Poissons de chalut, la dorade (*Pagellus centrodontus*). Revue des Travaux de l'Office des Pêches Maritimes I:5–32.

Table 13.2.1a. Blackspot sea bream in Subareas VI and VII; WG estimates of landings by country.

YEAR	FRANCE*	IRELAND	SPAIN	UK (E & W)	CH. ISLANDS	UK (Scot)	TOTAL
1988	52	0	47	153	0		252
1989	44	0	69	76	0		189
1990	22	3	73	36	0		134
1991	13	10	30	56	14		123
1992	6	16	18	0	0		40
1993	5	7	10	0	0		22
1994	0	0	9	0	1		10
1995	0	6	5	0	0		11
1996	0	4	24	1	0		29
1997	0	20	0	36			56
1998	0	4	7	6			17
1999	2	8	0	15			25
2000	4	n.a.	3	13			20
2001	2	11	2	37			52
2002	4	0	9	13			25
2003	13	0	7	20			40
2004	33		4	18			55
2005	29		4	7			41
2006	36	0	8	19			63
2007	46	0	27	57			130
2008	39	0	2	22			63
2009	34	1	16	10			61
2010	22	0	40	1			62
2011	21		11	4			37
2012	38		118				156
2013	28		146	4			178
2014	15		35	9		0	60

Table 13.2.1b. Red sea bream in Subarea VIII; WG estimates of landings by country.

YEAR	FRANCE*	SPAIN	UK (E & W))	TOTAL
1988	37	91	9	137
1989	31	234	7	272
1990	15	280	17	312
1991	10	124	0	134
1992	5	119	0	124
1993	3	172	0	175
1994	0	131	0	131
1995	0	110	0	110
1996	0	23	0	23
1997	18	7	0	25
1998	18	86	0	104
1999	13	84	0	97
2000	11	189	0	200
2001	8	168	0	176
2002	10	111	0	121
2003	6	83	0	89
2004	37	82	8	128
2005	28	90	0	118
2006	20	57	0	77
2007	44	149	1	193
2008	55	40	0	95
2009	5	137	0	142
2010	61	157	0	218
2011	19	122	0	141
2012	18	82	0	101
2013	26	91	0	117
2014	36	161	0	196

Table 13.2.1c. Red sea bream in Subareas VI, VII and VIII; WG estimates of landings by subarea.

YEAR	VI AND VII*	VIII*	TOTAL
1988	252	137	389
1989	189	272	461
1990	134	312	446
1991	123	134	257
1992	40	124	164
1993	22	175	197
1994	10	131	141
1995	11	110	121
1996	29	23	52
1997	56	25	81
1998	17	104	121
1999	25	97	122
2000	20	200	220
2001	52	176	227
2002	25	121	147
2003	40	89	129
2004	55	128	183
2005	41	118	158
2006	63	77	139
2007	130	193	324
2008	63	95	159
2009	61	142	203
2010	62	218	281
2011	37	141	177
2012	156	101	257
2013	178	117	295
2014	60	196	256

Table 13.2.2 Mean size and weight-at-age of blackspot sea bream in Bay of Biscay. From Lorance (2010), derived from Guéguen (1969b) and Krug (1998).

Age group	Mean size (total length, cm)	Mean weight (g)	Proportion of females mature
0			0
1	11.2	18	0
2	17.6	72	0
3	22.3	149	0
4	26	239	0
5	29.2	342	0
6	31.9	449	0.007
7	34.3	562	0.05
8	36.1	658	0.15
9	37.9	765	0.31
10	39.5	870	0.45
11	40.9	969	0.54
12	42.3	1076	0.62
13	43.7	1190	0.68
14	44.8	1285	0.73
15	45.9	1386	0.77
16	46.7	1462	0.80
17	47.8	1572	0.83
18	49.2	1719	0.86
19	49.9	1796	0.88
20	50.2	1830	0.89

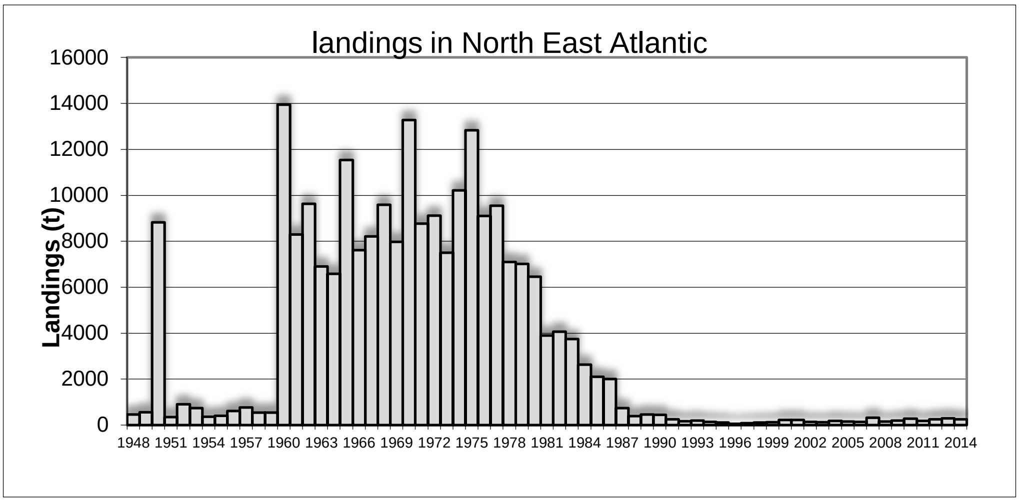


Figure 13.2.1a. Time-series of blackspot sea bream landings from 1948 to 2014 in Northeast Atlantic (Subareas VI, VII and VIII).

Reference/Source [1] of reconstructed landings data for blackspot sea bream in the Bay of Biscay	
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. ("sea breams") from the Northeast Atlantic. Source: Dardignac (1988), quoted by Castro (1990). SGDeep
Portugal	-Years 1948–1987 Subarea X: Landings of *P.bogaraveo* (*sic*). M.Pinho, pers. com. Source: H. Krug (for 1948–1969) and SGDeep 1995 (for 1970–1987). -Years 1948–1987, Subarea IX: Landings of *P.bogaraveo* (*sic*?). M.Pinho, pers. com. Source: H. Krug (for 1948–1969) and SGDeep 1995 (for 1970–1987).
Spain	-Years 1960–1986: Landings of *Pagellus* sp. ("sea breams") from the Northeast Atlantic. Source: Anuarios de Pesca maritima. Castro (1990). SGDeep 1996.Table 13.2.3. -Years 1983–1987: Landings of *P.bogaraveo* (*sic*) from Division IXa correspond only to southern IXa (Tarifa and Algeciras ports). Source: Cofradias de Pescadores.(WD Gil, 2004) and Cofradias de Pescadores. (Lucio, 1996). -Years 1985–1987: Landings of *Pagellus* sp. (mainly *P. bogaraveo*). Source: SGDeep 1996. Table 13.2.4. -Years 1948–1984: Landings of *P.bogaraveo* (*sic*) from "Division VIIIc" -mainly Division VIIIc (eastern) and Division VIIIb (southern) correspond only to the Basque
UK	-Years 1978–1987: Landings of *P.bogaraveo* (*sic*?) from the Northeast Atlantic. M .Pinho, pers. com. Source: SGDeep 1995.
All countries	-Years 1979–1985 SGDeep official data -Years 1988–2014 WGDeep official data

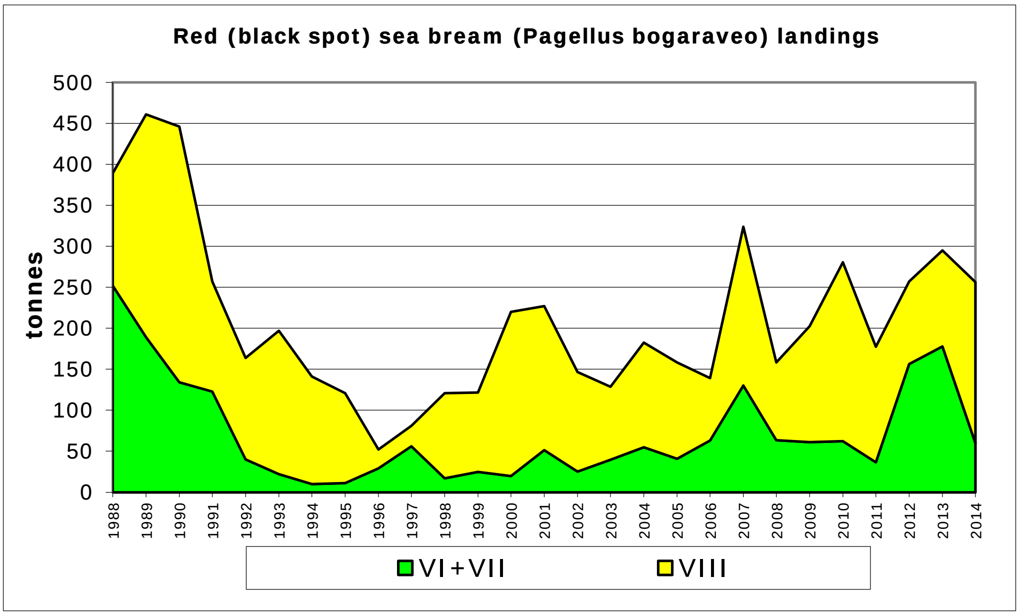


Figure 13.2.1b. Blackspot sea bream landing trends in ICES subareas VI and VII since 1988.

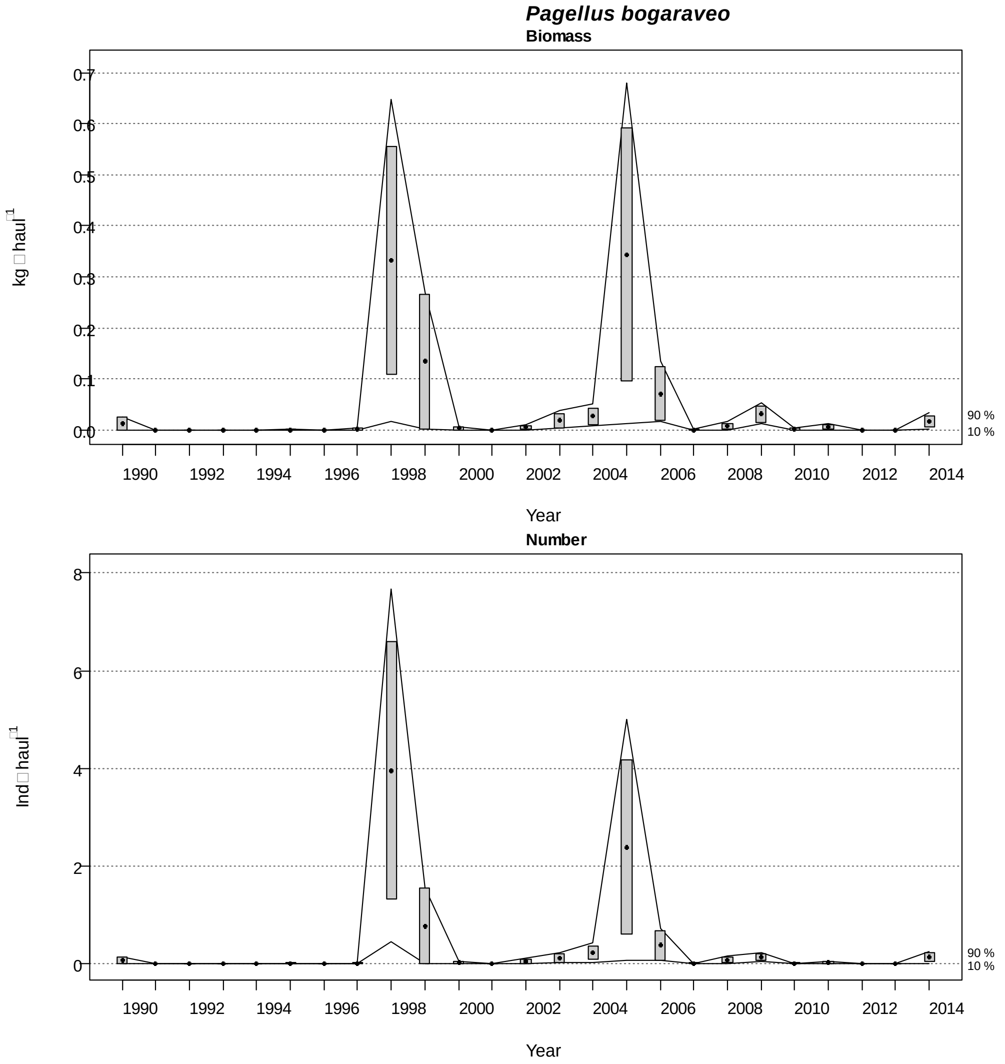


Figure 13.2.2. Evolution of blackspot sea bream (*P. bogaraveo*) mean stratified abundance in Northern Spanish Shelf survey time-series (1990–2014).

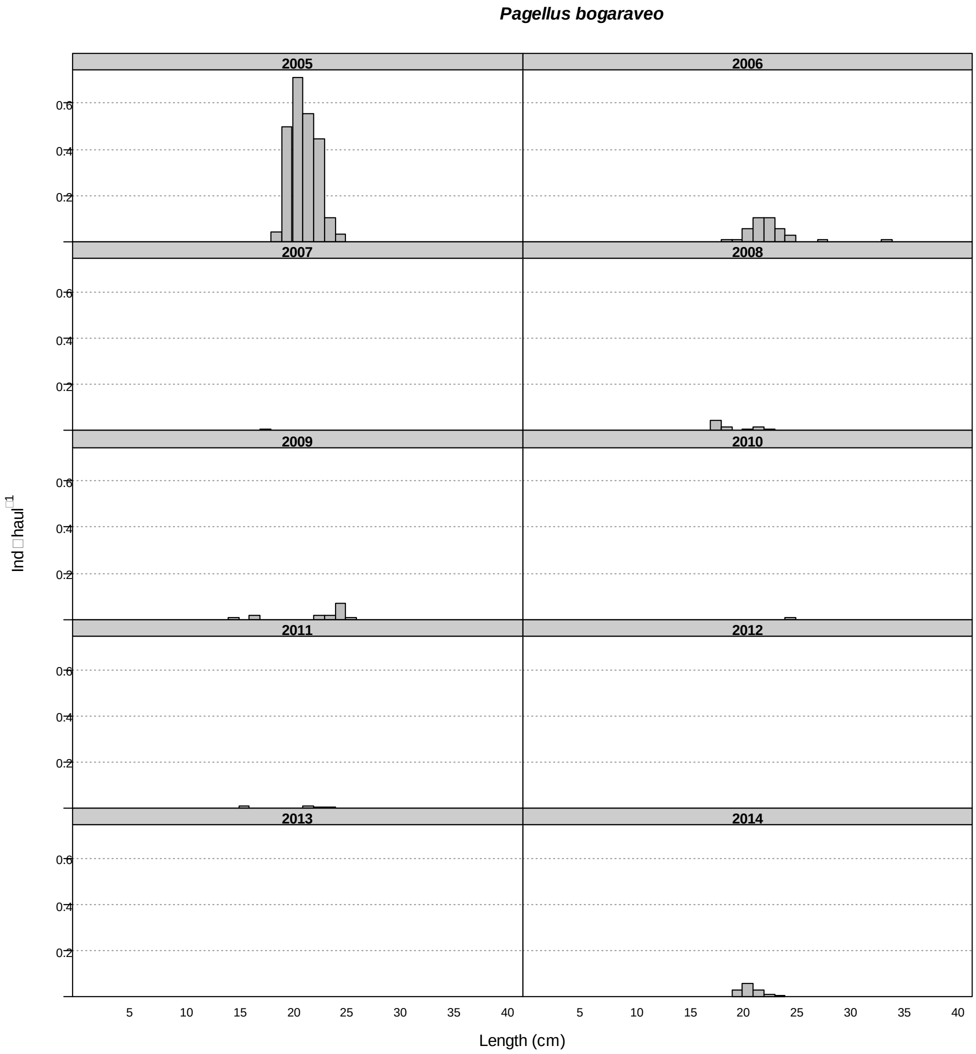


Figure 13.2.3. Mean stratified length distributions of blackspot sea bream (*P. bogaraveo*) in Northern Spanish Shelf surveys (2003–2014).

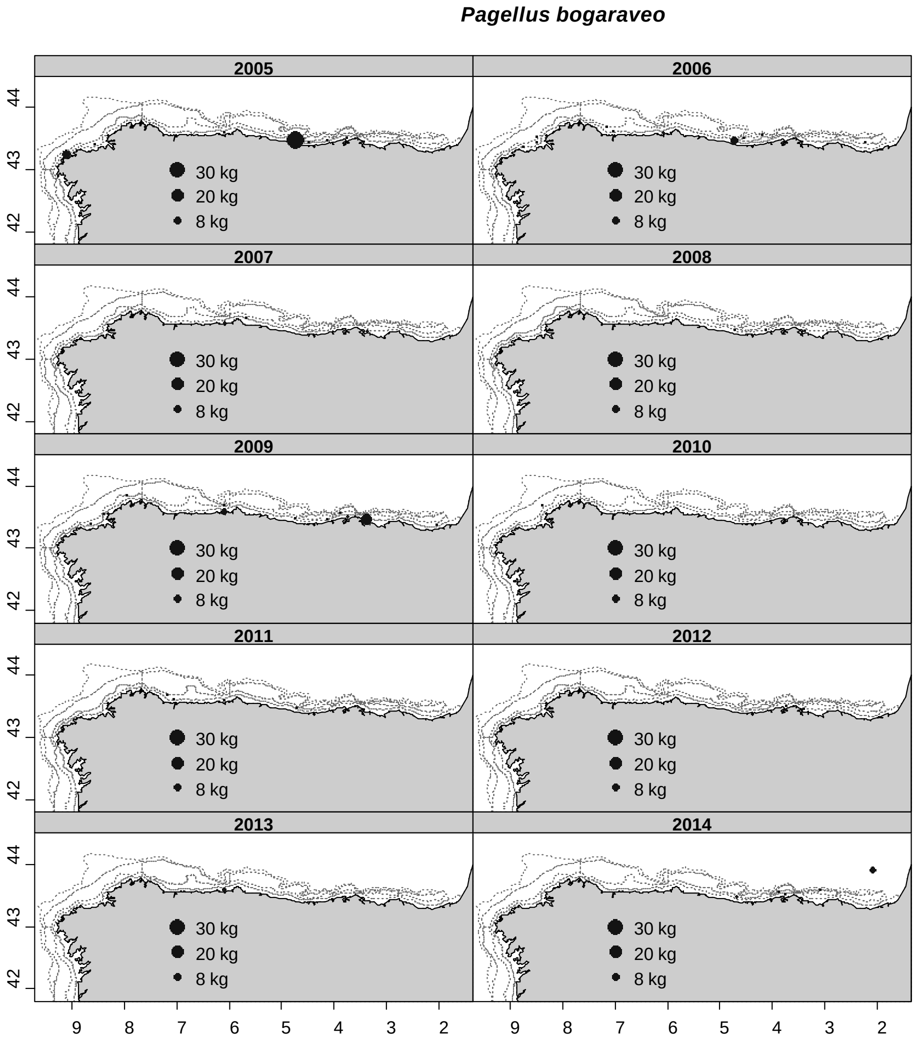


Figure 13.2.4. Catches in biomass of blackspot sea bream on the Northern Spanish Shelf bottom-trawl surveys during the last decade: 2003–2014.

13.3 Red (blackspot) sea bream (*Pagellus bogaraveo*) in Subarea IX

13.3.1 The fishery

Pagellus bogaraveo is caught by Spanish and Portuguese fleets in Subarea IX. Spanish landings data from this area are available from 1983, Portuguese data from 1988 and Moroccan information from 2001 till 2011. European landings in Subarea IX, most of which are taken with lines, are from Spain (62%) and Portugal (38%) 2012–2014.

An update of the description of the Spanish fishery and the available information, from the southern part of Subarea IX close to the Strait of Gibraltar, has been provided to the Working Group (Gil *et al.*, WD to the WGDEEP 2015). Currently, about 60 Spanish boats are involved in the fishery. The fishing grounds of the Spanish fleet are on both sides of the Strait of Gibraltar and near, i.e. mostly less than 20 nmi, the main ports (Tarifa and Algeciras). Fishing takes advantage of the fluctuation of the tide at depths from 350 to 700 m with "*voracera*" gear, a mechanised handline. Since 2002 other artisanal boats have joined the Red (blackspot) sea bream fishery from Conil port, although they operate in other fishing grounds and use longlines. This section of the fleet counts currently about six boats. Landings are aggregated into commercial categories due to the wide size range of the catch and size varying prices. Historically these categories have varied with time but from 1999 onwards have remained the same in all ports.

In addition, Moroccan longliners have been fishing in the Strait of Gibraltar area since 2001. These are about 102 boats that are mainly based in Tangier. The average technical characteristics of these boats are: 20 GRT and 160 HP. Moreover, 435 artisanal boats (±15 CV, ≤2 GRT and 4–6 m length) also target this species in the Strait of Gibraltar area (S. Benchoucha, *pers.com.*). The WG considers the account of Moroccan data appropriate as the fishery operates in the same area as the Spanish fishery and obviously targets the same stock. Unfortunately, no updated information was available in 2015 and no new information from the Moroccan fishery has been received in the last three years.

The majority of deep-water species landings as fresh fish in mainland Portugal correspond to the artisanal fleet, which uses mainly longlines (I. Figueiredo, *pers. com.*).

13.3.1.1 Landing trends

Since 1990, the maximum catch was reached in 1993–1994 and 1997 (about 1000 t) whereas the minimum (211 t) in 2013 (Figure and Table 13.1.1). Without the Moroccan landings, last year (2014) landings increased more than the 40% in the whole Subarea IX. In addition Gil *et al.* (WD to the WGDEEP 2015) reported more than the 100 % in the Strait of Gibraltar fishery.

13.3.2 Advice

The ICES advice for 2015 and 2016 was: "on the basis of the data-limited approach that annual catches should be no more than 115 t (EU catches). All catches are assumed to be landed. Additionally, ICES recommends the establishment of a recovery plan for Red sea bream. This plan should include all fisheries that take this stock."

13.3.3 Management

Since 2003, TAC and Quotas have been applied to the Red (blackspot) sea bream fishery in Subarea IX. The following table shows a summary of *P. bogaraveo* TAC in this Subarea:

P. BOGARAVEO	2007-2008		2009-2010		2011-2012		2013-2014	
ICES Subarea	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings
IX	1080	601–718	918–780	718–484	780–780	333–295	780–780	211–262

In addition to the TAC for 2011–2012 a minimum landing size of 35 cm (total length) shall be respected. However, 15% of fish landed may have a minimum landing size of at least 30 cm (total length). Furthermore, a maximum of 8% of each quota may be fished in EU and international waters of VI, VII and VIII. Currently, there is no longer a minimum landing size in the TAC regulation. European landings have always been far below the adopted TACs although these have been reduced over the years. However, in the last year (2014) landings (262 t) are above the 2016 TAC (183 t) (Figure 13.1.1).

13.3.4 Stock identity

Several tagging surveys (56 days at sea in 2001, 2002, 2004, 2006 and 2008) have been conducted in the Strait of Gibraltar area. A total of 4500 fish were tagged of which 404 recaptures have been reported. No significant movements have been observed, although local migrations were noted: feeding grounds are distributed along the entire Strait of Gibraltar and the species seems to remain within this area as a resident population (Gil, 2006). Recaptures of tagged fish have also been reported by the Moroccan fishery.

13.3.5 Data available

13.3.5.1 Landings and discards

Historical landing dataseries available to the Working Group are described in Section 13.1.1 and detailed in Figure 13.1.1. Portuguese and Spanish discard information was available to the Working Group from on-board sampling programme (EU DCF/NP). For this species discards can be assumed to be zero or negligible for most assessment purposes and those that do occur are mainly related to catches of small individuals. Therefore for this stock all catches are assumed to be landed.

13.3.5.2 Length compositions

Length frequencies of landings are only available for the Spanish "*voracera*" Red (blackspot) sea bream fishery in the Strait of Gibraltar (1983–2014). Figure 13.3.2 show the updated length distribution data (from Gil *et al.*, WD to the WGDEEP 2015). The table below shows the mean and median landed size since 1990:

Year	Mean	Std. Dev.	Median	Year	Mean	Std. Dev.	Median
1990	38.9	5.61	39	2003	38.9	6.27	38
1991	40.4	6.20	40	2004	37.1	5.69	35
1992	40.6	6.61	40	2005	37.3	6.02	35
1993	40.5	6.65	40	2006	36.4	5.58	35
1994	40.4	6.33	40	2007	37.8	5.95	36
1995	37.2	6.49	36	2008	38.3	6.22	36
1996	37.2	6.52	35	2009	38.8	6.23	37
1997	36.5	6.38	35	2010	36.6	5.29	35
1998	34.8	5.07	34	2011	36.8	6.37	34
1999	36.7	5.30	36	2012	36.9	5.90	35
2000	37.3	4.81	36	2013	35.3	3.59	34
2001	37.6	5.45	37	2014	37.6	5.14	36
2002	38.6	5.93	38				

Only one mean value (in 1998) is lower than the 2013 year´s mean landing size. Median values are well below the mean in recent years. However, changes are small and gradual. There seem to be a long-term decline, but the mean length has been mostly stable over the last decade (Figure 13.1.2).

13.3.5.3 Age compositions

Age and growth, based on otolith readings, were revised at the ICES WKAMDEEP meeting (October, 2013): The maximum age was estimated at ten years of age based on otolith readings in the Strait of Gibraltar area. However two tags from the tag–recapture programme were recaptured after ten years (J. Gil, *pers. com.*). Moreover, growth estimates from tag–recapture experiments suggest that otolith readings may underestimate age and that some hyaline rings are uncounted and/or missing. The use of these biased age estimates may have substantial consequences.

13.3.5.4 Weight-at-age

No new information was presented to the group.

13.3.5.5 Maturity and natural mortality

No new information was presented to the group.

13.3.5.6 Catch, effort and research vessel data

Figure 13.1.3 presents lpues information, restricted to the Strait of Gibraltar fishery (Gil *et al.*, WD to the WGDEEP 2015). Effort, as indicated, from sales sheets is not standardized and is potentially an underestimate in some years as the effort unit chosen may be inappropriate. However, the recent lpue decrease, even when overestimated, shows a clear decline which is quite consistent with recent landings. Moreover, 2009–2013 lpue estimated from VMS analysis shows lower values but the same decreasing trend. VMS information could not be updated within the WG but the lpue from sales sheets (as a proxy of fishing trip) reverted to increase.

13.3.6 Data analyses

From Figure 13.1.1 the trend is fairly clear; even though Moroccan landings from the Strait of Gibraltar are not available in the years 2012 and 2013. It is however assumed that these landings followed a decreasing trend. Landings have declined significantly over the last years which may be considered as an indication of a substantial reduction in exploitable biomass. Mean length distribution and lpue decreasing trends throughout these years may also be consistent with an overexploited population. However, in 2014 all signals (landings, lpue and length distribution) showed signs of an increase but without any evidence of its sustainability.

13.3.7 Comments on the assessment

No analytical assessment was presented at the meeting.

13.3.8 Management considerations

A TAC regime (374 and 183 t) was established for 2015 and 2016 for whole Subarea IX. Recent landings are far below previous TAC levels while last two years landings are above the 2016 TAC.

Only the Spanish target fishery (*"voracera"* gear) in the Strait of Gibraltar is under a local fishing plan. Therefore, from a precautionary point of view, the local technical measures adopted, such as an authorised vessels list, the cessation fishing for two and half months, (during the period of 15th January–31st March), should be continued or even expanded. It is suggested to enforce a minimum retainment- and landing size. In 2013, the minimum landing size for the species in Spain on the Atlantic part was reset to 25 cm whereas in the Mediterranean it is 33 cm. A common minimum landing size is desirable in both sides of the Strait of Gibraltar.

WGDEEP reiterates its advice of a need for a recovery plan for the Strait of Gibraltar fisheries: vital to its success is the involvement of non-EU countries (primarily Morocco).

Table 13.1.1. Red (blackspot) sea bream (*Pagellus bogaraveo*) in Subarea IX: Working Group estimates of landings (in tonnes). Spanish landings from 2012 are official statistics.

YEAR	PORTUGAL	SPAIN	MOROCCO	UNALLOCATED	TOTAL
1983		101			101
1984		166			166
1985		196			196
1986		225			225
1987		296			296
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	18		392
2002	111	248	35		394
2003	142	329	23		494
2004	183	297	33		514
2005	129	365	39		533
2006	104	440	74		618
2007	185	407	89		681
2008	158	443	76		677
2009	124	594	98		817
2010	105	379	146		630
2011	74	259	154		487
2012	143	60	n/a	92	295
2013	90	91	n/a		180
2014	59	203	n/a		262

Table 13.1.2. Spanish "*voracera*" Red (blackspot) sea bream fishery of the Strait of Gibraltar (ICES Subarea IX): Estimated lpue using sales sheets or VMS data as effort unit(adapted from Gil *et al.*, WD to the 2014 WGDEP).

Year	LPUE	VMS LPUE
1983	78	
1984	76	
1985	71	
1986	61	
1987	76	
1988	73	
1989	89	
1990	77	
1991	70	
1992	86	
1993	85	
1994	94	
1995	60	
1996	104	
1997	77	
1998	61	
1999	55	
2000	45	
2001	56	
2002	47	
2003	53	
2004	47	
2005	68	
2006	70	
2007	51	
2008	52	
2009	67	55
2010	46	38
2011	42	31
2012	35	21
2013	30	14
2014	39	n/a

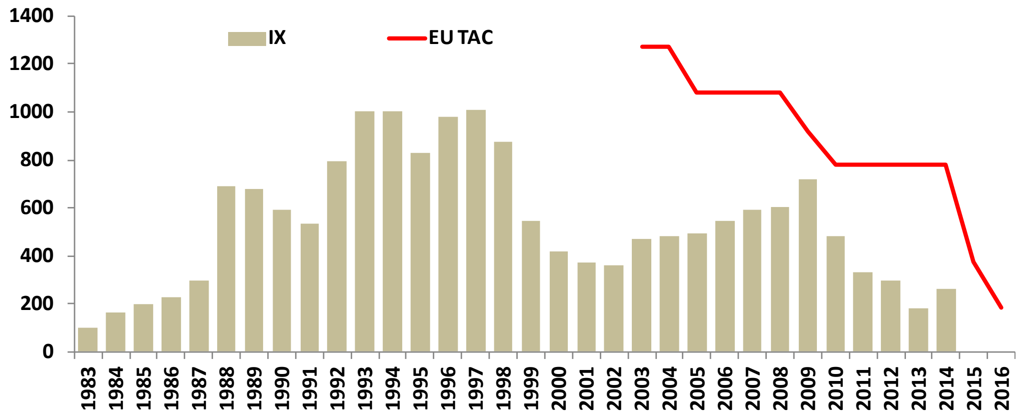


Figure 13.1.1. Red (blackspot) sea bream in ICES Subarea IX: Total landings (Morocco landings are not included) and EU TACs.

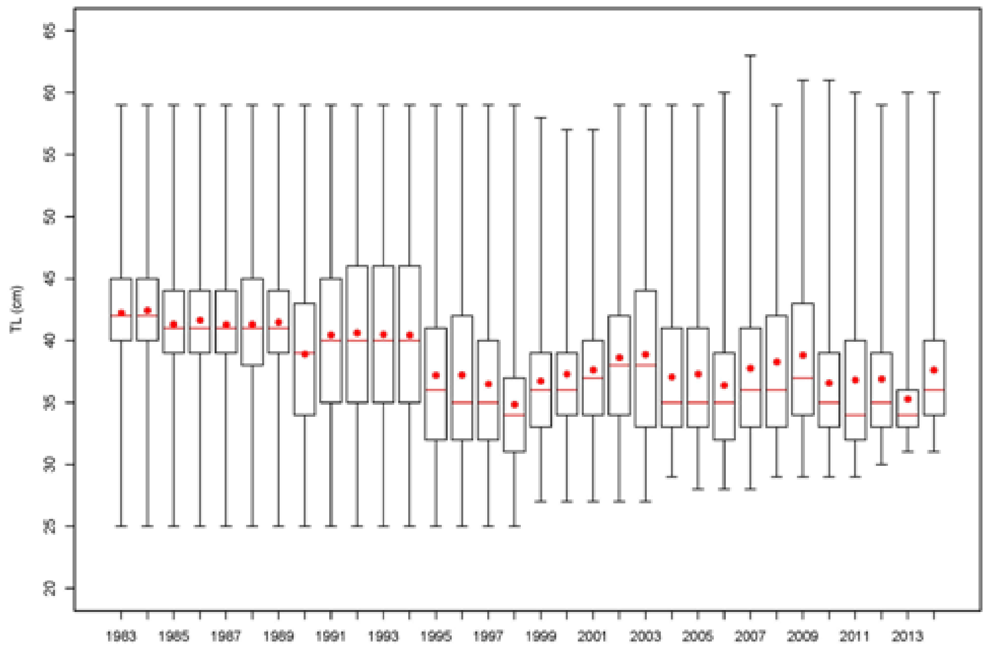


Figure 13.1.2. Spanish "*voracera*" Red (blackspot) sea bream fishery of the Strait of Gibraltar (ICES Subarea IX): 1983–2012 landings mean length distribution (from Gil *et al.*, WD to the 2015 WGDEEP).

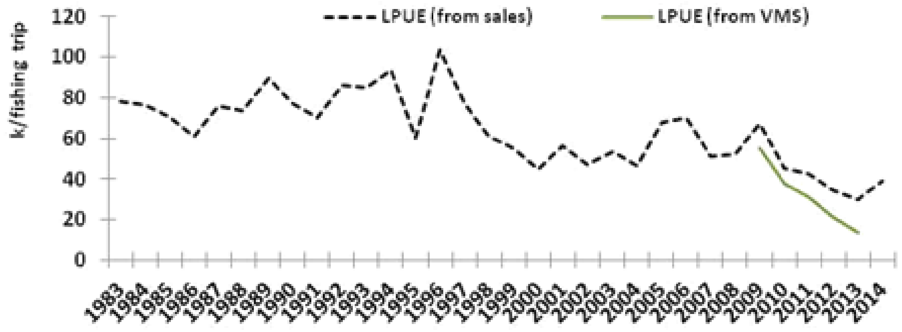


Figure 13.1.3. Spanish "*voracera*" Red (blackspot) sea bream fishery of the Strait of Gibraltar (ICES Subarea IX): Estimated lpue using sales sheets (dashed line) and VMS data as unit of effort (solid line) (adapted from Gil *et al.*, WD to the 2015 WGDEEP).

13.3.9 References

Burgos, C., J. Gil and L.A. del Olmo. 2013. The Spanish blackspot sea bream (*Pagellus bogaraveo*) fishery in the Strait of Gibraltar: Spatial distribution and fishing effort derived from a small-scale GPRS/GSM based fisheries vessel monitoring system. Aquatic Living Resources, 26: 399–407.

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13.4 Red (blackspot) sea bream (*Pagellus bogaraveo*) in Division Xa

13.4.1 The fishery

Blackspot sea bream has been exploited in the Azores (Area Xa2), at least since the XVI century as part of the demersal fishery. The directed fishery is a hook and line fishery where two components of the fleet can be defined: the artisanal (handlines) and the longliners (Pinho *et al.*, 1999; Pinho, 2003; Pinho *et al.*, 2014). The artisanal fleet is composed of small open deck boats (<12 m) that operate in local areas near the coast of the islands using several types of handlines. Longliners are closed deck boats (>12 m) that operate in all areas including banks and seamounts (Diogo *et al.*, 2015). The tuna fishery caught, until the end of the nineties, juveniles (age 0) of blackspot sea bream as live bait, but in a seasonal and irregular way because these catches depend on tuna abundance and on the occurrence of other preferred bait species like *Trachurus picturactus* (Pinho *et al.*, 2014). The juveniles are also caught by the recreational rod and reel fishery and coastal pelagic fishery as live bait (WD06, WGDEEP 2012).

The Azorean demersal fishery is a multispecies and multigear fishery where *P. bogaraveo* is considered the target species. The effect of these characteristics on the dynamics of the target fishery is not well understood.

13.4.2 Landings trends

Historically, landings increased from 400 t at the start of the eighties to approximately 1000 t at the start of the nineties (Figure 13.4.1), due to the development of new markets, increased fish value, entry of new and modern boats, better professional education of the fisher and introduction of bottom longline gear, permitting the expansion of the exploitable area to deeper waters, banks, and seamounts as well as the expansion of the fishing season (ICES, 2006). Between 1990 and 2009 the annual landings have fluctuated around 1000 t, with a peak in 2005. Important expansion of the fishery to offshore seamounts occurred during this period, particularly made by the longline fleet as a consequence of spatial management measures introduced. During the last four years (2010–2013) the landings decreased significantly to an average of 654 t which correspond to about 59% of the TAC during that period. In general a continuous decrease has been observed since 2005.

13.4.3 ICES Advice

The ICES advice for 2013 and 2014 is: "Catches should be no more than 400 tonnes."

13.4.4 Management

Under the European Union Common Fisheries policy a TAC was introduced in 2003 (EC. Reg. 2340/2002). TACs and landings are given below.

P. bogaraveo	2008		2009		2010		2011		2012	
ICES Sub-Area	TAC	Landing	TAC	Landing	TAC	Landing	TAC	Landing	TAC	Landing
Xa2	1116	1089	1116	1042	1116	1068	1116	624	1116	613

P. bogaraveo	2013		2014		2015		2016	
ICES Sub-Area	TAC	Landing	TAC	Landing	TAC	Landing	TAC	Landing
Xa2	1004	692	904	663	678		507	

For the 2006 the Regional Government introduced a quota system by Island and vessel. Specific access requirements and conditions applicable to fishing for deep-water stocks were established (EC. Reg 2347/2002). Fishing with trawl gears was forbidden in the Azores region. Since 2003 deep-water fishing within 100 miles of the Azores baseline is restricted to vessels registered in the Azores under the management of fishing effort of the common fishery policy for deep-water species (EC. Reg. 1954/2003).

For 2009, the Regional Government introduce new technical measures, including the minimum landing size (30 cm total length), area restrictions by vessel size and gear, and gear restrictions (hook size and maximum number of hooks on the longline gear). A seamount (Condor) was also closed to fisheries until 2016 to allow a multidisciplinary research (ecological, oceanography and geological).

13.4.5 Data available

13.4.5.1 Landings and discards

Total annual landings data are available since 1980. However, detailed and precise landing data are available for the assessment since 1990 (WD Pinho *et al.*, 2015). Landings from Area Xa2 are presented in the Table 14.2.1 and Figure 14.2.1.

Information on the discards in the longline fishery has been collected in the Azores by a team of observers on board the longline fleet. This information was presented during the 2012 meeting and updated (WD, Pinho, 2015). On average about 0,6% of blackspot sea bream was discarded annually on sampled trips between 2004 and 2012.

13.4.5.2 Length compositions

Length composition data of the catch of the fishery is available for the period 1990 to 2013. However data from 1990 to 1994 are based on low sampling coverage and so are not presented here. Data for subsequent years are presented in Figure 13.4.2.

Length compositions are similar to those from surveys (Figure 13.4.3) with a mode around 25–28 cm. Large quantities of adult individuals greater than 40 cm are observed in the fishery for the years 1999, 2002 and 2005 decreasing thereafter. This increase may relate to catchability factors or due to an expansion of the fishery to offshore areas and deeper depth strata.

13.4.5.3 Age compositions

The information is available from the fishery and surveys but are not presented here because it is not relevant for the current assessment.

13.4.5.4 Weight-at-age

No new information was presented to the group because there are no relevant changes on the biology of the species.

13.4.5.5 Maturity, sex-ratio and natural mortality

Maturity and sex-ratio data were updated in accordance with the methods outlined in the stock annex.

13.4.5.6 Catch, effort and research vessel data

Standardized fishery cpue was not updated. Available information from last year is resumed on the Figure 13.4.4. Catch rates for the period 1990–2010 were estimated using a Generalized Linear Mixed modelling approach assuming a delta-lognormal error distribution. The explanatory variables considered for standardization comprise geographical area, season, vessel category and port of fishing operation. Nominal cpue is presented for the recent years (2011–2013).

Survey data were updated accordance the methods in the stock annex (WD, Pinho, 2015).

13.4.6 Data analyses

The fishery cpue has been variable but shows no overall trend (Table 13.4.2; Figure no. 13.4.4). In recent years, the cpue appears to have shown a declining trend from a high point in 2005 with current cpue around the lowest observed level. This coincides with a declining trend in landings (Figure no. 13.4.1) and survey abundance indices (Figure no. 13.4.5) over the same period.

The Azorean bottom longline survey targeting *Pagellus bogaraveo* is reliable for abundance estimates, since the survey design is adapted to the stock behaviour covering most of the species habitat (with exception of seamounts around Mid-Atlantic Ridge) (Table 13.4.3). Survey indices from 1995 to 2013 show no trend with a high value every three years until 2005 (Figure 13.4.5). These high values may be related with some sort of catchability variability (fish are more available to the gear in some years) as a function of the feeding behaviour (bentho-pelagic), reproduction (protandric forming spawning aggregations) of the species or due to environmental effects. However, the last four years of the survey abundance indices are on the range of lowest values with a decrease trend. This period correspond to the lowest catch observed during the last 19 years being on average 60% of the precedent years (1995–2009) (Figure 13.4.1). Survey abundance indices of mature and immature follows the same trend of the total abundance estimates (Figure 13.4.6).

Annual mean length data from the fishery and from the survey follow a similar trend (Figure 13.4.7). An increase on the mean length by year, with interannual variability, is observed, particularly on the landings time-series.

Mean length of mature stock for the entire period (1995–2013) is around 37 cm (Figure 13.4.8) and immature about 25 cm (Figure 13.4.9) Mature fish mean length increased from 36 cm in 1995 to 40 cm in 1999 and decreased thereafter until 36 cm. Variance of the estimates is high and no trend is seen on the whole time-series. However, there is a decreasing trend in mean length of mature females over the last 15 years (Figure 13.4.11).

No analytical assessment was carried out this year.

Exploratory analysis

Trend of mature females

Following the stock annex methodology mature female abundance and mature female mean length was computed from survey and fishery length compositions (assuming females knife-edge maturity at the 30 cm FL). Results show that proportion of mature females on both, survey and fishery dataseries, appears to maintain stable until 2009 and decrease thereafter (Figure 13.4.10). Mean length results however, shows a decrease trend since 1999–2000 (Figure 13.4.11).

Natural mortality (M)

Estimation of natural mortality (dependent or independent of the population structure by length) for the species was explored, by reviewing the life history and using indirect methods collected from the literature (WD Silva *et al*., 2015). The indirect methods (M constant for all ages or lengths) collectively provided a very broad range of M estimates (0.11–0.94 per year; Figure 13.4.12). The overall mean natural mortality is around 0.3 per year (std=0.16). About 42% of the selected methods estimated mean M values around 0.2 per year. Sensitivity analysis show an overall range of estimates between 0.15 and 0.9 per year for indirect methods. Variability on the input life-history information introduced variability on the M estimates by method, overestimating or underestimating the predicted mean value in function of the type of the relation between M and the variable for a particular method. For example longevity base methods are inversely related with M (M decreases as T_{max} increase). High M estimates are observed for the same methods, e.g. Roff (1984) and Groeneveld (2000). With the exception of this two methods the overall estimates range from 0.1 to 0.5.

Predictions for the M by age (length or weight) dependent methods show, as expected an exponential decrease with age (length or weight). The M range values predicted by this methods are similar to the indirect methods when considering the ages (length or weight) of the fully recruited individuals to the red sea bream fishery ($t \geq tc$). Although a wide ranges of values predicted they include the current M used (0.2).

Total mortality (Z)

Fishery age compositions were used to estimate total mortality (Z) by year applying the catch curve method (Sparre and Venema, 1997) (WD Pinho *et al.*, 2015). Age–length compositions were compute by converting length to age using Age–Length Keys from the survey age readings for the period 1995–2013. Survey data were used because they cover a longer period than DCF data with age interpretation made by the same reader. A pseud cohort (equilibrium) approach was used, considering that the annual population structure is approximately the same as the cohort along life. Age–length keys cover the age range between 1 and 15. We use data from age 1 to 8, considering age 9 as a plus group because very small numbers of individuals are observed annually on the age range 9–15. Fishing mortality (F) was then estimated assuming a constant value of natural mortality (M=0.2) for the full recruited age interval. An annual mean exploitable biomass (B) was then estimated from the catch equation ($\bar{B}$=Y/F) and the annual trend was compared with the abundance indices from the longline survey.

Results show that annual Fishing mortality (F), presented an increase trend but with high fluctuations, with peaks during 1996–1997, 2003–2004, 2008 and 2011–2013 (Figure 13.4.13). Estimates of fishing mortality, lower than the adopted value of natural mortality (M=0.2) were observed for the period 2000–2002. Sensitivity analysis show that mortality estimates can vary according the age range selected for the regression, however, the same general increase trend is observed.

The estimated exploitable biomass, assuming the annual fishing mortality computed from the catch curve, correlated too well with the survey abundance estimates except for the years 2000 and 2001 (Figure 13.4.14). This result suggests that annual fishing mortality (F) is inversely correlated with the abundance observed each year with low mortality in the years of high abundance and vice versa. It also suggest that the variability of the total landings is in phase with the variability of the survey abundance indices. The source of this variability is not well understood but it appears that a change on the availability of the resource to the gear occurs in some years. The current mortality estimated (F=0.6–0.7) from the catch curve analysis for the recent years (2011–2013) is too high when compared to the stock natural mortality (M=0.2). An average fishing mortality of F=0.4 is estimated for the mean period of 1995–2013.

Yield per recruit

Length-based yield per recruit formulation (Thompson and Bell type) was used to explore the optimal exploitation pattern for this species (WD Pabon *et al.*, 2015). Two basic hypotheses were assumed for the analysis: hypotheses 1 consist on runs assuming logistic hook selectivity for *Pagellus bogaraveo* and independent length natural mortality (M constant for all lengths) and hypotheses 2 by considering logistic hook selectivity but with dependent length natural mortality (different M by length). A constant natural mortality of M=0.2 was used and for variable natural mortality variable by length was used the formulation suggested by Gislason *et al*. (2010). All the computations were performed using a multiplier of the current level assumed for the fishing mortality (varying F_{factor} between 0 and 2, step 0.001). For each analyse a set of variables where computed from each simulation and per recruit curves constructed and resumed in a graph, showing yield (Y/R), exploitable biomass (B/R) and females spawning biomass (SSB/R) evolution by fishing mortality or length of first capture (L_c). Input data used on the YPR analysis are resumed in Tables (13.4.4 and 13.4.5).

A set of reference points were computed: Y_{MAX}; $F_{0.1}$ and F_{SPR}, and the correspondent values of exploited biomass (B_x), spawning biomass (SSB_x), fishing mortality (F_x) or yield (Y_x) according each case (x). For the $F_{0.1}$ estimates we follow the procedure suggested by Cadima (2003), presenting whenever possible the "Fo.1 curve" (U) on the graphs. For the spawning potential ratio (SPR) we estimate the fishing mortality that reduces the SSB between 20 and 40% of the pristine level following the suggestions of Mace and Sissenwine (1993). Additionally the maximum sustainable yield (Y_{MAX}) in value (euros), and the correspondent F, B and SSB, was computed in order to address economic aspects.

Finally a long-term projections for different exploitation patterns was made by assuming working hypothesis 1 but with knife edge on the selectivity, simulating the effect of the adoption of different lengths of first capture (LC) and assuming constant M=0.2 for all lengths.

Results for the basecase (assuming current exploitation pattern and constant M=0.2 for all lengths) are resumed in Figure (13.4.15). The model is not able to estimate adequately fishing mortality correspondent to maximum sustainable yield (F_{MAX}) because the flat top nature of the yield per recruit curve. The estimated F_{MAX} value is 74% above the current level of fishing mortality. At this level the total exploitable biomass (B/R) is about 24% of the pristine level and females spawning biomass (SSB/R) about 6%. Considering as sustainable the fishing mortality for which exploitable spawning biomass (SSB/R) is at least above 20% of the pristine level F_{MAX} is not considered a useful reference point for this species.

The stock at the current fishing mortality (F_{curr}=0.4) is considered unsustainable at long term because the exploitable spawning biomass (SSB_{curr}/R) is about 13% of the pristine level. Total exploitable biomass (B_{curr}/R) estimated by the model at F_{curr} is about 30%. However, considering that the species is a protandric hermaphrodite the female SSB may be depleted at this fishing mortality because the skewed sex ratios in favour of males due to size selective fishing. Values of SSB about 30% depletion of pristine level are estimated for the $F_{0.1}$ reference point (which results are similar to F30%). The fishing mortality value estimated for the $F_{0.1}$ (F=0.18) is near the value of the natural mortality (M=0.2). Adopting $F_{0.1}$ as a long-term reference point YPR results suggests that the stock is overexploited since current fishing mortality is 53% above this level of fishing mortality (Figure 13.4.15). This reduction from F_{curr} to $F_{0.1}$ corresponds to an increase in SSB of about 129%. Adopting the natural mortality variable by length do not change this overexploitation perception of the stock implying only a reduction on the stock variables like Y/R, B/R or SSBB/R to about 50%.

Isopleths describing YPR, B/R and SSB/R for different values of F and Lc are shown in Figures 13.4.16, 13.4.17, and 13.4.18. YPR increase very rapidly at low values of F over most of Lc above which YPR is asymptotic. Maximum YPR is reached at high F_{factor} levels, between 1 and 1.7 (F=0.4 and 0.7 respectively). At higher Lc (Lc>30 cm FL) maximum YPR was not attained. About 80–90% of maximum YPR is attained at low fishing mortality level F<0.2.

In summary, the results show that if we intend to maintain the actual hook size (correspondent to length of first capture Lc=30 cm FL) there is considerable advantage in reducing the current fishing mortality between 47% and 53% to maintain the fishing mortality at the level of $F_{20\%}$ and $F_{0.1}$ respectively (correspondent to SSB/R depletion between 20 and 30% of the unexploited level). This option corresponds to a considerable increase in the females SSB/R (between 129% and 190% respectively).

If we intend to maintain the current fishing mortality (F_{curr}=0.4 year^{-1}) there is an advantage to change the current length of first capture from 30 cm FL to 35 cm FL increasing the females SSB/R. Under this option the SSB/R for the F_{curr} and Lc=35 cm is about 24% of the unexploited SSB, which is considered the minimum SSB/R depletion level for the sustainability. This option imply a reduction of 2% on the Y/R at long term but with an increase of 80% on the females SSB/R. No relevant difference is observed on the perception of the stock status when variable natural mortality (M) by length is used (hypothesis 2) (WD Pabon *et al.*, 2015). However, about half of the amounts are estimated for the different characteristics of the stock at long term (Y/R, B/R and SSB/R). No maximum YPR is attained under this M profile. The $F_{0.1}$ is attained around 0.15 and almost do not change over different lengths of first capture (Lc).

Comments on the explanatory analysis

The working group notes the considerable effort developed on the exploratory analysis made for this stock during this year. The working group notes however that the spawning biomass may be overestimated because the sex change is not take in account on the modelling. Work to address this aspect on the modelling is highly recommended to better improvement of the advice.

13.4.7 Management considerations

TACs should be consistent with catches in recent years.

13.4.8 References

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Table 13.4.1. Historical landings of *Pagellus bogaraveo* from the Azores (ICES Area Xa2).

YEAR	AZORES (XA2)	TOTAL
1980	415	415
1981	407	407
1982	369	369
1983	520	520
1984	700	700
1985	672	672
1986	730	730
1987	631	631
1988	637	637
1989	924	924
1990	889	889
1991	874	874
1992	1090	1090
1993	830	830
1994	989	989
1995	1115	1115
1996	1052	1052
1997	1012	1012
1998	1119	1119
1999	1222	1222
2000	947	924
2001	1034	1034
2002	1193	1193
2003	1068	1068
2004	1075	1075
2005	1113	1113
2006	958	958
2007	1063	1070
2008	1089	1089
2009	1042	1042
2010	687	687
2011	624	624
2012	613	613
2013	692	692
2014	663	663

Table 13.4.2. Standardized bottom longline fishery abundance index (cpue) of the backspot sea bream (*Pagellus bogaraveo)* in Subarea X.

Year	Nominal cpue	Standardized cPUE	CV
1990	0.895	0.803	0.24
1991	1.063	0.903	0.25
1992	1.610	0.865	0.27
1993	0.753	0.819	0.23
1994	0.963	0.900	0.23
1995	0.892	1.063	0.23
1996	1.181	1.245	0.25
1997	1.213	1.125	0.24
1998	1.073	1.058	0.25
1999	0.734	0.750	0.26
2000	0.549	0.398	0.26
2001	0.794	0.810	0.24
2002	0.943	0.866	0.25
2003	0.842	0.911	0.24
2004	1.058	1.122	0.24
2005	1.400	2.022	0.23
2006	1.092	1.163	0.24
2007	1.194	1.474	0.25
2008	1.010	1.220	0.26
2009	1.217	0.957	0.24
2010	0.523	0.526	0.23
2011	0.450		
2012	0.481		
2013	0.581		

Table 13.4.3. Survey relative abundance index in number of *Pagellus bogaraveo* from the Azores (ICES Area Xa2).

Year	RPN	CV
1995	127,0	0,10
1996	41,7	0,10
1997	62,1	0,12
1998	na	na
1999	141,5	0,13
2000	68,9	0,12
2001	84,3	0,07
2002	151,9	0,05
2003	97,5	0,10
2004	106,2	0,13
2005	186,7	0,08
2006	na	na
2007	93,2	0,15
2008	101,7	0,09
2009	na	na
2010	80,5	0,10
2011	87,9	0,12
2012	83,80	0,08
2013	61,05	0,11
2014	na	Na

Table 13.4.4. Input constant parameters used in Yield-per recruitment analysis for *Pagellus bogaraveo* of the Azores (ICES Area X).

PARAMETERS	VALUE	DEFINITION	OBS.
L_{oo} (cm)	56,72	Asymptotic average maximum length	ICES, 2012
K (year^{-1})	0,13	Growth coefficient of the von Bertalanffy growth model	ICES, 2012
T_o (year^{-1})	-1,46	Hypothetical age at which the species has zero length	ICES, 2012
a=	0,0172	Condition factor parameter of length–weight relationship	Rosa *et al*., 2006
b=	3,0273	Slope parameter of length–weight relationship	Rosa *et al*., 2006
L_{max} (LF, cm)	55	Maximum length usually observed on the population (not the max ever observed).	Pinho *et al*., 2012
L_r (LF,cm)	20	Length of recruitment to the fishing area	
T_r (year^{-1})	2	Age of recruitment to the fishing area	
L_c (LF, cm)	30	Length of first capture to the fishery ($L_{50\%}$ from selectivity curve)	Sousa *et al*., 1999
T_c (year^{-1})	4	Age of first capture to the fishery (age at $L_{50\%}$)	
M	0,2	Natural mortality	ICES, 2006
$Z_{current}$	0,6	Current total fishing mortality	Pinho *et al*., 2015
$F_{current}$	0.40	Current fishing mortality	Pinho *et al*., 2015

Table 13.4.5. Length specific input parameters used in the yield per recruit analysis for *P. bogaraveo* of the Azores (ICES Area X). Selectivity (si) of the gear (Sousa *et al.*, 1999); females sex-ratio for the period 1982–1991 (% Females) from Krug (1998) as computed by Pinho (2003); Maturation females for the year 1991 from Krug (1998) as computed by Pinho (2003).

Length	si	% Females	Maturation	Price per Kg (€)	Length	si	% Females	Maturation	Price per Kg (€)
20	0,000	0,055	0,000	2,4	38	0,985	0,605	0,985	13
21	0,000	0,065	0,001	2,4	39	0,985	0,648	0,992	13
22	0,000	0,077	0,002	2,4	40	0,985	0,688	0,996	13
23	0,000	0,091	0,003	6,6	41	0,985	0,726	0,998	13
24	0,001	0,108	0,006	6,6	42	0,984	0,760	0,999	13
25	0,002	0,126	0,011	6,6	43	0,984	0,792	0,999	13
26	0,007	0,148	0,021	6,6	44	0,984	0,820	1,000	13
27	0,021	0,172	0,041	6,6	45	0,984	0,845	1,000	13
28	0,063	0,200	0,076	6,6	46	0,983	0,868	1,000	13
29	0,173	0,230	0,138	6,6	47	0,983	0,887	1,000	13
30	0,393	0,264	0,238	6,6	48	0,983	0,904	1,000	13
31	0,664	0,301	0,378	6,6	49	0,982	0,919	1,000	13
32	0,853	0,340	0,541	6,6	50	0,982	0,931	1,000	13
33	0,939	0,382	0,696	6,6	51	0,982	0,942	1,000	13
34	0,970	0,426	0,817	13	52	0,981	0,951	1,000	13
35	0,981	0,471	0,897	13	53	0,981	0,959	1,000	13
36	0,984	0,516	0,944	13	54	0,980	0,966	1,000	13
37	0,985	0,561	0,970	13	55	0,980	0,971	1,000	13

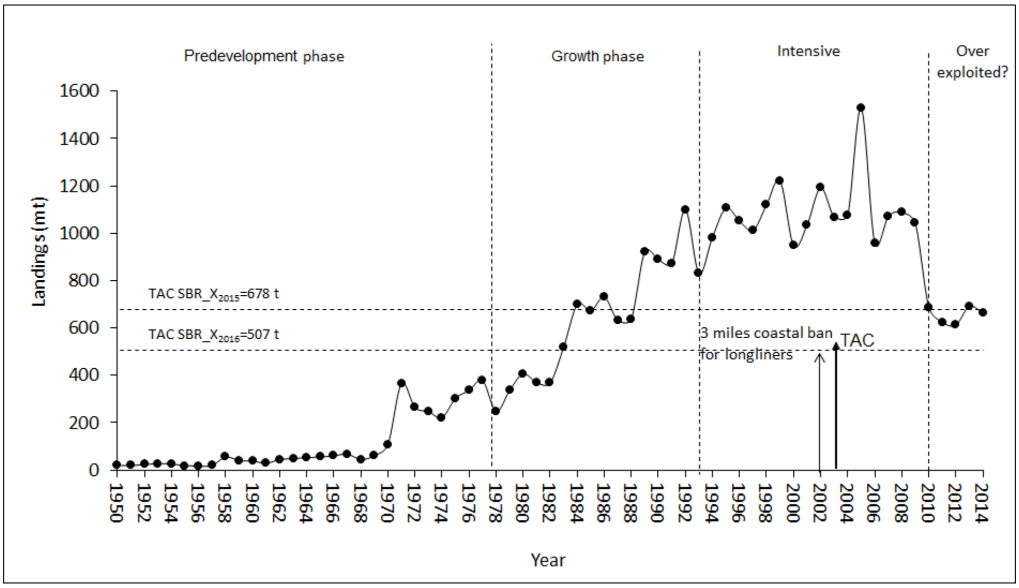


Figure 13.4.1. Historical landings of *Pagellus bogaraveo* from the Azores (ICES Area Xa2). Main technical management measures introduced to the fishery are also shown on the graph.

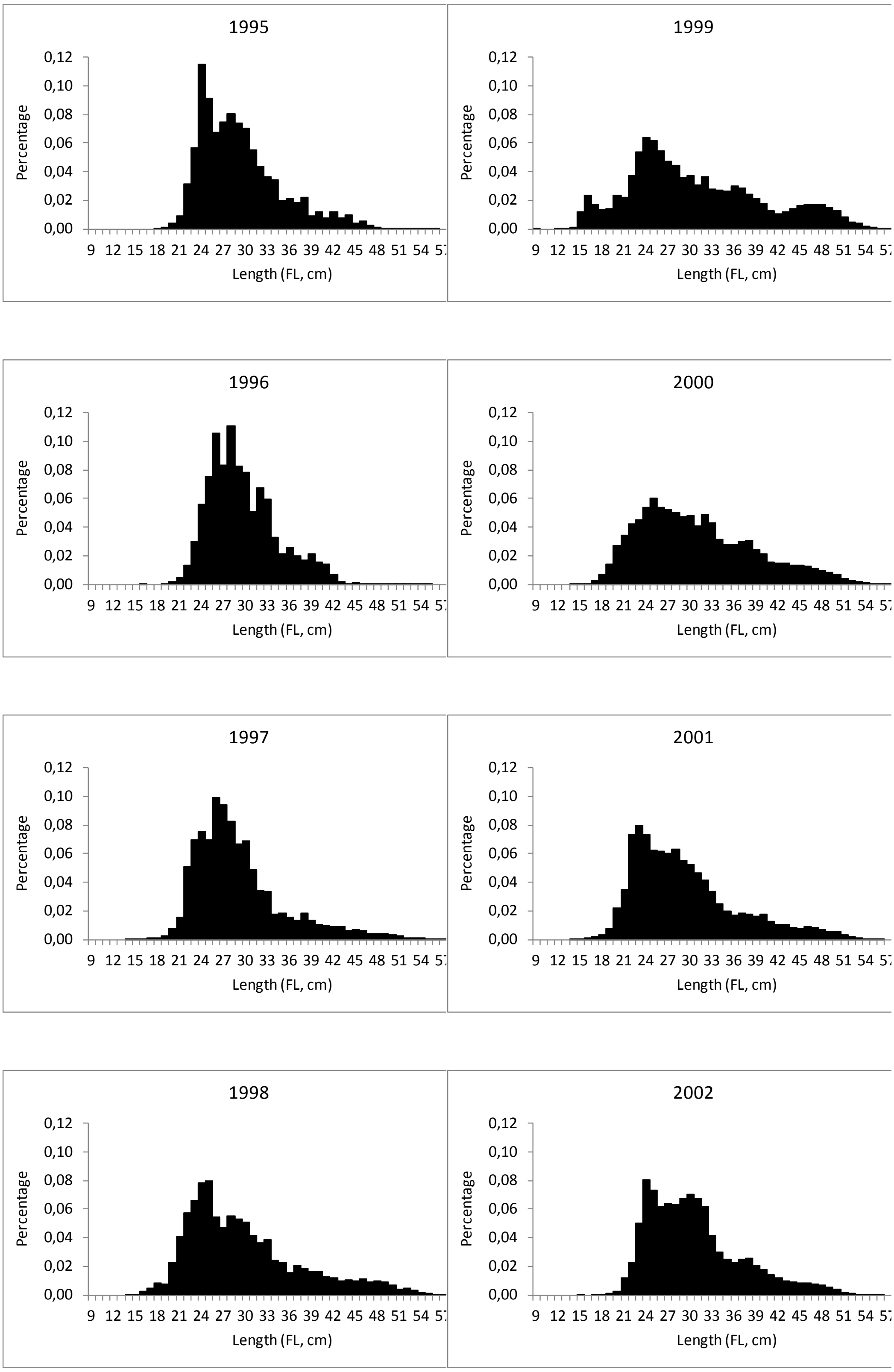


Figure 13.4.2. Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1995–2013 (ICES Area Xa2).

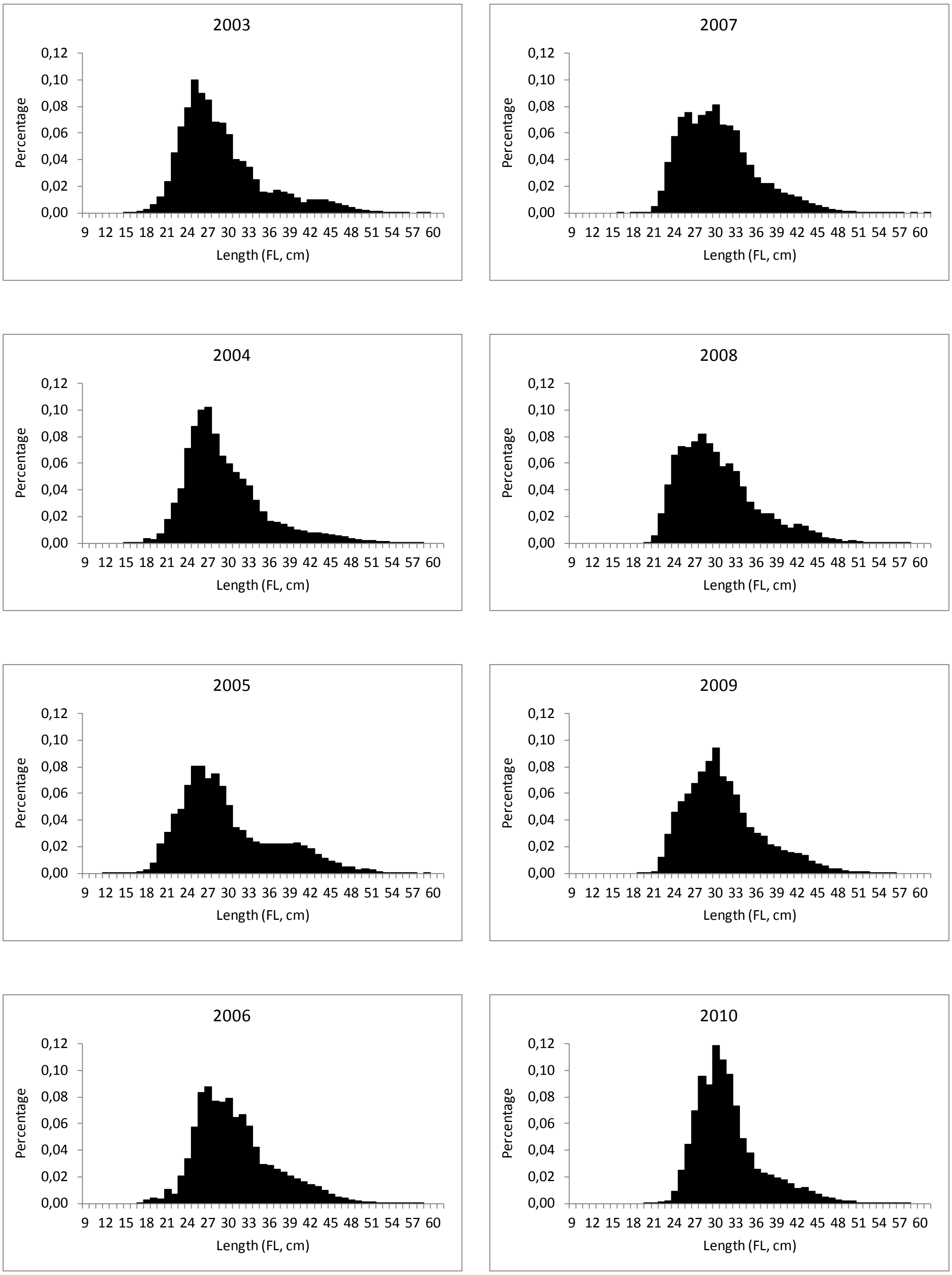
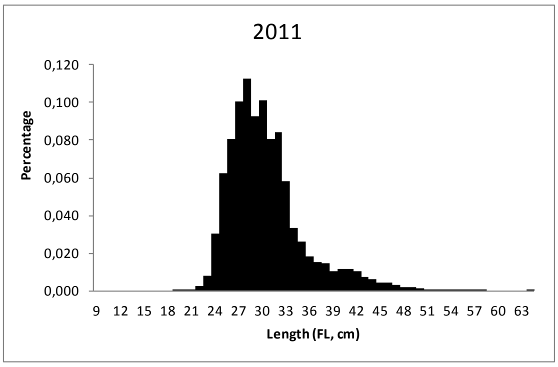
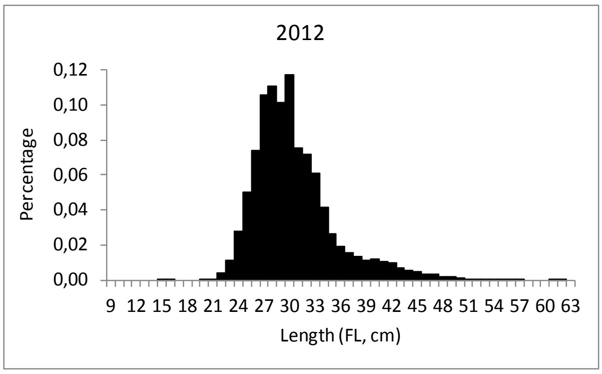


Figure 13.4.2. (Cont.). Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1995–2013 (ICES Area Xa2).





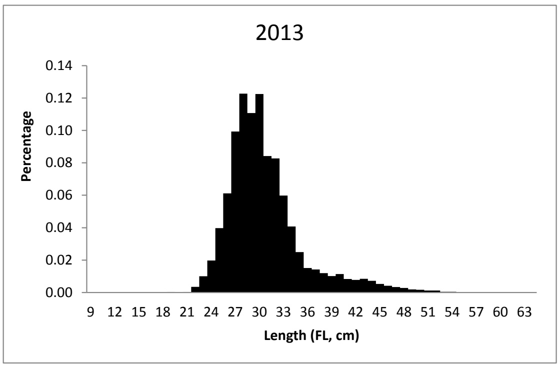


Figure 13.4.2. (Cont.) Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1995–2013 (ICES Area Xa2).

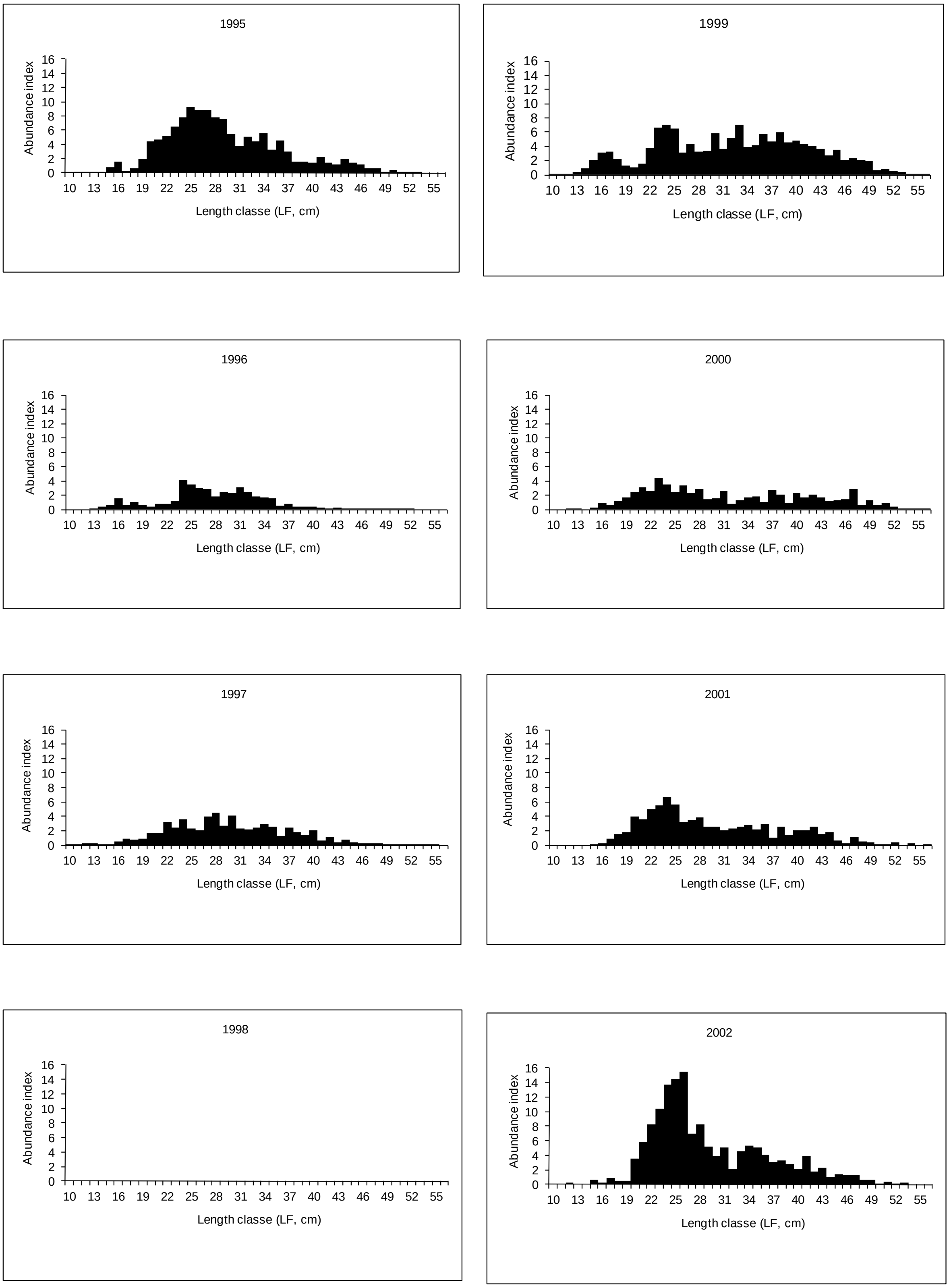


Figure 13.4.3. Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 1995–2003 (ICES Area Xa2).

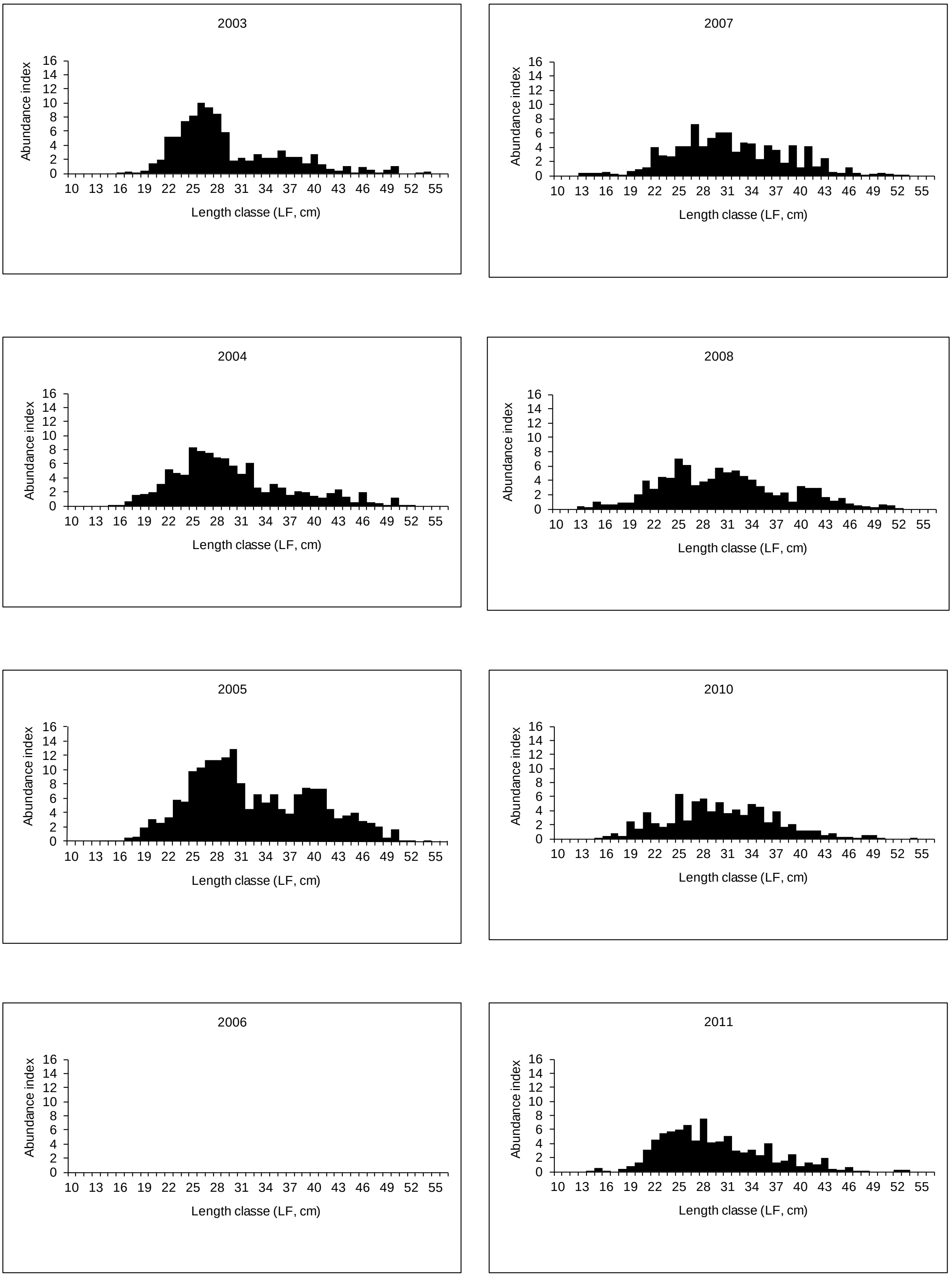


Figure 13.4.3. (Con't). Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 1995–2013 (ICES Area Xa2).

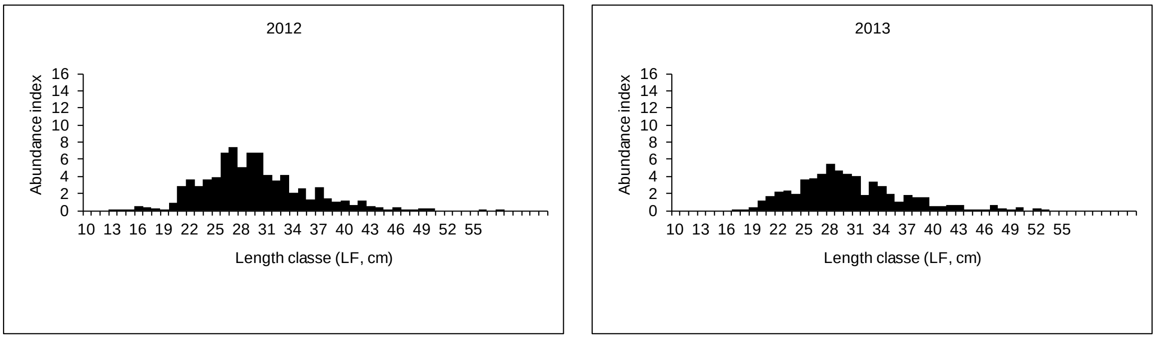


Figure 13.4.3. (Con't) Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 1995–2013 (ICES Area Xa2).

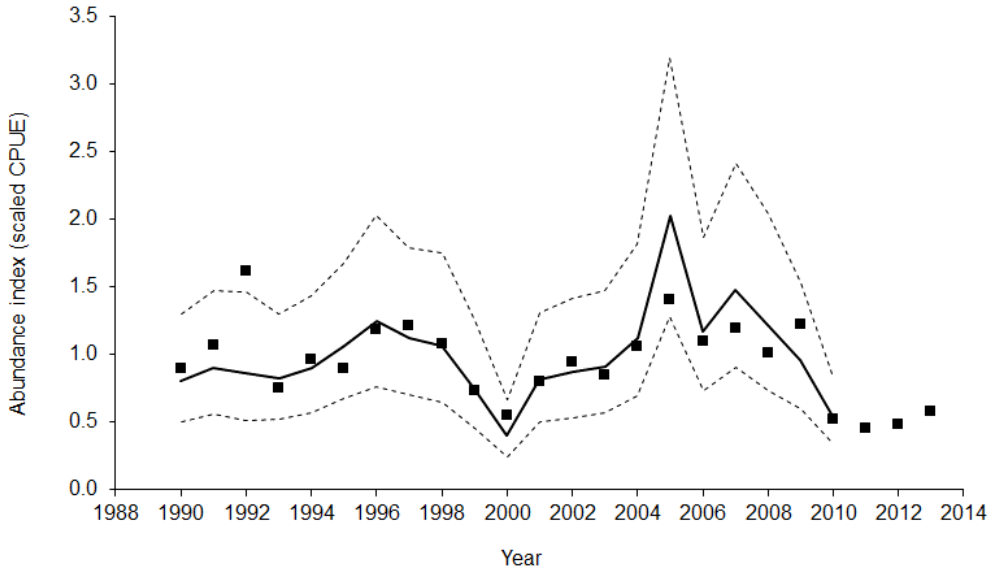


Figure 13.4.4. Standardized fishery catch rates of *Pagellus bogaraveo* from ICES Area Xa2. In the graph are shown the nominal cpue (squares), standardized cpue (solid line) and confidence intervals (dashed line).

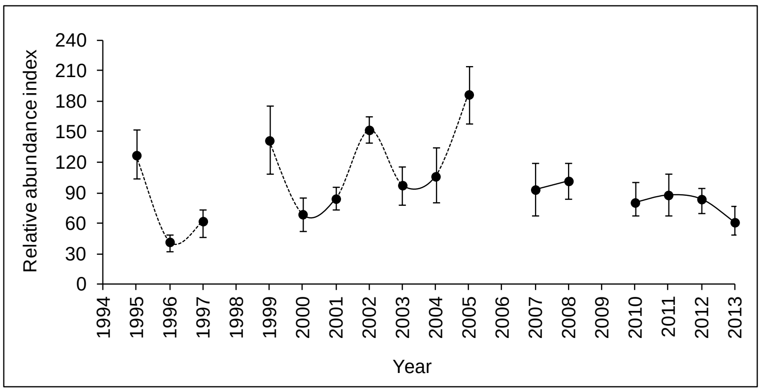


Figure 13.4.5. Annual abundance in number (Relative Population Number) and in weight (Relative Population Weight) of *Pagellus bogaraveo* from surveys for ICES Area Xa2.

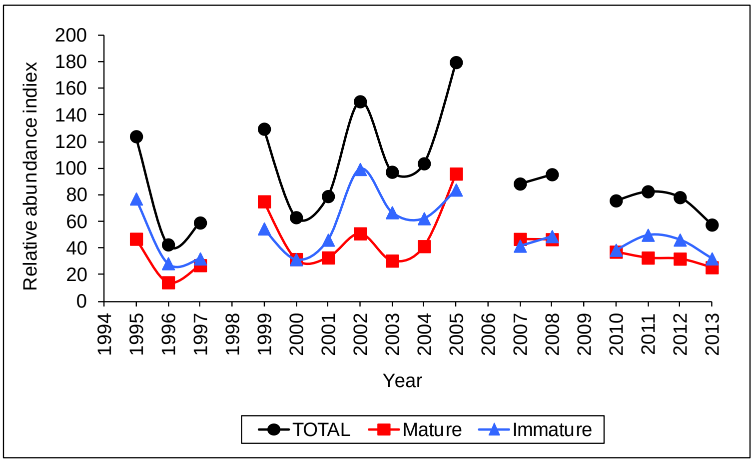


Figure 13.4.6. Survey abundance indices for mature and immature stock.

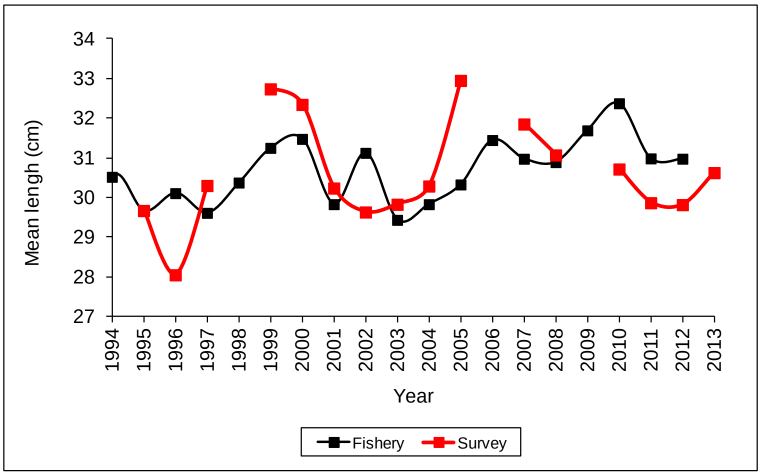


Figure 13.4.7. Annual mean length from the fishery (1990–2010) and from survey length compositions (1995–2008).

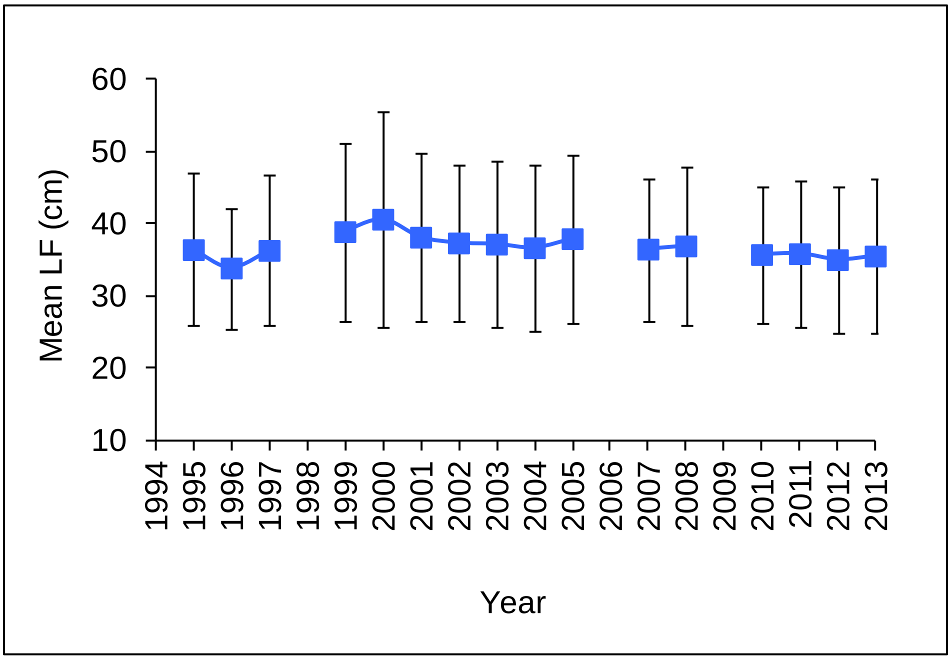


Figure 13.4.8. Annual mean length of mature individuals from the Azorean longline survey.

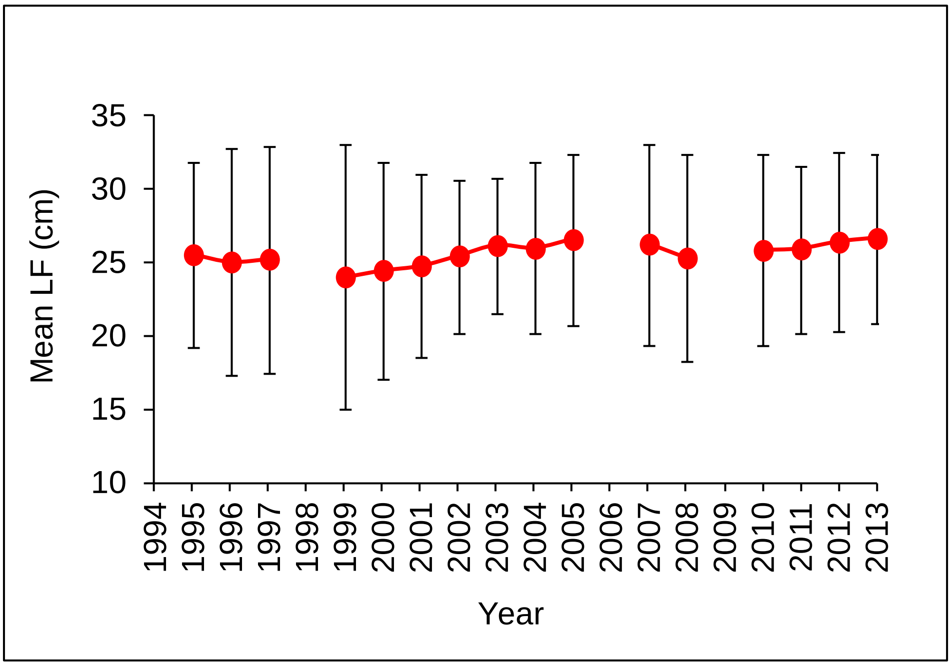


Figure 13.4.9. Annual mean length of immature individuals from the Azorean longline survey.

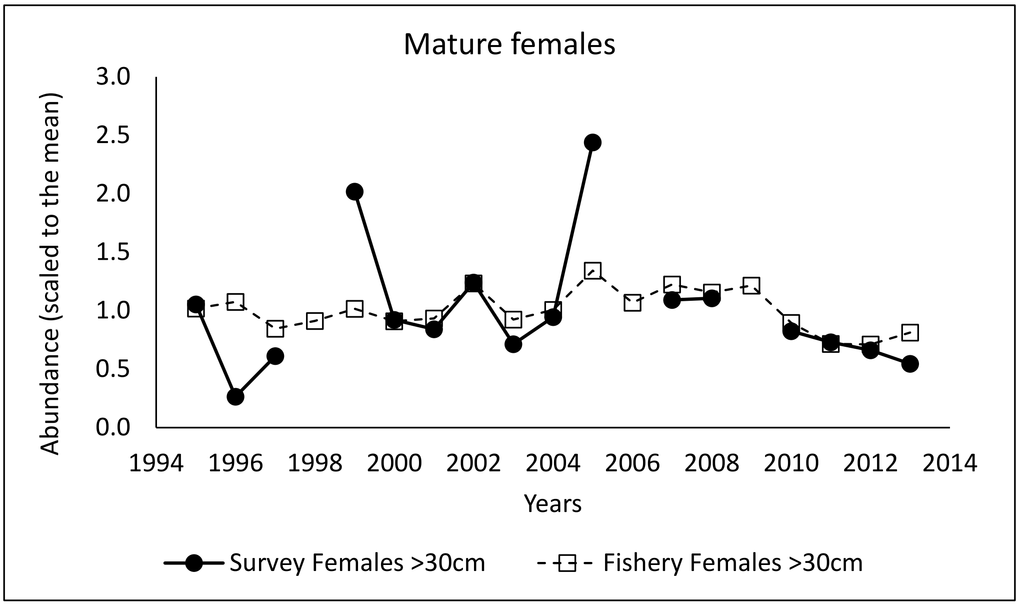


Figure 13.4.10. Survey and fishery abundance for mature female stock.

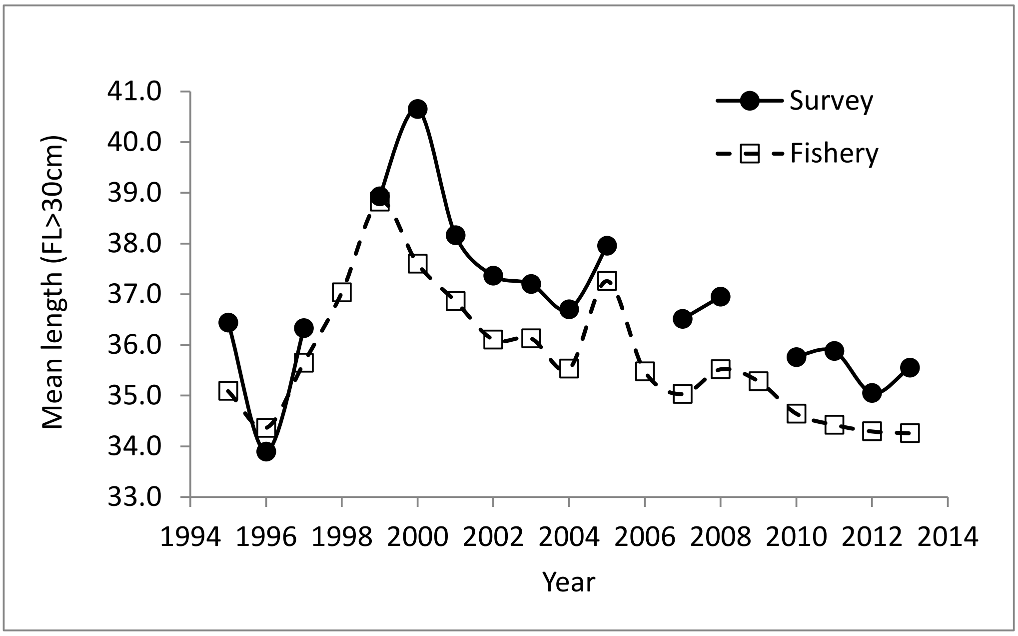


Figure 13.4.11. Annual mean length of mature female individuals from the Azorean longline survey and fishery.

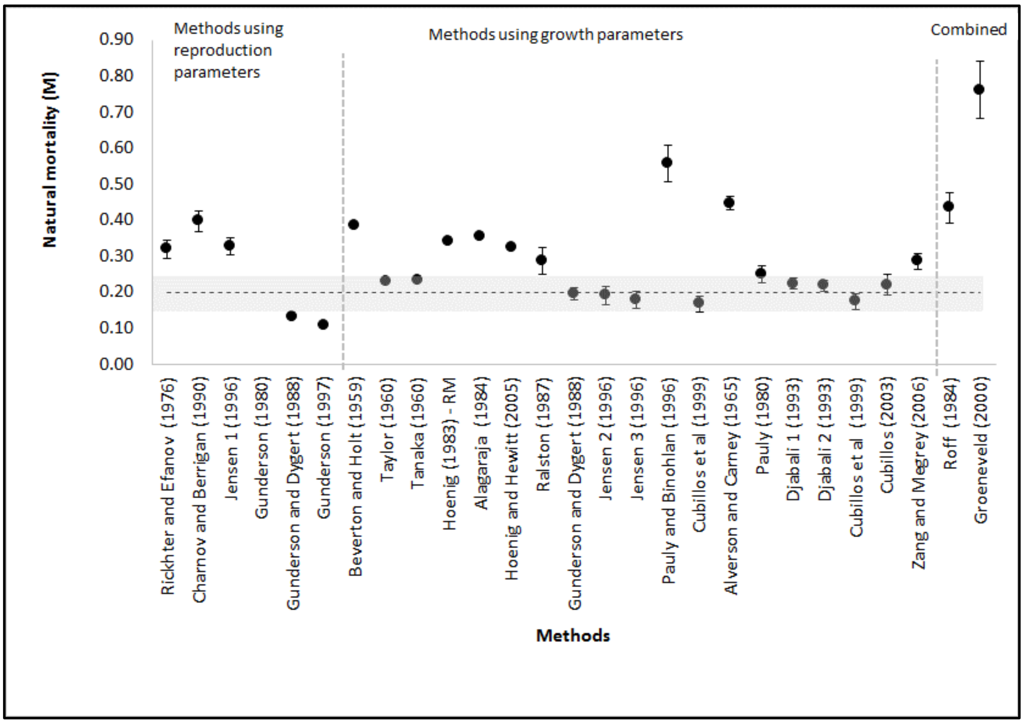


Figure 13.4.12. Natural mortality estimates, using indirect methods, for red blackspot sea bream (*Pagellus bogaraveo*) from the Azores (ICES Area X). Dashed line represents the value of M=0.2 historically used for stock assessment. Shading area represents 20% deviation interval of M=0.2.

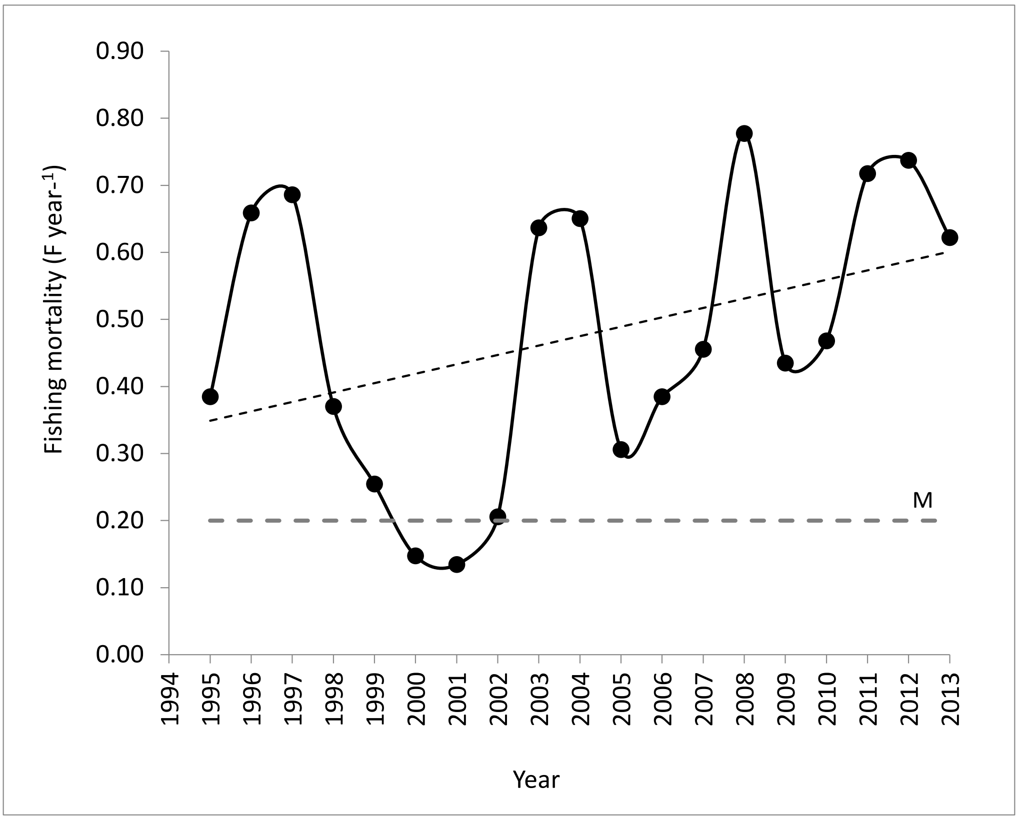


Figure 13.4.13. Annual evolution of fishing mortality (F) estimated for *Pagellus bogaraveo* fishery of the Azores (ICES Xa2) using catch curve analysis. Black dashed line shows the trend and grey line shows the value of natural mortality (M=0.2) traditionally used in the assessments.

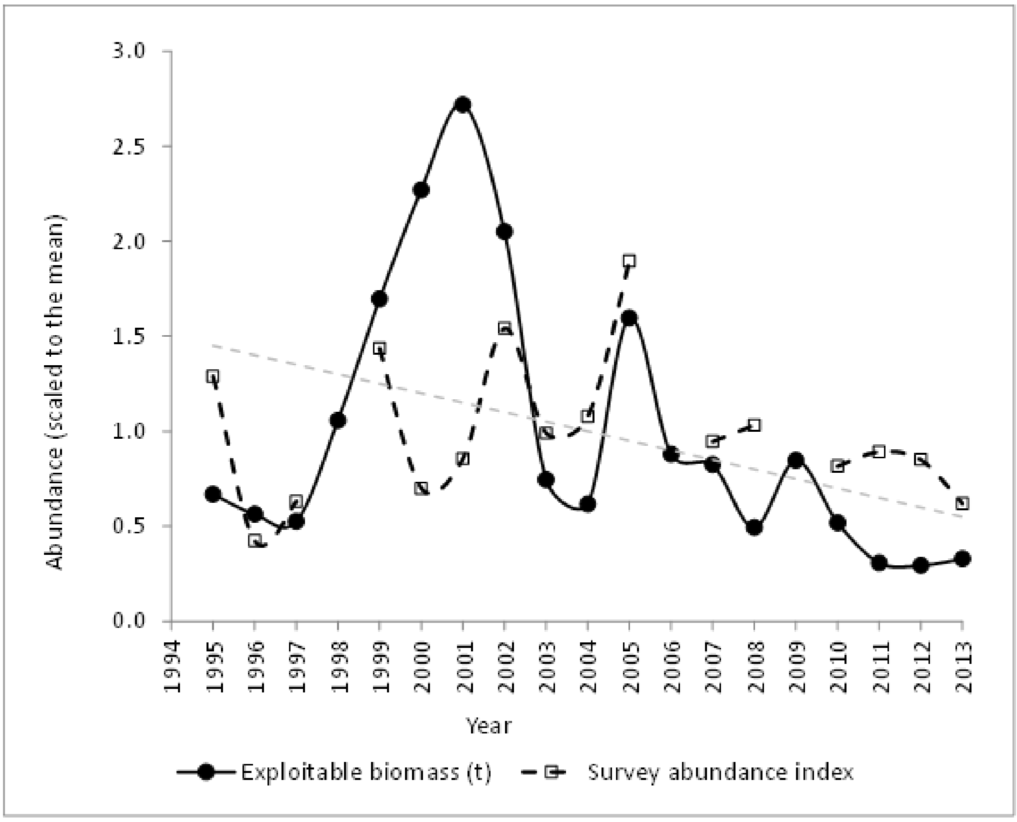


Figure 13.4.14. Annual biomass estimates from the catch curve analyses. On the graph are also shown for trend comparison the survey abundance index estimates for the same period. Grey dashed line shows the trend of the exploitable biomass.

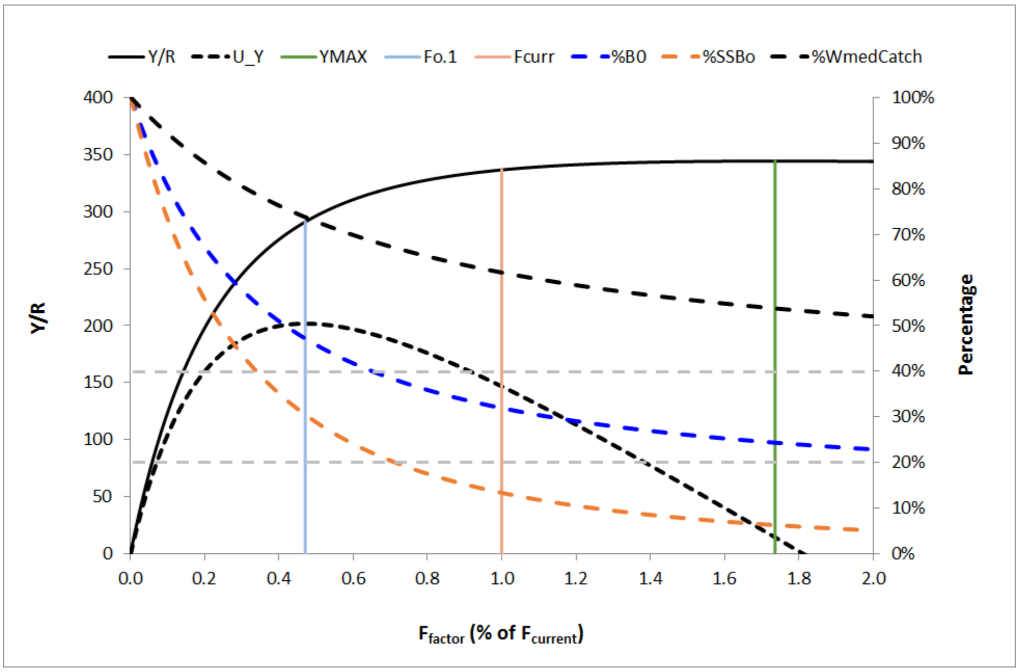


Figure 13.4.15. Yield per recruit analyse for the current exploitation pattern and M=0.2 constant for all lengths. Horizontal dashed grey line represents the 20–40% Spawning Potential Ratio range.

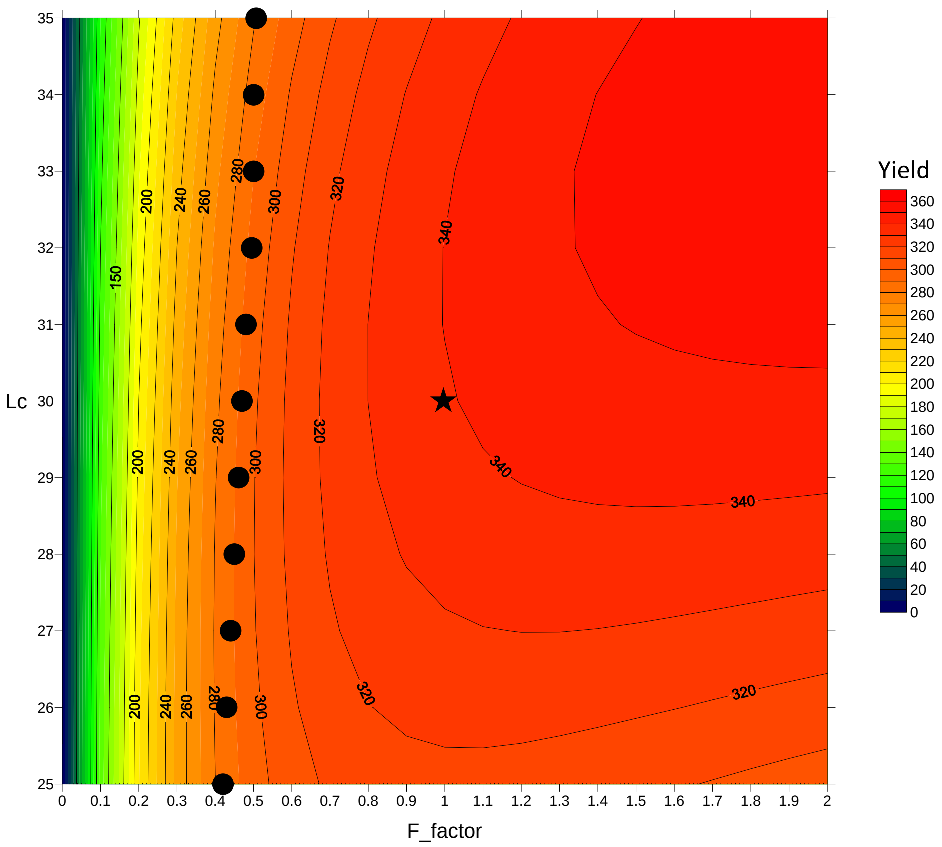


Figure 13.4.16. Yield per recruit isopleths for the assumption of M constant for all lengths. Dots indicate $F_{0.1}$ values estimated for each Lc and the star indicate the $F_{current}$ for Lc= 30 cm.

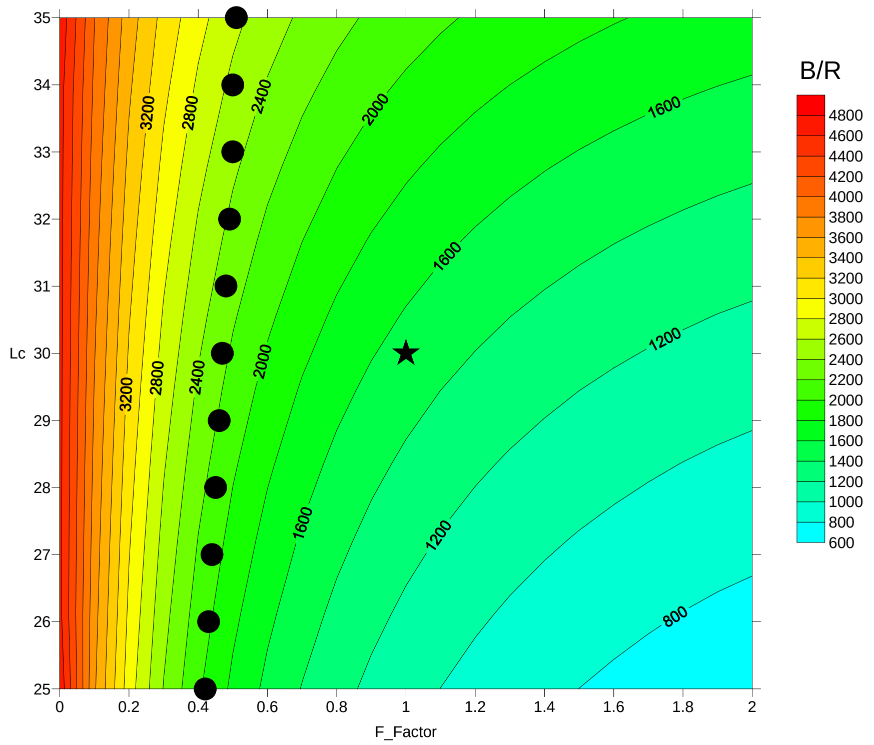


Figure 13.4.17. Biomass per recruit isopleths for the assumption of M constant for all lengths. Dots indicate $F_{0.1}$ values estimated for each Lc and the star indicate the $F_{current}$ for Lc= 30 cm.

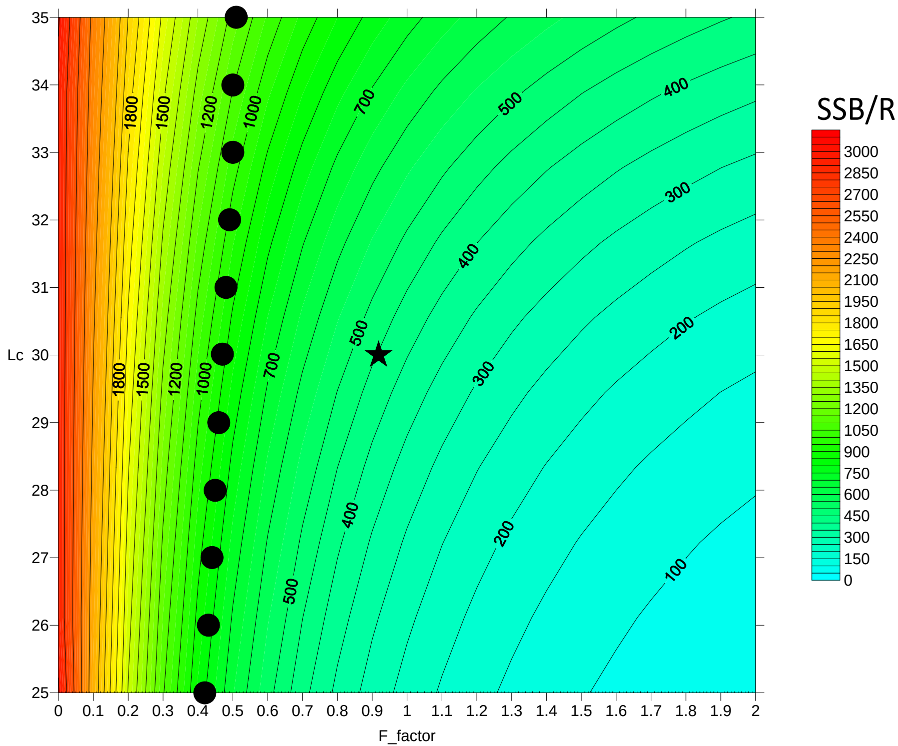


Figure 13.4.18. Spawning biomass per recruit isopleths for the assumption of M constant for all lengths. Dots indicate $F_{0.1}$ values estimated for each Lc and the star indicate the $F_{current}$ for Lc= 30 cm.

14 Roughhead grenadier (*Macrourus berglax*)

14.1 Stock description and management units

Currently there are neither stock description nor management units described for this species.

14.2 Roughhead Grenadier (*Macrourus berglax*) in NEAFC and Division V

14.2.1 The fishery

Roughhead grenadier has very low commercial value and the scarce landing data available correspond mostly to landed bycatch. However, there are recent records of unusually large catches (>500 t) in Divisions VI, XII and XIV.

Roughhead grenadier is mostly caught with bottom trawl but catches from XIV and XIIa are from the Spanish fleet targeting redfish and were taken with pelagic trawl, a GLORIA type in the first year (2010) and a modified Alfonsinos pelagic trawl in the following years.

The Spanish fleet fishing grenadiers in MAR consists of ten trawlers with an average length of 62 m and average GRT of roughly 1000 t, although the maximum number of ships present in the fishing ground in any given year is seven. This fleet alternates the redfish and grenadier fisheries. Most landings are taken in XIVb1, where the fishing season lasts between three and seven months. Effort and catches peak in late spring and early summer.

14.2.2 Landings trends

Because there is no stock defined or management units, this section describes the landing data available for the different ICES divisions.

In I and II there are landing records since 1990, year with the highest catch, about 600 t. Landings have declined significantly and since 2005 they are in the range of 30 to 50 t. Most landings correspond to Norway, followed by far by Russia. Landings from France are occasional and negligible, below 0.5 t most years (Table 14.2.1).

Landing records from III and IV also start in 1990 and they are very low, peaking in 2005 at 39 t. The remaining years landings oscillated from 0 to 10 t. They correspond mostly to Norway. France, UK (Scotland) and Ireland have also recorded landings in a few years (Va) (Table 14.2.2).

In Va, roughhead grenadier is occasionally caught and there are records of negligible landings since 1996 (Table 14.2.3.).

Landing data from Vb span from 1997 to 2013. The highest catch was 99 t in 1999, but the remaining years landings are <12 t (Table 14.2.4). The main fishing country is France, with Norway, UK and Russia registering negligible landings sporadically.

Landings from VI and VII correspond mostly to the demersal multispecific fishery in Hatton Bank. The series starts in 1992, with official landings peaking during the period 2005–2007, when they were in the range of 1000–2000 t. The remaining years landings were in the range 4 to 200 t, but mostly <50 t. Catches from these divisions are mostly from the Spanish freezer fleet. France has taken part in the fishery for a longer period but with much lower landings. Other minor participants in the fishery are Norway, UK, Ireland and Russia (Table 14.2.5).

There are hardly any records of roughhead grenadier from VIII, adding to just 8 tons caught by France in two years (Table 14.2.6).

Official landings in Division XII include landings from both the demersal multispecific fishery in Hatton Bank (XIIb) and the pelagic redfish and grenadier fishery in MAR (XIIa). The series starts in 2000, and peaked in 2005 at 2200 t. Most years however, landings were <500 t. Most of the landings correspond to the Spanish freezer fleet and the percentage recorded by Norwegian, Russian and French fleets is negligible (Table 14.2.7).

In XIV, landing records of roughhead grenadier date back to 1993, but it has traditionally been a very small fishery with landings peaking at 55 t in 2005 (Table 14.2.8). Norway and Russia have recorded landings more years than any other country, and Greenland and the UK have occasionally also recorded very small catches. The Spanish fleet commenced recently to record roughhead grenadier landings from this division, and official landing data range from 200 to 2700 t over the past five years.

14.2.3 ICES Advice

This is the first year that ICES gives advice for this species.

14.2.4 Management

There is no management plan for roughhead grenadier in NEAFC and Va. There has been no EU TAC for this species nor other species-specific management measure.

14.2.5 Data available

Landings and discards

Landing data are available from Divisions I and II since 1990, from III and IV since 1992, from Va since 1996, from Vb since 1997, from VI and VII since 1993, from VIII for 2002 and 2006, from XII since 2000, and from XIV since 1993.

There are some discard data for most years since 1996 from VI, XII and XIV, taken by Spanish scientific observers, onboard commercial Spanish trawlers. Discard rates, estimated as the discarded catch divided by kept catch, are high, averaging 0.77± 0.42 (mean ± standard deviation) for VI, 0.68 ± 0.23 for XII and 0.53± 0.50 for XIVb (Table 14.2.9).

14.2.5.1 Length composition of the landings and discards

No data available.

14.2.5.2 Age composition

No data available.

14.2.5.3 Weight-at-age

No data available.

14.2.5.4 Maturity and natural mortality

No data available.

14.2.5.5 Research vessel survey and cpue

Research vessel survey

The Icelandic autumn groundfish survey IS-SMH is the main source of fishery independent data for *M. berglax* in Icelandic waters. Further, data can be compiled from several other older surveys of exploratory nature.

The IS-SMH survey covers Icelandic shelf and slope at depths from 20 to 1500 m. It is a stratified systematic survey with standardized fishing methods. Small-meshed bottom trawls (40 mm in the codend) equipped with rock-hopper are towed at a speed of 3.8 knots for a predetermined distance of 3 nautical miles (See the Stock Annex for Greater Silver Smelt for a detailed description of methodology).

Cpue

The data available to WGDEEP only allow an estimation of non-standardised cpue for the Spanish fleet operating in VI, XII and XIV.

14.2.6 Data analyses

Not available.

14.2.6.1 Benchmark assessments

Not available.

14.2.7 Management considerations

The assessment is based on landing data and the reference period used for advice is 1992–2001. Later years are not considered because catches reported in some divisions are significantly larger than the historical landings and there is no additional information to confirm such catches (ICES, 2014).

Furthermore, information from scientific observers onboard and exploratory surveys in VI, XII and XIV indicates that the species is relatively scarce in the fishing grounds.

There are no biological data (length or age composition, weight-at-age, maturity, mortality) that could be used to assess changes in stock status.

Literature based mostly on survey data from Canadian waters indicates that this is a long-lived, slow-growing species, of low fecundity and vulnerable to overfishing (see Devine and Haedrich, 2008 and references therein, Gonzalez-Costas, 2010). Age estimations from otolith have found specimens of up to 23 years (Savvatimsky, 1984) and the species has been classified as of concern due to a decline of >90% of the survey index within Canadian waters over a period of 15 years (COSEWIC, 2007).

Thus no expansion of the actual fisheries should be permitted until enough data are collected from the exploited population to identify the stock and conduct an appropriate assessment.

14.2.8 References

COSEWIC 2007. COSEWIC assessment and status report on the roughhead grenadier *Macrourus berglax* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 40 pp.

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Table 14.2.1. Official landings (t) of Roughhead grenadier (*Macrourus berglax*) in I and II.

Year	Germany	Norway	Russia	France	TOTAL
1988					
1989					
1990	9	580			589
1991		829			829
1992		424			424
1993		136			136
1994					0
1995				1	1
1996				3	3
1997		17		4	21
1998		55			55
1999				<0.5	0
2000		35	13	<0.5	48
2001		74	20	<0.5	94
2002		28	1	<0.5	29
2003		47	30		77
2004		78	1		79
2005		64	13	<0.5	77
2006		74	4	<0.5	78
2007		44	5		49
2008		49	6		55
2009		51	2		53
2010		39	6		45
2011		29			29
2012		54			54
2013		34	1	1	36
2014					

Table 14.2.2. Official landings (t) of Roughhead grenadier (*Macrourus berglax*) in III and IV.

Year	France	Ireland	Norway	UK (SCO)	TOTAL
1991					
1992			7		7
1993					
1994					
1995					
1996	4				4
1997	5				5
1998	1				1
1999	<0.5				
2000	<0.5	1	3	<0.5	4
2001	<0.5	1	9		10
2002	<0.5		3	<0.5	3
2003	<0.5		2		2
2004	<0.5		<0.5	1	1
2005	1		38	<0.5	39
2006	<0.5				
2007					
2008					
2009					
2010				<0.5	
2011	2				2
2012	1			<0.5	1
2013	1				1
2014					

Table 14.2.3. Official landings (t) of Roughhead grenadier (Macrourus berglax) in Va.

Year	Iceland	TOTAL
1995		
1996	15	15
1997	4	4
1998	1	1
1999		
2000	2	2
2001	1	1
2002	4	4
2003	33	33
2004	3	3
2005	5	5
2006	7	7
2007	2	2
2008	<0.5	
2009	5	5
2010	22	22
2011	21	21
2012	16	16
2013	16	16
2014		

Table 14.2.4. Official landings (t) of Roughhead grenadier (*Macrourus berglax*) in Vb.

Year	France	Norway	UK (SCO)	Russia	TOTAL
1997	6				6
1998	9				9
1999	99				99
2000	1				1
2001	2	2			4
2002	3		<0.5		3
2003	12				12
2004	9		1		10
2005	6				6
2006	10				10
2007	3			2	5
2008	1			2	3
2009					
2010		1			1
2011					
2012	2		1		3
2013	2				2
2014					

Table 14.2.5. Official landings (t) Roughhead grenadier (*Macrourus berglax*) in VI and VII.

Year	UK (E+W)	France	Norway	UK (SCO)	Spain	Ireland	Russia	Unallocated	Total
1988									
1989									
1990									
1991									
1992									
1993	18								**18**
1994	5								**5**
1995	2	2							**4**
1996		13							**13**
1997		12							**12**
1998		10							**10**
1999		38							**38**
2000	<0.5	3		8					**11**
2001		2	27	16					**45**
2002		4	2	6					**12**
2003		8	2		1				**11**
2004		6		5	22				**33**
2005		6		2	1480				**1488**
2006		10		<0.5	1918	75			**2003**
2007		21			1141	18			**1180**
2008		2			122		**4**		**128**
2009		12		<0.5	198				**210**
2010		8		1	1		**1**		**11**
2011		3			1				**4**
2012		1		4	191				**195**
2013		2			179				**181**
2014					42				42

Table 14.2.6. Official landings (t) of Roughhead grenadier (*Macrourus berglax*) in VIII.

Year	France	TOTAL
2002	1	1
2003		<0.5
2004		
2005		
2006	3	3
2007		<0.5
2008		
2009		
2010		<0.5
2011		
2012		
2013		
2014		

Table 14.2.7. Official landings (t) Roughhead grenadier (*Macrourus berglax*) in XII.

Country	Norway	France	Spain	Russia	Unallocated	TOTAL
1999						
2000	7	<0.5				7
2001	10	<0.5				10
2002	7		1136			1143
2003	2	<0.5	223			225
2004	27	<0.5	725			752
2005		<0.5	2200	5		2205
2006		<0.5	968	8		976
2007			420			420
2008			73			73
2009	6		1			7
2010			1			1
2011			2			2
2012			526			526
2013			210			210
2014			164			164

Table 14.2.8. Official landings (t) of Roughhead grenadier (*Macrourus berglax*) XIV.

Country	Greenland	Norway	Russia	Spain	UK (E+W)	Unallocated	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**
2004		46	9				**55**
2005		30	10				**40**
2006		1	3				**4**
2007		6	9				**15**
2008			3				**3**
2009		3			1		**4**
2010		1	13	407	1		**422**
2011			27	237			**264**
2012		16	18	2687			**2740**
2013			32	803			**835**
2014*			11	448			**459**

(*) Preliminary data.

Table 14.2.9. Average discard rate (discarded catch / total catch), estimated from data collected by scientific observers onboard commercial trawlers.

Year	VIb	XIIa	XIIb	XIVb
1996			0.00	0.00
1997				
1998	0.42		0.56	
1999				
2000		1.00	0.41	0.12
2001	0.94		0.40	0.00
2002	0.79		0.50	1.00
2003	0.65		0.00	0.00
2004	1.00		0.97	
2005				
2006	0.33		0.00	
2007				
2008	0.00		0.04	
2009			0.00	
2010			0.17	
2011				0.13
2012				
2013	1.00		1.00	1.00
2014				
Mean	0.79	1.00	0.37	0.51

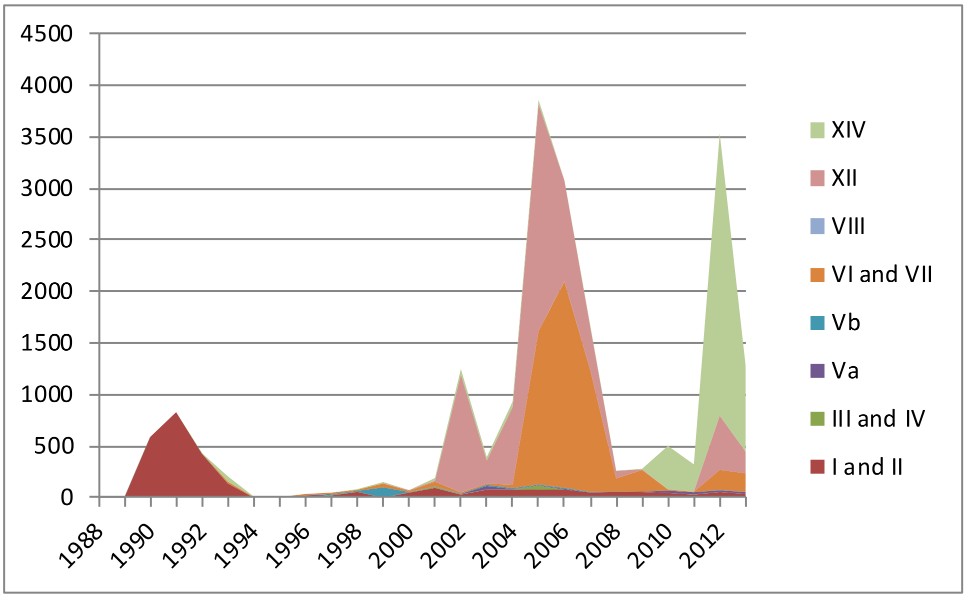

Figure 14.2.1 Reported landings of roughhead grenadier by ICES division and subarea.

15 Roundsnout grenadier (*Trachyrincusmurrayi*) in the Northeast Atlantic

15.1 Stock description and management units

There are taxonomic issues with this stock. The roundsnout grenadier (*Trachyrincus scabrus*) was formerly *Trachyrincus trachyrincus,* with various spellings. The rough-nose grenadier (*Trachyrincus murrayi*) is a closely related species that is abundant throughout the north of Northeast Atlantic (Jonsson, 1992). The scientific names and spelling of these species changed over time.

Along the slope to the west of Scotland in ICES Division VIa, only *Trachyrincus murrayi* was caught in surveys spanning depths from 500 to 2000 m and that took place in the 1970s and 1980s (Gordon and Duncan, 1984). In recent years, *Trachyrincus murrayi* is caught by the Marine Scotland deep-water research surveys in sufficient numbers to allow estimation of population indicators (Neat and Burns, 2010).

Published literature does not report the occurrence of *Trachyrincus scabrus* at significant level in northern areas of the Northeast Atlantic. In particular, there are no records of the species in surveys held along the Mid-Atlantic ridge (Fossen *et al*., 2008). In Icelandic surveys *Trachyrincus scabrus* does not occur but *Trachyrincus murrayi* is an abundant species.

T. scabrus has been reported in the Porcupine Seabight (ICES Division VIIj,k) at depths 500–1300 m. The species was also recorded further south in the Cantabrian Sea (ICES Division VIIIc). In the latter area, *T. scabrus* was report to occur at a high abundance on the Le Danois Bank (ICES Division VIIIb) at depths from 500 to 800 m (Sanchez *et al*., 2008).

Unlike in the Atlantic Ocean, *Trachyrincus scabrus* occurs in most of the Mediterranean Sea, along the Spanish slope to the Ionian Sea (D'Onghia *et al*., 2004; Moranta *et al*., 2006). In the Mediterranean Sea high abundances were reported at depths ranging from 800 to 1300 m. In the Mediterranean Sea, *T. scabrus* reaches larger size than the other macrourid species occurring at the same depth range.

Therefore, *T. scabrous* is a species occurring in the Mediterranean Sea and in the Atlantic and does not seem to occur at levels susceptible to support commercial fisheries in most areas north of 52°N.

The other *Trachyrincus* species (*T. murrayi*) occur in Subareas V, VI XII. There is no known fishery for this species, it does not reach sufficient sizes to be of commercial interest. It is only a bycatch of deep-water fisheries in Subareas V, VI and VII and probably XII.

As *T. scabrous* and *T. murrayi* can be misidentified this chapter addresses the two species.

Landings of *T. scabrus* were reported for ICES Subareas VI, XII and XIV. In these areas the species is considered to be at best a minor bycatch. The occurrence of the species is even not confirmed in Subareas XII and XIV. It may be that only *T. murrayi*, occurs in these Subareas. Therefore the species identity of commercial landings reported as *T scabrus* needs to be confirmed.

15.1.1 Landings trends

Landings have been reported in 2012 only amounting to 54 tonnes in Division XII and 3 tonnes in XIVb.

15.1.2 ICES Advice

No previous ICES advice was ever produced for these species. The present assessment was requested as a consequence of the existence of roundsnout grenadier records in official landings.

15.1.3 Management

There is no current species-specific management measure for the roundsnout grenadier.

15.1.4 Data availability

15.1.4.1 Landings and discards

Landings data are presented in Table 5.4.1.

T. murrayi is discarded by the French deep-water fishery. In 2014 observed discards of the species amounted 306 kg for a total observed catch weight of blue ling, roundnose grenadier and black scabbardfish combined of 677 tonnes (Table 5.2.1). It can be concluded that *T. murrayi* has a minor contribution to the total catch in weight in ICES Division Vb and VIa and Subarea VII, where the French fishery operates.

Discards of *Trachyrincus* spp are expected to occur in all deep-water fisheries and also in the other fisheries along the upper slope such as fisheries targeting hake, monkfish and megrims, which may operate down to 800 m.

15.1.4.2 Length compositions

No length data are available.

In the Icelandic autumn survey specimens of *T. murrayi* with sizes up to 40 cm total length have been recorded. Nevertheless the bulk of the catch is made of specimens with a length range from 5 to 20 cm.

T. murrayi of 45 cm total length would weigh less than 300 g using the following weight–length relationship estimated Length–weight relationship for *T. murrayi* :W=0.00129 LT^3.232 (Borges *et al.*, 2003).

15.1.4.3 Age compositions and longevity

No age composition is available. There are, however some studies on growth and longevity.

In the Mediterranean *T. scabrus* has a maximum age of eleven years (Massutti *et al.*, 1995).

Swan and Gordon (2001) analysed otoliths from 218 specimens of *T. murrayi*, with head–length ranging from 2.1 to 11.7 cm and found up to nine growth bands on otolith. Converting the head length (HL) to total length (TL)by using the conversion estimated by the Swan and Gordon (2001): HL=3.630*HL - 0.402 (n=488),the largest fish in the sample had 42 cm total length, which seems to be at or close to the maximum length of the species in the area.

It can be concluded that the two *Trachyrincus* species appear to have similar longevities, of around ten years. Similar lifespans have been estimated for other small macrourids (Coggan *et al.*, 1999).

15.1.4.4 Weight-at-age

No weight-at-age data are available.

15.1.4.5 Maturity and natural mortality

No data were available.

15.1.4.6 Catch, effort and research vessel data

Population indicators of *T. Murrayi* were estimated from data collected during deep-water research surveys held by the Marine Scotland. The abundance and length distribution varied along the time period under analysis (from 2000 to 2008) and no trend was observed (Neat and Burns, 2008). Recent Scottish survey data for this species were not requested to Marine Scotland.

15.1.5 Data analyses

Available data on *T. Murrayi* suggest that the species is too small to have commercial interest to be explored. In fact, the weight of the largest specimen caught in Icelandic survey (45 cm TL) had no more than 500 g.

15.1.5.1 Biological reference points

Not applicable.

15.1.6 Comments on assessment

Not applicable.

15.1.7 Management considerations

These species are primarily discarded in all fisheries. As most of small sized species are bycatches of most fisheries, there is no option for species-specific management measures for *T. Murrayi* and *T. scabrus*.

Furthermore, owing to the smaller size and shorter longevity of *T. Murrayi* and *T. scabrus* compared to the target species of deep-water fisheries, levels of fishing mortality that are sustainable to the target species are most likely to be also sustainable for the smaller species.

The only, management that can be propose is to include minor landings in the TAC of the main grenadier species, the roundnose grenadier. This should not imply any increase of the TAC of roundnose grenadier, because the contribution of *Trachyrincus* spp. to landings is negligible.

15.1.8 References

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Table 5.1.1.Landings of roundsnout grenadier by ICES Subarea.

YEAR	Spain VIb	Spain XIIa	Spain XIIb	Spain XIVb	Total
2012		54		3	57
2013					0
2014	42	4	155	448	649

Table 5.2.1. Catch of *T. murrayi* in the French deep-water fishery compared to the catch of the target species and the total landings and discards in 2014.

Total catch in observed hauls	677 tonnes
Landings	621 tonnes
Discards	56 tonnes
Catch of roundnose grenadier, black scabbardfish and blue ling	497 tonnes
Catch of *T. murrayi*	306 kilogrammes
Rank of *T. murrayi* in weight of caught species	36/108
Rank of *T. murrayi*in weight of discarded species	17/77

16 Other deep-water species in the Northeast Atlantic

16.1 The fisheries

The following species are considered in this chapter: common Mora (*Mora moro*) and Moridae, rabbit fish (*Chimaera monstrosa* and *Hydrolagus* spp), Baird's smoothhead (*Alepocephalus bairdii*) and Risso's smoothhead (*A. rostratus*), wreckfish (*Polyprion americanus*), blackbelly rosefish (*Helicolenus dactylopterus*), silver scabbard fish (*Lepidopus caudatus*), deep-water cardinal fish (*Epigonus telescopus*) and deep-water red crab (*Chaceon affinis*). In previous years, roughhead grenadier (*Macrourus berglax*) was included in this chapter but this has now been moved to a separate chapter (Section 14.) Mora, rabbitfish, smoothheads, blackbelly rosefish and deep-water cardinal fish are taken as bycatch in mixed-species demersal trawl fisheries in Subareas VI, VII and XII and to a lesser extent, II, IV and V.

Mora, wreckfish, blackbelly rosefish and silver scabbardfish are caught in targeted and mixed species longline fisheries in Subareas VIII, IX and X.

Deep-water red crab were formerly caught in directed trap fisheries principally in Subareas VI and VII but this fishery ceased to operate in the ICES area in 2008.

16.1.1 Landings trends

Landings are presented in Tables 16.1–16.9.

16.1.2 ICES Advice

ICES has not previously given specific advice on the management of any of the stocks considered in this chapter.

16.1.3 Management

No TACs are set for any of these species in EC waters or in the NEAFC Regulatory Area. None of these species are included in Appendix I of Council Regulation (EC) No 2347/2002 meaning that vessels are not required to hold a deep-water fishing permit in order to land them; they are therefore not necessarily affected by EC regulations governing deep-water fishing effort.

16.2 Stock identity

No information available.

16.3 Data available

16.3.1 Landings and discards

Landings for all of these species are presented in Tables 16.1–16.9. In 2015, other deep-water species (OTH_COMB) were included in the data call for deep-water species, accompanied with a list of species for which landings data are required. A number of countries did not split the landings data but simply provided a single value for other species combined. Species-specific landings data for 2014 are therefore incomplete and it is expected that they will be updated from STATLANT in 2016.

16.3.2 Length compositions

Trends in mean length of blackbelly rosefish, silver scabbardfish, *Mora moro* and wreckfish in Azorean surveys are presented 16.2 to 16.5.

16.3.3 Age compositions

No new information.

16.3.4 Weight-at-age

No new information.

16.3.5 Maturity and natural mortality

No new information.

16.3.6 Catch, effort and research vessel data

A standardized abundance index for blackbelly rosefish in the Spanish Porcupine Bank Survey from 2001 to 2010 is shown in Figure 16.7. The geographic distribution of catch rates is given in Figure 16.8. These series have not been updated in 2014, but the survey is ongoing and it is expected that they will be updated in future.

Abundance indices for blackbelly rosefish silver scabbard, *Mora moro* and wreckfish fish from the Portuguese survey at the Azores are given in Figures 16.9 to 16.12. Survey indices for 2014 were not available at the time of the working group meeting.

16.3.7 Data analysis

Standardised abundance indices for blackbelly rosefish in the Spanish Porcupine Bank Survey declined between 2005 and 2008 but have increased in recent years. Modal length appears to have increased slightly across the time-series.

The standardized abundance index for blackbelly rosefish in the Azores longline survey shows no continuous trend between 1995 and 2008 but catch rates since 2010 have been low with 2012 being the lowest in the time-series (Figure 16.10). The abundance index in 2013 remained at a very low level. Mean length has declined slightly across the time-series.

The standardized abundance index for silver scabbard fish in the Azores longline survey declined between 1995 and 2000 and has remained at very low levels since then. Mean length has declined across the time-series.

The cpue for wreckfish in the Azores longline survey fluctuated greatly with no overall trend between 1995 and 2008. Since 2010, the level has continuously been very low, with the lowest value in 2013. .Mean length showed no significant trend between 1995 and 2013.

The cpue for *Mora moro* in the Azores longline survey displayed no obvious trend between 1999 and 2008. Since 2010, cpue has been at a considerably lower level. There was been an overall increasing trend in mean length across the time-series.

No data other than landings are available to assess any of the other stocks included in this section. These data are not considered sufficient to assess the status of the stocks.

16.3.8 Comments on the assessment

None.

16.3.9 Management considerations

No advice was required for these stocks this year.

Table 16.1. Working group estimates of landings of *Mora moro* and *Moridae* (t). Data from 2014 are provisional.

YEAR	II	VB	VI AND VII	VIII AND IX	X	XII	XIVB	TOTAL
1988								
1989								
1990					2			2
1991		5	1		4			10
1992			25					25
1993			10					10
1994			10					10
1995				83				83
1996				52				52
1997				88				88
1998			41					41
1999		1	20					21
2000	8	3	159	25		1		196
2001	1	100	194	25		87		407
2002	1	19	159	10	100	13		302
2003		8	327	12	125	15	7	494
2004		1	71	15	87	4		178
2005		1	63	19	69			152
2006		5	111	45	92			253
2007		8	64	18	86			176
2008		4	57	4	53			118
2009		1		5	68			74
2010		11	1	4	54			70
2011		7	86	4	55			152
2012		5	71	1	31			108
2013			99	1	52			152
2014*				1	54			55

Table 16.3. Working group estimates of landings of rabbitfish (t) (*Chimaera monstrosa* and *Hydrolagus* spp.) Data from 2014 are provisional.

YEAR	I/II	III/IV	VA	VB	VI/VII	VIII	XII	XIV	TOTAL
1991			499						499
1992		122	106						228
1993		8	3						11
1994		167	60		2				229
1995			106	1					107
1996		14	32						46
1997		38	16				32		86
1998		56	32		2		42		132
1999		47	9	3	237	2	114		412
2000	6	34	6	54	404	2	48		554
2001	7	23	1	96	797	7	79		1010
2002	15	24		64	570	6	98	1	778
2003	57	25	1	61	469	2	80	4	699
2004	22	40		100	444	6	128	5	745
2005	77	171		63	571	14	249	1	1146
2006	29	17	1	62	325	10		5	449
2007	64	2	1	78	391	3			539
2008	81	12	1	49	370	3			516
2009	89	6	2	6	47		70		220
2010	197	21	7	5	31		25		286
2011	150	7	4	2	88				251
2012	104	17	4	29	475	2	434		1065
2013	103	40	2	30	160	1	56		392
2014		4		32	131	4	77		178

Table 16.4. Working group estimates of landings of Baird's smoothhead (t). Data from 2014 are provisional.

YEAR	VA	VB	VI AND VII	XII	XIV	TOTAL
1991			31			31
1992	10		17			27
1993	3			2		5
1994	1					1
1995	1					1
1996				230		230
1997				3692		3692
1999				4643		4643
1999				6549		6549
2000			978	4146	12	5136
2001			5305	3132		8897
2002			260	12 538	661	13 459
2003			393	6883	632	7908
2004		6	2657	4368	245	7276
2005		1	5978	6928		12 412
2006			4966	3512		8150
2007			2565	1781		4140
2008			896	744		1611
2009			295	508		803
2010			511	317		828
2011			187	252		252
2012			335	472		472
2013			342	351		693
2014			235	228		463

Table 16.5. Working group estimates of landings of wreckfish (t). Data from 2014 are provisional.

Wreckfish (*Polyprion americanus*) All areas				
Year	VI and VII	VIII and IX	X	TOTAL
1980			38	38
1981			40	40
1982			50	50
1983			99	99
1984			131	131
1985			133	133
1986			151	151
1987			216	216
1988	7	198	191	396
1989		284	235	519
1990	2	163	224	389
1991	10	194	170	374
1992	15	270	240	525
1993		350	315	665
1994		410	434	844
1995		394	244	638
1996	83	294	243	620
1997		222	177	399
1998	12	238	140	390
1999	14	144	133	291
2000	14	123	263	400
2001	17	167	232	416
2002	9	156	283	448
2003	2	243	270	515
2004	2	141	189	332
2005		195	279	474
2006		331	497	828
2007	2	553	662	1217
2008	3	317	513	833
2009	8	13	382	403
2010	3	5	238	246
2011		150	266	416
2012		256	226	482
2013			209	209
2014		95	121	216

Table 16.6. Working group estimates of landings of blackbelly rosefish (t). Data from 2014 are provisional.

YEAR	III AND IV	VB	VI	VII	VIII AND IX	X	TOTAL
1980						18	18
1981						22	22
1982						42	42
1983						93	93
1984						101	101
1985						169	169
1986						212	212
1987						331	331
1988						439	439
1989			79	48	2	481	610
1990	4		69	31	5	480	589
1991	5		99	29	12	483	628
1992	3		112	47	11	575	748
1993	1		87	65	8	650	811
1994	2		62	55	4	708	831
1995	2		62	9		589	662
1996	2		77	10		483	572
1997	1		78	10	1	410	500
1998			53	92	3	381	529
1999	8	64	194	160	29	340	795
2000		16	213	119	33	441	822
2001			177	102	34	301	614
2002			81	115	18	280	494
2003			184	213	124	338	859
2004	2	3	142	291	135	282	855
2005			103	204	206	190	703
2006			59	160	287	209	715
2007			61	259	293	274	887
2008			105	193	214	281	752
2009			182	14	75	267	450
2010			195	6	120	213	294
2011			176	14	149	231	400
2012		2	161	944	1332	190	2629
2013			121	20	1320	235	1696
2014			25	23	141	200	389

Table 16.7. Working group estimates of landings of silver scabbardfish (t). Data from 2014 are provisional.

	VI AND VII	VIII AND IX	X	XII	TOTAL
1980			13		13
1981			6		6
1982			10		10
1983			43		43
1984			38		38
1985			28		28
1986			65		65
1987			30		30
1988		2666	70		2736
1989		1385	91	102	1578
1990		584	120	20	724
1991		808	166	18	992
1992		1374	2160		3534
1993	2	2397	1724	19	4142
1994		1054	374		1428
1995		5672	788		6460
1996		1237	826		2063
1997		1725	1115		2840
1998		966	1187		2153
1999	18	3069	86		3173
2000	17	16	27		60
2001	6	706	14		726
2002	1	1832	10		1843
2003		1681	25		1706
2004		836	29		865
2005	57	527	31		615
2006	377	624	35	3	1039
2007	88	649	55	1	793
2008	40	845	63	0	948
2009	44	898	64	25	1031
2010	32	829	68	43	972
2011		927	148	82	1157
2012	655	36	271	244	1206
2013	200		361	123	648
2014	253		713	88	1056

Table 16.8. Working group estimates of landings of deep-water cardinal fish (t). Data from 2014 are provisional.

YEAR	VB	VI	VII	VIII AND IX	X	XII	TOTAL
1990					3		3
1991					11		11
1992							0
1993		15	15				30
1994	4	35	182				221
1995	3	20	71				94
1996	8	13	32				53
1997	8	27	22				57
1998		86	29				115
1999	8	54	224	3			289
2000	2	121	181	5	3		312
2001	7	109	284	4			404
2002		97	888	8	14		1007
2003	2	47	1031	5	16	1	1102
2004	1	30	843	10	21	2	907
2005		50	637	8	4		699
2006		30	383	12	10		435
2007		6	218	19	7		250
2008		19	5	6	7		37
2009		8	2	130	7		147
2010		4	6		5		15
2011		3	2	128	5		138
2012		16	4	2	4		26
2013		10	1	1	4		16
2014		4	1	2	2		9

Table 16.9. Working group estimates of landings of deep-water red crab (t). Data from 2010 are provisional.

Year	IV/V	VI	VII	VIII/IX	XII	Total
1995		6	4			12
1996	20	1288	77	2	17	1413
1997	58	139	48	11	4	437
1998	35	313	34	188	2	384
1999	642	289	46		3	980
2000	38	580	108			726
2001	13	335	20			368
2002	29	972	21		6	1028
2003	26	960	123		92	1201
2004	21	546	115		13	695
2005	94	626	184		15	1230
2006	16	185	19	310		530
2007	11	732	104	85	24	957
2008	2	124	1			127
2009						0
2010						0
2011						0
2012						0
2013						0
2014						0

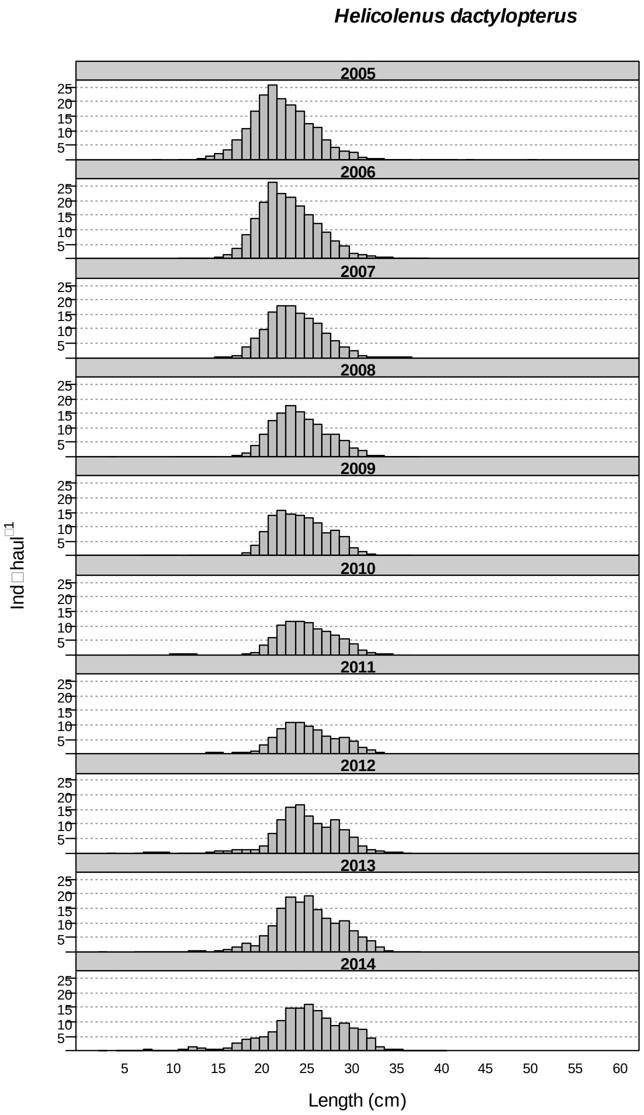

Figure 16.1. Mean stratified length distributions of *Helicolenus dactylopterus* in Porcupine surveys in the last decade (2005–2014).

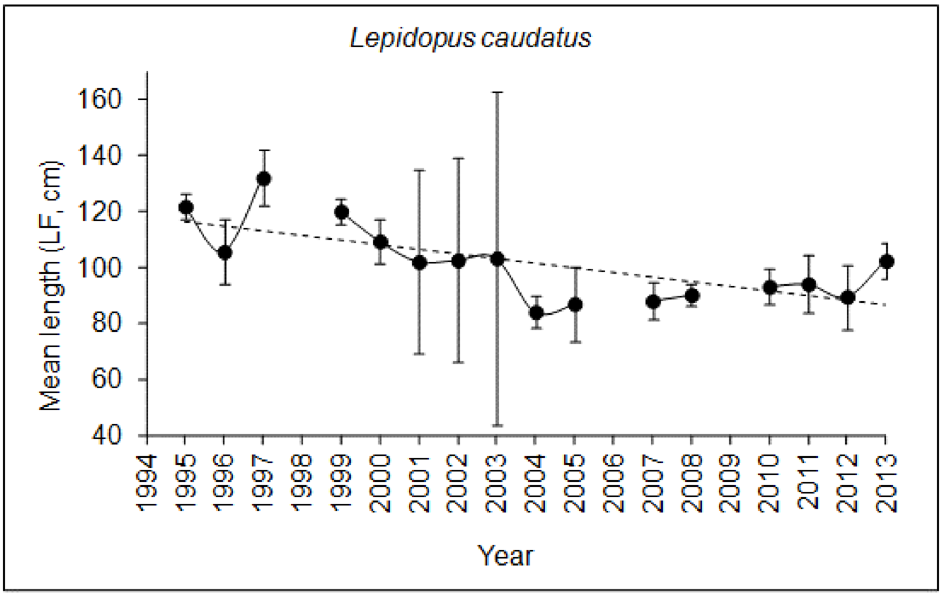

Figure 16.3. Mean length of silver scabbardfish in Azores bottom longline survey 1995–2013.

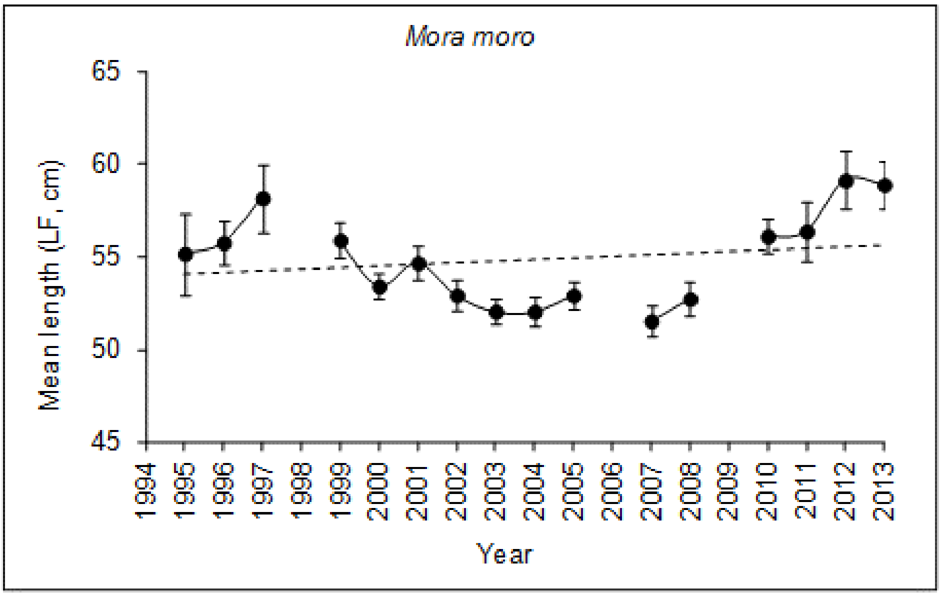

Figure 16.4. Mean length of *Mora moro* in Azores bottom longline survey 1995–2013.

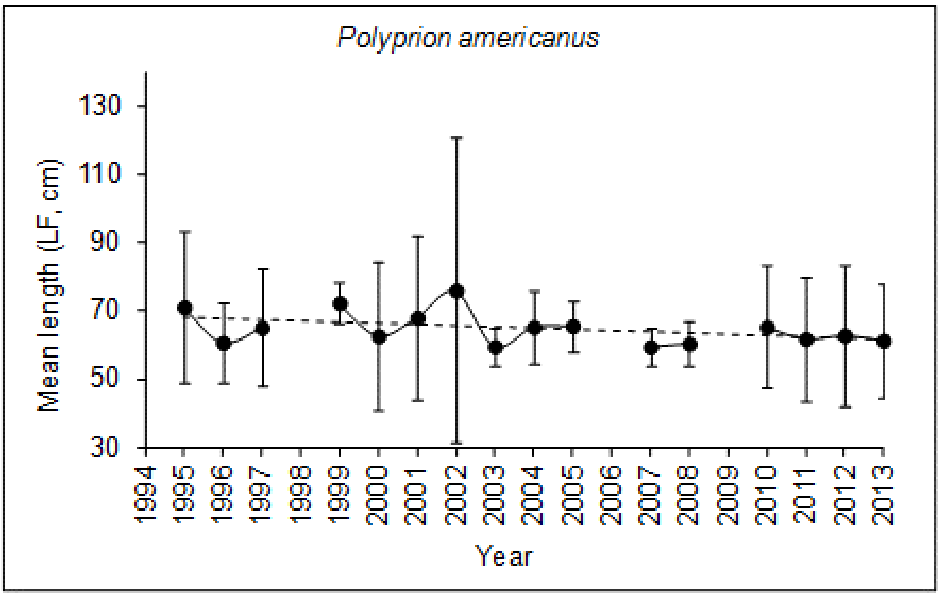

Figure 16.5. Mean length of Wreckfish in Azores bottom longline survey 1995–2013.

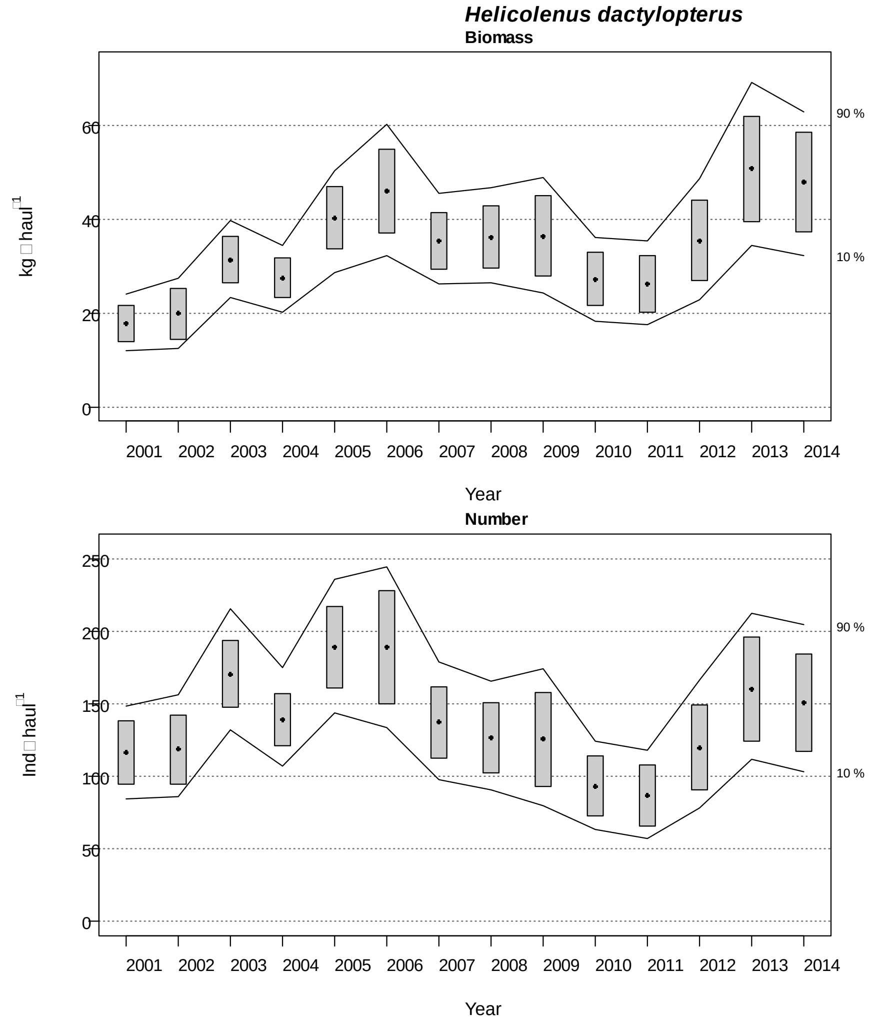

Figure 16.7. Changes in *Helicolenus dactylopterus* biomass and abundance indices during Porcupine Survey time-series (2001–2014). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

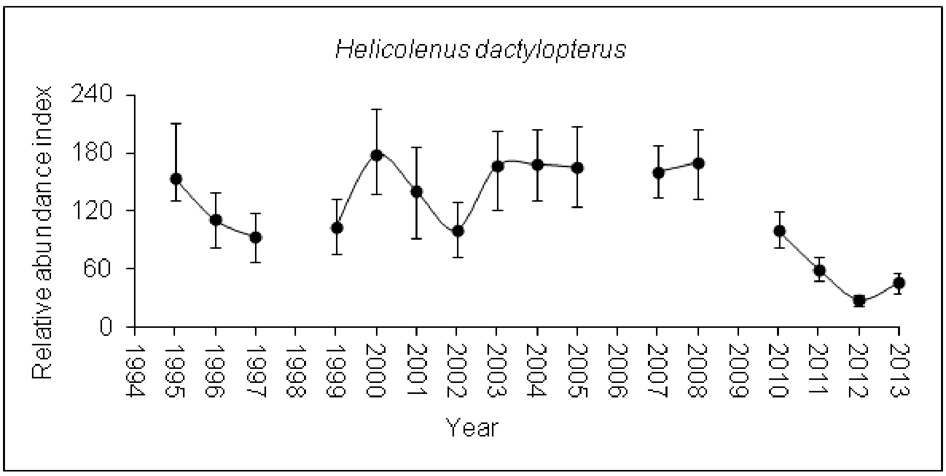

Figure 16.9. Annual bottom longline survey abundance index (number) for blackbelly rosefish in Azorean bottom longline surveys.

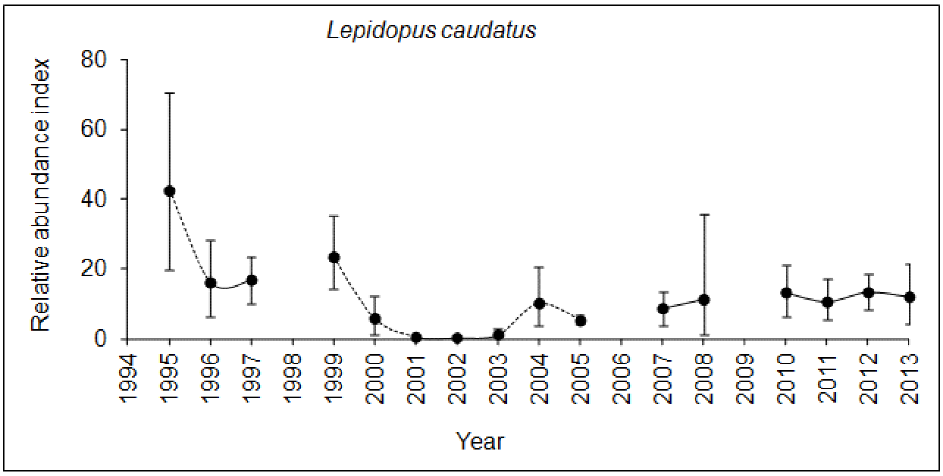

Figure 16.10. Annual bottom longline survey abundance index (numbers) for silver scabbardfish in Azorean bottom longline surveys.

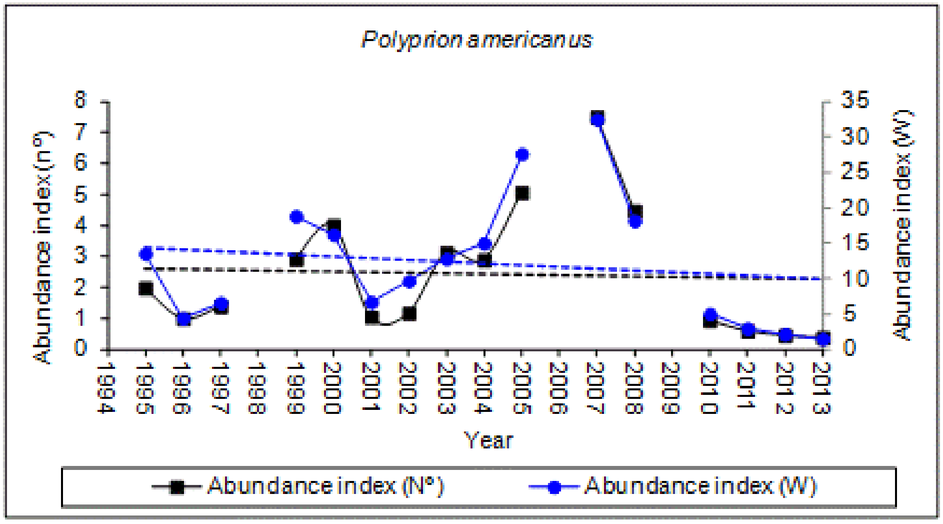

Figure 16.11. Annual bottom longline survey nominal cpue for wreckfish in Azorean bottom longline surveys.

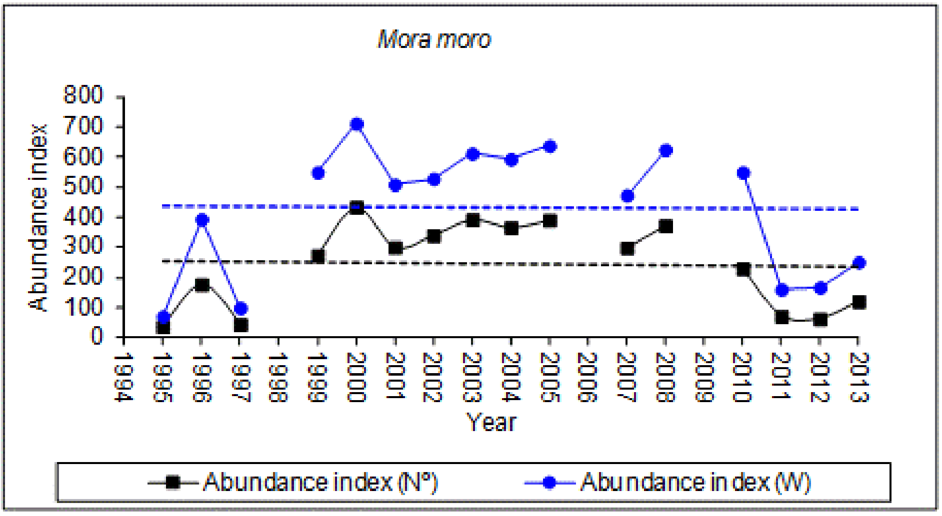

Figure 16.12. Annual bottom longline survey nominal cpue for *Mora moro* in Azorean bottom longline surveys.

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Annex 2: Working documents

The following Working Documents were presented to the WGDEEP and are included below in Annex 2 of the WGDEEP 2015 report:

1) The development of the Norwegian longline fleet's fishery for Ling and Tusk during the period 2000–2014; Kristin Helle and Michael Pennington.

2) Tusk in Faroese Waters; Lise H. Ofstad.

3) Stock Assessment of Greater silver smelt in Faroese waters (Vb); Lise H. Ofstad.

4) Research on Greater silver smelt in Norway 2014; Elvar H. Hallfredsson and Lise Heggebakken.

5) Faroese fishery of Orange roughy; Lise H. Ofstad.

6) Update on Norwegian fishery-independent information on abundance, recruitment, size distributions, and exploitation of Roundnose grenadier (*Coryphaenoides rupestris*) in the Skagerrak and northeastern North Sea (ICES Division IIIa and IVa); Hege Øverbø Hansen, Odd Aksel Bergstad and Terje Jørgensen.

7) Roundnose grenadier and Black scabbardfish in Faroese waters (Vb); Lise H. Ofstad.

8) Catch curve analysis for the Red blackspot sea bream (*Pagellus bogaraveo*) stock from the Azores (ICES Xa2); Mário Rui Pinho, Ana Pabon, João Gil Pereira, Helena Krug.

9) On the stock size and fishery management of splendid Alfonsino *Beryx splendens* in the North Azores area; V.I. Vinnichenko.

10) Blue ling in Faroese waters (Vb); Lise H. Ofstad.

11) Information from deep-water fishery of the Azores; Mário Rui Pinho, João Gil Pereira.

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The development of the Norwegian longline fleet's fishery for ling and tusk during the period 2000-2014

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Introduction

Ling, tusk and blue ling have been fished by Norway for centuries and the amount landed has been recorded since 1896 (Figure 1). The major catches of these species are taken by longliners, and the catches are to a large degree bycatches. The fishery for these species is mainly influenced by the size of various quotas for other species, especially the quota for Arcto Norwegian cod. Therefore the total catch may not be a good indicator of the condition of these stocks (Figure 2).

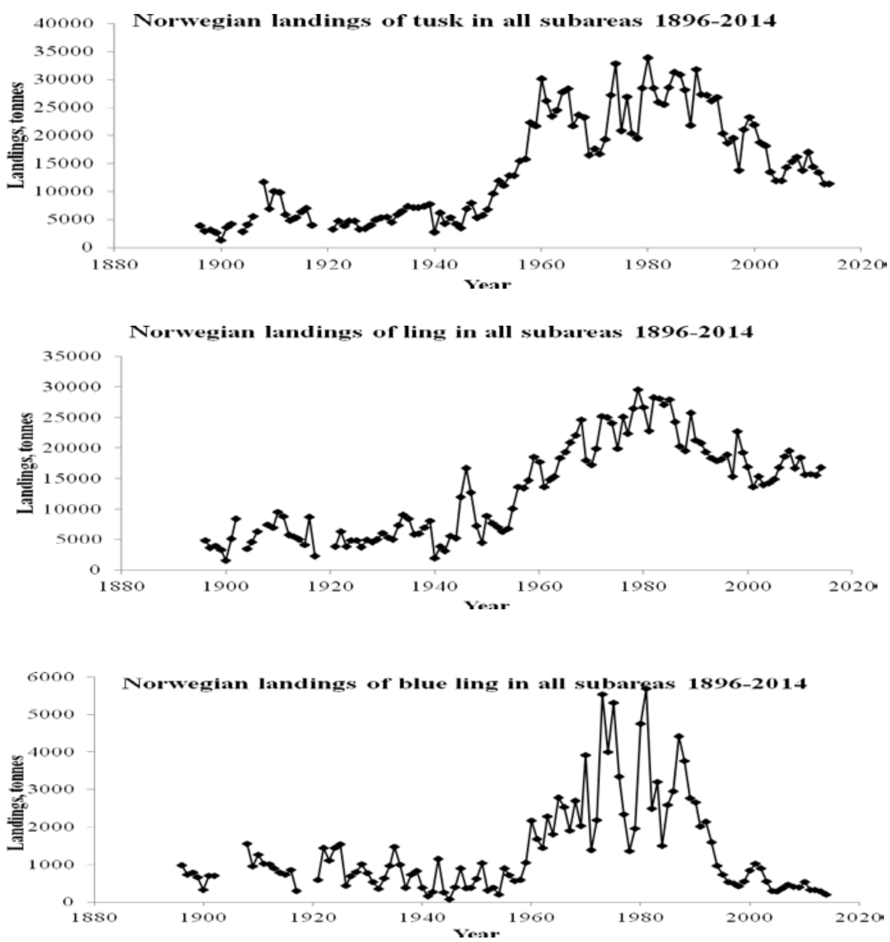


Figure 1. Reported Norwegian landings of tusk, ling and blue ling for the period 1896 -2014.

Scientific surveys do not cover the main habitats of ling, blue ling and tusk. Therefore these stocks need to be monitored based on commercial data. One possible way to track their abundance, based only on commercial data, would be to develop a catch per unit of effort series for the fishery. But again, the major challenge for using any such cpue series, which in practice are easy to generate, is to determine, if possible, whether the selected series actually is tracking the abundance of the entire stock.

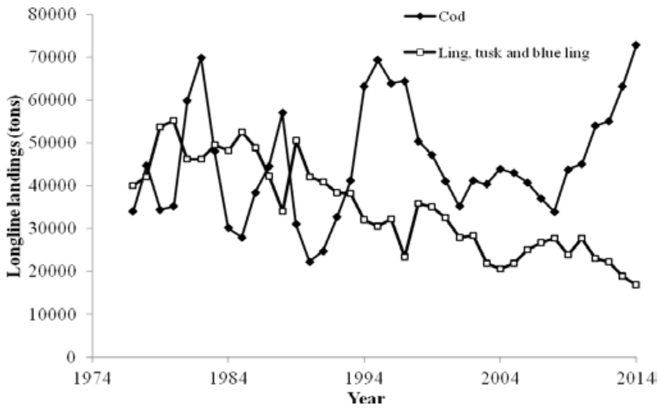


Figure 2. Total landings by longliners of cod (diamonds) and the combined total landings of ling, tusk and blue ling (open squares) for the period 1977- 2014.

Development of the Norwegian fleet of longliners, 1977- 2014

In addition to data on total landings*, the NDF also provides data on how many fishing vessels participated in the fishery, the gear employed, areas fished and changes in vessel ownership. In Table 1 are; the number of long liners during the period 1977 to 2014, the total landed catch by the fleet, and the average annual catch per vessel. The number of vessels increased from 36 in 1977 to a peak of 72 in 2000, and after that the number decreased to 26 in 2014.

The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The decrease in the number of vessels was accompanied by a decrease in total catches until 2004; afterwards there was an increase, especially in 2007 and 2008 (Figure 3a). The catch-per-vessel was relatively stable from 1980 until 2003. In the period 2003- 2008 there was a steady increase in catch-per-vessel, afterwards the catches remained relatively stable (Figure 3b).

In 2012 new regulations were initiated and the number of cod quotas each vessel can own was raised from 3 to 5. This caused a further reduction in the number of long-liners; from 36 in 2012, to 26 in 2014.

* The data provided by the NDF are; the total landed catch, the logbook data, and the catch along with its location.

a)

b

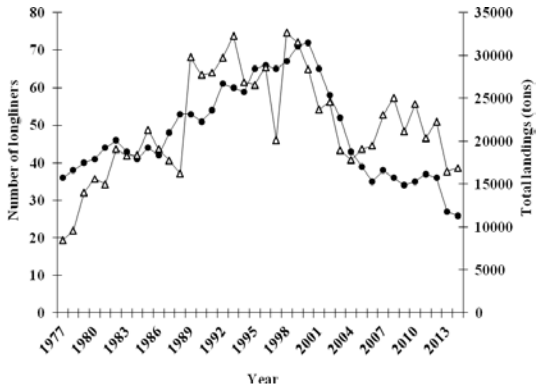


Figure 3. a) The number of long liners (filled circles) and the average landings per vessel of ling and tusk (open diamonds) in the period 1977-2014 and, b) the number of longliners and the total landings of ling and tusk (open triangles).

Logbooks

All available logbooks for the years 2000-2014 are now in the database, and the data have undergone extensive quality control procedures. The data for 2010 are incomplete because of problems getting some of the logbook data, both for the paper logbooks and for the electronic logbooks. In 2010 electronic logbooks were implemented for the longline fleet. The Norwegian Directorate of Fisheries has received the data, but because of a lack of quality control, the 2010 data will not be released. Some fishermen didn't send paper logbooks because they had delivered the data electronically. Because of this, logbooks from only 11 of 35 vessels are available for 2010. The quality of the logbooks varies considerably, and a serious problem is that some lack information on the number of hooks used per day. The dataset from 2011 is almost complete with data from 35 of 37 vessels. In 2012 to 2014 all logbooks are available although some days have been deleted due to punching errors.

Days in the fishery

The Norwegian longline logbooks provide information on the geographical distribution of the fleet. In Table 2 are the average number of days a vessel spent fishing for tusk, ling and blue ling, jointly or separately, for all ICES Subareas and

Divisions. After 2000, when new quota regulations for cod were introduced, the number of days each vessel fished for these three deep-water species increased, and by 2005 the number of days in the fishery was twice what it was in 2000. The data for 2006 show that the number of days in the fishery has decreased by more than 20 percent compared with 2005 and 2007. The data have been checked for errors but none were discovered. The number of fishing days has trended downward since 2007, most likely because of the record large stock of Arcto Norwegian cod.

Division IIa has been the main fishing grounds since 2000, followed by IVa and Vb. For both ling and tusk the number of fishing days increased in area IIa until 2011, afterwards there has been a decline (Table 2).

Average number of hooks used per day

In Table 3 are estimates of the average number of hooks used per day in each ICES area and in the total fishery for the years 2000-2014. For all areas combined there was a steady increase in the number of hooks used from 2000 through 2009. This is also the general trend for the subareas (Figure 4). The combined time series for 1972-1994 (Bergstad and Hareide, 1996) and the series based on data from 2000-2012 show that the number of hooks has increased from 10 000 hooks per day in 1972 to around 35 000 in 2014 (Figure 6).

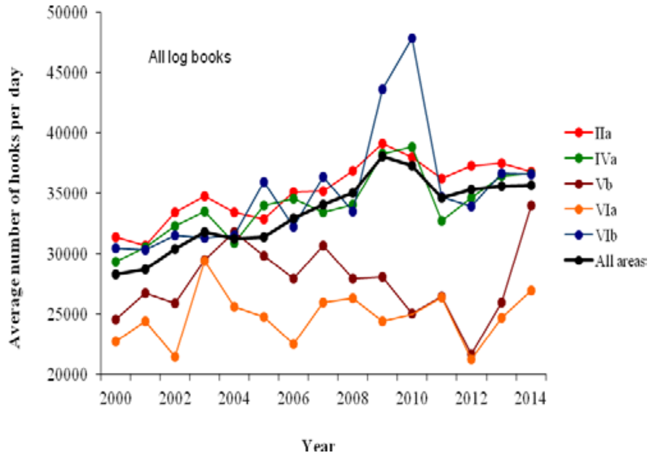


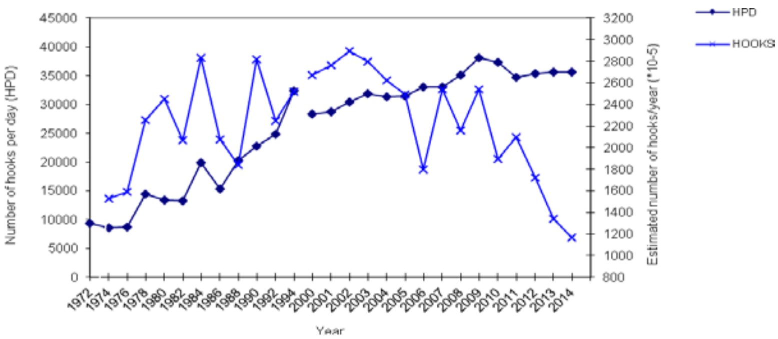
Figure 4. Average number of hooks the Norwegian longliner fleet used per day in each of the ICES subareas and in the total fishery for the years 2000-2014 for the fishery for tusk, ling and blue ling.

Total number of hooks per year

Based on the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, estimates of the total number of hooks used per year were generated (Tables 1, 2 and 3). Table 4 and Figure 5 show the estimated number of hooks (in thousands) set in each of the ICES subareas and in the total for all areas for the years 2000-2014. During the period 1974 to 2014 the total number of hooks per year has varied considerably, but with a downward trend since 2002 (Figure 6).

Since total number of hooks per year takes into account; the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, it follows that it may be a suitable measure of changes in applied effort. Based on this gauge, it appears that the average effort for the years 2011-2014 is 43% less than the average effort during the years 2000-2003.

a.



b.

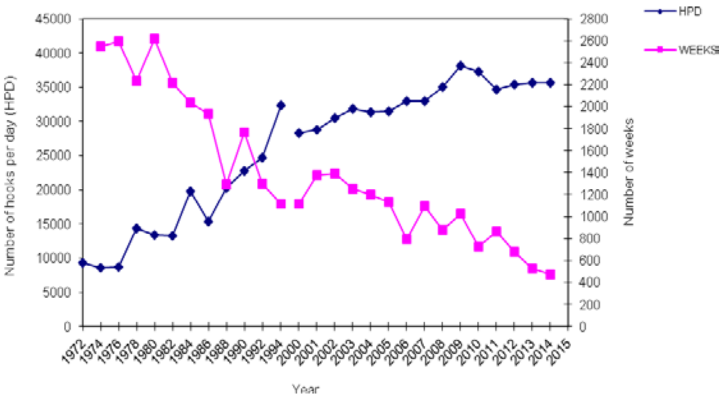


Figure 5. The combined time series for 1972-1994 (Bergstad and Hareide, 1996) and the series based on data from 2000-2014. a) The numbers of hooks used per day and the total number of hooks used per year. b) The numbers of hooks used per day and the total number of weeks the long liners participated in the fishery for ling and tusk.

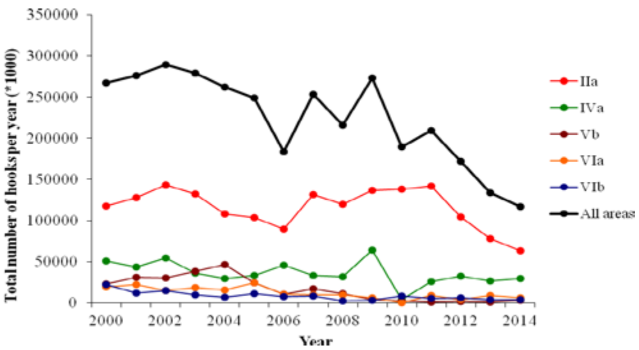


Figure 6. Estimated total number of hooks (in thousands) the Norwegian longliner fleet used in the ICES subareas with highest catches and in the total fishery for the years 2000-2014 for the fishery for tusk, ling and blue ling.

The size of the vessels

There has been a steady increase in the average size of the vessels from 34 m in 1977 to almost 43 m in 2014. Figure 7 show the average size of the vessels and the smallest and the largest vessel in the fleet for the period 1977 to 2014.

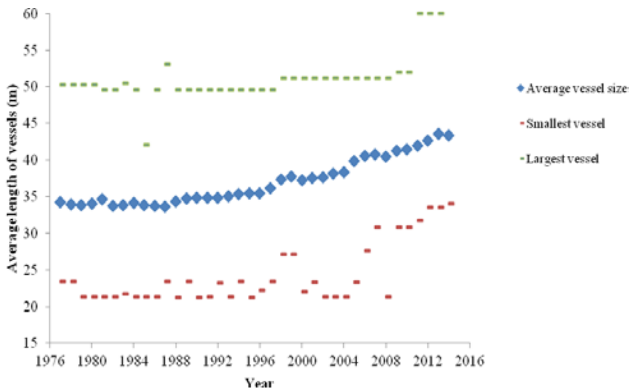


Figure 7. Average size of longliners >21 m for the period 1977-2014.

Fishing area

Approximately 65-70% of the commercial catch of ling is taken by vessels using demersal longlines, either as the target species or as bycatch (Helle and Pennington, 2015), the rest is taken by mainly gillnets but also some by trawlers. Although the fishery takes place from Rockall to the southern Barents Sea (Helle and Pennington, 2004), between 70 to 80 percent of the catch by Norwegian vessels is from the Norwegian Economic Zone.

Figure 8 show all the catches of ling registered in the electronic logbooks; by all vessels, by longliners and by gillnetters in 2014.

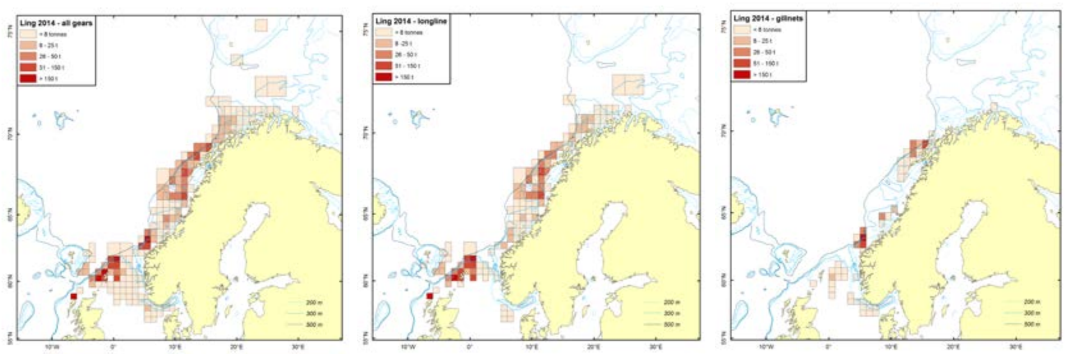


Figure 8. Distribution of the total catch of ling, the catches using longlines and by gillnets for the Norwegian longline fishery in 2014.

Tusk is mainly fished by longliners (approximately 90 percent of the total catch). Figure 9 show all catches of tusk registered in the electronic logbooks by all vessels, and by longliners in 2014

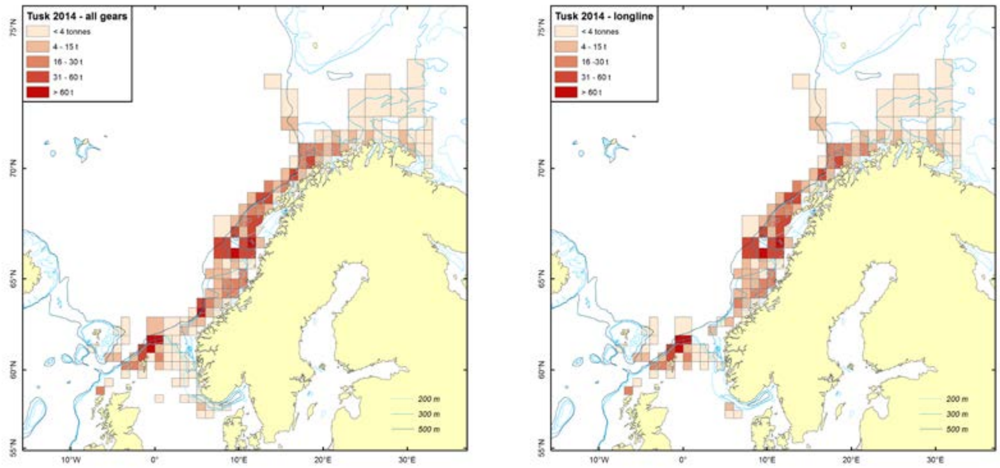


Figure 9 Distribution of total catch and the catches using longlines by the Norwegian fishery for tusk in 2014.

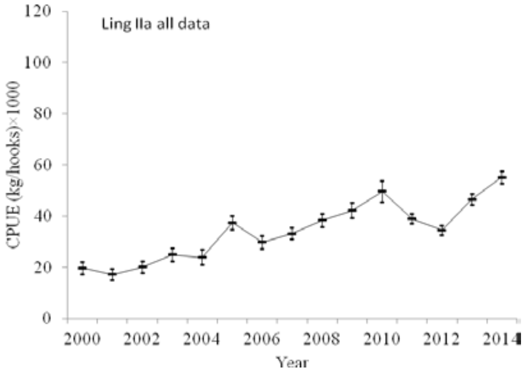
CPUE

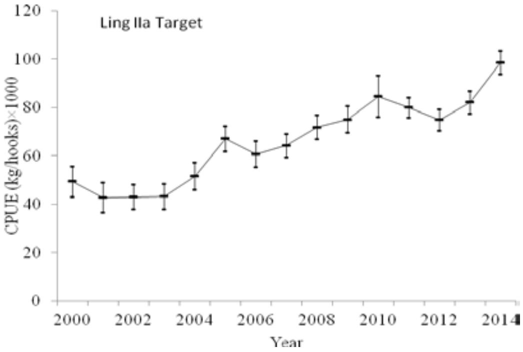
Based on methods described in Helle et al., 2015, CPUE series were calculated for all the data available and when ling and tusk was targeted.

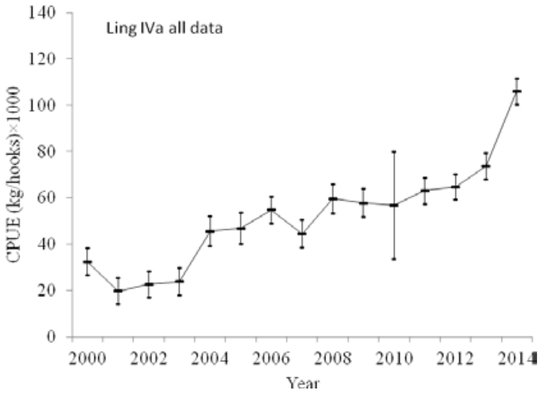
In Figures 1 and 2 are graphs of the estimated CPUE series for the most important ICES subareas for the ling and tusk fishery: one based on all available data, and a series based on only those catches that ling and tusk appeared to have been targeted; along with the estimated 95% confidence intervals.

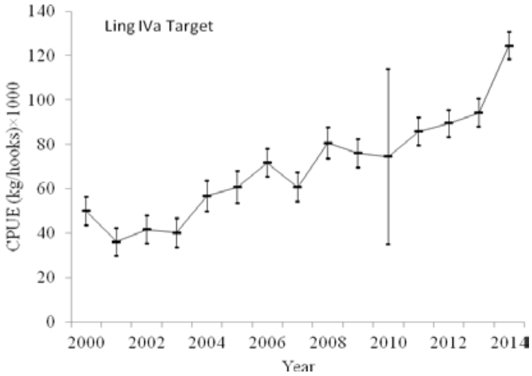
For ling there is a positive development in CPUE for all areas. Norway was not allowed to fish in area Vb during the period 2010-2012, and thus only a few catches from international waters were available. This may bias the estimates and, therefore, the series may not represent the true development of the stock. A large part of Rockall (area VIb) was closed for fishing in the beginning of 2007. After 2007 the CPUE for ling has increased considerably with a small decline the two last years.

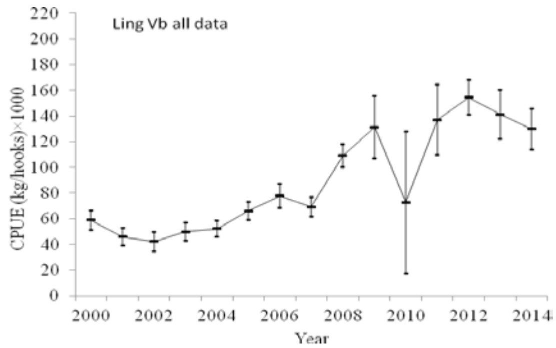
Also for tusk there has mainly been a positive development in all areas, especially in area IIa. For areas IVa, Vb and Via there has been a positive development with a small decrease the last two years. In area VIb the CPUE series declined from 2000 to 2006 and afterwards the series has remained stable though at a very low level.

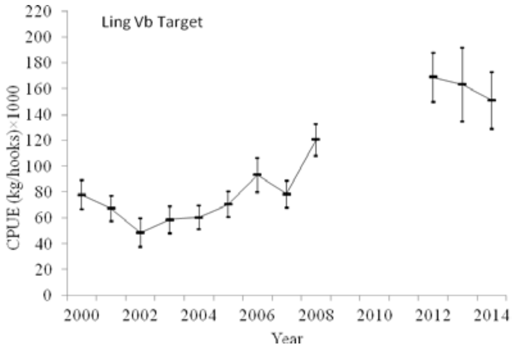

Ling IIa all data
CPUE (kg/hooks)×1000
Year


Ling IIa Target
CPUE (kg/hooks)×1000
Year


Ling IVa all data
CPUE (kg/hooks)×1000
Year


Ling IVa Target
CPUE (kg/hooks)×1000
Year


Ling Vb all data
CPUE (kg/hooks)×1000
Year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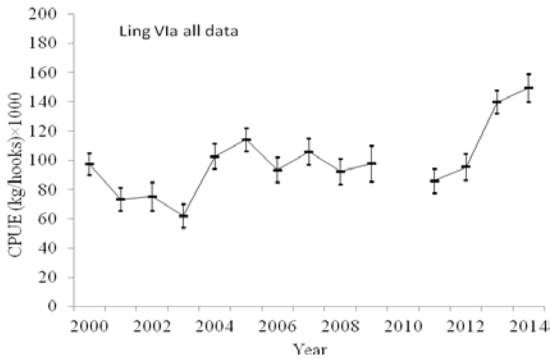
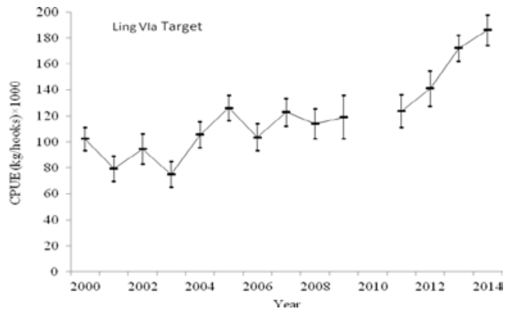
CPUE (kg/hooks)×1000
Year


Ling VIa all data
CPUE (kg/hooks)×1000
Year


Ling VIa Target
CPUE (kg/hooks)×1000

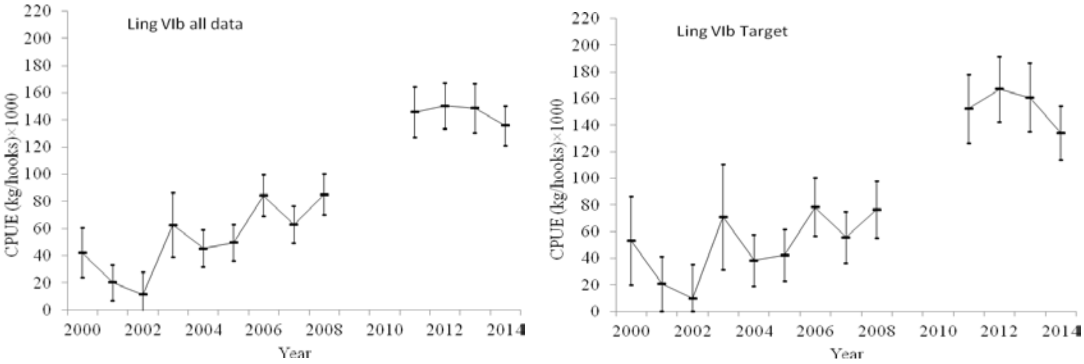
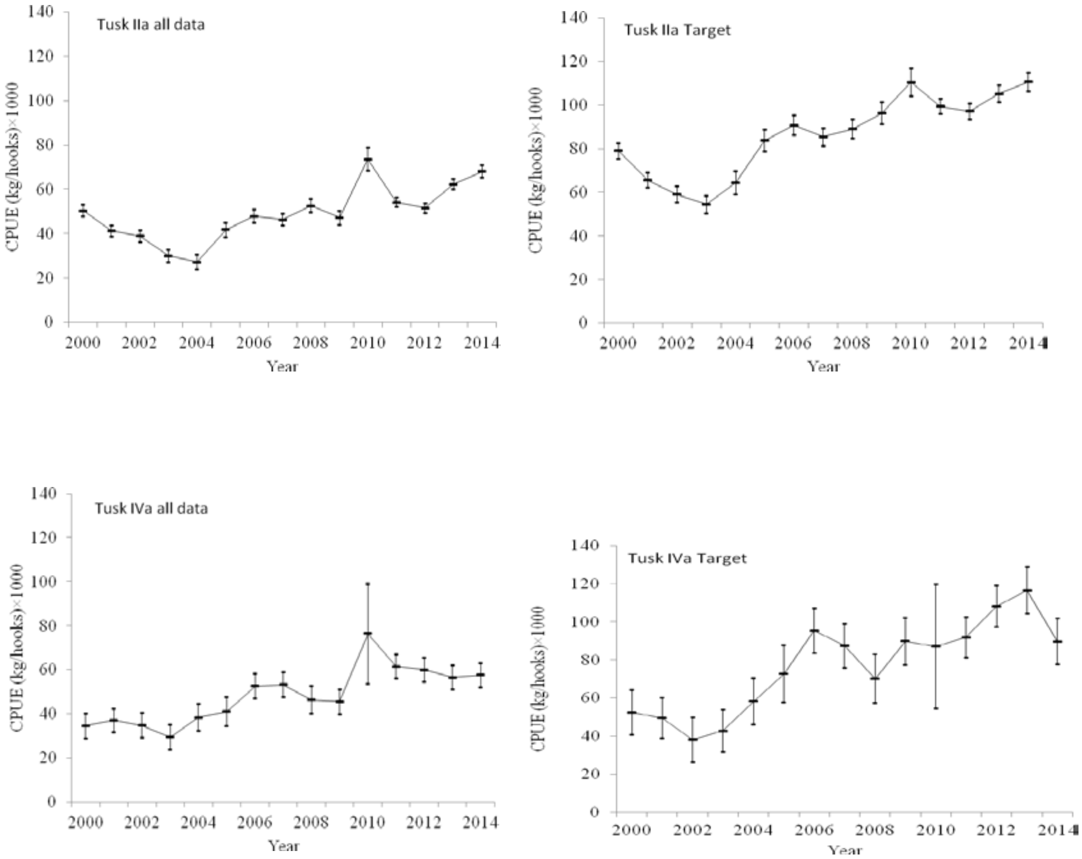


Figure 10. Estimated CPUE (kg/1000 hooks) of ling in Subareas IIa, IVa, Vb, VIa and VIb based on skipper's logbooks during the period 2000-2014. The bars denote the 95% confidence intervals.



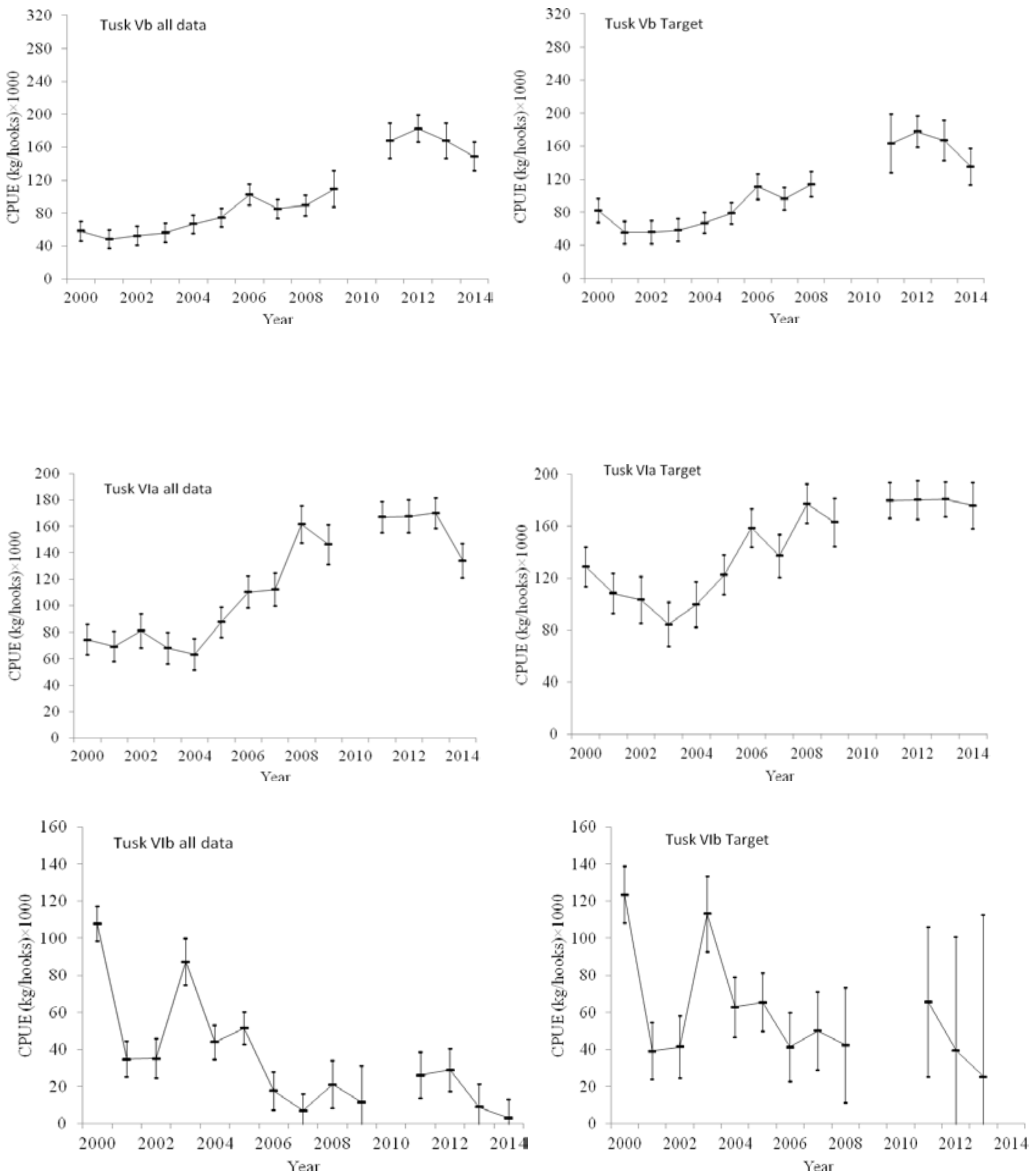


Figure 11. Estimated CPUE (kg/1000 hooks) of tusk in Subareas IIa, IVa, Vb, VIa and VIb based on skipper's logbooks during the period 2000-2014. The bars denote the 95% confidence intervals.

Conclusions and discussion.

Legislation enacted since 2000 for regulating the cod fishery caused a continuous reduction in the number of longliners in the fishery for tusk, ling and blue ling and by 2009, there were only 34 vessels above 21 m in the fishery, and due to new regulations the number of vessels in 2014 was only 26. Because of the reductions in; the number of vessels (64 % reduction since 2000), the total number of hooks employed and the total number of weeks fished, it is quite clear that there has been a significant reduction in effort. Compared with 2000, a decrease in total effort has occurred even though there was an increase in the number of hooks set per vessel/day, and it is quite likely that the amount of applied effort has been reduced to the 1998-level (Figures 5 and 6).

During the period 1998 through 2003, the total landings declined from 32 675 to 19 000 tons, while the catch-per-vessel remained relatively constant. The total catches were fairly stable in the years 2004 through 2006, but after that there was a sharp increase in 2007 and 2008. The average catch-per-vessel has increased considerably during the period 2003- 2008, afterwards the catch has been relatively stable.

It should be noted that using the total landings as a measure of stock development can be very misleading. For example, there is a negative correlation between the landings of cod and the total landings of ling, blue ling and tusk (Figure 2), which is due to cod being the most valued species. Therefore, in this case the decrease in total landings does not indicate a reduced stock size, but only an increase in cod quotas.

If a stock is not covered by a scientific survey, then a commercial cpue index is often used to track temporal trends in abundance. It is widely recognised that caution must be used when interpreting a cpue series based on commercial catch data. But by considering: the application and distribution of fishing effort; species specific knowledge, such as if and when a species is targeted or if it is a preferred species; patterns in the total catch by fleet and by vessel; etc., then based on all these factors, a reliable assessment may be made of a stock's condition.

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Table 1. Summary statistics for the Norwegian longliner fleet during the period 1995-2014 (vessels exceeding 21m).

Year	Number of longliners	Total landed catch by fleet	Catch per vessel (Tons)
1977	36	8471	235
1978	38	9563	252
1979	40	14038	351
1980	41	15651	382
1981	44	15002	341
1982	46	19079	415
1983	43	18338	426
1984	41	18398	449
1985	44	21364	486
1986	42	19080	454
1987	48	17788	371
1988	53	16253	307
1989	53	29816	563
1990	51	27726	544
1991	54	27979	518
1992	61	29718	487
1993	60	32290	538
1994	59	26908	456
1995	65	26571	409
1996	66	28645	434
1997	65	20173	310
1998	67	32675	488
1999	71	31528	444
2000	72	28391	394
2001	65	23681	364
2002	58	24619	424
2003	52	18969	365
2004	43	17815	414
2005	39	19106	490
2006	35	19475	556
2007	38	23060	607
2008	36	25069	696
2009	34	21158	622
2010	35	24360	696
2011	37	20344	550
2012	36	22302	620
2013	27	16522	612
2014	26	16907	650

Table 2. Average number of days that each Norwegian longliner operated in an ICES subarea/division.

Tusk	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
I	3	1	5	5	6	5	1	5	4	6	4	12	9	6	5
IIa	34	57	66	58	60	69	67	89	92	87	93	103	78	63	66
IIb	1		2		1	2	1	3	4	2	2	4	4	2	2
IVa	18	22	28	19	21	25	37	26	30	56	2	21	25	22	31
IVb	1			2						2					
Va		1		3	2	2	3	2	4	2	3	2	2	2	2
Vb	11	18	20	25	34	21	11	15	14	4		1	2	1	4
VIa	12	14	12	12	14	23	13	10	15	7		9	5	11	9
VIb	4	6	8	5	5	8	7	6	5	2	4	4	4	3	3
VIIc	2	1			1	0		0					1		
XII	1	3													
XIVb	2	1	2	1	3	3				1	2		2	1	2
All areas	88	124	141	130	148	158	140	157	169	159	112	155	132	111	125

Ling	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
IIa	23	40	50	40	37	51	54	65	52	65	70	73	59	44	53
IIIa	+			1					1	1					
IVa	19	22	29	20	22	25	38	27	25	49	3	21	26	22	31
IVb	1	+		1				3				3	1	1	1
Va		1		3	2	2	3	2	4	2	3	4	2	2	2
Vb	12	17	18	24	34	21	11	15	11	4		2	2	1	4
VIa	13	13	11	12	14	23	13	10	9	7		8	5	11	9
VIb	4	5	7	4	5	8	7	6	2	2	7	4	5	4	4
VIIc	3	1			1	+		1					1		
XIVb															1
All areas	76	100	114	104	115	126	126	128	104	130	83	113	98	85	106

Blue ling	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
IIa	1	1	1	1	+	+	1	1	2	1	2	2	1	1	1
IVa	1	+	1		1	1	2	2	4	4	1	2	2	2	3
Va		1		1	2	1	2	1	3	2	2				1
Vb	4	3	4	5	5	1	4	5	4	3		1	2	1	2
VIa	9	6	4	8	6	10	8	6	10	6		7	5	8	5
VIb	1	1	2	2	+		+	1							1
XII	2	5		2											
XIVb	+		+	+	+	+			1	1	2		1		1
All areas	18	15	11	14	14	14	18	16	25	17	7	12	12	13	12

Table 3. Average number of hooks the Norwegian long liner fleet used per day in each of the ICES subareas/divisions and in the total fishery for the years 2000-2014 in the fishery for tusk, ling and blue ling. n is the total number of days with hook information contained in the logbooks.

All		I	IIa	IIb	IIIa	IVa	IVb	Va	Vb	VIa	VIb	VIIc	XII	XIVb	All areas
2000	**Average**	31688	31439	35409	30250	29378	30263		24594	22763	30471	29600	18136	2815	28325
	n	353	1916	71	4	685	38		411	435	227	80	22	191	4429
2001	**Average**	33325	30703	34638		30553	33500		26760	24419	30340	33108	17548	2465	28743
	n	163	2196	315		727	10		613	447	140	37	175	135	4958
2002	**Average**	35432	33431	34756		32291	33867		25939	21484	31557			9458	30432
	n	263	2031	45		667	15		475	186	149			251	4083
2003	**Average**	35045	34766	34776	33037	33484	32559	22605	29513	29421	31325		13063	11515	31794
	n	376	1839	67	27	510	34	38	515	302	97		48	228	4081
2004	**Average**	32431	33475	31859		30934		25815	31804	25636	31559	25250		12474	31285
	n	433	1389	217		439		54	693	308	111	28		105	3777
2005	**Average**	32671	32861	35082		34039		23100	29885	24807	35949	33429		18960	31438
	n	316	1248	207		331		30	374	369	137	7		91	3110
2006	**Average**	33182	35140	39298		34561		21526	27943	22504	32273				32959
	n	187	1252	57		673		57	159	248	139				2711
2007	**Average**	34380	35207	37881	35000	33414	38086	25414	30681	25958	36400	31071			34110
	n	318	2103	328	8	587	58	58	355	249	145	14			4223
2008	**Average**	36833	36890	39650	36467	34056	31500	32704	27968	26319	33514			9464	35042
	n	96	1500	297	15	395	10	71	188	138	35			45	2790
2009	**Average**	39184	39142	43744	34636	38299	30167	26106	28123	24455	43645			7034	38127
	n	267	1419	281	11	680	6	33	57	99	31			38	2922
2010	**Average**	40519	38057	41607		38838		20182	25067		47904			7672	37296
	n	19	1089	135		37		11	30		52			58	1491
2011	**Average**	37205	36260	35280	35275	32737	37343	28062	26492	26424	34727			25750	34668
	n	411	3622	126	8	740	104	63	24	310	137			4	5549
2012	**Average**	36434	37298	38357		34639		33647	21702	21249	33934	39064		9091	35381
	n	307	2817	157		933		68	63	196	176	22		59	4765
2013	**Average**	39500	37500	42000		36500	43000	30900	26000	24700	36700	31000		27500	35600
	n	211	2073	81		710	34	69	34	351	132	10		36	3678
2014	**Average**	37699	36782	39660		36715	44614	35015	34000	26979	36551			22374	35676
	n	112	1501	44		707	22	46	101	214	97			65	2909

Table 4. Estimated total number of hooks (in thousands) that the Norwegian longliner fishery for tusk, ling and blue ling used in each of the ICES subareas/divisions and in the total area for the years 2000-2014.

All	**I**	**IIa**	**IIb**	**IIIa**	**IVa**	**IVb**	**Va**	**Vb**	**VIa**	**VIb**	**VIIc**	**XII**	**XIVb**	**All areas**
2000	20534	117708	5099	218	50765	4358		23020	19667	21939	4262	1306	1216	267161
2001	10831	127724	20263		43691			31309	22221	11833	2152	5703	481	276508
2002	20551	143486	4032		54313			30089	14953	14642			4389	289469
2003	21868	131972	5425	1718	36565	1693	3526	38367	18359	9773		2038	5389	279406
2004	27891	107957	15069		29264		2220	46497	15433	6785	1086		4827	262325
2005	29306	103808	19155		33188		1802	24476	24187	11216	521		3697	248895
2006	12775	89783	4126		45966		2260	10758	10239	7907				183567
2007	19081	131569	29434		33381	4228	1881	17028	9604	8081	1150			253676
2008	9282	119524	25693	1313	31876		4709	11075	9475	2413			681	215719
2009	25313	137075	29746	1178	63806	1026	1775	3825	5820	2968			717	273523
2010	11345	138527	18931		4078		706	2632		8383			1343	189277
2011	16965	141922	5363		26124	4257	2133	1007	9037	5279				209464
2012	11805	104733	5523		32422	1230	2423	1566	3825	6108			655	171952
2013	7821	77963	2772		26500	1419	2039	858	8966	3633			1815	133752
2014	4901	63118	2062		29592	1160	1821	3536	6313	3801			1163	116875

WD WGDEEP 2015

Tusk in Faroese waters (Vb)

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Introduction
The objective for this document is to provide information on tusk from the commercial fisheries and surveys in Faroese waters (Division Vb).

1 The fishery
Tusk was mainly caught by longliners (around 90%), and the rest was mostly caught as bycatch by large trawlers. The main fishing grounds for the longliners targeting tusk in Faroese waters was on the slope around the Faroes Plateau, Faroe Bank, Bill Bailey bank and Lousy bank (Appendix 1). In addition, fishery also occurs on the Wyville-Thomson ridge. The fishing depths were usually deeper than 200 m.

2 Landings trends
The nominal landings of tusk in Faroese waters were mainly bycatch by the British trawlers until the 1950ies when the Faroese longline fishery of tusk started. In the latest years, foreign catches was mainly by the Norwegian longliners. There was no bilateral agreed quota between Norway and Faroe Islands in 2011-2013, which probably was the reason for the small foreign catches in that period.

Since 2000, the landings have varied between 3000 and 4000 tons, with a peak in 2010 of 5000 tons (Figure 1). There was a decrease in the catch from around 4000 tons in 2012 to only 1500 tons in 2013 (1464 tons Faroes and 36 tons France). In 2014 the total preliminary catch of tusk in Faroese waters has increased to 2430 tons (1764 tons Faroes, 32 tons France, 633 tons Norway).

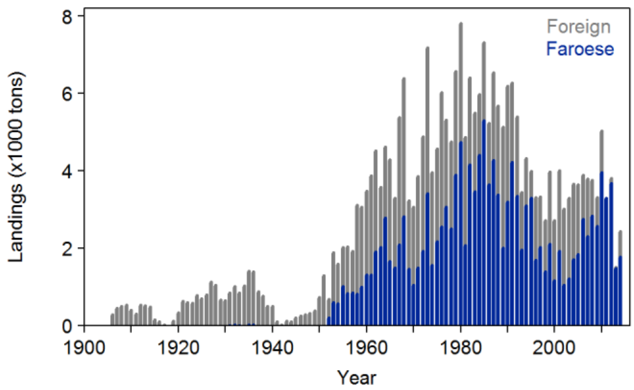


Figure 1. Tusk Vb. Nominal landings in Faroese waters from 1906 to 2014.

3 ICES Advice
Advice for 2013 and 2014: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 8500 tonnes.

4 Management
In Faroese waters there are a licensing scheme and effort limitations. The recommended minimum landing length for tusk is 40 cm. Usually there is a bilateral agreed quota between Norway and Faroe Islands, but no such agreement was in 2011-2013. In 2014, Norway could catch 1250 tons ling/tusk and 1025 tons tusk in Faroese waters.

5 Data available
Data on length and gutted weights of tusk were available from the commercial landings (Table 1). There are no tusk otolith samples from the landings since 1999. Also there are available lengths and round weights of tusk from the

annual spring and summer groundfish trawl surveys available and from the Greenland halibut trawl survey. In addition, gutted weights, gender, maturity and otoliths of total 840 tusks were sampled in these surveys in 2013-2014.

Table 1. Tusk Vb. Overview of the sampling level of tusk from the commercial landings.

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Length	10004	9021	7049	4693	1581	2380	2043	4075	3776	5106	4583	2750	1283	1671	1680	1720	832	606	623
Gutted w.	358	480	359	238					1380	3128	3178	1648	1283	1488	1680	1299	628	606	623
Age	810	1567	1383	600															

Spatial distribution

Tusk catches in the annual spring and summer groundfish surveys are mainly distributed deeper than 200 m (Appendix 2-4). Tusk was caught on depths from 450 m to 550 m on the Faroe Plateau slope as bycatch in the annual Greenland halibut trawl survey (Appendix 5). In 2014, a deepwater survey was conducted in Faroese waters and the largest amounts of tusk were caught on the Wyville-Thomson ridge (Figure 2).

Juvenile tusk (2-3 cm in length), caught in the annual 0-group trawl survey in June/July, and are distributed both on the Faroe Plateau and on the Faroe Bank (Appendix 6).

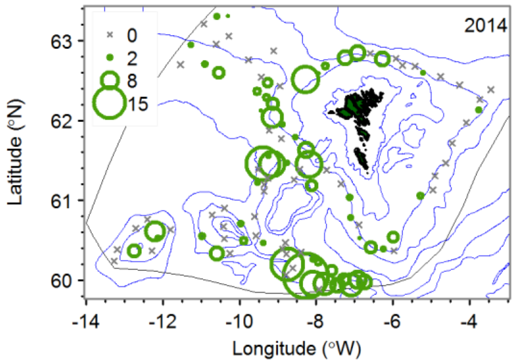


Figure 2. Tusk Vb. Distribution of tusk (kg/h) in the Faroese deepwater survey in September 2014.

5.1 Landings and discards

The landing statistics was available for all relevant fleets in Faroese waters. There is no estimate of discards in Faroese waters because there is a ban on discarding, and incentives for illegal discarding are believed to be low. The landing statistics and logbooks are therefore regarded as being adequate for assessment purposes.

5.2 Length composition

Length distribution from the commercial catches by Faroese longliners were presented for the period 1994-present (Figure 3). The estimated mean lengths from the longliners varied from 46 to 56 cm, and there was no downward trend in mean lengths with year (Figure 3). The commercial longline catches had fish lengths mainly between 40 and 60 cm.

Length distributions of tusk from four different trawl surveys conducted in Faroese waters: the annual Faroese spring (1994-present, Figure 4) - and summer survey (1996-present, Figure 5), the annual Greenland halibut survey (1995-present, Figure 6) and a deepwater survey (2014, Figure 7).

The mean length in the spring and summer groundfish surveys varied between 43 and 55 cm (Figure 4 and 5). The length distributions from these surveys are noisy and some lengths seem to be overestimated (especially small fish). The reason behind this is probably that small tusk, below commercial landing size, are sampled as a subsample from the catch and thereafter multiplied up to the total catch weight. Very few tusk smaller than 30 cm is caught in these surveys.

The mean length of tusk in the Greenland halibut survey, which used commercial trawl, was quite stable around 55 cm (Figure 6).

The mean length of 150 tusk caught in the deepwater survey was 56 cm (Figure 7).

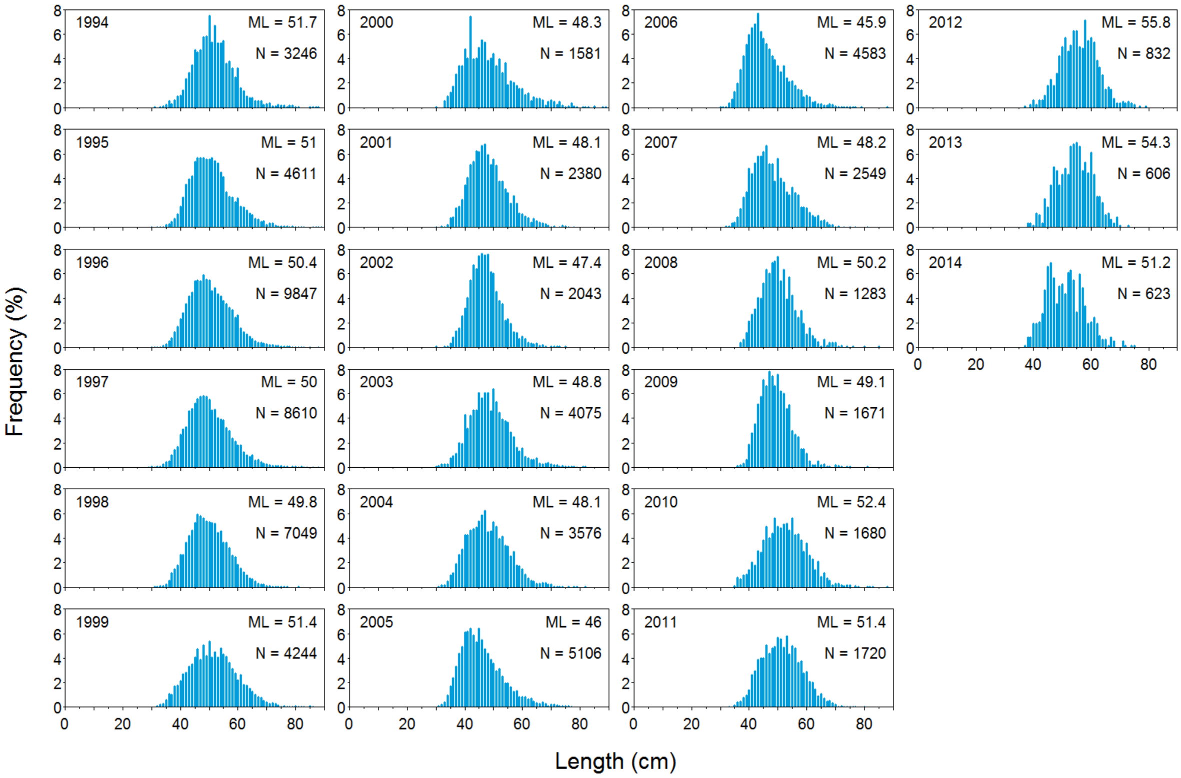


Figure 3. Tusk Vb. Length distribution from the fishery by longliners (>100 BRT).

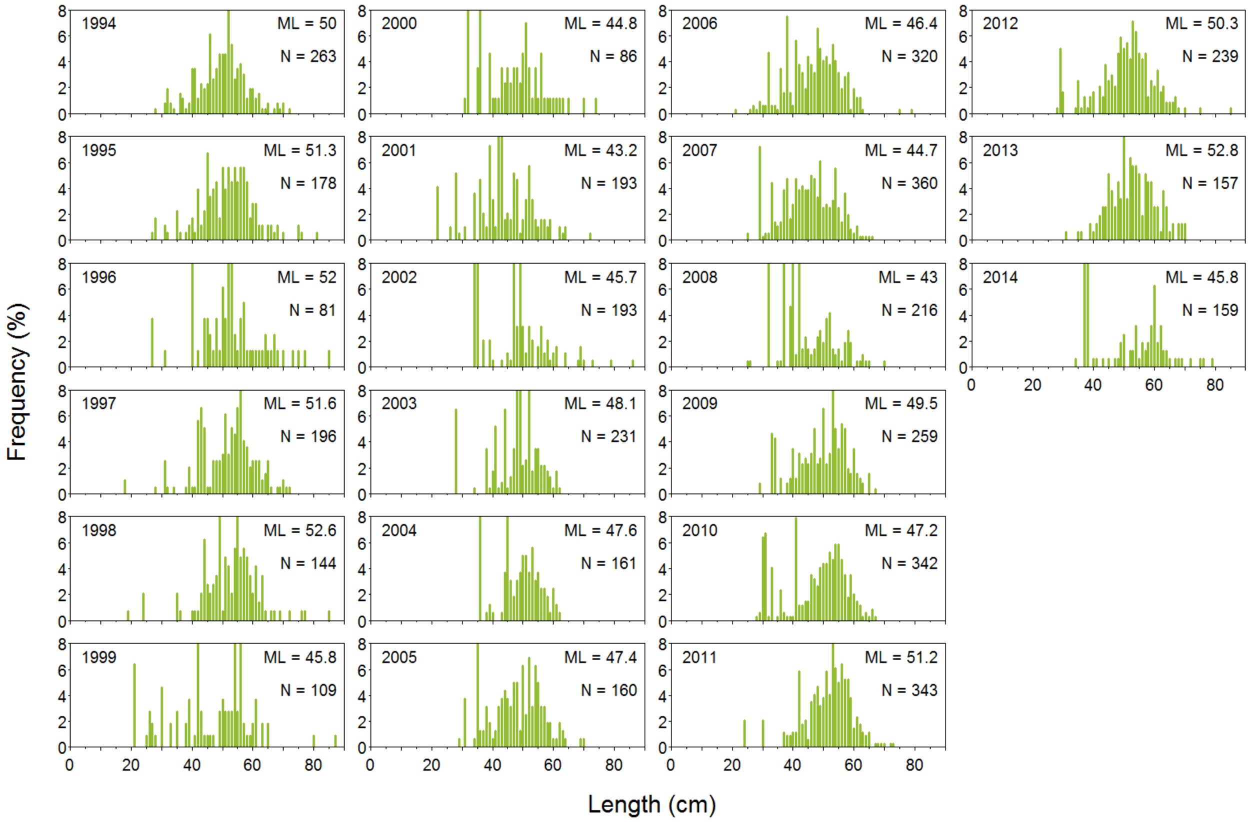


Figure 4. Tusk Vb. Length distribution in the spring groundfish surveys.

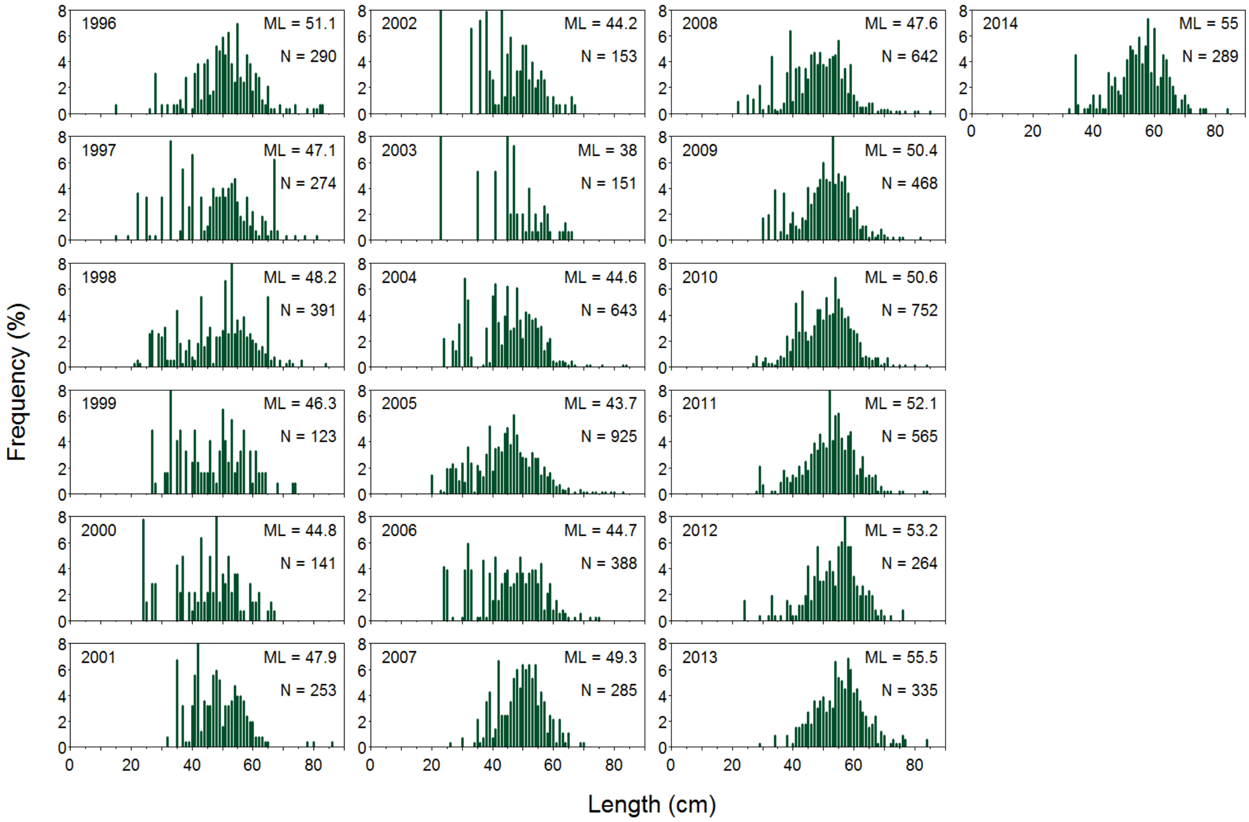


Figure 5. Tusk Vb. Length distribution in the summer groundfish surveys.

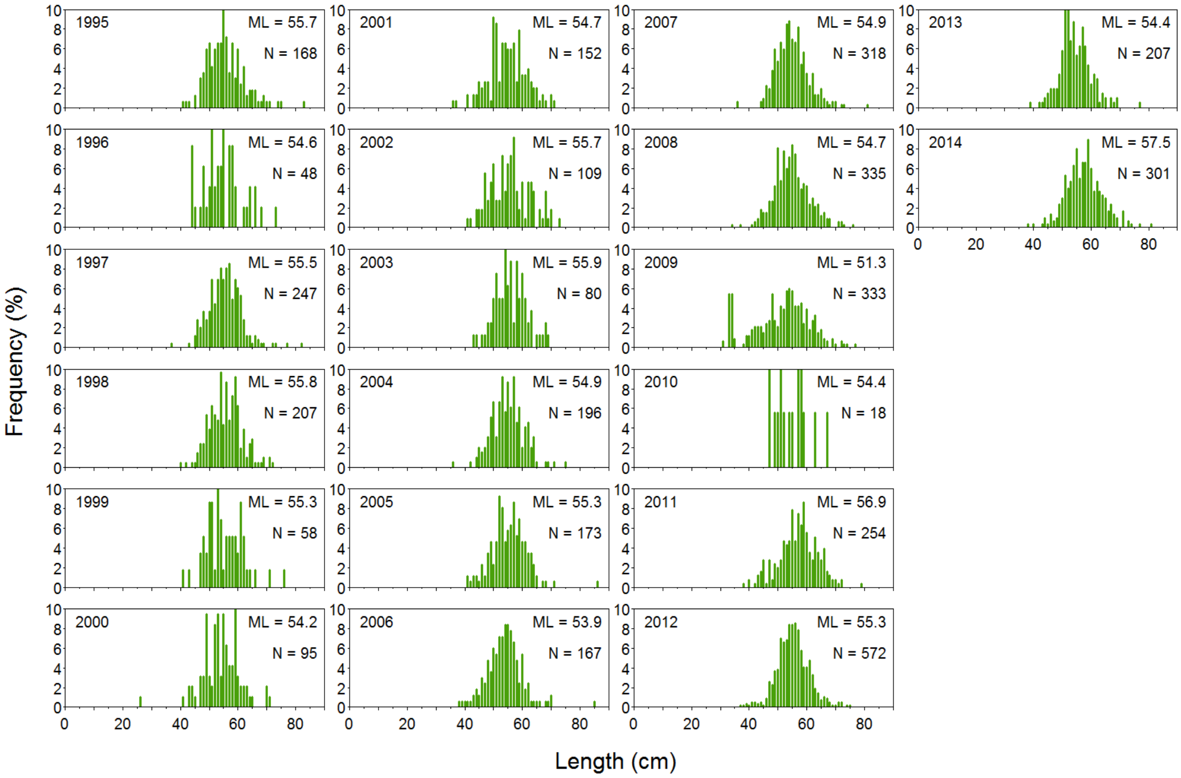


Figure 6. Tusk Vb. Length distribution from the annual Greenland halibut trawl survey.

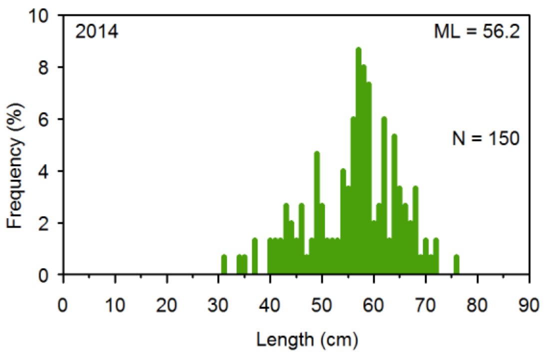


Figure 7. Tusk Vb. Length distribution in the deepwater survey in 2014

5.3 Age composition

A total of 840 tusk otoliths from different Faroese surveys in 2013-2014 were age read and the age-length key from these results were used to do an age composition in the longline fishery (Figure 8). This preliminary results show that the longline landings are largely of 6 to 10 years old fish and the mean age in the catch were around eight years (Figure 8).

Growth, as mean length at age and mean gutted weight at length, of tusk in Faroese waters are presented in Figure 9.

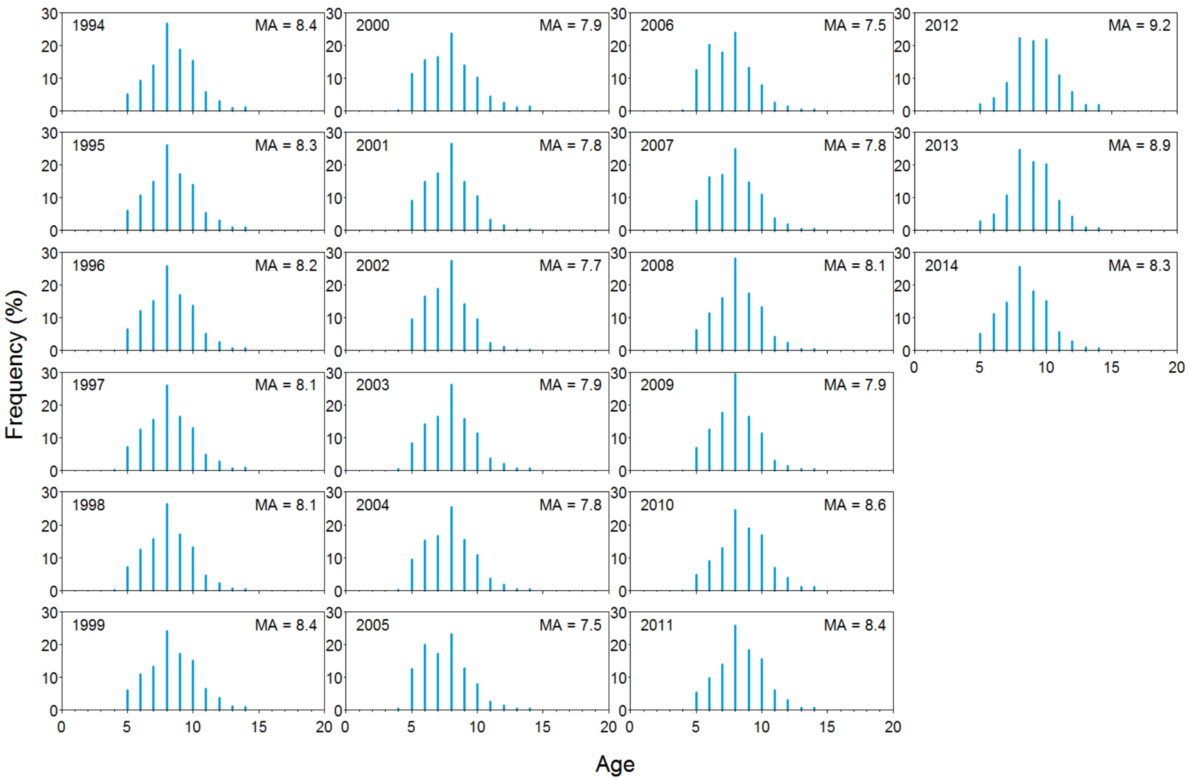


Figure 8. Tusk Vb. Age distribution in the longline fishery.

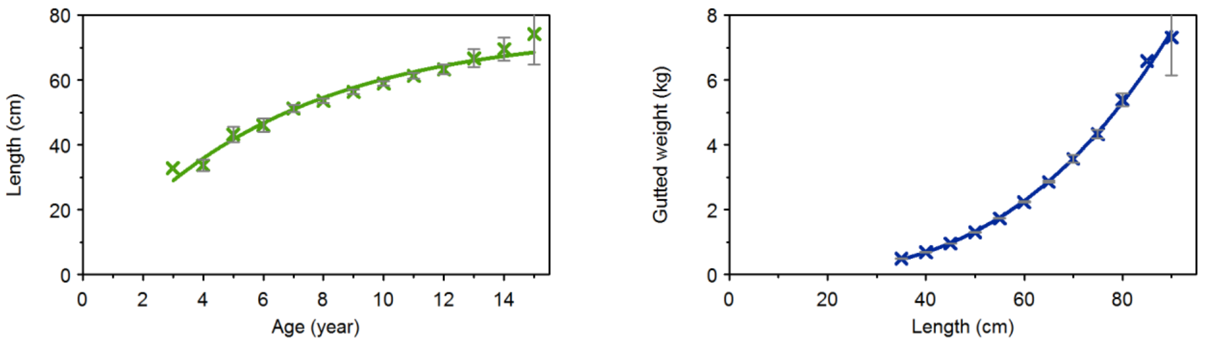


Figure 9. Tusk Vb. Growth of tusk as mean length at age (left figure) and mean gutted weight at length (right figure).

5.4 Weight-at-age

Mean weight at age of tusk in the commercial catches in Faroese waters are presented in Figure 10. The mean weight at age was relative stable during the period from 1994 to 2014 with the highest individual weights at age in 2012 (Figure 10).

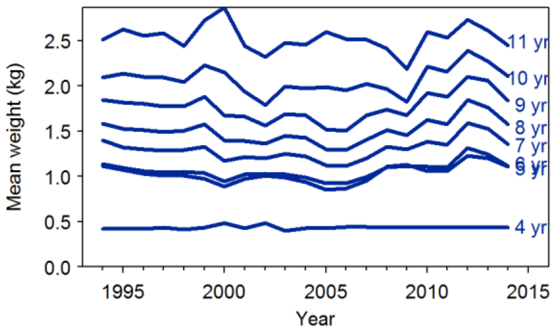


Figure 10. Tusk Vb. Mean weight at age in the landings.

5.5 Maturity and natural mortality

Data on maturity of tusk from different Faroese surveys in 2013 and 2014 indicated a L_{50} around 50-55 cm (N=840) and an A_{50} around 7-8 years (N=840) (Figure 11).

No information is available on natural mortality of tusk in Vb.

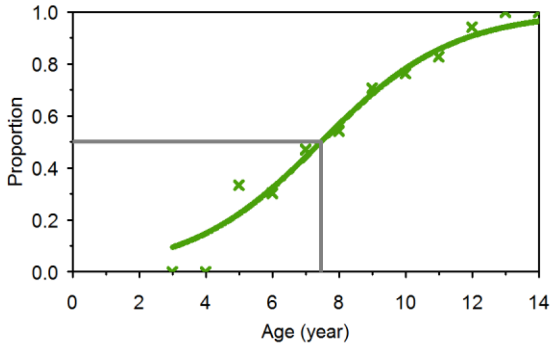


Figure 11. Tusk Vb. Maturity ogive .

5.6 Catch, effort and research vessel data

A standardized commercial CPUE from longliners fishing in Faroese waters was presented (Figure 12). The background data was based mainly on data from logbooks of 5 longliners. The data selected was only from sets where tusk was in the catch, tusk+ling was more than 60% of the total catch and the depth was deeper than 200 m. The CPUE for the period 2005 to 2013 has been quite stable around 50 kg/1000 hooks with a small decrease in the last three years to 40 kg/1000 hooks in 2014 (Figure 12).

Abundance indices from different surveys were presented. A standardized CPUE from the annual Faroese groundfish surveys in spring (1994-present) and summer (1996-present) were presented in Figure 13. Also, CPUE from the spring survey 1983-1993 were presented, and these data are not stratified (Figure 13). These surveys are only conducted down to maximal 530 m, so these estimates are not covering the whole distribution area of tusk. The CPUE from the annual groundfish surveys do also show a decrease during the past three years (Figure 13).

CPUE of tusk caught as bycatch in the annual Greenland halibut trawl surveys was presented in Figure 13. The CPUE from the Greenland halibut survey shows an overall increase since 1999 from around 1 kg/hour to 4 kg/hour in 2014 (Figure 13).

Abundance indices of tusk < 40 cm caught in the Faroese groundfish surveys on the Plateau was presented in Figure 14. Indices of tusk < 40 cm from the two surveys do not show the same trend and the level of the index in the last years are low (Figure 14).

Abundance indices of tusk caught in the Faroese 0-group survey on the Plateau show a very low level in the period 1983-2011, whereas the level has increased in 2012-2013, but decrease again in 2014 (Figure 14).

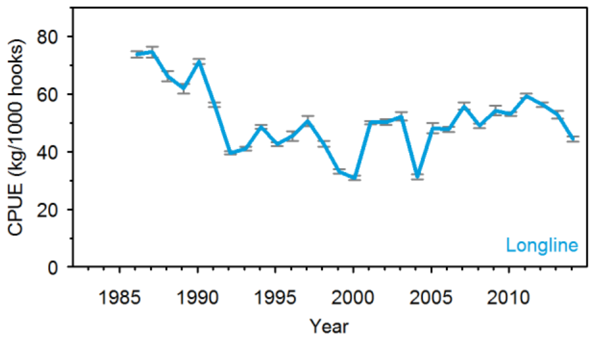


Figure 12. Tusk Vb. Standardized CPUE for 4-5 longliners (<110 GRT) fishing in Faroese waters. Criteria: tusk was in the catch, ling+tusk>60% of total catch and the depth was >200 m.

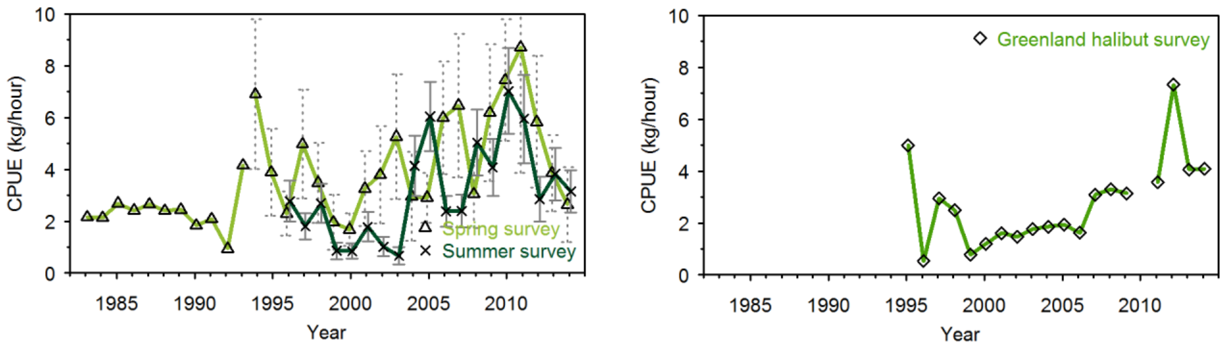


Figure 13. Tusk Vb. CPUE from the annual trawl groundfish surveys (left figure) and from the annual Greenland halibut survey (right figure). The spring survey data from 1983-1993 is not stratified.

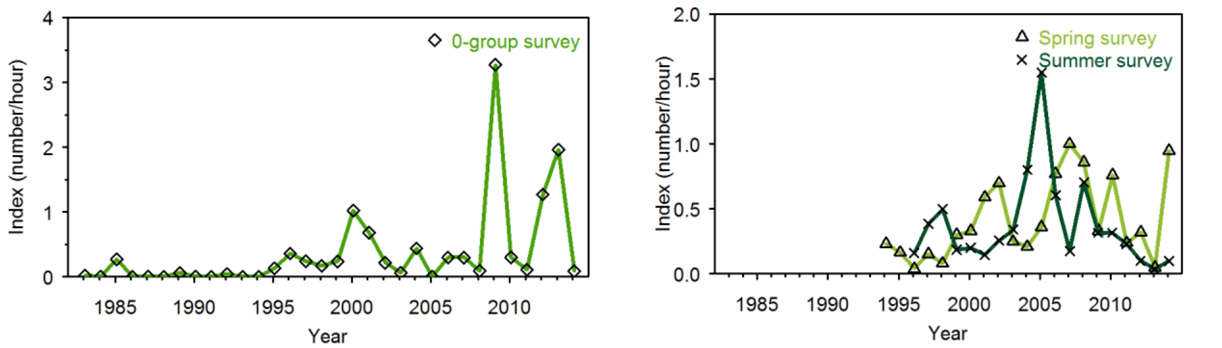
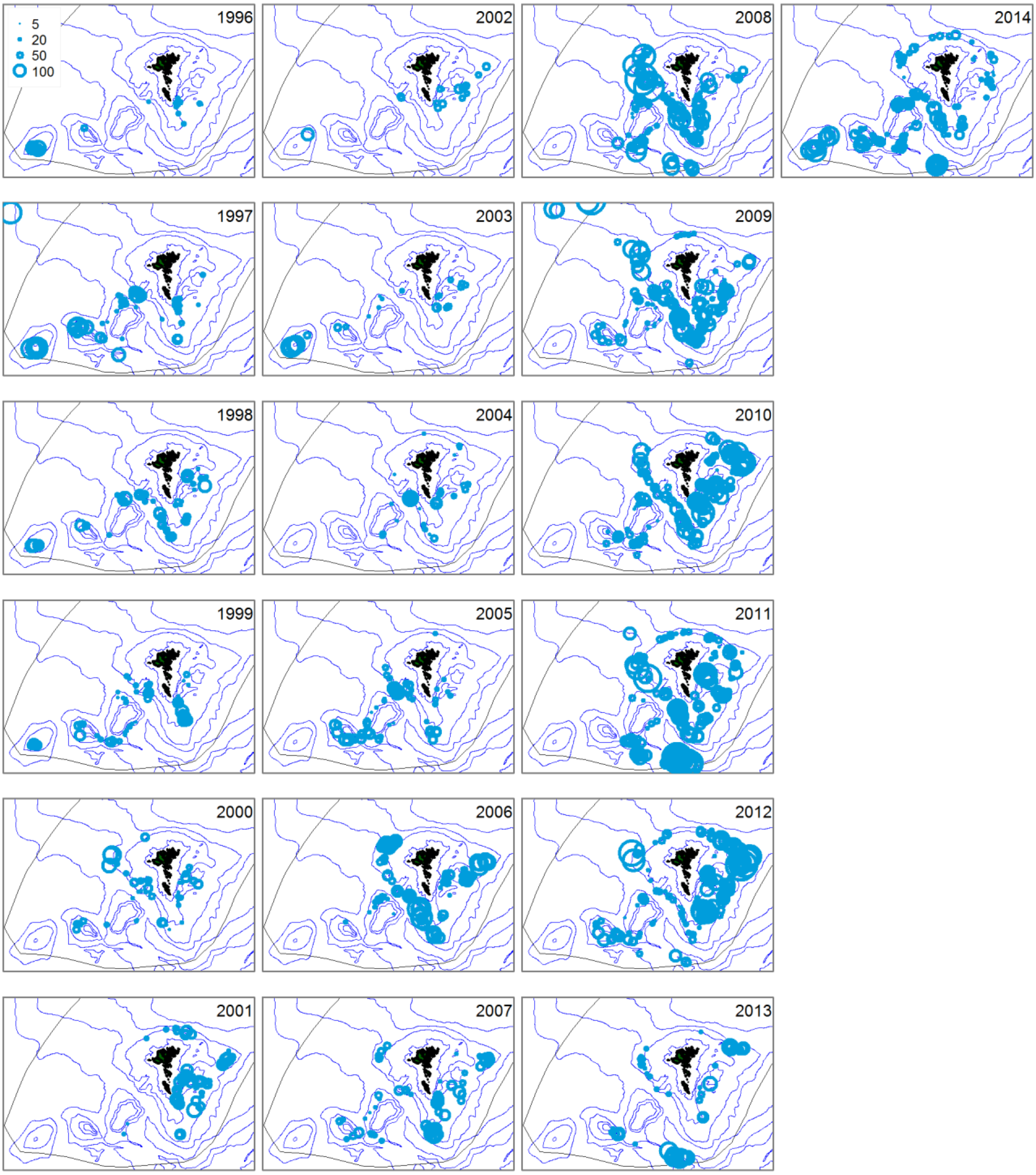


Figure 14. Tusk Vb. Abundance index of tusk (2-3 cm in length) (number/hour) on the Faroe Plateau from the 0-group survey (left figure) and abundance index of tusk < 40 cm in the annual spring- and summer survey (right figure).

Appendix



Appendix 1. Tusk Vb. Distribution of tusk (kg/1000 hooks) from longliners. This data is behind the CPUE index from longliners.

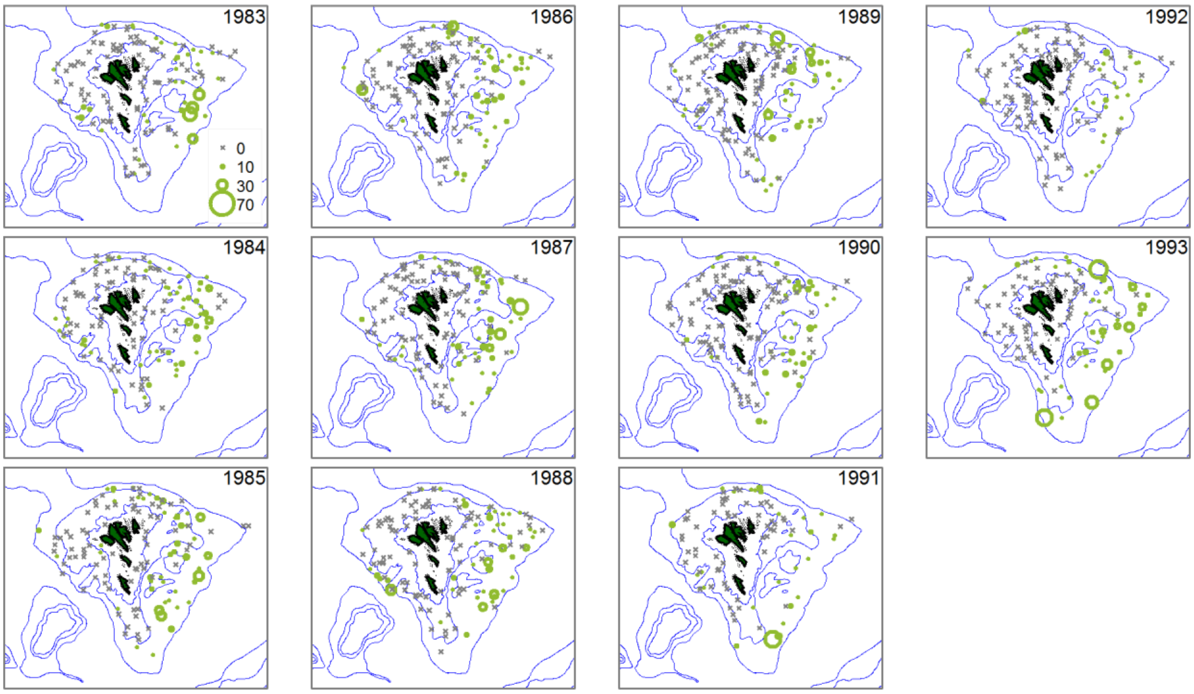


Figure 2. Tusk. Distribution of tusk (kg/h) caught in the spring survey.

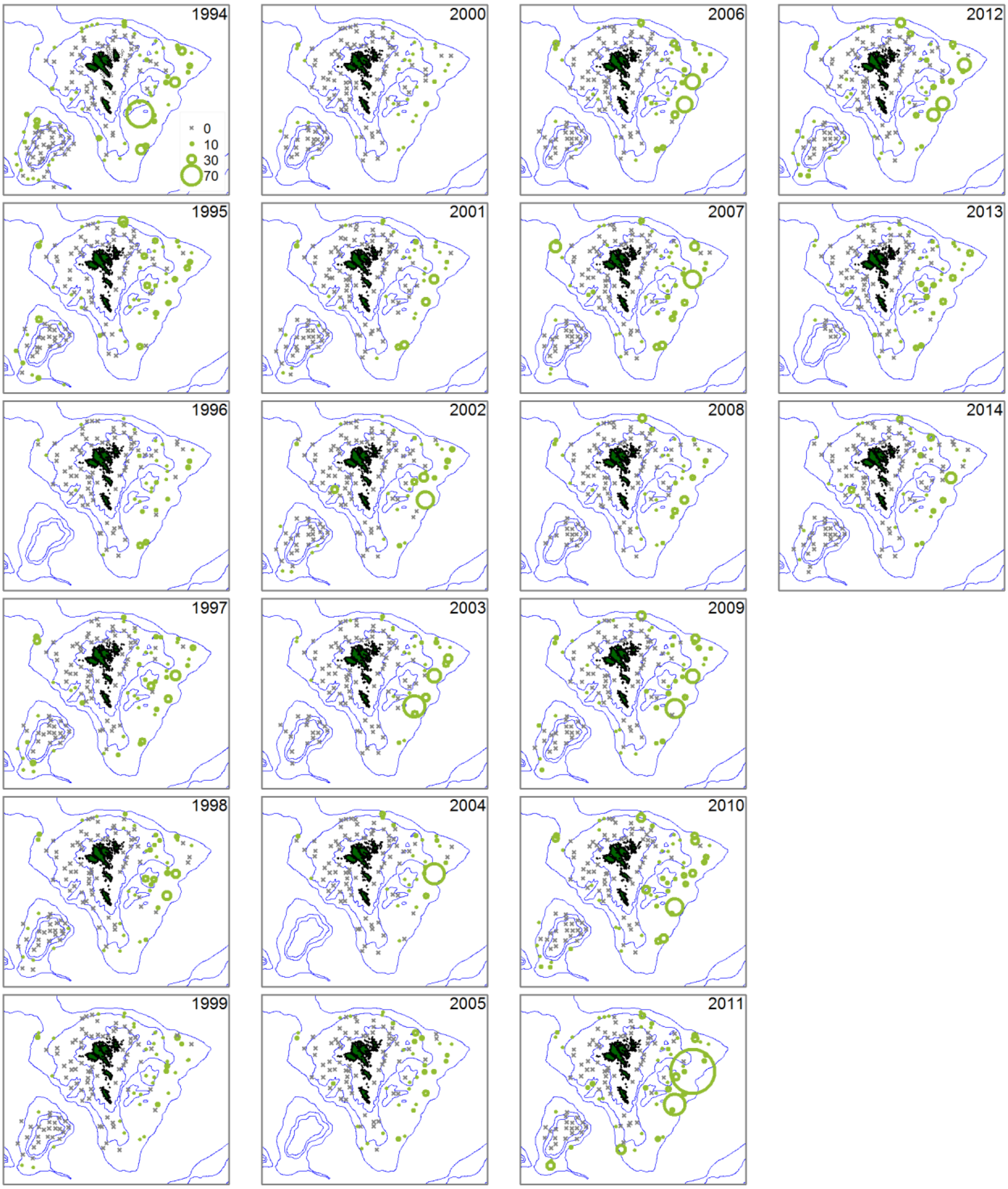


Figure 3. Tusk. Distribution of tusk (kg/h) caught in the spring survey.

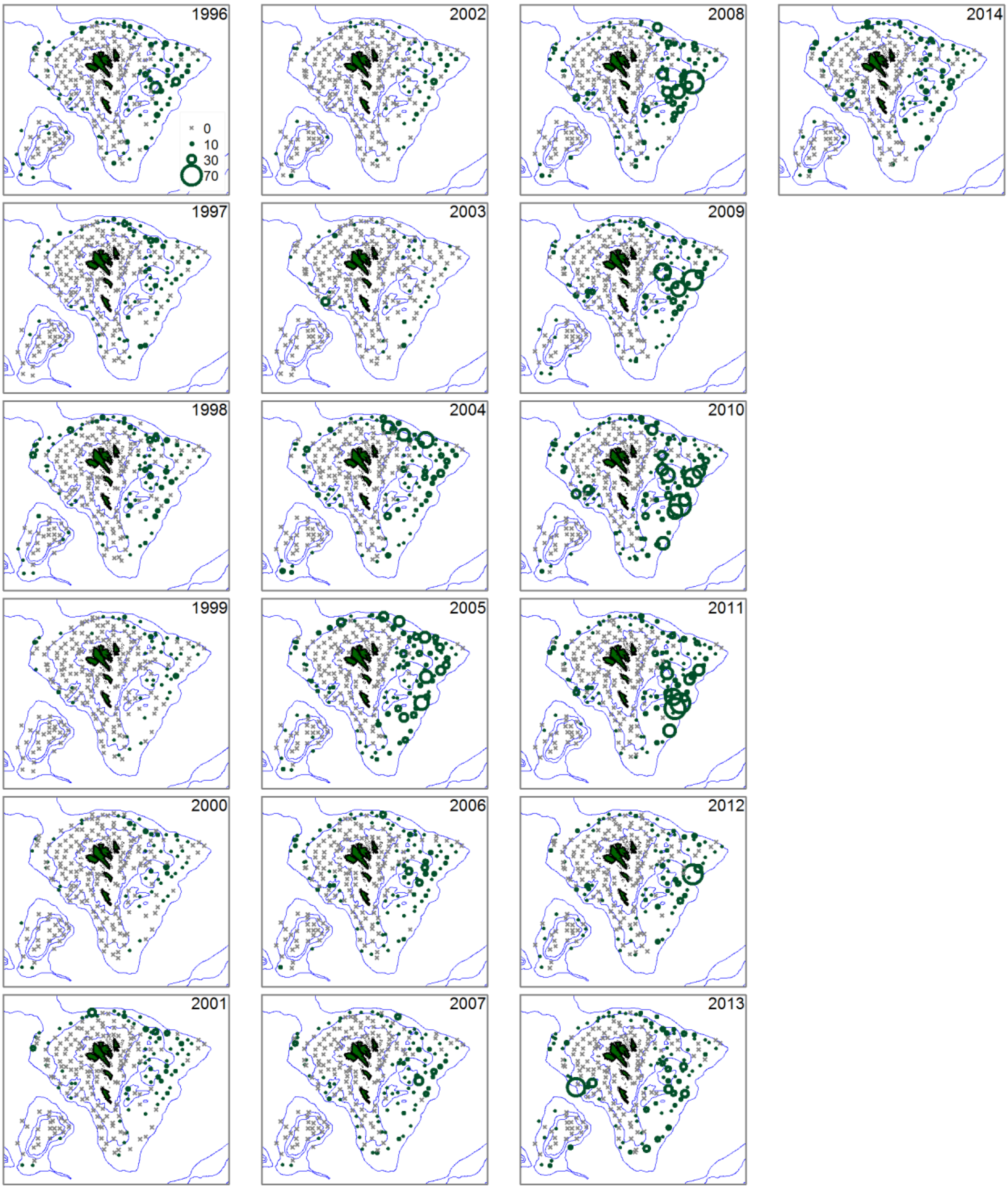
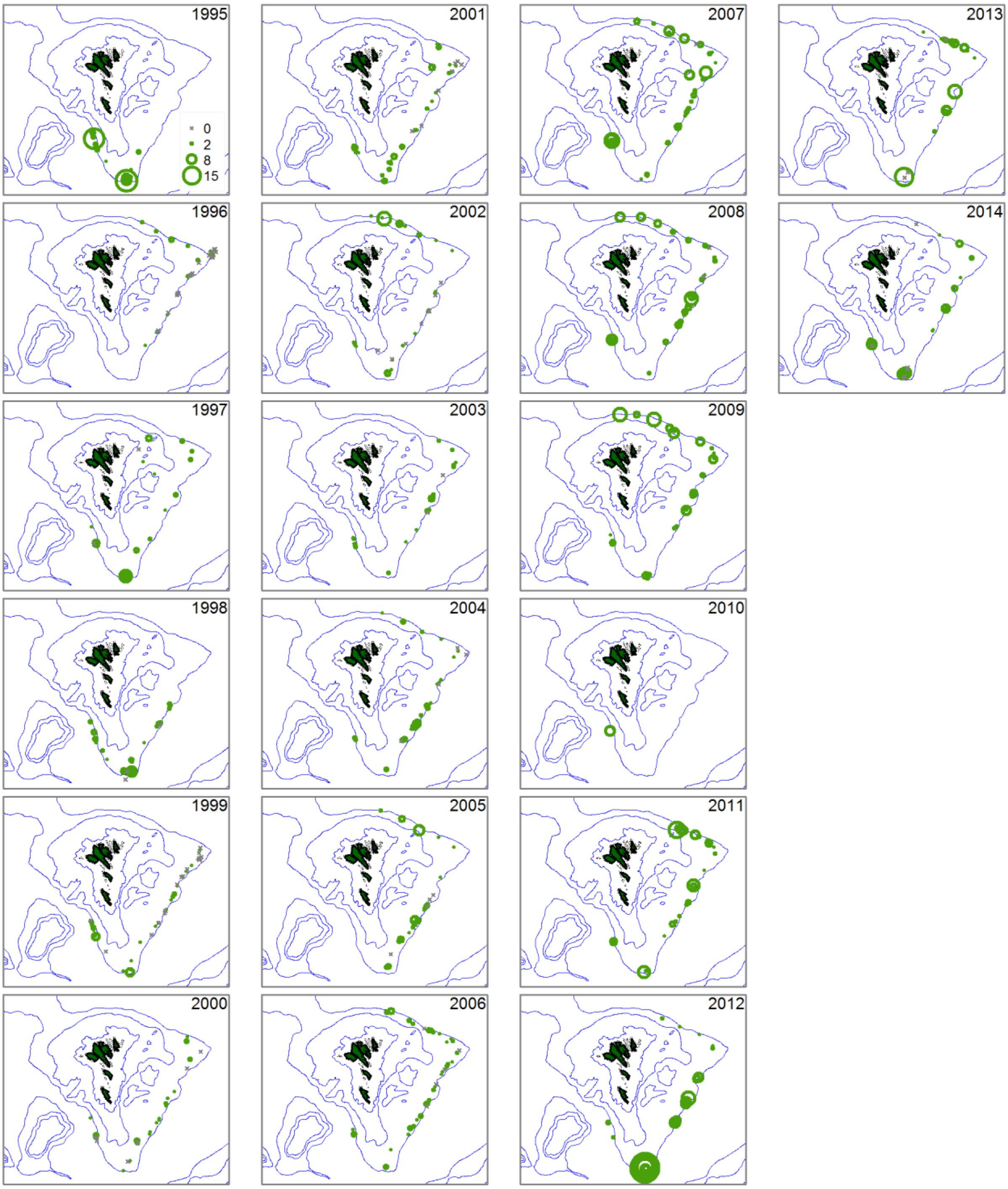
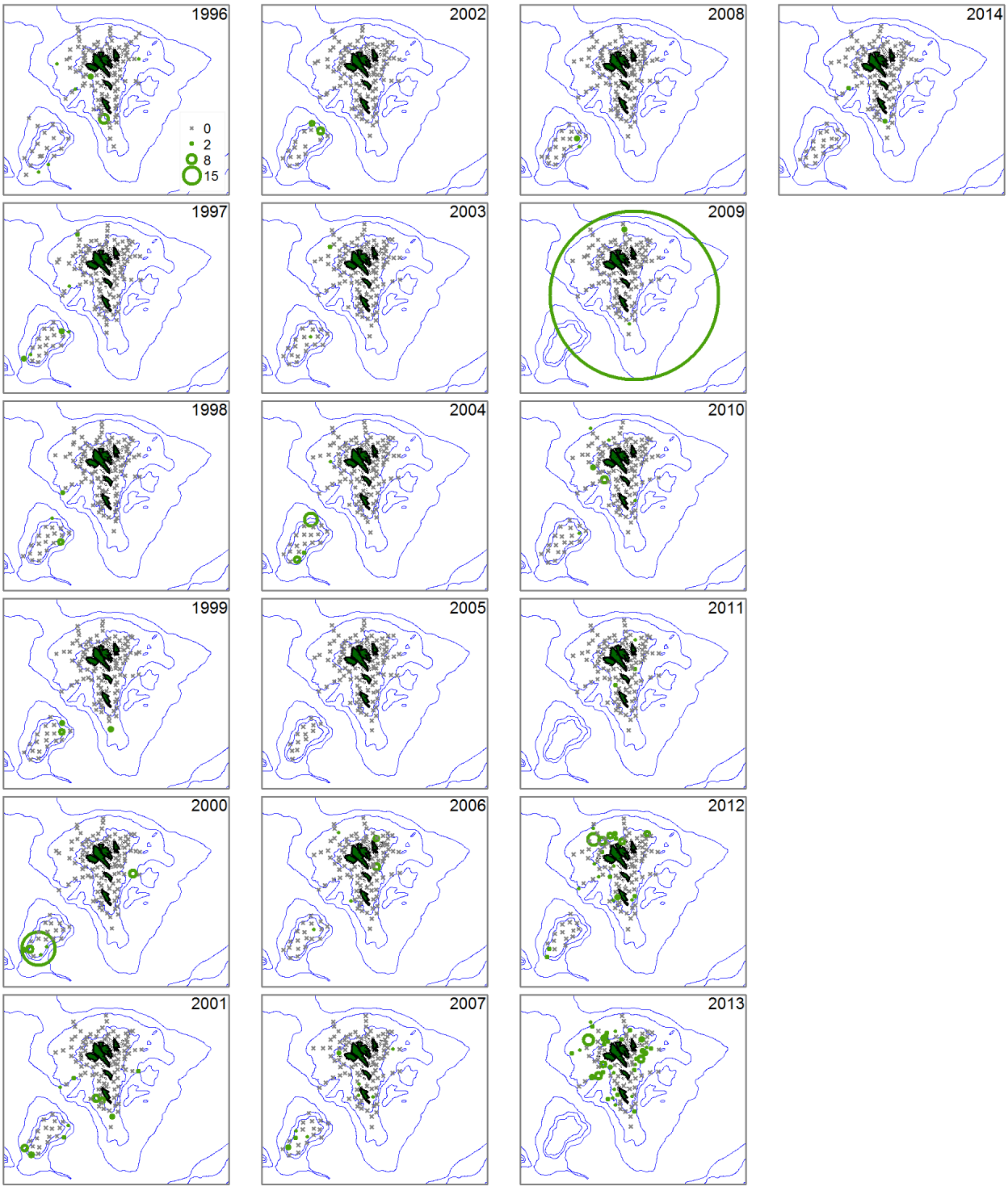


Figure 4. Tusk. Distribution of tusk (kg/h) caught in the summer survey.



Appendix 5. Tusk Vb. Distribution of tusk (kg/h) caught in the Greenland halibut trawl survey, May-June 1995-2014.



Appendix 6. Tusk Vb. Distribution of tusk (number/hour) caught in the annual 0-group survey in June/July.

WD ICES WGDEEP 2015

Stock assessment of greater silver smelt in Faroese waters (Vb).

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(liseo@hav.fo)

Introduction

This working document contains updated information and an age based assessment of greater silver smelt (GSS) in Faroese waters.

In connection with the MSC certification of the fishery of GSS in Faroese waters, the Faroe Marine Research Institute (FaMRI) has been asked to do an annual assessment of GSS in Faroese waters. This year, the catch number at age matrix in the assessment was expanded from 14+ to 21+.

According to the stock/management question regarding GSS it was stated in the report from DNV that 'there is no apparent reason why this assessment should not be put on a par with that for Icelandic GSS fishery and assessment, a fishery and assessment for which the assumptions concerning stock isolation seem to no more nor less robust than those upon which the FaMRI assessment is based' (www.dnv.com, Report No. 2013-021).

Fishery and landings

Historically, greater silver smelt were only taken as bycatch in shelf-edge deep-water fisheries and either discarded or landed in small quantities. Targeted fishery for GSS in Faroese waters did not develop until the mid-1990s. In 2014 the preliminary landings in Faroese waters, from mainly three pairs of pair trawlers, were 11252 t GSS (9747 t in Vb and 1495 t in VIa) (Figure 1). The decrease in catch during the last two years (2012 -2014) can be because the trawlers also participated in the mackerel fishery. The landing data presented are the official landings from 1985-2014, but for the period after 2008 was the Faroese landings in VIa added to the landings used in the assessment since the Faroese fishery in VIa was inside the Faroese 200 nm EEZ just south of Vb border (Wyville Thomsons-ridge).

The fishing depths were around 300-700 m. The fishery has explored new fishing sites during the period and the newest fishing site was on the Wyville Thomsons-ridge south of the Islands (Figure 2 and 3). The geographical range of the directed GSS fishery in Faroe Island was in 2008-2014 west and north of the Faroe Plateau, around the Faroe Bank, Lousy Bank and on the Wyville Thomsons-ridge south of the Islands (Appendix 1). Around 50% of the catch was fished in the newest fishing area on the Wyville Thomsons-ridge since 2012 (Figure 2).

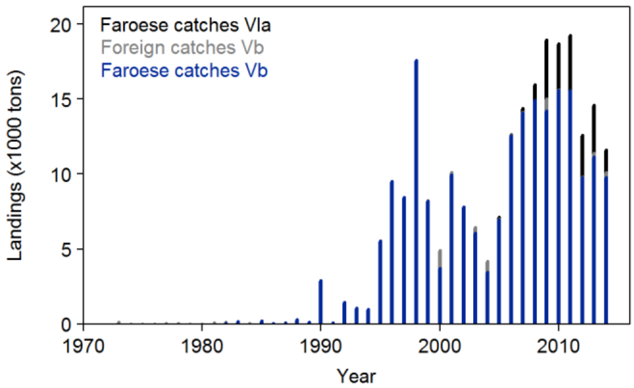


Figure 1. GSS Vb. Landings of GSS in Faroese waters. The total catch is higher than reported ICES catch in Vb for 2007-2014 because the catch caught by Faroese fleet in VIa is added to the total catch in Vb (fished just south of the Vb ICES border but inside the Faroese 200 EEZ border).

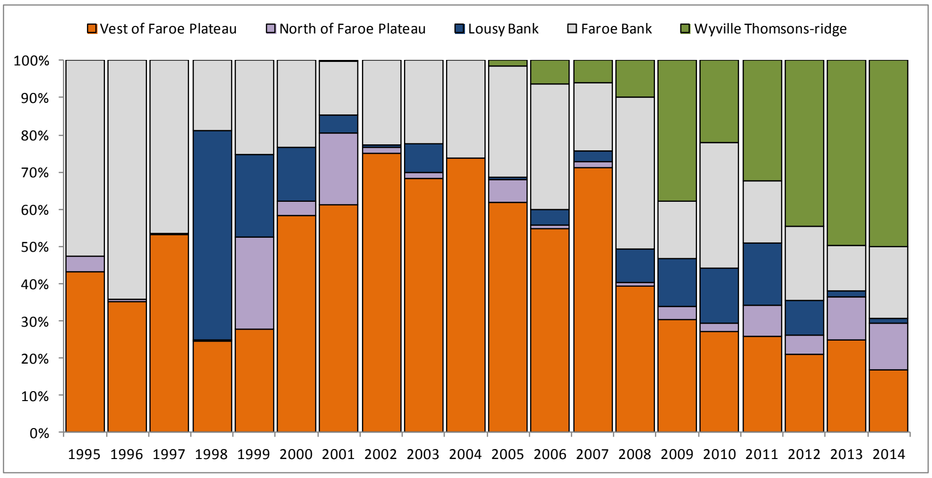


Figure 2. GSS Vb. Distribution of the GSS catch divided in 5 main areas.

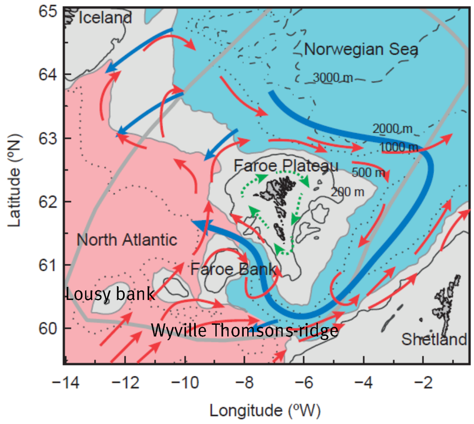


Figure 3. Map of the Faroe Islands showing the location of the Faroe Plateau, Faroe Bank, Lousy bank and Wyville Thomsons-ridge.

ICES Advice
The ICES advice in 2011 was: 'The fishery should not be allowed to expand, and a reduction in catches should be considered, in light of survey data indicating a recent decline.'

The 2012 advice for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012): Based on the ICES approach for data-limited stocks, ICES advices that for GSS in other areas than Va catches should be no more than 31 300 tonnes.

Management
In 2014, the Faroese authorities set a law of species-specific management of GSS in Vb (Kunngerð nr. 36 frá 6. mai 2014 um skipan av fiskiskapinum eftir gulllaksi á føroysku landleiðunum í 2014). The TAC in 2014 was 16 000 tons and 6 trawlers had licenses to direct fishery of GSS. There were also limitations in e.g. bycatch, mesh size and fishing area. There will be set a new TAC for 2015 before the direct fishery of GSS in Faroese waters begins. Other nations are also regulated by TACs. Details on management measures in Faroese waters are given in the Faroe overview.

Data available
1 Landings and discard
Landing data from Faroese vessels are provided by the Faroese Coastal Guard and the data for 2014 is preliminary. Discarding is banned in Faroese waters and there is no available information on GSS discard.

2 Length compositions
The majority of the landed GSS in Faroese waters was between 30 and 45 cm in length (Figure 4). The mean length from the landings has decreased since 1994 from around 45 cm to 38 cm in 1999. Since then the mean length has fluctuated between 36 and 39 cm. The reason for the decrease in mean length is thought to be directed fishery on a virgin stock (WD WKDEEP 2010). The variation in mean length could be due to sampling from different depths in the various areas, as the size of GSS is increasing with depth.

The mean length in the groundfish surveys varied from 26 to 34 cm in the spring and 26 to 30 cm in the summer (Figure 5 and 6).

In WKDEEP 2010 it was suggested to divide the length composition of GSS from the surveys into juvenile and mature individuals, and then calculate the mean length. This is done here, and there is no decrease in the mean length in the period 1994-2014 (Figure 7).

The mean length in the deepwater survey was 39.5 cm (Figure 8). This corresponds very well with increasing mean length with increasing depths.

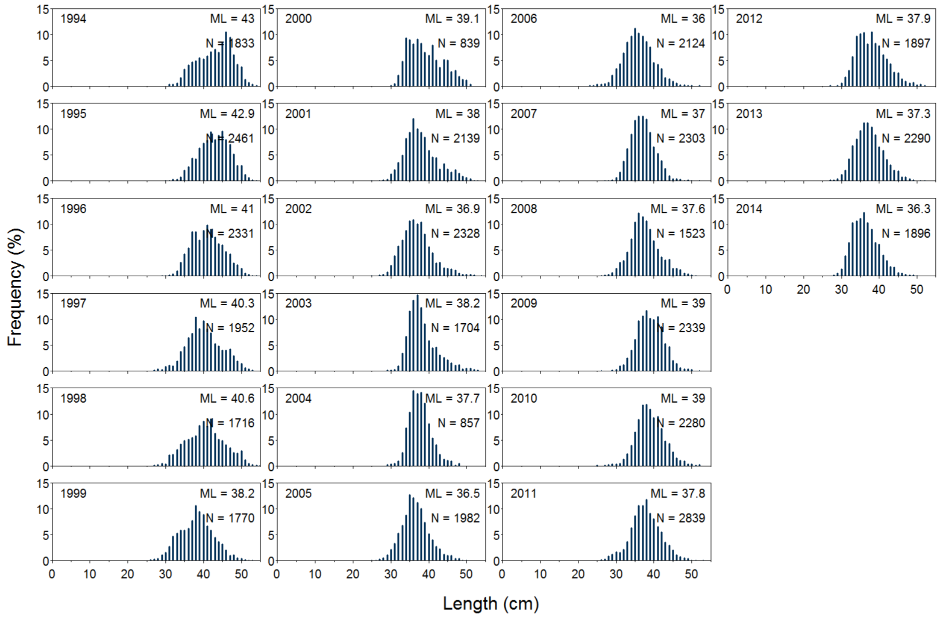


Figure 4. GSS Vb. Length distribution from the commercial trawl landings with mean length (ML) and number of measurements (N).

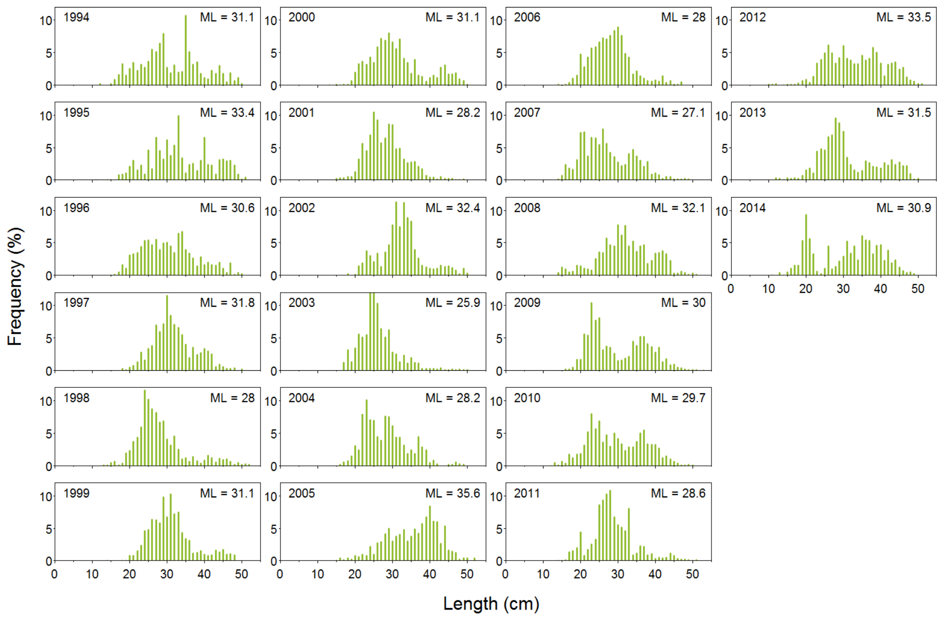


Figure 5. GSS Vb. Length distribution from the spring survey with mean length (ML). GSS is sampled from a subsample of the total catch, so the values are multiplied to total catch.

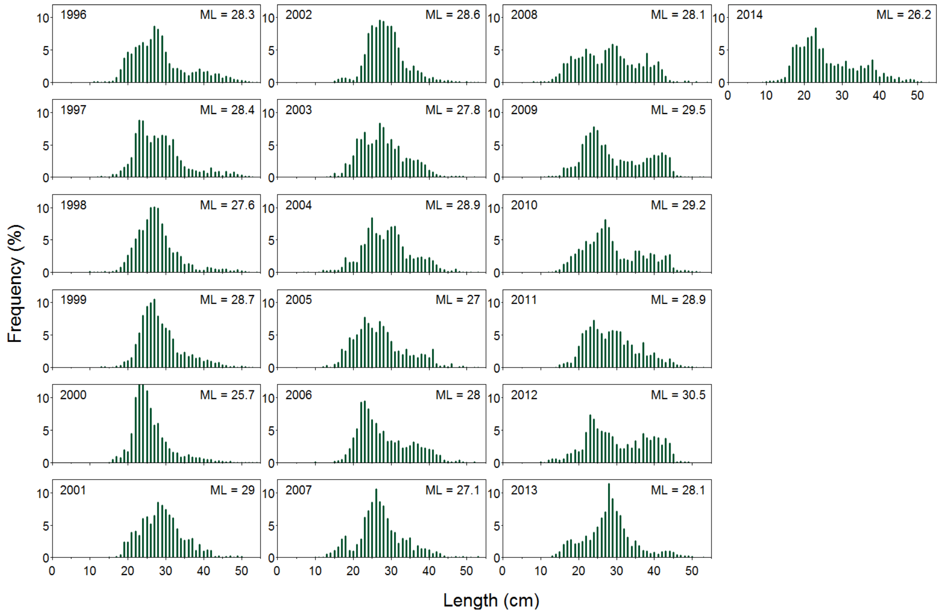


Figure 6. GSS Vb. Length distribution from the summer survey. ML- mean length. GSS is sampled from a subsample of the total catch, so the values are multiplied to total catch.

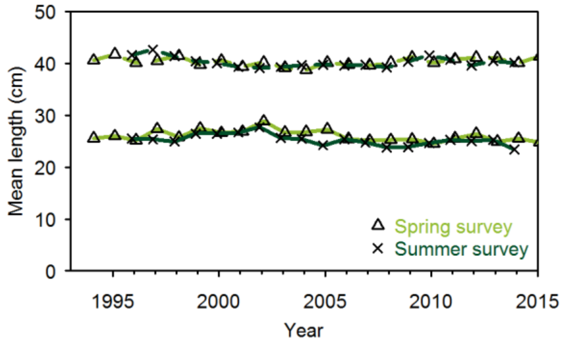


Figure 7. GSS Vb. Mean length for juvenile (<35cm) and mature (>34.9cm) GSS from the two annual groundfish surveys on the Faroe Plateau.

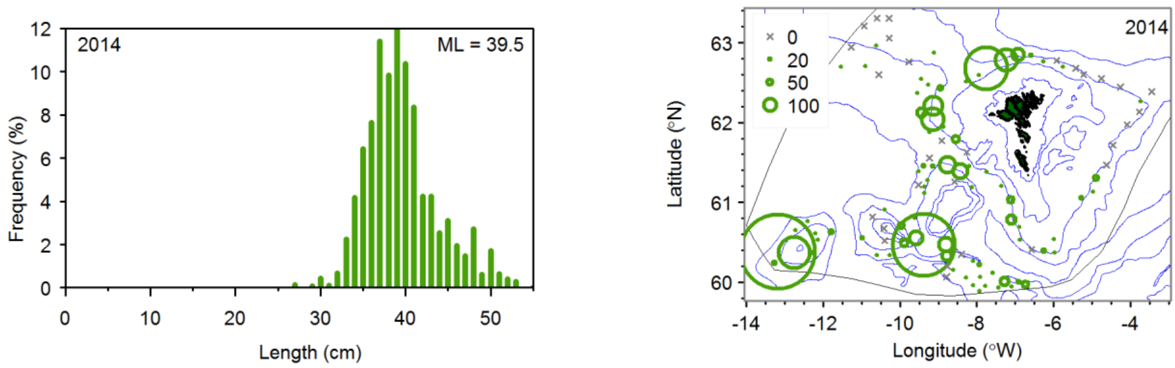


Figure 8. GSS Vb. Length distribution (left figure) and spatial distribution (kg/h) (right figure) of GSS from the deep water survey in 2014.

3 Age composition

The age of landed fish ranged between 4 and 29 years old fish, but the main catch was of 7 to 12 years old fish (Figure 9). The mean age in the landings decreased from 13 years in 1994 to 10 years in 2001 and has since then fluctuated between 9-11 years. The increase in mean age the last years could be due to new and deeper fishing areas. The age distribution of GSS from the deepwater survey had a mean length of 12.5 years (Figure 10). Numbers of ages from GSS available for calculation of ALK from the landings in Vb was presented Table 1. Estimates of catch in numbers were given in Appendix 4.

The conclusion from an otolith exchange was that the precision in age reading was probably high enough to support age-structured analytical assessments (WGDEEP, 2013).

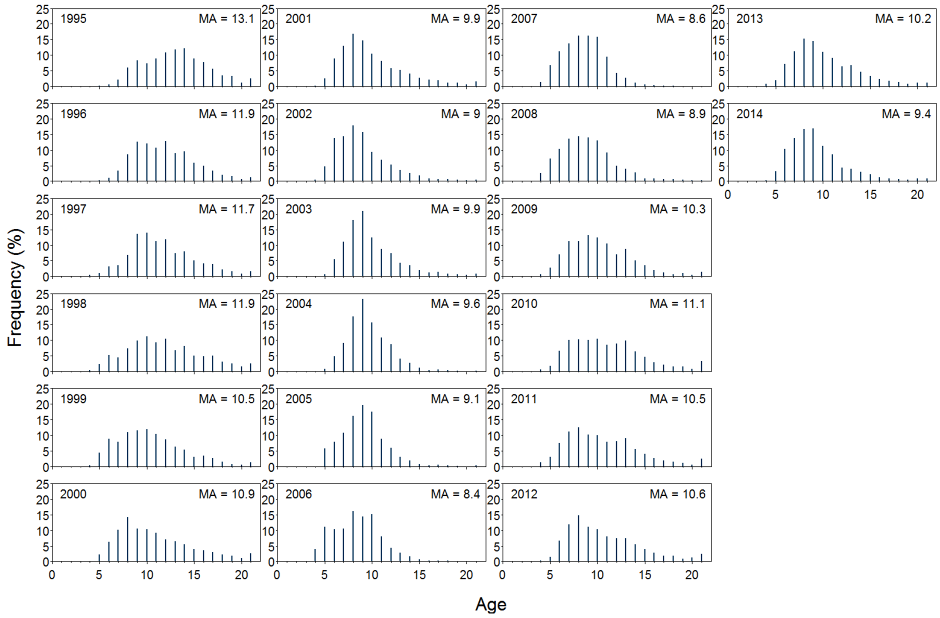


Figure 9. GSS Vb. Age distribution from commercial pair trawlers used in the assessment. MA- mean age.

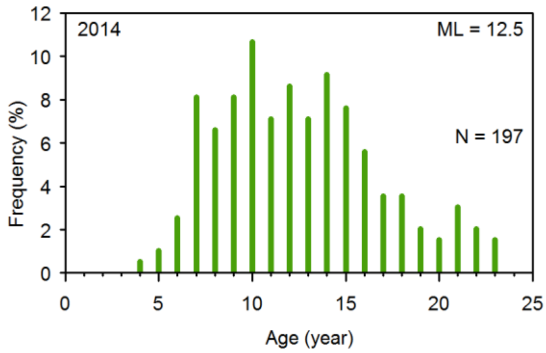


Figure 10. GSS Vb. Age distribution from the deep water survey. MA- mean age.

Table 1. GSS Vb. Number of GSS ages from commercial landings each year and age.

Year	Age 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	Total
1994			1	4	18	44	29	18	20	34	38	53	46	50	33	20	21	5	4	438
1995				1	3	16	45	48	55	65	75	71	55	42	35	18	16	8	22	575
1996		1	1	4	10	31	59	71	60	77	43	60	32	24	21	19	9	5	5	532
1997		3	4	15	17	24	44	56	45	44	33	33	27	28	36	15	12	5	8	449
1998			11	17	17	42	32	31	35	30	29	32	19	23	19	13	12	11	21	394
1999			6	14	22	30	33	43	44	37	32	23	10	15	12	8	4	2	10	345
2000			3	11	17	29	16	24	18	14	16	11	15	3	4	8	6	1	4	200
2001		1	7	32	55	75	86	42	35	23	21	23	11	10	9	2	3	3	6	444
2002		1	15	54	58	87	83	53	48	46	27	18	16	8	5	5	4	2	2	532
2003				3	22	54	94	67	46	43	20	19	3	3	8	6	2	0	2	392
2004			1	5	13	32	49	38	27	16	9	8	2	0	0	0	0	0	0	200
2005			16	31	46	60	74	101	51	31	18	5	6	5	0	2	0	0	2	448
2006	6	20	51	46	44	84	60	66	43	25	19	14	4	2	6	3	2	0	0	495
2007		3	22	63	93	76	101	73	60	22	18	8	4	3	2	1	0	1	0	550
2008		9	19	29	51	39	38	50	33	24	20	13	4	5	1	3	5	1	3	347
2009			7	29	39	57	60	47	51	47	75	41	35	16	12	6	8	3	15	548
2010			2	31	49	46	39	51	40	58	49	42	30	23	17	15	10	6	32	540
2011		9	20	37	92	115	89	104	77	71	81	51	34	26	18	15	9	6	14	868
2012			3	14	36	73	69	46	54	27	28	29	23	12	7	7	3	13	4	448
2013		2	4	42	47	59	93	60	51	34	35	28	22	16	15	11	9	12	10	550
2014			15	41	76	67	58	58	37	21	16	14	13	6	3	6	4	3	12	450
Total	6	49	208	523	825	1140	1251	1147	930	789	702	596	411	320	263	183	139	87	176	9745

4 Weight at age

There are no clear changes observed in the mean weight at age from commercial catches over the period of time for ages 4 to 14 (Figure 11, Appendix 5). The decrease in mean weight for ages 15 to 20 was probably because of few samples from large fish.

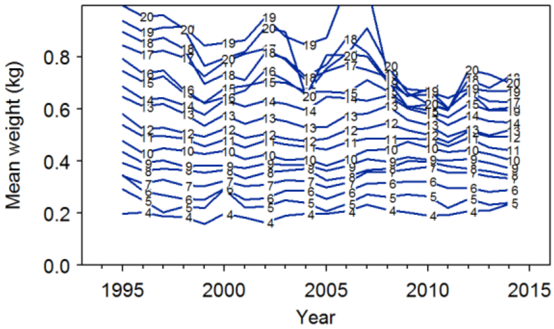


Figure 11. GSS Vb. Mean weight at ages 4 to 20 of GSS in the commercial catch.

5 Maturity and natural mortality

Estimates of maturity ogive of GSS in Vb were done by using all available data from both surveys and landings and the results were presented at the WKDEEP-2010. In the assessment is proportion mature of gender combined used for all years (Appendix 6). Most of the GSS caught in commercial catches in Vb is mature.

The natural mortality used in the assessment is set at 0.1 and that value comes from a calculation done on the "virgin" stock and was presented in WKDEEP-2010.

6 Catch, effort and research vessel data

Catch and effort data of GSS in Faroese waters are available from the commercial fishery and from the groundfish surveys in spring and summer on the Faroe Plateau.

Catch per unit effort (CPUE) on GSS from the commercial fleet is calculated as a mean value for all trawl hauls where the GSS is more than 50% of the total catch per haul (Figure 12). A general linear model (GLM) was used to standardize the CPUE series for the commercial fleet where the independent variables were the following: vessel (actually the pair ID for the pair trawlers), month, fishing area and year. The dependent variable was the log-transformed kg per hour measure for each trawl haul, which was back-transformed prior to use. The reason for this selection of GSS hauls was to try to get a series that represents changes in stock abundance.

CPUEs from the groundfish surveys on the Faroe Plateau (Figure 13) were noisy, probably due to the influence of large hauls in large strata or because the surveys do not cover the whole distribution area for GSS as most of the stations are shallower than 300 m. Even so, a closer look at the data on GSS from the summer survey compared with the commercial CPUE series showed a similar signal for the period 1998-2013 (Figure 13). The summer groundfish survey showed a larger variation between years than the commercial series. This could be because the groundfish surveys only cover a part of the GSS distribution area. The distribution of GSS on the Faroe Plateau and Faroe Bank covered by the surveys are showed in Appendix 2 and 3. The spatial distribution of GSS from the deep water survey (Figure 8) covers the distribution of the directed fishery of GSS (Appendix 1).

Index of juvenile GSS was calculated as number per hour of GSS < 20 cm from the two groundfish surveys (Figure 14). The index from the summer survey was from 2 fish per hour in 1999 and 2002 to 25 fish per hour in 2008. The index for 2014 was well above the mean value for both surveys. There were very low numbers of small fish and it have to be taken into account that the catch of GSS in the survey are taken in a sub sample that are multiplied to total catch.

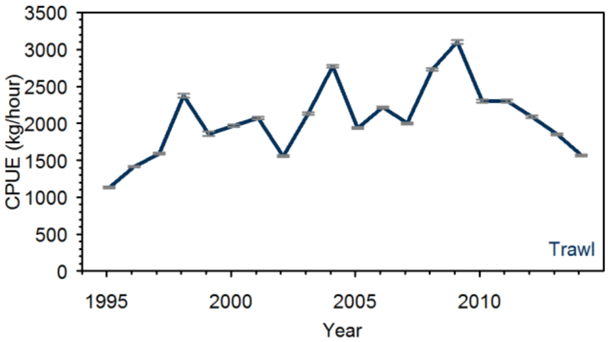


Figure 12. GSS Vb. Standardized CPUE from pair trawlers fishing greater silver smelt where catch of GSS is more than 50% of total catch in each haul. The vertical arrows present standard error.

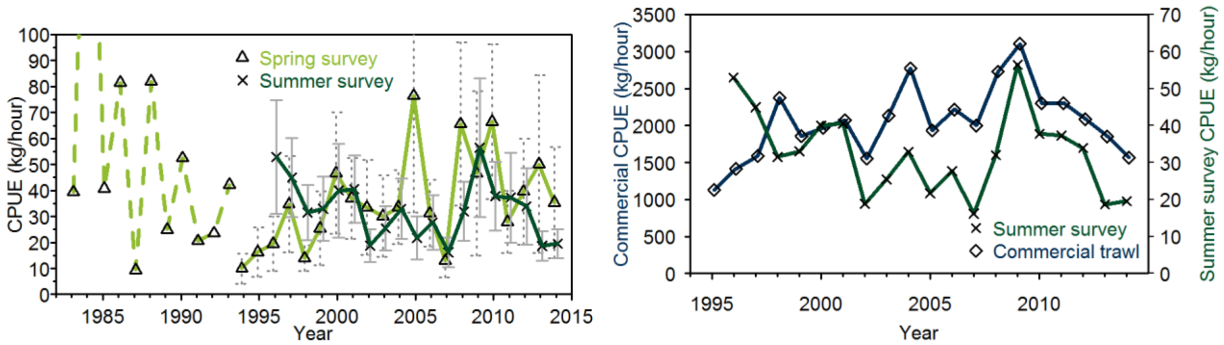


Figure 13. GSS Vb. CPUE from Faroese groundfish surveys on the Faroe Plateau (left figure). The data from 1994 to present was standardized and the vertical arrows present standard error. Comparisons between the cpue from the summer groundfish survey and the commercial trawler series (right figure).

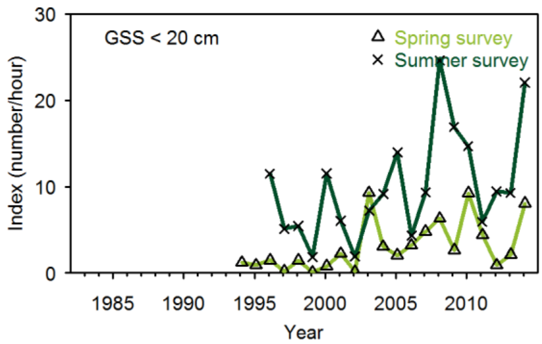


Figure 14. GSS Vb. Index (number/hour) of juvenile GSS < 20 cm.

Data analyses

Landings have increased in Vb from 1995 due to a directed fishery (Figure 1). In the period from 1995-2005 it varied from 4200 t in 2004 to 17800 in 1998. Since 2006 the catches in Vb have been quite stable around 14-15700 t except in 2012 it was 9800 t.

Length and age compositions from the landings in Vb have decreased since 1994-2000 and have been stable since then (Figures 4 and 9). The reason for the decrease is thought to be directed fishery on a virgin stock (Ofstad, WD WKDEEP 2010). The variation in mean length from the latest years could be due to sampling from different depths in the various areas, as the size of GSS is increasing with depth. In WKDEEP 2010 it was suggested to divide the length composition of GSS in the survey into juvenile and mature individuals; to check if the trend in mean length changed over time. No change in trends for mean length is found for juveniles, while a slight decrease in mean length since the start of the series for mature fish (Figure 7).

CPUE

The standardized commercial CPUE series showed an increasing trend from 1995-1997 (Figure 12) and this period was treated as a ‘learning’ period, i.e. the CPUE is not believed to be proportional to abundance in those years and are not used in the assessment tuning series. Mean CPUE from 1998 to 2013 was around 2200 kg/hour. There has been a decrease in the commercial CPUE from around 3100 kg/hour in 2009 to 1100 kg/hour in 2014.

The survey CPUEs fluctuates (Figure 13). Given the reported low turnover rate (high turnover time) in this species you would not expect to see large changes in abundance by year, this implies that changes in year values in the Faroese survey may be noise related. Comparing the CPUE from the summer groundfish survey with the commercial CPUE gave similar trends in the period from 1998-2014 (Figure 13). One need to keep in mind that the survey only cover a small part of the fishing area and the relatively shallow depth range covered by the survey will likely result in poor sampling of adult fish as larger individuals are generally found on greater depths.

Analytical assessment

An exploratory stock assessment of GSS in Vb using XSA was presented. It is basically an update of previous assessments, with new years added to the time series. In addition, the catch number at age was changed from 14+ to 21+ and the summer survey was also used as a tuning series. The input data are presented in Appendix 4-7, XSA diagnostic in Appendix 8 and XSA output for fishing mortality and stock size in Appendix 9-10. The XSA model was tuned with a commercial cpue series and summer survey series (Figure 13, Appendix 7). The commercial CPUE series was on beforehand treated by a Genereal Linear Model (GLM), which standardized the effect of vessel, month, and fishing area and the summer survey series was also standardized.

The XSA model fitted the cpue-data quite well (Figure 15, Appendix 8), at least when comparing with similar assessments of other fish stocks at the Faroes (eg. Faroe saithe).

The results from the XSA model showed that the recruitment was quite stable, i.e., between 20 and 70 millions. The total biomass ranged between 73 and 141 thousand tons, the spawning stock biomass between 40 and 93 thousand tons, and the fishing mortality between 0.07 and 0.22 (Table 2, Figure 16). The natural mortality was set to 0.1.

The retrospective pattern pointed out the difficulties already seen in previous assessments, i.e., that it was hard for the model to estimate the level of biomass and F (Figure 17). However, the last three lines in the plots indicate that we might have got stable results. As a result, the estimate of F0.1 has ranged between 28 thousand tons (assessment in 2011) and 11 thousand tons (the present assessment in 2015, Figure 18). Calculated $F_{0.1}$ (absolute F of 0.06) gave a catch of 10 760 tons and corresponding biomass of 148 671 tons. The difficulties of the XSA model to find the “correct” level of stock size and fishing mortality comes from the fact that there is not much contrast between years in the tuning series (Figure 12), and the “real” stock size might not be discovered until the cpue either increases or decreases markedly in the future. It have to be noticed that the yield per recruit plot show no well define maximum (Figure 18).

The fishing mortality has been around 0.2 since 2008 and is above the mean value (Figure 16). In the previous assessments it has been feared that the catch (and the perception of stock size) would decline when no new areas were available for the trawlers. However, the last “new” fishing site (on the Wyville-Thompson ridge to the south of the Faroes) has been explored since 2008 and a decline in CPUE has been observed (although the GLM-model reduced the influence of this fishing site). In the last years the pair trawlers has shift to fish for mackerel instead of GSS during a period of the GSS fishing season.

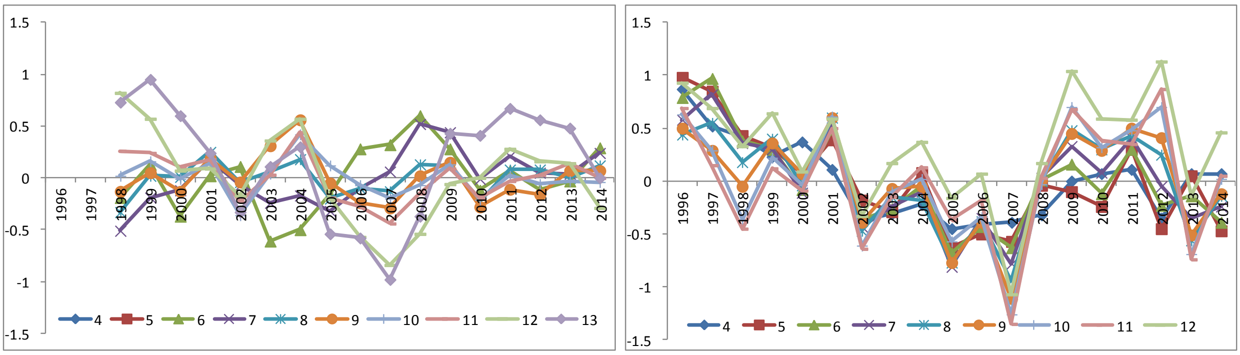


Figure 15. Greater silver smelt Vb. Log catchability residuals for age group 4-13 from XSA diagnostic for pair trawlers (left) and summer survey (right).

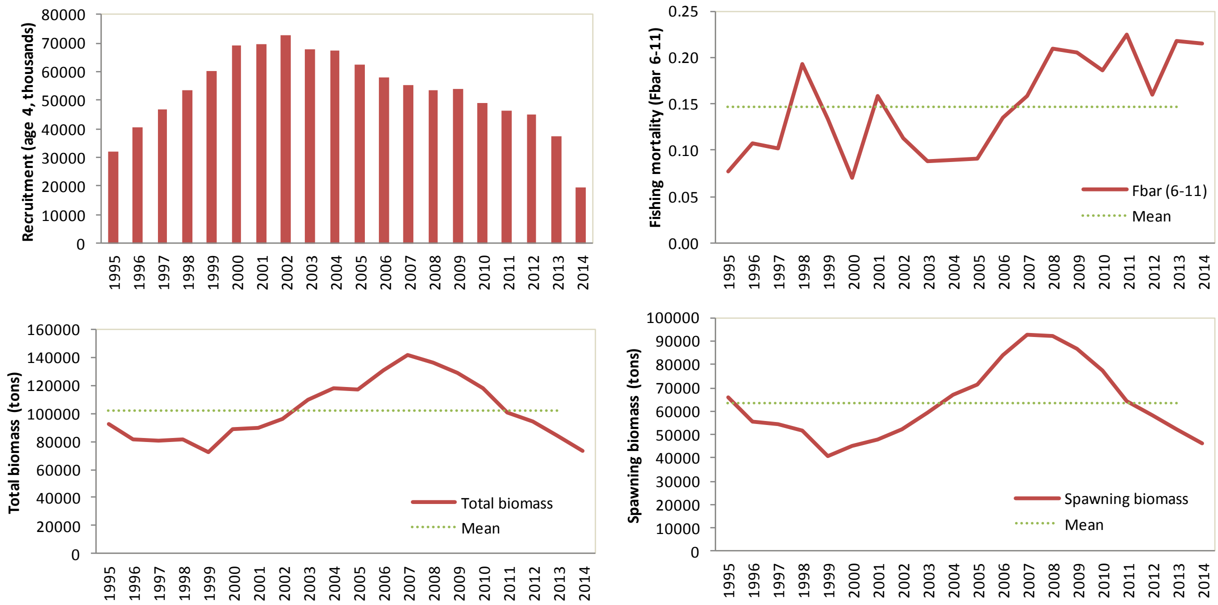


Figure 16. Greater silver smelt Vb. Output from XSA.

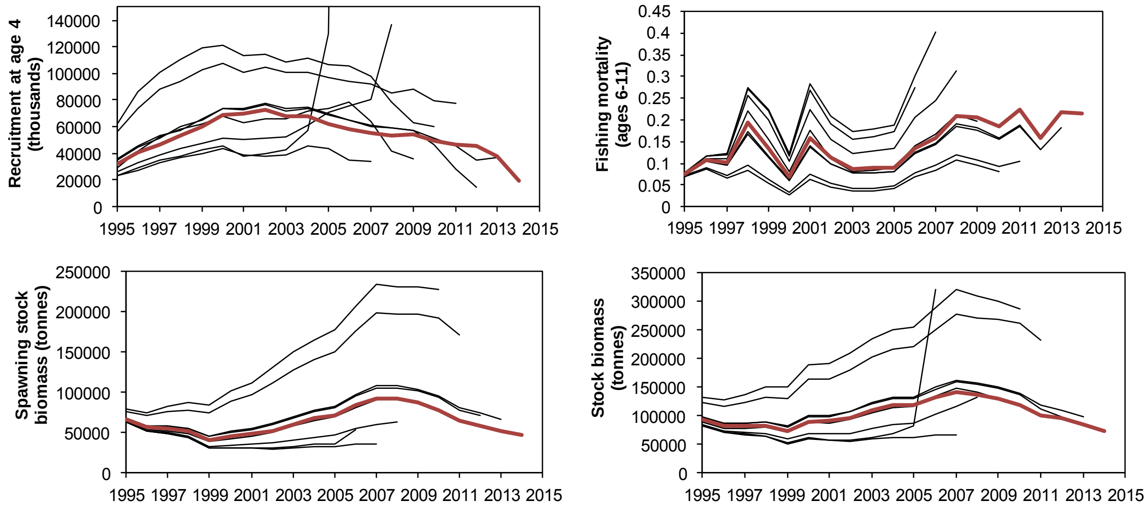


Figure 17. Greater silver smelt Vb. Output from retrospective analysis.

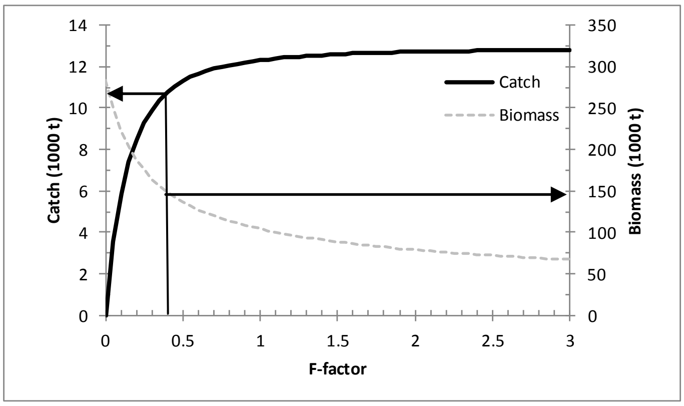


Figure 18. Greater silver smelt in Vb. A modified yield-per-recruit plot. The F0.1 catch is 10 760 tons and biomass is 148 671 tons. The selection pattern, as well as the weights, were calculated as the average for the whole assessment period (1995-2014).

Table 2. Greater silver smelt Vb. Output from XSA

	Recruits Age 4	Totalbio	Totspbio	Landings	Yield/SSB	Fbar 6-11
1995	32052	92669	65748	12286	0.187	0.076
1996	40615	81526	55568	9498	0.171	0.108
1997	46766	80891	54247	8433	0.156	0.102
1998	53500	81580	51504	17570	0.341	0.193
1999	60219	72714	40841	8214	0.201	0.134
2000	69084	89090	45094	5209	0.116	0.070
2001	69516	89884	47751	10081	0.211	0.158
2002	72756	96495	52182	7471	0.143	0.113
2003	67717	109793	59502	6549	0.110	0.088
2004	67359	117755	66755	6451	0.097	0.089
2005	62375	117485	71460	7009	0.098	0.090
2006	57973	131311	83883	12559	0.150	0.135
2007	55357	141543	92621	14093	0.152	0.159
2008	53447	136391	92044	19249	0.209	0.209
2009	53943	129142	86928	19740	0.227	0.205
2010	49098	117845	77632	19190	0.247	0.186
2011	46434	100299	64216	18712	0.291	0.225
2012	45059	94423	58056	12545	0.216	0.160
2013	37394	84583	51956	14306	0.275	0.217
2014	19378	73438	45984	11581	0.252	0.216
Arith. Mean	53002	101943	63199	12037	0.193	0.147
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

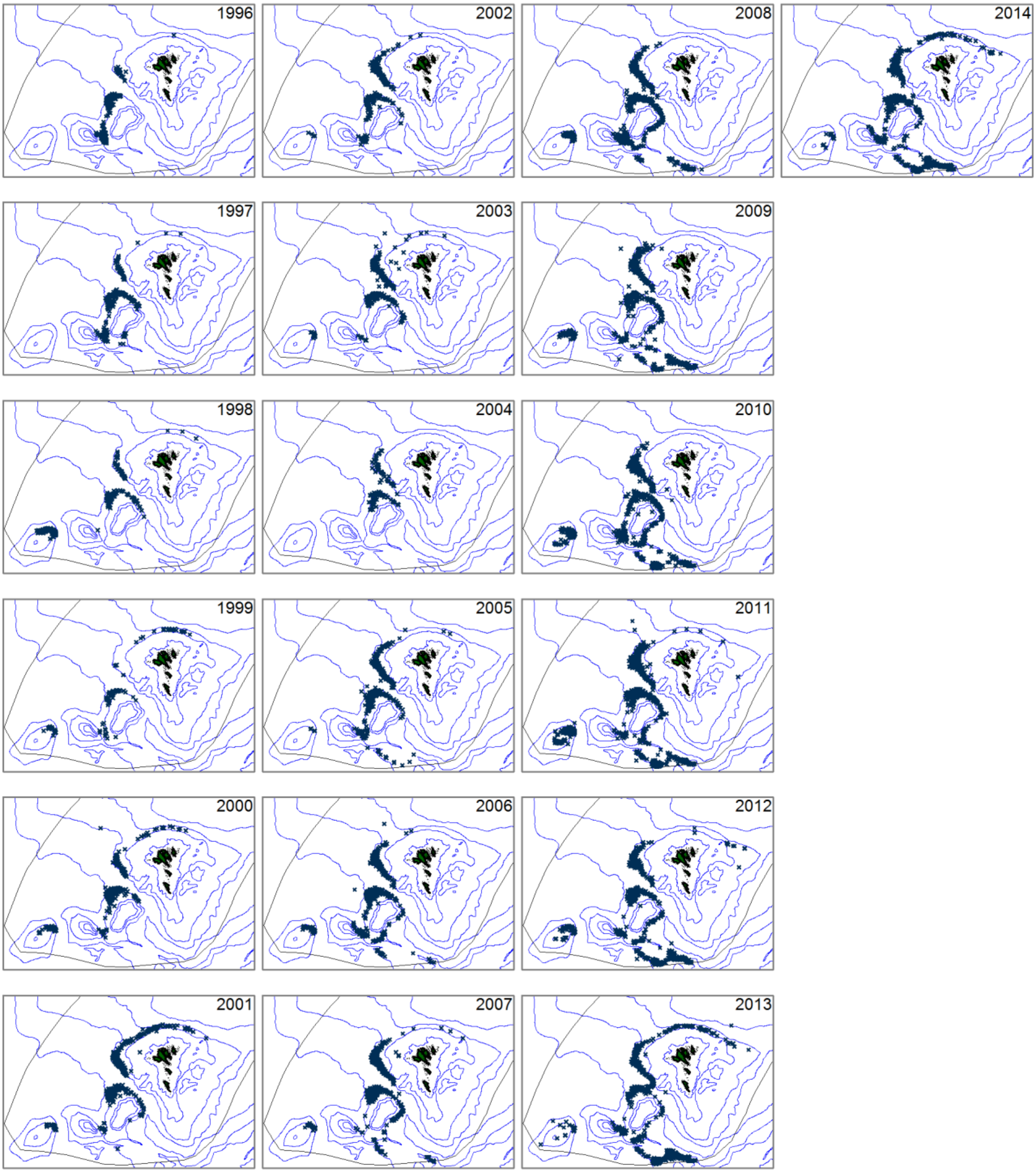
Comments on the assessments

The diagnostics for the present assessment are acceptable except for the youngest and oldest ages. The logQ residuals are normally below 0.5, which is lower than for other age-based assessed stocks at the Faroes. The problem with earlier assessments, that the level of stock size and fishing mortality was difficult to find, seems to be less in the 2015 assessments. Still there were some problems with patterns in the data.

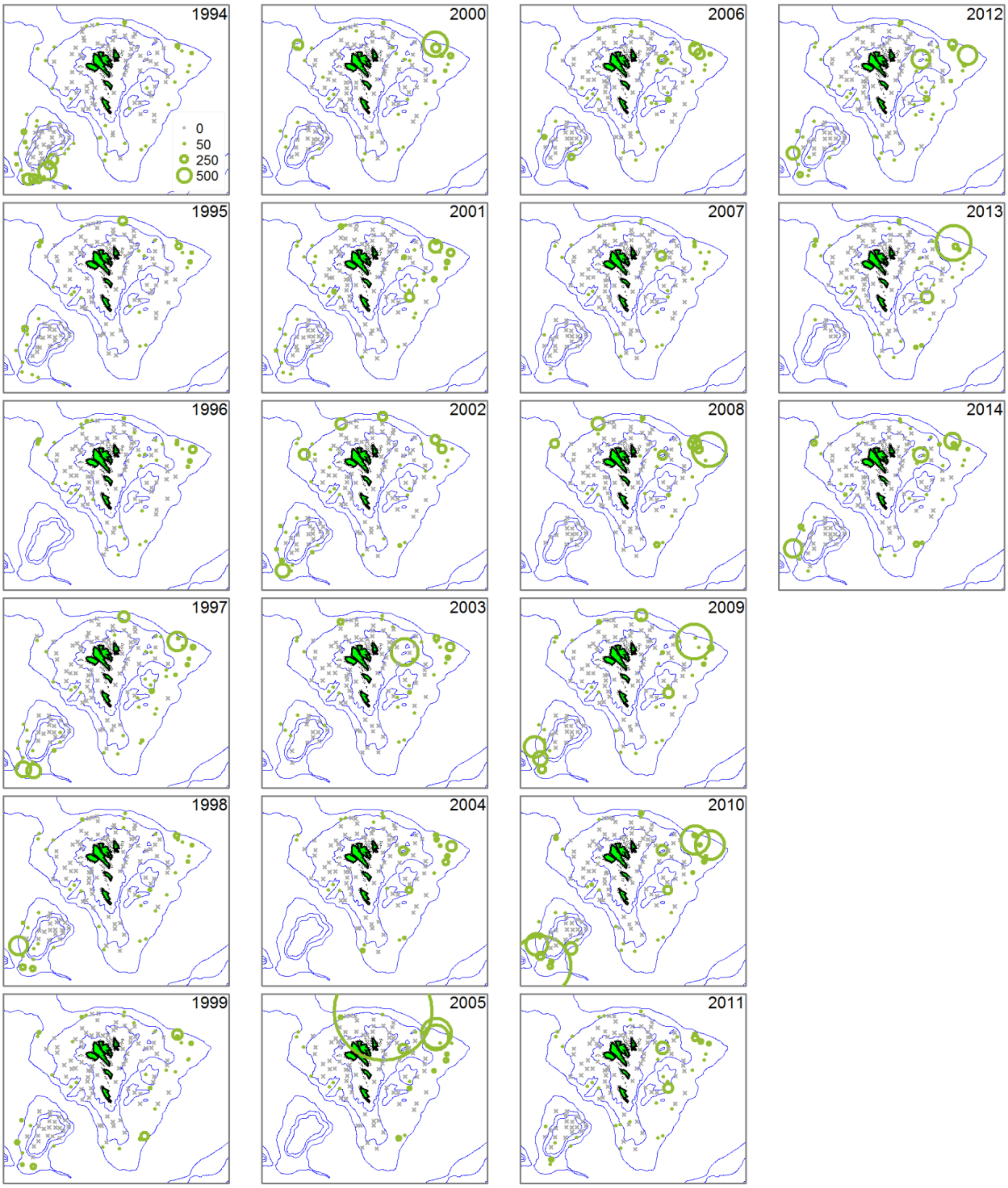
References

ICES WKDEEP report 2010 (page 133-198)
ICES WGDEEP report 2010
ICES WKAMDEEP report 2013

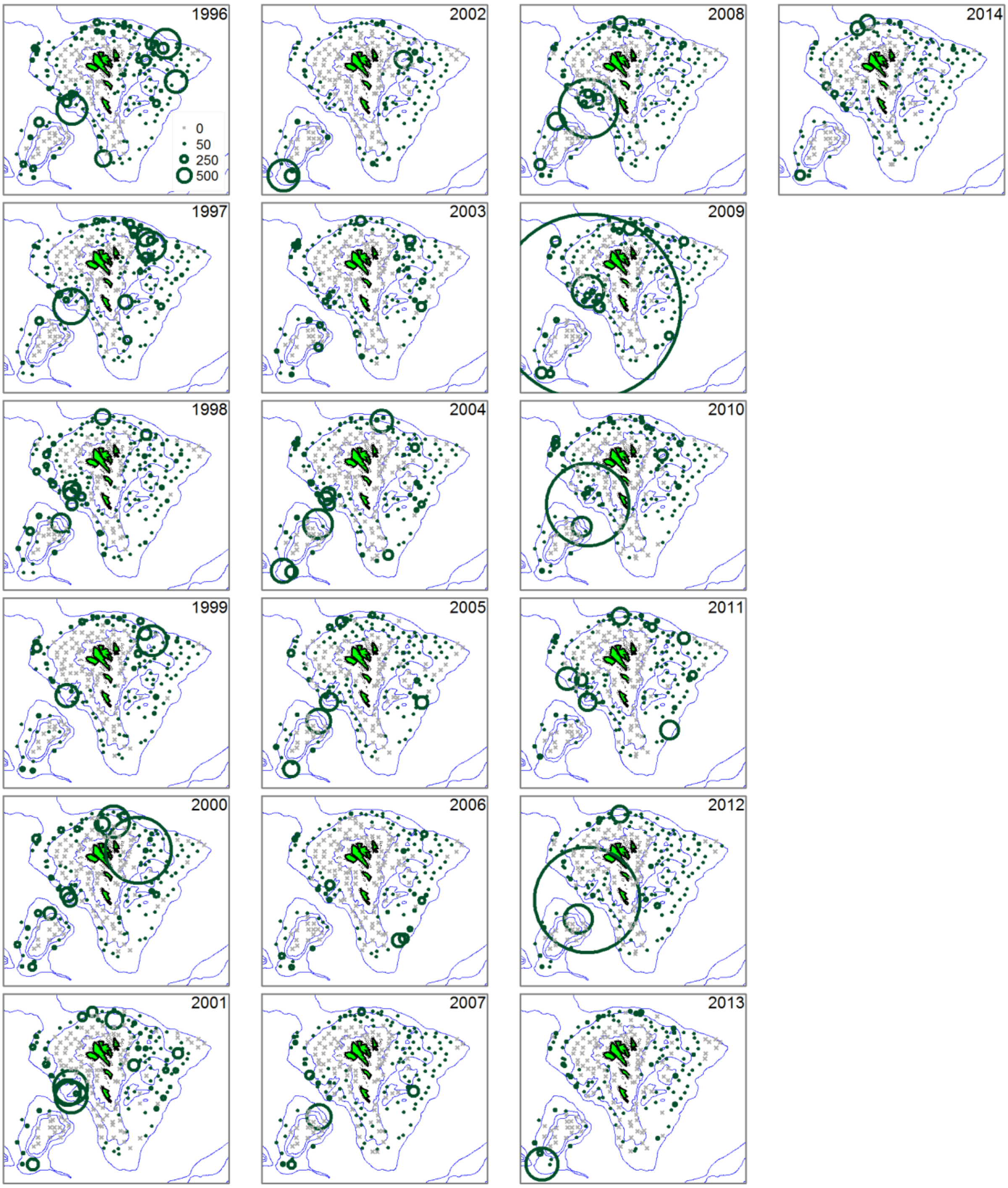
Appendix 1. GSS Vb. Spatial distribution in the directed GSS fishery in Faroese waters for the period 1996-2014.



Appendix 2. GSS Vb. Spatial distribution of GSS as CPUE (kg/hour) from the spring survey.



Appendix 3. GSS Vb. Spatial distribution of GSS as CPUE (kg/hour) from the summer survey.



Appendix 4. GSS Vb. Catch number at age (thousands) from the commercial fleet.

YEAR\AGE	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
1995	0	11	83	392	1156	1572	1415	1680	2056	2259	2311	1693	1485	1075	641	635	230	461
1996	15	35	187	590	1536	2225	2142	1891	2263	1597	1709	1045	869	613	366	292	103	208
1997	75	163	480	541	1061	2136	2186	1774	1849	1165	1248	789	656	628	350	259	119	239
1998	112	795	1755	1473	2434	3298	3725	3103	3457	2268	2680	1680	1618	1641	1050	806	499	831
1999	64	812	1643	1475	2049	2165	2255	1957	1609	1200	1009	574	658	498	269	144	108	253
2000	0	236	690	1103	1536	1135	1126	994	760	698	595	419	383	316	248	188	116	286
2001	47	608	2114	3113	4011	3512	2490	1955	1385	1250	963	621	488	441	289	244	110	347
2002	95	883	2593	2701	3368	2984	1766	1288	1000	676	475	358	164	129	112	105	39	83
2003	2	106	825	1693	2743	3192	1880	1340	1140	662	545	302	192	209	119	88	57	127
2004	0	124	743	1419	2767	3634	2458	1697	1371	633	412	178	73	77	60	16	6	25
2005	0	1102	1492	2017	3068	3709	3294	1680	1113	566	370	135	79	89	73	13	0	59
2006	1345	3780	3478	3530	5440	4862	5091	2693	1434	956	522	247	116	106	87	29	0	26
2007	466	2357	3927	4779	5700	5680	5521	3287	1486	952	396	159	90	83	65	15	10	16
2008	1201	3364	4754	6274	6586	6435	5963	4205	2255	1853	1263	417	354	336	266	192	97	110
2009	254	1173	3000	4771	4776	5653	5247	4449	2963	3732	2175	1503	839	519	303	403	188	611
2010	226	676	2650	4004	4125	4054	4211	3415	3566	3917	2546	1862	1169	834	607	596	278	1327
2011	531	1338	3216	4800	5366	4355	4293	3372	3448	3840	2341	1693	1096	767	629	462	250	1014
2012	68	413	1816	3209	4023	3017	2797	2188	2029	2007	1480	1065	769	515	484	253	320	632
2013	241	633	2368	3686	5054	4783	3650	2990	2092	2213	1524	1089	724	540	418	252	395	351
2014	98	944	3028	4062	4900	4925	3307	2495	1277	1152	894	670	370	256	205	163	235	260

Appendix 5. GSS Vb. Catch weight (kg) at age from the commercial fleet.

Year/Age	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
1995	0.198	0.291	0.347	0.344	0.392	0.435	0.476	0.539	0.581	0.647	0.687	0.746	0.793	0.844	0.896	0.937	0.997	0.862
1996	0.204	0.249	0.285	0.313	0.363	0.392	0.431	0.494	0.522	0.609	0.637	0.703	0.736	0.812	0.856	0.896	0.955	0.822
1997	0.189	0.204	0.269	0.330	0.371	0.404	0.449	0.496	0.529	0.620	0.643	0.726	0.748	0.824	0.873	0.914	0.959	0.909
1998	0.186	0.225	0.254	0.306	0.367	0.381	0.440	0.487	0.508	0.582	0.614	0.662	0.675	0.798	0.832	0.915	0.908	0.899
1999	0.158	0.220	0.252	0.305	0.355	0.382	0.428	0.457	0.494	0.536	0.578	0.625	0.622	0.725	0.696	0.845	0.766	0.738
2000	0.198	0.291	0.295	0.323	0.365	0.383	0.439	0.481	0.523	0.577	0.634	0.68	0.645	0.78	0.732	0.854	0.794	0.787
2001	0.184	0.222	0.252	0.305	0.335	0.374	0.409	0.451	0.490	0.543	0.610	0.688	0.672	0.813	0.71	0.864	0.819	0.833
2002	0.164	0.225	0.258	0.309	0.357	0.391	0.424	0.479	0.503	0.568	0.632	0.706	0.747	0.832	0.818	0.953	0.913	0.972
2003	0.192	0.249	0.287	0.326	0.363	0.385	0.405	0.465	0.487	0.553	0.619	0.702	0.712	0.79	0.795	0.879	0.896	0.918
2004	0.198	0.241	0.286	0.324	0.372	0.386	0.407	0.455	0.477	0.529	0.594	0.667	0.656	0.709	0.723	0.847	0.65	0.809
2005	0.198	0.209	0.256	0.299	0.327	0.363	0.382	0.446	0.486	0.531	0.647	0.666	0.756	0.746	0.77	0.874	0.806	0.808
2006	0.208	0.236	0.282	0.317	0.340	0.380	0.408	0.472	0.519	0.575	0.642	0.662	0.813	0.769	0.871	1.072	0.806	0.832
2007	0.232	0.272	0.315	0.358	0.367	0.408	0.442	0.487	0.527	0.582	0.631	0.712	0.802	0.751	0.816	1.077	0.91	0.85
2008	0.213	0.262	0.316	0.359	0.372	0.398	0.446	0.486	0.547	0.613	0.652	0.67	0.703	0.724	0.712	0.734	0.766	0.728
2009	0.203	0.272	0.321	0.369	0.400	0.414	0.474	0.487	0.519	0.558	0.603	0.609	0.653	0.649	0.608	0.676	0.661	0.704
2010	0.191	0.265	0.322	0.377	0.398	0.406	0.452	0.485	0.501	0.539	0.581	0.594	0.654	0.677	0.617	0.67	0.62	0.739
2011	0.193	0.220	0.296	0.355	0.381	0.402	0.434	0.456	0.473	0.495	0.539	0.568	0.603	0.605	0.601	0.641	0.596	0.703
2012	0.208	0.256	0.298	0.357	0.371	0.408	0.443	0.488	0.513	0.522	0.576	0.62	0.67	0.666	0.714	0.68	0.751	0.775
2013	0.210	0.234	0.282	0.342	0.361	0.393	0.428	0.453	0.495	0.500	0.553	0.596	0.598	0.63	0.681	0.669	0.734	0.716
2014	0.236	0.241	0.29	0.334	0.347	0.374	0.405	0.443	0.494	0.518	0.548	0.594	0.604	0.628	0.723	0.668	0.702	0.696

Appendix 6. GSS Vb. Proportion mature at age

AGE	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
Prop Mature	0.05	0.13	0.29	0.52	0.75	0.89	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Appendix 7. GSS Vb. Effort (hours) and catch in numbers at age for commercial pair trawlers (1998-2014) and summer survey (1996-2014).

Argentina Silus (ICES Div. Vb) PTandSS.dat
102
PairTrawl >1000 HP
1998 2014
1 1 0 1
6 13

1525	362	304	502	680	768	639	712	467
718	267	240	333	352	366	318	261	195
2526	659	1054	1468	1085	1076	950	726	667
3437	1492	2197	2830	2478	1757	1379	977	882
3075	1660	1730	2157	1911	1131	825	640	433
2462	662	1358	2201	2561	1508	1075	915	531
951	304	580	1131	1486	1005	694	561	259
3281	1350	1826	2777	3357	2981	1520	1007	512
4525	2777	2819	4344	3882	4065	2150	1145	763
5836	3255	3961	4724	4708	4576	2724	1232	789
5268	3550	4685	4918	4806	4453	3140	1684	1384
5274	2487	3955	3959	4686	4350	3688	2456	3094
7314	2324	3511	3617	3555	3692	2994	3127	3434
8143	3222	4808	5375	4363	4301	3378	3454	3847
5933	1791	3165	3968	2976	2759	2158	2001	1979
6272	1944	3027	4150	3927	2997	2455	1718	1817
6527	2678	3593	4334	4356	2925	2207	1129	1019

Summer survey
1996 2014
1 1 0.6 0.7
2 12

200	7.437	13.690	12.532	5.302	2.670	1.138	1.034	1.213	1.282	0.949	1.064
200	4.692	13.297	10.180	5.897	3.321	1.399	1.052	1.102	0.933	0.530	0.660
200	3.544	10.799	10.493	4.435	2.262	0.887	0.665	0.677	0.509	0.264	0.345
200	1.923	9.604	9.750	4.545	2.382	1.025	0.829	0.944	0.804	0.521	0.508
200	7.965	25.700	12.895	4.028	1.914	0.783	0.680	0.753	0.624	0.412	0.392
200	3.547	8.977	9.999	6.315	3.774	1.736	1.417	1.516	1.208	0.724	0.619
200	0.917	5.301	6.453	3.596	1.820	0.732	0.558	0.616	0.433	0.237	0.238
200	3.738	7.343	6.386	3.391	2.088	1.024	0.889	1.008	0.806	0.493	0.406
200	2.658	7.418	7.004	4.560	2.712	1.232	1.023	1.200	1.066	0.721	0.646
200	4.358	7.056	5.135	2.205	1.336	0.641	0.592	0.705	0.689	0.519	0.430
200	4.144	9.072	4.892	2.259	1.631	0.905	0.882	1.050	1.015	0.696	0.643
200	1.878	5.165	4.797	1.938	1.165	0.538	0.438	0.498	0.403	0.249	0.225
200	4.782	5.470	4.943	3.131	1.997	0.999	0.979	1.260	1.297	0.939	0.866
200	5.673	12.386	6.934	2.883	2.267	1.242	1.297	1.677	2.131	1.651	1.842
200	4.145	7.512	6.749	2.611	1.710	0.968	1.017	1.198	1.269	0.957	0.993
200	4.026	8.827	6.626	4.027	2.685	1.334	1.123	1.361	1.221	0.791	0.733
200	2.459	6.048	4.100	1.817	1.456	0.898	0.961	1.256	1.486	1.111	1.168
200	2.065	3.682	5.136	2.929	1.498	0.605	0.457	0.487	0.363	0.211	0.269
200	5.814	6.083	2.688	1.422	1.120	0.622	0.613	0.766	0.696	0.461	0.487

Appendix 8. GSS Vb. Diagnostics from XSA (M=0.1, sh=0.5) with commercial pair trawler and summer survey as tuning series.
Lowestoft VPA Version 3.1

```
   17/03/2015  11:29
 Extended Survivors Analysis
 Argentina Silus (ICES Division Vb)                  AS_IND
 CPUE data from file D:\WGDEEP\WGDEEP2015\SilverSmelt\XSA2014\9_xsa_21p_3yrALK\PTandSS.DAT
 Catch data for  20 years. 1995 to 2014. Ages  4 to  21.
      Fleet             First  Last  First  Last  Alpha   Beta
                         year  year   age    age
 PairTrawl >1000 HP      1998  2014    6     13    .000   1.000
 Summer survey           1996  2014    2     12    .600    .700

 Time series weights :
      Tapered time weighting not applied
 Catchability analysis :
      Catchability independent of stock size for all ages
      Catchability independent of age for ages >=   11

 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   60 iterations

 Regression weights
        1.000  1.000  1.000  1.000  1.000  1.000  1.000  1.000  1.000  1.000
```

Fishing mortalities

Age	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
4	.000	.025	.009	.024	.005	.005	.012	.002	.007	.005
5	.019	.073	.050	.074	.026	.015	.032	.011	.016	.030
6	.029	.070	.091	.120	.079	.069	.081	.051	.069	.092
7	.041	.079	.117	.184	.153	.129	.155	.098	.124	.146
8	.076	.133	.159	.209	.186	.172	.227	.169	.198	.215
9	.117	.150	.179	.243	.249	.214	.247	.172	.277	.268
10	.160	.208	.227	.257	.285	.265	.327	.222	.290	.279
11	.119	.170	.181	.241	.277	.271	.312	.245	.347	.293
12	.118	.127	.120	.163	.239	.332	.426	.279	.348	.218
13	.084	.126	.105	.193	.390	.501	.634	.417	.491	.292
14	.090	.094	.064	.177	.324	.445	.561	.473	.571	.333
15	.041	.072	.034	.080	.294	.450	.532	.475	.676	.468
16	.028	.041	.030	.088	.203	.348	.461	.434	.609	.451
17	.039	.044	.033	.136	.161	.285	.359	.363	.548	.398
18	.088	.043	.031	.128	.157	.256	.321	.359	.498	.366
19	1.876	.041	.008	.108	.260	.462	.282	.184	.285	.326
20	.416	.048	.016	.063	.131	.257	.318	.287	.430	.416

XSA population numbers (Thousands)

	AGE									
YEAR	4	5	6	7	8	9	10	11	12	13
2005	6.24E+04	6.09E+04	5.53E+04	5.30E+04	4.38E+04	3.54E+04	2.35E+04	1.57E+04	1.05E+04	7.38E+03
2006	5.80E+04	5.64E+04	5.41E+04	4.86E+04	4.61E+04	3.67E+04	2.85E+04	1.81E+04	1.26E+04	8.47E+03
2007	5.54E+04	5.12E+04	4.75E+04	4.56E+04	4.07E+04	3.65E+04	2.86E+04	2.09E+04	1.38E+04	1.00E+04
2008	5.34E+04	4.96E+04	4.41E+04	3.92E+04	3.68E+04	3.14E+04	2.76E+04	2.06E+04	1.58E+04	1.11E+04
2009	5.39E+04	4.72E+04	4.17E+04	3.53E+04	2.95E+04	2.70E+04	2.23E+04	1.93E+04	1.47E+04	1.22E+04
2010	4.91E+04	4.86E+04	4.16E+04	3.49E+04	2.74E+04	2.22E+04	1.90E+04	1.51E+04	1.33E+04	1.05E+04
2011	4.64E+04	4.42E+04	4.33E+04	3.51E+04	2.78E+04	2.09E+04	1.62E+04	1.32E+04	1.05E+04	8.60E+03
2012	4.51E+04	4.15E+04	3.87E+04	3.61E+04	2.72E+04	2.00E+04	1.48E+04	1.06E+04	8.76E+03	6.18E+03
2013	3.74E+04	4.07E+04	3.72E+04	3.33E+04	2.96E+04	2.08E+04	1.52E+04	1.07E+04	7.49E+03	6.00E+03
2014	1.94E+04	3.36E+04	3.62E+04	3.14E+04	2.66E+04	2.20E+04	1.43E+04	1.03E+04	6.85E+03	4.79E+03

Estimated population abundance at 1st Jan 2015

0.00E+00 1.74E+04 2.95E+04 2.99E+04 2.45E+04 1.94E+04 1.52E+04 9.77E+03 6.97E+03 4.98E+03

Taper weighted geometric mean of the VPA populations:

5.09E+04 4.69E+04 4.13E+04 3.52E+04 2.90E+04 2.27E+04 1.71E+04 1.27E+04 9.40E+03 6.85E+03

Standard error of the weighted Log(VPA populations) :

.3166 .2531 .2610 .2639 .2698 .2763 .2813 .2693 .2803 .3397

	AGE						
YEAR	14	15	16	17	18	19	20
2005	4.53E+03	3.52E+03	2.96E+03	2.47E+03	9.11E+02	1.61E+01	3.09E-01
2006	6.13E+03	3.75E+03	3.06E+03	2.60E+03	2.15E+03	7.55E+02	2.24E+00
2007	6.75E+03	5.05E+03	3.16E+03	2.66E+03	2.25E+03	1.86E+03	6.56E+02
2008	8.18E+03	5.73E+03	4.42E+03	2.77E+03	2.33E+03	1.98E+03	1.67E+03
2009	8.26E+03	6.20E+03	4.79E+03	3.66E+03	2.19E+03	1.85E+03	1.60E+03
2010	7.45E+03	5.40E+03	4.18E+03	3.54E+03	2.82E+03	1.69E+03	1.29E+03
2011	5.74E+03	4.32E+03	3.12E+03	2.67E+03	2.41E+03	1.98E+03	9.64E+02
2012	4.13E+03	2.96E+03	2.29E+03	1.78E+03	1.69E+03	1.58E+03	1.35E+03
2013	3.68E+03	2.33E+03	1.67E+03	1.34E+03	1.12E+03	1.07E+03	1.19E+03
2014	3.32E+03	1.88E+03	1.07E+03	8.20E+02	7.03E+02	6.16E+02	7.26E+02

Estimated population abundance at 1st Jan 2015

3.23E+03 2.16E+03 1.07E+03 6.18E+02 4.99E+02 4.41E+02 4.02E+02

Taper weighted geometric mean of the VPA populations:

4.83E+03 3.30E+03 2.31E+03 1.60E+03 1.01E+03 5.66E+02 2.36E+02

Standard error of the weighted Log(VPA populations) :

.3941 .4908 .6192 .7530 .9951 1.4446 2.3172

Log catchability residuals.

Fleet : PairTrawl >1000 HP

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004
4	No data for this fleet at this age								
5	No data for this fleet at this age								
6	99.99	99.99	-.19	.13	-.37	.02	.11	-.61	-.50
7	99.99	99.99	-.51	-.19	-.12	.17	-.07	-.24	-.17
8	99.99	99.99	-.33	.02	.01	.25	-.04	.06	.18
9	99.99	99.99	-.13	.05	-.13	.19	-.04	.31	.56
10	99.99	99.99	.02	.16	-.01	.14	-.36	.04	.42
11	99.99	99.99	.26	.24	.11	.18	-.23	.03	.44
12	99.99	99.99	.82	.57	.07	.09	-.17	.36	.57
13	99.99	99.99	.73	.95	.60	.24	-.33	.11	.30

Age	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	-.16	.28	.32	.60	.28	-.12	.07	-.11	-.03	.29
7	-.32	-.10	.06	.52	.44	-.01	.21	.05	.04	.24
8	-.20	-.10	-.13	.13	.12	-.23	.08	.08	.00	.12
9	-.05	-.24	-.29	.02	.15	-.28	-.11	-.16	.07	.07
10	.12	-.07	-.20	-.07	.13	-.21	.02	-.06	-.03	-.04
11	-.19	-.28	-.44	-.15	.09	-.20	-.03	.03	.14	.00
12	-.20	-.57	-.84	-.54	-.06	.00	.28	.16	.14	-.29
13	-.54	-.58	-.98	-.37	.43	.41	.67	.56	.48	.00

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         12         13
Mean Log q   -11.5804   -11.0744   -10.5635   -10.2977   -10.1483   -10.1370   -10.1370   -10.1370
S.E(Log q)      .3142      .2639      .1558      .2205      .1749      .2247      .4383      .5663

Regression statistics :
Ages with q independent of year class strength and constant w.r.t. time.
Age  Slope   t-value   Intercept  RSquare  No Pts  Reg s.e   Mean Q
 6     1.81    -1.021      12.29      .09      17      .57   -11.58
 7      .99      .043      11.07      .42      17      .27   -11.07
 8      .97      .210      10.56      .74      17      .16   -10.56
 9      .99      .054      10.30      .61      17      .23   -10.30
10     1.06     -.379      10.17      .70      17      .19   -10.15
11     1.76    -2.503      10.64      .42      17      .34   -10.14
12     6.42    -2.747      15.33      .02      17     2.37   -10.11
13     3.03    -1.916      12.35      .06      17     1.52    -9.98

Fleet : Summer survey
 Age     1996   1997   1998   1999   2000   2001   2002   2003   2004
    4     .87    .52    .42    .23    .37    .11   -.38   -.31   -.22
    5     .98    .85    .43    .32    .07    .39   -.18   -.29    .08
    6     .79    .97    .38    .30   -.08    .49   -.37   -.26   -.05
    7     .58    .82    .36    .30   -.11    .55   -.43   -.24   -.10
    8     .44    .55    .18    .40   -.04    .60   -.47   -.15   -.18
    9     .50    .29   -.05    .36    .07    .60   -.39   -.07   -.05
   10     .63    .29   -.36    .22   -.04    .61   -.61   -.10    .02
   11     .69    .15   -.45    .12   -.09    .50   -.64   -.15    .13
   12     .93    .69    .33    .64    .09    .59   -.33    .17    .37
   13   No data for this fleet at this age
  Age     2005   2006   2007   2008   2009   2010   2011   2012   2013   2014
    4    -.45   -.41   -.39   -.32    .00    .07    .11   -.35    .07    .07
    5    -.63   -.50   -.57   -.04   -.10   -.24    .30   -.45    .05   -.47
    6    -.68   -.43   -.63    .01    .16   -.12    .30   -.23   -.14   -.39
    7    -.81   -.35   -.78    .03    .33    .08    .41   -.05   -.35   -.24
    8    -.77   -.38   -.94    .00    .48    .30    .43    .25   -.56   -.14
    9    -.77   -.39  -1.11    .01    .45    .29    .50    .41   -.51   -.12
   10    -.57   -.34  -1.26   -.03    .70    .32    .48    .70   -.69    .02
   11    -.37   -.18  -1.35    .03    .68    .38    .35    .87   -.74    .05
   12    -.16    .07  -1.07    .17   1.04    .59    .58   1.13   -.14    .46
   13   No data for this fleet at this age

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

   Age          4          5          6          7          8          9         10         11         12
Mean Log q   -14.1877   -14.8149   -15.1641   -15.7235   -15.6285   -15.2078   -14.9987   -15.1056   -15.1056
S.E(Log q)      .3703      .4589      .4497      .4504      .4624      .4679      .5390      .5505      .6235

Regression statistics :
Ages with q independent of year class strength and constant w.r.t. time.
Age  Slope   t-value   Intercept  RSquare  No Pts  Reg s.e   Mean Q
 4     1.52    -1.216      15.92      .24      19      .56   -14.19
 5    11.91    -2.098      58.79      .00      19     5.01   -14.81
 6    -3.39    -4.053      -4.67      .05      19     1.12   -15.16
 7    -3.65    -4.477      -8.65      .05      19     1.15   -15.72
 8    -4.78    -3.939     -15.20      .03      19     1.64   -15.63
 9   -16.46    -3.248     -74.88      .00      19     6.23   -15.21
10     5.23    -1.924      37.16      .01      19     2.63   -15.00
11     1.53     -.724      18.08      .10      19      .85   -15.11
12     1.22     -.401      16.00      .17      19      .66   -14.78

Terminal year survivor and F summaries :
Age  4   Catchability constant w.r.t. time and dependent on age
Year class = 2010
Fleet                   Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e    Ratio       Weights     F
PairTrawl >1000 HP           1.     .000        .000     .00    0   .000      .000
Summer survey            18795.     .380        .000     .00    1   .633      .005
  F shrinkage mean       15332.      .50                             .367      .006
Weighted prediction :
Survivors         Int       Ext     N     Var      F
at end of year    s.e       s.e          Ratio
    17441.        .30       .12     2     .408    .005

Age  5   Catchability constant w.r.t. time and dependent on age
Year class = 2009
Fleet                   Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e    Ratio       Weights     F
PairTrawl >1000 HP           1.     .000        .000     .00    0   .000      .000
Summer survey            25501.     .296        .262     .89    2   .734      .035
  F shrinkage mean       44187.      .50                             .266      .020
Weighted prediction :
Survivors         Int       Ext     N     Var      F
at end of year    s.e       s.e          Ratio
    29511.        .25       .26     3    1.004    .030

Age  6   Catchability constant w.r.t. time and dependent on age
Year class = 2008
Fleet                   Estimated     Int        Ext     Var     N  Scaled   Estimated
```

```
                       Survivors    s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP       39814.    .323       .000     .00    1   .320      .070
 Summer survey            23277.    .249       .134     .54    3   .533      .117
   F shrinkage mean       39794.     .50                            .147      .070
 Weighted prediction :
 Survivors         Int       Ext     N     Var      F
 at end of year    s.e       s.e          Ratio
     29903.        .18       .15     5     .831    .092

 Age  7   Catchability constant w.r.t. time and dependent on age
 Year class = 2007
 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP       27702.    .220       .137     .62    2   .453      .131
 Summer survey            21088.    .219       .119     .54    4   .442      .168
   F shrinkage mean       27416.     .50                            .105      .132
 Weighted prediction :
 Survivors         Int       Ext     N     Var      F
 at end of year    s.e       s.e          Ratio
     24528.        .15       .09     7     .586    .146

Age  8   Catchability constant w.r.t. time and dependent on age
 Year class = 2006
 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP       20022.    .178       .064     .36    3   .520      .209
 Summer survey            18152.    .200       .109     .55    5   .391      .229
   F shrinkage mean       22180.     .50                            .089      .191
 Weighted prediction :
 Survivors         Int       Ext     N     Var      F
 at end of year    s.e       s.e          Ratio
     19445.        .13       .06     9     .450    .215

 Age  9   Catchability constant w.r.t. time and dependent on age
 Year class = 2005
 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP       15955.    .154       .017     .11    4   .559      .257
 Summer survey            13624.    .186       .111     .60    6   .357      .296
   F shrinkage mean       17926.     .50                            .083      .232
 Weighted prediction :
 Survivors         Int       Ext     N     Var      F
 at end of year    s.e       s.e          Ratio
     15227.        .12       .06    11     .474    .268

 Age 10   Catchability constant w.r.t. time and dependent on age
 Year class = 2004
 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP       10145.    .140       .050     .36    5   .598      .270
 Summer survey             9091.    .180       .121     .67    7   .318      .297
   F shrinkage mean        9808.     .50                            .084      .278
 Weighted prediction :
 Survivors         Int       Ext     N     Var      F
 at end of year    s.e       s.e          Ratio
      9769.        .11       .06    13     .502    .279

 Age 11   Catchability constant w.r.t. time and dependent on age
 Year class = 2003
 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP        6976.    .130       .051     .39    6   .628      .293
 Summer survey             6933.    .177       .138     .78    8   .290      .294
   F shrinkage mean        7022.     .50                            .082      .291
 Weighted prediction :
 Survivors         Int       Ext     N     Var      F
 at end of year    s.e       s.e          Ratio
      6968.        .11       .06    15     .551    .293

 Age 12   Catchability constant w.r.t. time and age (fixed at the value for age) 11
 Year class = 2002
 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP        5120.    .129       .110     .85    7   .622      .213
 Summer survey             5414.    .179       .178     .99    9   .288      .202
   F shrinkage mean        3157.     .50                            .090      .326
 Weighted prediction :
 Survivors         Int       Ext     N     Var      F
 at end of year    s.e       s.e          Ratio
      4982.        .11       .09    17     .890    .218

 Age 13   Catchability constant w.r.t. time and age (fixed at the value for age) 11
 Year class = 2001
 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP        3476.    .131       .075     .58    8   .624      .274
 Summer survey             3623.    .180       .173     .96    9   .257      .264
   F shrinkage mean        1741.     .50                            .120      .488
```

```
 Weighted prediction :
 Survivors        Int       Ext     N     Var      F
 at end of year   s.e       s.e           Ratio
      3235.        .11       .09    18     .831    .292

Age 14   Catchability constant w.r.t. time and age (fixed at the value for age) 11
 Year class = 2000
 Fleet                   Estimated     Int        Ext     Var     N  Scaled   Estimated
                         Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP        2347.    .130        .073     .56    8   .576      .309
 Summer survey             2436.    .178        .206    1.16    9   .244      .299
   F shrinkage mean        1394.     .50                             .181      .476
 Weighted prediction :
 Survivors        Int       Ext     N     Var      F
 at end of year   s.e       s.e           Ratio
      2156.        .13       .10    18     .764    .333

 Age 15   Catchability constant w.r.t. time and age (fixed at the value for age) 11
 Year class = 1999
 Fleet                   Estimated     Int        Ext     Var     N  Scaled   Estimated
                         Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP        1110.    .131        .091     .70    8   .482      .454
 Summer survey             1052.    .174        .184    1.06    9   .208      .474
   F shrinkage mean        1016.     .50                             .310      .487
 Weighted prediction :
 Survivors        Int       Ext     N     Var      F
 at end of year   s.e       s.e           Ratio
      1068.        .17       .07    18     .417    .468

Age 16   Catchability constant w.r.t. time and age (fixed at the value for age) 11
 Year class = 1998
 Fleet                   Estimated     Int        Ext     Var     N  Scaled   Estimated
                         Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP         585.    .126        .112     .89    8   .374      .471
 Summer survey              519.    .170        .199    1.17    9   .169      .517
   F shrinkage mean         689.     .50                             .457      .413
 Weighted prediction :
 Survivors        Int       Ext     N     Var      F
 at end of year   s.e       s.e           Ratio
       618.        .24       .08    18     .337    .451

 Age 17   Catchability constant w.r.t. time and age (fixed at the value for age) 11
 Year class = 1997
 Fleet                   Estimated     Int        Ext     Var     N  Scaled   Estimated
                         Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP         421.    .123        .084     .68    8   .348      .456
 Summer survey              426.    .167        .207    1.24    9   .162      .452
   F shrinkage mean         593.     .50                             .490      .344
 Weighted prediction :
 Survivors        Int       Ext     N     Var      F
 at end of year   s.e       s.e           Ratio
       499.        .25       .09    18     .348    .398

Age 18   Catchability constant w.r.t. time and age (fixed at the value for age) 11
 Year class = 1996
 Fleet                   Estimated     Int        Ext     Var     N  Scaled   Estimated
                         Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP         392.    .121        .105     .87    8   .342      .404
 Summer survey              345.    .165        .189    1.14    9   .162      .448
   F shrinkage mean         519.     .50                             .496      .319
 Weighted prediction :
 Survivors        Int       Ext     N     Var      F
 at end of year   s.e       s.e           Ratio
       441.        .25       .09    18     .340    .366

 Age 19   Catchability constant w.r.t. time and age (fixed at the value for age) 11
 Year class = 1995
 Fleet                   Estimated     Int        Ext     Var     N  Scaled   Estimated
                         Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP         378.    .121        .140    1.16    8   .369      .344
 Summer survey              341.    .166        .152     .92    9   .174      .375
   F shrinkage mean         451.     .50                             .457      .296
 Weighted prediction :
 Survivors        Int       Ext     N     Var      F
 at end of year   s.e       s.e           Ratio
       402.        .23       .08    18     .333    .326

 Age 20   Catchability constant w.r.t. time and age (fixed at the value for age) 11
 Year class = 1994
 Fleet                   Estimated     Int        Ext     Var     N  Scaled   Estimated
                         Survivors     s.e        s.e    Ratio       Weights     F
 PairTrawl >1000 HP         408.    .120        .149    1.24    8   .420      .437
 Summer survey              456.    .166        .115     .70    9   .197      .399
   F shrinkage mean         450.     .50                             .383      .403
 Weighted prediction :
 Survivors        Int       Ext     N     Var      F
 at end of year   s.e       s.e           Ratio
       433.        .20       .07    18     .362    .416
```

Appendix 9. GSS Vb. Fishing mortality (F) at age.

Year\Age	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	FBAR (6-11)
1995	0.000	0.000	0.003	0.016	0.061	0.106	0.120	0.151	0.229	0.286	0.367	0.364	0.448	0.470	0.504	0.893	0.538	0.538	0.076
1996	0.000	0.001	0.008	0.027	0.073	0.144	0.184	0.209	0.279	0.250	0.324	0.251	0.286	0.298	0.256	0.401	0.299	0.299	0.108
1997	0.002	0.005	0.019	0.026	0.056	0.125	0.184	0.204	0.290	0.202	0.281	0.218	0.220	0.308	0.247	0.259	0.251	0.251	0.102
1998	0.002	0.020	0.057	0.069	0.138	0.219	0.295	0.382	0.670	0.609	0.843	0.660	0.800	1.145	1.095	1.248	0.995	0.995	0.193
1999	0.001	0.018	0.047	0.056	0.116	0.157	0.205	0.222	0.310	0.456	0.532	0.376	0.519	0.539	0.491	0.359	0.458	0.458	0.134
2000	0.000	0.005	0.017	0.037	0.069	0.078	0.103	0.117	0.113	0.192	0.381	0.389	0.410	0.448	0.499	0.672	0.485	0.485	0.070
2001	0.001	0.010	0.046	0.090	0.162	0.200	0.220	0.233	0.213	0.245	0.389	0.765	0.946	1.034	0.847	1.218	0.967	0.967	0.158
2002	0.001	0.015	0.050	0.069	0.119	0.156	0.131	0.152	0.160	0.137	0.124	0.217	0.409	0.616	0.711	0.765	0.546	0.546	0.113
2003	0.000	0.002	0.016	0.038	0.084	0.142	0.125	0.125	0.175	0.136	0.140	0.097	0.155	1.240	2.028	2.298	1.171	1.171	0.088
2004	0.000	0.002	0.013	0.030	0.072	0.138	0.139	0.143	0.163	0.125	0.106	0.056	0.028	0.077	1.512	3.917	1.124	1.124	0.089
2005	0.000	0.019	0.029	0.041	0.077	0.117	0.160	0.119	0.118	0.084	0.090	0.041	0.029	0.039	0.088	1.876	0.416	0.416	0.090
2006	0.025	0.073	0.070	0.079	0.133	0.150	0.208	0.170	0.127	0.126	0.094	0.072	0.041	0.044	0.043	0.041	0.048	0.048	0.135
2007	0.009	0.050	0.091	0.117	0.160	0.179	0.227	0.181	0.120	0.105	0.064	0.034	0.030	0.033	0.031	0.009	0.016	0.016	0.159
2008	0.024	0.074	0.120	0.184	0.209	0.243	0.257	0.241	0.163	0.193	0.177	0.080	0.088	0.136	0.128	0.108	0.063	0.063	0.209
2009	0.005	0.027	0.079	0.153	0.186	0.249	0.285	0.277	0.239	0.390	0.324	0.294	0.203	0.161	0.157	0.260	0.131	0.131	0.205
2010	0.005	0.015	0.069	0.129	0.172	0.214	0.265	0.271	0.332	0.501	0.445	0.450	0.348	0.285	0.256	0.462	0.257	0.257	0.186
2011	0.012	0.032	0.081	0.155	0.227	0.247	0.327	0.312	0.426	0.634	0.561	0.532	0.461	0.359	0.321	0.282	0.318	0.318	0.225
2012	0.002	0.011	0.051	0.098	0.169	0.173	0.222	0.245	0.279	0.418	0.473	0.475	0.434	0.363	0.359	0.184	0.287	0.287	0.160
2013	0.007	0.017	0.069	0.124	0.198	0.277	0.290	0.347	0.348	0.491	0.571	0.676	0.610	0.548	0.498	0.286	0.430	0.430	0.217
2014	0.005	0.030	0.092	0.146	0.215	0.268	0.279	0.293	0.218	0.292	0.333	0.468	0.451	0.398	0.366	0.326	0.416	0.416	0.216
FBAR	0.005	0.019	0.071	0.123	0.194	0.239	0.264	0.295	0.282	0.400	0.459	0.540	0.498	0.436	0.408	0.265	0.378		

Appendix 10. GSS Vb. Stock number at age (start of year, thousands).

Year\Age	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	
1995	32052	27775	25929	25625	20472	16463	13114	12569	10552	9544	7902	5835	4327	3012	1702	1131	581	1159	219745
1996	40615	29002	25121	23383	22813	17425	13401	10520	9775	7592	6487	4952	3669	2503	1702	930	419	843	221153
1997	46766	36736	26209	22553	20596	19181	13650	10088	7720	6692	5351	4244	3487	2493	1682	1192	564	1130	230333
1998	53500	42244	33085	23258	19892	17627	15324	10272	7441	5227	4947	3654	3090	2531	1659	1189	832	1374	247145
1999	60219	48302	37468	28267	19644	15684	12813	10322	6342	3444	2572	1927	1709	1257	729	502	309	721	252230
2000	69084	54428	42933	32339	24174	15825	12132	9448	7479	4208	1975	1368	1198	920	663	404	317	779	279673
2001	69516	62510	49024	38191	28213	20413	13240	9906	7604	6044	3144	1221	839	719	532	364	187	584	312248
2002	72756	62856	55983	42347	31596	21713	15129	9611	7104	5563	4280	1929	514	295	231	206	97	206	332416
2003	67717	65742	56034	48189	35748	25385	16808	12010	7471	5477	4390	3421	1405	309	144	103	87	192	350631
2004	67359	61271	59385	49917	41993	29737	19933	13420	9592	5676	4326	3454	2808	1088	81	17	9	39	370105
2005	62375	60949	55322	53027	43817	35364	23451	15698	10529	7375	4534	3522	2956	2471	911	16	0	182	382500
2006	57973	56439	54101	48638	46062	36729	28471	18086	12606	8468	6135	3750	3059	2600	2151	755	2	581	386607
2007	55357	51177	47473	45644	40652	36504	28609	20919	13803	10043	6753	5055	3158	2657	2251	1864	656	1049	373623
2008	53447	49646	44065	39220	36755	31361	27627	20635	15801	11076	8181	5734	4422	2772	2325	1975	1672	1895	358610
2009	53943	47218	41722	35349	29520	26992	22256	19326	14671	12153	8259	6201	4791	3665	2189	1851	1605	5207	336918
2010	49098	48568	41609	34898	27447	22167	19046	15147	13255	10456	7446	5404	4181	3537	2822	1692	1292	6149	314216
2011	46434	44211	43303	35129	27768	20911	16201	13228	10457	8601	5735	4316	3119	2672	2407	1976	964	3899	291333
2012	45059	41510	38731	36123	27220	20021	14779	10576	8762	6182	4130	2963	2295	1779	1688	1580	1349	2656	267403
2013	37394	40707	37167	33318	29633	20803	15246	10712	7488	5998	3685	2329	1668	1345	1120	1067	1189	1052	251920
2014	19378	33607	36231	31377	26641	22006	14273	10323	6848	4786	3322	1884	1072	820	703	616	726	800	215412
2015	0	17441	29511	29903	24528	19445	15227	9769	6968	4982	3235	2156	1068	618	499	441	402	910	167100
GMST 95-**	54589	48119	41792	35515	29105	22900	17361	12936	9684	7040	5009	3473	2459	1681	1021	544	203		
AMST 95-**	55737	49477	43194	36783	30243	23861	18110	13432	10054	7435	5364	3830	2835	2071	1437	986	608		

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Research on greater silver smelt in Norway 2014.

Elvar H. Hallfredsson and Lise Heggebakken.

Introduction

This working document summarises results from Norwegian research on greater silver smelt (*Argentina silus*) in 2014.

Landings by Norway from Subareas I and II declined in the 1990s from peak levels of 10000 t to 11000 t in the 1980s. Landings were relatively stable at 6–8 000 t until 2003, but do reach high levels some years (e.g. 14357 t in 2001). In 2004 to 2006 landings increased gradually to reach 21 700 t in 2006. It is thought that these fluctuations reflect variation in the market demands rather than changes in abundance of Greater silver smelt. In 2007-2013 the Norwegian catches were around 12000 t per year in accordance to regulations. Preliminary numbers for catches in 2014 are approximately 14500 t (figure 1), including 2700 t bycatch in ICES areas III and IV.

Norwegian regulations

For a period after 1983 a precautionary unilateral annual TAC applied in IIa, but the landings never exceeded the quota and this regulation was abandoned in 1992. In addition there is a licensing system that regulates number of trawlers that can take part in the aimed fishery, equipment restriction and an area- and time restriction. In 2007 a 12000 t TAC was introduced as a precautionary measure to reduce an increase in the fishery. This TAC has been the same for the years 2007-2014. Bycatch of greater silver smelt in other fisheries is now regulated in the Norwegian EEZ not to exceed 10% in total catches and in individual catches.

Samples from the catches in Norway in 2014

On request from IMR inspectors from the Norwegian Directorate of Fisheries conducted sampling of greater silver smelt at fishing ports in the 2014 fishing season (Hallfredsson and Heggebakken 2014). Data from the fisheries have been collected this way yearly since 2009. In addition to field measurements, frozen samples were sent to IMR for biological sampling. Data came also from a vessel in the commercial reference fleet (F/V Cetus). Length measured samples from the fisheries were 14 and biological samples were taken in 13 cases (Table 1). The samplings from the fisheries were in the time period 1st of March until 3rd of May 2014 and came from the traditional fishing grounds in the direct fisheries (Figure 2).

Length distributions from catches in the direct fisheries in 2014 did not show obvious differences compared to previous years (figure 3) with bulk of the catches being in the range 25-40 cm. No considerable increase in occurrence of large greater silver smelt (> 40 cm) was found in the catches. It should be noted that the summed up length distributions in figure 3 are simply sum of the length distributions in the samples and are not weighted in any way.

Age distributions in the biological samples in 2014 show that greater silver smelt in general were less than 20 years old (figure 5). Age distributions from the fisheries cannot be considered as representative for age distribution in nature. Still it should be noted that the age distributions found in today's catches has considerably larger proportion of fish under 10 year of age than Monstad and Johannesen (2003) found in surveys in 1981 and 1983 (figure4). Especially there was a large proportion of older fish in depths below 300 m in the 1981 and 1983 surveys. Today's age distributions are similar only to those found on the depths shallower than 300m, where small fish traditionally is assumed to be more represented. Catches from which samples are taken from are not chosen by any predetermined plan and might thus be considered random and might give a representative picture of the fisheries. These catches were in general taken at depths between 350-450 m (table 1).

Survey 2014

An acoustical survey was conducted in April 2014 along the continental slope in Norwegian EEZ from 62-74° N, in deep grooves on the shelf and in Bjørnøyrenna. This survey is planned to run biennially and 2014 is the third time the survey is carried out. Highest densities of greater silver smelt in 2014 were found in similar areas as in 2009 on the continental slope off central Norway. The estimated total biomass in the survey area was based on acoustics 328 000 tonnes in 2014. The proportion of estimated acoustical biomass further north than 70°N was 1%, 9% and 2% in 2009, 2012 and 2014 respectively (table 2). Large fish are more abundant in the survey results than in samples from the catches (figure 3 and 7), and the survey length distributions are closer to what was found in surveys in 1981 and 1983 than samples from the fisheries show. As were noticeably represented in studies from the 1980ties and 1990ties (Bergstad 1993, Monstad and Johannessen 2003, Johannessen and Monstad 2003) (figure 4). Also age distribution in the 2012 and 2014 surveys are closer to what found in surveys in the 1980ties, with considerable proportion of fish older than 20 years (figure 4, 5 and 6). Age of greater silver smelt in the bottom-trawl catches increases with increasing depth (figure 8).

Distribution of greater silver smelt has not markedly changed in comparison between the surveys, and the survey seems to cover the south and north outscores of the distribution (figure 9). In 2012 there are some more greater silver smelt registered in northernmost part compared to 2009, but this trend not as pronounced in 2014.

Acoustics on greater silver smelt was studied in a working document at the last ICES benchmark on the species (Harbitz 2010). As the survey now is becoming close to give trends there is a need to have a more thorough scrutiny of acoustics as a method for estimates of greater silver smelt. The survey is also a trawl survey, and a future task is to calculate distribution and swept area index from the trawl sampling to compare with the acoustic estimates.

Conclusion

Sampling from the Norwegian fisheries indicates that large and old individuals still make up lesser proportion of the greater silver smelt in the area in 2014 compared to surveys in the 1980ties, but there are small changes compared to the most recent years. Length and age in survey in 2014 are also lower than in the 1980ties, but higher then resent age and length distributions from the fisheries.

Samples from the fisheries are now available for six consecutive years, and continuation of this sampling will gradually give basis to consider trends in e.g. age and length distributions in catches in Norwegian waters. Landings of greater silver smelt catches in Norway in 2014 are 11750 tons from ICES area IIA and 2719 from IV, in total around 4% of the estimated biomass in the acoustic survey in 2014. This could imply that fishing pressure has been on an acceptable level, but it should be carefully noted that absolute biomass estimates from acoustical surveys can be inaccurate of various reasons. At present acoustical biomass indices should rather be used to analyze trends. Next planned survey is in 2016 and the survey will be the fourth in the biennial survey plan. With time the surveys will provide further trends for greater silver smelt within Norwegian waters of ICES areas I and II. Thus data from Norwegian waters that are available for management of greater silver smelt should gradually improve in the coming years.

At present short time series other than amounts of catch and limited knowledge about stock structure imply caution in management of greater silver smelt fisheries in Norwegian waters.

Acknowledgment

Thanks to Kjell Gamst, Karl-Erik Karlsen, Hege Øverbø Hansen, Alf Harbitz and Odd Aksel Bergstad who in addition to the authors all are involved in the year-cycles of work at IMR that provides data and advice on Greater silver smelt in Norway.

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Tables

Table 1: Overview over greater silver smelt sampling from Norwegian catches in 2014. Type 1 is in field while type 2 is biological sampling at IMR from frozen samples.

	Type of sampling			Vessel		Depth	Position (decimal)			
Ser.no	1	2		Call.signal	Name	m	N	E	Fishing field	
48201	Length	Bio.sample	Age	LLVN	Trønderkari	427-490	64.2000	8.5833	Helgelandsbanken	Omr 0605
48202	Length			LLYM	Cetus		67.0000	8.0000	Trænadjupet	Omr 3709
48203	Length			LCMN	Rødholmen		67.0000	8.0000	Trænadjupet	Omr 3709
48204	Length			LLAS	Viking Bank		65.0000	6.0000	Garsholbanken	Omr 0613
48205	Length			LLAS	Viking Bank		65.0000	6.0000	Garsholbanken	Omr 0613
48206	Length			LLVN	Trønderkari	440-492	64.1917	8.5667	Helgelandsbanken	
48207	Length			LJVY	Trønderbas	469-508	65.0000	5.0000	Skjoldsryggen	Omr 3703
86465	Length	Bio.sample	Age	LLYM	Cetus		65.0000	5.0000	Skjoldsryggen	Omr 3703
86467	Length	Bio.sample	Age	LLYM	Cetus		65.0000	5.0000	Skjoldsryggen	Omr 3703
86468	Length	Bio.sample	Age	LLYM	Cetus	349-412	65.3833	5.0000	Skjoldsryggen	Omr 3703
86469	Length	Bio.sample	Age	LLYM	Cetus	380-415	67.0167	8.3171	Trænadjupet	Omr 3709
86470	Length	Bio.sample	Age	LLYM	Cetus		67.0000	8.0000	Trænadjupet	Omr 3709
86472	Length	Bio.sample	Age	LLYM	Cetus		67.0000	8.0000	Trænadjupet	Omr 3709
86474	Length	Bio.sample	Age	LLYM	Cetus	373-395	67.0500	8.3833	Trænadjupet	Omr 3709
86490		Bio.sample	Age	LLYM	Cetus		67.0000	8.0000	Trænadjupet	Omr 3709
86492		Bio.sample	Age	LLYM	Cetus		67.0000	8.0000	Trænadjupet	Omr 3709
86494		Bio.sample	Age	LLYM	Cetus		67.0000	8.0000	Trænadjupet	Omr 3709
86495		Bio.sample	Age	LLYM	Cetus		67.0000	8.0000	Trænadjupet	Omr 3709
86497		Bio.sample	Age	LLYM	Cetus		67.0000	8.0000	Trænadjupet	Omr 3709

Table 2. Estimated biomass (in tons) for greater silver smelt for acoustic surveys in March-April 2009, 2012 og 2014 (for method see Harbitz 2010)

	2009	**2012**	**2014***
Latitude < 70°N, depth 300-500 m	92200	96400	110000
Latitude < 70°N, depth 500-750 m	105200	55200	211000
Latitude > 70°N, depth 300-500 m	1800	2400	
Latitude > 70°N, depth 500-750 m	1000	12800	7000
SUM	200200	166800	328000

*In 2014 the survey was conducted without pelagic trawl. This could increase the possibility of incorrect species determination in the upper waterlayers during the interpretation of the acoustic data which again leeds to increased uncertainty in the estimates.

Table 3. Catches (tons) for Greater silver smelt in years 2011-2014 from port landings.

Fishing gear	2011	2012	2013	2014
Bottom trawl	3923	3472	3279	3001
Pelagic trawl	8138	8890	9955	11469
Undef. trawl				0,1
SUM	12061	12362	13234	14470

Figures

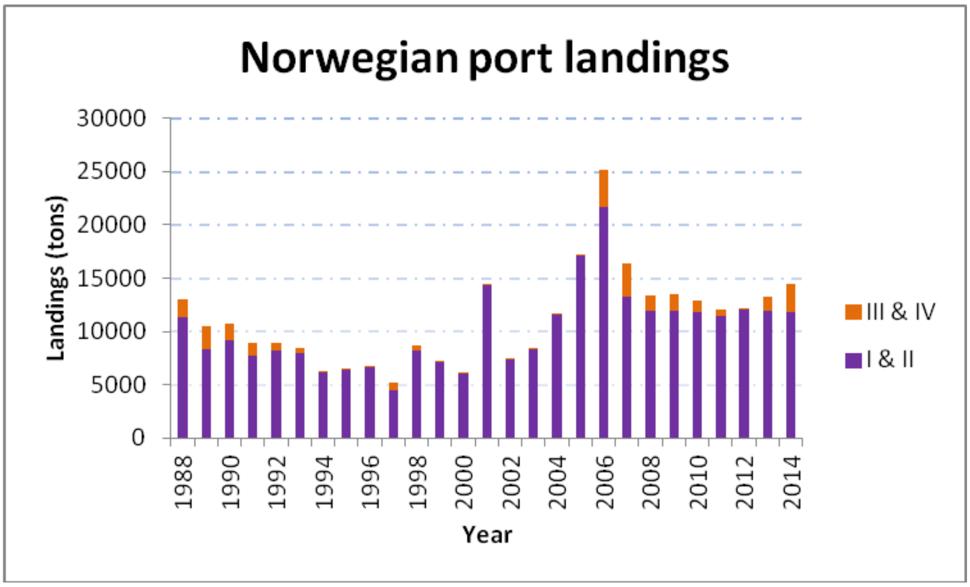

Figure 1.Cathes in Norway 1988-2014. (Divided between ICES area I-II and III-IV)

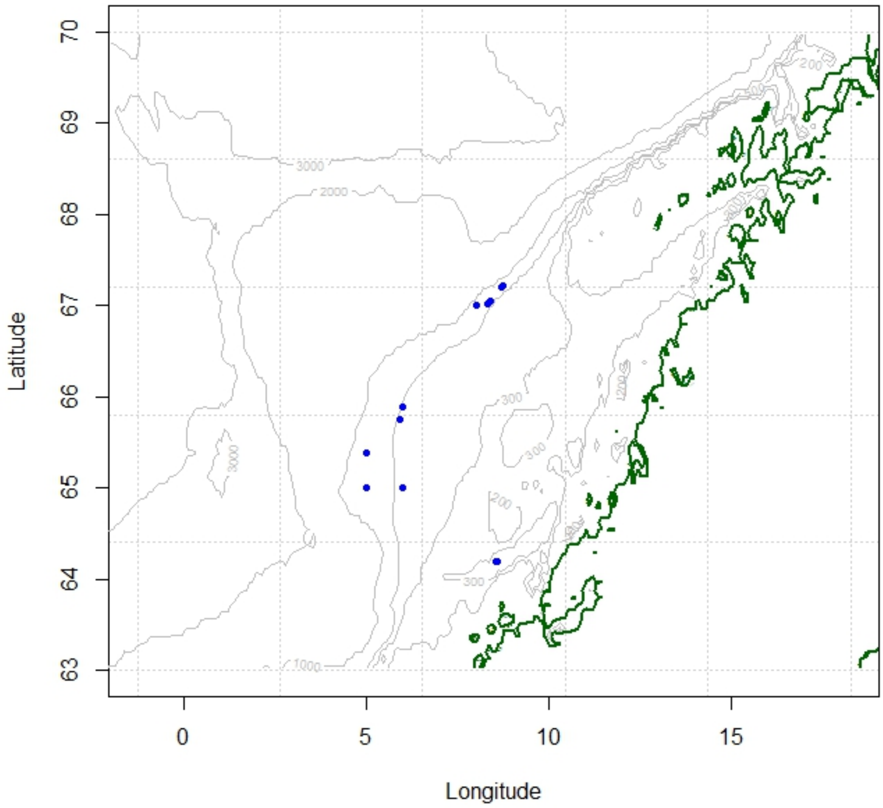

Figure 2: Positions for the greater silver smelt catches that samples were taken from in 2014.

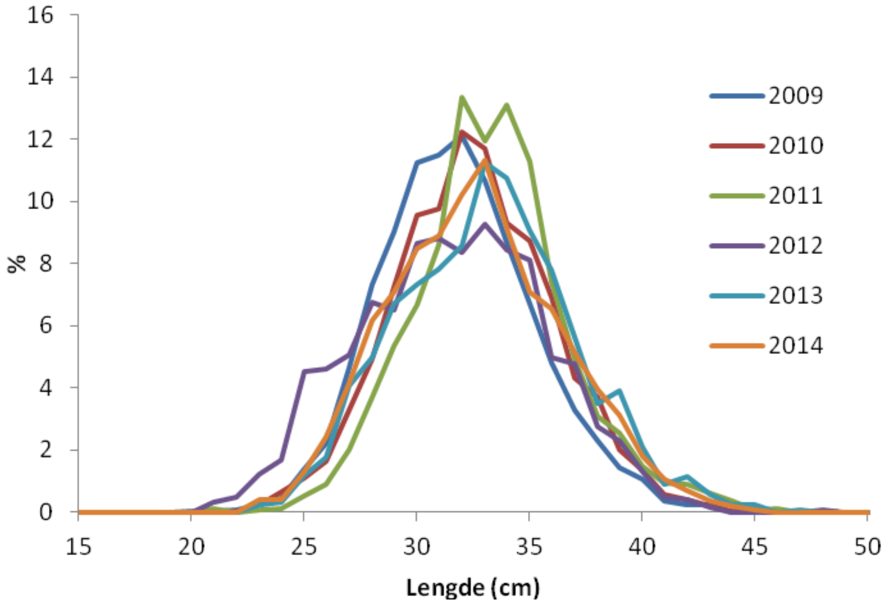

Figure 3: Length distributions from the fisheries in 2009-2014. Samples from all fishing fields summed up within a year.

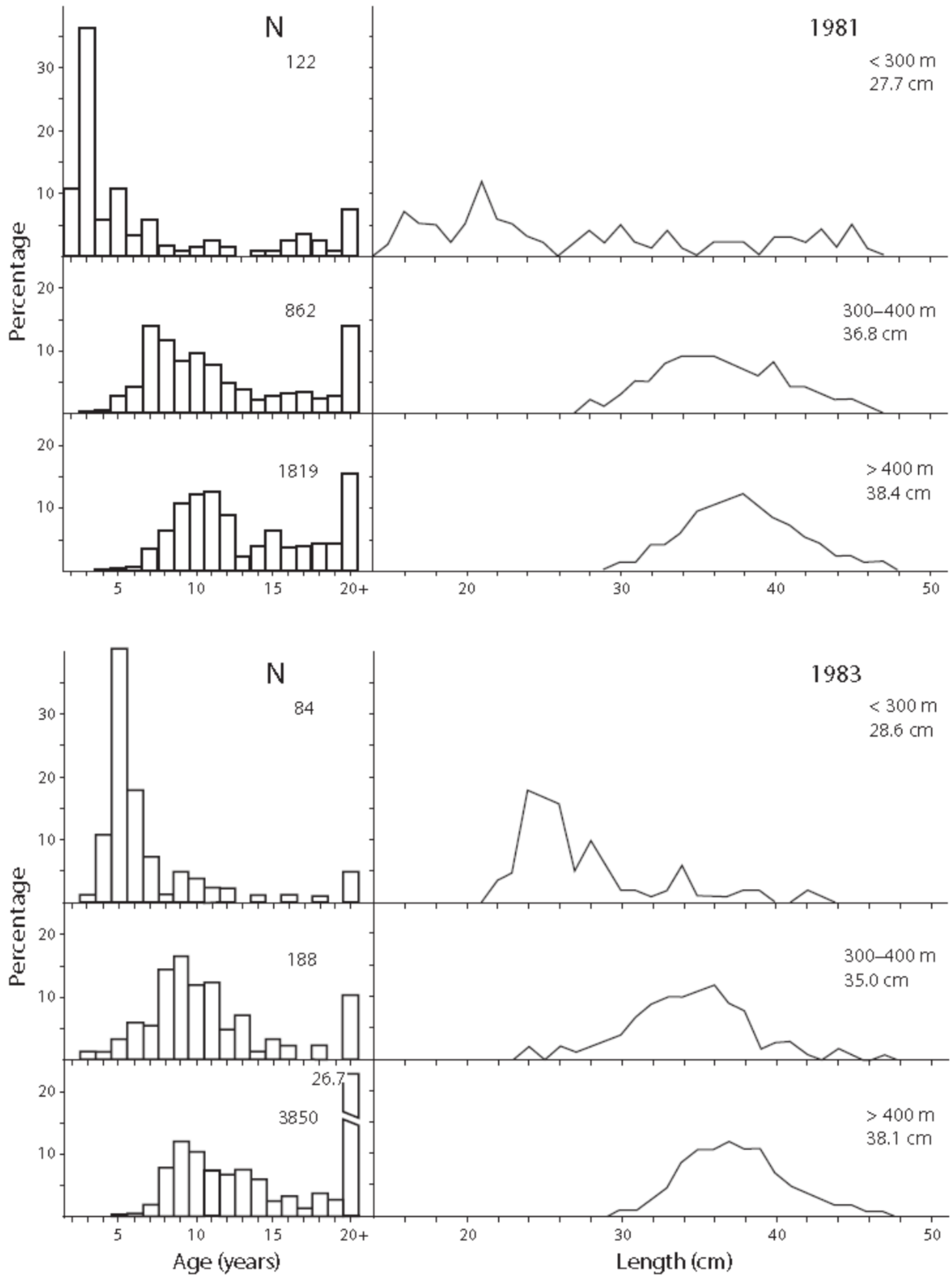

Figure 4: Age and length distributions for greater silver smelt in 1981 and 1983. Bottom trawl samples from three different depth intervals in geographic area limited to 64°-66°N (Monstad and Johannesen 2003).

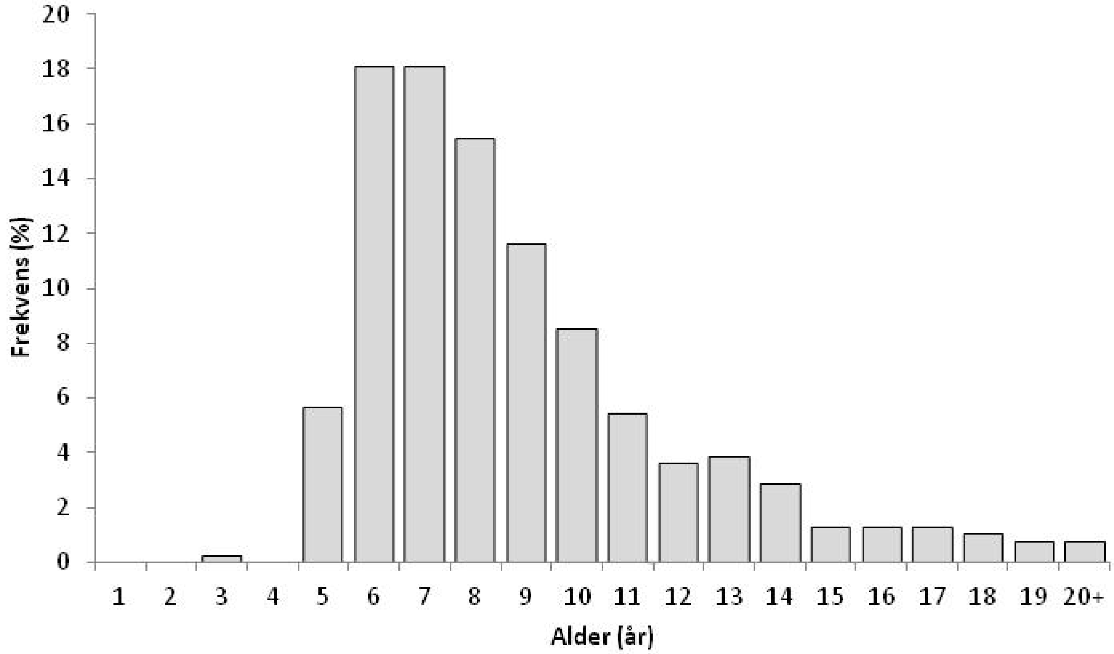

Figure 5: Age distributions from the fisheries north from 62˚N in 2014. The distribution is not weighted on fishing area or in any other way. (X-axis: Age (year), Y-axis: Frequensy)

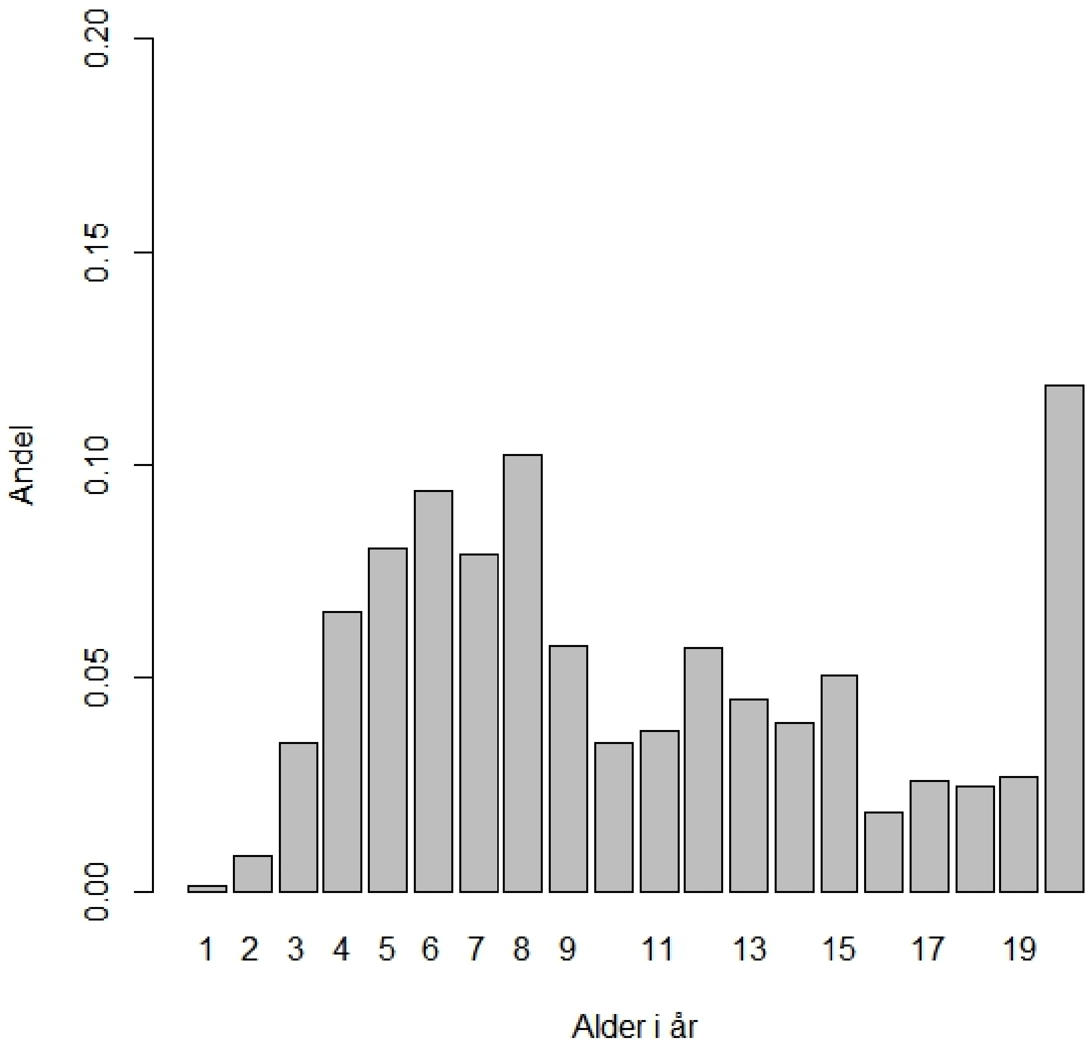

Figure 6. Age distribution for greater silver smelt in the survey 2014 . (X-axis: Age (year), Y-axis: proportion, 20 is a plus group)

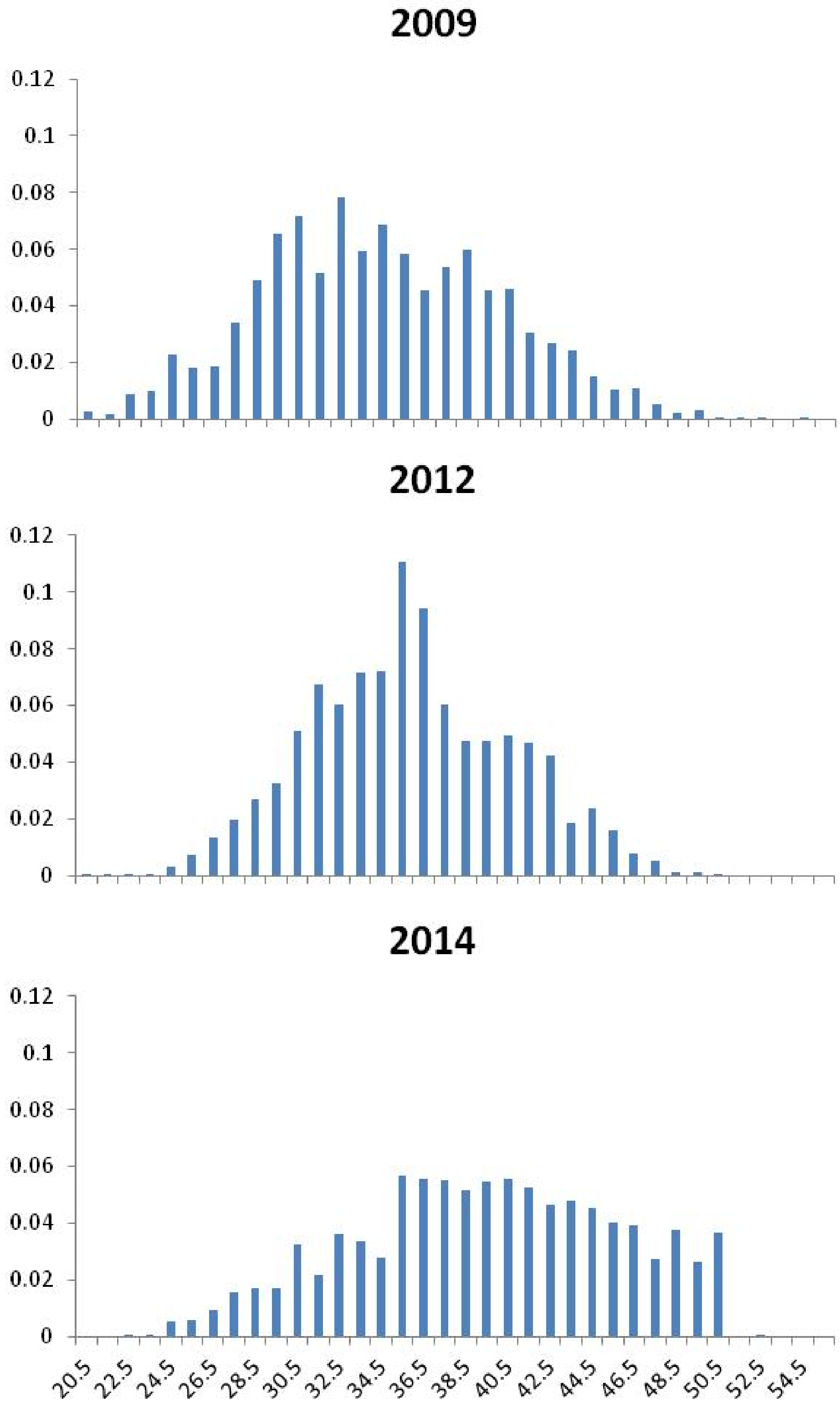

Figure 7. Length distribution for greater silver smelt in surveys (2009, 2012 and 2014). (X-axis: Length (cm), Y-axis: proportion)

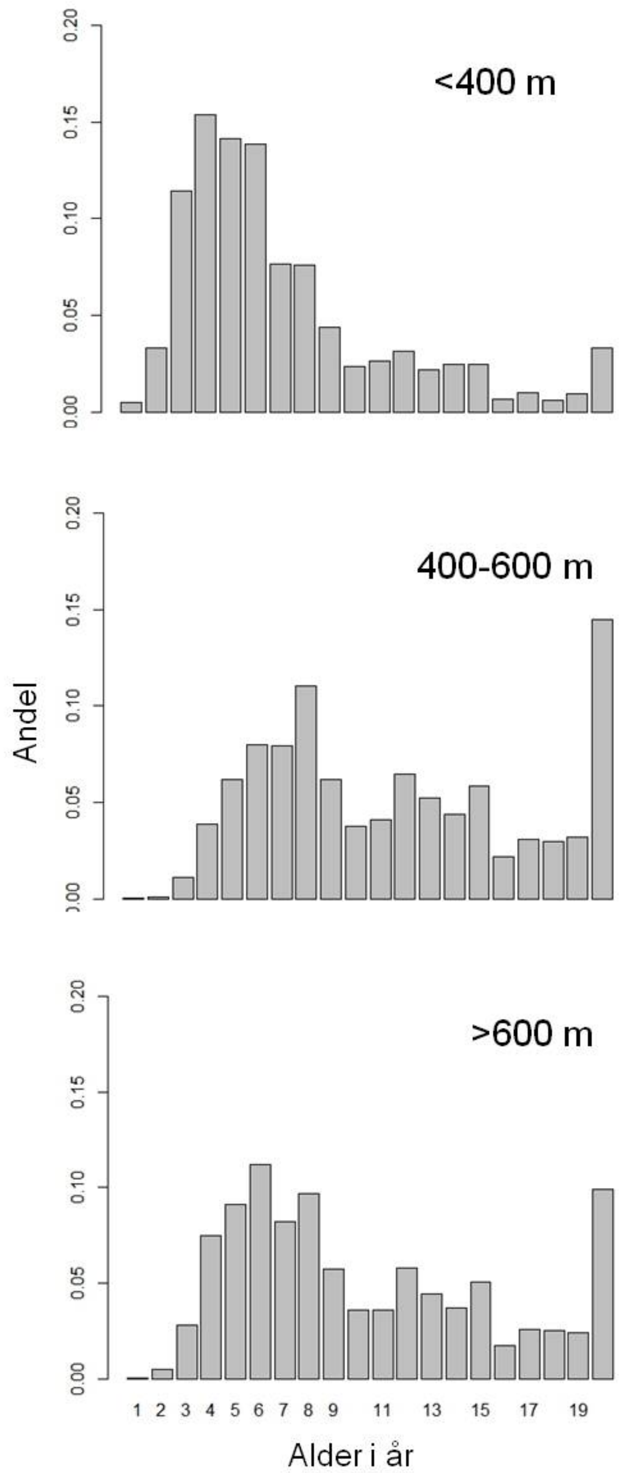

Figure 8. Agedistribution for greater silver smelt in different depths during survey (April 2014). (X-axis: Age (year), Y-axis: proportion, 20 is a plus group)

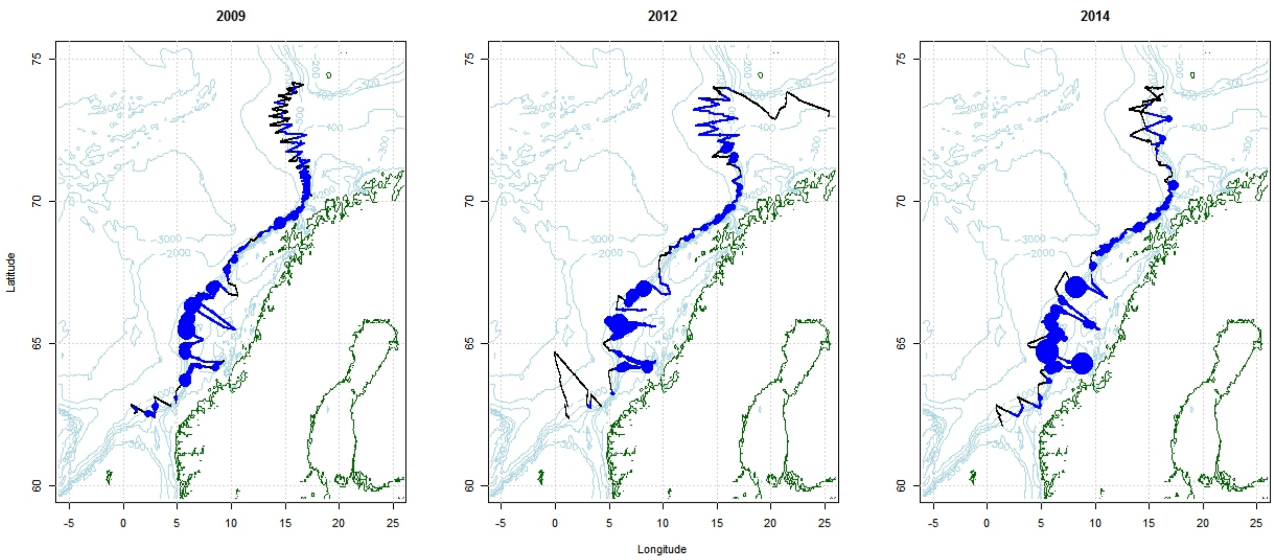

Figure 9. Acoustic estimates (SA-values) for distribution of Greater silver smelt in the Norwegian slope survey in 2009, 2012 and 2014. Radius of blue dots is scaled by the SA-values per nautical mile, and black line is cruse track.

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Faroese fishery of orange roughy

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Fishery

Faroese vessels continued their fisheries for orange roughy in 2014. The Faroese catches of orange roughy in 2014 were in total 58 tons. 46.668 tons were caught in area X and 11.004 tons in area XII. In 2013, the Faroese trawler caught 1.869 tons of orange roughy in area XII.

Fisheries were undertaken in the period 19 June to 1 August 2014 in traditional fishing areas in ICES areas X and XII. Orange roughy were mainly caught on one seamount north of the Azores (area X) and a smaller amount south of the Hatton Bank area (area XII) (Figure 1). The fishery was carried out with one trawler (M/S Ran) which has many years' experience in the Faroese orange roughy fishery.

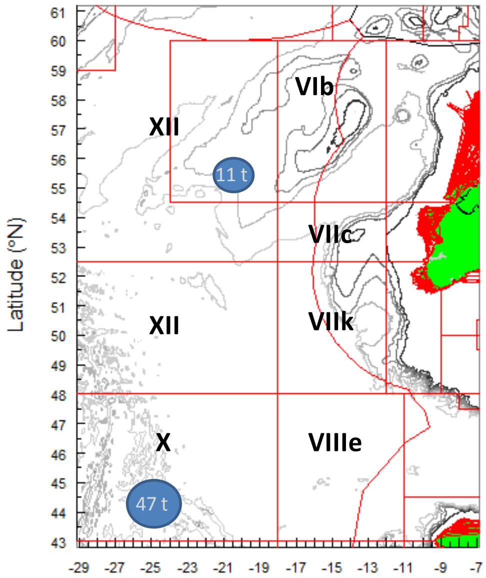

Figure 1. Faroese catch of orange roughy in 2014.

The logbook information was provided on a haul-by-haul basis. Trained crew members did the biological sampling and lengths, weight and gender of orange roughy were randomly taken from the catch. Approximately 5% of the Faroese landings of 58 tons in 2014 were sampled (753 individuals). The length distribution of the catch is between 50-70 cm total length (Figure 2), which is the same as in the Faroese experimental fishery in the nineties (Thomsen, 1998). The average length and weight of orange roughy females and males were around the same in 2011-2014 compared with the results from the experimental fishery in 1992-1998 (Thomsen, 1998) (Table 1, Figure 3).

Table 1. Mean length and weight of orange roughy

Year	Area	Average length (cm)		Average weight (kg)		
		Female	Male	Female	Male	
1992-1998	Faroe Islands	61.4	58.6	4.4	3.7	Thomsen, 1998
	Hatton Bank	64.6	62.8	4.9	4.3	Thomsen, 1998
	Reykjanes ridge	58.9	56.4	3.6	3.0	Thomsen, 1998
	North of Azores	60.6	59.7	3.9	3.7	Thomsen, 1998
2011		61.4	60.5	3.5	3.2	
2012		61.4	60.8	3.5	3.2	
2013		60.9	57.7	4.3	3.8	
2014		62.1	58.4	4.2	3.7	

Reference:
Thomsen, B. 1998. Faroese quest of orange roughy in the north Atlantic. ICES CM 1998/O:31.

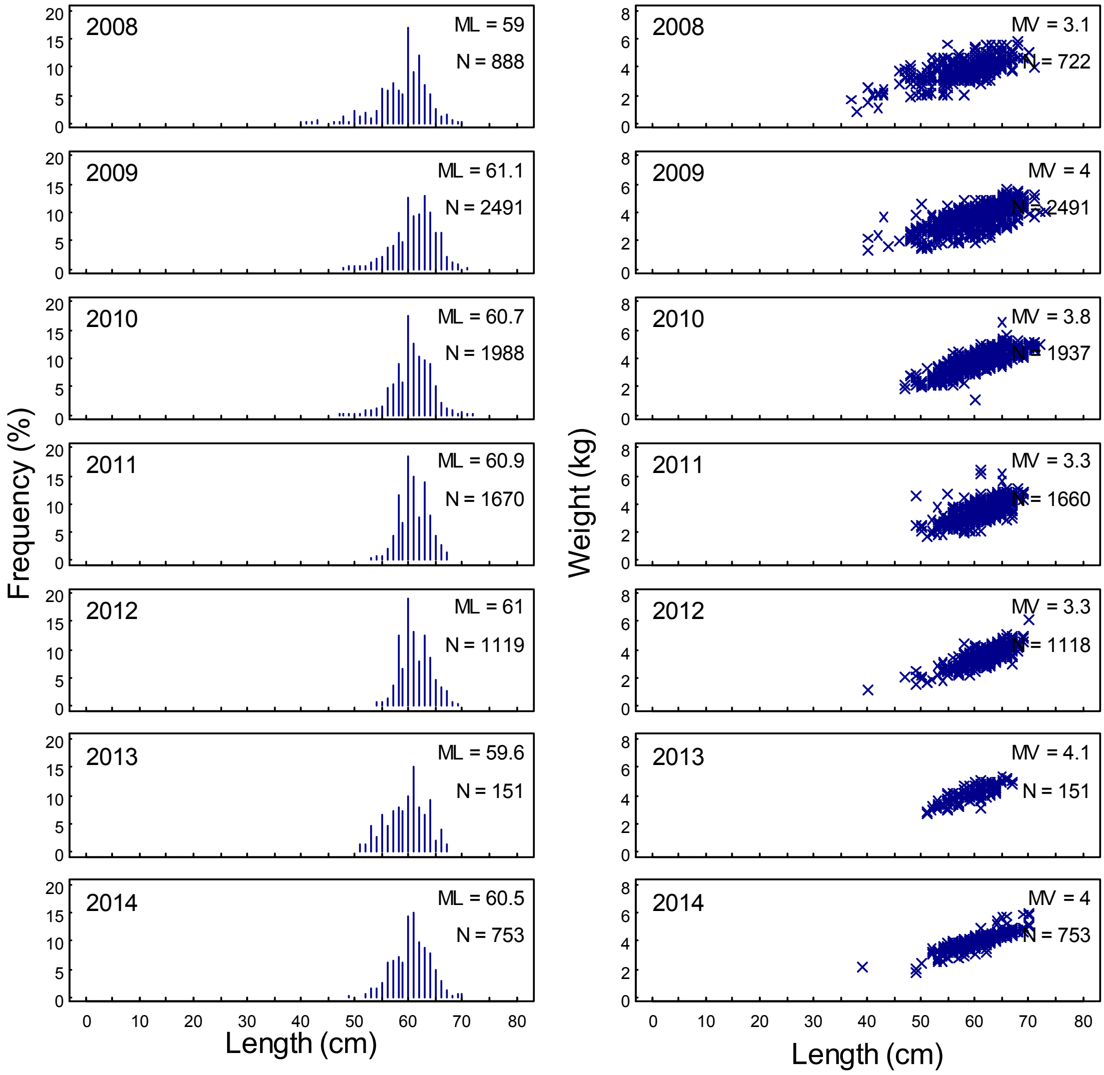

Figure 2. Data of orange roughy in 2008-2014 a) length distribution per year and b) length at weight.

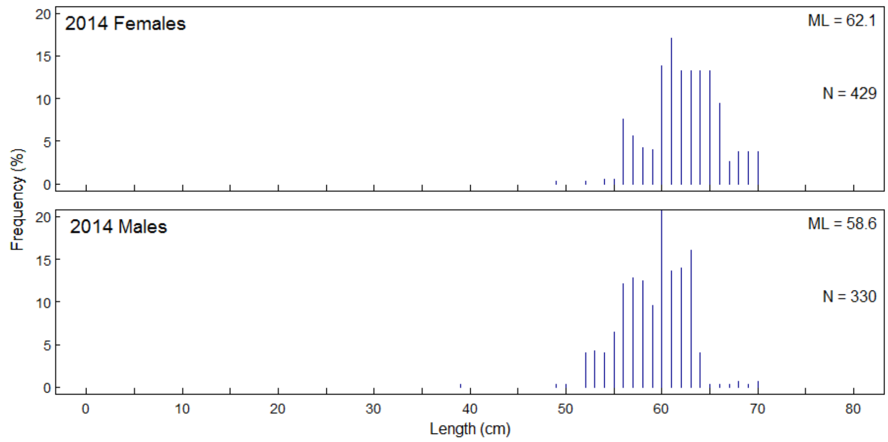

Figure 3. Length distribution of females and males in 2014.

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Update on Norwegian fishery independent information on abundance, recruitment, size distributions, and exploitation of roundnose grenadier (*Coryphaenoides rupestris*) in the Skagerrak and north-eastern North Sea (ICES Division IIIa and IVa)

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Introduction

The roundnose grenadier is a long-lived deepwater species which in the relevant study area reaches ages of 70 years or more and attains maturity at the age of 8-12 year (Bergstad 1990). It has a limited area of distribution within the Norwegian deep and in the deep Skagerrak basin (300-720m) (ICES Div IVa & IIIa). Analyses using microsatellite DNA have demonstrated that the Skagerrak grenadier is currently likely to be isolated from grenadier elsewhere in its North Atlantic distribution area (Knutsen *et al*., 2012). In 2003-2005 a major expansion of the previously quite minor targeted grenadier fishery occurred, and this expansion was followed by a complete closure of the fishery from 2006 onwards. Apart from targeted exploitation, grenadier is a by-catch in the traditional trawl fishery for *Pandalus borealis* which is currently the major demersal trawl fishery in the area. Most shrimp fishing occurs however shallower than the main distribution area of the grenadier.

This Working Document presents results derived from a research vessel bottom trawl survey conducted annually during the past 32 years (1984-2015). While the main objective of the survey is to monitor *Pandalus borealis*, the survey samples the entire depth range and distribution area of roundnose grenadier.

We report temporal variation in survey catch rates in terms of biomass and abundance (kg/hour and number/hour), length distributions, occurrence of recruits, and geographical distribution. We also attempt to estimate by-catch in the commercial shrimp fishery. Most of the information in this Working Document is an update of a WD first submitted to WGDEEP in 2009 (Bergstad *et al*. 2009). The survey series is currently the only information available to assess temporal variation and trends for the grenadier in this area. A full analysis of the time-series was recently published (Bergstad *et al*., 2013), but this working paper extends the series to include the years 2014-2015.

Material and Methods

Data was collected from the annual *Pandalus borealis* shrimp survey performed by the Institute of Marine Research in the years 1984-2015 (Table 1). The survey is a depth stratified shrimp trawl survey with approximately 25% of the stations deeper than 300 m (depth range 110-520 m). The trawl used has small meshes overall and a 6mm cod-end liner and retains all sizes of grenadiers, including the smallest newly settled juveniles (Bergstad 1990, Bergstad and Gordon 1994). The stations are placed at random within strata and subareas, and the same sites area sampled every year. Although some changes occurred over the years (Table 1), the overall standardization was maintained throughout the time series (Bergstad *et al.* 2014~~3~~).

Catch rates in terms of biomass and abundance were calculated for stations 300 m and deeper, i.e. excluding shallower survey depths where the species only occurs sporadically in small numbers (Bergstad 1990). Stations with zero catches were included, and the catches at non-zero stations were standardized by tow duration.

Annual length distributions were derived for the pooled standardized catches at 300m and beyond. In cases were catches were subsampled, length distributions were raised to the total catch prior to pooling.

Standardized mean catches by number of small juveniles of PAFL $\leq$ 5 cm were calculated to show recruitment during the survey period.

A time series of maps showing geographical distributions by year were plotted, representing scaled catch rates at the actual sample sites for each survey year.

In a first attempt to estimate commercial by-catch of grenadier, we derived a time-series of mean survey catch rate of grenadier from depths shallower than 400m (i.e. where shrimp fishing is carried out) and multiplied that with annual estimates of effort in the Norwegian shrimp fishery (extracted from Søvik and Thangstad, 2014). Most of the distribution area of grenadier lies within the Norwegian EEZ and the Norwegian trawler fleet is assumed to be predominant in that area.

Results

Biomass and abundance

The estimates of catch rates in terms of biomass (kg/h) and abundance (nos/h) varied substantially through the time series (Fig.1), but elevated levels were observed from 1998 to 2005. The recent decline appears to have continued and in 2015 both biomass and abundance estimates were the lowest on record.

Size distributions

The time series of annual length distributions show a major shift in the early 1990s (Fig. 2). From 1992 the proportion of large fish with PAFL>15cm declined to less than 10% which contrasts with the pre-1990 distributions dominated by large fish. From 1992, a pronounced mode of small fish can be followed in subsequent years, with modal length increasing through the time series.

The very recent distribution contrasts with the pre-1990 distributions by having low proportions of large fish, and with the 1991-2004 distribution by their low proportions of small fish.

Occurrence of juveniles <5cm AFL

In 2008-2015 some small juveniles appear every year, but there is no indication of a pronounced recruitment pulse as that observed in the early 1990s, neither in the length distributions (Fig 2.), nor in the time series of mean abundance of small fish < 5 cm (Fig. 3).

Geographical distribution

The area sampled in a given year and the corresponding geographical distribution of grenadier catches is presented in Figure 4. The overall distribution area does not seem to have changed considerably during the time series 1984-2015. Catches of roundnose grenadier are restricted to the Norwegian Deep north to 59°N and extend eastwards into the Skagerrak basin.

Commercial by-catch

The survey catches of shrimp (*Pandalus borealis*) drop off significantly by depth and few catches occur deeper than 400m (Fig. 5). The shrimp fishery is mostly conducted shallower than 300m. By-catch estimates derived using the mean annual survey catches of grenadier (at depths <400 m) and annual effort in the Subarea IVa and IIIa shrimp trawl fishery (Fig. 6) illustrate the likely historical variation in by-catch rates. There is a recent trend towards very low levels (less than 100 tonnes), but by-catches in the shrimp fishery were probably historically less than 2000 tonnes/year yet probably higher in the mid-2000s when grenadier abundance appeared elevated.

Discussion

Despite high inter annual variability, the catch rates in terms of biomass and abundance from the survey suggest a long term pattern of variation through the time series 1984-2015. An increase in biomass and abundance from the late 1980s until 1998-2004 seemed to be followed by a major decline from the mid-2000s onwards. In 2015 abundance and biomass estimates were the lowest observed in the 32-year time series.

The survey catch rates declined in all areas, also where high survey catches were common, i.e. in the eastern part of the Skagerrak (Fig. 4).

The time-series of size distributions also suggest pronounced structural changes during the period 1984-2015. The distributions from the 1980s with a dominance of fish around 15 cm PAFL contrasts with those from the late 1990s when the population was apparently rejuvenated by a pulse in recruitment from 1991-1992 onwards. The recruits from 1991-1992 can be tracked as a mode in the size distributions for 15 years until 2005.

High mean survey biomass coincided with very high commercial landings in 2004-05 (Fig. 7). The fishery may have utilized a period of elevated abundance resulting from what appears to be the single large pulse in recruitment in the 32 years surveyed. From the recent length distributions no similar pulse in recruitment has been observed.

The reported landings peaked in 2005 at about 11000 tonnes (Fig. 7) and have since declined to less than a ton per year. From 2006 onwards this decline in landings is a result of regulations (Bergstad 2006) as the targeted fishery ceased. By-catches from shrimp fisheries still occur, however. Our attempt to estimates by-catches suggests that current levels are minor, probably reflecting decreasing effort in the shrimp fishery and low grenadier abundance at relevant depths. However, our calculation misses a potentially important factor, i.e. the probable reduction in by-catch rates due to the introduction of sorting grids in the commercial trawls. Our estimates may thus be too high. On the other hand, we did not estimate Swedish and Danish by-catches that should be added to derive more accurate totals.

Conclusion

The decline in abundance after 2005-2006 suggested by the survey catch rates may reflect the combined effect of the enhanced targeted exploitation in 2003-2005 and the low recruitment in the years following the single recruitment pulse in the early 1990s. The percentage of fish >15cm is lower than recent years and there is no suggestion of a new recruitment pulse as seen in the 1990s. Since the targeted fishery has stopped and the by-catch in the shrimp fishery seems low, there is a potential for recovery of the roundnose grenadier in Skagerrak. However, rejuvenation and growth of the population would at present seem unlikely due to low recruitment during the recent decade. The survey information suggests that it may be a feature of this population that only a single good recruitment event may be expected in a period of 3 decades.

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Table 1. Summary of data on the bottom trawl survey series, 1984-2015. Rg- rockhopper ground gear. ‘Strapping’ – maximum width of trawl constrained by rope connecting warps in front of otter doors. MS – RV Michael Sars, HM – RV Håkon Mosby. Data from 2015 survey is included. All trawls were fitted with a 6mm mesh cod-end liner.

YEAR	Survey month	Vessel	IMR Gear code	Additional gear info.	No. trawls >300m	No. trawls >400m	No. trawls survey
1984	OCT	MS	3230	Shrimp trawl (see text)	10	1	67
1985	OCT	MS	3230	“	21	5	107
1986	OCT/NOV	MS	3230	“	24	9	74
1987	OCT/NOV	MS	3230	“	35	14	120
1988	OCT/NOV	MS	3230	“	31	11	122
1989	OCT	MS	3236	Campelen 1800 35mm/40, Rg	31	7	106
1990	OCT	MS	3236	“	26	5	89
1991	OCT	MS	3236	“	28	9	123
1992	OCT	MS	3236	“	27	10	101
1993	OCT	MS	3236	“	30	10	125
1994	OCT/NOV	MS	3236	“	27	10	109
1995	OCT	MS	3236	“	29	12	103
1996	OCT	MS	3236	“	27	11	105
1997	OCT	MS	3236	“	25	6	97
1998	OCT	MS	3270	Campelen 1800 20mm/40, Rg	23	6	97
1999	OCT	MS	3270	“	27	8	99
2000	OCT	MS	3270	“	25	10	109
2001	OCT	MS	3270	“	18	4	87
2002	OCT	MS	3270	“	24	6	82
2003	OCT/NOV	HM	3230	Shrimp trawl (as in 1984-1988)	13	0	68
2004	MAY	HM	3270	Campelen 1800 20mm/40, Rg	17	6	65
2005	MAY	HM	3270	“	23	8	98
2006	FEB	HM	3270	“	10	0	45
2007	FEB	HM	3270	“	11	1	66
2008	FEB	HM	3271	Campelen 1800 20mm/40, Rg and strapping*	18	5	73
2009	JAN/FEB	HM	3271	“	25	7	91
2010	JAN	HM	3271	“	24	7	98
2011	JAN	HM	3271	“	22	7	93
2012	JAN	HM	3271	“	20	5	65
2013	JAN	HM	3271	“	28	8	101
2014	JAN	HM	3271	“	16	7	69
2015	JAN	HM	3271	“	28	9	92

* Path width of the tow constrained by a 10 m rope connecting the warps, 200 m in front of otter boards.

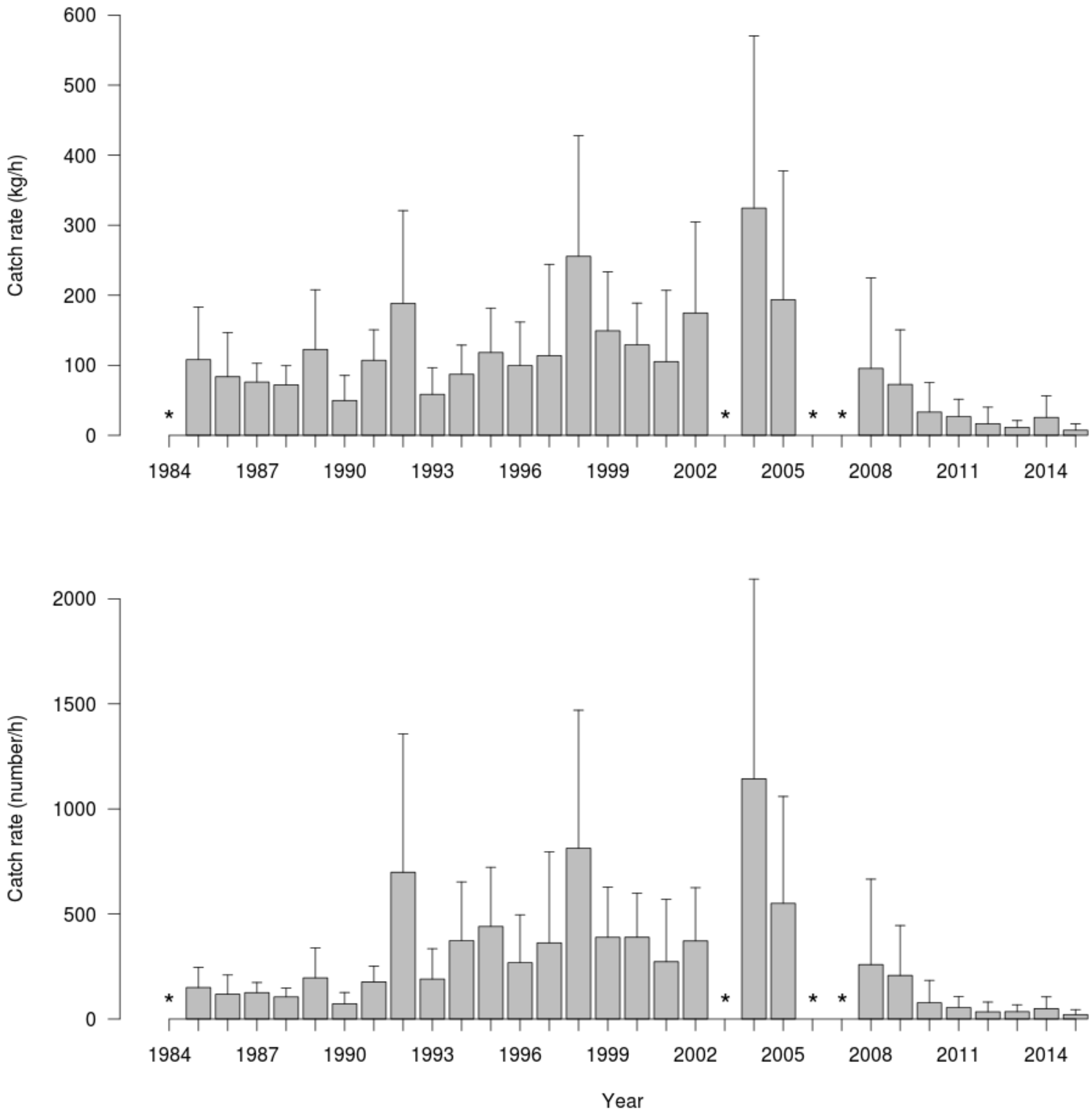


Figure 1. Standardized survey catches of grenadier, 1984-2015. Upper: Biomass (kg/h), Lower: Abundance (number/h). *In 1984, 2003, 2006 and 2007, only one single or no trawls were made deeper than 400 m, and data from those years were excluded.

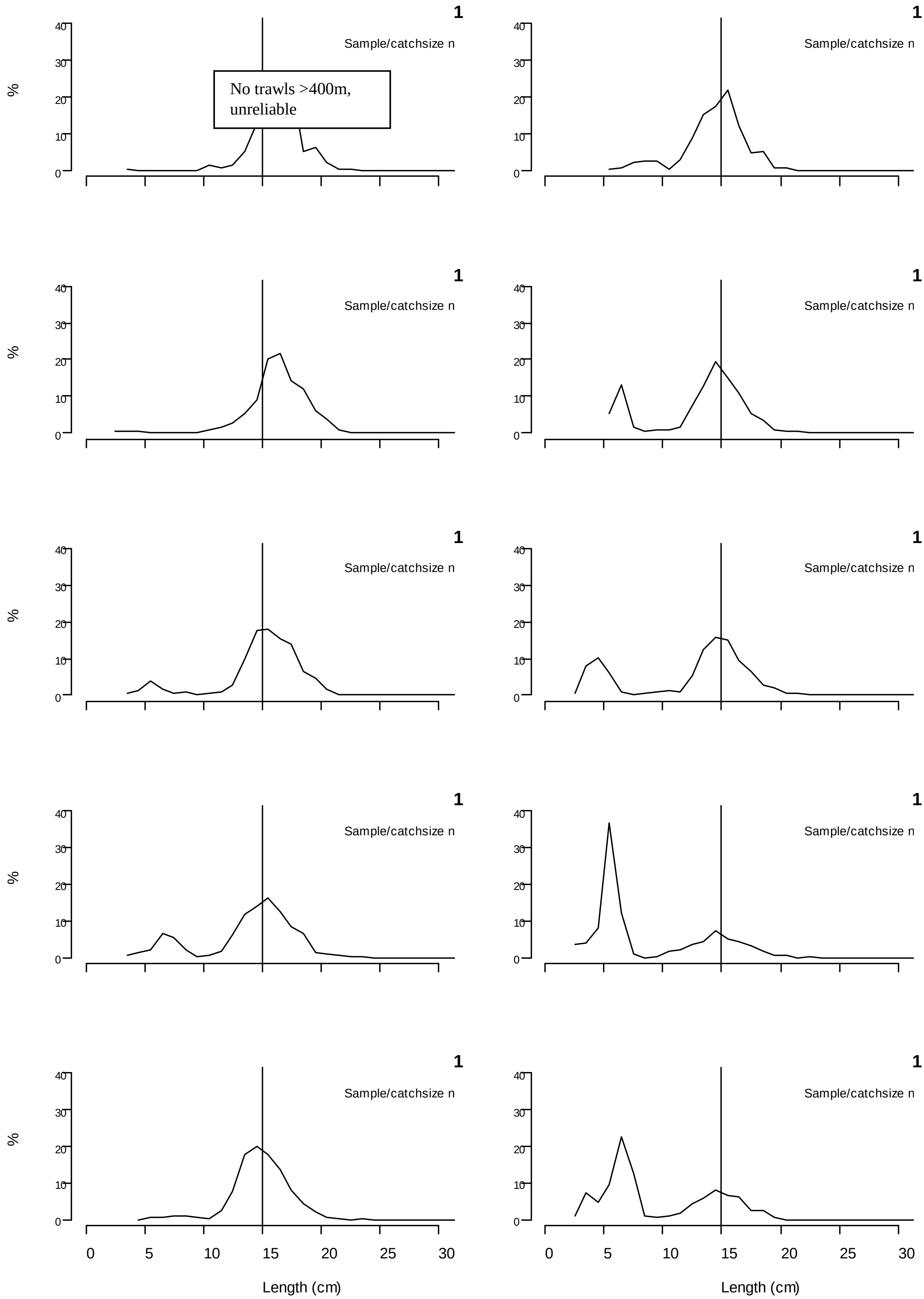
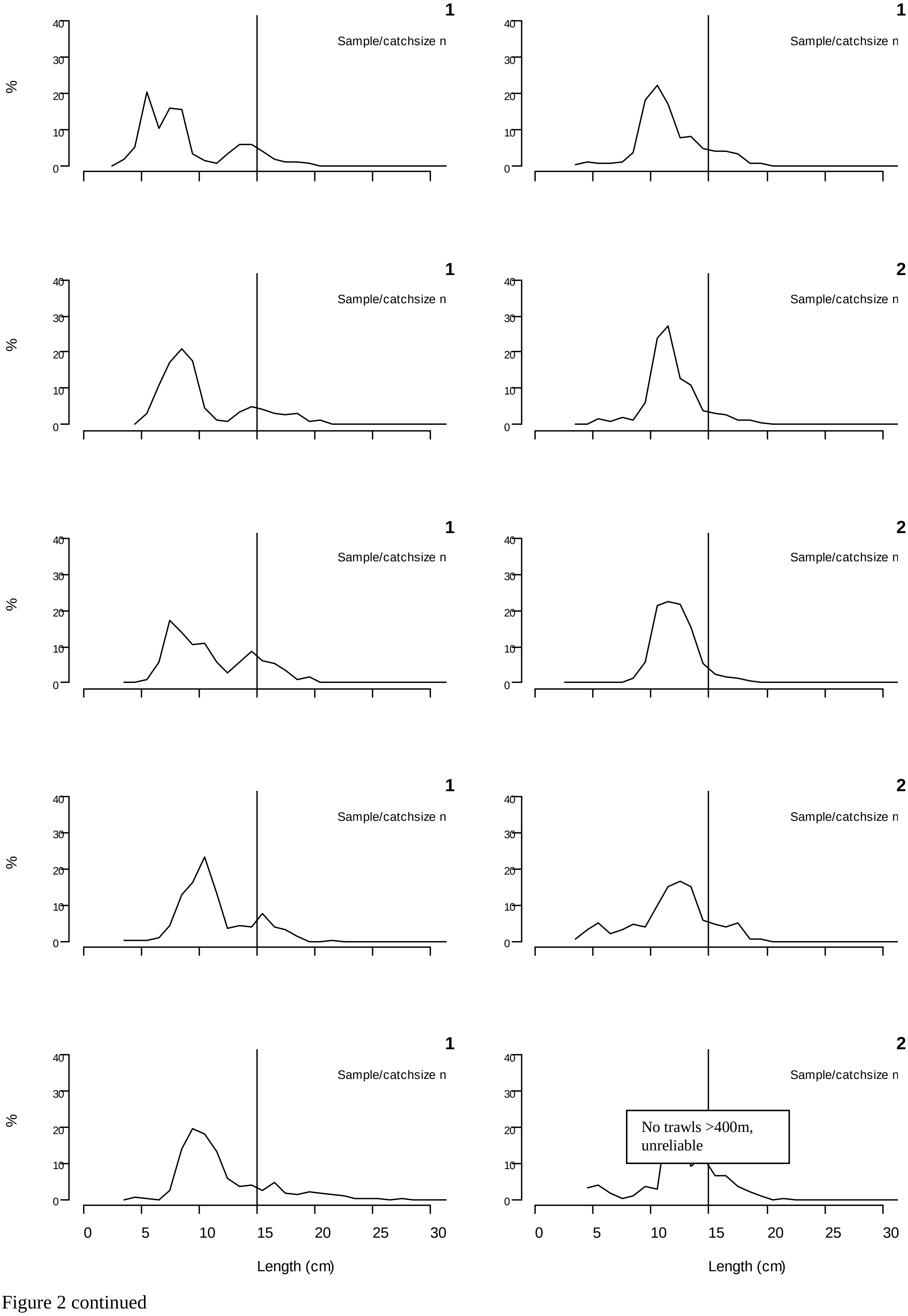


Figure 2. Length distributions of roundnose grenadier from annual *P. borealis* surveys, 1984-2015. Length is measured as PAFL (cm). The length distributions are calculated as percentage number of fish in each centimetre length interval standardized to total catch number and trawling distance for each station each year.



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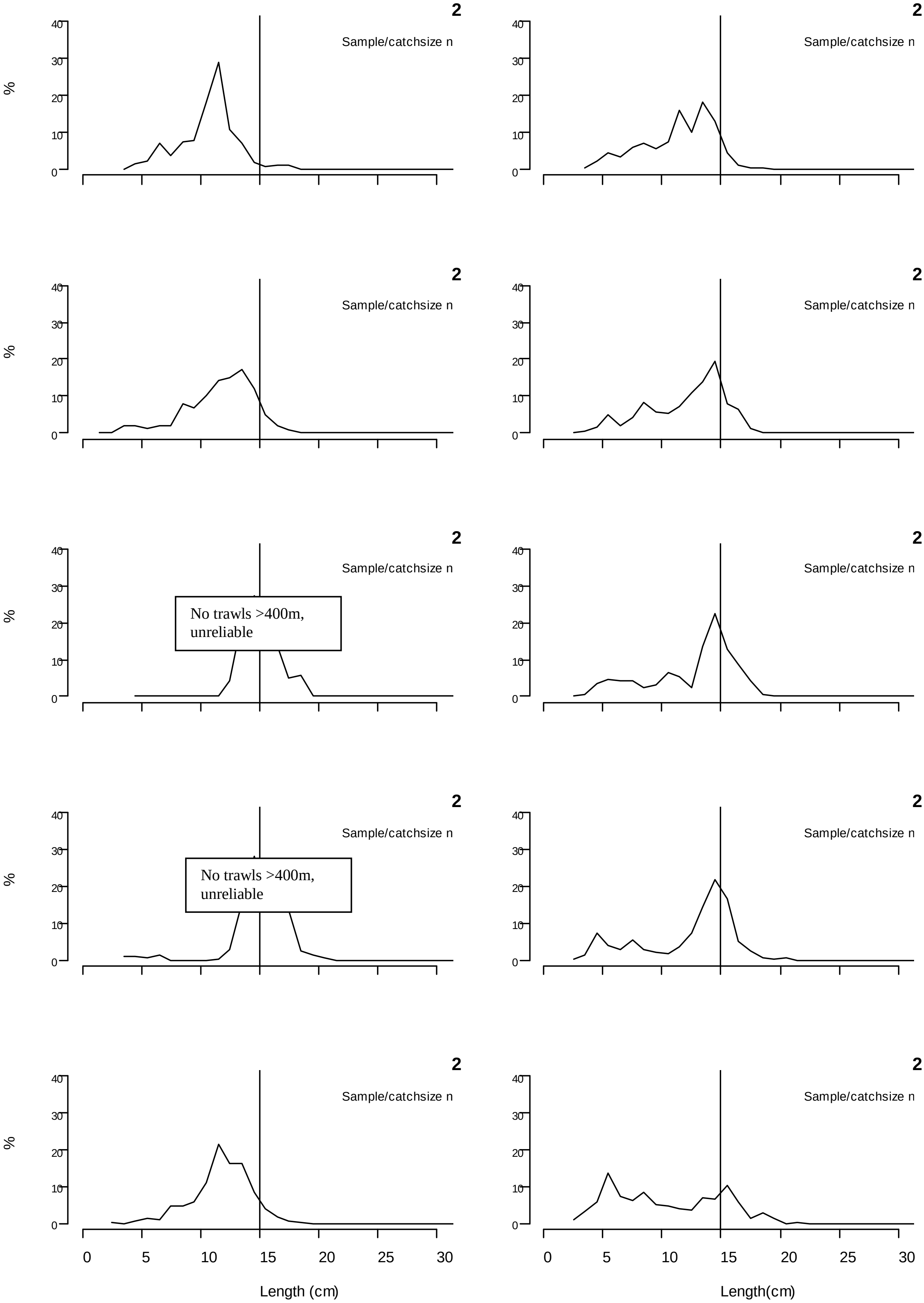

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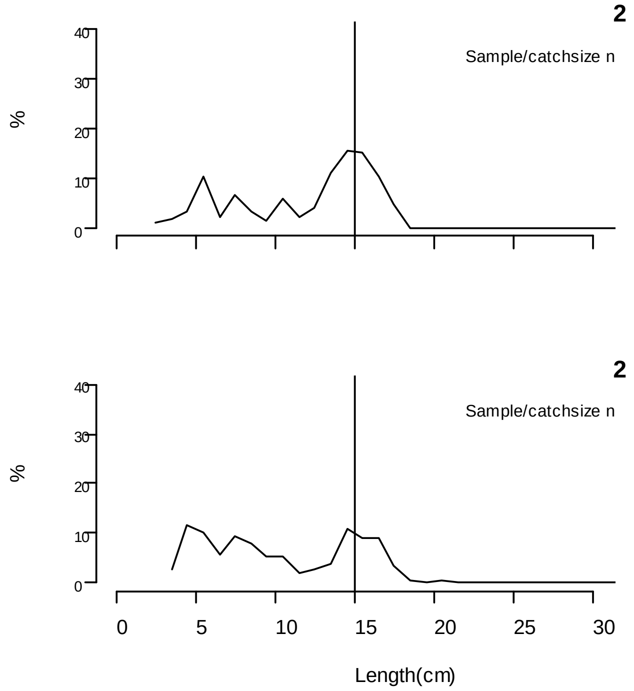

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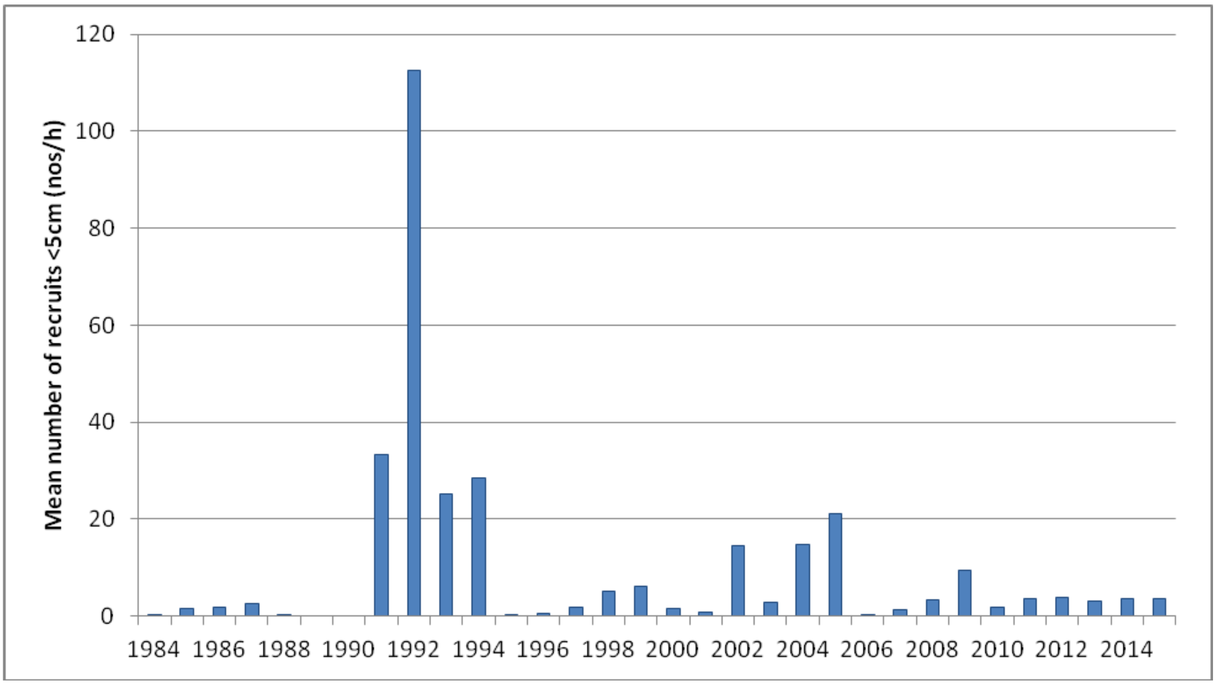


Figure 3. Mean catch rate of roundnose grenadier of PAFL ≤ 5 cm, 1984-2015. Data from shrimp survey, trawls deeper than 300 m. *In 1984,2003,2006 and 2007, no trawls were made deeper than 400 m, and data from these years should be disregarded.

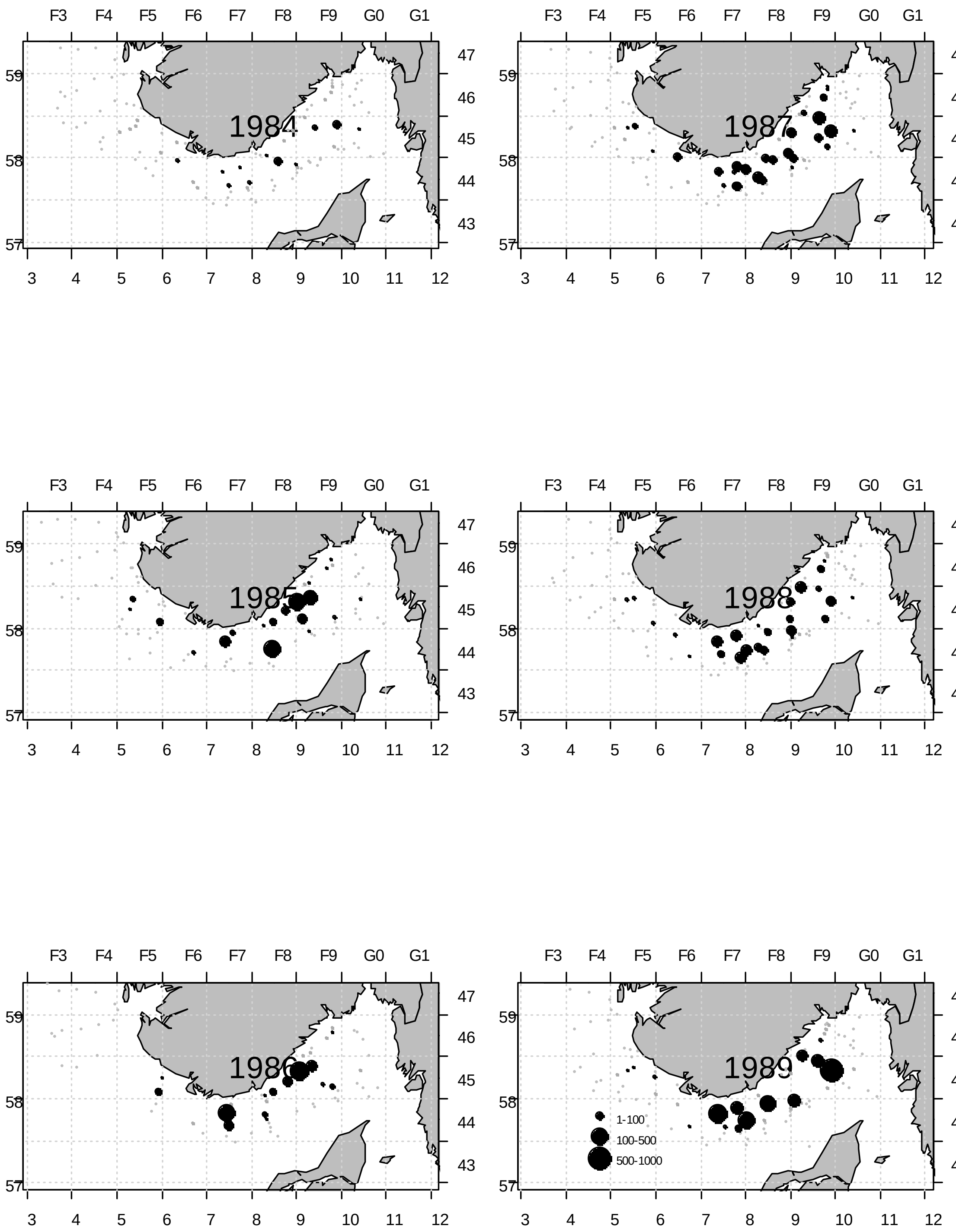
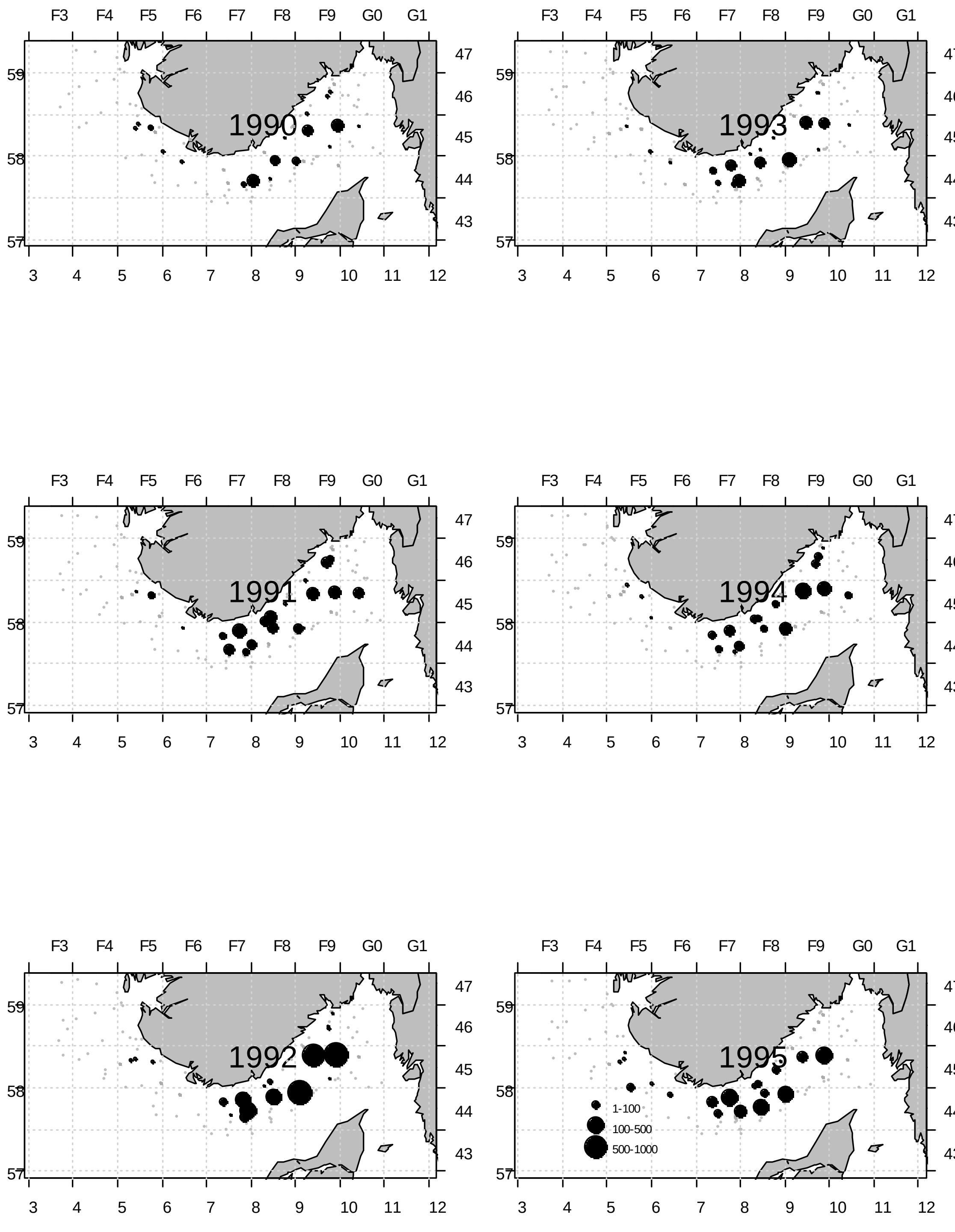


Figure 4. Geographical distribution of catches of roundnose grenadier (kg/h). Data from shrimp survey, trawls deeper than 300 m. Grey circles are trawls with no catch of grenadier.



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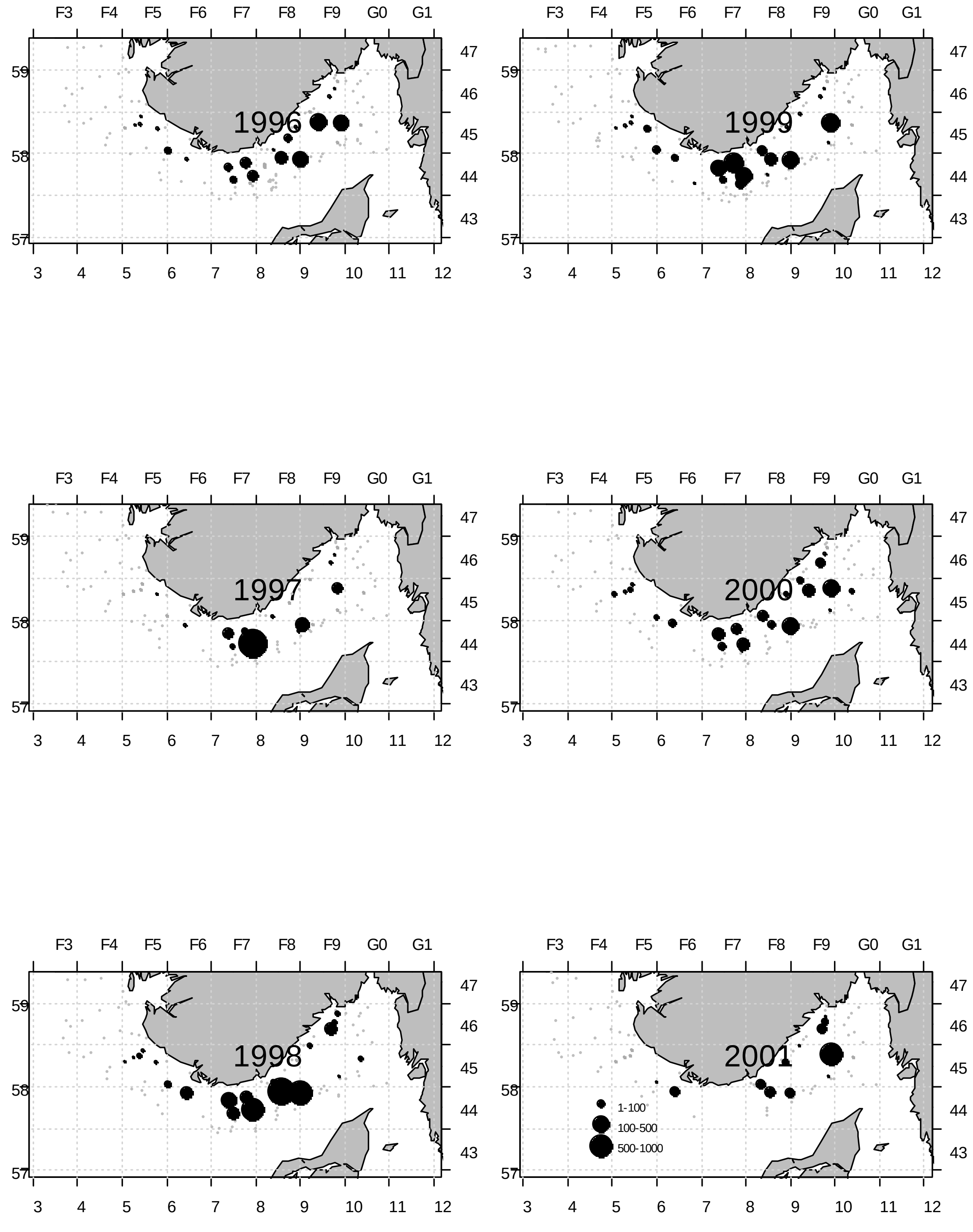

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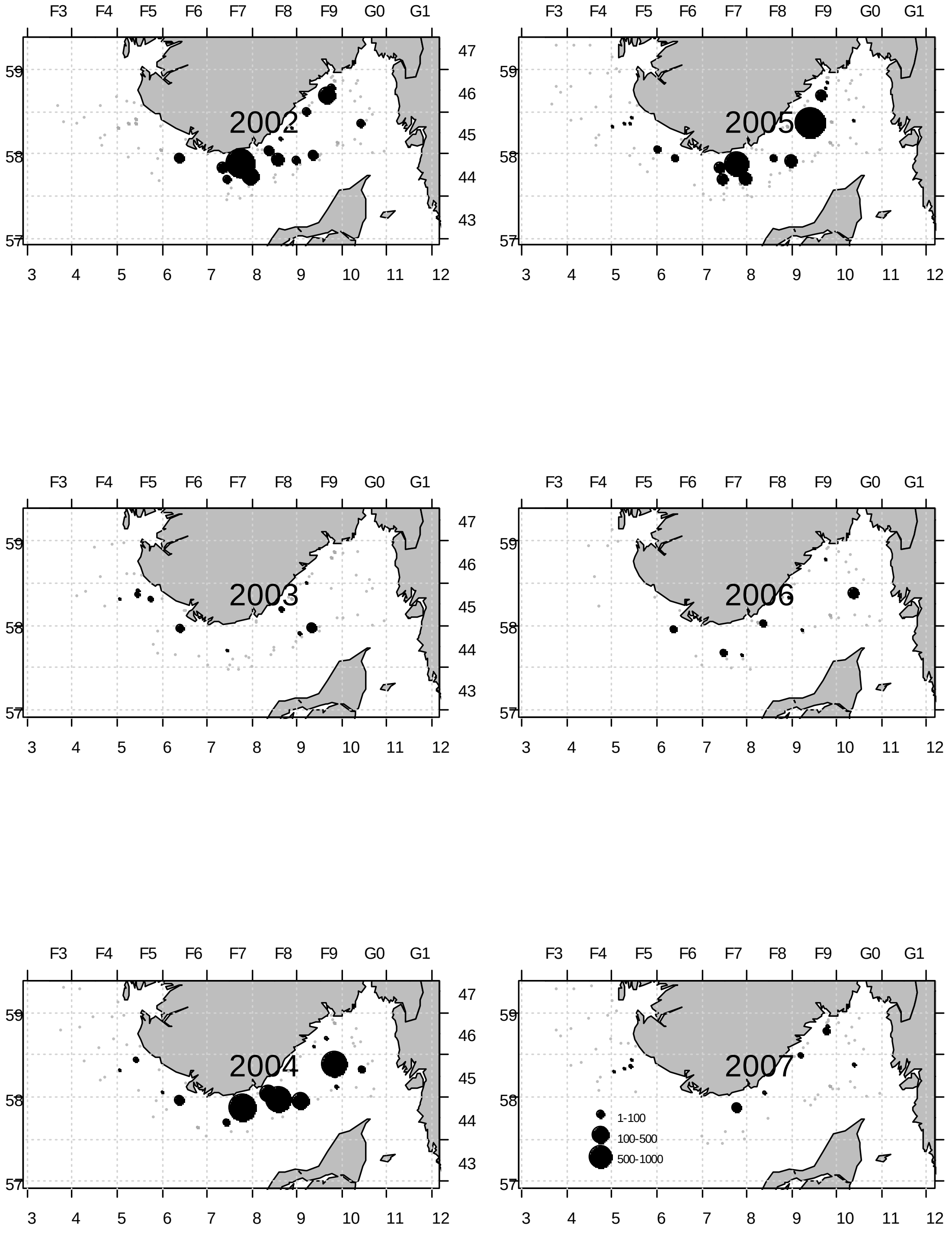

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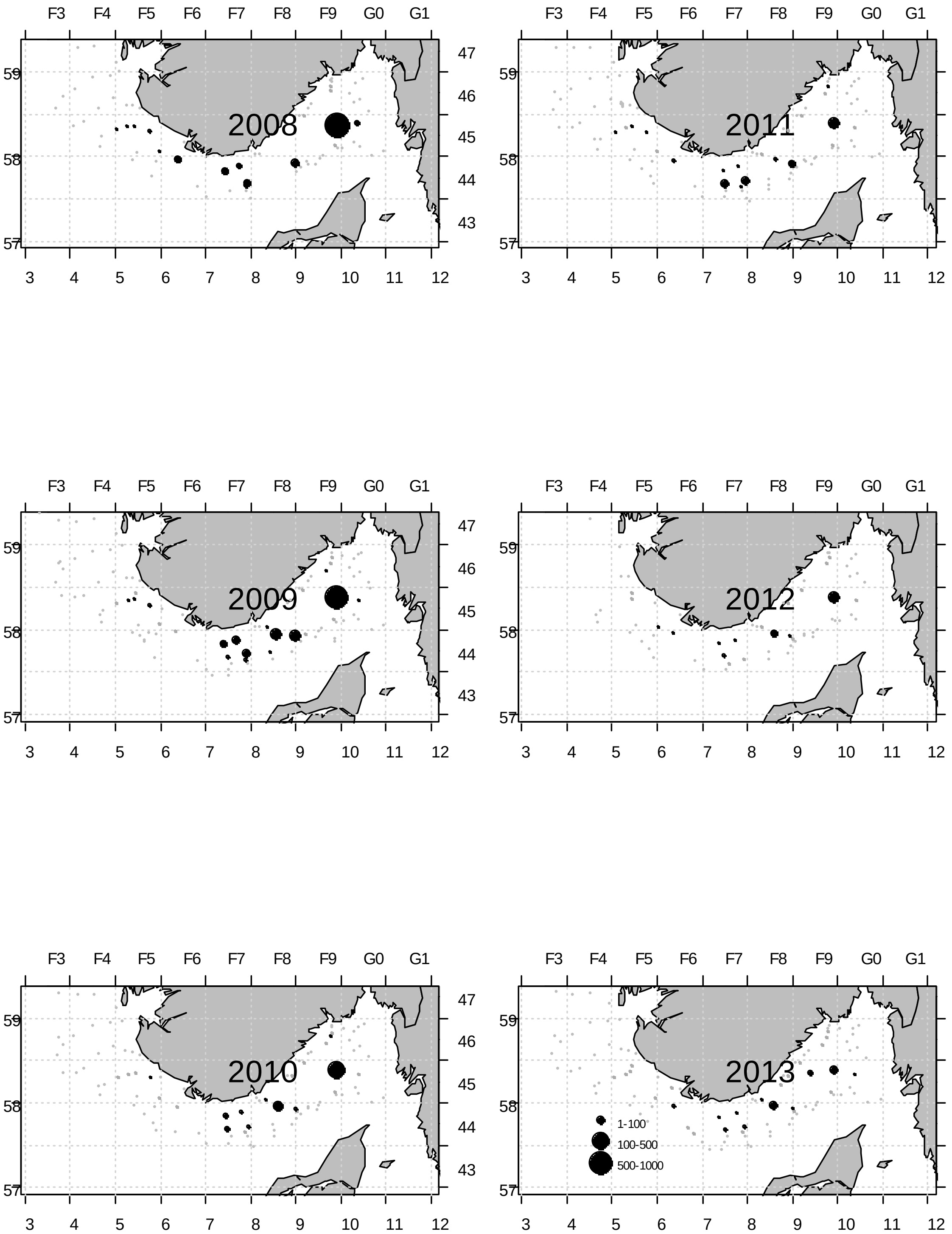

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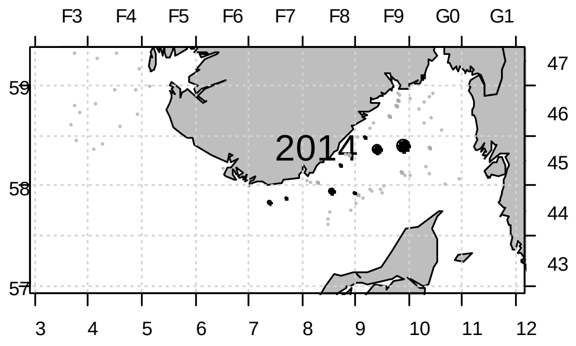

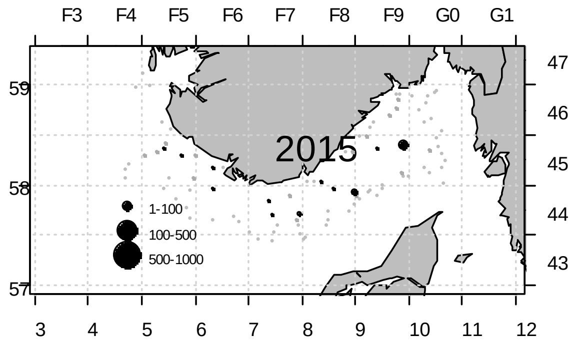

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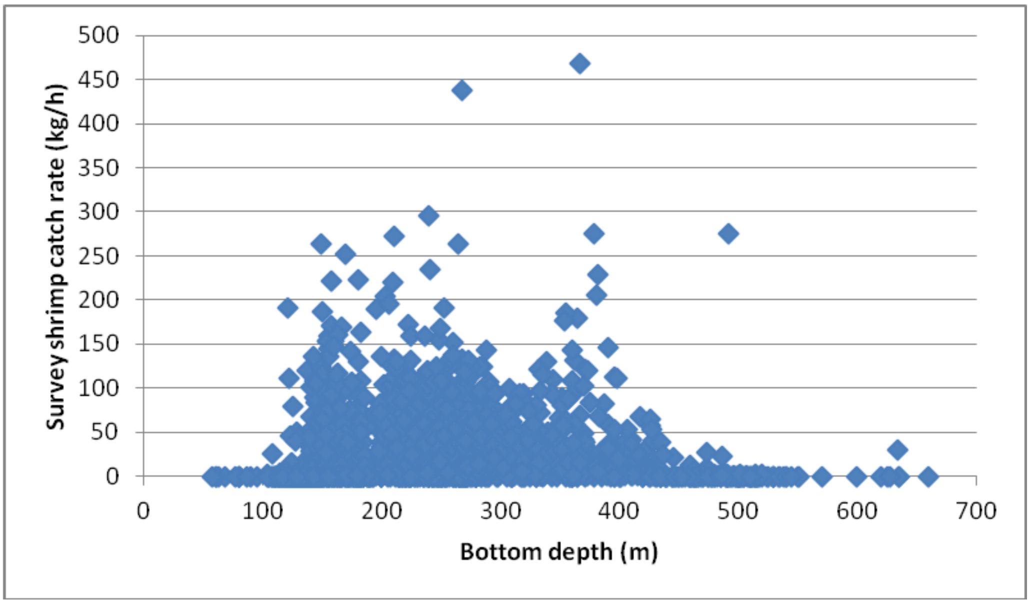


Figure 5. Depth distribution of deepwater shrimp (*Pandalus borealis*) as illustrated by catch rates in the Norwegian shrimp trawl survey, 1984-2013.

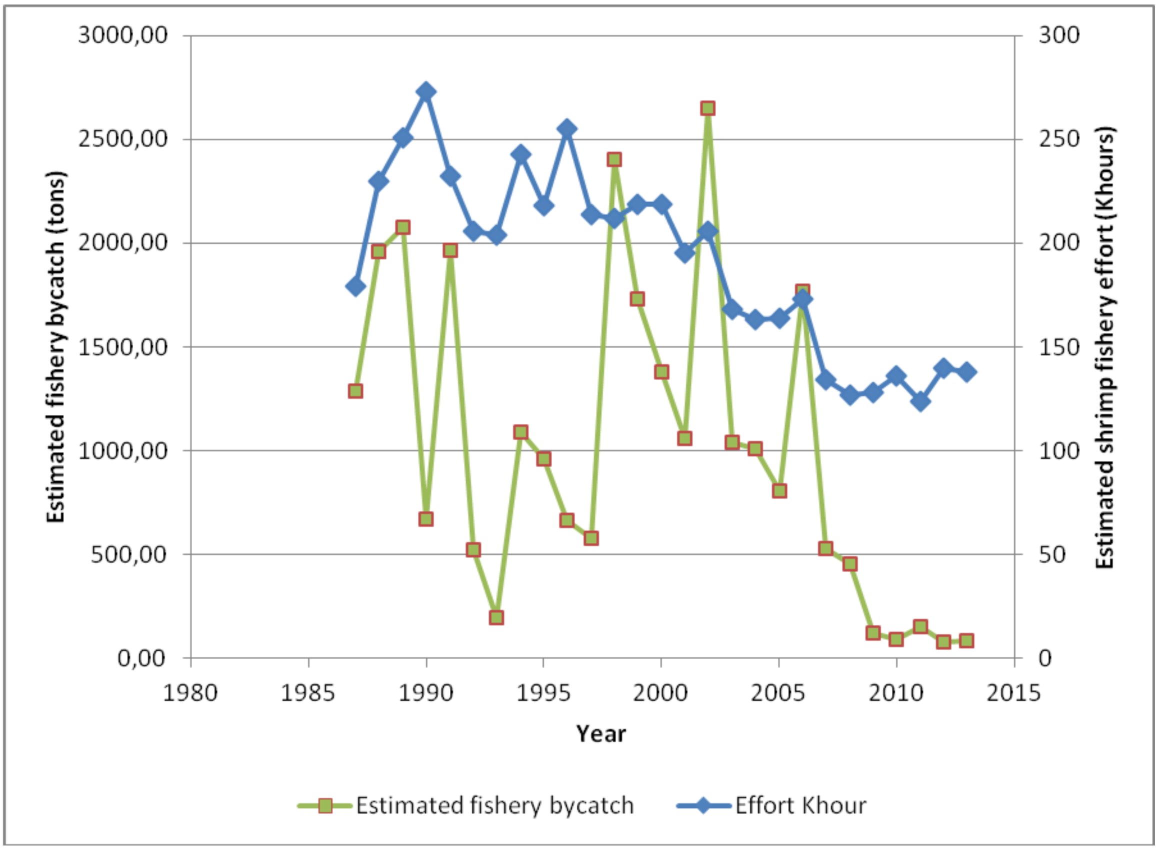
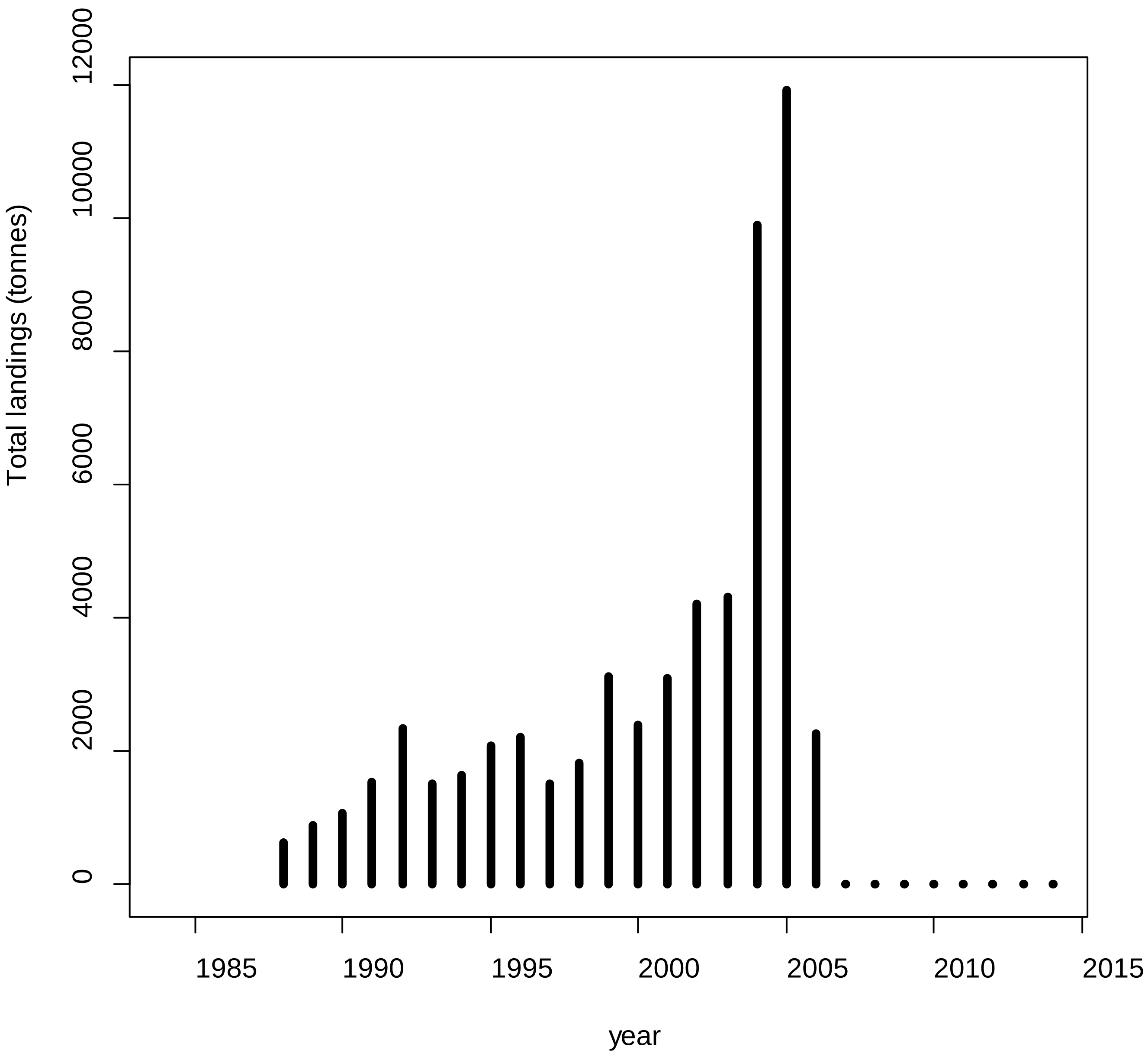


Figure 6. Estimated by-catch of roundnose grenadier in the Norwegian shrimp fishery in ICES Div. IVa and IIIa, and the estimated commercial shrimp fishery effort in the same area. See text for explanation.


Total landings (tonnes)
0
2000
4000
6000
8000
10000
12000
1985
1990
1995
2000
2005
2010
2015
year

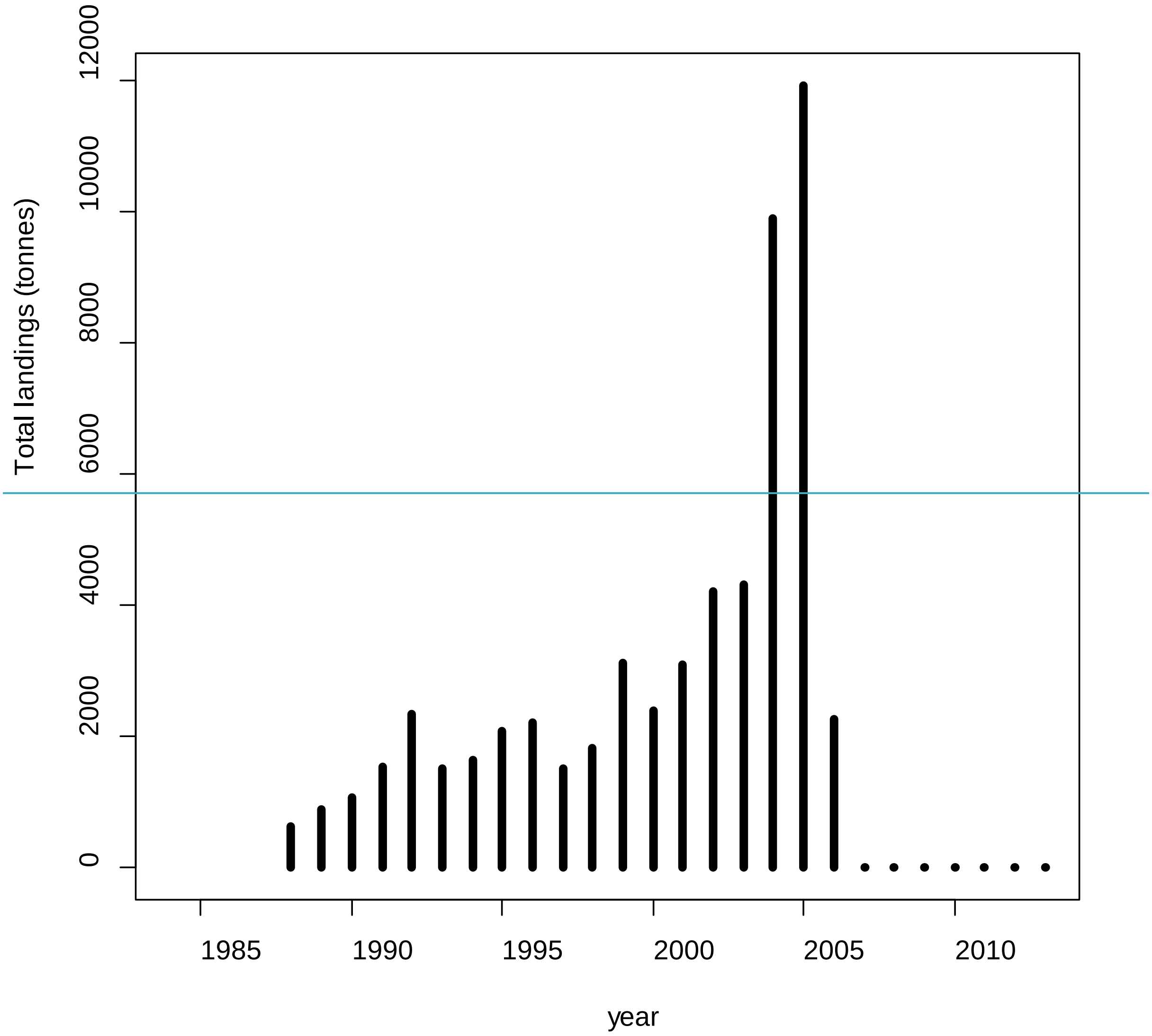


Figure 7. Total reported landings of roundnose grenadier in ICES Division IIIa, 1988-2013. (ICES 2014).

WD ICES WGDEEP 2015

Roundnose grenadier and black scabbard fish in Faroese waters (Vb).

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Introduction

The objective for this document is to provide information on roundnose grenadier and black scabbard fish.

1 Roundnose grenadier

The commercial CPUE series was from trawlers, where the criteria were that grenadier contributed more than 30% of the total catch. The CPUE for the period 2009-2010 were the same as average CPUE for the whole period; while CPUE in 2011 was above average and 2012-2014 were below average (Figure 1, Table 1). Notice the very low number of hauls behind the CPUE for the period 1991-2002 and 2010-2014 (Table 1).

Roundnose grenadier was only fished by large trawlers and the main fishing area was on the slope around the Faroe Bank (Figure 2).

Samples of roundnose grenadier from the deepwater survey were 212 length measures, 186 round weights and 85 fish sampled for gender, 72 for maturity and 69 otoliths. The mean length in the survey was 17.5 cm and the spatial distribution was mainly on the Wyville Thomsen ridge (Figure 3).

Table 1. Roundnose grenadier Vb. Original (org_) and standardized (fit_) CPUE from trawlers where roundnose grenadier was more than 30% in the haul. N was number of hauls.

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
mean_org	241.1	1268.1	292.4	267.4	745.9	290.3	209.7	319.5	729.2	135.0	353.0	150.0	297.0	359.5
se_org	116.1	294.4	38.7	56.8	106.3	95.2	41.7	49.0	176.0	15.7	46.7	6.0	17.3	21.9
mean_fit	231.9	474.9	214.4	173.0	364.8	174.8	181.9	309.3	405.6	134.4	281.2	149.5	242.0	280.6
se_fit	95.4	32.8	9.3	8.1	9.9	9.2	11.8	39.3	32.6	14.9	19.8	5.7	4.8	4.4
N	**2**	64	71	80	120	**26**	**11**	**8**	**20**	**6**	**34**	58	184	195

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
mean_org	304.7	374.1	502.6	459.7	351.8	291.6	479.3	125.8	116.8	83.1
se_org	19.5	14.6	25.0	22.6	26.2	33.7	126.5	0.0	25.4	
mean_fit	233.6	288.7	369.8	356.0	271.2	199.1	330.5	125.8	116.8	83.1
se_fit	5.4	3.6	5.7	4.3	6.0	7.3	15.8	0.0	25.4	
N	222	355	287	217	116	79	**11**	**2**	**2**	**1**

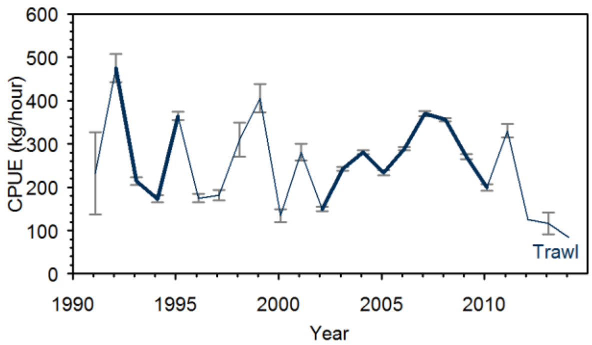

Figure 1. Roundnose grenadier Vb. CPUE from otterboard trawlers. Criteria: >30% of roundnose grenadier in the catch.

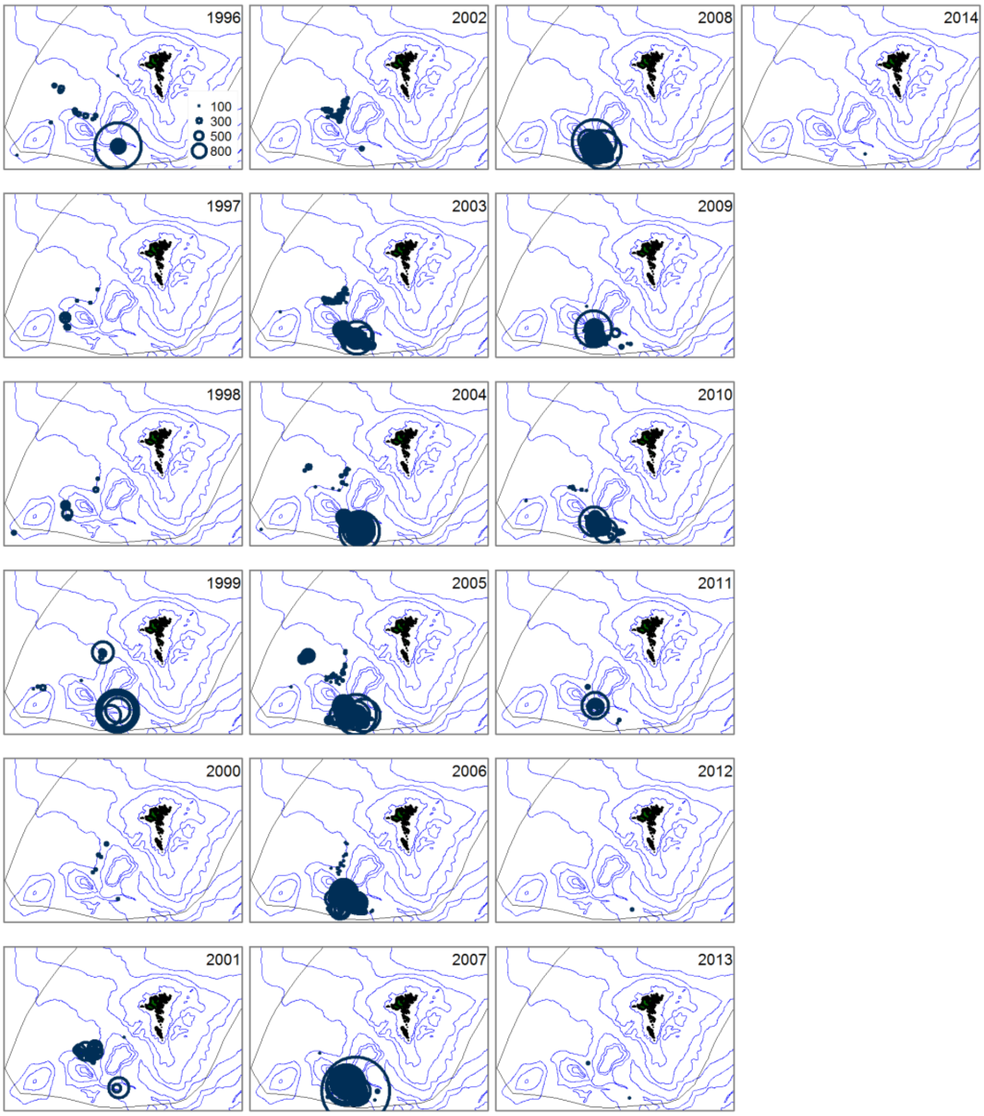

Figure 2. Roundnose grenadier Vb. Spatial distribution (kg/hour) in the commercial trawl fishery.

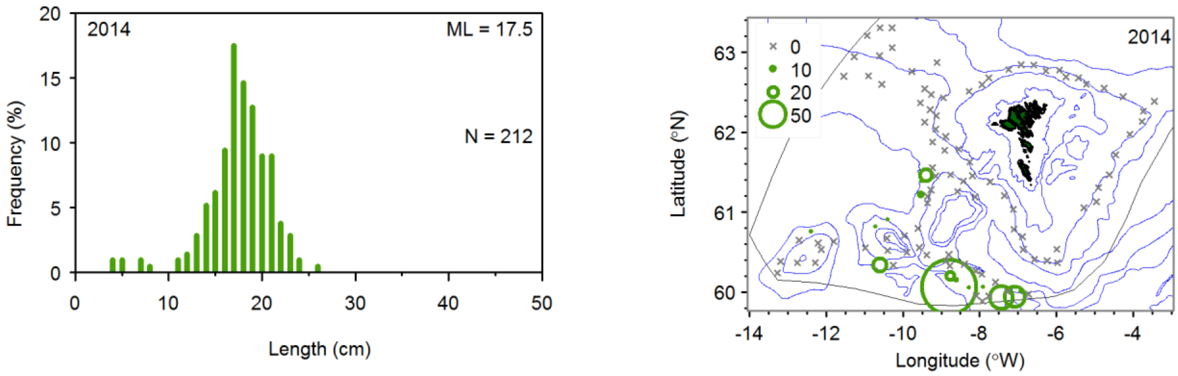

Figure 3. Roundnose grenadier Vb. Length distribution (left) and spatial distribution (right) in the deepwater survey 2014.

2 Black scabbardfish

The commercial CPUE was based on trawlers, and only hauls where black scabbardfish contributed more than 30% of the total catch were used. The CPUE for 2009-2010 are at around the same level as average CPUE for the whole period, while the CPUE has increased since 2010 to 500 kg/hour in 2014 (Figure 4, Table 2). Notice the few hauls behind the CPUE in 1992-2000 (Table 2).

Black scabbardfish was only fished by large trawlers and the main fishing area was on the slope around the Faroe Bank and on the Wyville Thomsen ridge (Figure 5).

Samples of black scabbardfish from the deepwater survey were 4477 length measures, 787 round weights and 150 fish sampled for gender, maturity and otoliths. The mean length in the survey was 94 cm and the spatial distribution was mainly on the Wyville Thomsen ridge and on the slope north of the Faroe Bank (Figure 6). All the sampled fish was immature.

Table 1. Black scabbardfish Vb. Original (org_) and standardized (fit_) CPUE from trawlers where black scabbardfish was more than 30% in the haul. N was number of hauls.

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
mean_org	230.9	496.7	223.2	165.4	62.6	90.9	157.5		480.2	362.6	412.5	268.5	164.2	145.0	151.5
se_org	54.6	129.8	17.6	17.0	27.4	22.1			79.5	21.0	19.5	9.3	5.7	5.4	4.9
mean_fit	185.3	271.0	193.8	138.2	56.5	80.9	158.5		298.1	278.7	280.5	203.1	138.9	124.0	127.8
se_fit	15.2	7.4	6.1	2.8	5.4	3.8			13.7	2.8	1.3	1.2	0.9	1.1	0.9
N	**7**	**26**	70	**36**	**2**	**5**	**1**	**0**	**42**	186	615	810	422	310	449

Year	2007	2008	2009	2010	2011	2012	2013	2014
mean_org	153.0	200.3	181.0	159.2	273.4	274.5	566.3	625.3
se_org	5.9	7.8	6.8	5.2	12.6	17.3	45.2	34.1
mean_fit	122.4	158.2	145.1	131.4	226.6	226.8	455.0	499.6
se_fit	1.0	1.1	1.0	1.0	1.8	0.5	7.5	6.2
N	447	430	620	556	212	176	71	189

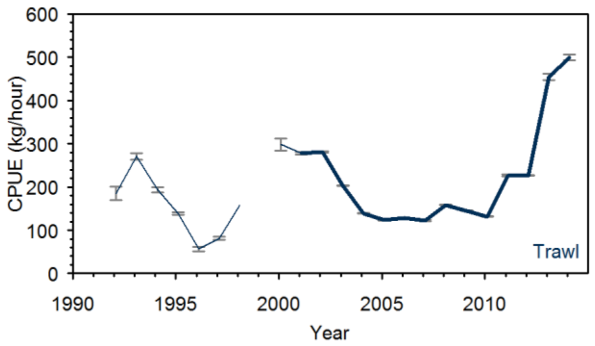

Figure 4. Black scabbardfish Vb. CPUE from otterboard trawlers (> 1000 HK). Criteria: black scabbardfish >30% of total catch per haul.

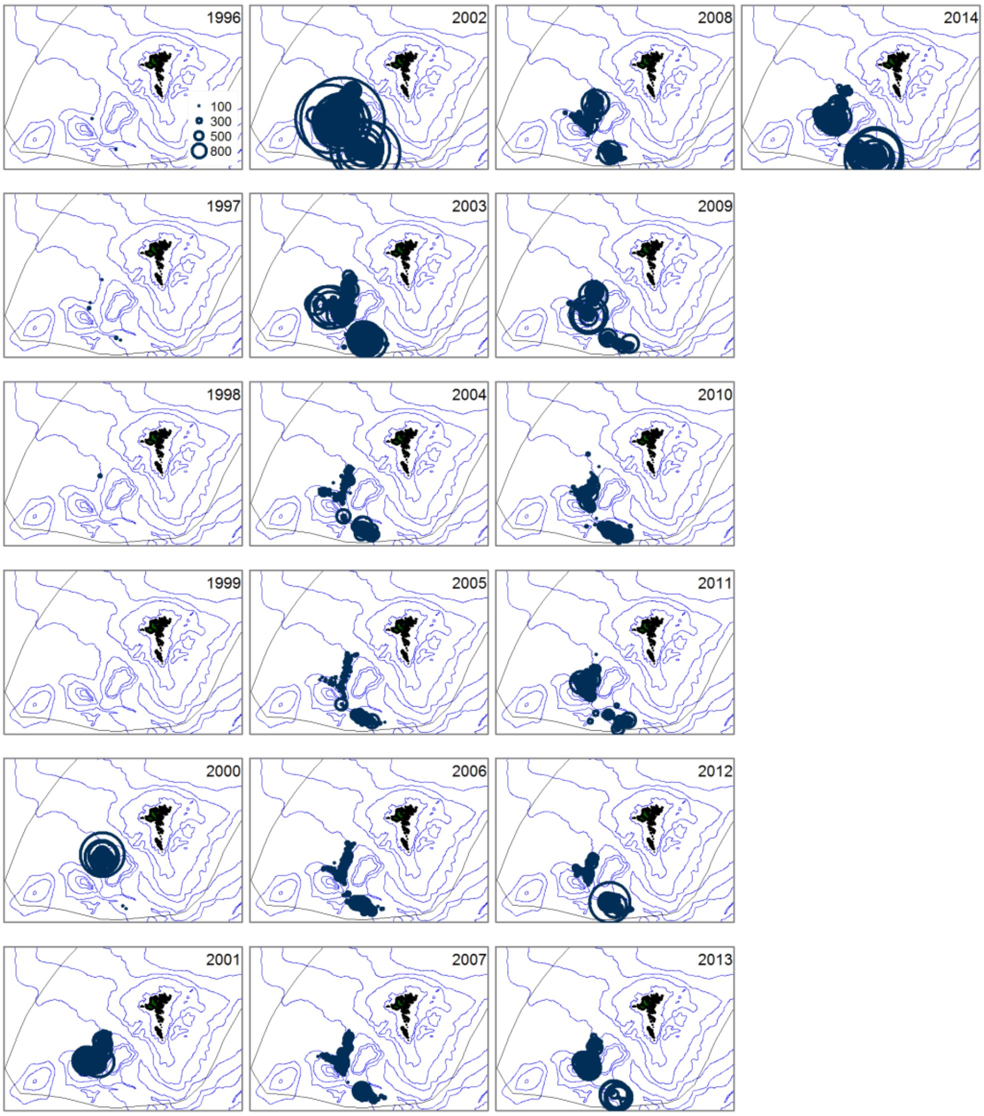

Figure 5. Black scabbardfish Vb. Spatial distribution (kg/hour) in the commercial trawl fishery. Only hauls with more than 30% black scabbardfish of the total catch.

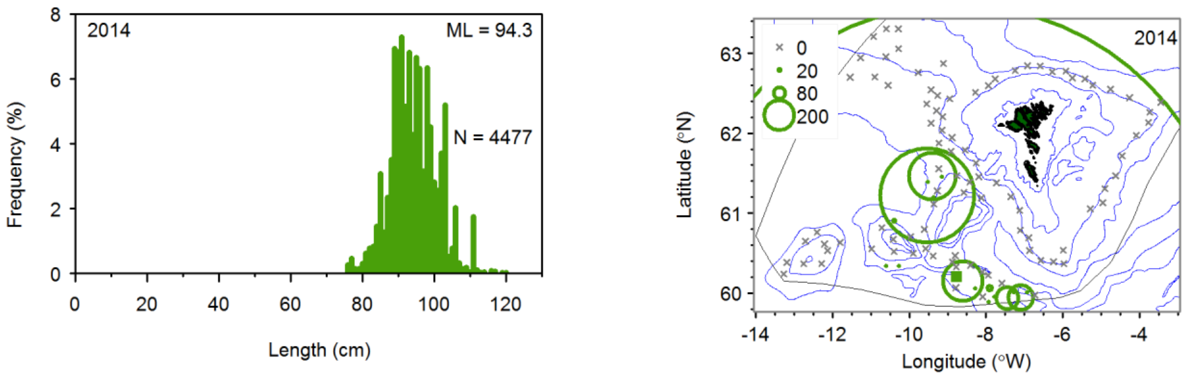

Figure 6. Black scabbardfish Vb. Length distribution (left) and spatial distribution (right) in the deepwater survey 2014.

Not to be cited without prior reference to the authors

Catch curve analysis for the red black spot seabream (*Pagellus bogaraveo*) stock from the Azores (ICES Xa2).

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University of the Azores

Abstract

Total mortality (Z) of *Pagellus bogaraveo* fishery from the Azores (ICES Xa2) was estimated using the catch curve analysis. Annual fishery length composition from 1995 to 2013 was used and converted to catch at age using annual survey age length keys (ALK). Adopting a constant value of natural mortality (M) for the species the annual fishing mortality (F) was estimated. Total mean annual biomass of the exploited stock was then estimated from the catch equation. Results suggested an increase trend on the annual fishing mortality along time but with very high fluctuations. High values of fishing mortality (F=0.6-0.7) are estimated during the three first (1995-1998) and last years (2011-2013), although high uncertainty are observed for the estimates of both periods. Similar values are punctually observed in 2003-2004 and 2008. Only for the period 2000-2002 fishing mortality is equal or lower than natural fishing mortality (M=0.2). The estimated mean exploitable biomass follows similar trend observed on the survey abundance index but with particular opposite estimates during 2000, 2001 and 2008. The correlation between survey relative abundance indices and biomass values estimated from the catch curve suggests that mortality is dependent of fish availability. Changes on the catchability along time is suggested as an explanation for the high variability on fishing mortality.

Introduction

Red seabream (*Pagellus bogaraveo*) is the main commercial species of the mix demersal hook and line fishery from the Azores (Ices area X). This stock has no management objectives defined because the uncertainty on the assessment, being precautionary managed based on trends of abundance indices and landings (ICES, 2014). Structured models and yield per recruit analysis have been explored for the stock assessment of this resource however, assessment of the current situation is necessary permitting at the same time screening of the data to identify problems that might otherwise be missed (Kell *et al*., 2013). Catch curve is one of the direct methods available to estimate total fishing morality (Z) (Ricker, 1975; Sparre and Venema, 1997; Quinn and Deriso, 1999; Cadima, 2003; Haddon 2011). Once known the value of total fishing morality (Z=F+M) we can calculate the value of fishing mortality (F), adopting a value for the natural mortality (M), which is a key parameter for the stock assessment. In this paper we use a simple method for the analysis of age composition of red seabream (*Pagellus bogaraveo*) from the Azores to estimate total fishing mortality. The method is also applied for diagnostic purposes.

Methods

Data

Red (black spot) seabream (*Pagellus bogaraveo*) commercial fishery landings length compositions for the period 1995-2013, collected under the national Data Collection Framework (DCF), were used. 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. Reliable annual fishery length information is available only since 1995. Annual length compositions were converted to age compositions using annual age length keys (ALK) data collected from the annual spring bottom longline survey (ARQDAÇO). Survey data was used because it covers a longer period than DCF data (see ICES 2012). Survey otoliths sampling for red seabream follows a random stratified design by length. Detailed survey methods can be found on Pinho (2003) and ICES (2010). Information on age determination methods used can be found on Krug (1994). Since there is no survey data for the years 1998, 2006 and 2009 substitutions were made using ALK from the neighbor year with similar abundance (usually the next or earlier year). Annual survey abundance index for the period 1995-2013 was used to compare the trend with the abundance estimates from the catch curve analysis.

Catch curve

Age length compositions were used to estimate total mortality (Z) by year applying the catch curve method (Sparre and Venema, 1997). A pseud cohort (equilibrium) approach was used, considering that the annual population structure is approximately the same as the cohort along life (see the formulation derived in the annex I). Age length keys covers the age range between 1 and 15. We use data from age 1 to 8, considering age 9 as a plus group because very small numbers of individuals are observed annually on the age range 9-15. Points corresponding to the fully recruited individuals to the fishery were selected manually for each year by analyzing visually the correspondent annual catch curve plot. As a default the first point was considered the one immediately after the mode as suggested by Robson and Chapman (1961) and Pauly (1990). Points with small number of observations were not used on the analysis. A regression analysis was then performed to the selection interval and a value for total mortality (Z) estimated. Sensitivity analysis was performed computing the total mortality for different ranges of ages selected for the regression. Fishing mortality (F) was then estimated assuming a constant value of natural mortality (M) for the full recruited age interval. A value of M=0.2 was adopted as suggested by Priscila *et al.* 2015. Total landings in weight (Y) by year were compiled from the regional auction company (Lotaçor). Annual mean biomass was then estimated from the catch equation ($\bar{B}$=Y/F).

Results

Data

No major problems are observed on the commercial length compositions for the study period however, annual survey age length-keys (ALK) presents some problems, because there is no information for some years (no surveys during 1998, 2006 and 2009) (Fig. 1). This problem was overcome by carrying out ALK substitutions for the missing years.

Otoliths sampling follows a stratified design by length and represents well the annual survey length distribution for red seabream, being as expected proportional to the annual abundance of the species (Fig. 1). However, for some years large length classes, are not represented on the ALK because the annual variability on the abundance of the species. Maximum length sampled for age on the survey was 56 cm corresponding to a maximum age of 16 years (Fig. 1). Very few fish larger than 50cm are observed and sampled for age on the survey. A plus group was adopted at age 9 (≈42cm FL). Smaller individuals (age group zero and one, LF<20cm) are also usually scarce on the survey due to gear selectivity and so are not very well represented on the sampling. For this reason these ages were excluded from the catch curve analysis or grouped at age 1. Mean age composition from ALK for the period 1995-2013 presents a mode on age 3-4 and seems to suggest less vulnerability (probability of encounter of the fishing gear and fish) of the fish to the gear after age 5. Two distinct periods, divided by the year 2005, can be observed in the mean length by age but without difference within each of the periods (Fig. 1).

Age composition

The resultant age composition of the landings (landings catch-at-age) presents a distribution with a mode on general centered at age 4 during 1995-1997 and age 3 thereafter (Fig. 2). A clear and continuous decrease of the large mature individuals (age≥5) are observed a long time, being the landings of this mature stock about 50% of the total landings at the start of the time series and only about 12% during the last three years. More large mega spawners (age≥6) are observed during the period 1998-2000 and 2003-2004 due to a particular increase of large individuals (plus group age 9^+, LF>40cm) on the landings. This group almost disappear from the landings since 2009.

Catch curve

Age of full recruitment, detected graphically, vary between age 3 and 5 (Figure 3). The selection interval of ages for the regression analysis vary between years being usually selected the range of ages 4-7 or 4-8. Annual total mortality (Z) estimated from the regression on the selected range of ages presented an increase trend but with high fluctuations with peaks during 1996-1997, 2003-2004, 2008 and 2011-2013 (Figure 4, Table 2). Fishing mortality (F) follows the same trend (Fig. 5). Estimates of fishing mortality, lower than the adopted value of natural mortality (M=0.2) were observed for the period 2000-2002. The total mortality estimates (Z) can vary according the age range selected for the regression (Table 2). However, the same general increase trend is observed for the mortality.

Exploitable biomass estimated assuming annual fishing mortality estimated from the catch curve correlated too much with the survey abundance estimates except for the years 2000 and 2001 (Fig 6).

Discussion

Enough data is available from sampling to the landings to compute the annual fishery length compositions for red seabream. No major problems were detected on this data for the period 1995-2013. Age data is available from the landings biological sampling, but covering the period since 2002. Additionally, different readers were used for the age interpretation. For this reason we use in this study the survey data which covers the entire time-series (1995-2013) and age interpretation was always made by the same reader. However, efforts should be done in the future in order to combine this two sampling and age readings programmes.

Survey sampling for aging presents problems for the extremes of the length distribution, juveniles (<20cm) and older individuals (LF>50cm). This problem as increasing along time because the mark-recapture program on the survey, which covers a significant proportion of juveniles, and the decreasing of the abundance of large individuals due to fishing (ICES, 2014). Missing values were observed on the survey ALK for some length classes. This problem was overcome by computing a plus group at age 9 (representing the ages 1-8 more than 80% of the total landings) and grouping ages 0-1. Exploratory analysis were performed examining interpolations for missing values (see results on the annex II) however, this is a more serious problem that future work should address in order to define a methodology to deal with the ALK missing values, such as modelling solutions (Gerritsen *et al.*, 2006). Mean length by age from ALK increase after 2005 (see Fig. 1) meaning that the same age is covering an amplitude of larger lengths for the recent period (or the annual sample distribution has a mode centered at larger individuals).

Annual landings catch-at age, estimated by converting annual length-at-ages to catch-at-age using the ALK, show a decrease of larger portion of the red seabream in the Azores (Fig.2). This is a consequence of fishing and may suggest growth overexploitation as reported by ICES (2014) and Diogo *et al.* (2015). Pinho *et al.* (2014) have already suggest an increase on fishing mortality on the recent years considering the actual exploitable level unsustainable. However, some level of variability on the vulnerability of the mega spawners is observed, with high abundance occurring suddenly on some particular years (e.g 1998-2000). Pinho *et al.* (2011) suggested as a possible explanation the environmental effects which could introduce catchability effects. Diogo *et al.* (2015) suggested that it may be an effect of the expansion of the fishery to new areas. This problems seems to be reflected on the form of the catch curve by year, affecting the slope of the descending portion of the curve and so producing potential bias on the total fishing mortality (Z) (Fig. 3). This problems can also arise as a consequence of violations of the model assumptions, particularly the assumption of constant mortality, vulnerability and recruitment that may lead to nonlinear catch curves (see also annex II).

Although the procedure to define the range of points (ages) of a catch curve to be included on the regression is a matter of debate (Chapman and Robson 1960; Smith *et al.* 2012) the results from the sensibility analysis from this study (Table 2) shows that overall the change of this range does not change the perception of an increase trend in mortality over time for red seabream fishery in the Azores (Fig. 4 and 5). Low mortality values are estimated for the period 1999-2002 and large variability are observed for the estimates for the very recent years (2011-2013) (Fig. 4 and Table 1). Confronting the abundance indices estimates from the catch curve and from the bottom longline survey (ARQDAÇO) high correlation is observed (with both time series in temporal phase) except for the years 2001 and 2002 (Fig. 6), which may suggest that those estimates may be underestimate. It appears from this result that annual mortality variability is probably related with catchability variability of the mega spawners (LF>37cm age 6) which seems to be correlated with the species annual abundance variability on the Azores (see Pinho, 2003, 2011).

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Table 1. Total annual mortality (Z) estimates, from the age catch curve analyze, for the Azorean *Pagellus bogaraveo* stock (ICES Xa2). Z- total mortality; n- number of observations used for the regression; SE- Standard error; Lower and upper- limits of 95% confidence interval; On the table are also shown the estimates for the fishing mortality (F) and exploitable biomass (B) for the assumed natural mortality (M) and observed yield (Y). Estimates for different periods of mean age composition are also presented.

Year	Z	n	SE	Lower 95%	Upper 95%	M	F	Y	B
1995	0.5843	4	0.0568	0.3398	0.8288	0.2	0.3843	1115	2901
1996	0.8588	4	0.1819	0.0763	1.6413	0.2	0.6588	1052	1597
1997	0.8859	4	0.1405	0.2811	1.4906	0.2	0.6859	1012	1476
1998	0.5700	4	0.0170	0.4967	0.6432	0.2	0.3700	1119	3025
1999	0.4542	4	0.0090	0.4154	0.4931	0.2	0.2542	1222	4807
2000	0.3471	5	0.0706	0.1224	0.5717	0.2	0.1471	947	6438
2001	0.3343	5	0.0645	0.1289	0.5396	0.2	0.1343	1034	7701
2002	0.4053	5	0.0956	0.1012	0.7094	0.2	0.2053	1193	5810
2003	0.8365	4	0.0823	0.4822	1.1908	0.2	0.6365	1068	1678
2004	0.8503	4	0.0681	0.5573	1.1432	0.2	0.6503	1075	1653
2005	0.5058	4	0.0888	0.1239	0.8877	0.2	0.3058	1383	4522
2006	0.5845	5	0.0852	0.3135	0.8556	0.2	0.3845	958	2491
2007	0.6551	5	0.0854	0.3833	0.9269	0.2	0.4551	1063	2336
2008	0.9772	4	0.1213	0.4554	1.4989	0.2	0.7772	1089	1401
2009	0.6347	5	0.0759	0.3931	0.8764	0.2	0.4347	1042	2397
2010	0.6679	5	0.0937	0.3696	0.9662	0.2	0.4679	687	1469
2011	0.9173	4	0.1338	0.3415	1.4932	0.2	0.7173	624	870
2012	0.9369	4	0.1379	0.3437	1.5301	0.2	0.7369	613	831
2013	0.8219	4	0.3623	-0.7368	2.3807	0.2	0.6219	692	1112
Mean (95-13)	0.6553	4	0.0683	0.3615	0.9490	0.2	0.4553	999	2195
Mean (95-97)	0.6840	4	0.1390	0.0858	1.2822	0.2	0.4840	1060	2189
Mean (98-10)	0.4964	5	0.0818	0.2359	0.7569	0.2	0.2964	1068	3602
Mean (11-13)	0.8900	4	0.1866	0.0871	1.6929	0.2	0.6900	643	931

Table 2. Annual estimates of total mortality by selecting different age intervals for the full recruited individuals. Bold values were the adopted mortality values.

Year	Age range						
	A_{3-6}	A_{3-7}	A_{4-6}	A_{4-7}	A_{4-8}	A_{5-7}	A_{5-8}
1995	0.0849	0.2411	0.4534	0.5034	0.5068	0.6550	**0.5843**
1996	0.1463	0.4227	0.7171	0.8463	0.7513	1.1562	**0.8588**
1997	0.7200	0.7391	0.9944	**0.8859**	0.6610	0.9759	0.5936
1998	0.5054	0.5368	0.5405	**0.5700**	0.4760	0.5894	0.4387
1999	0.4336	0.4434	0.4453	**0.4542**	0.3606	0.4506	0.3120
2000	0.5100	0.3869	0.5637	0.3521	**0.3471**	0.2111	0.2740
2001	0.5996	0.5080	0.5006	0.4127	**0.3343**	0.4332	0.3054
2002	0.7379	0.5970	0.6455	0.4803	**0.4053**	0.2248	0.2401
2003	0.6716	0.6834	0.9659	**0.8365**	0.5951	0.7056	0.4089
2004	0.6384	0.6731	0.9578	**0.8503**	0.6905	0.8147	0.5928
2005	0.8269	0.6707	0.6534	**0.5058**	0.3141	0.3753	0.1530
2006	0.8808	0.7254	0.8712	0.6428	**0.5845**	0.5309	0.4994
2007	0.9328	0.7804	0.9421	0.7089	**0.6551**	0.5912	0.5693
2008	0.9651	0.9539	1.0227	**0.9772**	0.6756	0.7940	0.4332
2009	0.8150	0.6952	0.8438	0.6497	**0.6347**	0.6071	0.6060
2010	0.8625	0.7392	0.9601	0.7264	**0.6679**	0.7528	0.6051
2011	1.0162	0.9061	1.1487	**0.9173**	0.7217	0.7528	0.5417
2012	1.0405	0.9264	1.1756	**0.9369**	0.7290	0.7732	0.5431
2013	1.3428	0.9920	1.3536	**0.8219**	0.6600	0.7159	0.5260
Mean (95-13)	0.6611	0.6260	0.7548	**0.6553**	0.5425	0.6365	0.6840
Mean (95-97)	0.2972	0.4455	0.6653	0.7037	0.6272	0.8937	**0.6840**
Mean (98-10)	0.7071	0.6310	0.7502	0.6144	**0.4964**	0.5174	0.6144
Mean (11-13)	1.1199	0.9393	1.2019	**0.8900**	0.7068	0.7453	0.5429

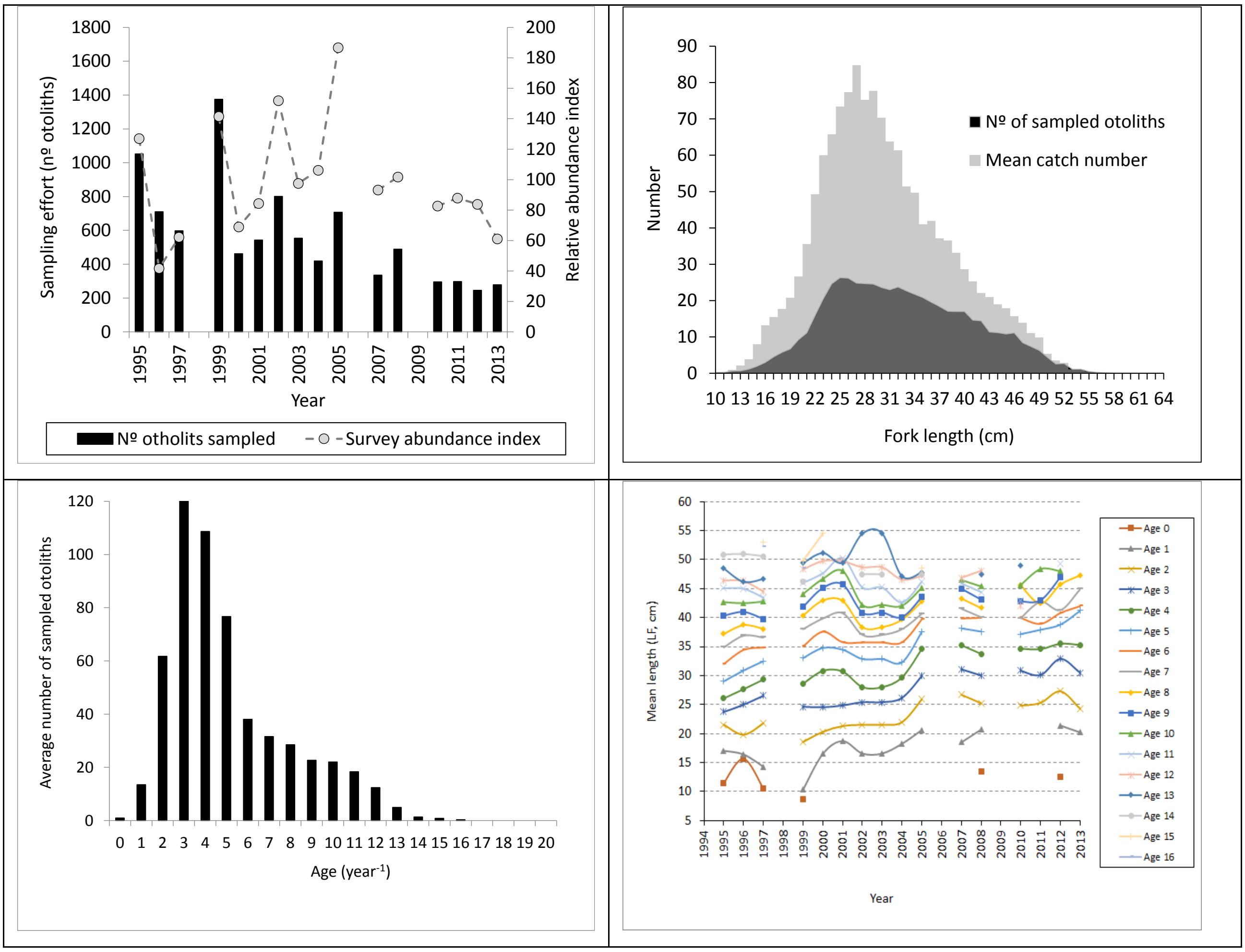

Figure 1. Annual survey (ARQDAÇO) sampling effort for ageing. Top left - annual number of otoliths of red seabream (*Pagellus bogaraveo*) sampled. On the figure is also shown the annual relative abundance index of red seabream. Top right – Annual mean number of otoliths sampled by length. On the figure is also shown the mean annual sampled length composition of the survey for the period 1995-2013. Below left – Mean age composition of age length keys (ALK) for the period 1995-2013. Below right – Annual mean length from ALK.

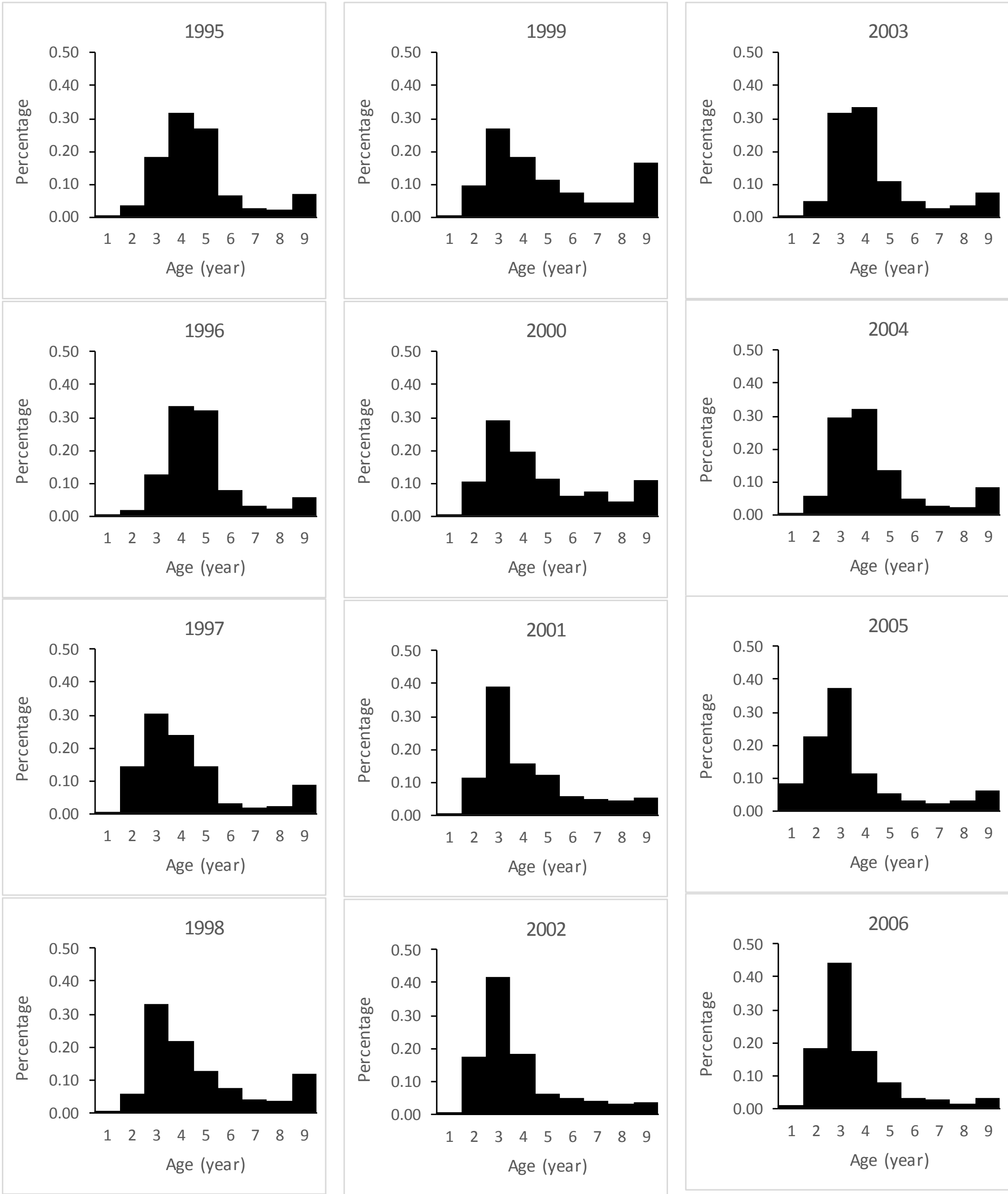

Figure 2. Age composition of the landings by year and age of *Pagellus bogaraveo* from the Azores (ICES Xa2).

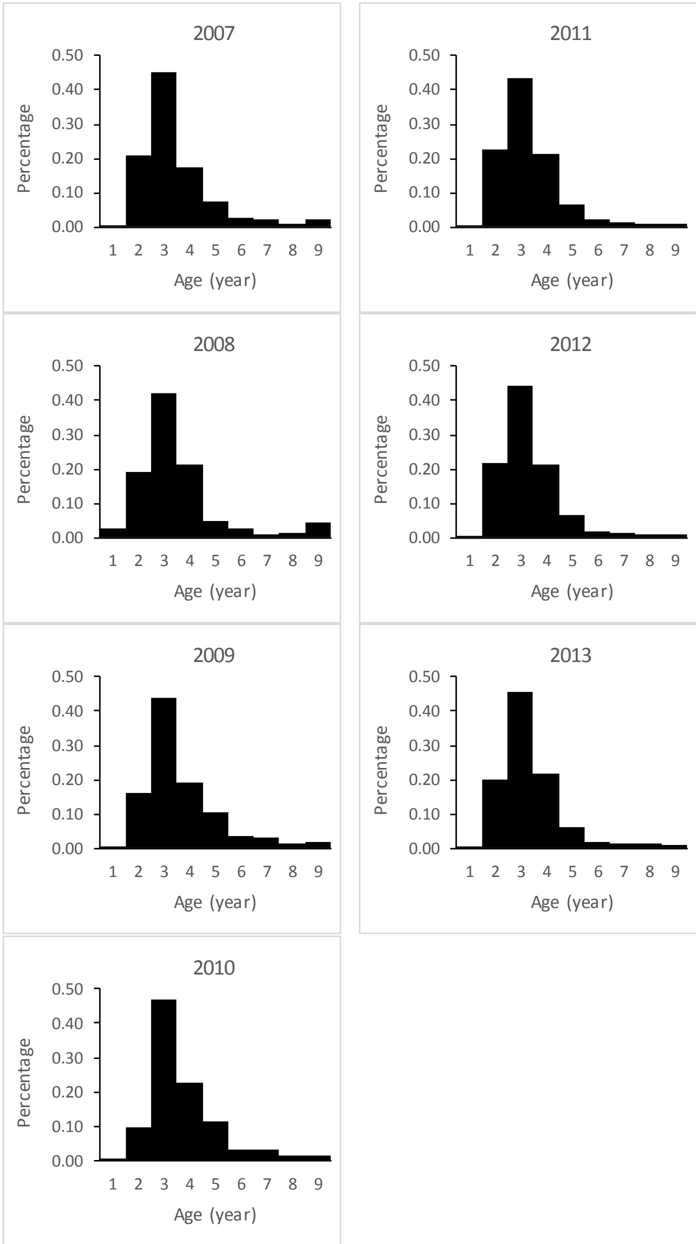

Figure 2 (cont). Age composition of the landings by year and age of *Pagellus bogaraveo* from the Azores (ICES Xa2).

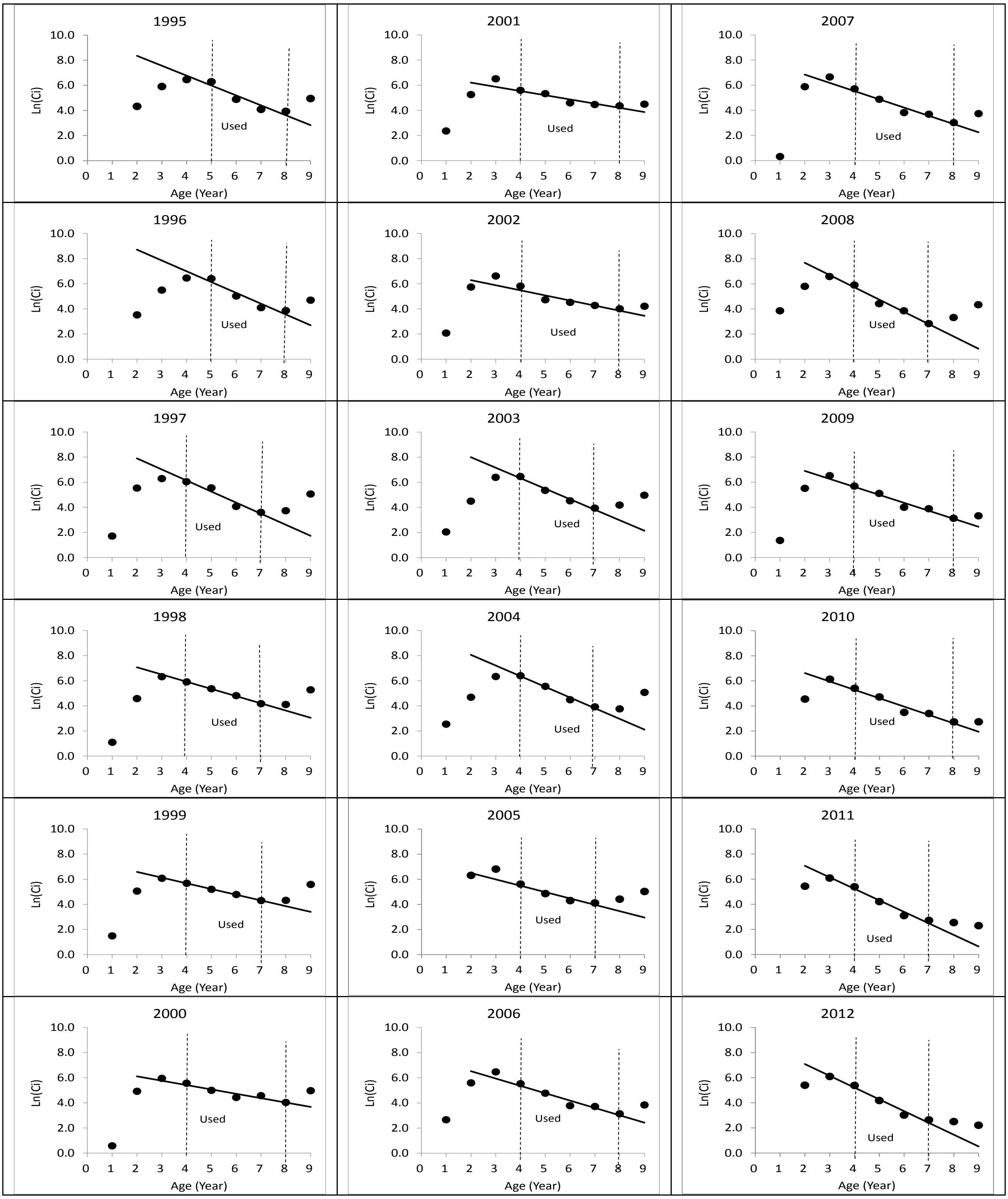

Figure 3. Catch curve of *Pagellus bogaraveo* from the Azores (ICES Xa2) based on the annual age structure of the population on the landings (pseudcohort approach). On the graph are identified, with dashed vertical lines, the points used for the analysis (interval of full recruited individuals for which mortality is considered constant). Solid line represent the regression line adjusted to the selected points. . Age 9 is considered de plus group.

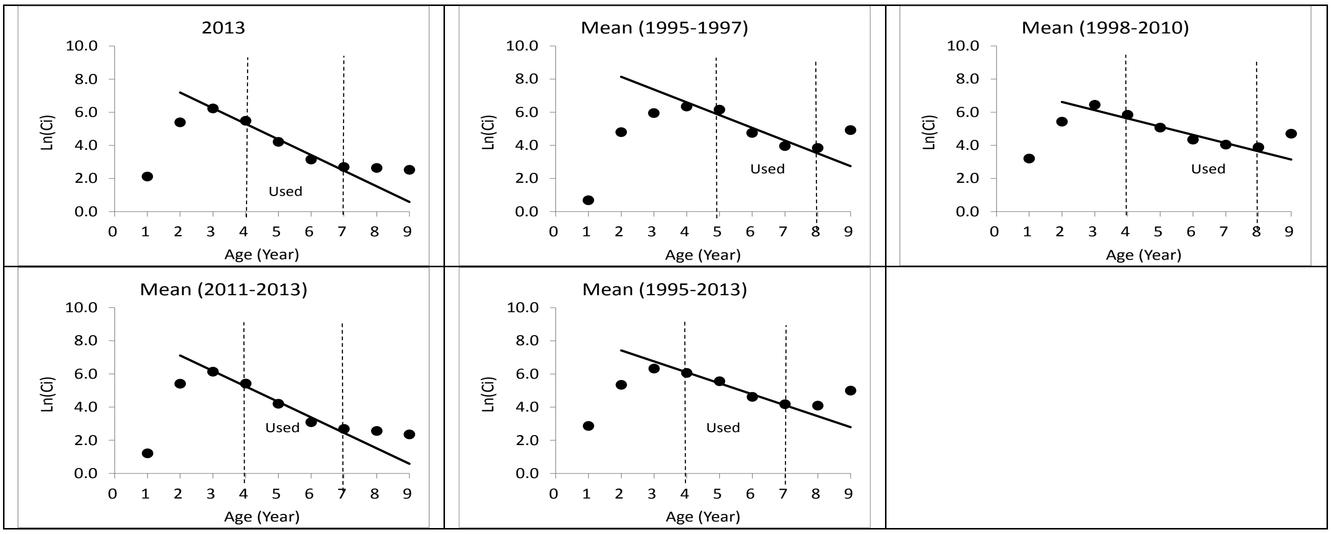

Figure 3 (cont). Catch curve of *Pagellus bogaraveo* from the Azores (ICES Xa2) based on the annual age structure of the population on the landings (pseudcohort approach). On the graph are identified, with dashed vertical lines, the points used for the analysis (interval of full recruited individuals for which mortality is considered constant). Solid line represent the regression line adjusted to the selected points. Age 9 is considered de plus group.

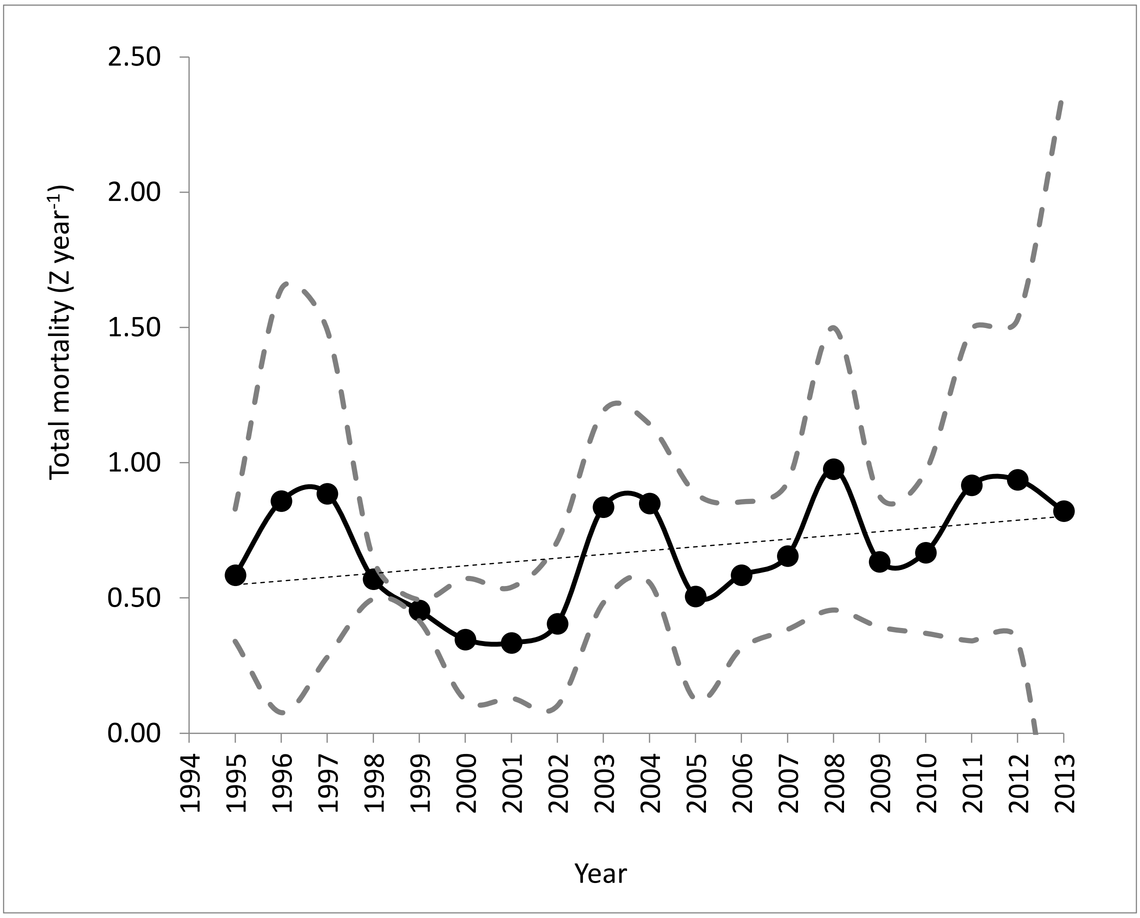

Figure 4. Annual evolution of total mortality (Z) estimated for *Pagellus bogaraveo* fishery of the Azores (ICES Xa2). Dashed grey line is the 95% confidence interval of the estimates; Black dashed line illustrate the mortality trend over time.

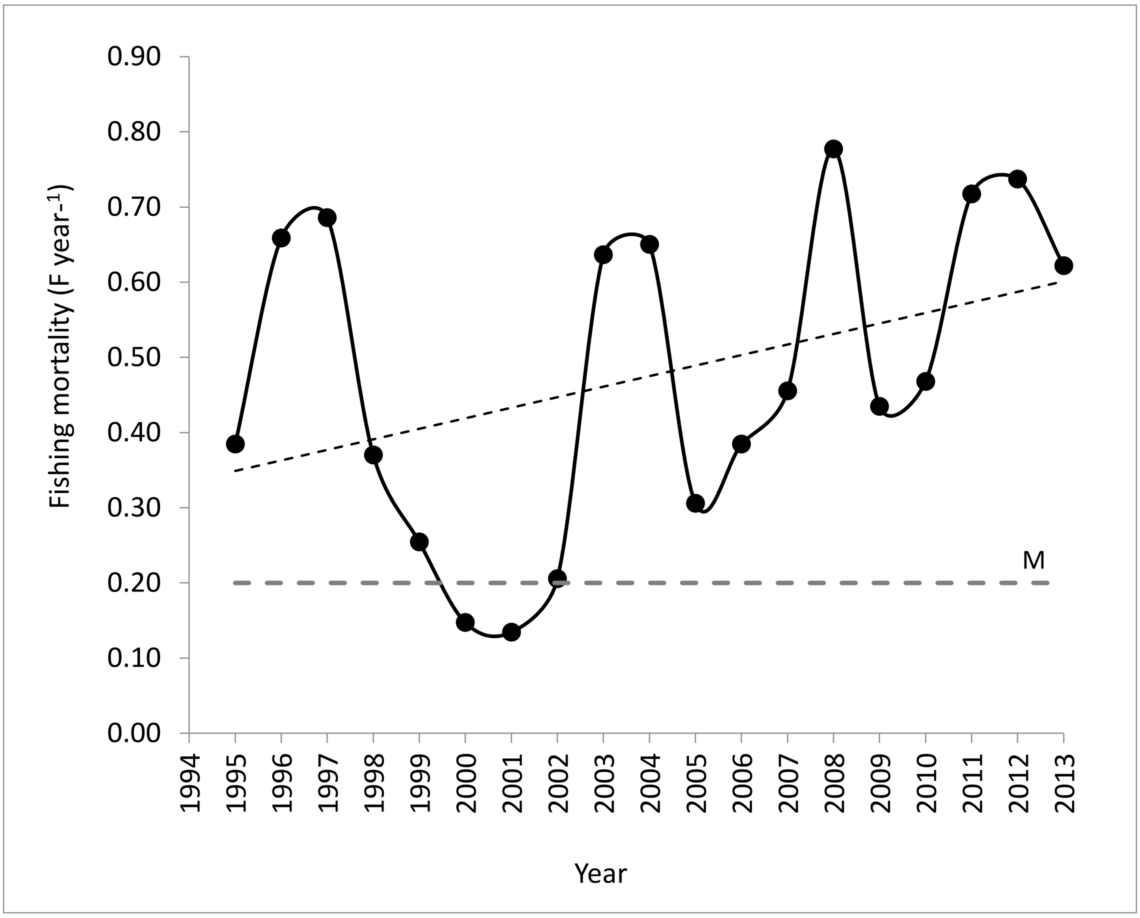

Figure 5. Annual evolution of fishing mortality (F) estimated for *Pagellus bogaraveo* fishery of the Azores (ICES Xa2). Grey dashed line shows the trend and grey line shows the value of natural mortality (M).

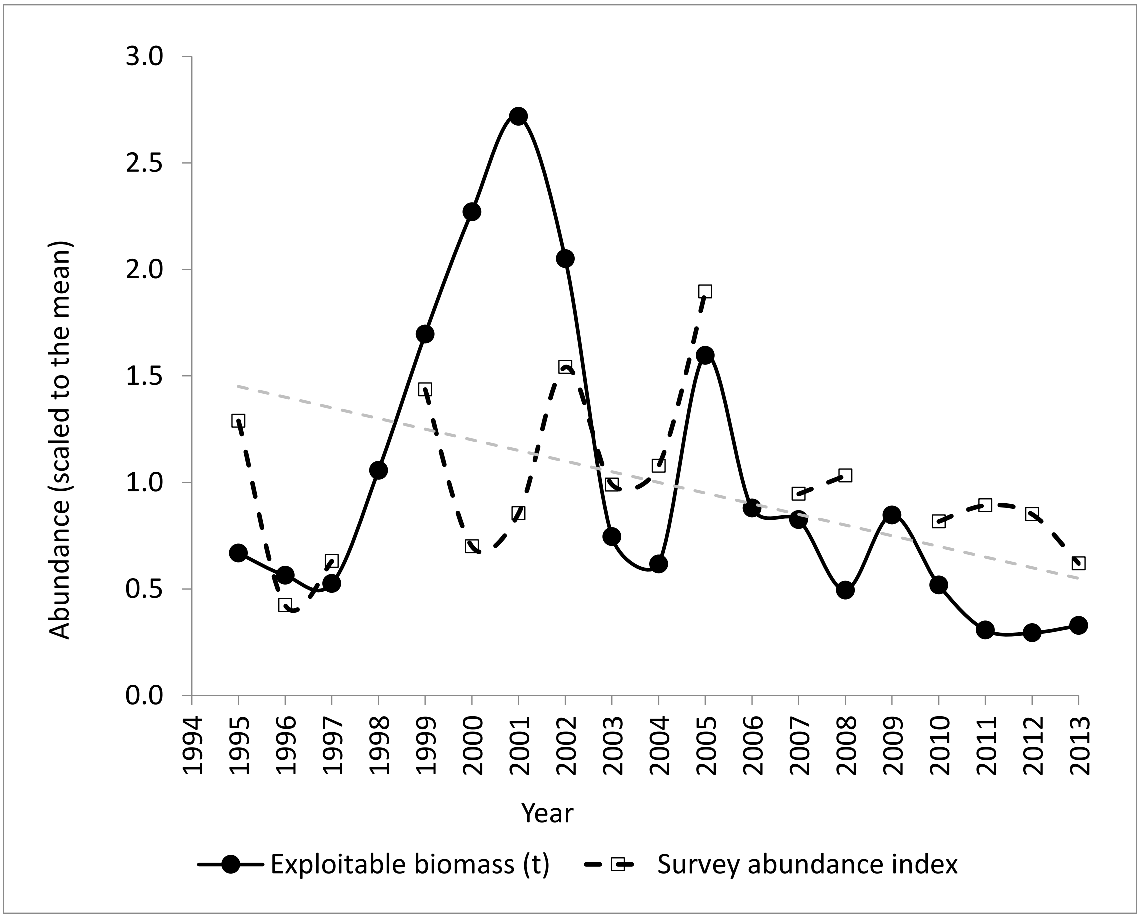

Figure 6. Annual biomass estimates from the catch curve analyses. On the graph are also shown for trend comparison the survey abundance index estimates for the same period. Grey dashed line shows the trend of the exploitable biomass.

ANNEX I – Catch curve by age formulation

Consider a close population where a period of fully recruited ages (where **a** is the age from which individuals are considered fully recruited – constant vulnerability) are defined, of constant interval T (for example equal to 1 year), where total mortality (Z) can be considered constant. The number of survivors (Ni) during this period are estimated as:

Ni = Na * $e^{-Z(i-a)}$ and taking logarithms comes:

Ln(Ni) = Ln(Na) - Z(i-a) (1)

The mean number $\overline{N}_i$ of survivors are estimated as:

$\overline{N}_i$=Ni*(1-e^{-ZT})/ZT and taking logarithms comes:

Ln ($\overline{N}_i$) = Ln (Ni) + Ln ((1-e^{-ZT})/ZT) and from (1) comes:

Ln($\overline{N}_i$)= [Ln(Na)+Za+ Ln((1-e^{-ZT})/ZT)] – Z.i (2)

From the catch equation comes:

Ci = F_i T * $\overline{N}_i$

where T=constante. Taking logarithmes come:

Ln(Ci) = Ln(FT) + Ln ($\overline{N}_i$) (3)

Substituting (2) in (3) comes :

Ln(Ci) = [Ln(FT)+Ln(Na)+Za+ Ln((1-e^{-ZT})/ZT)] – Z*i
Y = constant - b*X by regression Z=-b

ANNEX II. Catchability effects on the estimates of total mortality (Z)?

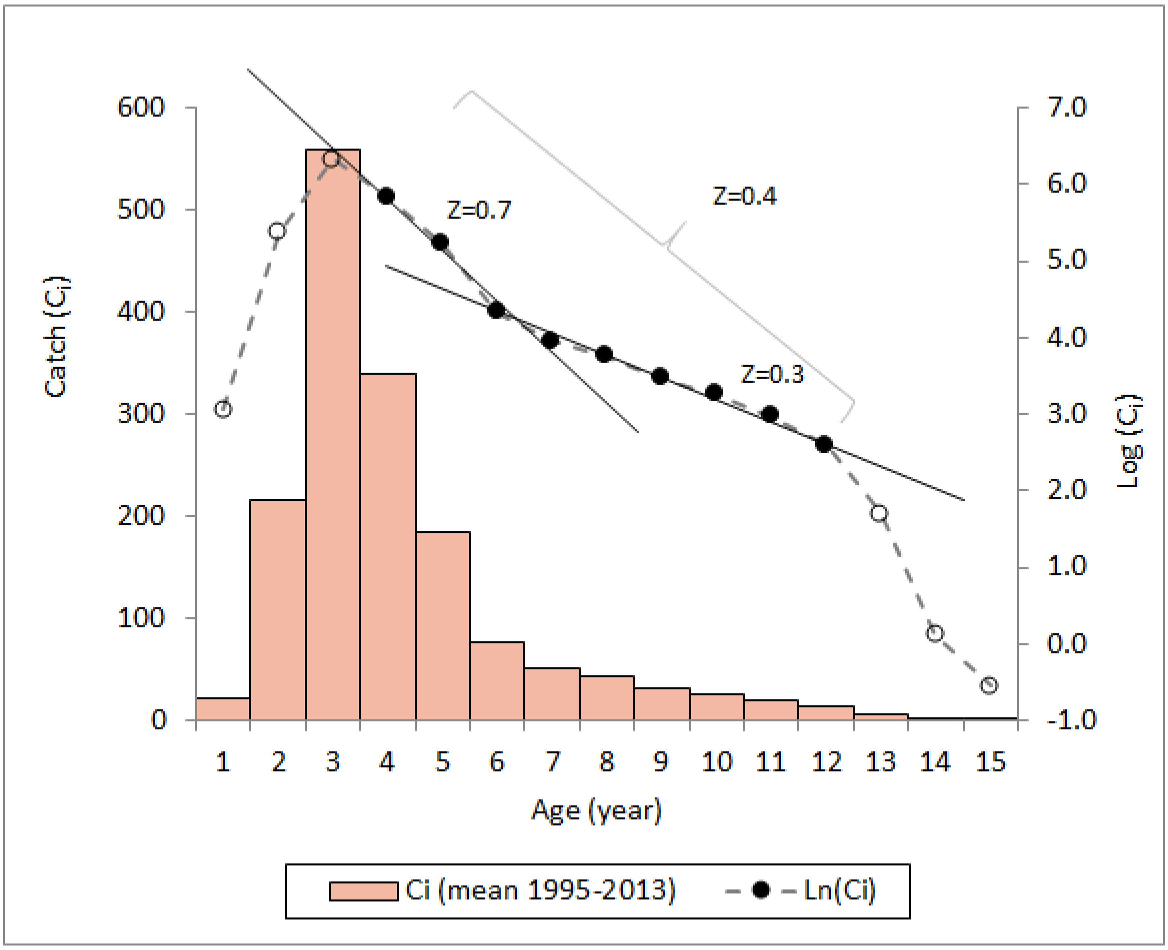

Figure I. Catch curve analysis for red seabream (*Pagellus bogaraveo*) of the Azores (ICES area X). Colour bars – catch-at-age composition; Dashed line – catch curve; Black points – points used on the regression; White points – points excluded from the regression. Mean catch-at-age for this exercise was constructed performing interpolations on the ALK for the missing values in order to consider the total range of age values.

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Working Document

On the stock size and fishery management of splendid alfonsino *Beryx splendens* in the North Azores area

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Abstract

Fishing concentrations of alfonsino are distributed all year round on four seamounts in the North Azores area, where the fish biomass is estimated at 7,000-10,000 t. The alfonsino may be easily to overfishing but its stock rapidly recovers. The TAC should not exceed 9% (F=0.1) of the stock size. The stock assessment should be based on the results from the annual trawl-acoustic surveys. The temporary measures of fishery management involving the TAC for each separate seamount, the limitation of fishing efforts, a ban of bottom fishery and the presence of the observers aboard fishing vessels should be established in the nearest future.

Introduction

In the North Azores area (ICES Subarea Xb), the research was most active in the 1970-1990s. In that period, Russian exploratory, research and commercial vessels (EV, RV, CV) conducted 15 cruises (Vinnichenko, 2002), by the results of which more than ten of publications on different aspects of biology, habitat and fishery of splendid alfonsino were prepared.

In the last two decades the interest in study and fishery development in the North Azores area has been shown by some other countries, notably Faroese Islands and Norway. The vessels of those countries carried out exploratory cruises, collected research and fishing data which became the basis for a several scientific papers.

On the whole, the study of the North Azores area was complex in several directions. However, the size and status of the alfonsino stocks were poorly studied, and there was the only publication considering that problem (Vinnichenko, 1995). To some extent, that was caused by the deficiency of data on research and fishery of alfonsino.

In 2012, ICES first advised the catch limitation of 280 t for alfonsino of the Northeast Atlantic (ICES, 2012). In 2014, the ICES advice for alfonsino practically remained unchanged (ICES, 2014a). In both cases, the advices were based on ICES approach to data-limited stocks, at that, the information on alfonsino from the coastal waters at the Azores was mainly used.

No specific regulation of the alfonsino stocks in the NEAFC Regulatory Area has been used so far. At the same time, some other measures, which are important for the alfonsino fishery, are applied there, including:

- a ban to use bottom fishing gears in the Southern MAR area (NEAFC, 2013);
- the effort does not exceed 65% of the highest level put into deep sea fishing in previous years for the relevant species (NEAFC, 2014a).

Recently, ICES and NAFO much attention is paid to development of general approach to management of deep sea species. In particular, at the last annual NEAFC meeting, the procedure to establish regulation measures for distinct stocks was approved, and it was decided to update the database on deep sea fisheries (NEAFC, 2014b).

This paper is aimed at summarizing the available research and fishery information and assessing the stock status on this basis as well as at preparing the advice on splendid alfonsino fishery management in the North Azores area.

Materials and Methods

The following was used during the preparation of the paper:

- cruise reports of Russian EVs, RVs and CVs in 1974-2010 as well as Norwegian vessel in 1993;
- Russian and other countries' publications;
- reports of ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP);
- ICES advices for splendid alfonsino;
- NEAFC reports and recommendations.

The statistics of alfonsino fishery has been formed on the basis data from WGDEEP and scientific sources.

Behavior and distribution of the species were studied on the results from the hydroacoustic observations, tows and the ichthyological investigations.

In order to assess the stock status the results from the trawl-acoustic surveys (TAS) conducted in 1991 and 2003, as well as the data collected in 1978, 1979, 1993 and 1994 were used.

In 1991, TAS was carried out using EK-400 echosounder and SIORS echointegrator, in 2003, - with the aid of EK60 echosounder.

When using the materials from EVs and CVs the alfonsino biomass was estimated by the data of hydroacoustic observations with the help of the vessel standard equipment. as well as of the hauls by pelagic and bottom trawls based on K.Judanov *et al* (1984) methods adapted to the concrete conditions of seamounts. The density of alfonsino pelagic schools was calculated by comparing catch values and the trawl eye echograms, at that, for a pelagic trawl the catchability 0.2 was used in 1978 and 0.3 in 1979. Density of bottom concentrations was estimated by matching catch size and area of fished concentration. The catchability of bottom trawl was taken as to be equal to 0.2.

The analytical stock assessment and possible total allowable catch (TAC) of alfonsino have not been made due to the lack of initial data.

Results

Historical Review of Fishery

At present, there are four seamounts (banks) with commercial concentrations of alfonsino in the North Azores area. Two banks, named “Spektr” and “Bliznetsy”, are the tops of one large seamount located in the axial part of the Mid-Atlantic Ridge (MAR). The seamount “Stepan” is also within the ridge, in several tens of miles to the south of the two first banks. One more isolated seamount, with the name of “Agat”, is located to the east of the MAR.

In the North Azores, the first commercial catches of alfonsino were taken on the seamount “Spektr” in 1977. In the following year, on that seamount, the commercial fishery with the catch of 700 t was executed. In 1979, the alfonsino concentrations were found also on the seamounts “Bliznetsy” and “Agat”. In the area, the total catch increased to 1,100 t (Vinnichenko, 2002).

In the 1980s, on the North Azores seamounts, there was no commercial fishery. During the decade, in the area, 9 research and exploratory and research cruises were performed. Most of them confirmed the occurrence of alfonsino concentrations. In total, during the period, about 1,000 t of deep sea fish (mainly alfonsino) were caught.

In 1994, in the North Azores, Russian fishery was resumed and executed with different intensity (the annual catch from 200 to 1,000 t) till the end of 20th century (Clark *et al*, 2007; ICES, 2014a). In that period, the catches of alfonsino were taken on the the seamounts “Spektr”, “Agat” and “Bliznetsy”, as well as seamount “Stepan”.

In the following 15 years, Russian commercial trawlers visited the North Azores area only in 2010 and 2011. In both cases, the dense concentrations of alfonsino were observed on the banks, however, due to the lack of experience of work on the seamounts the daily catch did not exceed 5 t.

Russian data on fishing efforts are not given in this paper owing to their fragmentariness and insufficient reliability.

There is no statistics of Russian fishery on separate seamounts. At the same time, the available data allow us to estimate roughly the commercial importance of each seamount. The vessels worked most often and continuously on the seamount “Spektr” where 60-70% of total catch were taken. There were 20-30% of total catch on the seamount “Agat”, 10-15% on the seamount “Bliznetsy” and approximately 2% on the seamount “Stepan”.

The pelagic trawls were used by Russian vessels as the basic gear with catches reaching 40-60 t per a short hauling and they consisted almost completely of splendid alfonsino. The bottom trawl was only applied on the “Agat” and “Bliznetsy” banks, where other deep sea species presented the significant part of catches.

Besides Russia, some other countries occasionally fished alfonsino in the North Azores area. In 1993, a Norwegian trawler caught 300 t of deepwater fish by bottom trawl during 12 fishing days on the “Agat” and “Bliznetsy” seamounts. The catches contained, mainly, alfonsino (200 t) as well as black cardinal fish *Epigonus telescopus*, orange roughy *Hoplostethus atlanticus*, black scabbardfish *Aphanopus carbo* and other species (Vinnichenko *et al*, 1994; ICES, 2014a).

Since 1994, on the North Azores banks, bottom trawl fishery of orange roughy and black scabbardfish has been undertaken by Faeroes vessels (Thomsen, 1998). In some years, in that fishery, a small alfonsino bycatches (1-10 t) were registered (ICES, 2014a).

By unconfirmed data, the Great Britain also attempted to fish alfonsino in the ICES Div.Xb and reported on the catch of 15 t in 2000 (ICES, 2014a).

In the North Azores, the investigation of longlining possibility was carried out beside with the trawl fishery. In 1984, alfonsino was not found in the catches of a Russian vessel (Zaferman, Shestopal, 1991). Its single specimen occurred during the cruises of Norwegian (2001) and Spanish (2004) longliners (Hareide, Garnes, 2001; Duran Muñoz *et al*, 2005a).

Biological characteristics

According to the Russian data, in the North Azores area alfonsino was represented in trawl catches by specimens ranging from 15 to 62 cm, mainly 20-42 cm length. The area is inhabited by both small immature and large mature fishes (Vinnichenko *et al*, 1979; Vinnichenko *et al*, 1994; Vinnichenko, 1996; Vinnichenko, 2002).

As compared with the other deep sea species, alfonsino has a relatively short life cycle (up to 14 years) and higher growth and maturation rates (Anon, 1993; Kotlyar, 1996). The sexual maturation begins in the second year of life under 18 cm mean length, and, by age of 5-6, all specimens become mature under 25-30 cm length (Pshenichny *et al*, 1986; Anon, 1993). The most intensive spawning is observed in the near-bottom layers in July-August. Alfonsino spawns by portions, their number is about 10-12. The individual fecundity is very high, from 810,000 to 2,350,000 eggs. The duration of individual spawning period was estimated to be up to 2 months (Alekseeva, 1983).

Alfonsino feeds on various mesopelagic fish (Myctophidae, Sternoptychidae, Chauliodontidae etc.), squids, shrimps and euphausiids. (Pshenichny *et al*, 1986; Anon, 1993; Vinnichenko, 1997).

Behavior, distribution, migrations and habitat

Behavior and distribution of alfonsino are highly variable. Echo records of its schools can be registered in the pelagial and near-bottom layers; and they can appear and disappear for short or long time periods. However, the absence of schools echo records does not mean the absence of fish on the seamount, as a smaller or greater portion of alfonsino aggregations is permanently distributed near bottom in folds of the microrelief where fish cannot be registered by echo instruments (Pshenichny *et al*, 1986; Anon, 1993; Vinnichenko, 1996).

The aggregations of alfonsino in the North Azores area were registered by echo sounder at 150-850 m depths (mainly, at 250-750 m depths) under the water temperature of 7.5-17.0 °C, mainly 9.5-15.0 °C (Vinnichenko *et al*, 1986; Anon, 1993; Vinnichenko *et al*, 1994; Vinnichenko, 1996).

A tendency of fish size growing is noticed with increase of depth. By this reason, on the relatively shallow seamount “Spektr”, where due to complex relief, fishing is possible only within its top part, small beryx is mostly caught. On the other deeper banks, sizes of alfonsino in the catches are significantly higher (Vinnichenko *et al*, 1979; Vinnichenko, 1996).

The horizontal migrations of alfonsino are limited by the area of seamounts (within isobath of 3,000 m), where their extent is not more than a few miles (Galaktionov, 1984; Vinnichenko, 1996). In the open sea, despite the study to be thorough enough, there were not any migrating mature alfonsino found (Kotlyar, 1996; Duran Muñoz, personal communication). The indirect evidence indicating the absence of large alfonsino migrations from the seamounts is occurrence of its concentrations within banks. Single alfonsino juveniles only occurred outside the seamounts (Kotlyar, 1996; Duran Muñoz *et al*, 2005b) and they might be brought by currents for a great distance.

The main factor which appeared to determine a pattern of alfonsino vertical migrations is the vertical shifting of its food organisms. The latters, in their turn, are closely related to variations in light penetration of the sea (by the Sun and the Moon) and hydro-meteorological conditions in the area of seamounts. The results of the investigations have revealed several types of alfonsino vertical migrations (Vinnichenko, 1997).

Stock structure

There are two points of view between Russian scientists concerning the stock structure of alfonsino.

In the opinion of most investigators this species forms a population on each separate seamount or closely situated group of banks, does not migrate for a long distance, and all the stages of its life cycle are developed within the same seamount (Klimenko, 1983; Melnikov *et al*, 1993; Vinnichenko, 1995; Vinnichenko, 2006).

Some scientists assume that the alfonsino migrate between the Corner Rise and the Azores seamounts and there is a single population in those areas (Alekseev *et al*, 1987). With regard to the open part of the North Atlantic, this hypothesis supposes the existence of the reproductive part of the area on the Corner Rise and feeding grounds on the Azores banks.

Due to lack of data on stock structure of *Beryx splendens*, ICES advices are currently being developed for a single stock in the North Atlantic (ICES, 2014b).

Biomass of aggregations

By Russian data, in the North Azores area, the greatest biomass of alfonsino was registered on the "Spektr" seamount (Table 1). On the "Agat" and "Bliznetsy" seamounts, on the whole, the aggregation biomasses were much lower. On the bank "Stepan" surveys have not been conducted, however, the small concentrations on this seamount give a reason to consider that biomass of alfonsino is not large here also.

In some cases, on the seamounts, the alfonsino schools were practically not registered or they were weak (Table 1). According to V.N. Schnar *et al*. (2005), during researches in December 2003, the fishing concentrations of beryx were not found within "Spektr" and "Agat" banks (Table. 1). Observations on other Russian vessels show that a similar situation also occurred in August 2000 and May 2003 on all the banks, in September 1979 and July 1994 on the "Agat" bank, in August 1994 on the seamount "Spektr", in May 1994 and October 2010 on the bank "Bliznetsy".

Discussion

The North Azores seamounts are among the areas with unstable fishery resources and higher commercial risk. The fish behavior and distribution as well as the forms and density of aggregations are quite variable (see above), which together with hard ground conditions and partitioned bottom topography of the banks highly complicates haulings. The fishery is also hampered by small parameters of alfonsino schools and unsteady water circulation above the seamounts, which causes abrupt catch fluctuations. In some cases, vessels having records of dense concentrations could not have a catch (Anon, 1993; Vinnichenko, 1996; Vinnichenko, 2006). In these conditions, the experience of fishery on the seamounts has become especially important depending on which catch per unit effort (CPUE) of the similar trawlers might differ in more than two times (Vinnichenko, 2014).

The aggregations of alfonsino were revealed on the North Azores seamounts about 40 years ago. Nevertheless, during the past period, the fishing vessels worked there only for 7 years including 1978-1979, 1994-1996 and 1999-2000 that is not enough to form the appropriate data base. In some other years, EVs went to work there, but the results of their fishing activities often did not correspond to fishing possibility since the vessels fished for a short time (from 1 to 4 days), sometimes they left the area where the dense aggregations were present.

Thus, in the North Azores area, the fishery statistics did not always show a real state of fishery resources, and, therefore, using it to estimate the alfonsino stock status is complicated. In future, some efforts should be made to improve the fishery reports from this area.

It is currently impossible to use information on fishing efforts and CPUE for the alfonsino stock assessment since available raw data is patchy and insufficiently valid. Particularly, data on fishing efforts of the Russian fishery are available only for some years, and also there is the information on the Norwegian fishery in 1993. Solution of this issue involves obtaining of the missing data and revision of the existing statistics, as well as standardization of CPUE.

To avoid the accidents in operating on the seamounts, fishermen try not to conduct pelagic trawling near bottom. In this relation, applying pelagic trawls does not mean a significant adverse impact on vulnerable marine ecosystem and alfonsino spawning (Vinnichenko, 2014).

Knowledge of fish intraspecific structure is quite important for development of the fishery management. As for the splendid alfonsino of the North Atlantic, this issue still needs to be resolved. However, already now there are some reasons to consider that the hypothesis of some scientists according to which the alfonsino migrates between the North Azores and the Azores seamounts and there is a single population in these areas seems to be grounded insufficiently. In particular, the mentioned hypothesis cannot explain:

- the occurrence of several alfonsino populations in the North Atlantic by the data from genetic and biometric investigations (Titova, 1981; Schönhuth et al, 2005);
- permanent presence of young and old alfonsino groups both on the Corner Rise and in the Azores (Vinnichenko *et al*, 1979; Sherstyukov, Noskov, 1986; Vinnichenko, 1995; Vinnichenko, 1996);
- the absence of migrating mature alfonsino in the oceanic areas outside the seamounts;
- long time (during several years) absence of alfonsino commercial concentrations on the seamounts after extremely intensive fishery.

At the same time, the above-mentioned information proves the occurrence of isolated alfonsino populations on each separate seamount.

The necessity to develop grounded measures of fishery regulation causes the continuation of alfonsino stock structure studies. Until more complete data to manage its fishery have been obtained it is reasonable to be based on the principle of population existence on each separate seamount. Such regulation agrees well with ICES precautionary approach, since, at that, the risk of stock overfishing as a consequence of fishery concentration on separate seamounts decreases. The ICES already advises to use the same principle for assessment and regulation of orange roughy fishery (ICES, 2014c). The approach should be applied in practice in relation to alfonsino in the North Azores area as establishing individual TACs for isolated seamounts “Agat” and “Stepan”, as well as a unified common TAC for two closely spaced seamounts, “Spektr” and “Bliznetsy” (the distance between them is about 2 miles).

The stock size of alfonsino is comparatively small. By the analysis of the data collected in 1980-1995, in the open part of the North Atlantic, the alfonsino biomass was about 50,000-80,000 t (Vinnichenko, 1995), including that one in the North Azores area being 22,000-34,000 t. The values mentioned were probably overestimated because the biomasses were calculated applying the catchability coefficient of 0.3 for a pelagic trawl. Applying the catchability coefficient of 1.0 would be obviously more reasonable, since it is more corresponding to peculiarities of the fish behavior and the precautionary approach (Vinnichenko, 2014). Then, the calculated alfonsino biomass values obtained on the North Azores banks in 1980-1995 decrease to 7,000-10,000 t.

It should be taken into consideration that the data with a 20-30 year period of limitation were used for the calculations mentioned above. Therefore, most of them have turned old, need correcting, and at present they can only serve as a landmark to determine a possible catch. Besides, the lack of regular surveys (first of all, TASs) and low accuracy of estimates do not allow us to see year-to-year dynamics of beryx stocks in the North Azores.

A reliability of alfonsino TAS requires separate consideration. In our opinion the notions of “estimation of concentration biomass” and “stock assessment” of this species should be distinctly differentiated. Due to the patterns of alfonsino distribution and behavior, the pelagic concentrations accessible for assessment may only represent the part of the stock on the bank (see above). At present, apparently, it is not possible to estimate the meaning of this factor for the results of the TAS conducted before, but its influence is evident (Vinnichenko, 2014). In future, when conducting these works it is necessary to consider variability of vertical migrations and distribution of the alfonsino. Particularly the TAS should be carried out under the presence of dense pelagic schools above the seamounts. At that, it is reasonable to fish several times in different day time and periods. Following these conditions increases the probability of the main stock part assessment, and the data from survey during which the maximal biomass is registered should be the most impartial. But, implementation of this aboard RVs is complicated by limited research periods. Therefore, conducting TAS aboard CVs equipped with special instruments seems to be more reasonable (Vinnichenko, 2014).

According the ICES advice, due to the spatial distribution associated with seamounts, the life-history, and the aggregation behavior, the alfonsino stocks are easily overexploited; they can only sustain low rates of exploitation. To prevent depleting localized aggregations that have not yet been mapped and assessed the exploitation of new seamounts should not be allowed (ICES, 2014b). Under a limited stock this species form dense local concentrations and, therefore, may be easily overexploited. The gained experience in fishery shows that even comparatively small catch of the alfonsino leads to the decrease in size, density and stability of aggregations and, as a consequence, to the reduction in catch and fishing efficiency. On the other hand, the alfonsino abundance is relatively quickly recovered after intensive fishery that is caused by peculiarities of the fish biology (see above). The previous experience shows that it takes about 5 years to recover the alfonsino stock (on conditions fishing absence) to the level, which will permit to have profitable fishery (Vinnichenko, 1996; Vinnichenko, 2006; Clark *et al*, 2007).

In the last years there were no TASs in the North Azores area, and, at present, the alfonsino stocks status is unknown. At the same time, in the 2000s, fishing of beryx in that area was not practically carried out. Numerous examples of the fisheries in different areas of the World Ocean indicate that a significant reduction of intensity and especially the complete cessation of fishing finally lead to stock recovery. It allows considering, that after 15 year fishery stop in this area, the alfonsino abundance was recovered and now the fish stocks are at the level of the 1980s-90s, which was about 7,000-10,000 t. An indirect confirmation of recovery beryx stocks nowadays in the North Azores area may be a registration of echo records of its dense aggregations by Russian trawlers during 2010-2011.

When determining allowable catch of the alfonsino the precautionary approach should be applied which taking into account the vulnerability of the species for fishery has to provide the fishing mortality of F=0,1 that corresponds to catch of not more than 9% of fish biomass on each separate bank. In this case, the stock size, perhaps, will not reduce significantly. In future, after the basic biological reference points have been determined, the level of fishing mortality should be revised.

In accordance with the results of Russian investigations, the alfonsino stock was the greatest on the “Spektr” bank, and the main catch was taken there. The rest alfonsino biomass were much less on other seamounts. Taking all this mentioned into account it is recommended to establish for the “Spektr” and “Bliznetsy” banks the annual catch of 550 t, for the seamount “Agat” – 150 t, for the seamount “Stepan” – 50 t.

The NEAFC experience showed that, in the conditions of the deficiency in data on the state of deep-water stocks such a regulation measure as the restriction of fishing efforts was very efficient. In this context, it seems to be reasonable also to keep the mentioned measure for alfonsino fishery regulation in the North Azores, alongside with catch limitation.

Conclusion

This paper is attempted to estimate a fishery potential and to develop the advice on the stock exploitation of splendid alfonsino in the North Azores area. Owing to scattered and heterogeneous initial data, using mainly retrospective data base, as well as the shortcomings of methods, the results should be considered as preliminary. Nevertheless, the following conclusions can be already drawn:

1. In the North Azores area, the commercial concentrations of splendid alfonsino are distributed on 4 seamounts all the year round.
2. The stocks of alfonsino are relatively small. By the research data on the North Azores banks for 1978-1995, its biomass was estimated at 7,000-10,000 t. At present, the stocks are probably at the same level.
3. Under comparatively small stocks the alfonsino forms dense local concentrations and may be easily overfished. At the same time, this species is relatively quickly recovered after intensive fishery.
4. When determining the allowable catch of alfonsino the existing of separate quite limited stocks on each separate seamount should be taken into account. The annual catch of alfonsino should not exceed 9% of its stock size (F=0.1).
5. Arranging fishery management on the North Azores banks is only possible within the framework of NEAFC and should provide:
   - obtaining reliable statistical data on fishery;
   - conducting integrated researches including the studies of biology, intraspecific structure and habitat;
   - carrying out the stock assessments on the regular basis;
   - development of scientifically grounded measures for fishery managment.
6. The stock estimation should be based on the results of annual TASs which should be conducted by CPs with appropriate special equipment.
7. In future, after having accumulated scientific and fishery data the analytical assessment of alfonsino stocks should be developed and used in practice.
8. In the nearest future, it is expedient to arrange the complex of temporal alfonsino management measures which should provide:
   - establish the annual catch 550 t for the “Spektr” and “Bliznetsy” banks. for the seamount “Agat” – 150 t, for the seamount “Stepan” – 50 t;
   - a ban to use bottom gear for the purpose of the protection of VME and alfonsino spawning;
   - the effort restriction (not more than 65% of the highest level put into deep sea fishing in previous years);

- assignment of observers to all the fishing vessels in order to provide collecting scientific data and making the control of fishery management measures.

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Table 1. Biomass of splendid alfonsino concentrations on the seamounts in the North Azores area by data from cruises of RVs, EVs and CVs

Seamount	Period		Vessel	Biomass, 000 t
	Year	Month		
«Spektr»	1978	August	EV «Andrus Johani»	7,5 (37,3)
	1979	April	EV «Rzhev»	5,5 (18,3)
	1991	May	RV «Professor Marti»	1,2
	2003	December	RV «Atlantida»	no concentrations
«Agat»	1993	September	EV «Ramuen»	1,2
	1994	June	CV «Pyotr Petrov»	0,5 (1,8)
	2003	December	RV «Atlantida»	no concentrations
«Bliznetsy»	1979	April	EV «Rzhev»	0,2 (0,6)
	1993	September	EV «Ramuen»	0,6
	2003	December	RV «Atlantida»	0,2

Note: In the brackets biomass values calculated using pelagic trawl catchability (0,2-0,3) are shown

WD ICES WGDEEP 2015

Blue ling in Faroese waters (Vb).

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Introduction

The objective for this document is to provide information on the data of blue ling in Faroese waters. The data are mainly from the two annual groundfish surveys, commercial landings and commercial fishery logbooks.

Landings

Landings of blue ling in Division Vb for the period 1966 to 2014 are showed in Figure 1. Mean landings were around 5600 tons in the period 1966-1989 and around 2600 tons in the period 1990-2014 (Figure 1). The landings have been below average since 2008. Final landings in 2013 and preliminary landings in 2014 are presented in Table 1.

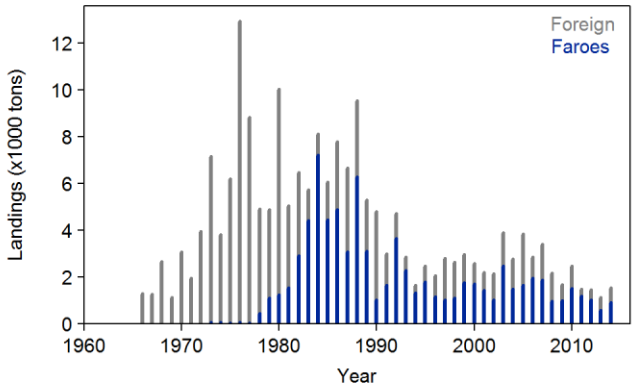


Figure 1. Blue ling Vb. Nominal landings of blue ling in Vb for the period 1966 to 2014.

Table 1. Blue ling Vb. Final landings (tons) in Div Vb in 2013 and preliminary landings in 2014.

Country	Area	2013	2014
Faroe Islands	Vb1	440.364	729.824
	Vb2	133.019	150.186
	Vb total	573.383	880.010
France	Vb total	551.945	609.238
Norway	Vb1b		28.913
	Vb2		6.084
	Vb total		34.997
All countries	Vb grand total	1125.328	1524.245

Commercial fishery

The data from logbooks for the period 1985-2009 have been quality controlled. The CPUE are from a subset of the commercial ships: all available logbooks from 6-8 otterboard trawlers mainly fishing in deep water, 4-8 pair trawlers fishing on the slope from about 150 m and 4-5 long liners (GRT >110). The data for 2010-present are selected directly from the database at the Faroese Coastal Guard and all available logbooks have been available. For comparison the same ships were selected as used previously in the WG.

A general linear model (GLM) was used to standardize all the CPUE (kg/h) series for the commercial fleet where the independent variables were the following: vessel (actually the pair ID for the pair trawlers, otterboard trawlers or longliners), month (Jan-Apr, May-Aug, Sep-Dec), fishing area (Vb1, Vb2) and year. The dependent variable was the log-transformed kg per hour measure for each trawl haul/setting, which was back-transformed prior to use. The reason for this selection of hauls was to try to get a series that represents changes in stock abundance.

The mean lengths in the landings of the trawlers varied from 88 to 103 cm in the period 1989-2014. There were no length measurements from the landings in 2004, 2012 and 2013. There was no decreasing trend in mean lengths with year (Figure 2). The main length group in the catches from 2001- present was from 80 to 110 cm. There was also a few length samples available from gillnet and longline fisheries. There are only 120 aged blue ling from the commercial catch in 1998, but there exists otoliths that are not aged read (Table 2).

The standardized commercial CPUE from deepwater trawlers was of hauls where blue ling was more than 30% of the total catch. The CPUE for 2009-2010 are at the same level as average CPUE for the whole period, while 2011 was above average, 2012 at average and 2013-2014 above average (Figure 3, Table 3). Distribution of the blue ling fishery, where the trawl hauls contained more than 30% blue ling, was mainly in the Faroe Bank area southwest of the

Faroe Plateau (Appendix 1). Around 70% of the hauls with more than 30% blue ling were done in the month March-May.

Blue ling has mainly been fished by the large trawlers >1000 HK (75% in 2010), and the rest is taken by the longliners. In 2011 blue ling catches were divided evenly between the large trawlers and the longliners and in 2012 about 66% was taken by longliners and 27% by trawlers. Only a minor part is taken in the gillnet fishery for Greenland halibut, as bycatch.

Table 2. Blue ling Vb. Samples from landings in the period 1980-2014

year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
length	308	326	188	113	1004	602	1043			757	1348	2003	1625	1601	1161	1295	1578	339	1053	850
gutted weight																			59	
age																			120	
otoliths	40	44	70			62	190	533	264	92	299			277						

year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
length	160	1881	633	428		202	187	625	285	371	520	412			202
gutted weight	25	120						68							
age	25	120													
otoliths															

Table 3. Blue ling Vb. Unstandardized and standardized CPUE from commercial trawlers. N is number of hauls with more than 30% blue ling in catch.

	Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Unstandardized	Mean	310	303	292	189	197	276	284	324	774	738	727	399
	se	49	11	13	7	8	16	10	13	56	42	42	33
Standardized	Mean	205	253	235	168	162	233	257	279	510	488	469	255
	se	6	4	3	3	3	5	4	4	6	7	7	7
	N	56	433	388	255	318	163	182	264	326	299	373	258

	Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Unstandardized	Mean	320	219	326	291	310	316	146	242	317	198	563	396
	se	16	9	15	10	18	24	7	11	18	10	59	21
Standardized	Mean	243	183	221	233	203	196	122	179	267	182	454	334
	se	3	3	3	4	3	4	2	3	6	4	25	3
	N	714	474	596	562	540	255	202	511	108	78	45	167

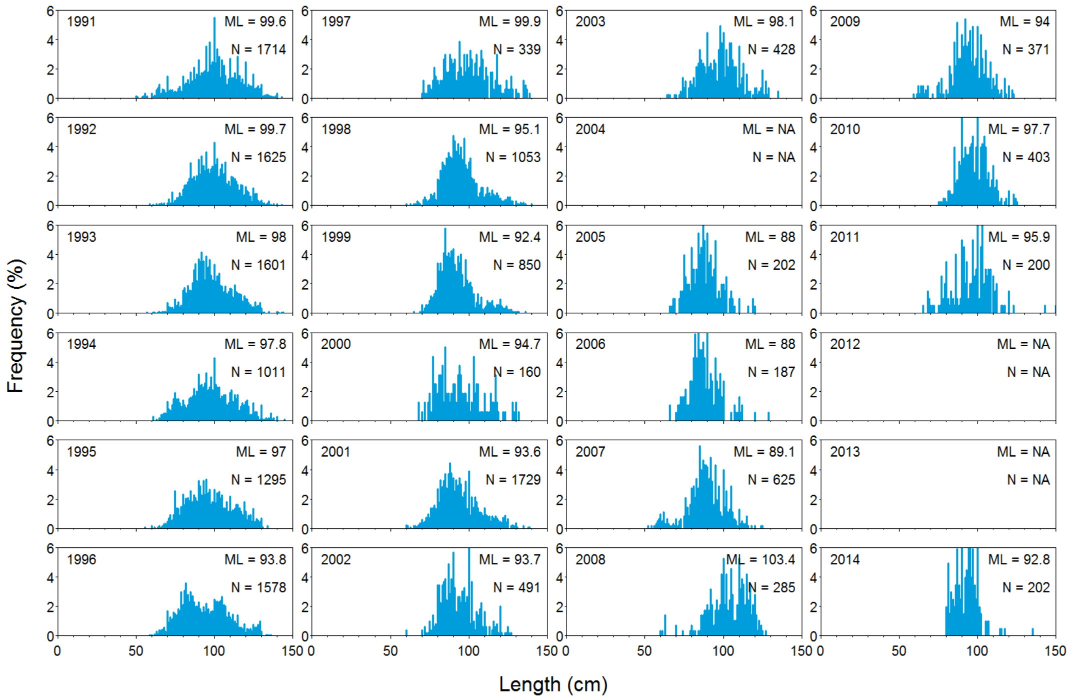


Figure 2. Blue ling Vb. Length distribution from commercial trawlers (no data for 2004, 2012 and 2013).

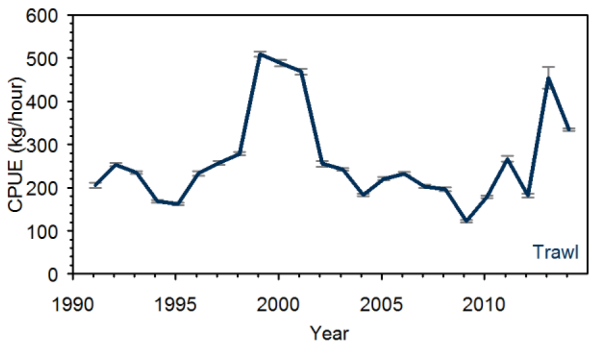


Figure 3. Blue ling Vb. Standardized CPUE for trawlers (>1000 HP) fishing in Faroese waters. Criteria: >30% blue ling in the catch.

Surveys

The Faroese groundfish surveys are mainly targeting cod, haddock and saithe. The survey has fixed stations. The shallowest are at about 60-70 m depth and the deepest at about 510 m. The stations are distributed in fixed strata; each stratum placed after the 100, 200 and 500 m depth contours (Figure 4). The spring survey in February/March has 100 stations (1994-present) and the summer survey in August has 200 stations (1996-present). Subsamples are taken of all the caught fish; minimum the lengths and partly also round weights.

The abundance indices from groundfish surveys (kg/hour) are standardized according to number of stations in each stratum and weighted with strata area for all the different strata.

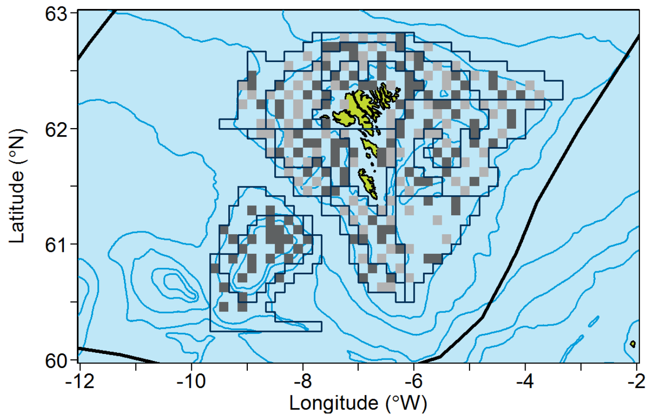


Figure 4. Overview of the trawl stations and stratifications in the Faroese groundfish surveys on the Faroe Plateau and Faroe Bank.

There were data on lengths and round weights of blue ling from different surveys (Table 4). There was not much data on gender, maturity and age. There exist otoliths from a blue ling “survey” for the period from 1995-2003, but the data from those trips are not in any database and the otoliths are not age read.

The mean length of blue ling from the spring and summer survey was between 53 to 80 cm (Figure 5 and 6). The length distributions from the groundfish surveys are very noisy and some lengths seem to be overestimated (especially small fish). The reason for that could be that small blue ling below commercial landing size are measured from a subsample from the total catch and thereafter multiplied up to the total catch weight. The length distribution from the deepwater survey in 2014 showed a mean length of 97 cm (Figure 7).

The number of juveniles (< 80 cm) increased in the catch in 2009-2012 in the spring survey and partly also in the summer survey, but have decreased in the last two-three years (Figure 8). The occurrence of juveniles does also show a decrease in the last two years (Figure 8).

The abundance indices (CPUE) from the groundfish surveys show a small increase in the latest years (Figure 9). The CPUE in 2013 is above mean CPUE for the whole period for both spring and summer surveys, but there was a decrease the spring survey in 2014. Maps of blue ling distribution show that the fish was caught in the deepest stations (Appendix 2 and 3).

Table 4. Blue ling Vb. Samples from the research ship in the period 1994-2014

year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
length	165	516	483	647	417	141	197	450	135	371	770	707	358	264	249	746	898	628	809	397	815
round weight	51	29	86	82	254	127	123	166	99	116	297	385	249	207	123	421	476	567	588	394	732
gender	44	83	51	28	38	20	2								2					56	235
age		29	51																		
otoliths		531	582	509	500	502	500	349	500	503										56	235

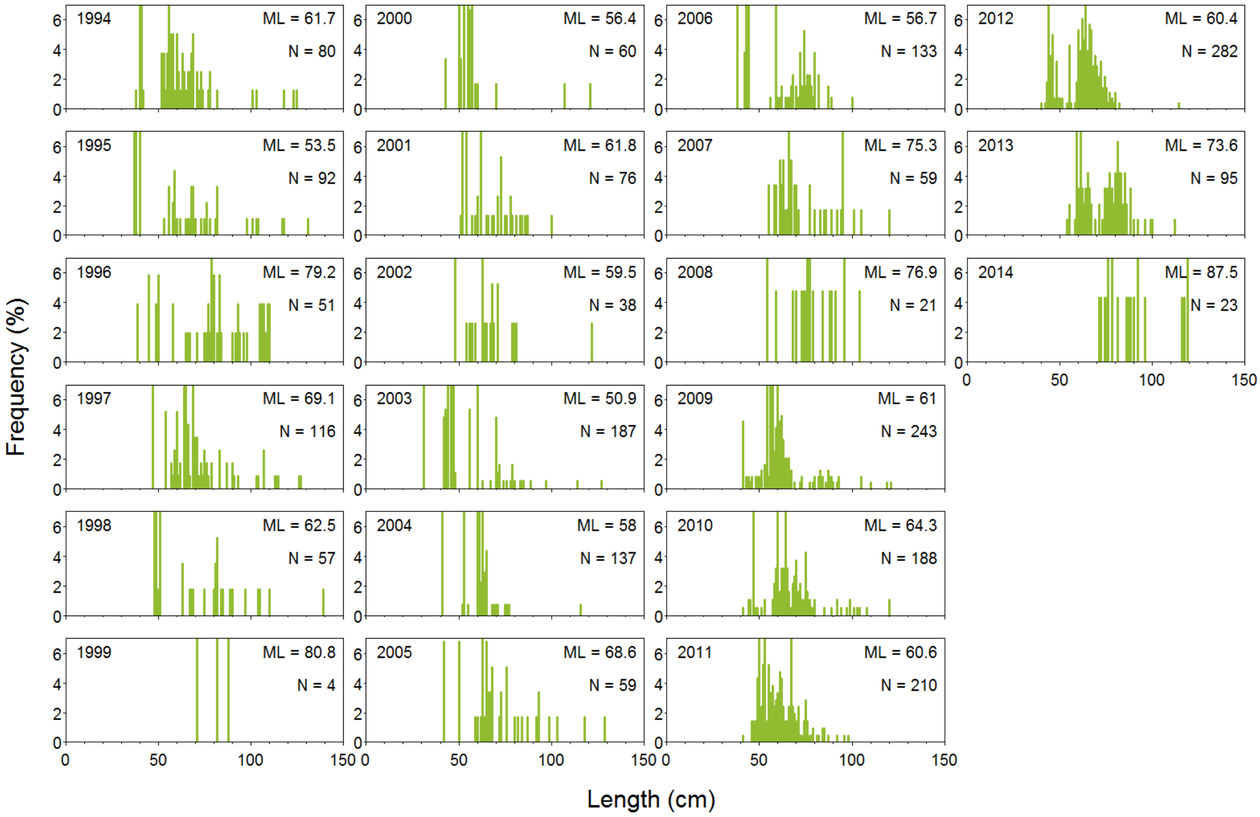


Figure 5. Blue ling Vb. Length distribution from the spring groundfish surveys.

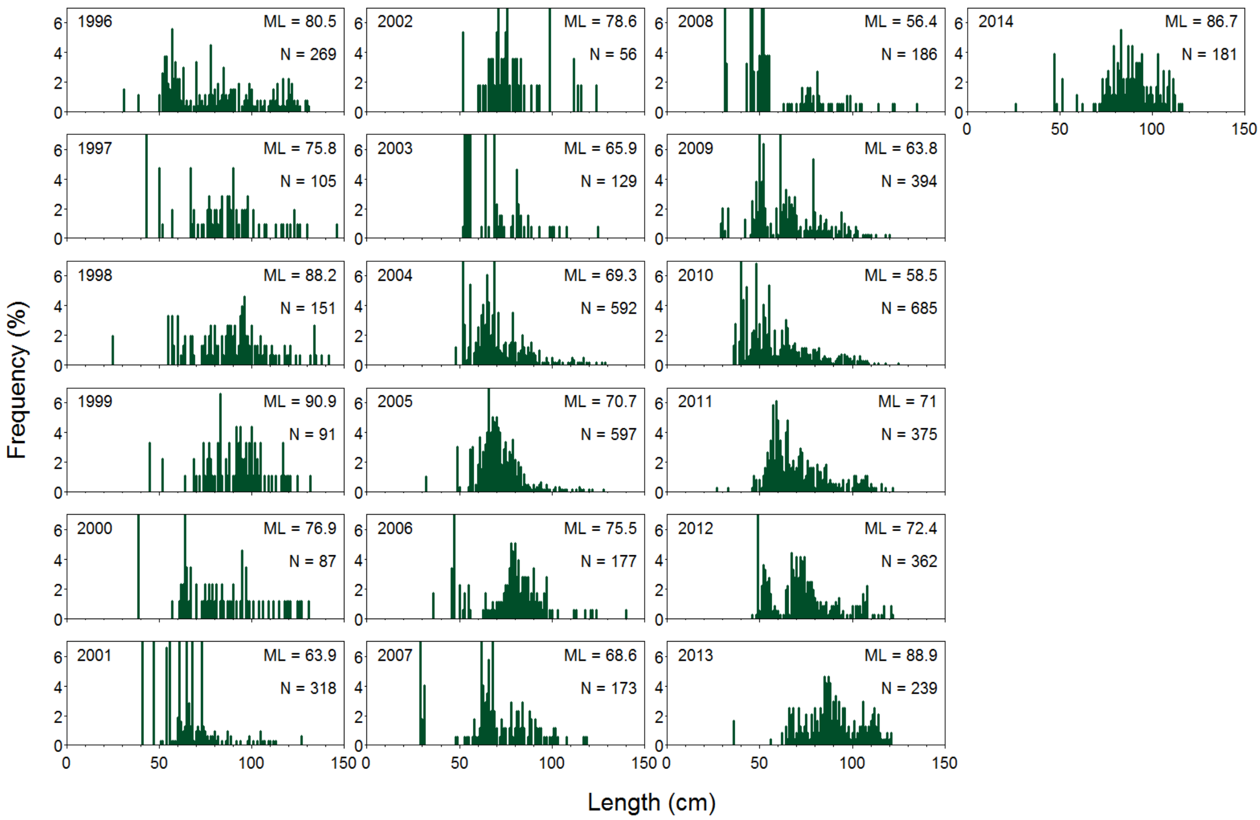


Figure 6. Blue ling Vb. Length distribution from the summer groundfish surveys.

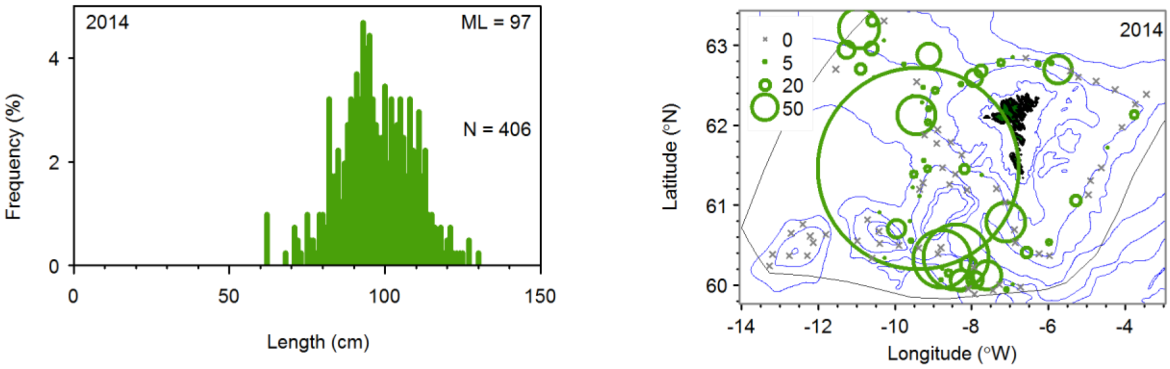


Figure 7. Blue ling Vb. Length distribution (left) and spatial distribution (right) from the deepwater survey 2014.

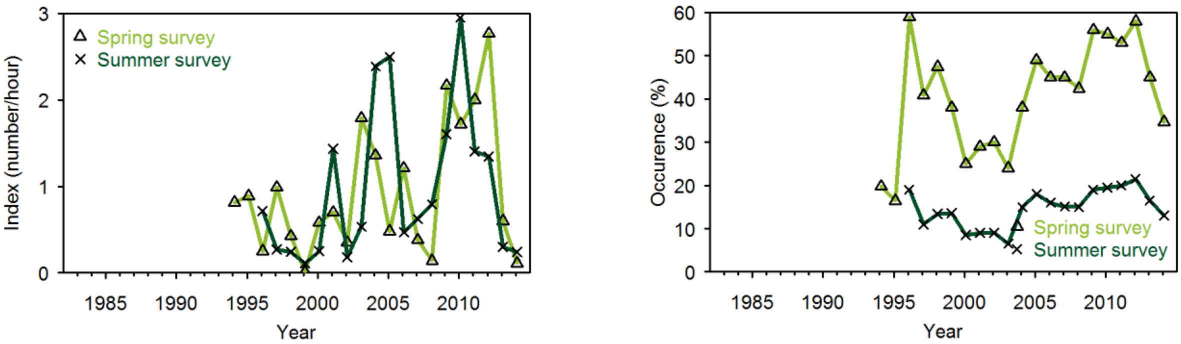


Figure 8. Blue ling Vb. Index (number/hour) of juvenile (< 80 cm) fish caught in the groundfish survey on the Faroe Plateau (left figure) and occurrence (right figure).

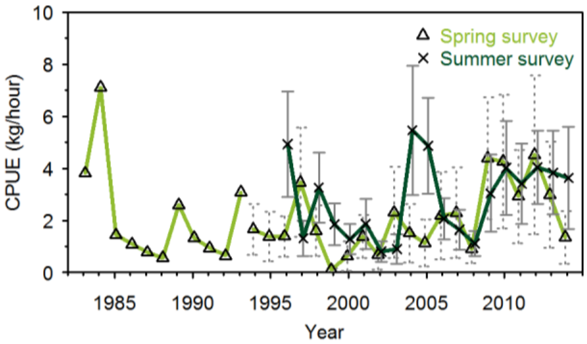
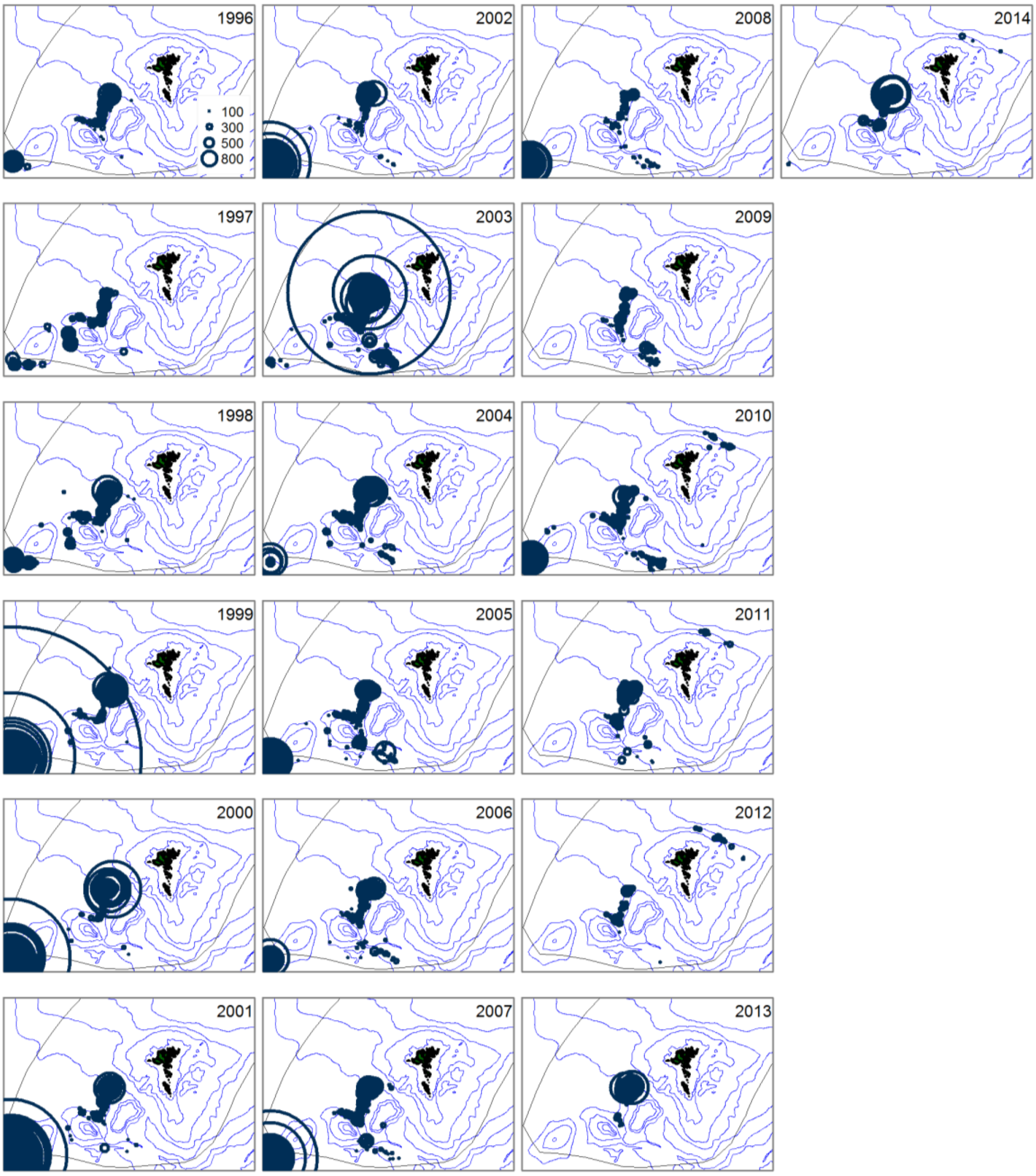
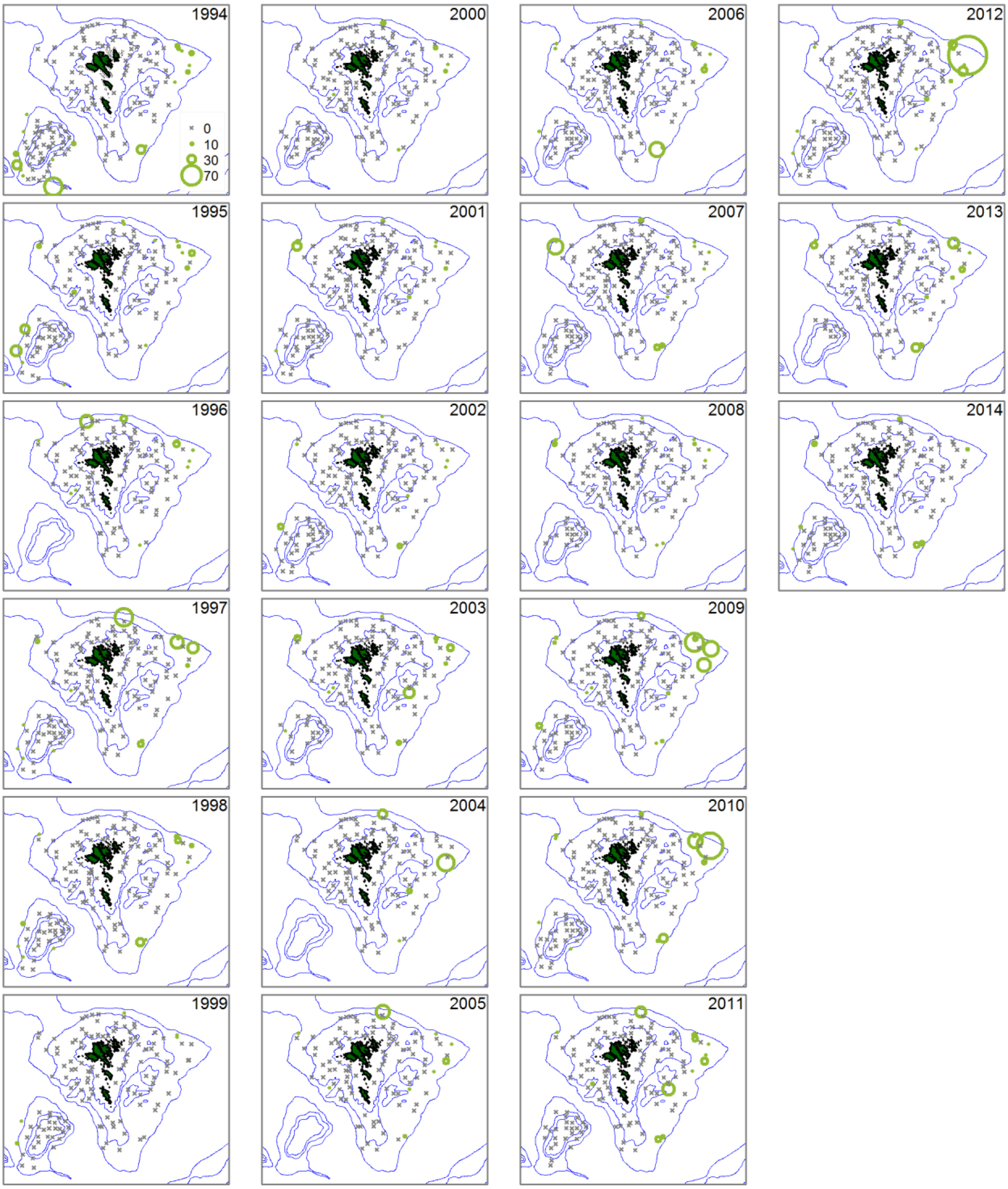


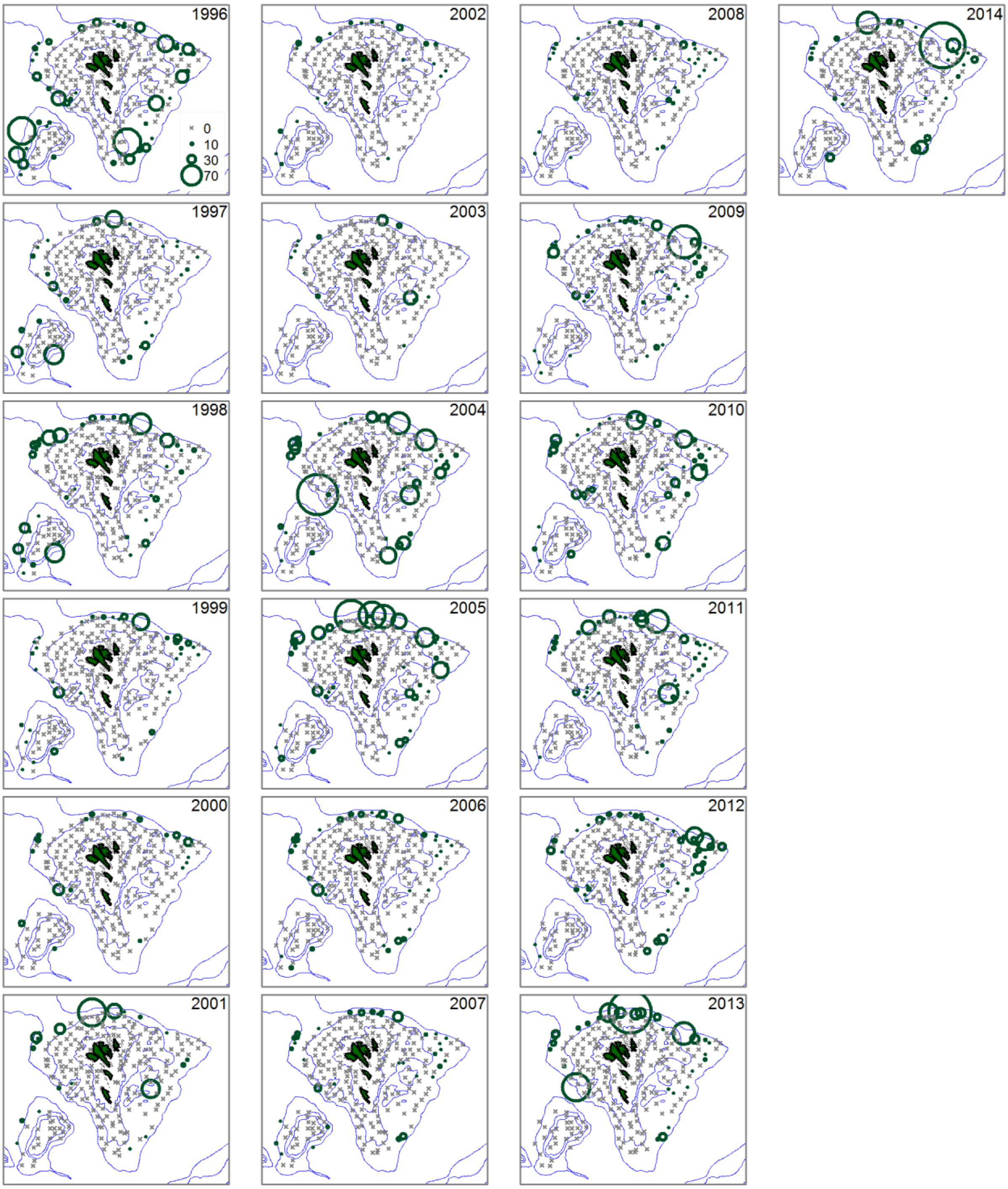
Figure 9. Blue ling Vb. CPUE from the annual spring- (1983-present) and summer (1996-present) groundfish survey on the Faroe Plateau. Data from 1994 to present are standardized.



Appendix 1. Blue ling Vb. Distribution of blue ling hauls (kg/hour) from the commercial trawl fishery. Blue ling was more than 30% of the total catch per haul. Depth contours for 100, 200, 500 and 1000 m.



Appendix 2. Blue ling Vb. Distribution and catch (kg/h) from the groundfish spring survey. Depth contours for 100, 200 and 500 m.



Appendix 3. Blue ling Vb. Distribution and catch (kg/h) from the groundfish summer surveys. Depth contours for 100, 200 and 500 m.

The ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP 2015).

Information from deep water fishery of the Azores

by

Mário Rui Pinho
João Gil Pereira

Abstract

This document resumes and updates the information of the demersal/deep-water fishery from the Azores for the 2015 ICES working group WGDEEP. A summary description of the fishery is presented including information on landings, spatial distribution of effort and catches, annual length compositions, mean lengths and mean weight in the catch for most important deep-water species.

1. Description of the Fishery

The Azores deep-water fishery is a multispecies and multigear fishery (Pinho and Menezes, 2005, 2009). About 70 demersal species are landing in the Azores, from which around 24 are classified as deep-water representing their landings about 2500 tons in weight and around 12 million Euros in value at the first sale on the auctions (Fig. 1). The dynamic of the fishery seems to be dominated by the main target species *Pagellus bogaraveo*. However, others commercially important species are also caught (*Beryx sp, Poliprion americanus* and *Helicollenus dactylopterus*) and the target species seems to change seasonally according abundance, species vulnerability and market (Pinho, 2003; Menezes et al, 2006; Pinho et al, 2014; Diogo et al 2015). The fishery is clearly a typical small scale one, where the small vessels (<12m; 90% of the total fleet) predominate, using mainly traditional bottom longline and several types of hand lines. The ecosystem is a seamount type with fishing operations occurring in all available areas, from the islands coasts to the seamounts within the Azorean EEZ (Fig. 2). Few seamounts are explored outside the EEZ, being the most frequently visited those at south on CECAF areas (see Fig. 2). The fishery takes place at depths until 1000 m, catching species from different assemblages, with a mode on the 200-700 m strata, the intermediate strata (slope) where the most commercially important species occur (Fig 2, 3).

Since the nineties the landings of most of the commercially important species start to decrease (Table 1, Fig. 4 and 5). This may be a result of intensive fishing as a consequence of the development or entry of new and more technological vessels to the fishing, increasing the catchability (Diogo et al, 2015). Notably, the target species of the fishery, *Pagellus bogaraveo* seems to be the more resilient with landings starting to decrease a decade later (see Fig. 3 and 6). To avoid species overexploitation some technical measures were introduced by the regional government since 1998 (including fishing restrictions by area, vessel type and gear, fishing licence based on landing threshold and minimum lengths). Under the E. C. Common Fisheries Policy, TAC's where introduced for some species, namely blackspot seabream, black scabbardfish, alfonsinos, and deep-water sharks (Table 2). As an attempt to increase the exploitation of the deeper strata (>700m) and to reduce effort on traditional stocks, new fisheries have been encouraged in recent years, but the market conditions have limited the expansion of the fishery. A fishery targeting black scabardfish has been developing during the recent years with some vessels licensed for this deep-water species (Table 1, Fig. 5). However the fishery has been developed by pulses because the inter annual variability of the abundance and low market prices.

Since 2002, the use of bottom longline in the coastal areas has significantly been reduced, since the local authorities have banned the use of this gear in the coastal areas on a range of 3 miles. This box has been extended to the majority of the islands coastal to the 6 miles. As a consequence, the smaller boats that operate in this area have changed their gears to several

types of handlines, which may have increased the pressure on some species included the red seabream. The deep water bottom longline is actually a seamount fishery. Also in one other fleet component, the medium size boats, ranging from 12 to 16 meters, a change from bottom longline to hand lines has been observed during the last 10 years. Longline vessels less than 24m cannot operate at areas less than 30nm of the coast. As a consequence the fishery expanded to offshore seamounts areas, with high concentration on the seamounts along the Mid Atlantic Ridge, including small vessels, targeting mainly red blackspot seabream (*Pagellus bogaraveo*), bluemouth (*Helicolenus dactylopterus*), alfonsinos (Beryx, sp.) and wreckfish (*Polyprion americanus)* (Fig. 2 and 3) (see Diogo et al, 2015).
All this changes in the fishing pattern of the fleet may explain the changes in the landings of some species that were more vulnerable to the use of bottom longlines (Table 1, Fig. 5).
An important issue is the effect of the management measures on the the dynamic of the fishery. The alfonsinos fishery for example has a fishing season shorter and shorter during each year due to target effect mainly from the offshore fishery.

2. Landings

Total landings in weight of deep-water species increase until 1994, decreasing thereafter with an abrupt decrease in 1999 due to the decrease observed on the silver scabbard fish (*Lepidopus caudatus*) (Fig 1). Landings in value increase until 2008 and decrease thereafter. The landings of the major deep-water species caught by the Azores fleet, for the period 1980 to 2013, are resumed in Table 1 and Figures 5 and 6. The fishery has expanded to more offshore areas, with high effort on the seamounts along the Mid Atlantic Ridge (Fig. 2, 3). This area expansion is a consequence of the decrease on the abundance observed for almost all the demersal/deep water species in the coastal and nearby areas since 1994 (Fig. 4 and 5) except for seabream (*Pagellus bogaraveo*) that start declining in 2005 (Fig. 5 and 6).

Disaggregated landing data by vessel is available since 1985. Information by gear type and effort data are collected by shore based samplers that inquire the fishing masters during the landings operations. The present reported annual catches in weight include only the official landings collected in the Azorean port auctions, since the discards and the frozen or transformed fish are not quantified on the landings.

The present accepted definition of “deep-water species” presents some conflicts with the case of the Azores fishery, since the local ecosystem is a natural deep-water one, the dynamics of some species covers both strata, shallow and deep, and literally all the Azorean fleet can be considered as a deep-water fishery. However, landings of some deep-water species as defined by ICES (Annex I species, EC Reg. 2347/2002) represents actually a minor fraction of total demersal landings because the exploitation of these species is not economical profitable under the actual framework of a small scale fishery (see Table 1).

Historical landing of *Pagellus bogaraveo* is presented on Fig. 6. Landings of this species show a decrease trend since 2005, with a very significant reduction during the last four years being actually at the 663ton corresponding about 69% of the 2013 TAC (Table 2). This result may be a consequence of possible depletion of most seamounts areas. Landings by commercial categories suggest also a decrease of large (adult) individual and an increase of small (immature) individuals (Fig.7).

3. Discards

Discards data were analysed for the period 2004-2011 for the bottom demersal/deep-water metier using DCF data. There is no new information, however, the same level of discards are expected because there is no significant change on the exploitation pattern of the fleets.

4. Length compositions

Annual length compositions of some selected species are resumed on Fig.8-18. Annual mean length and mean weight in the catch for the most important species are presented at the Fig. 19 and 20 respectively. No specific trends are observed on the length compositions with interanual variability associated with the annual abundance variability or species target effects.

For *Pagellus bogaraveo* two modes are indentified in the landings in 1990 with the first mode at 25 cm (pre adults) and a second at 35cm (spawning stock) (Fig. 8). The first mode is more or less consistent along time, except in 1992 (suggesting a recruitment failing) due probably to sampling problems, and moving slowly to 27-30cm due to management measures (minimum size). The annual variability of the second mode is much more difficult to explain, being more evident during 1990, 1999, 2000 and 2005, corresponding to the years for which much more large fish were caught. Mean length on the landings seems to be stable around 30cm (or with a slow increasing trend due to management measures introduced such as minimum size) (Fig. 19). Same trend is observed on the mean weight in the catch (Fig 20). However, while mean length of immature fish presents an increase trend along time, the mature females mean length show a decrease trend (Fig. 21). This trend is also observed on the landings by commercial categories (Fig. 7).

For *Helicolenus decadactylus* a trimodal distribution is observed on the early years with modes on 21cm, 29cm and 37cm approximately (Fig. 14). The last mode almost disappears from the landings along time, particularly after 2005. Large number of small fish was caught between 1999 and 2001. Mean length on the landings presents a decrease trend until 2003 and an increase thereafter, most probably due to management measures effect (Fig 19). Same trend is observed on the mean weight in the catch (Fig 20). Mean length of immature fish presents an increase trend along time but with high interanual variability and the mature mean length show a decrease trend (Fig. 22).

For the other species length composition analysis is more difficult due to annual abundance variability, target effects, management measures effects and sampling resolution. Mean length and mean weight in the catch for most target species present a decrease trend while for the other non target species present a stable or an increase trend (Fig 19 and 20).

5. Fishery abundance index

Standardized fishery abundance index is available for *Pagellus bogaraveo* until 2010 and was not updated. Nominal cpue was updated until 2013. It follows similar trend of standardized cpue since it corresponds to a longline métier, which is itself a more homogeneous fleet. A significant decrease is observed on the cpue of this species since 2005 (Fig. 23). This decrease is in according with the trend observed on survey abundance index and landings and may suggest overexploitation of the resource.

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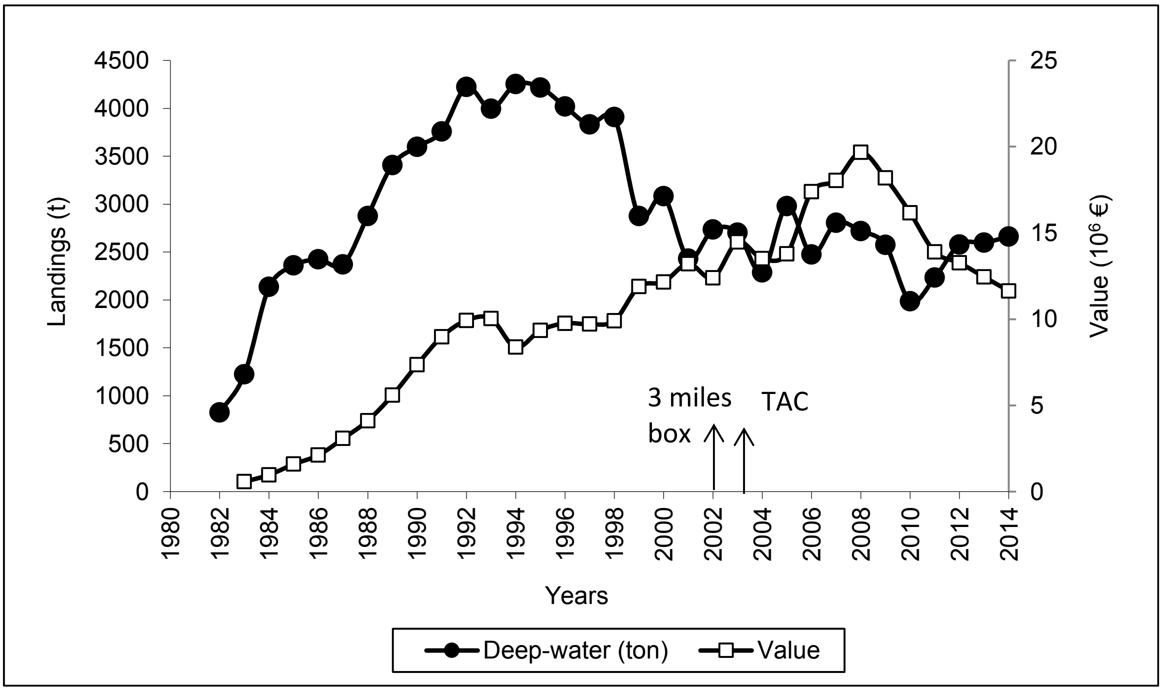


Figure 1. Total landings, in weight and value, of deep-water species from Azores. Important historical management events are also shown on the graph.

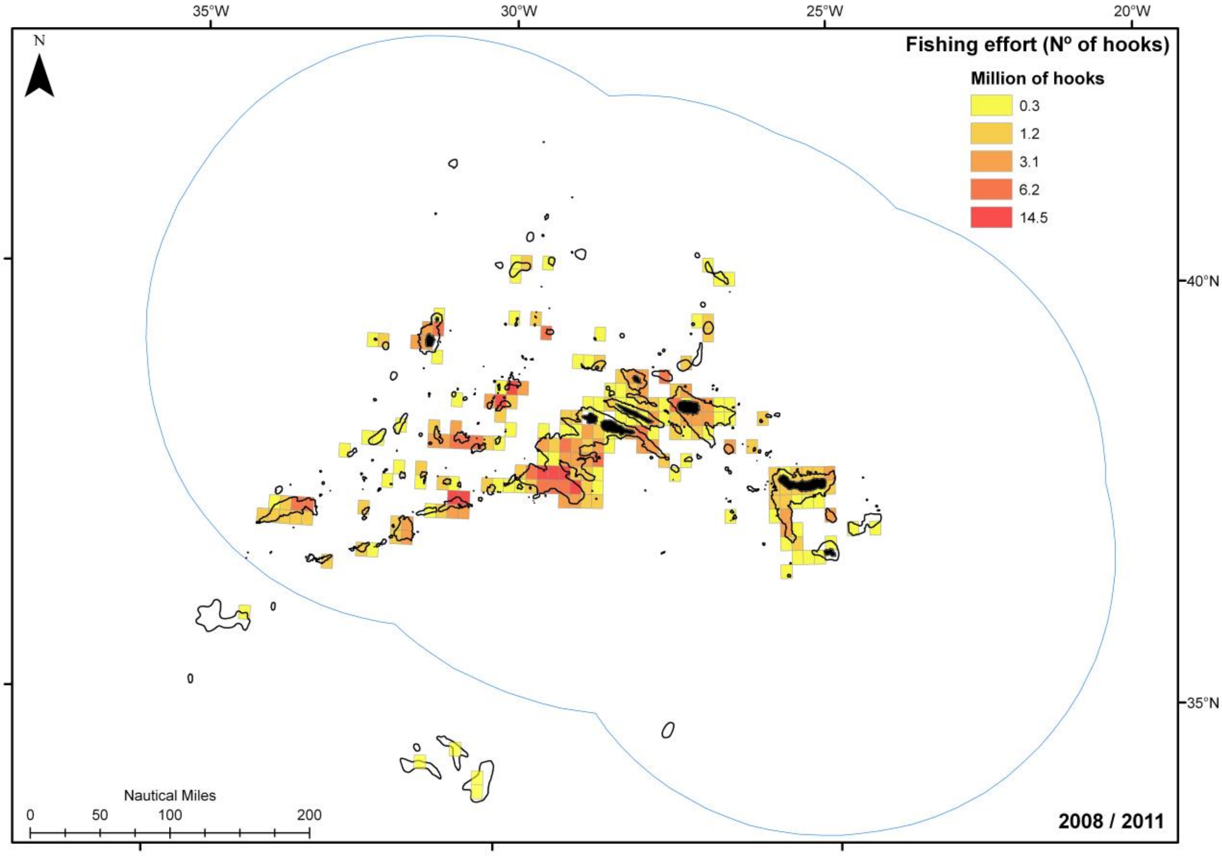


Figure 2. Fishing effort of demersal/deep-water species by area from the Azorean fishery (ICES Xa2) for the period 2008-2013. Black (islands); Colors represents the proportional fishing effort (habitat until 700m depth); Blue line (EEZ).

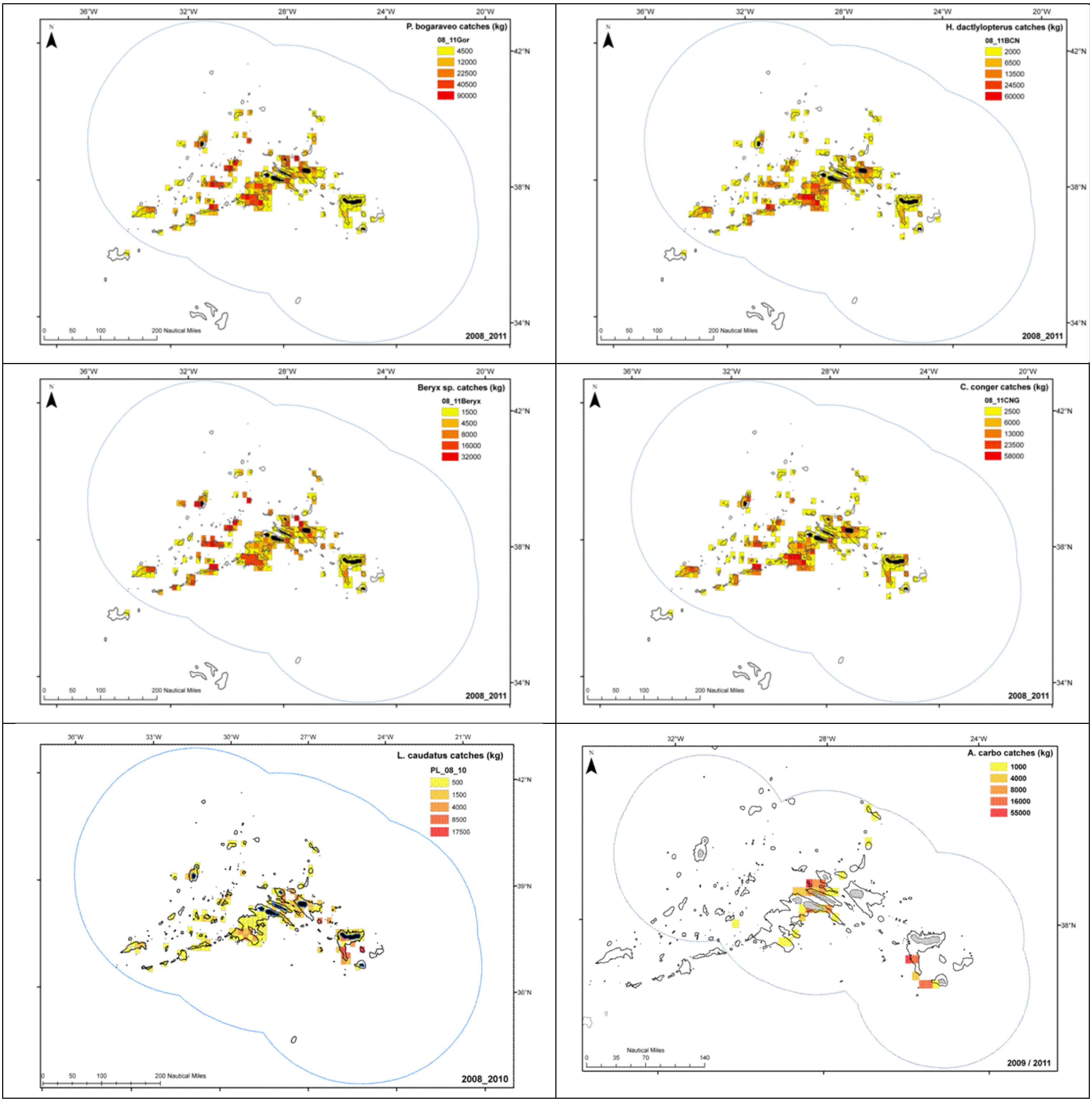


Figure 3. Cumulative catches for selected demersal/deep-water species by area from the Azorean fisheries (ICES Xa2) for the period 2008-2011. Grey (islands); Colors represents the level of catches intensity (habitat until 700m depth); Blue box (EEZ).

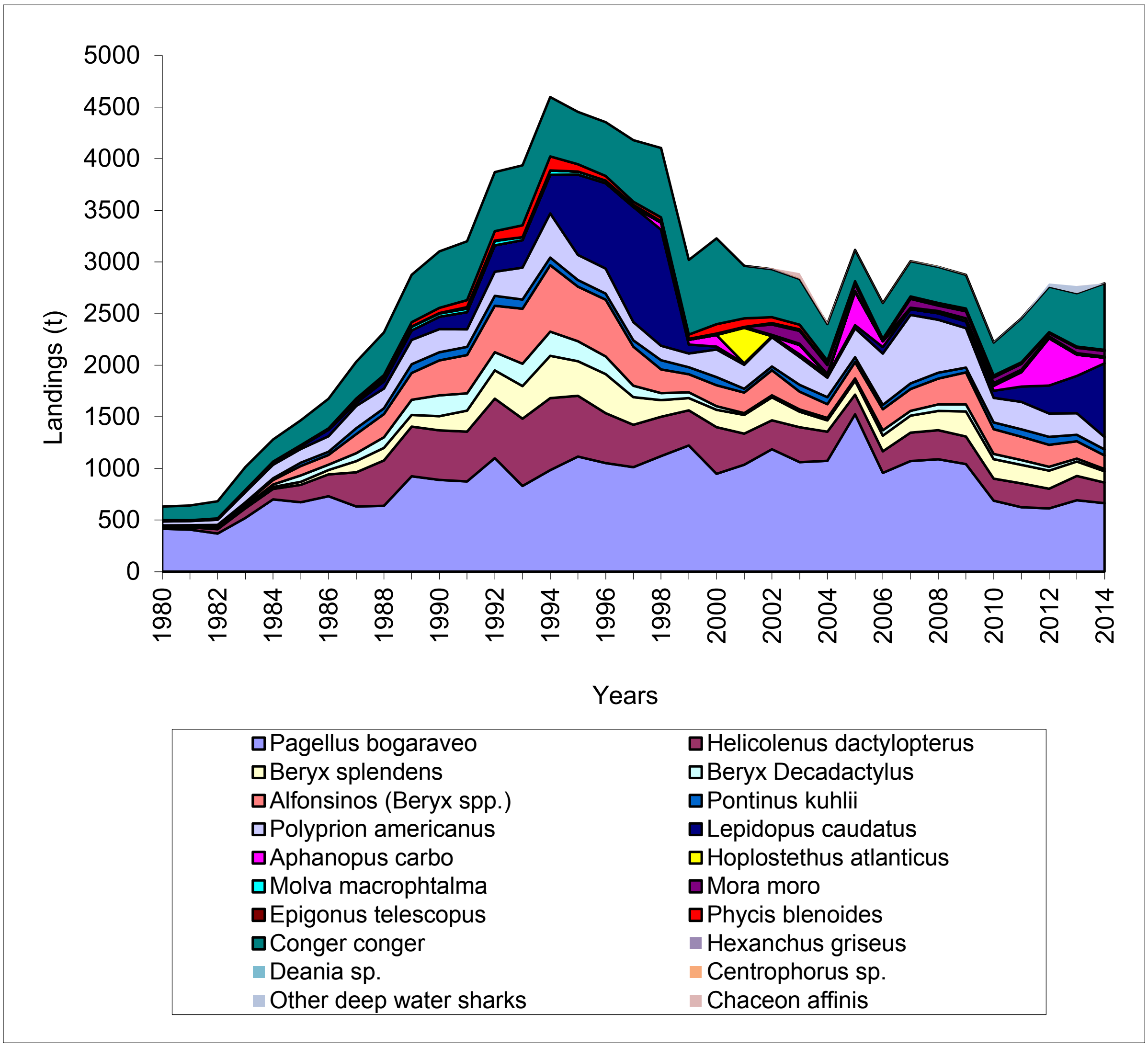


Figure 4. Overview of the deep-water species landings from the Azores (ICES Xa2).

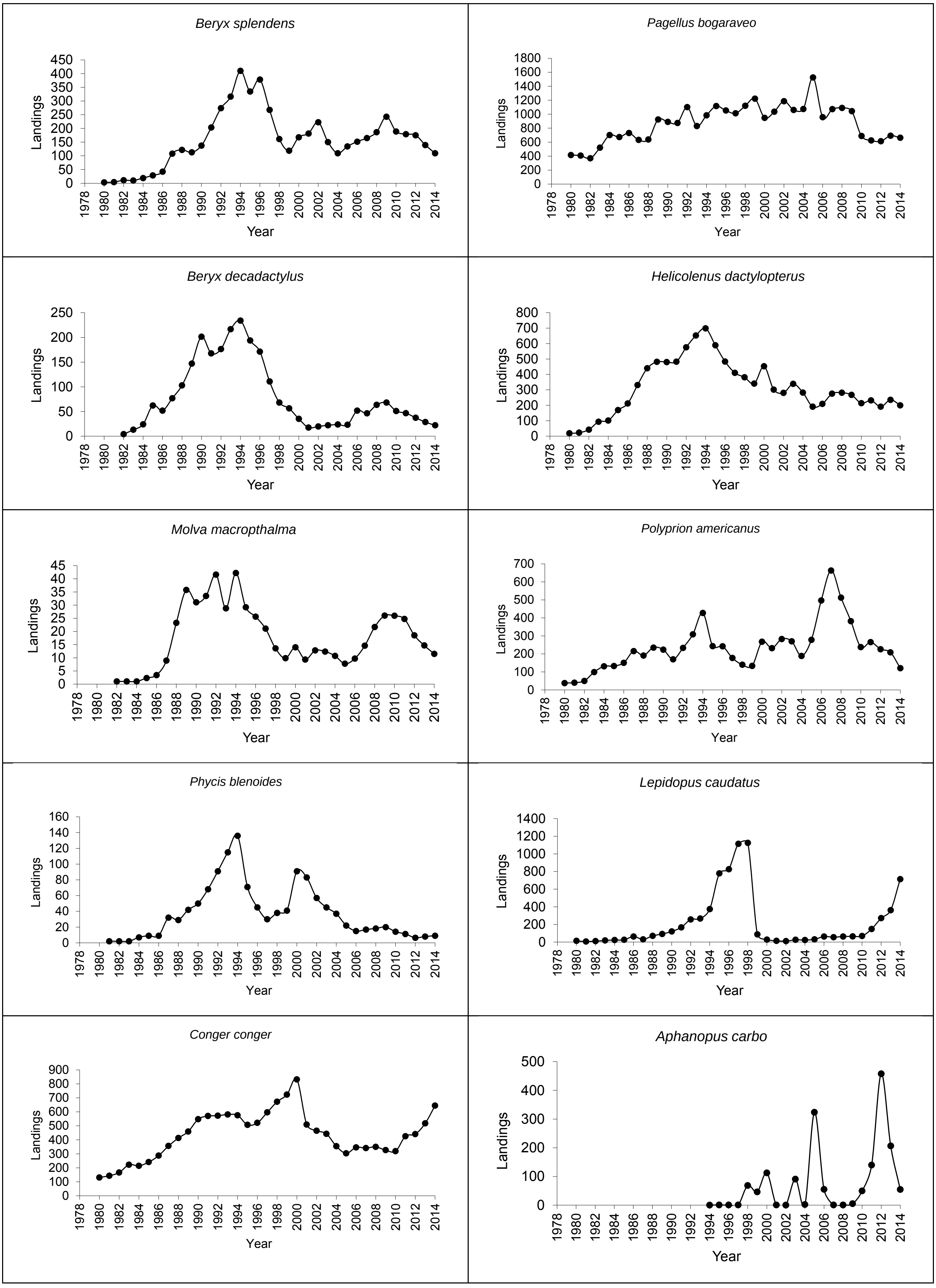


Figure 5. Annual landings of major demersal/deep-water species of the Azores (1980-2014).

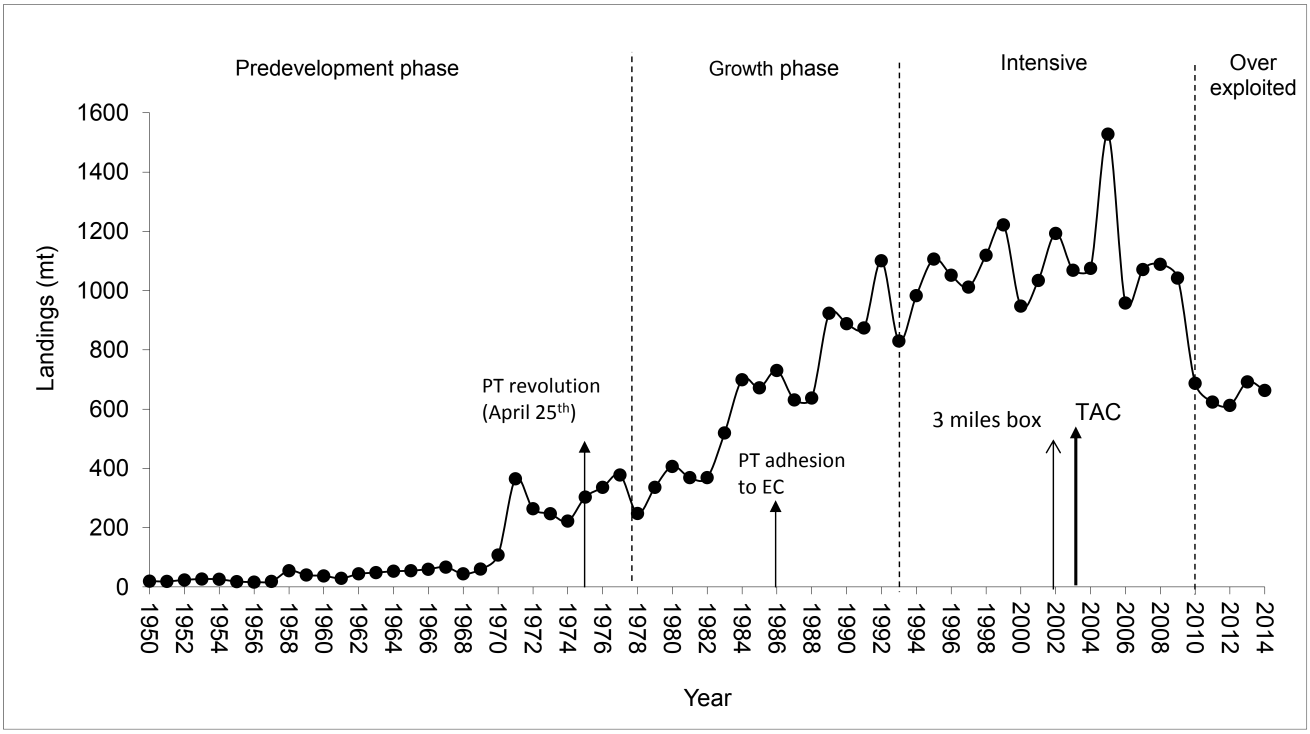


Figure 6. Historical development of the Azorean red (blackspot) seabream (*Pagellus bogaraveo*) fishery (ICES, X). Important events and management measures are represented on the graph.

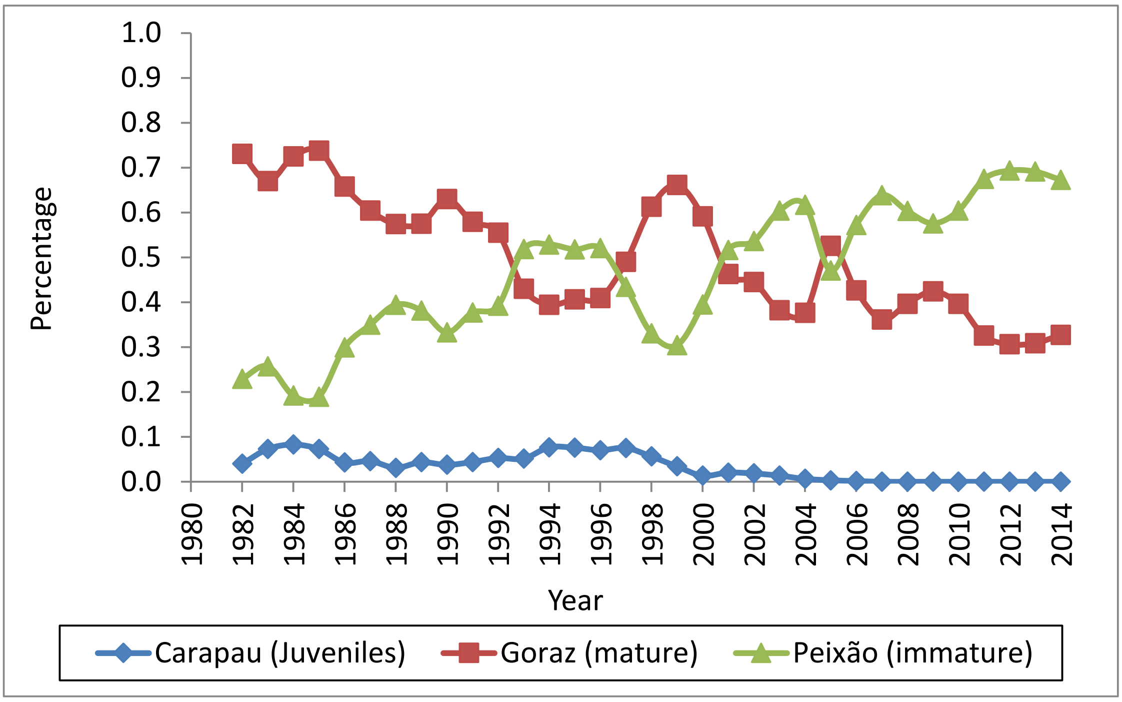


Figure 7. Landings of *Pagellus bogaraveo* from the Azores by commercial categories.

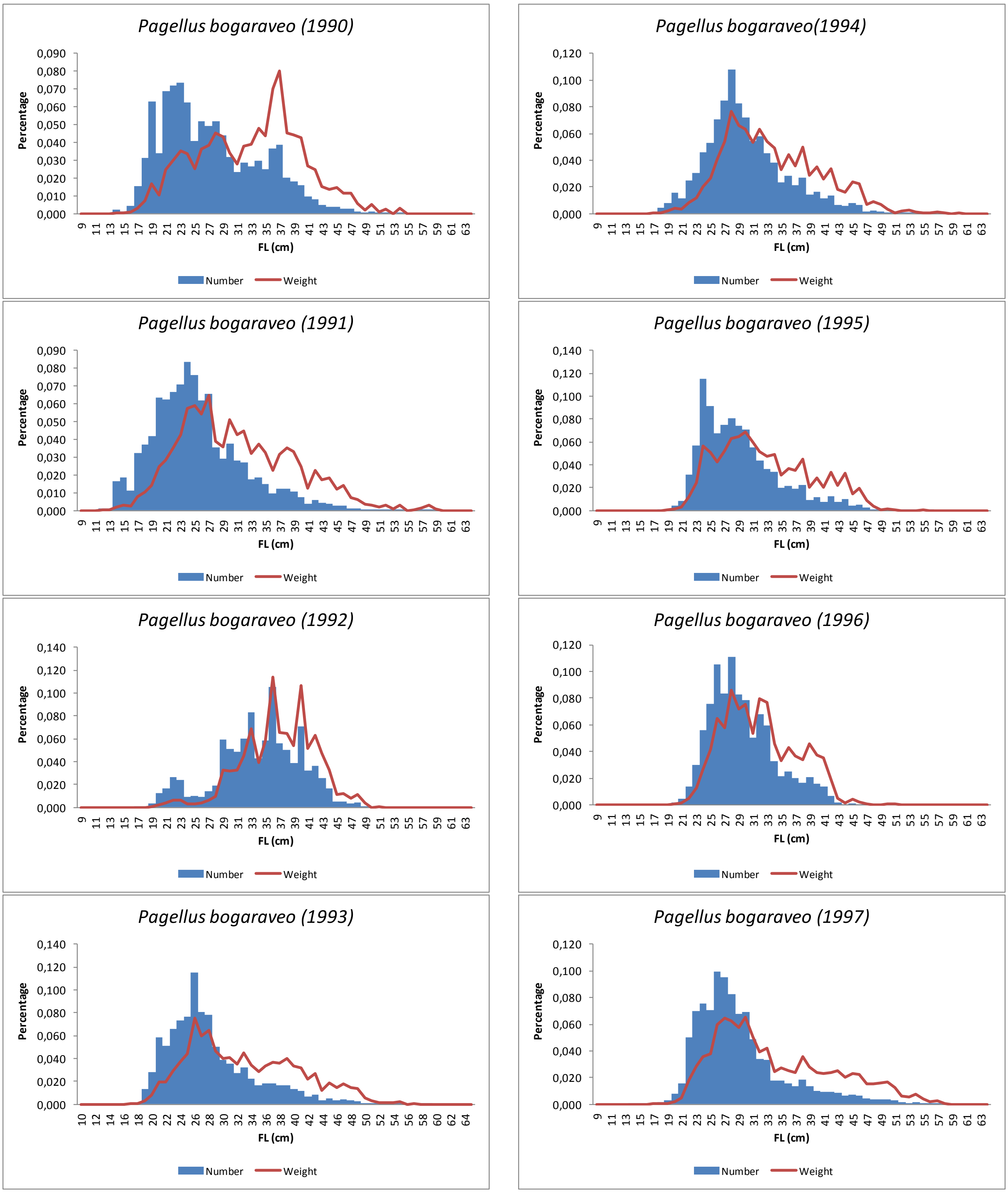


Figure 8. Length composition, in number and weight, of *Pagellus bogaraveo* from the Azores landings (1990-1997).

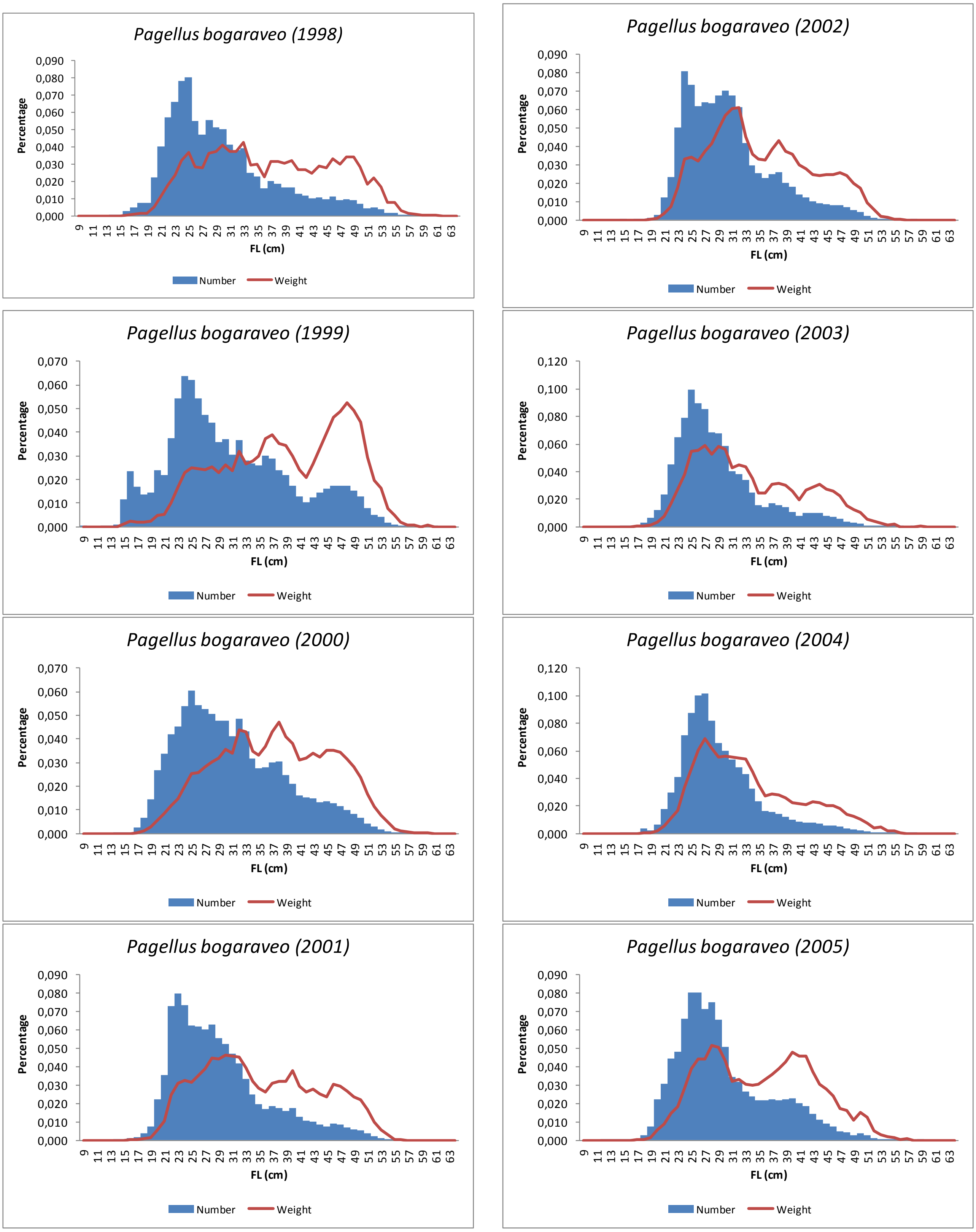


Figure 8 (Cont.). Length composition, in number and weight, of *Pagellus bogaraveo* from the Azores landings (1998-2005).

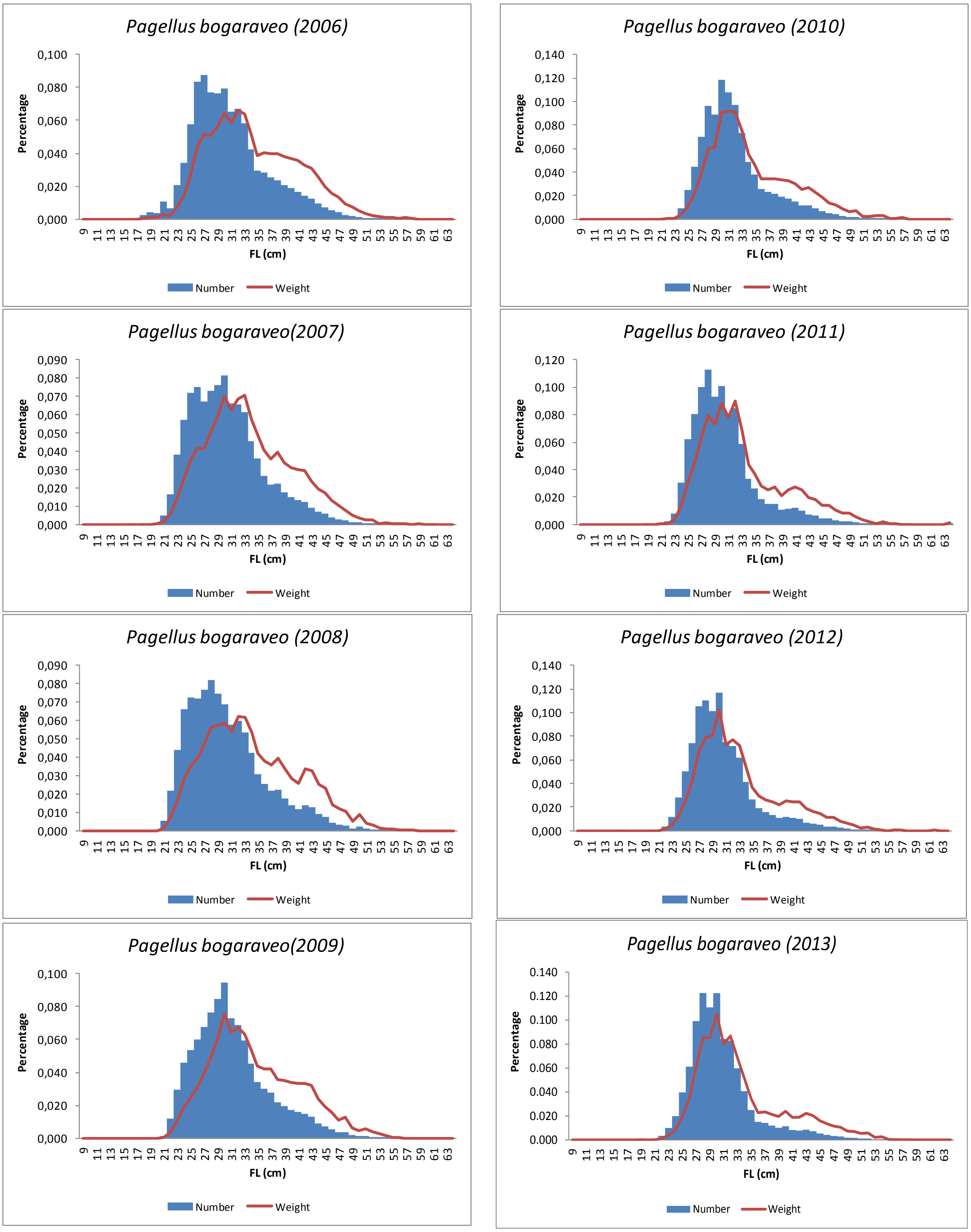


Figure 8 (cont). Length composition, in number and weight, of *Pagellus bogaraveo* from the Azores landings (2006-2013).

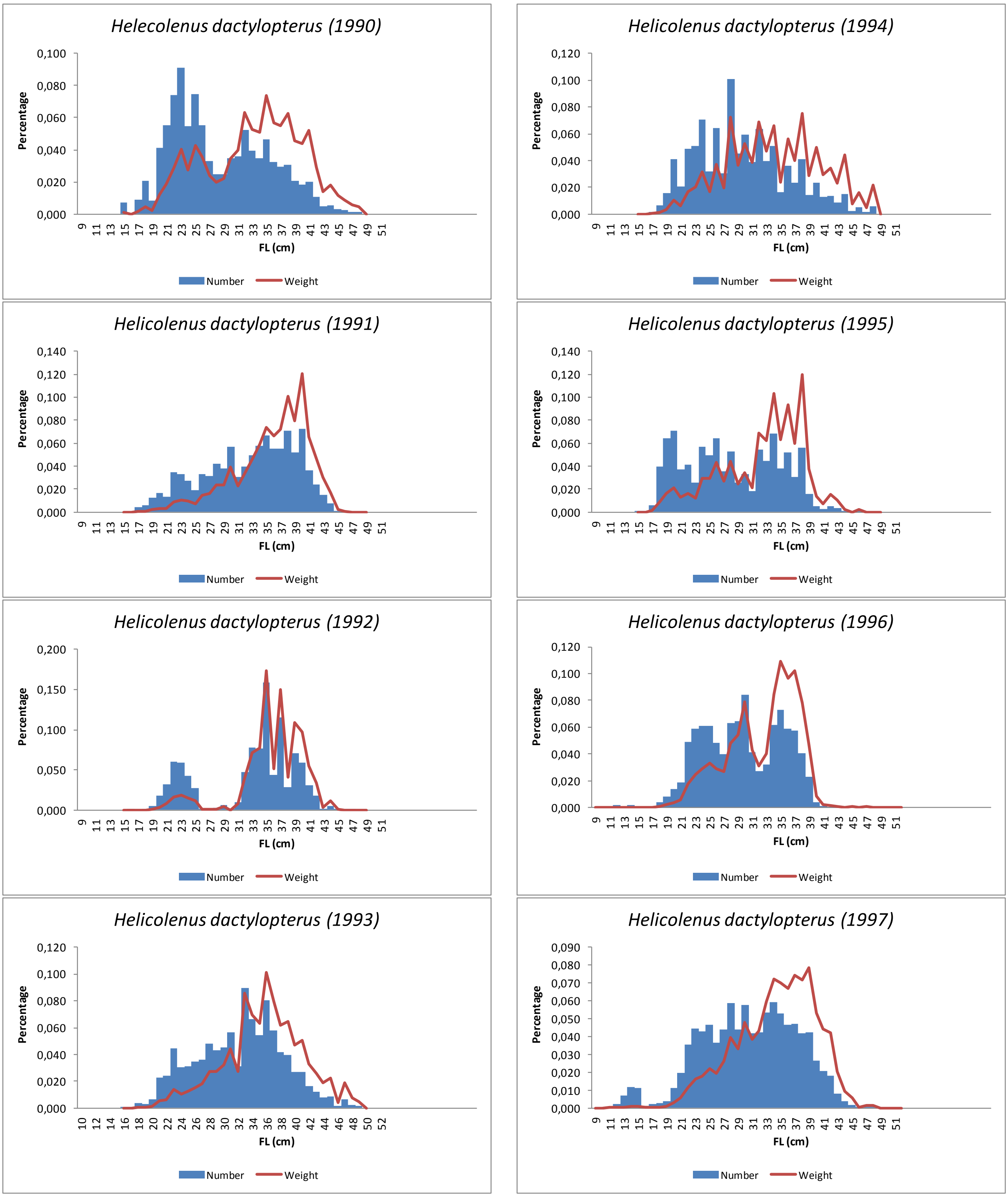


Figure 9. Length composition, in number and weight, of Bluemouth rockfish (*Helicolenus dactylopterus*) from the Azores landings for the period 1990-1997.

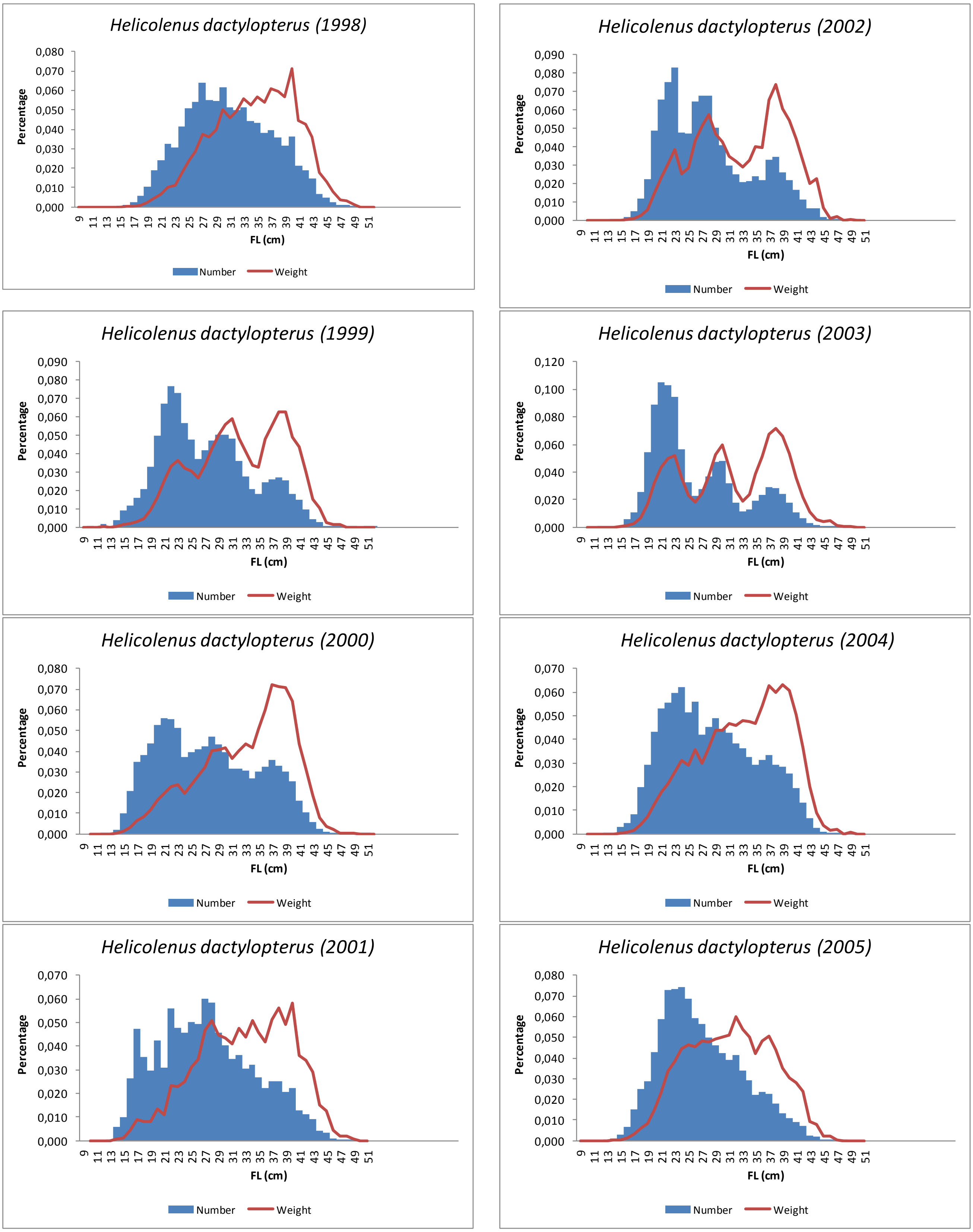


Figure 9 (cont.). Length composition, in number and weight, of Bluemouth rockfish (*Helicolenus dactylopterus*) from the Azores landings for the period 1998-2005.

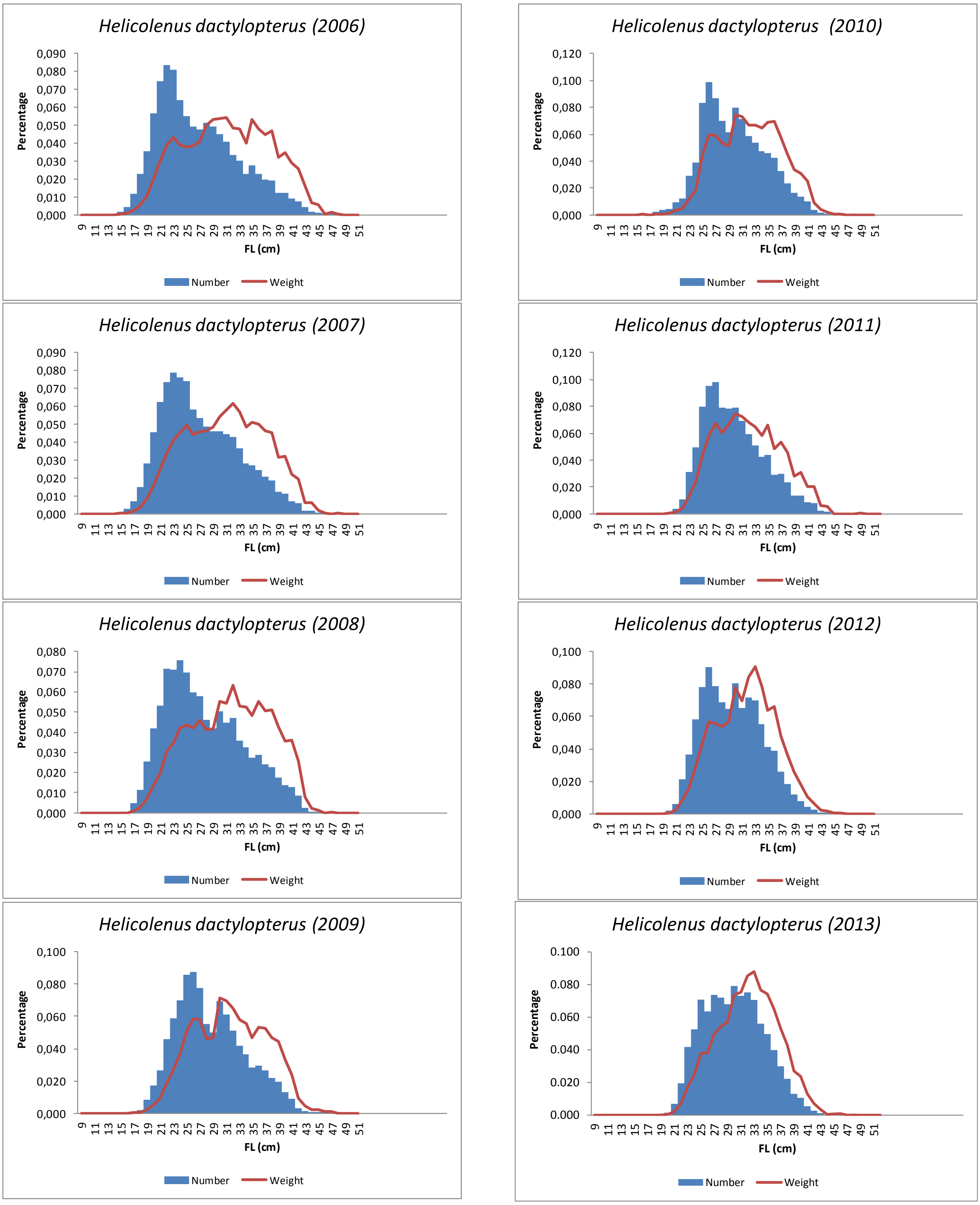


Figure 9 (cont.). Length composition, in number and weight, of Bluemouth rockfish (*Helicolenus dactylopterus*) from the Azores landings for the period 2006-2013.

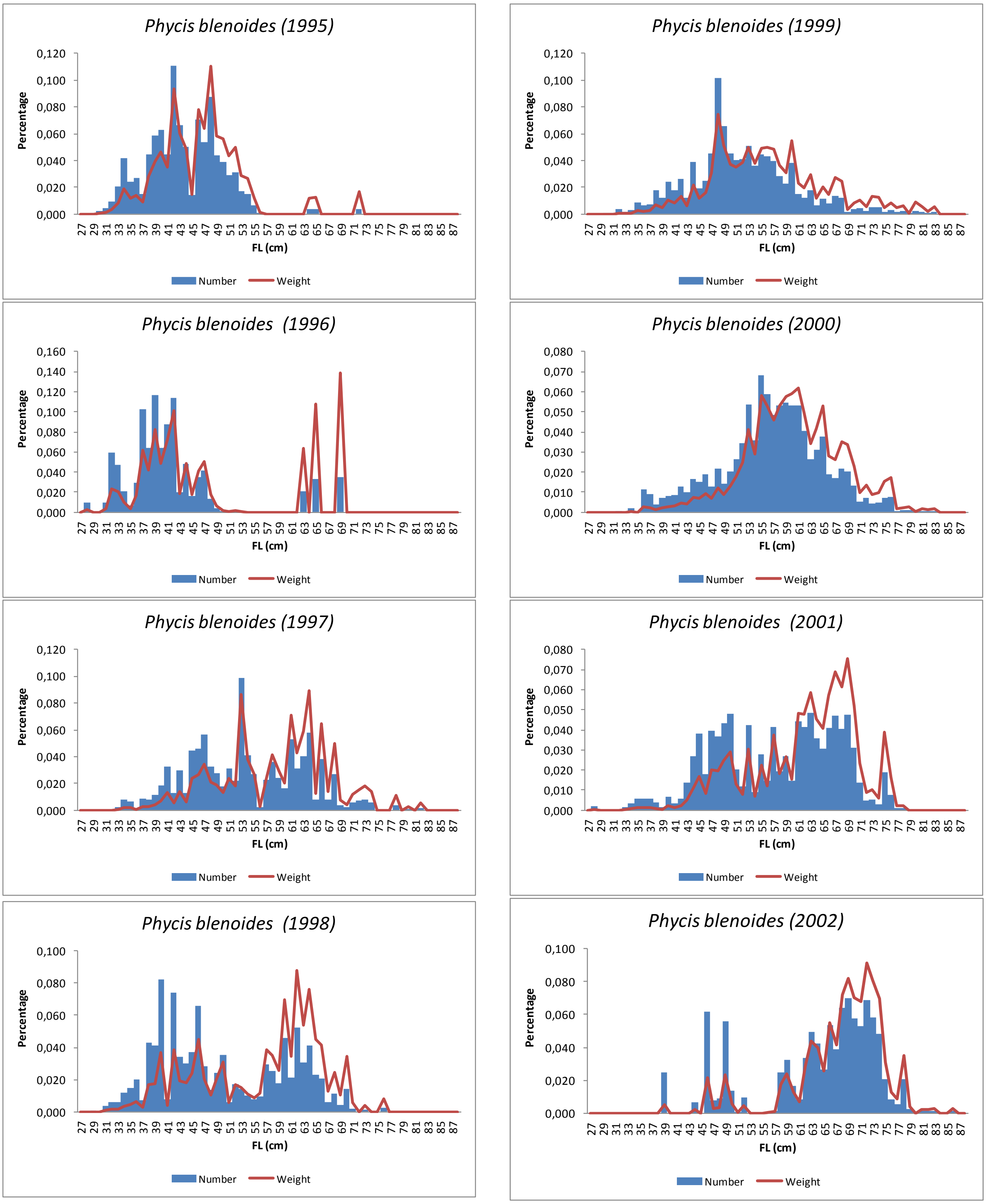


Figure 10. Length composition, in number and weight, of *Phycis blenoides* from the Azores landinga (1995-2002).

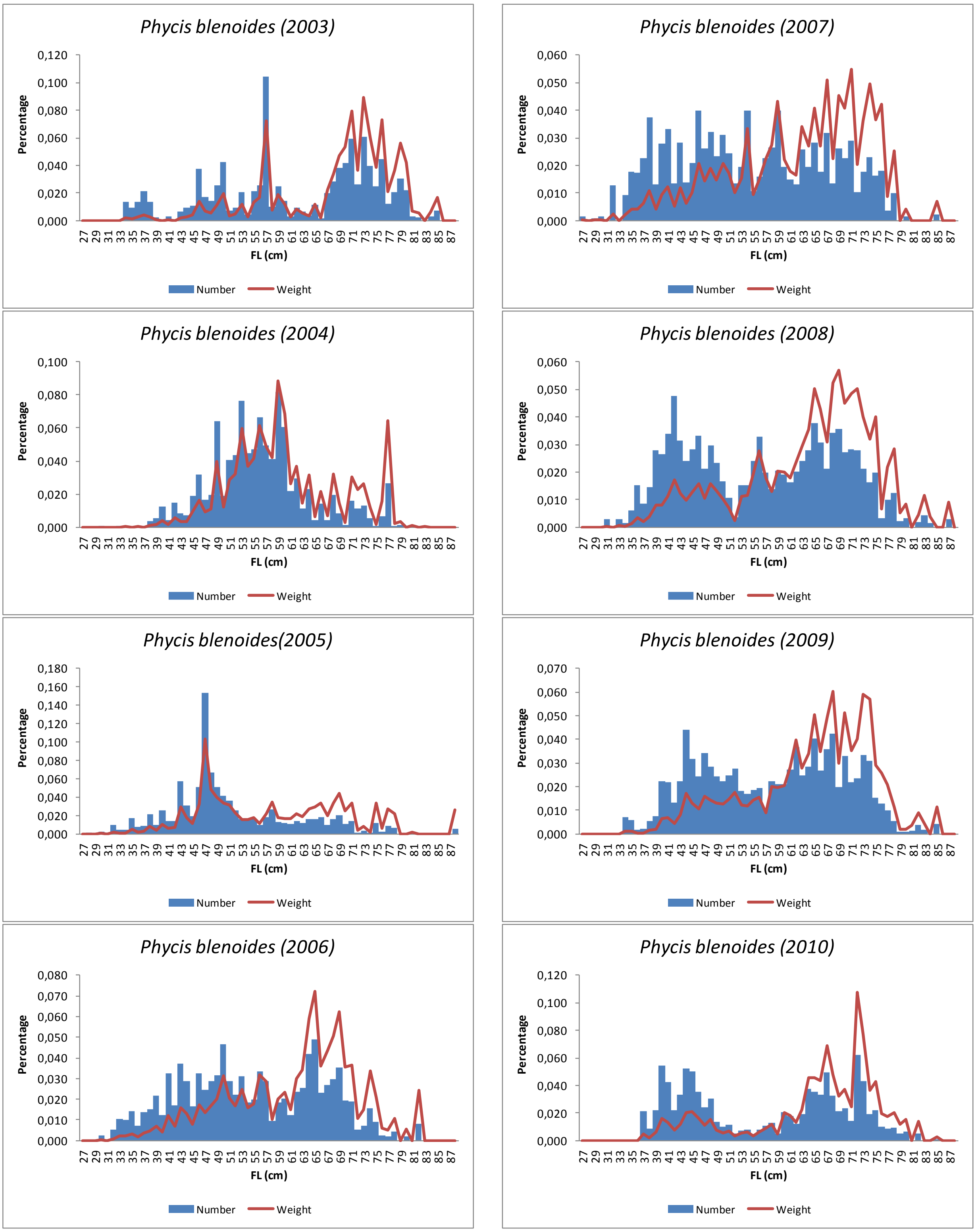


Figure 10 (cont.). Length composition, in number and weight, of *Phycis blenoides* from the Azores landings (2003-2010).

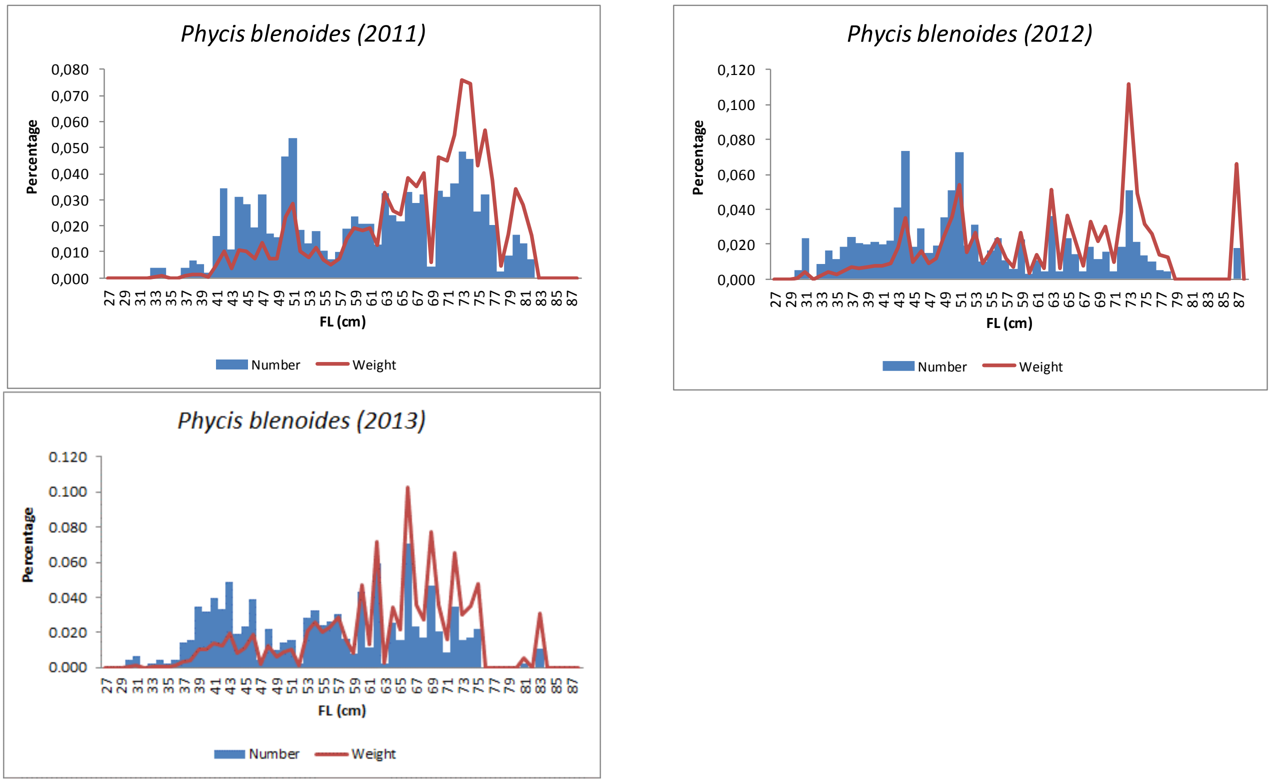


Figure 10 (cont.). Length composition, in number and weight, of *Phycis blenoides* from the Azores landings (2011).

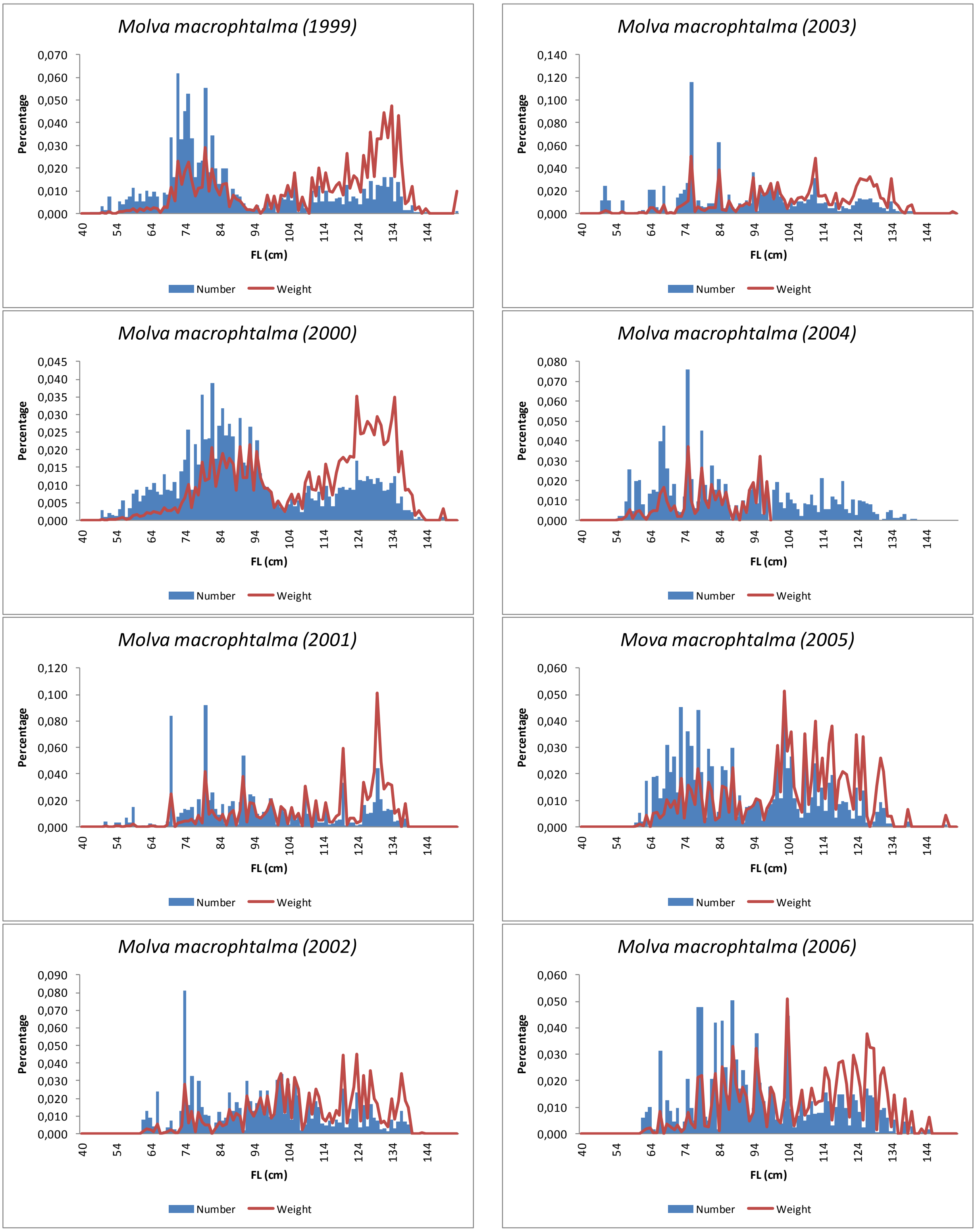


Figure 11. Length composition, in number and weight, of *Molva macrophtalma* from the Azores landings (1999-2006).

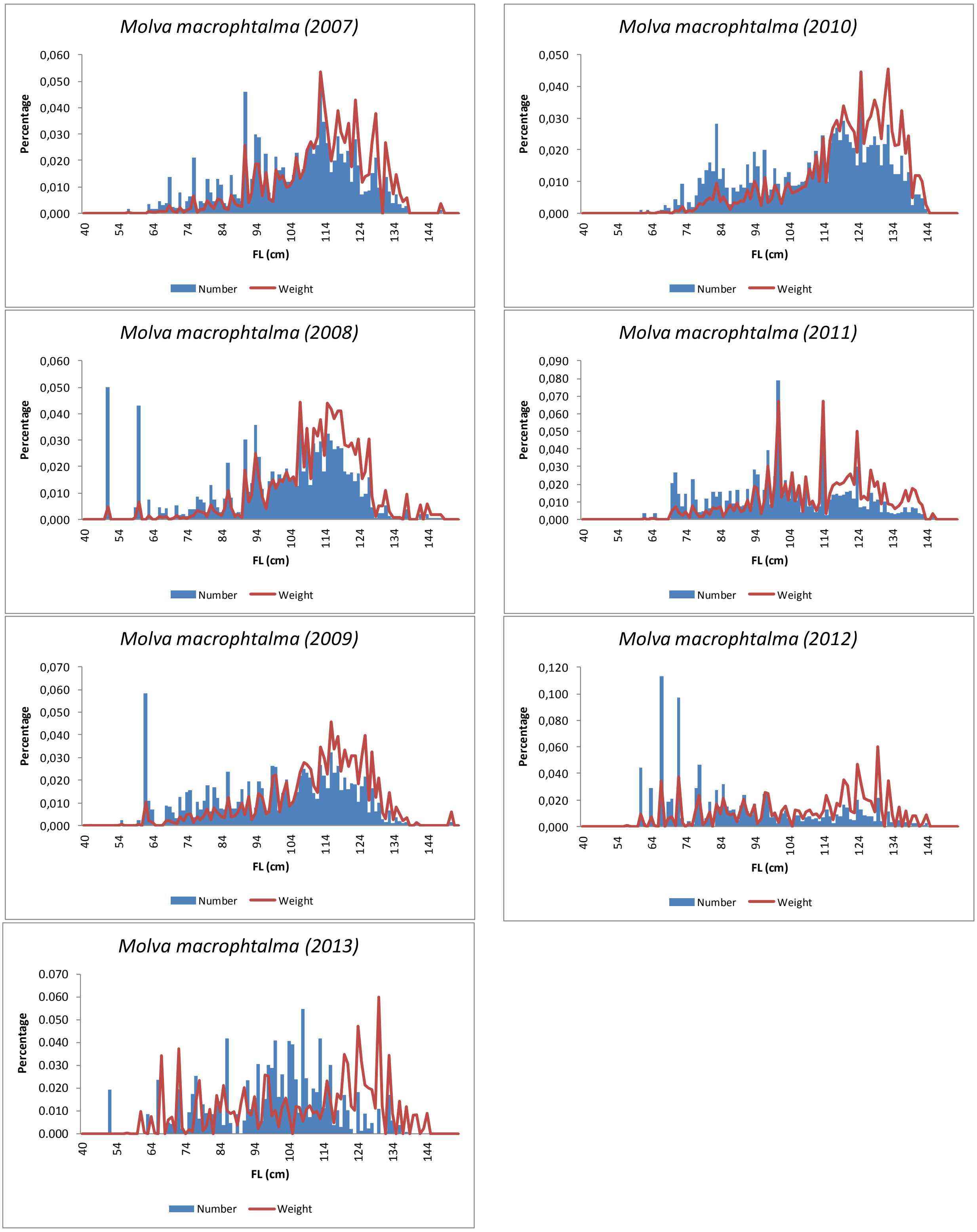


Figure 11 (Cont.) . Length composition, in number and weight, of *Molva macrophtalma* from the Azores landings (2007-2013).

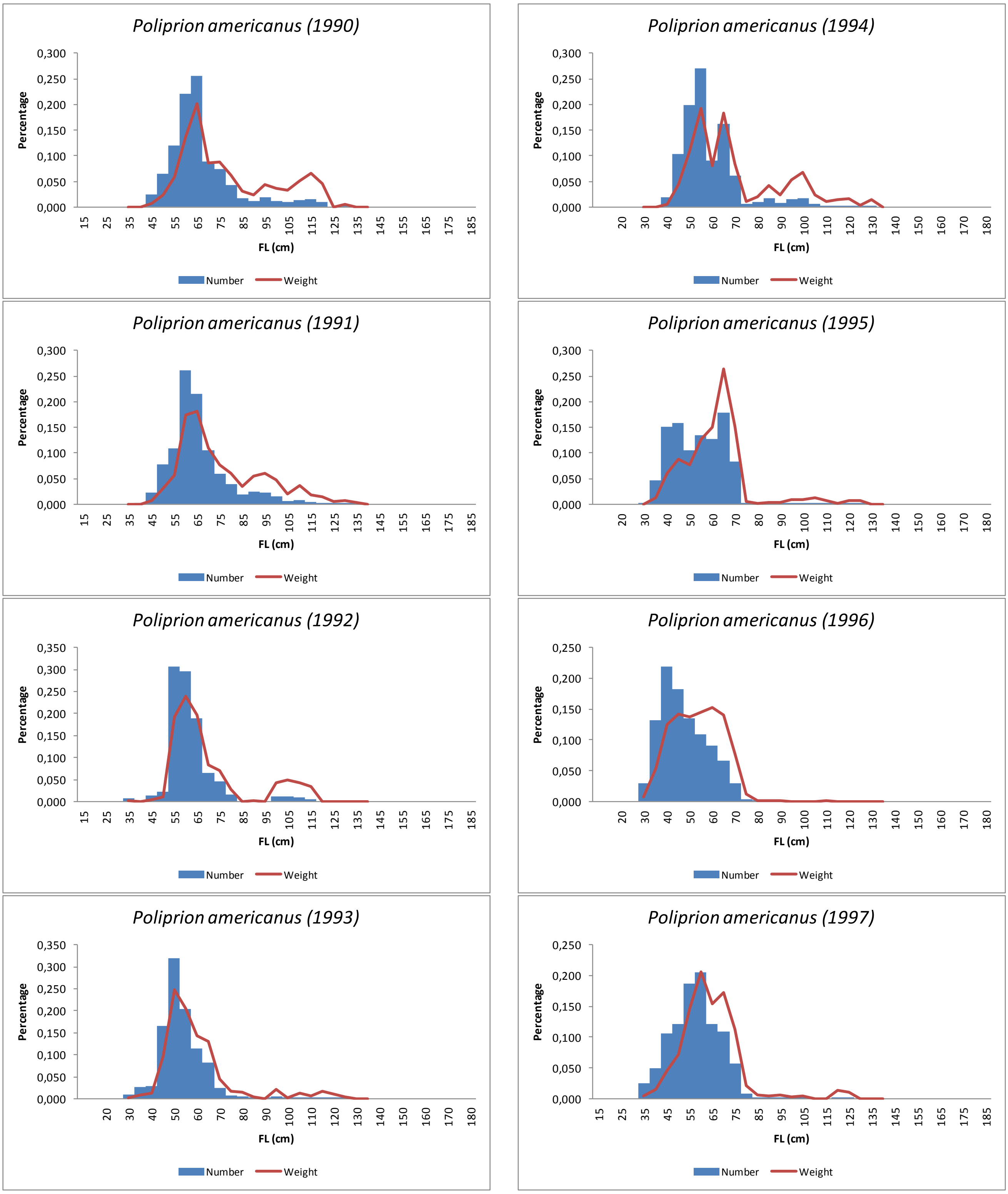


Figure 12. Length composition (class 5cm), in number and weight, of *Polyprion americanus* from the Azores landings (1990-1997).

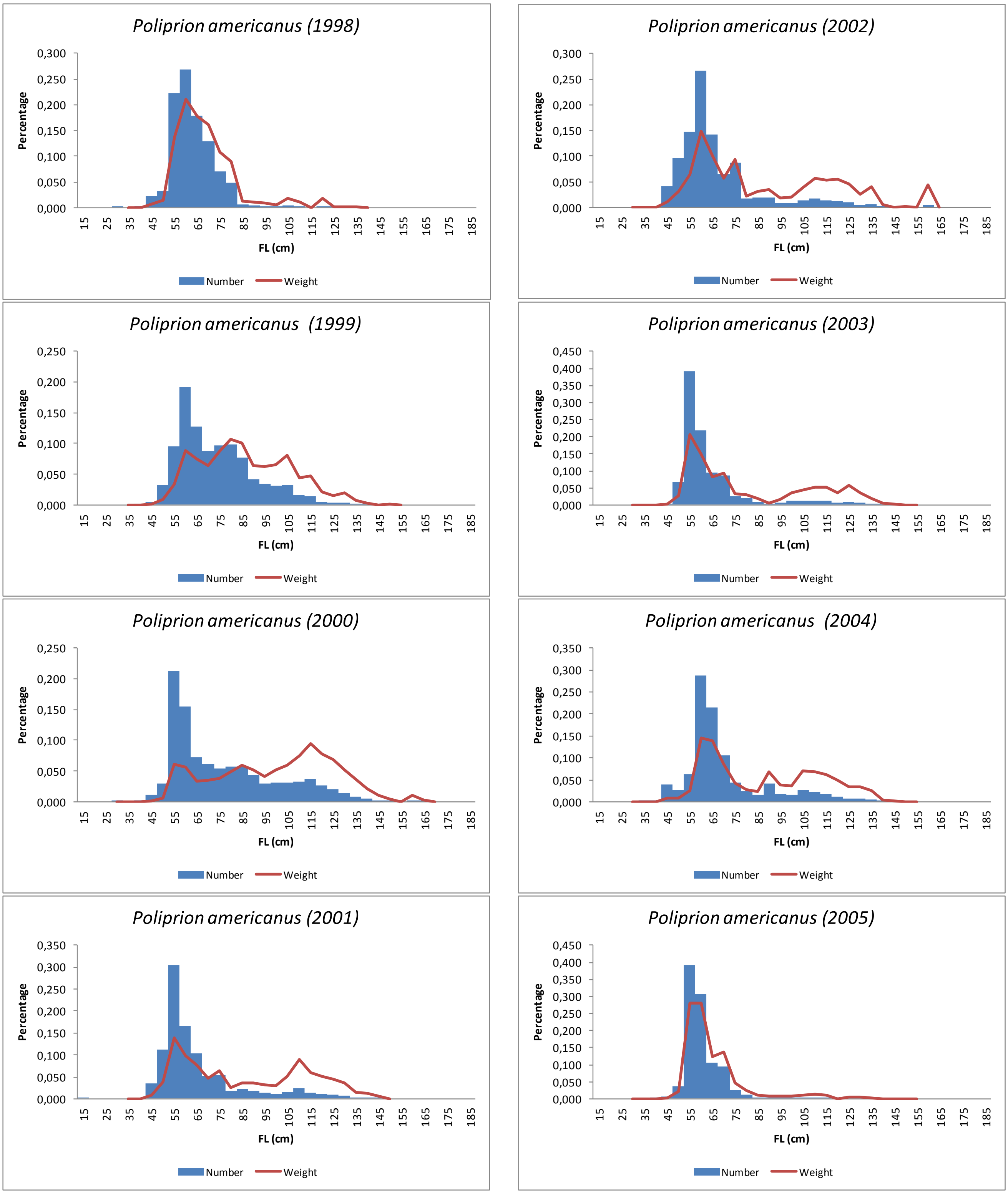


Figure 12 (cont.). Length composition (class 5cm), in number and weight, of *Polyprion americanus* from the Azores landings (1998-2005).

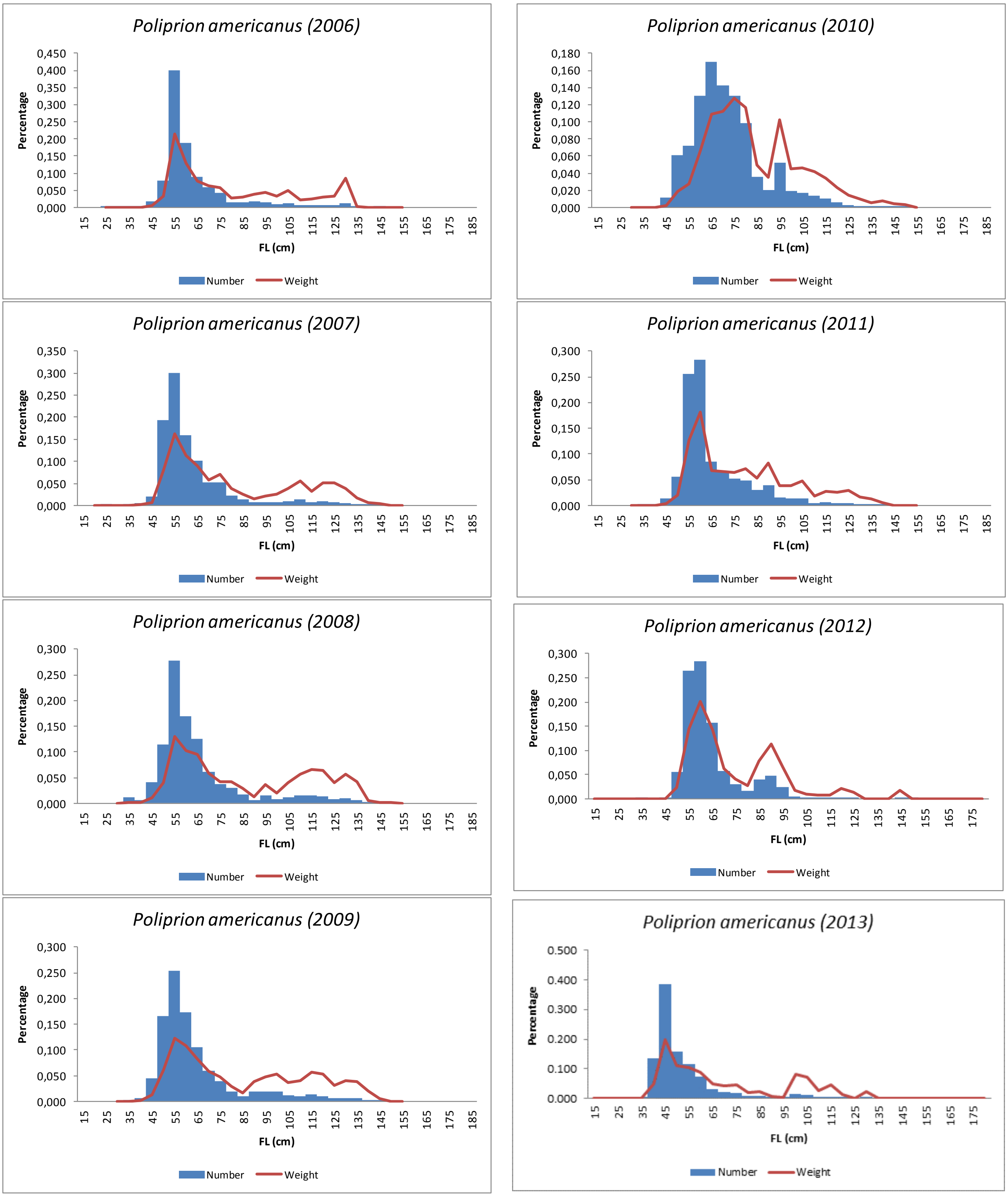


Figure 12 (cont.). Length composition (class 5cm), in number and weight, of *Polyprion americanus* from the Azores landings (2005-2013).

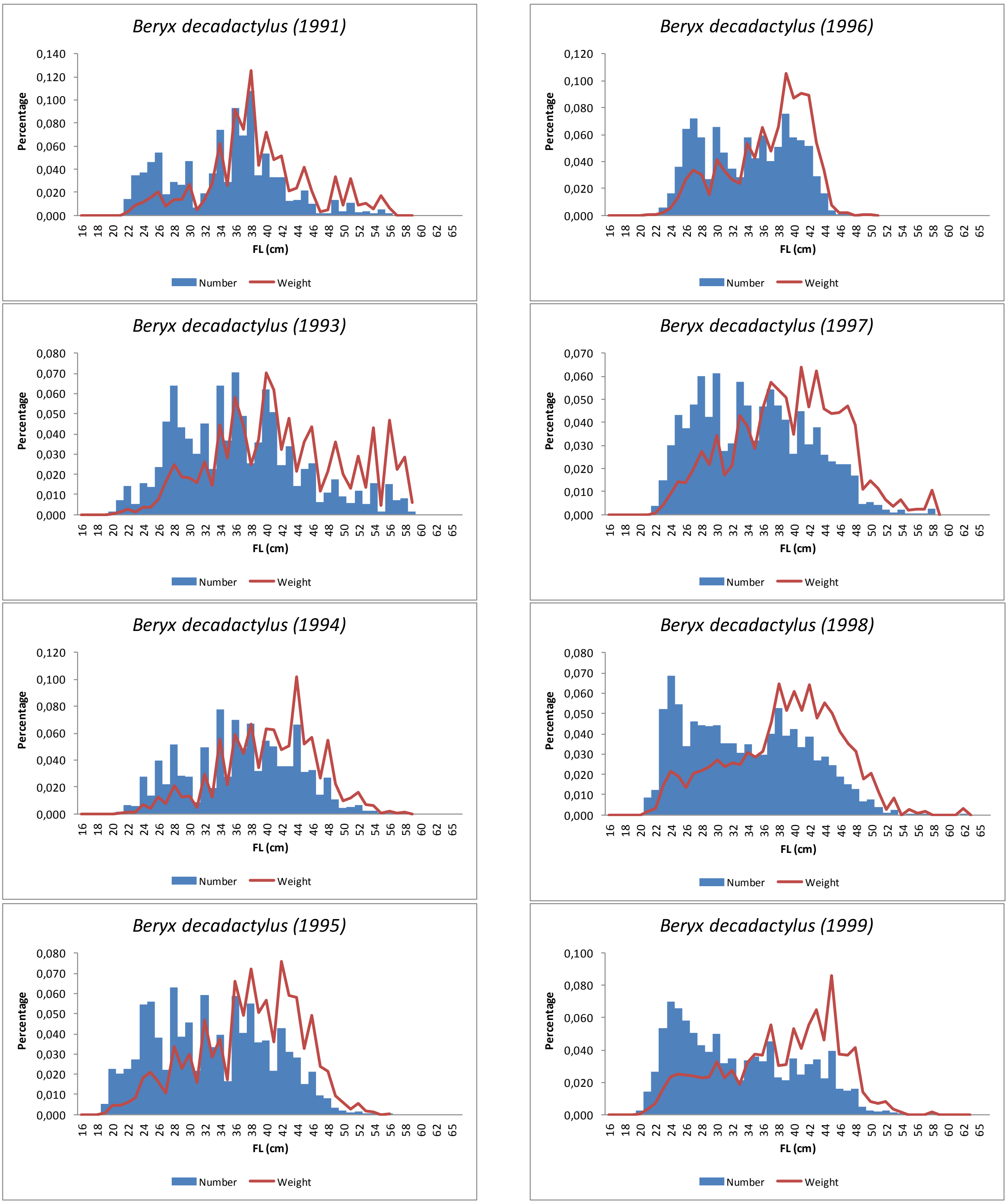


Figure 13. Length composition, in number and weight, of Golden eye perch (Beryx decadactylus) from the Azores landings for the period 1991-1999.

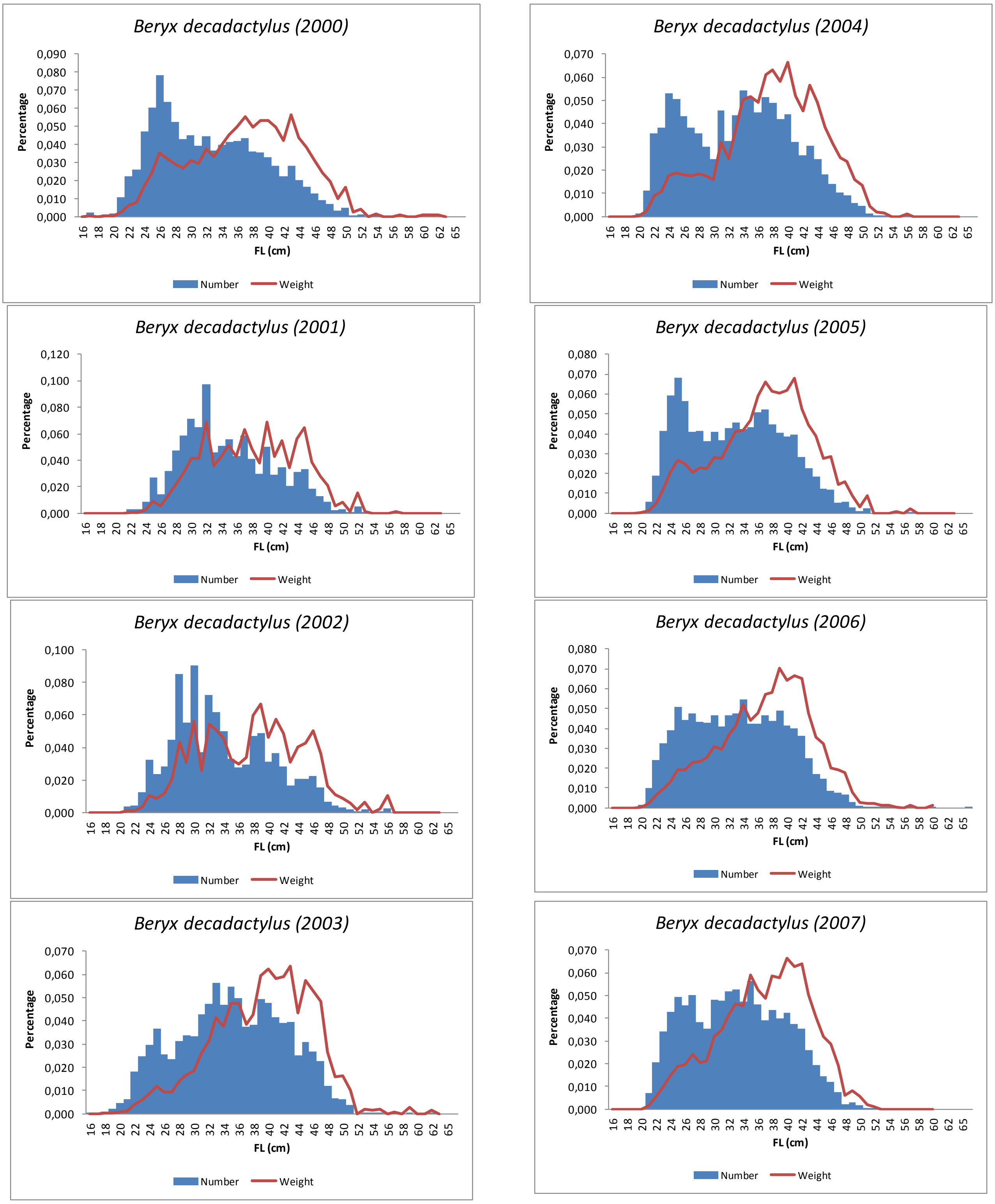


Figure 13 (cont.). Length composition, in number and weight, of Golden eye perch (*Beryx decadactylus*) from the Azores landings for the period 2000-2007.

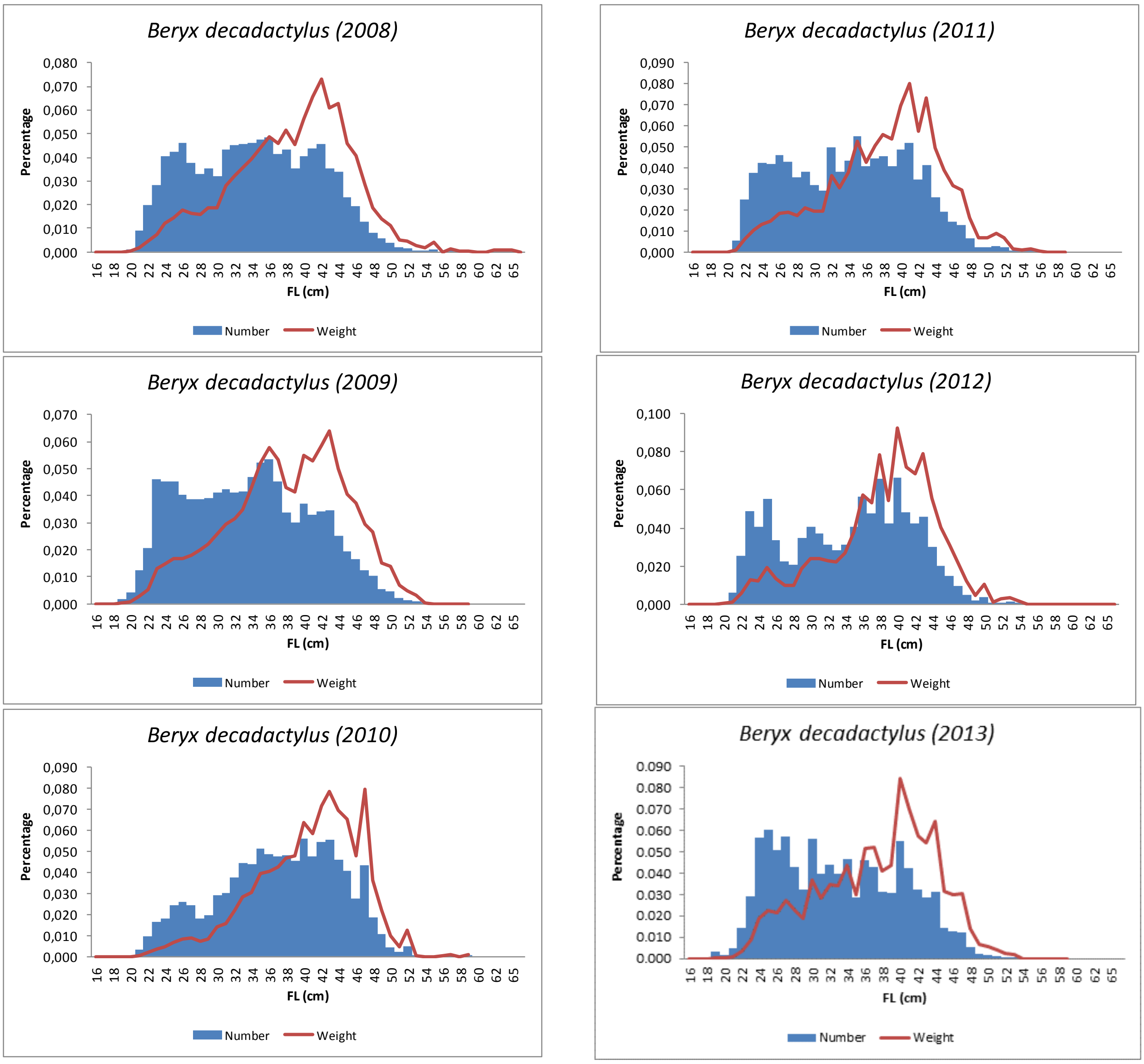


Figure 13 (cont.). Length composition, in number and weight, of Golden eye perch (*Beryx decadactylus*) s from the Azores landings for the period 2008-2013.

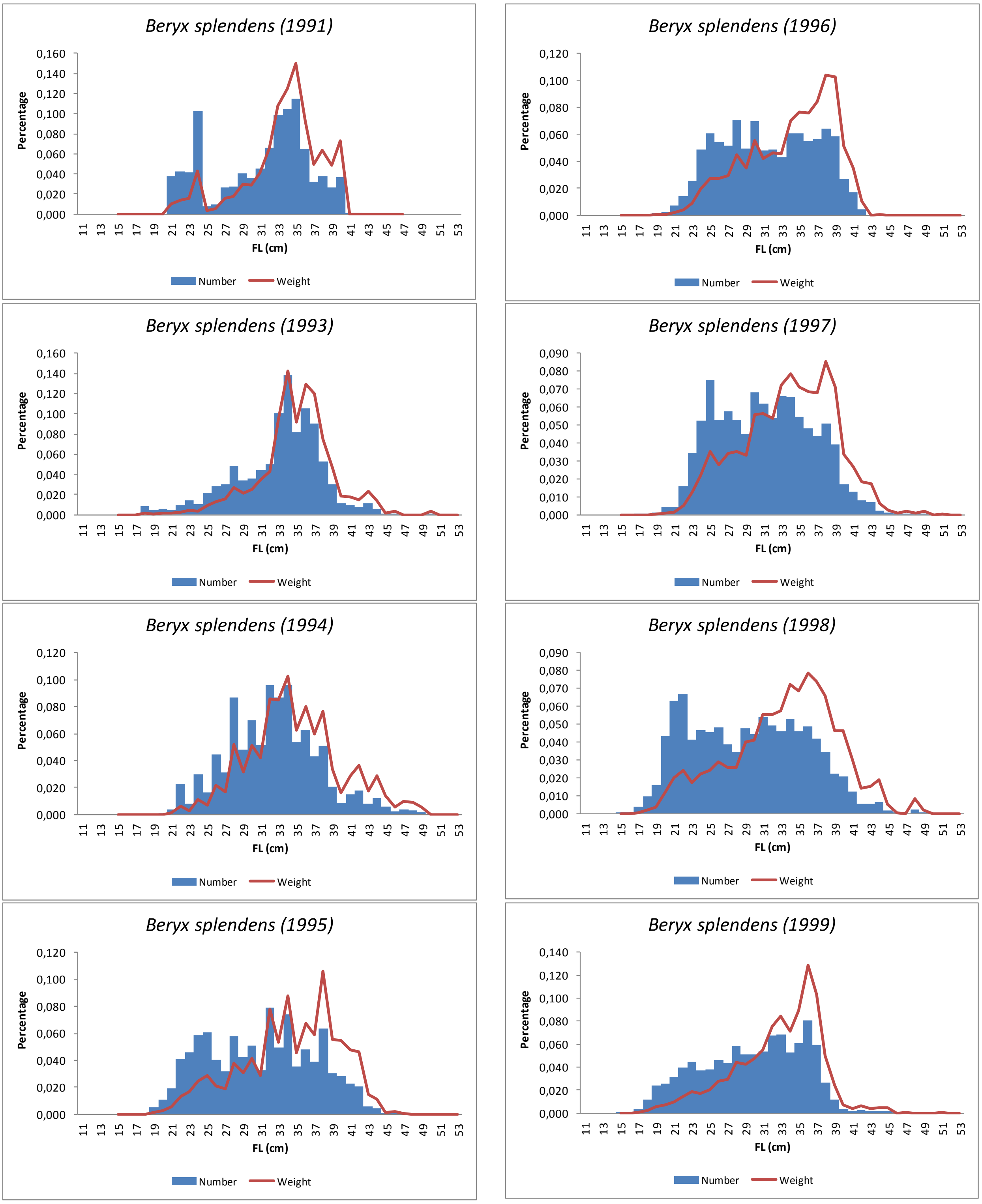


Figure 14. Length composition, in number and weight, of the alfonsino (*Beryx splendens*) from the Azores landings, for the period 1991-1999.

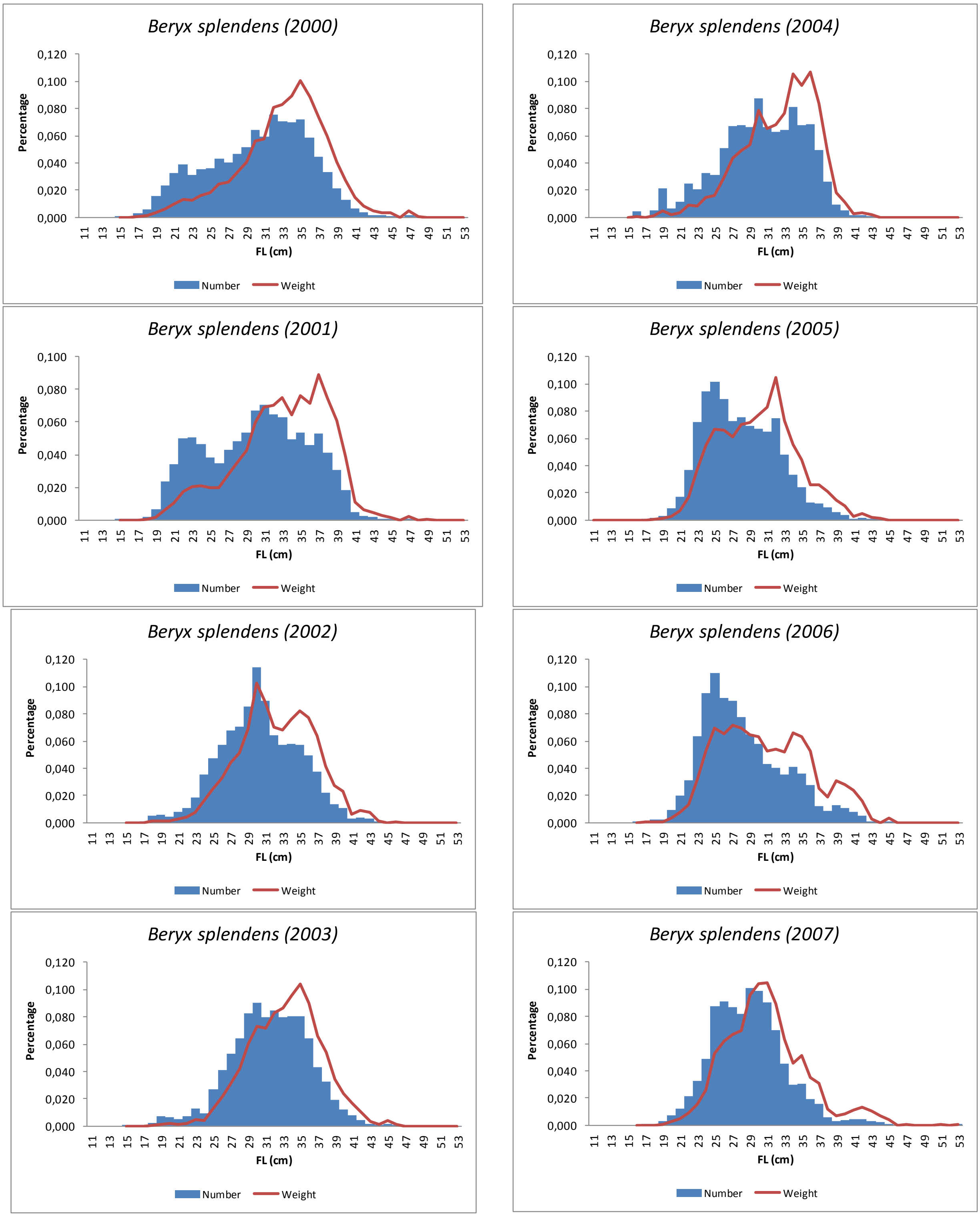


Figure 14 (cont). Length composition, in number and weight, of the alfonsino (*Beryx splendens*) from the Azores landings, for the period 2000-2007.

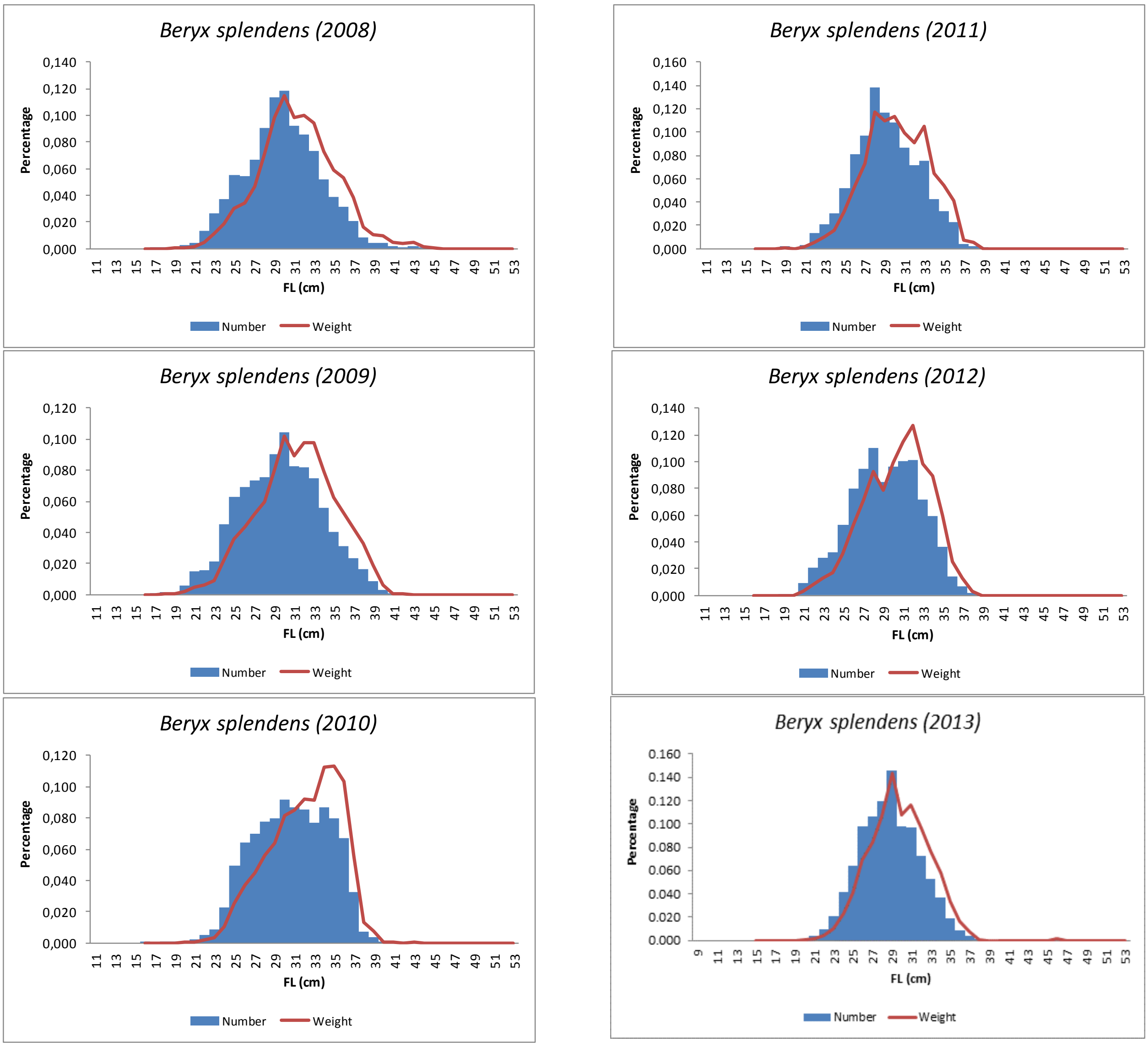


Figure 14 (cont). Length composition, in number and weight, of the alfonsino (*Beryx splendens*) from the Azores landings, for the period 2008-2013.

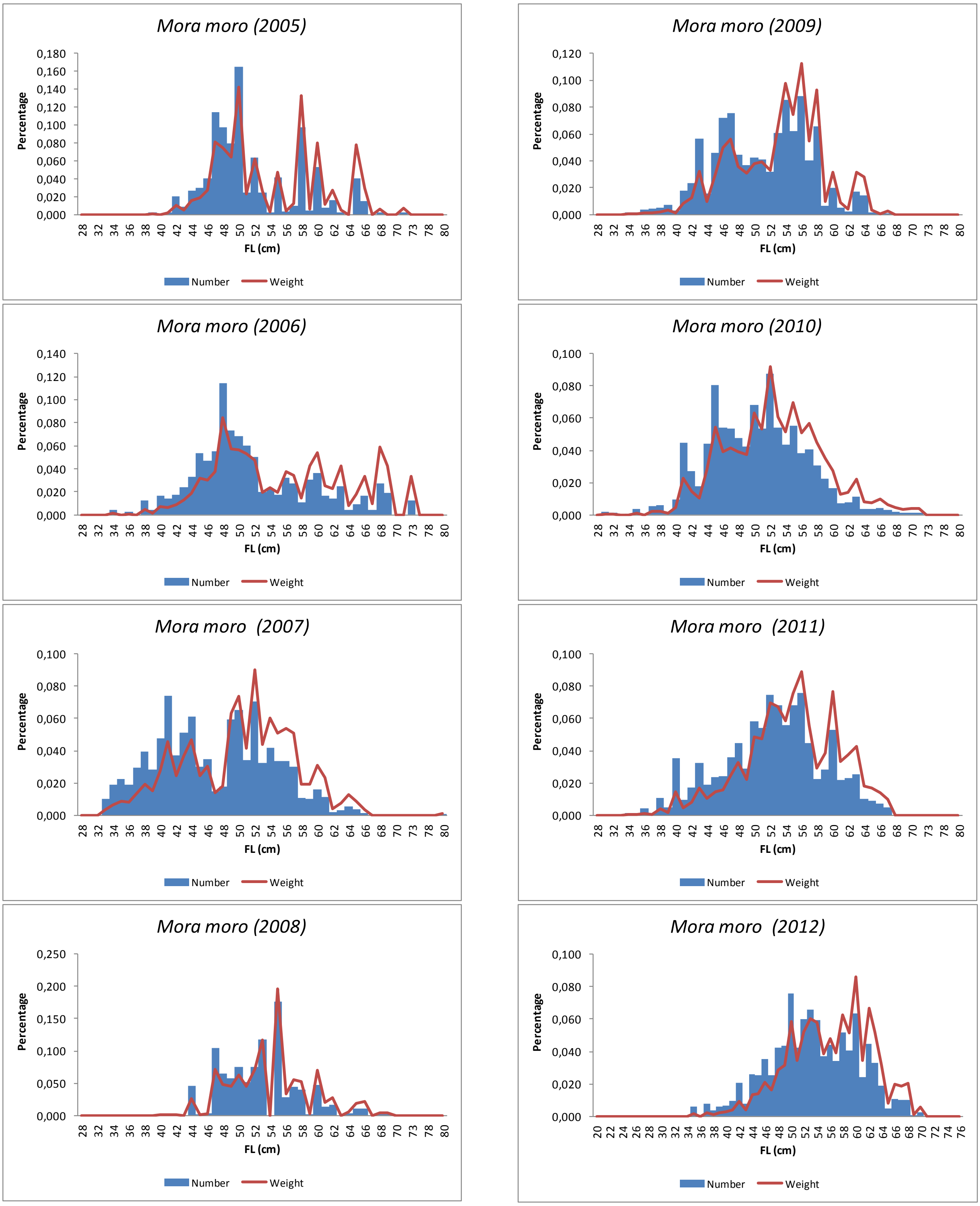


Figure 15. Length composition, in number and weight, of *Mora moro* from the Azores landings for the period 2005-2012.

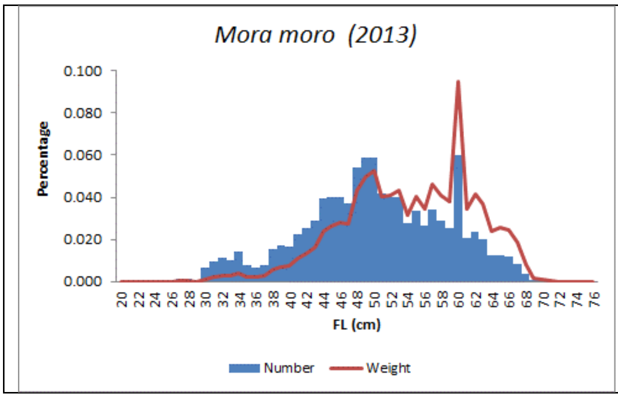


Figure 15. Length composition, in number and weight, of *Mora moro* from the Azores landings for the period 2013.

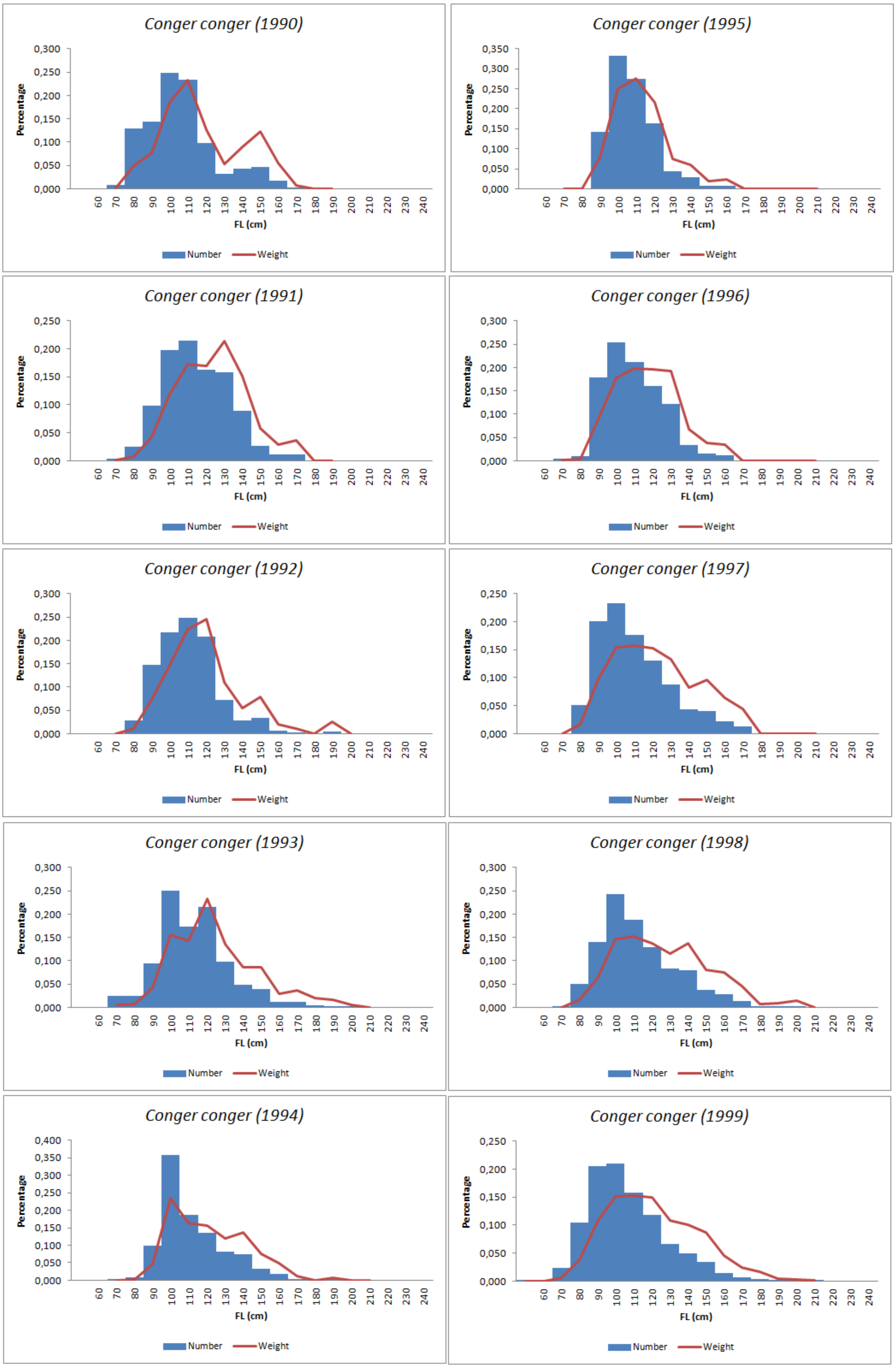


Figure 16. Length composition, in number and weight, of *Conger conger* from the Azores landings for the period 1990-1999.

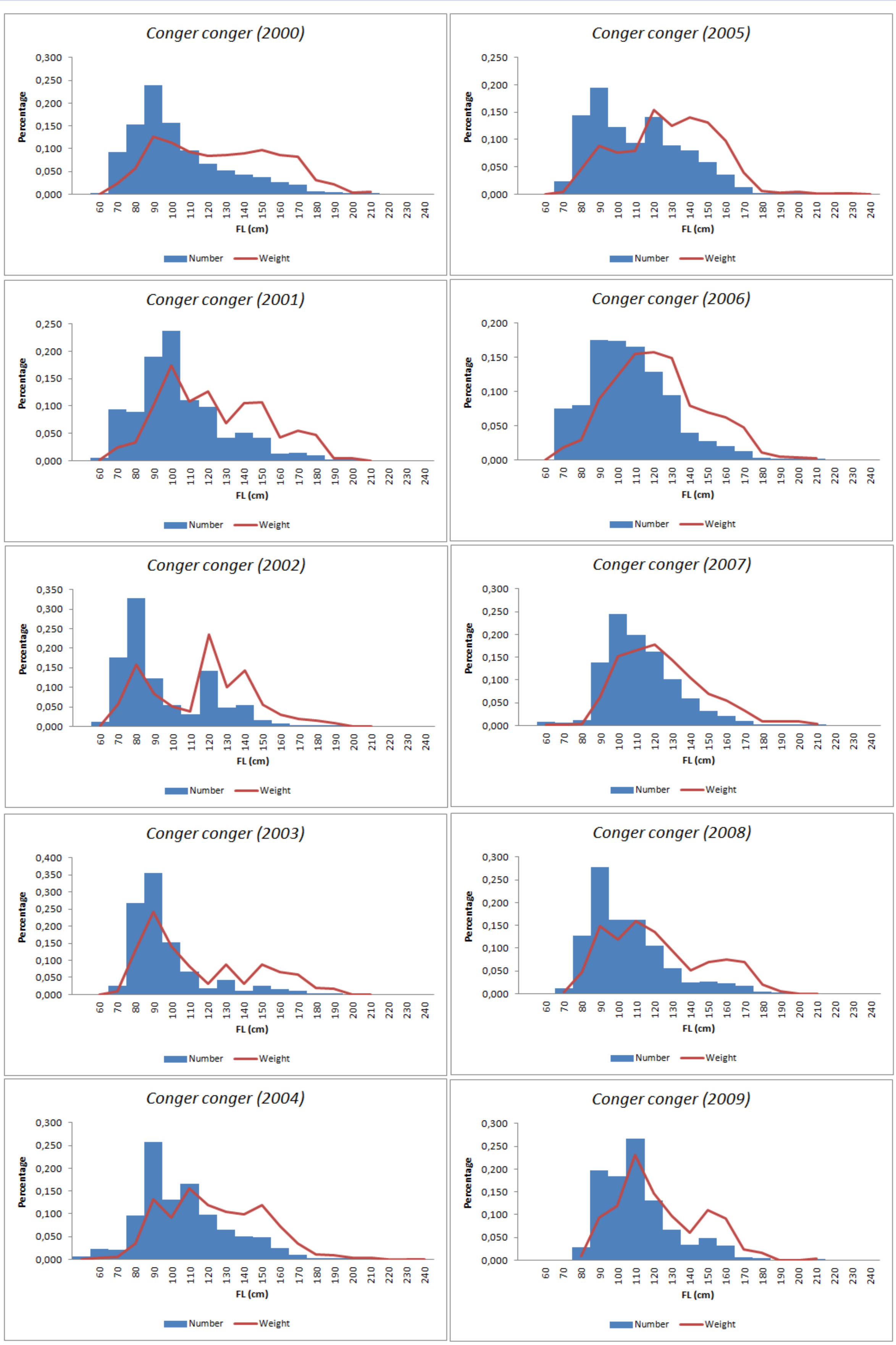


Figure 16 (cont.). Length composition, in number and weight, of *Conger conger* from the Azores landings for the period 2000-2009.

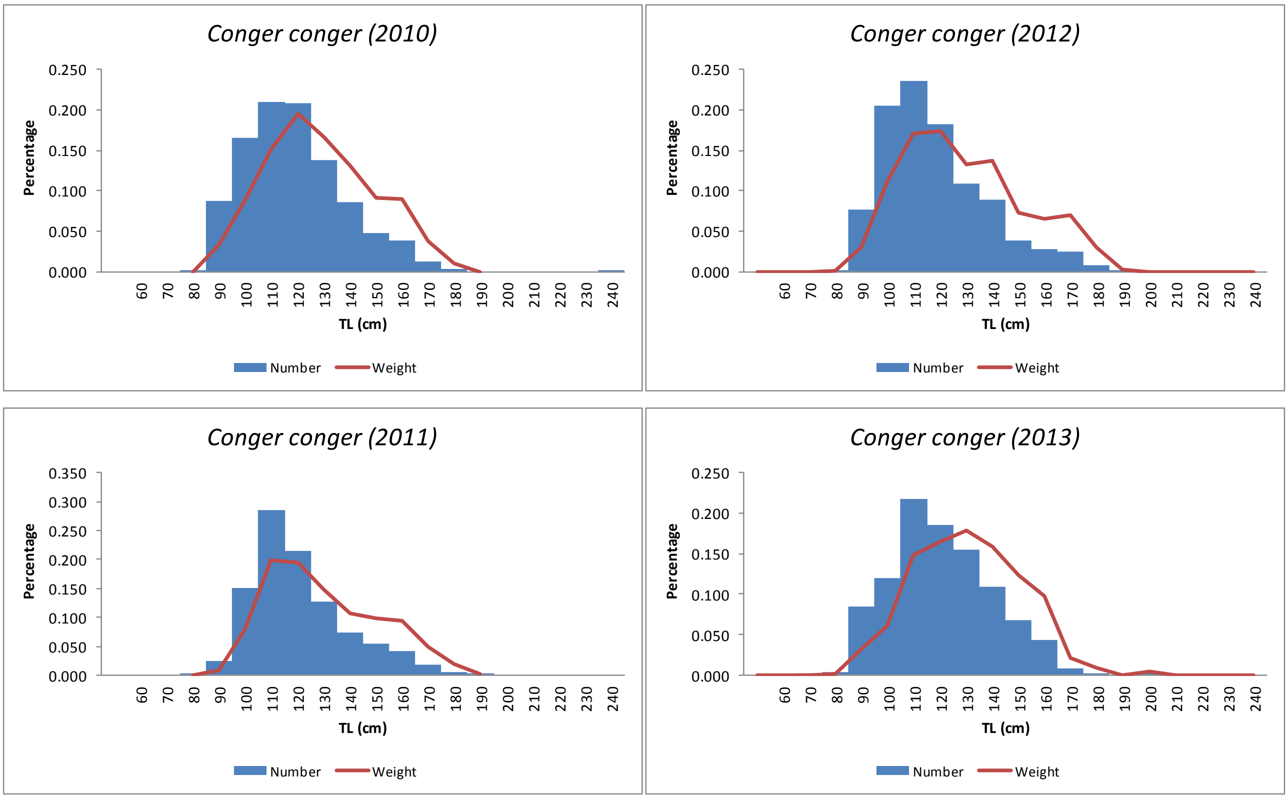


Figure 16 (cont). Length composition, in number and weight, of *Conger conger* from the Azores landings for the period 2010-2012.

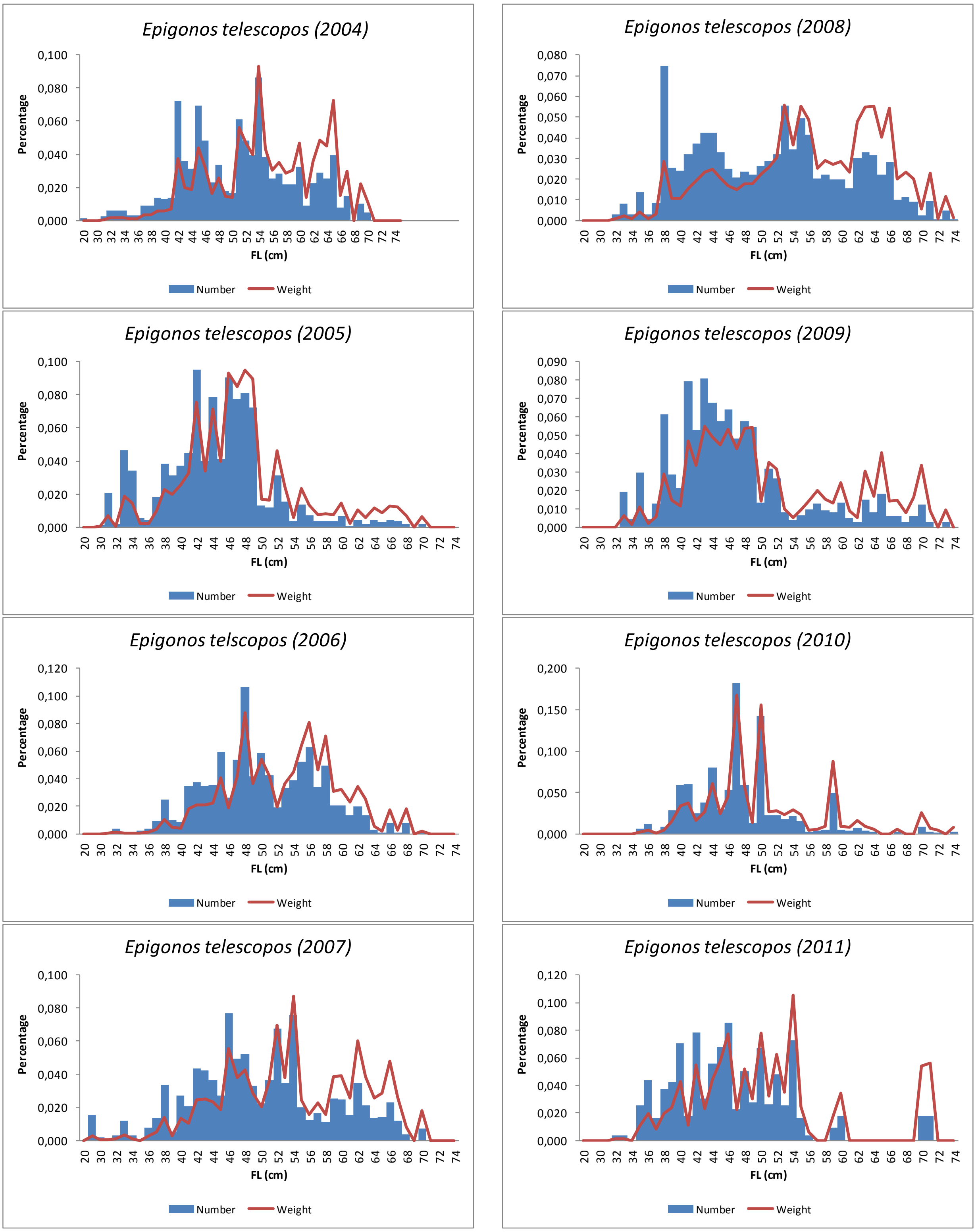
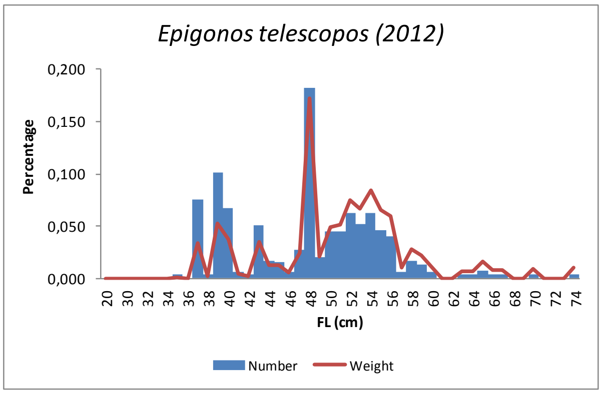


Figure 17. Length composition, in number and weight, of *Epigonus telescopus* from the Azores landings for the period 2004-2011.



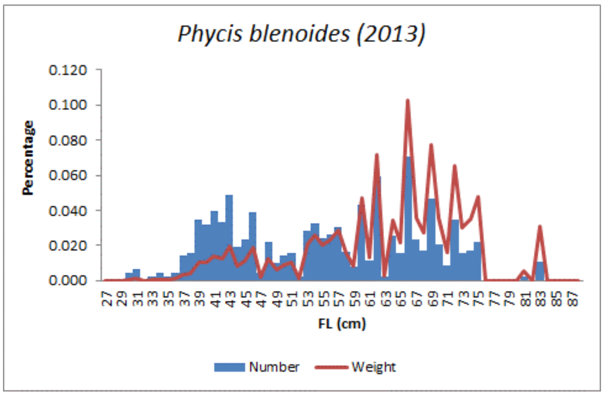


Figure 17 (cont.). Length composition, in number and weight, of *Epigonus telescopus* from the Azores landings for 2012.

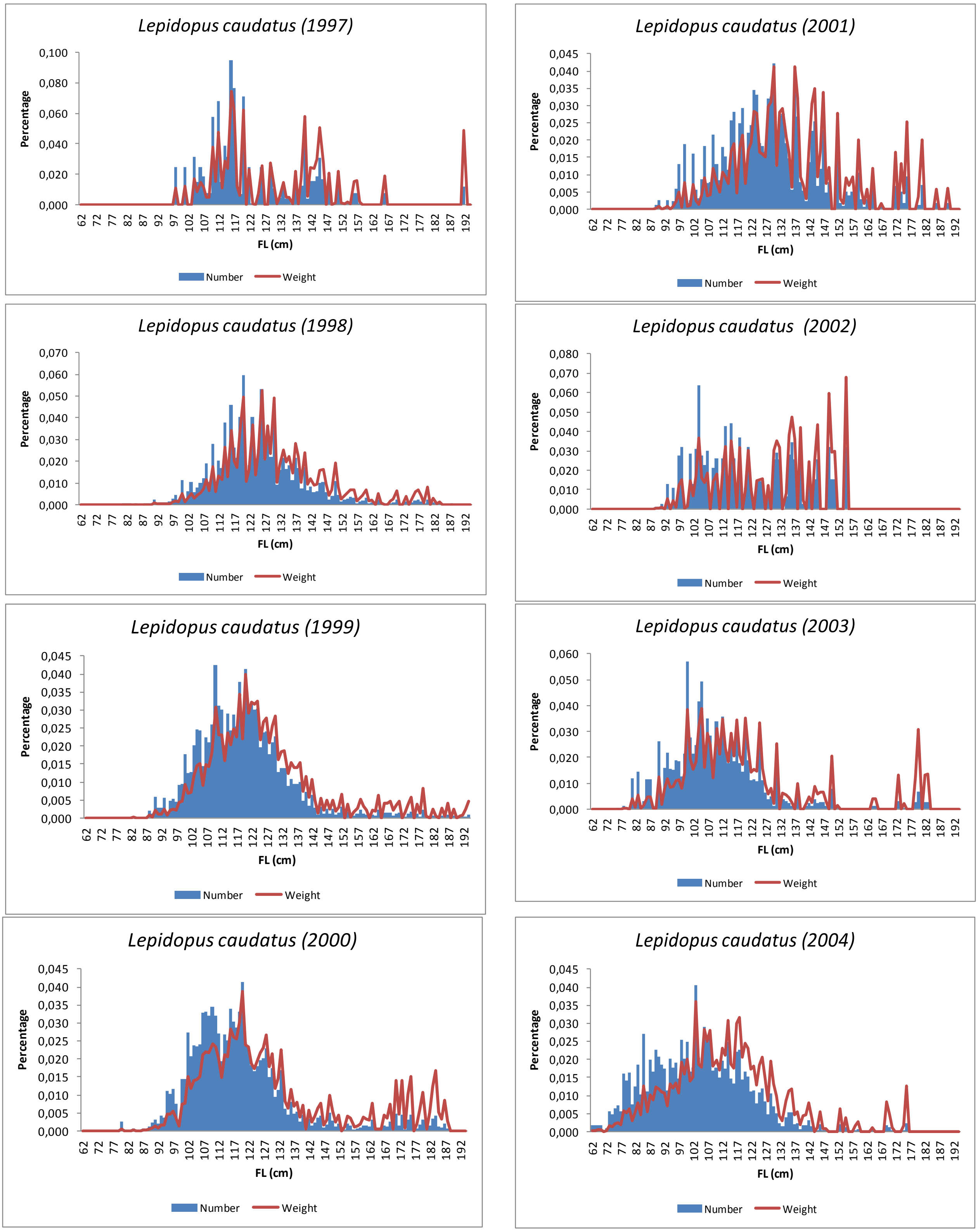


Figure 18. Length composition, in number and weight, of *Lepidops caudatus* from the Azores landings for the period 1997-2004.

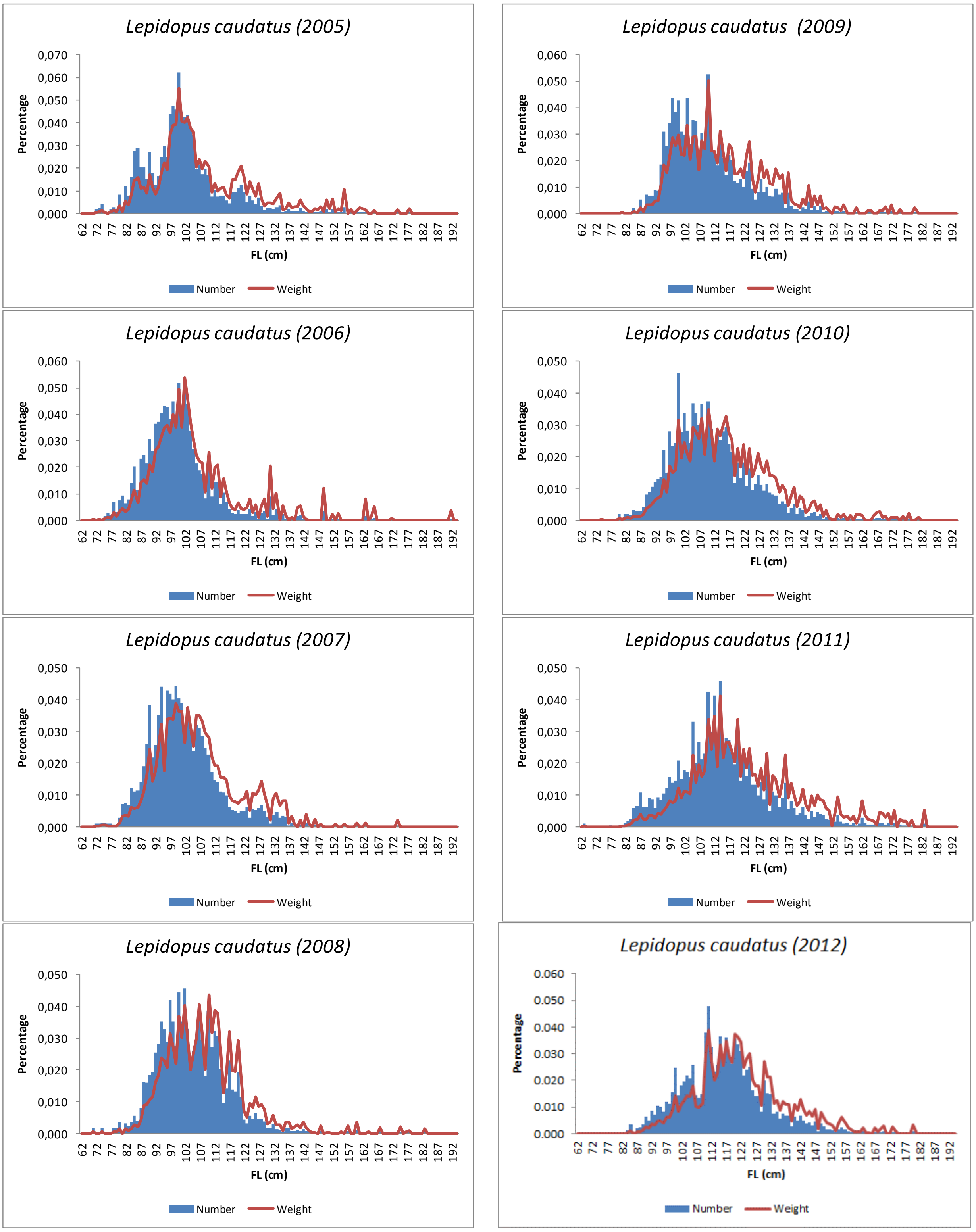


Figure 18 (cont.). Length composition, in number and weight, of *Lepidops caudatus* from the Azores landings for the period 2005-2012.

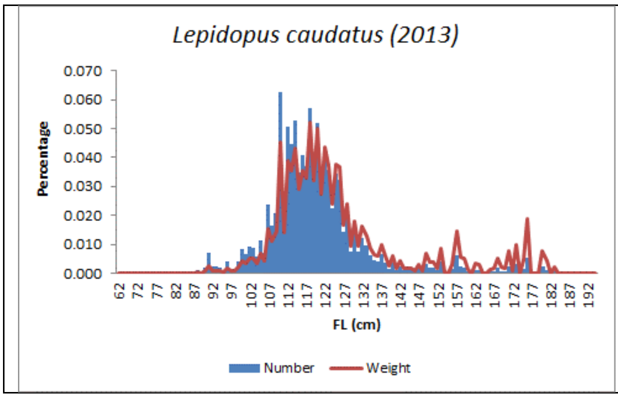


Figure 18 (cont.). Length composition, in number and weight, of *Lepidops caudatus* from the Azores landings for the period 2013.

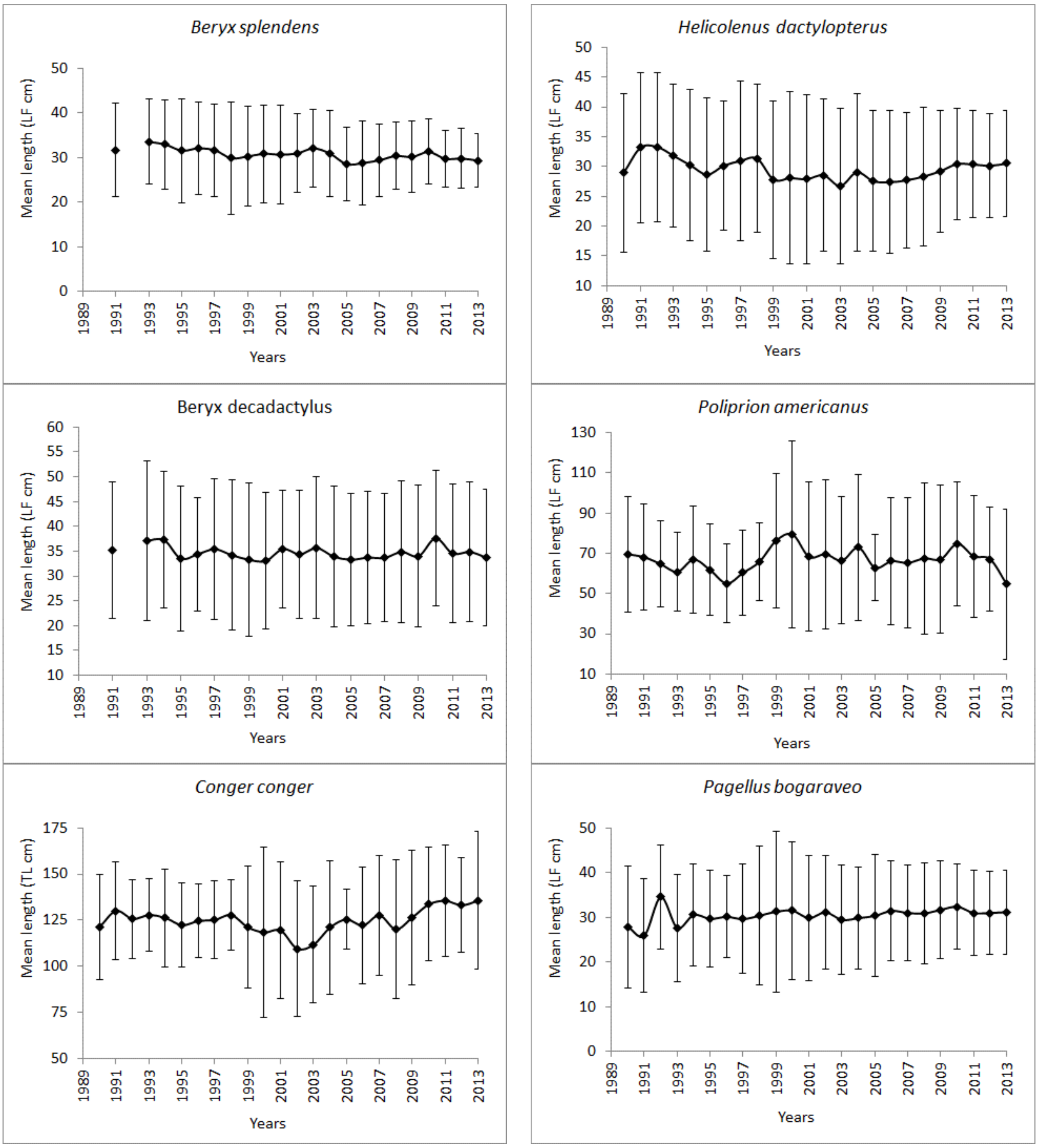


Figure 19. Annual mean length of some selected deep water species, landed at the Azores (ICES Xa2). Bar represent the 95% confidence interval.

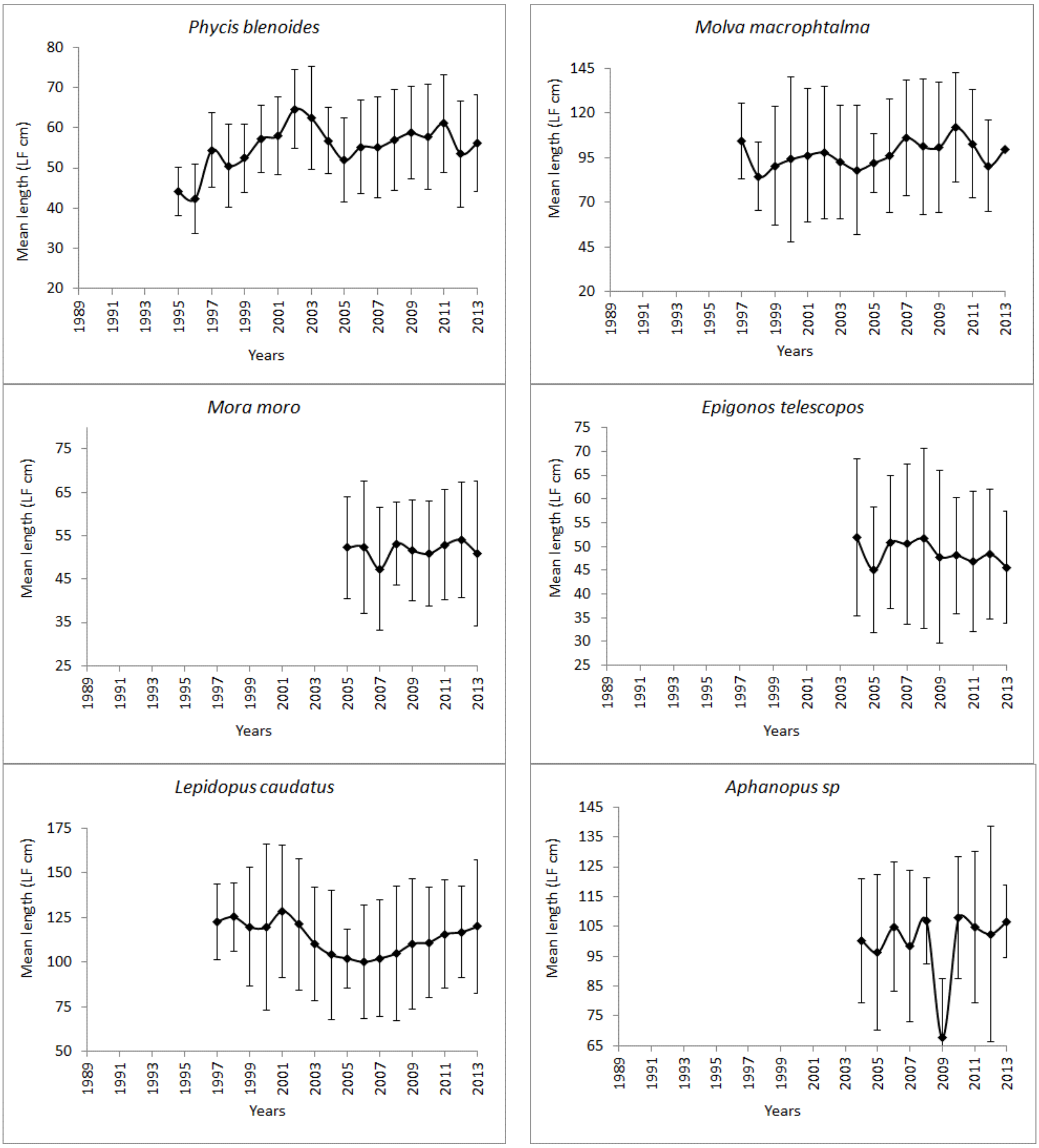


Figure 19 (cont.). Annual mean length of some selected deep water species, landed at the Azores (ICES Xa2). Bar represent the 95% confidence interval.

Figure 20. Annual mean weight in the catch of some selected deep water species, caught by the Azores fishery (ICES Xa2).

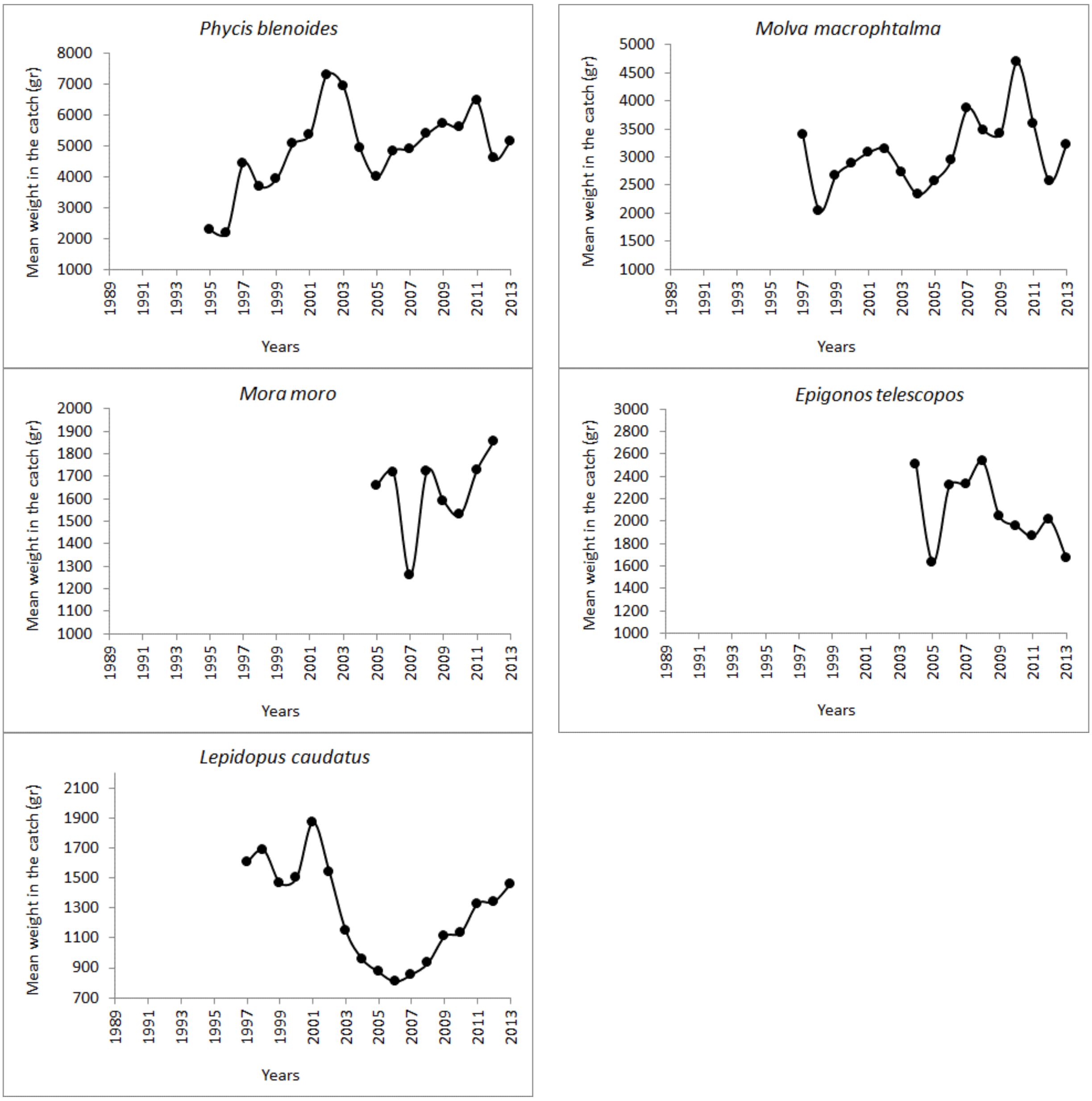


Figure 20 (cont.). Annual mean weight in the catch of some selected deep water species, caught by the Azores fishery (ICES Xa2).

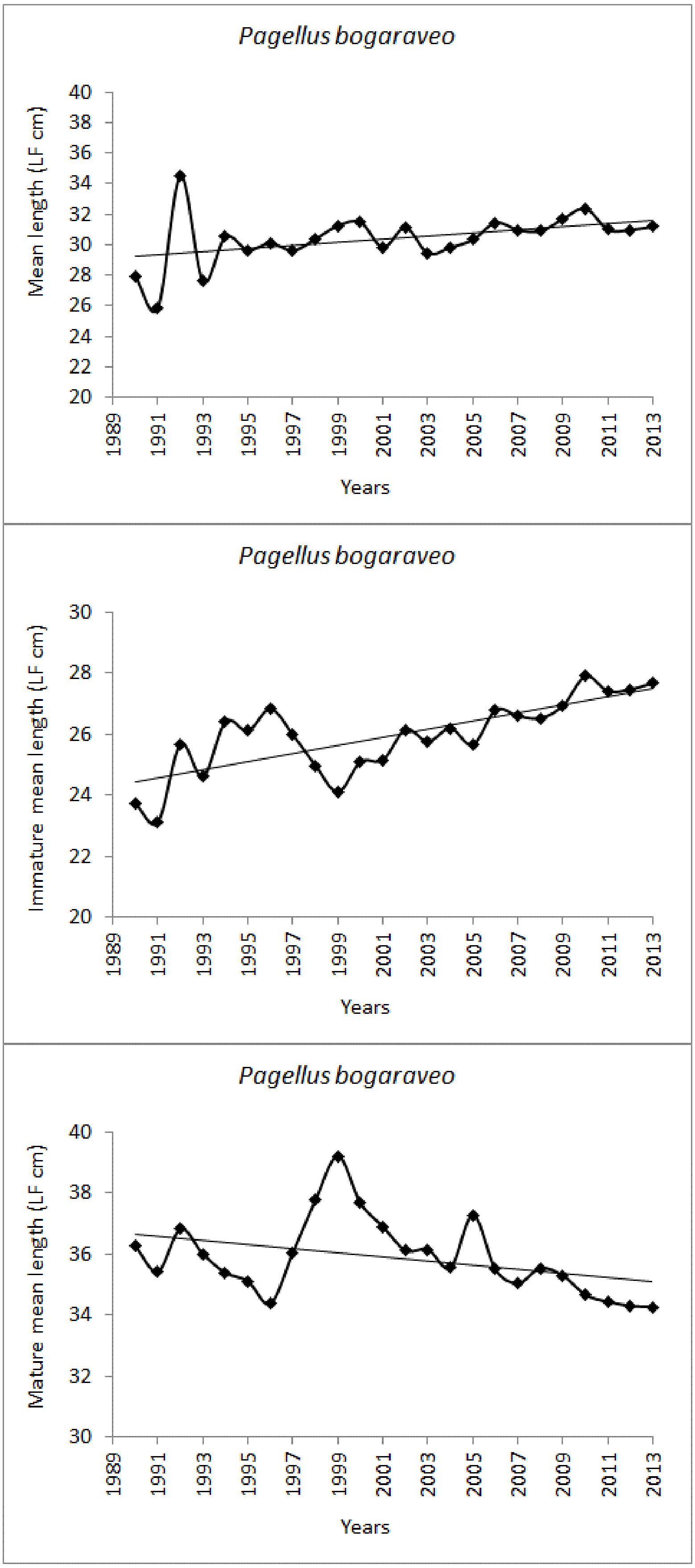


Figure 21. Mean length of Pagellus bogaraveo from the Azorean landings.

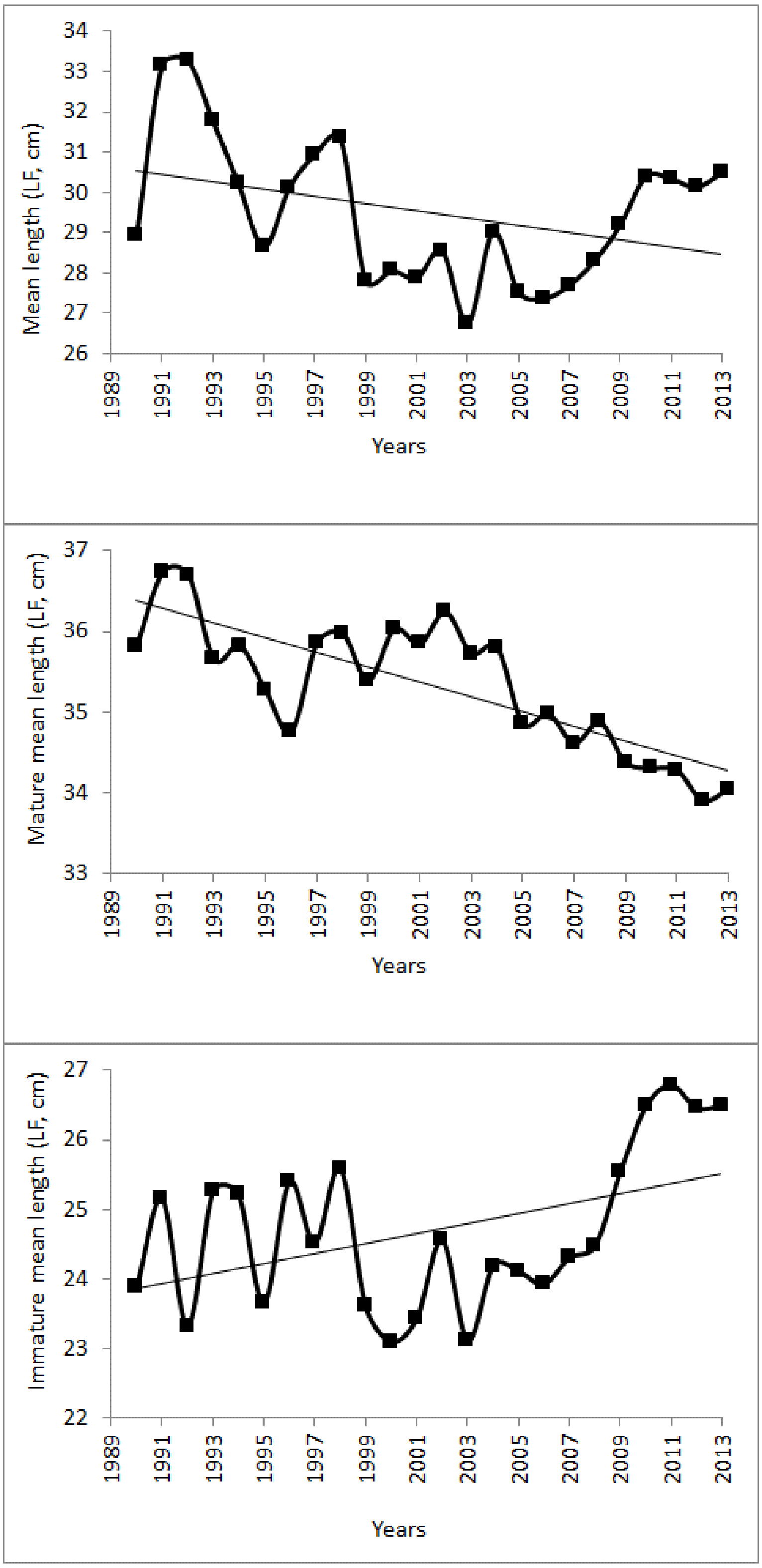


Figure 22. Mean length of *Helicolenus dactylopterus* from the Azorean landings.

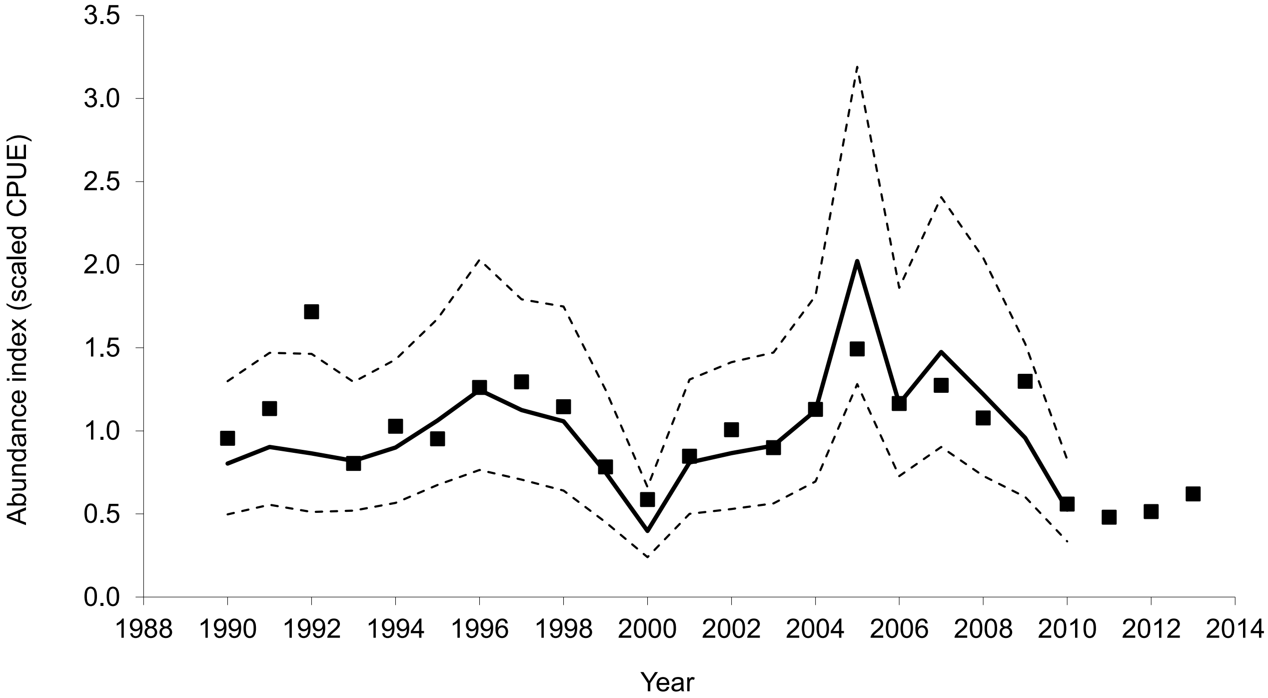


Figure 23. CPUE, in number, for *Pagellus bogaraveo* from the Azorean fishery (ICES area X) and for the period 1990-2013. Black squares are nominal cpue, black line standardized cpue and dashed lines the 95% confidence interval.

Table 1. Landings (tons) of deep-water species from the Azores (ICES area X).

Year	*Aphanopus carbo*	*Beryx decadactylus*	*Beryx splendens*	*Conger conger*	*Epigonus telescopus*	*Helicolenus dactylopterus*	*Hoplostetus atlanticus*	*Molva macrophalma*	*Mora moro*	*Pagellus bogaraveo*	*Phycis blenoides*	*Polyprion americanus*	*Lepidopus caudatus*	*Dalatias licha*	*Hexanchus griseus*	*Deania sp. (+)*	*Centrophorus sp. (+)*	*Other deep water sharks (+)*	*Chaceon affinis*
1980			3	131		18				415	0	38	13						
1981			4	143		22				407	2	40	6						
1982		4	11	166		42		1		369	2	50	10						
1983		13	10	222		93		1		520	2	99	18						
1984		24	19	214		101		1		700	7	131	23						
1985		62	29	241		169		2		672	9	133	25						
1986		52	42	287		212		3		730	9	151	63						
1987		77	108	356		331		9		631	32	216	30						
1988		103	122	413		439		18		637	29	191	70						
1989		147	113	459		481		17		924	42	235	91						
1990		201	137	547	3	480		23	2	889	50	224	120						
1991		168	203	570	11	483		36	4	874	68	170	166						
1992		176	274	572	+	575		35	+	1090	91	233	255						
1993		217	316	581	+	650		33	+	830	115	309	266						
1994		234	410	575	+	708		42	+	989	136	433	374						
1995		194	335	507	+	589		29	+	1115	71	244	780	321					
1996		171	379	521	+	483		26	+	1052	45	243	826	216					
1997		111	268	596	+	410		21	+	1012	30	177	1115	30					
1998	5	68	161	672	+	381		14	+	1119	38	140	1187	34					
1999	46	56	119	723	+	340		10	+	1222	41	133	86	31					
2000	112	35	168	831	+	441		13	+	947	91	263	27	31					
2001	+	17	182	509	+	301	343	9	+	1034	83	232	14	13					
2002	+	20	223	465	14	280	+	13	100	1193	57	283	10	35	7		4		
2003	91	22	150	443	15	338	+	12	125	1068	45	270	25	25	2		6		49
2004	2	29	110	354	6	282	+	11	87	1075	37	189	29	6	1	1	1		13
2005	323	23	134	304	4	190	+	8	69	1383*	22	279	31	14	1	1	1		
2006	55	40	152	346	10	209	+	10	92	958	15	497	35	10	1	1	3		
2007	0.2	46	165	340	7	274	+	14	86	1063	17	662	55	7	1	0.3	3	1	
2008	0.2	63**	187**	349	7	281	+	22	53	1089	18	513	63	10	0.4	6	3	0.1	0.1
2009	5	68**	243**	326	7	267	+	26	68	1042	20	382	64	6	0.3	0	3	0.4	
2010	49	51	189	318	5	213	+	26	54	687	14	238	68	2	1	3	1	1.8	0
2011	139	47	179	426	5	231	+	25	55	624	11	266	148	0	0	0	0	4.6	0
2012	458	37	175	441	4	190	+	19	31	613	6	226	271	0	0	0	0	31.1	0
2013	206	28	140	517	4	235	+	15	52	692	8	209	361	0	0	0	0	69.7	0
2014	54	22	109	644	2	200	+	11	54	663	9	121	713	0	0	0	0	0.0	0

\+ landed as mixed species

** includes 270 t from CECAF 34.2.0

Table 2. Historical quotas for deep-water species of the Azores (ICES X).

Regulation	Species	Year	ICES Area	TAC	Landings PT	Landing Azores
	P. bogaraveo	2003	X	1116	1068	1068
	P. bogaraveo	2004	X	1116	1075	1075
Reg 2270/2004	*P. bogaraveo*	2005	X	1116	1528	1528
	P. bogaraveo	2006	X	1116	958	958
Reg 2015/2006	*P. bogaraveo*	2007	X	1116	1071	1071
	P. bogaraveo	2008	X	1116	1089	1089
Reg 1359/2008	*P. bogaraveo*	2009	X	1116	1042	1042
	P. bogaraveo	2010	X	1116	687	687
Reg 1225/2010	*P. bogaraveo*	2011	X	1116	624	624
	P. bogaraveo	2012	X	1116	613	613
Reg 1262/2012	*P. bogaraveo*	2013	X	1004	692	692
	P. bogaraveo	2014	X	920	663	663
Reg. 1367/2014	*P. bogaraveo*	2015	X	678		
	P. bogaraveo	2016	X	507		
Reg 2270/2004	*Beryx sp*	2005	III, IV, V, VI, VII, VIII, IX, X, XII	214	202	157
	Beryx sp	2006	III, IV, V, VI, VII, VIII, IX, X, XII	214	212	192
Reg 2015/2006	*Beryx sp*	2007	III, IV, V, VI, VII, VIII, IX, X, XII	214	256	211
	Beryx sp	2008	III, IV, V, VI, VII, VIII, IX, X, XII	214	292	250
Reg 1359/2008	*Beryx sp*	2009	III, IV, V, VI, VII, VIII, IX, X, XII	214	353	311
	Beryx sp	2010	III, IV, V, VI, VII, VIII, IX, X, XII	214	267	240
Reg 1225/2010	*Beryx sp*	2011	III, IV, V, VI, VII, VIII, IX, X, XII	214	247	226
	Beryx sp	2012	III, IV, V, VI, VII, VIII, IX, X, XII	214	224	213
Reg 1262/22012	*Beryx sp*	2013	III, IV, V, VI, VII, VIII, IX, X, XII	203	168	168
	Beryx sp	2014	III, IV, V, VI, VII, VIII, IX, X, XII	193		131
Reg. 1367/2014	*Beryx sp*	2015	III, IV, V, VI, VII, VIII, IX, X, XII	194		
	Beryx sp	2016	III, IV, V, VI, VII, VIII, IX, X, XII	195		
	Aphanopus carbo	2003	VIII, IX, X	4000	2630	91
	Aphanopus carbo	2004	VIII, IX, X	4000	2463	2
Reg 2270/2004	Aphanopus carbo	2005	VIII, IX, X	3956	2746	323
	Aphanopus carbo	2006	VIII, IX, X	3956	2674	55
Reg 2015/2006	Aphanopus carbo	2007	VIII, IX, X	3956	3453	0
	Aphanopus carbo	2008	VIII, IX, X	3956	3602	0
Reg 1359/2008	Aphanopus carbo	2009	VIII, IX, X	3561	3601	5
	Aphanopus carbo	2010	VIII, IX, X	3561	3453	49
Reg 1225/2010	Aphanopus carbo	2011	VIII, IX, X	3561	3476	139
	Aphanopus carbo	2012	VIII, IX, X	3561	2668	458
Reg 1262/22012	Aphanopus carbo	2013	VIII, IX, X	3659	2130	206
	Aphanopus carbo	2014	VIII, IX, X	3659		54
Reg. 1367/2014	Aphanopus carbo	2015	VIII, IX, X	3660		
	Aphanopus carbo	2016	VIII, IX, X	3661		
Reg 2270/2004	Phycis blenoides	2005	X and XII	43	22	22
	Phycis blenoides	2006	X and XII	43	15	15
Reg 2015/2006	Phycis blenoides	2007	X and XII	43	17	17
	Phycis blenoides	2008	X and XII	43	18	18
Reg 1359/2008	Phycis blenoides	2009	X and XII	36	20	20
	Phycis blenoides	2010	X and XII	36	14	14
Reg 1225/2010	Phycis blenoides	2011	X and XII	36	11	11
	Phycis blenoides	2012	X and XII	36	6	6
Reg 1262/22012	Phycis blenoides	2013	X and XII	36	8	8
	Phycis blenoides	2014	X and XII	36		9
Reg. 1367/2014	Phycis blenoides	2015	X and XII	37		
	Phycis blenoides	2016	X and XII	38		
Reg 2270/2004	Deep-water sharks	2005	X	120 (1)	4	4
	Deep-water sharks	2006	X	120 (1)	4	4
Reg 2015/2006	Deep-water sharks	2007	X	20	4	4
	Deep-water sharks	2008	X	20	9	9
Reg 1359/2008	Deep-water sharks	2009	X	10	4	4
	Deep-water sharks	2010	X	0	4	4
Reg 1225/2010	Deep-water sharks	2011	X	0	0	0
	Deep-water sharks	2012	X	0	0	0
Reg 1262/2012	Deep-water sharks	2013	X	0	0	0
	Deep-water sharks	2014	X	0	0	0
Reg. 1367/2014	Deep-water sharks	2015	X	0		
	Deep-water sharks	2016	X	0		
Reg 1225/2010	Hoplostethus atlant	2010-12	X	0	0	0
Reg 1262/22012	Hoplostethus atlant	2013-14	X	0	0	0
Reg. 1367/2014	Hoplostethus atlant	2015-16	X	0		

(1) Reg. 860/2005

Annex 3: WGDEEP Stock Annexes

The table below provides an overview of the WGDEEP Stock Annexes. Stock Annexes for other stocks are available on the ICES website Library under the Publication Type "Stock Annexes". Use the search facility to find a particular Stock Annex, refining your search in the left-hand column to include the *year*, *ecoregion*, *species*, and *acronym* of the relevant ICES expert group.

Stock ID	Stock name	Last updated	Link
alf-comb	Alfonsinos/Golden eye perch (*Beryx* spp.) in the Northeast Atlantic	March 2012	Alfonsinos NEA
arg-icel	Greater silver smelt (*Argentina silus*) in Division Va and XIV	February 2010	GSS Va
arg-123a4	Greater silver smelt (*Argentina silus*) in Subareas I and II (Northeast Atlantic)	Needs new stock annex	NA
arg-5b6a	Greater silver smelt (*Argentina silus*) Divisions Vb and VIa (Northeast Atlantic)	Needs new stock annex	NA
arg-rest	Greater silver smelt (*Argentina silus*) in Division VIb and Subareas VII, VIII, IX, X and XII (other areas)	Needs new stock annex	NA
bli-5a14	Blue ling (*Molva dypterygia*) in Division Va and Subarea XIV (Iceland and Reykjanes ridge)	March 2011	Blue ling Va&XIV
bli-5b67	Blue ling (*Molva dypterygia*) in ICES Division Vb and Subareas VI and VII	March 2014	Blue ling Vb, VI&VII
bli-oth	Blue ling (*Molva dypterygia*) in Divisions IIIa, and IVa and Subareas I, II, VIII, IX, and XII	March 2011	Blue ling other
bsf-nea	Black scabbardfish (*Aphanopus carbo*) in Subareas I, II, IV, VI-VIII, X, XIV and Divisions IIIa, Va,Vb, IXa and XIIb (Northeast Atlantic)	March 2014	Black scabbard NEA
gfb-comb	Greater forkbeard (*Phycis blennoides*) in all ecoregions	March 2015	Greater forkbeard combined
lin-arct	Ling (*Molva molva*) in Subareas I and II	March 2011	Ling I&II
lin-faro	Ling (*Molva molva*) in Division Vb	March 2013	Ling Vb
lin-icel	Ling (*Molva molva*) in DivisionVa	February 2014	Ling Va
lin-oth	Ling in (*Molva molva*) Divisions IIIa and IVa, and in Subareas VI, VII, VIII, IX, XII, and XIV (other areas)	March 2011	Ling other
ory-comb	Orange roughy (*Hoplostethus atlanticus*) IN I, II, IIIa, IV, V, VI, VII, VIII, IX, X, XII, XIV	March 2011	Orange roughy combined

Stock ID	Stock name	Last updated	Link
rng-1012	Roundnose grenadier (*Coryphaenoides rupestris*) in Mid-Atlantic Ridge (Divisions Xb, XIIc and Subdivisions Va1, XIIa1, XIVb1)	March 2012	Roundnose grenadier MAR
rng-5b67	Roundnose grenadier (*Coryphaenoides rupestris*) in Division Vb and Subareas VI, VII and Division XIIb	April 2014	Roundnose grenadier Vb, VI, VII&XIIb
rng-kask	Roundnose grenadier (*Coryphaenoides rupestris*) in Division IIIa	March 2011	Roundnose grenadier IIIa
rng-oth	Roundnose grenadier (*Coryphaenoides rupenstris*) in all other areas (I, II, IV, Va2, VIII, IX, XIVa, and XIVb2)	Needs new stock annex	NA
sbr-678	Red (=blackspot)Seabream (*Pagellus Bogaraveo*) in Subareas VI, VII & VIII	March 2015	Red seabream VI, VII&VIII
sbr-ix	Red (=blackspot) seabream (*Pagellus bogaraveo*) in Subarea IX	March 2015	Red sea bream IX
sbr-x	Red (=blackspot) seabream (*Pagellus bogaraveo*) in Subarea X (Azores region)	February 2010	Red sea bream X
tsu-nea	Roughsnout grenadier (*Trachyrincus scabrus*) in the Northeast Atlantic	Needs new stock annex	NA
usk-arct	Tusk (*Brosme brosme*) in Subareas I and II (Arctic)	March 2011	Tusk I&II
usk-icel	Tusk (Division Va and Subarea XIV)	March 2011	Tusk Va&XIV
usk-mar	Tusk (*Brosme brosme*) on the Mid-Atlantic Ridge (Subdivisions XIIa1 and XIVb1)	March 2011	Tusk MAR
usk-oth	Tusk (*Brosme brosme*) in Divisions IIIa, Vb, VIa, and XIIb, and Subareas IV, VII, VIII, and IX (other areas)	March 2011	Tusk other
usk-rock	Tusk (*Brosme brosme*) in VIb (Rockall)	March 2011	Tusk VIb