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14–20 March 2013

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International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 Executive summary

WGDEEP met at ICES Headquarters in Copenhagen, Denmark on 14–20 March 2013. The group was chaired by Tom Blasdale from the UK. Terms of Reference of the Working Group are given in Section 2.

For all of the stocks assessed by WGDEEP, 2013 was the second year in a biennial advice schedule, meaning that no new advice was required this year. 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.

For some fisheries, significant discrepancies were found between official landings data supplied to ICES and scientific estimates of catches. 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 working group evaluated the harvest control rule (HCR)for data-limited stocks developed by WKLIFE2, providing generic commentary on the application of the HCR to deep-water stocks in the ICES area and specific comments on the application of the HCR in the 2012 advisory process with respect to specific stocks assessed by WGDEEP. To further develop methods to provide quantitative advice consistent with the MSY framework, WGDEEP has applied a new approach to Productivity Susceptibility Analysis (PSA) using orange roughy stocks to the west of the British Isles as a case study (Chapter 15).

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 depletion at the finest spatial resolution possible by ICES subarea and division (Chapter 16).

The working group considered the timing and frequency of management advice for deep-water stocks taking into consideration recommendations previously made by ICES Workshop on Frequency of Assessments 2012 (WKFREQ) and the Deepfishman project. WGDEEP's recommendations are presented in Chapter 17.

2 Introduction

WGDEEP met at ICES Headquarters in Copenhagen, Denmark on 14–20 March 2013. The group was chaired by Tom Blasdale from the UK.

Sixteen participants from nine countries 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 WKLIFE2 and further develop methods to provide quantitative advice consistent with the MSY framework for stocks assessed by WGDEEP.

c) Complete the development of stock annexes for all the stocks assessed by WGDEEP.

d) 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.

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

f) Assess the progress on the benchmark preparation for WKDEEP 2014, including blue ling in Vb, VI and VII, black scabbardfish in Vb, VI, and VII, black scabbardfish in IXa, and ling in Va.

g) In order to support a rolling provision of advice, biennial or less frequency, the working group is asked to propose a schedule of assessments, to provide advice on a rolling basis over the period 2013–2015 for all the stocks in the group. The aim of this schedule should be to have advice every year for a subset of the stocks. The guidance from ACOM and WKLIFE should be considered in this regard. Considering the considerations of ACOM, WKLIFE and WKFREQ.

This was coordinated as indicated in the table below.

Fish Stock	Stock name	Stock Coord.	Assess. Cood.	Advice
alf-comb	Alfonsinos/Golden eye perch (*Beryx* spp.)	Portugal (Azores)	UK (England and Wales)	Biennial 2nd year
arg-icel	Greater silver smelt in Subdivision Va	Norway	UK (England and Wales)	Biennial 2nd year
arg-rest	Greater silver smelt in other areas (Subdivisions I, II, IIIa, IV, Vb, VI, VII, VIII, IX, X, XII, and XIV)	Norway	UK (England and Wales)	Biennial 2nd year
bli-5a14	Blue ling in Subdivisions Va and XIV	UK (England and Wales)	UK (England and Wales)	Biennial 2nd year
bli-5b67	Blue ling in Subdivisions Vb, VI, and VII	UK (England and Wales)	UK (England and Wales)	Biennial 2nd year
bli-rest	Blue ling in other areas (Subdivisions I, II, IIIa, IVa, VIII, IX, and XII)	UK (England and Wales)	UK (England and Wales)	Biennial 2nd year
bsf-89	Black scabbardfish (*Aphanopus carbo*) in Divisions VIII and IX	Portugal	UK (England and Wales)	Biennial 2nd year
bsf-nort	Black scabbardfish (*Aphanopus carbo*) in in Subareas VI, VII, and Divisions Vb, XIIb	Portugal	UK (England and Wales)	Biennial 2nd year
bsf-rest	Black scabbardfish (*Aphanopus carbo*) in all the other areas	Portugal	UK (England and Wales)	Biennial 2nd year
gfb-comb	Greater forkbeard (*Phycis blennoides*) in the Northeast Atlantic	Spain (AZTI)	UK (England and Wales)	Biennial 2nd year
lin-arct	Ling (*Molva molva*) in Divisions I and II	Norway	UK (England and Wales)	Biennial 2nd year
lin-icel	Ling (*Molva molva*) in Subdivision Va	Norway	UK (England and Wales)	Biennial 2nd year
in-faro	Ling (*Molva molva*) in Subarea Vb	Norway	UK (England and Wales)	Biennial 2nd year
lin-rest	Ling (*Molva molva*) in Divisions IIIa and IVa, and in Subareas VI, VII, VIII, IX, XII, and XIV	Norway	UK (England and Wales)	Biennial 2nd year
ory-comb (ory-scrk; ory-vii; ory-rest)	Orange roughy (*Hoplostethus atlanticus*) in Notheast Atlantic	Ireland	UK (England and Wales)	Biennial 2nd year
rng-1012;	Roundnose grenadier (*Coryphaenoides rupenstris*) in Mid-Atlantic Ridge (Xb, XIIc, Va1, XIIa1, XIVb1)	France	UK (England and Wales)	Biennial 2nd year
rng-nsea	Roundnose grenadier (*Coryphaenoides rupenstris*) in Division IIIa	France	UK (England and Wales)	Biennial 2nd year
rng-675b	Roundnose grenadier (*Coryphaenoides rupenstris*) in Subareas VI and VII, and Divisions Vb and XIIb	France	UK (England and Wales)	Biennial 2nd year
rng-rest	Roundnose grenadier (*Coryphaenoides rupenstris*) in Northeast Atlantic	France	UK (England and Wales)	Biennial 2nd year
sbr678	Red (=blackspot) seabream in Subareas VI, VII and VIII	Spain (IEO)	UK (England and Wales)	Biennial 2nd year
sbr-ix	Red (=blackspot) seabream in Subarea IX	Spain (IEO)	UK (England and Wales)	Biennial 2nd year
sbr-x	Red (=blackspot) seabream in Subarea X	Portugal	UK (England and Wales)	Biennial 2nd year
usk-arct	Tusk in Subareas I and II (Arctic)	Norway	UK (England and Wales)	Biennial 2nd year

Fish Stock	Stock name	Stock Coord.	Assess. Cood.	Advice
usk-icel	Tusk in the Iceland Grounds (Fishing Area Va)	Norway	UK (England and Wales)	Biennial 2nd year
usk-mar	Tusk in Division XIIb (Mid Atlantic Ridge)	Norway	UK (England and Wales)	Biennial 2nd year
usk-rest	Tusk in Divisions IIIa, Iva, Vb, VI, VII, VIII, IX and XIIa (other areas)	Norway	UK (England and Wales)	Biennial 2nd year
usk-rock	Tusk in Division Vb (Rockall)	Norway	UK (England and Wales)	Biennial 2nd year
oth-comb	Other deep-sea species combined	Ireland	UK (England and Wales)	Collated data

For all of the stocks assessed by WGDEEP, 2013 was the second year in a biennial advice schedule, meaning that no new advice was required this year. 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.

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 in 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 Greenland and Iceland Seas

This section gives a very broad and general overview of the ecosystem, fishery, fleet and species composition of the commercially landed species as well as management measures in the Icelandic Exclusive Economic Zone and in Greenland waters. The Icelandic zone covers a number of different ICES statistical regions. These include parts of IIa2, Va1, Va2, Vb1b, XIIa4, XIVa and XIVb2. Although the Icelandic EEZ covers quite a number of different areas, in practice, the Icelandic landings of different species are generally reported as catches/landings in Va.

The information presented here is based to a large extend on the information presented in the NWWG and WGRED reports.

3.1.1 Fisheries overview

Iceland

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

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

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

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

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

- Boats using jiggers. These are small boats (<10 GRT). Cod is the most important target species of this fleet with saithe following as the second most important species.
- Boats using Danish seine. (20–300 GRT). The most important species for this fleet are cod and haddock but this fleet is the most important fleet fishing for a variety of flat fish like plaice, dab, lemon sole and witch.

The total catch in Icelandic waters in 2011 amounted to 1151 thousand tonnes where pelagic fish amounted to 773 thousand tonnes, and deep-sea species amounted to around 343 thousand tonnes (Figure 3.1.1; Table 3.1.1).

Greenland

There is no directed fishery for any of the species dealt with in this working group in ICES XIV. A number of the species are, however, taken as very small bycatches in the fishery for Greenland halibut in XIVb. Roundnose grenadier is the only species for which catches have been reported though the years. There were no catches reported by Greenland or other countries (EU, Norway) in 2011.

Fisheries targeting marine resources off Greenland can be divided into inshore and offshore fleets. The Greenland fleet has been built up through the 1960s and is today comprised of 450 ships with an inside motor and a large fleet of small boats. It is estimated that around 1700 small boats are dissipating in some sort of artisanal fishery mainly for private use or in the poundnet fishery.

There is a large difference between the fleet in the northern and southern part of Greenland. In south, where the cod fishery was a major resource the average vessel age is 22 years, in north only nine years.

Inshore fleet

The fleet is constituted by a variety of different platforms from dog sledges used for ice fishing, to small multipurpose boats engaged in whaling or deploying mainly passive gears like gillnets, poundnets, traps, dredges and longlines. West Greenland water is ice free all years up to Sisimiut at 67°N.

In the northern areas from the Disko Bay at 72°N and north to Upernavik at 74°30N, dog sledge are the platforms in winter and small open vessels the units in summer, both fishing with longlines to target Greenland halibut in the icefjords. The main bycatch from this fishery is redfish, Greenland shark, roughhead grenadier and in recent years cod in Disko Bay.

The inshore shrimp fisheries are departed along most of the West coast from 61–72°N. The main bycatch with the inshore shrimp trawlers is juvenile redfish, cod and Greenland halibut. An inshore shrimp fishery is conducted mainly in Disko Bay but also occasional in fjords at southwest Greenland. Most of the small inshore shrimp trawlers have dispensation for using sorting grid, which is mandatory in the shrimp fishery.

Cod is targeted all year, but with a peak time in June–July, and poundnet and gillnet are main gear types. Bycatches are mainly the Greenland cod (*Gadus ogac*) and wolffish.

In the recent years there has been an increasing exploitation rate for lumpfish. Fishing season is rather short, around April and along most of the West coast the roe is landed. Bycatch is mainly comprised of seabirds (eiders). The scallop fishery is conducted with dredges at the West coast from 64–72°N, with the main landings (<3000 t) at 66°N. Bycatch in this fishery is considered insignificant. Fishery for snow crab is presently the fourth largest fishery in Greenland waters measured by economic value. The snow crabs are caught in traps in areas 62–70°N. Problems with bycatch are at present unknown. A small salmon fishery with driftnets and gillnets are conducted in August to October, regulated by a TAC.

Offshore fleets

Apart from the Greenland fleet resources are exploited by several nations mainly EU, Iceland, Norway and Russia. Recently, Greenland halibut and redfish were targeted using demersal otter-board trawls with a minimum mesh size of 140 mm since 1985.

Cod fishing has ceased since 1992 in the West Greenland offshore waters, but started again in the 2000s. In 2010 the fishery was closed off West Greenland. In East Greenland the fishery has been closed north of 62°N since 2008 in order to protect cod spawning grounds. The Greenland offshore shrimp fleet consists of 15 freezer trawlers. They exclusively target shrimp stocks off West and East Greenland, landing in 2011 around 128 000 and 1084 t, respectively. The shrimp fleet is close to or above 80 BT and 75% of the fleet process the shrimps onboard. They use shrimp trawls with a minimum mesh size of 44 mm and a mandatory sorting grid (22 mm) to avoid bycatch of juvenile fish. The three most economically interesting species, redfish, cod and Greenland halibut are only found in relatively small proportions of the bycatch.

The longliners are operating on the east coast with Greenland halibut and cod as targeted species. Bycatches for the longliners fishing for Greenland halibut are roundnose grenadier, roughhead grenadier, tusk and Atlantic halibut, and Greenland shark (Gordon *et al*., 2003). Some segments of the longline fleet target Atlantic halibut.

At the east coast an offshore pelagic fleet targets redfish, a rather clean fishery without any significant bycatches, in the Irminger Sea and extending south of Greenland into NAFO area. There used to be a capelin fishery but it ceased in 2009.

3.1.2 Trends in fisheries

Iceland

Tusk, ling and blue ling remains the most important "deep-sea species" in Icelandic waters). In recent years, about 120 vessels were engaged in these fisheries with registered annual catches from less than 100 kg to nearly 1000 tonnes. In 2011 about 13 000 tonnes of deep-water species were caught in bottom-trawl, plus 11 000 t of greater silver smelt. There has been an increase in the landings of ling, tusk and blue ling in the period 2006–2010, with a slight drop in 2011(Figure 3.1.1). The increase in the two former stocks was a consequence of increase in quota (a TAC is not set for blue ling). Since 2008 the longline fishery for blue ling seems to have changed from almost a pure bycatch fishery to a more targeted fishery (Figure 3.1.3). This trend is against ICES advice (ACOM May 2008 and 2010 which states that *"There should be no directed fisheries for blue ling in Areas Va and XIV and measures should be implemented to minimize bycatches in mixed fisheries. Blue ling is susceptible to sequential depletion of spawning aggregations and therefore closed areas to protect spawning aggregations should be maintained and expanded where appropriate."*

Table 3.1.1 gives the catches of the Icelandic fleet of the most important deep-sea species taken by different gears in 2007 to 2010 and Table 3.1.2 gives the total landings of deep-sea species from Subdivision Va since 2000.

Greenland

In the last century the main target species of the various fisheries in Greenland waters have changed. A large international fleet landed in the 1950s and 1960s, large catches of cod reaching historic high in 1962 with about 450 000 t. The offshore stock collapsed in the late 1960s early 1970s due to heavy exploitation and changes in environmental conditions. Since then the stock remained depended on occasional Icelandic larval cod transported. From 1992 to 2004 the biomass of offshore cod at West Greenland has been negligible, but increased in the late 2000s due to incoming cod from Iceland (2003 YC). Since 2010 the cod biomass has been concentrated in the spawning grounds off East Greenland. In 1969 the offshore shrimp fishery started and has been increasing ever since reaching a historic high of 157 000 t in 2006. Recent catches however indicate a decline in the shrimp fishery.

There is no directed fishery for the stocks covered by WGDEEP in Greenland waters.

3.1.3 Technical interactions

Iceland

The ling, blue ling and tusk in Icelandic waters constitute only a minor portion of the total demersal removal from the Icelandic Ecosystem (Figure 3.1.2). These three species are to some extent bycatch in fisheries targeting other species; both in the longline (Figure 3.1.3) and the bottom-trawl (Figure 3.1.4) fisheries. As stated above, this may be changing in the longline fishery for blue ling, but also for ling and tusk. Greater silver smelt on the other hand is targeted in the trawl fishery (Figure 3.1.4).

The geographical distribution of bottom-trawl catches of ling and blue ling overlap to a large extent with those that are the main target species, among other being Greenland halibut, *Sebastes* sp., saithe and cod (Figure 3.1.5).

However some limited targeted longline fishery of ling and in particular tusk takes place. For the latter species, there are indications that the fishery in the southwest of the Icelandic fishing area on the Reykjanes is directed at tusk, with relatively little catch of other species (Figure 3.1.6).

Greenland

As stated above there are no directed fisheries for the stocks covered by WGDEEP in Greenland waters. However tusk is caught as a bycatch in the longline fishery targetting cod off the east coast.

3.1.4 Ecosystem considerations

Iceland

Iceland is located at the junction of the Mid-Atlantic Ridge and the Greenland-Scotland Ridge, just south of the Arctic Circle. This is reflected in the topography around the country. Generally hard bottom is found in shallower areas, while softer sediments dominate in the troughs and outside the continental slope. The shelf around Iceland is narrowest off the south coast and is cut by submarine canyons around the country.

The Polar Front lies west and north of Iceland and separates the cold and southward flowing waters of Polar origin from the northward flowing waters of Atlantic origin. South and east of Iceland the North Atlantic Current flows towards the Norwegian Sea. The Irminger Current is a branch of the North Atlantic Current and flows northwards over and along the Reykjanes Ridge and along the western shelf brake. In the Denmark Strait it divides into a branch that flows northeastward and eastward to the waters north of Iceland and another branch that flows southwestwards along the East Greenland Current. In the Iceland Sea north of Iceland a branch out of the cold East Greenland Current flows over the Kolbeinsey Ridge and continues to the southeast along the northeastern shelf brake as the East Icelandic Current, which is part of a cyclonic gyre in the Iceland Sea., and continues into the Norwegian Sea along the Atlantic water flowing eastwards over the Iceland–Faroes Ridge (Stefansson, 1962; Valdimarsson and Malmberg, 1999).

The Icelandic Shelf is a high (150–300 gC/m2-yr) productivity ecosystem according to SeaWiFS global primary productivity estimates. Productivity is higher in the southwest regions than to the northeast and higher on the shelf areas than in the oceanic regions (Gudmundsson, 1998). In terms of numbers of individuals, copepods dominate the mesozooplankton of Icelandic waters with *Calanus finmarchicus* being the most abundant species, often comprising between 60–80% of net-caught zooplankton in the uppermost 50 m (Astthorsson and Vilhjalmsson, 2002; Astthorsson *et al*., 2007).

The underlying features which appear to determine the structures of benthic communities around Iceland are water masses and sediment types. Accordingly, the distribution of benthic communities is closely related to existing water masses and, on smaller scale, with bottom topography (Weisshappel and Svavarsson, 1998). Survey measurements indicate that shrimp biomass in Icelandic waters, both in inshore and offshore waters, has been declining in recent years. Consequently the shrimp fishery has been reduced and is now banned in most inshore areas. The decline in the inshore shrimp biomass is in part considered to be environmentally driven, both due to increasing water temperature north of Iceland and due to increasing biomass of younger cod, haddock and whiting.

Based on information from fishermen, eleven coral areas were known to exist close to the shelf break off northwest and southeast Iceland at around 1970. Since then more coral areas have been found, reflecting the development of the bottom-trawling fisheries extending into deeper waters in the 1970s and 1980s. At present considerably large coral areas exist on the Reykjanes Ridge and off southeast Iceland. Other known coral areas are small (Steingrímsson and Einarsson, 2004). Since January 1st 2006, five areas, covering 80 km^2 have been closed to all fishing except those targeting pelagic fish.

The database of the BIOICE programme provides information on the distribution of soft corals, based on sampling at 579 locations within the territorial waters of Iceland. The results show that gorgonian corals occur all around Iceland. They were relatively uncommon on the shelf (<500 m depth) but are generally found in relatively high numbers in deep waters (>500 m) off south, west and north coasts of Iceland. Similar patterns were observed in the distribution of pennatulaceans off Iceland. Pennatulaceans are relatively rare in waters shallower than 500 m but more common in deep waters, especially off South Iceland (Guijarro *et al*., 2006).

Iceland is a partner in the European project CoralFISH, started in 2008 to investigate the interaction between cold-water corals, fish and fisheries and develop monitoring and predictive modelling tools for ecosystem based management. Most coral areas investigated have been damaged by fishing activity to different extents (Anon., 2009; Ólafsdóttir and Burgos, unpublished).Icelandic waters are comparatively rich in species and contain over 25 commercially exploited stocks of fish and marine invertebrates. Main species include cod, haddock, saithe, redfish, Greenland halibut and various other flatfish, wolffish, tusk (*Brosme brosme*), ling (*Molva molva*), herring, capelin and blue whiting. Most fish species spawn in the warm Atlantic water off the south and southwest coasts. Fish larvae and 0-group drift west and then north from the spawning grounds to nursery areas on the shelf off northwest, north and east Iceland, where they grow in a mixture of Atlantic and Arctic water.

Capelin is important in the diet of cod as well as a number of other fish stocks, marine mammals and seabirds. Unlike other commercial stocks, adult capelin undertake extensive feeding migrations north into the cold waters of the Denmark Strait and Iceland Sea during summer. Capelin abundance has been oscillating on roughly a decadal period since the 1970s, producing a yield of up to 1600 Kt at the most recent peak. In recent years the stock size of capelin has decreased from about 2000 Kt in 1996/1997 to about 1000 Kt in 2006/2007 (NWWG, 2007). Herring were very abundant in the early 1960s, collapsed and then have increased since 1970 to a historical high level in the last decade. Abundance of demersal species has been trending downward irregularly since the 1950s, with aggregate catches dropping from over 800 Kt to under 500 Kt in the early 2000s.

A number of species of sharks and skates are known to be taken in the Icelandic fisheries, but information on catches is incomplete, and the status of these species is not known. Information on status and trends of non-commercial species are collected in extensive bottom-trawl surveys conducted in early spring and autumn, but information on their catches in fisheries, is not available.

The seabird community in Icelandic waters is composed of relatively few but abundant species, accounting for roughly ¼ of total number and biomass of seabirds within the ICES area. Auks and petrel are most important groups comprising almost $^3/_5$ and $^1/_4$ of abundance and biomass in the area, respectively. The estimated annual food consumption is on the order of 1.5 million tonnes.

At least twelve species of cetaceans occur regularly in Icelandic waters, and additional ten species have been recorded more sporadically. In the continental shelf area minke whales (*Balaenoptera acutorostrata*) probably have the largest biomass. According to a 2001 sightings survey, 67 000 minke whales were estimated in the Central North Atlantic stock region, with 44 000 animals in Icelandic coastal waters (NAMMCO 2004). Two species of seal, common seal (*Phoca vitulina*) and grey seal (*Halicoerus grypus*) breed in Icelandic waters, while five northern vagrant species of pinnipeds are found in the area.

Ecosystem considerations

After 1996 a rise in both temperature and salinity were observed in the Atlantic water south and west of Iceland. Temperature and salinity have remained at similar high levels since and west of Iceland amounts to an increase of temperature of about 1°C and salinity by one unit. These are notorious changes for Atlantic water in this area. Off central N-Iceland similar changes have been observed although with higher interannual variability. This period has been characterized with an increase of temperature and salinity in the winter north of Iceland in the last ten years is on average about 1.5°C and 1.5 salinity units.

It appears that these changes have had considerable effects on the fish fauna of the Icelandic ecosystem. Species which are at or near their northern distribution limit in Icelandic waters have increased in abundance in recent years. The most obvious examples of increased abundance of such species in the mixed water area north of Iceland are haddock, whiting, monkfish, ling, tusk, greater silver smelt, blue ling lemon sole and witch. The semi-pelagic blue whiting has lately been found and fished in E-Icelandic water in far larger quantities than ever before.

On the other hand, cold-water species like Greenland halibut and northern shrimp have become scarcer. Capelin have both shifted their larval drift and nursing areas far to the west to the colder waters off E-Greenland, the arrival of adults on the overwintering grounds on the outer shelf off N-Iceland has been delayed and migration routes to the spawning grounds off S- and W-Iceland have been located farther off N- and E-Iceland and not reached as far west along the south coast as was the rule in most earlier years. The change in availability of capelin in the traditional grounds may have had an effect on the growth rate of various predators, as is reflected in low weight of cod in recent years.

There is one demersal stock, which apparently has not taken advantage, or not been able to take advantage, of the milder marine climate of Icelandic waters. This is the Icelandic cod, which flourished during the last warm epoch, which began around 1920 and lasted until 1965. By the early 1980s the cod had been fished down to a very low level as compared to previous decades and has remained relatively low since. During the last 20 years the Icelandic cod stock has not produced a large year class and the average number of age 3 recruits in the last 20 years is about 150 million fish per annum, as compared to 205–210 recruits in almost any period prior to that, even the ice years of 1965–1971.

Greenland

The marine ecosystem around Greenland is located from arctic regions to subarctic regions. The water masses in East Greenland are composed of the polar East Greenland Current and the warm and saline Irminger Current. As the currents rounds Cape Farewell at Southernmost Greenland the Irminger water subducts the polar water and mix extensively and forms the relatively warm West Greenland Current. The Irminger Current play a key role in the transport of larval and juvenile fish from spawning grounds south and west of Iceland to nursery areas, not only off N- and E-Iceland but also across to E- and then W-Greenland. In recent years spawning cod has been observed on the banks of East Greenland, eggs and larvae from these cod are also being transported with the current to West Greenland.

Depending on the relative strength of the two East Greenland currents, The Polar Current and the Irminger Current, the marine environment experiences extensive variability with respect to temperature and speed of the West Greenland Current. The general effects of such changes have been increased bio-production during warm periods as compared to cold ones, and resulted in extensive distribution and productivity changes of many commercial stocks. Historically, cod is the most prominent example of such a change.

In recent years temperature have increased significant in Greenland water to about 2°C above the average for the historic average, with historic high temperatures registered in 2005 (50 years' time-series). Recently increased growth rates for some fish stocks as indicated from the surveys might be a response of the stock to such favourable environmental conditions. As has been observed with the Icelandic cod stock an important interaction between cod and shrimp exist and with a historic large shrimp biomass in West Greenland water in present time feeding conditions would be optimal for fish predators such as cod (Hvingel and Kingsley, 2006).

In recent years more southerly distributed species such as monkfish, lemon sole, saithe and whiting has been observed on surveys in offshore West and East Greenland and inshore West Greenland.

3.1.5 Management measures

Iceland

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

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

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

With the extension of the fisheries jurisdiction to 200 miles in 1975, Iceland introduced new measures to protect juvenile fish. The mesh size in trawls was increased from 120 mm to 155 mm in 1977. Mesh size of 135 mm was only allowed in the fisheries for redfish in certain areas. Since 1998 a mesh size of 135 is allowed in the codend in all trawl fisheries not using "Polish cover". A quick closure system has been in force since 1976 with the objective to protect juvenile fish. Fishing is prohibited for at least two weeks in areas where the number of small fish in the catches has been observed by inspectors to exceed certain percentage. If, in a given area, there are several consecutive quick closures the Minister of Fisheries can with regulations close the area for longer time forcing the fleet to operate in other areas. Such permanent closure took place at several places along the south–southeast area for tusk in 2003 (Figure 3.1.5). Inspectors from the Directorate of Fisheries supervise these closures in collaboration with the Marine Research Institute. In 2005, 85 such closures took place.

In addition to allocating quotas on each species, there are other measures in place to protect fish stocks. Based on knowledge of the biology of various stocks, many areas have been closed temporarily or permanently aiming at protect juveniles. Figure 3.1.7 shows a map of such legislation that was in force in 2004. Some of them are temporarily, but others have been closed for fishery for decades.

Greenland

Management of the inshore fleets is regulated by licences, TAC, mesh size, grids, minimum landing size and closed areas for the Atlantic cod, snow crab, scallops, salmon and shrimp. Fishery for Greenland cod and lumpfish are unregulated.

The demersal and pelagic offshore fishing is managed by TAC, minimum landing sizes, gear specifications and irregularly closed areas.

Table 3.1.1. Overview of the Icelandic deep-sea landings (in tonnes) in Icelandic waters (Va) in 2007 to 2011 by gear type.

Species	Fishing Gear	2007	2008	2009	2010
Ling	Bottom-trawl	1395	1509	1540	1535
	Danish seine	238	290	428	404
	Gillnet	633	476	723	363
	Lobster trawl	243	416	653	981
	Longline	4042	5002	6229	6529
	Other gears	49	35	39	55
	Total	6600	7736	9613	9867
Blue ling	Bottom-trawl	1483	2081	2079	1900
	Danish seine	44	54	63	92
	Gillnet	22	28	136	91
	Lobster trawl	55	29	166	283
	Longline	375	1454	1679	3978
	Other gears	17	7	9	33
	Total	1995	3653	4132	6377
Tusk	Bottom-trawl	95	114	107	92
	Gillnet	38	43	72	52
	Hook	9	5	8	5
	Lobster trawl	9	12	8	5
	Longline	4833	6756	6755	6760
	Other gears	2	2	3	3
	Total	5986	6932	6954	6917
Greater silver smelt	Bottom-trawl	4108	8774	10 825	16 429
	Pelagic trawl	108	4	4	185
	Total	4226	8778	10 829	16 428

Table 3.1.2. Total landings of deep-sea species (other than blue ling, tusk, ling and greater silver smelt)in ICES Subdivision Va.

Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ALFONSINOS (*Beryx* spp.)								0	0	0	0
BLACK SCABBARDFISH (*Aphanopus carbo*)	18	8	13	0	0	19	23	1	0	15	109
BLUEMOUTH (*Helicolenus dactylopterus*)								0	0	0	0
GREATER FORKBEARD (*Phycis blennoides*)						0	0	1	3	2	1
MORIDAE							0	0	0	0	0
ORANGE ROUGHY (*Hoplostethus atlanticus*)	68	19	10	+		9	2	0	4	1	1
RABBITFISH (Chimaerids)	5						1	1	1	2	7
ROUGHHEAD GRENADIER (*Macrourus berglax*)	2	1	4	33	3	5	7	2	0	5	23
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	54	40	60	57	181	76	62	16	29	46	59
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)								0	0	0	0
SHARKS, VARIOUS	45	57				54	0	2	43	0	43
WRECKFISH (*Polyprion americanus*)								0	0	0	

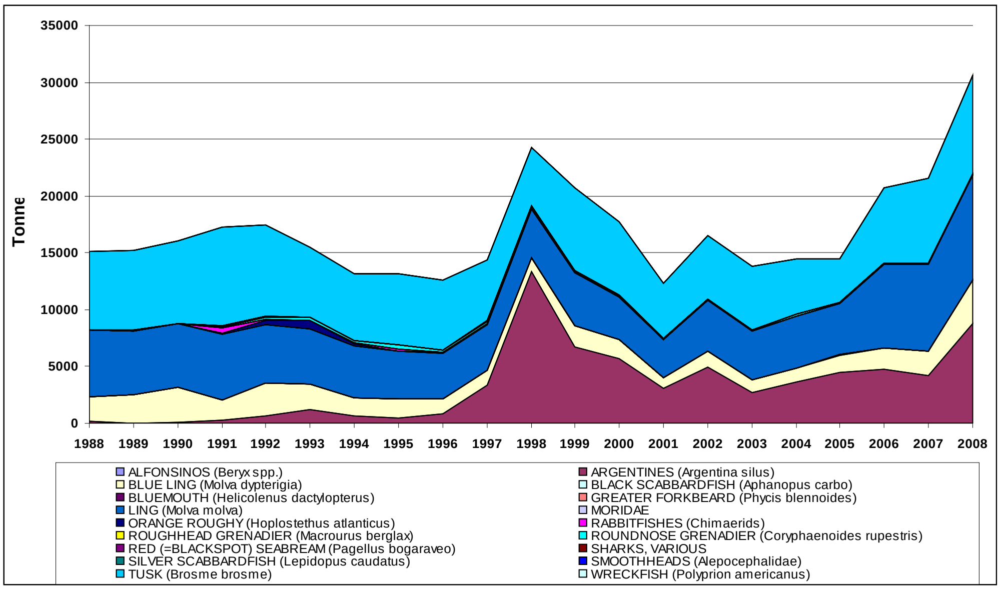


Figure 3.1.1. Fishery of deep-sea species in Subdivision Va 1988–2008, by species.

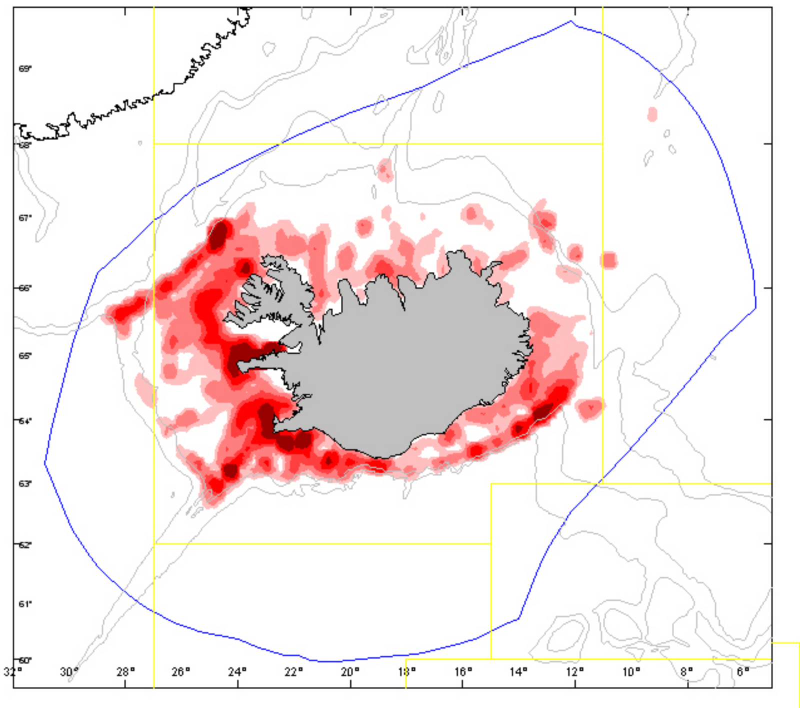


Figure 3.1.2. The spatial distribution of the total removal of all species by the Icelandic demersal fishing fleet in the Icelandic EEZ in 2007. The EEZ is shown as a blue line, regular thin lines show major ICES areas and contour lines indicate 500 and 1000 m depth.

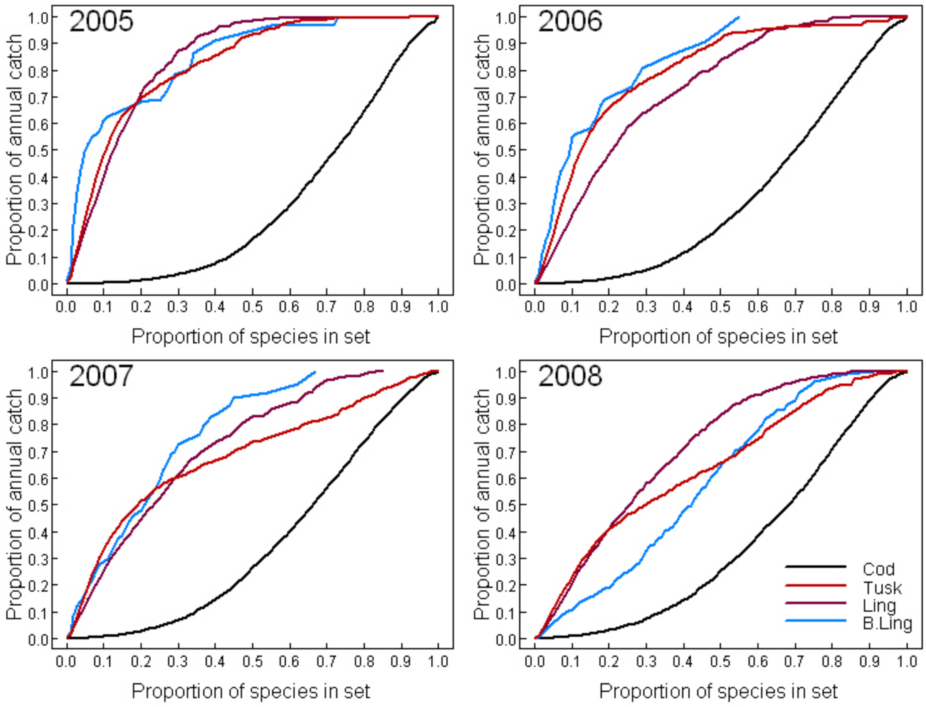


Figure 3.1.3. Cumulative plot for longline in 2005–2008. An example describes this probably best. Looking at the figure for 2005 above it can be seen from the solid line that 50% of the catch of ling comes from sets where tusk is less than 15% of the total catch whereas only insignificant % of the catch of cod sets where it is less than 15% of the total catch in each set. Over 90% of ling catches are caught where ling is less than about 30% of total catches in given set. For comparison, only around 15% of cod is caught in sets where cod is less than 50% of the total catch.

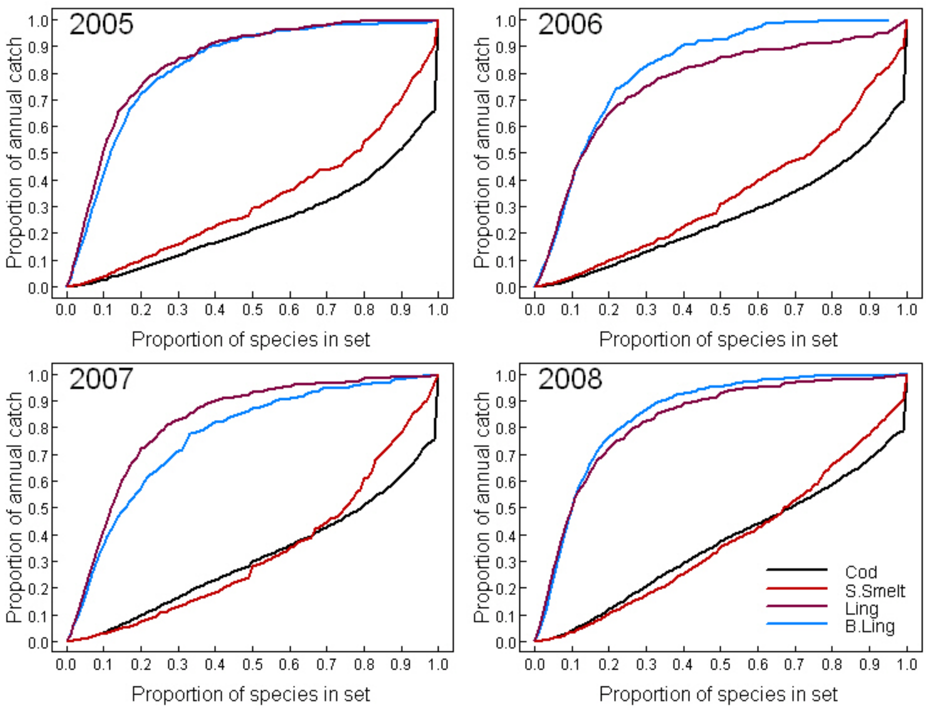


Figure 3.1.4. Cumulative plot for bottom trawl in 2005–2008. See Figure 3.1.3 for details.

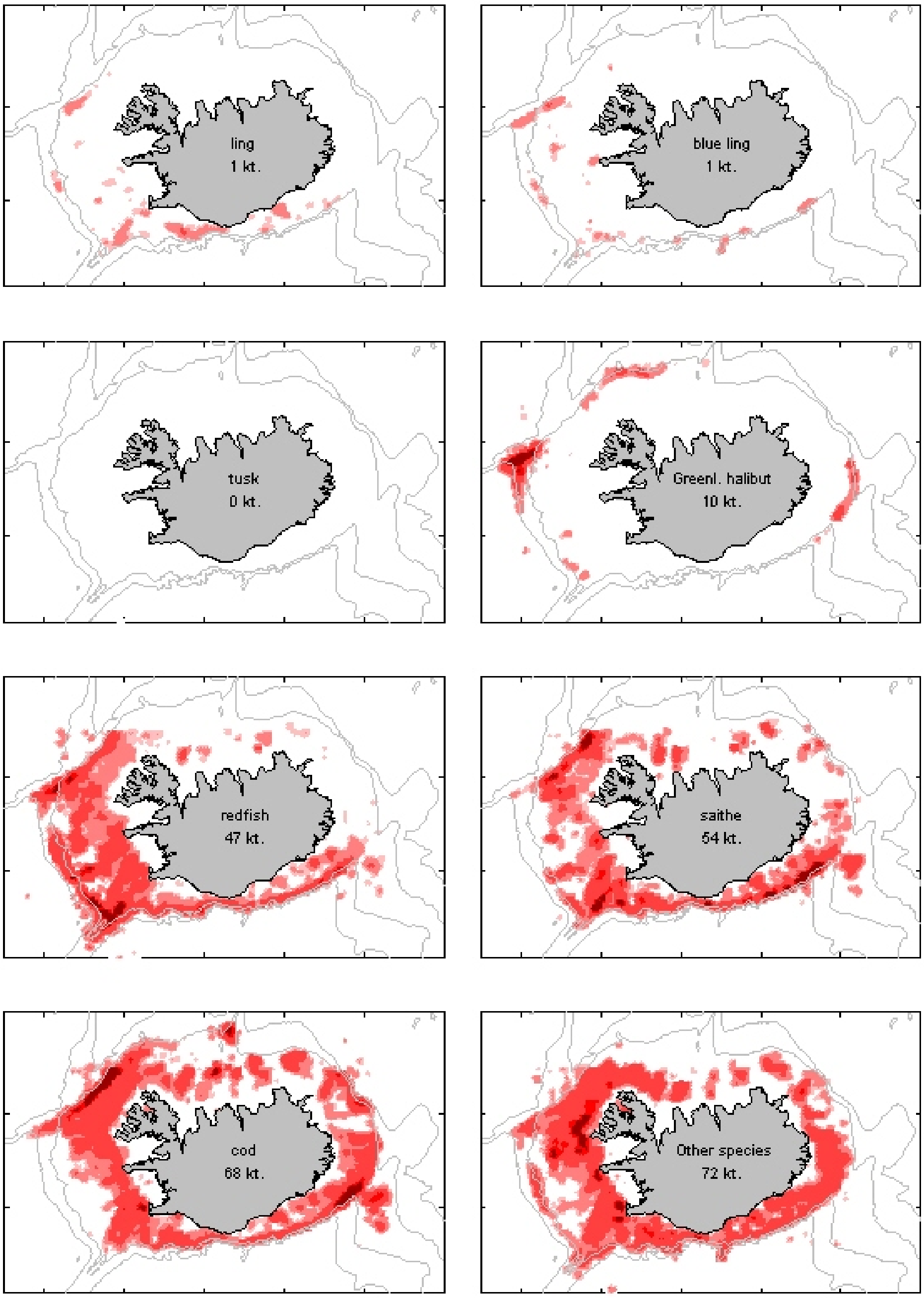


Figure 3.1.5. Spatial distribution of the removal of various species by the bottom trawling in 2007. The densities scale is comparable among the figures. The total catch by species is shown in units of thousand tonnes (kilotonnes). The grey lines correspond to 500 and 1000 meter depth contours.

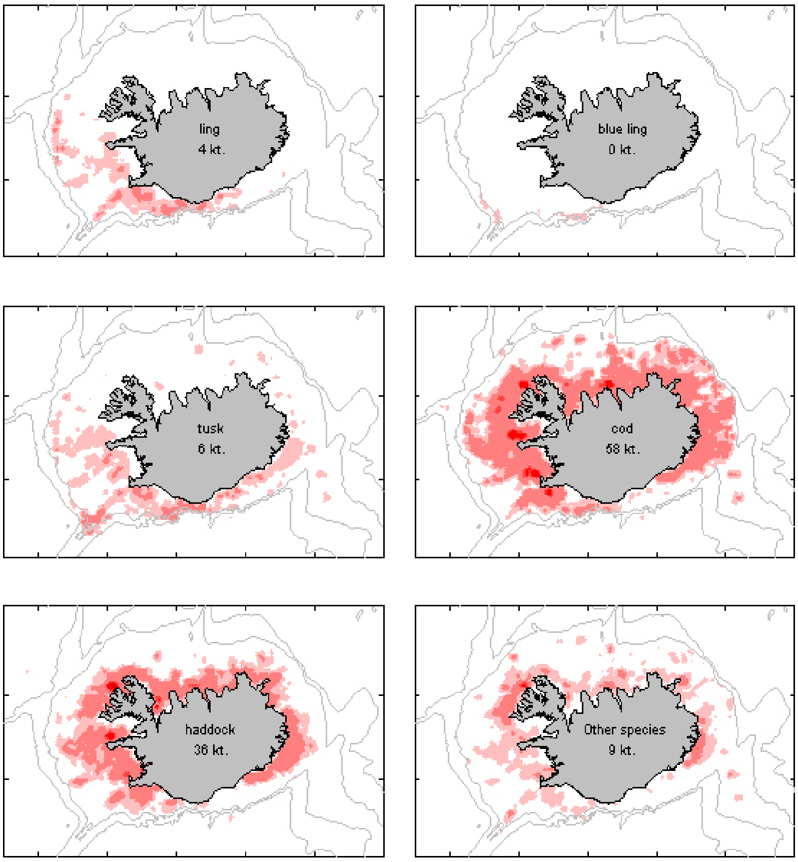


Figure 3.1.6. Spatial distribution of the removal of various species by the long lining in 2007. The densities scale is comparable among the figures. The total catch by species is shown in units of thousand tonnes (kilotonnes). The grey lines correspond to 500 and 1000 meter depth contours.

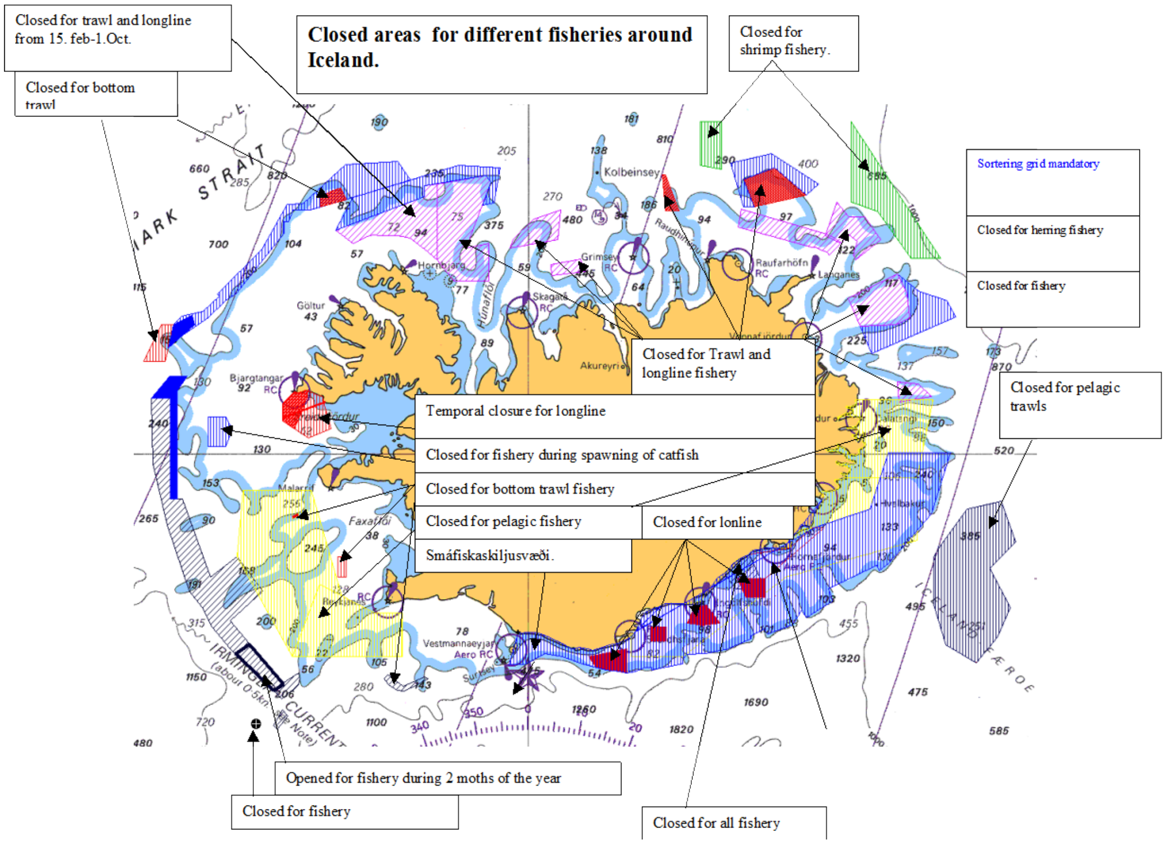


Figure 3.1.7. Overview of closed areas around Iceland. The boxes are of different nature and can be closed for different time period and gear type.

3.2 Stocks and fisheries of the Barents Sea and Norwegian Sea

3.2.1 Fisheries overviews I and II

In Subareas I and II three species, ling (*Molva molva*), tusk (*Brosme brosme*) and greater silver smelt (*Argentina silus*) make up almost 99 per cent of the landed catches (Table 3.2.1 and Figure 3.2.1). Ling and tusk are mainly caught by longliners and a small proportion is caught in gillnets. Greater silver smelt are caught by bottom and mid-water trawls. Minor catches of other species, which are mainly taken as bycatches, include roughhead grenadier (*Macrourus berglax*), greater forkbeard (*Phycis blennoides*), roundnose grenadier (*Coryphaenoides rupestris*), rabbitfish (Chimaerids) and blue ling (*Molva dypterigia*). Norway lands by far the largest amount of the three species. The Faroes, France, Germany, Russia, Scotland, Ireland and England and Wales report small bycatch landings of ling, blue ling and tusk. Occasional landings of these species in the direct fishery for greater silver smelt were reported by the Netherlands and as bycatches by Germany, Russia, Scotland and the Faroes.

Longline fisheries

The longline fishery for ling (*Molva molva*) and tusk (*Brosme brosme*) has for many years been the most targeted deep-sea fishery in Norway (e.g. Bergstad and Hareide, 1996). The number of fishing vessels over 21 m targeting ling, tusk and blue ling has declined from 72 in 2000 to 36 in 2012 (Table 3.2.2). The number of vessels declined during this period mainly as a consequence of changes in the laws concerning quotas for catching cod.

Trawl fisheries

Argentina silus has been targeted in trawl fisheries off mid-Norway (Division IIa) since the late 1970s, especially in the southern southeast area off the coast of Norway. The fishery has changed to be dominated by semi-pelagic trawlers operating further north but still off the coast of Norway at deeper areas and along the continental slope. This fishery effort directed at *A. silus* varied and was highly correlated with market demand. In Division IIa landings declined from approximately 10 000–11 000 t in the mid-1980s to about half that level in the 1990s. During the period 2004–2006 there was a large increase in landings resulting in a Norwegian TAC set to 12 000 tons from 2007 and onwards. Landings in have since then reflected the TAC.

Gillnet fisheries

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

3.2.2 Trends in fisheries

Landing statistics for Subareas I and II for the period 1988–2012 are given in Table 3.2.1.

Tusk, ling and blue ling

There was a steady decline in the landings of tusk during the period 1988 through 2005 and the landed catches have declined from almost 20 000 tons at the end of the eighties to about 7000 tons in 2005. During the last years the reported catches has increased significantly compared to the level in 2005. Preliminary landings for 2012 is about 10 379 tonnes. Landings of ling have remained stable at 10 000 tons. Preliminary landings in 2012 are 9343 tons. Blue ling landings declined markedly from 1988 through 1993, and the catches have been at a low level until 2012 (Figure 3.2.2).

Greater silver smelt

During the period 1988–2000 there was a slight downwards trend in the landed catches. From 2000 through 2006 there was an increase in the landed catches to about 22 000 tons. Preliminary data for 2012 demonstrate that the catches have declined level around the TAC set for this area (Figure 3.2.2).

3.2.3 Ecosystem considerations

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

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

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

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

No new information was provided to the working group.

3.2.4 Management measures

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 quota for the EU for bycatch species such as ling and tusk in Norwegian waters of Areas I and II is in 2012 set to 5000 t. There is no minimum landing size in the Norwegian EEZ. There is no directed fishery for blue ling and a 10% bycatch is allowed from other fisheries in Norwegian waters for this species.

The total TAC for greater silver smelt in Subarea I and II in 2012 was 12 000 t. The Norwegian greater silver smelt fishery has since 2007 been regulated by a Norwegian TAC. In addition, the EU sets TACs and quotas applicable to EC vessels fishing in community waters and international waters of Subarea I and II.

Table 3.2.1. Overview of landings in Subareas I and II. * Preliminary data.

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

Table 3.2.1. Overview of landings in Subareas I and II, continued.

Species	2006	2007	2008	2009	2010	2011	2012
ALFONSINOS (*Beryx* spp.)							
ARGENTINES (*Argentina silus*)	21 685	13 273	11 876	11929	11843	11476	12116
BLUE LING (*Molva dypterigia*)	202	262	333	285	426	437	337
BLACK SCABBARDFISH (*Aphanopus carbo*)							
BLUEMOUTH (*Helicolenus dactylopterus*)							
GREATER FORKBEARD (*Phycis blennoides*)	49	47	117	76	128	113	99
LING (*Molva molva*)	8845	10 338	11 339	8400	10580	10099	9343
MORIDAE							
ORANGE ROUGHY (*Hoplostethus atlanticus*)							
RABBITFISH (*Chimaerids*)	28	63	80	88	197	150	TOM?
ROUGHHEAD GRENADIER (*Macrourus berglax*)	78	50	55	53	45	29	54
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	8	12	9	9	21	31	5
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)							
SHARKS, VARIOUS			1				
SILVER SCABBARDFISH (*Lepidopus caudatus*)							
SMOOTHHEADS (*Alepocephalidae*)							
TUSK (*Brosme brosme*)	9988	10 744	11 883	9629	12658	11646	10 379
WRECKFISH (*Polyprion americanus*)							

Table 3.2.2. Number of vessels exceeding 21 m in the Norwegian longliner fleet during the period 1995–2012.

Year	Number of longliners
1995	65
1996	66
1997	65
1998	67
1999	71
2000	72
2001	65
2002	58
2003	52
2004	43
2005	39
2006	35
2007	38
2008	36
2009	34
2010	35
2011	37
2012*	36

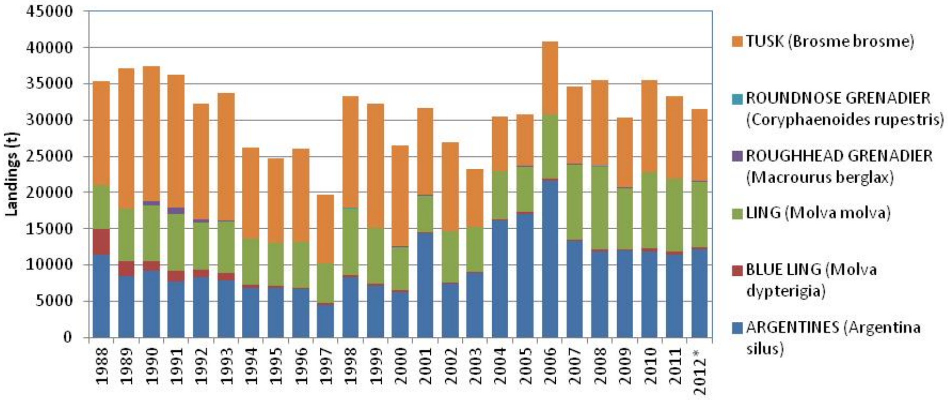


Figure 3.2.1. Trends in the landings in Subareas I and II. Landings of roundnose and roughhead grenadier are insignificant in Subareas I and II. * Preliminary data.

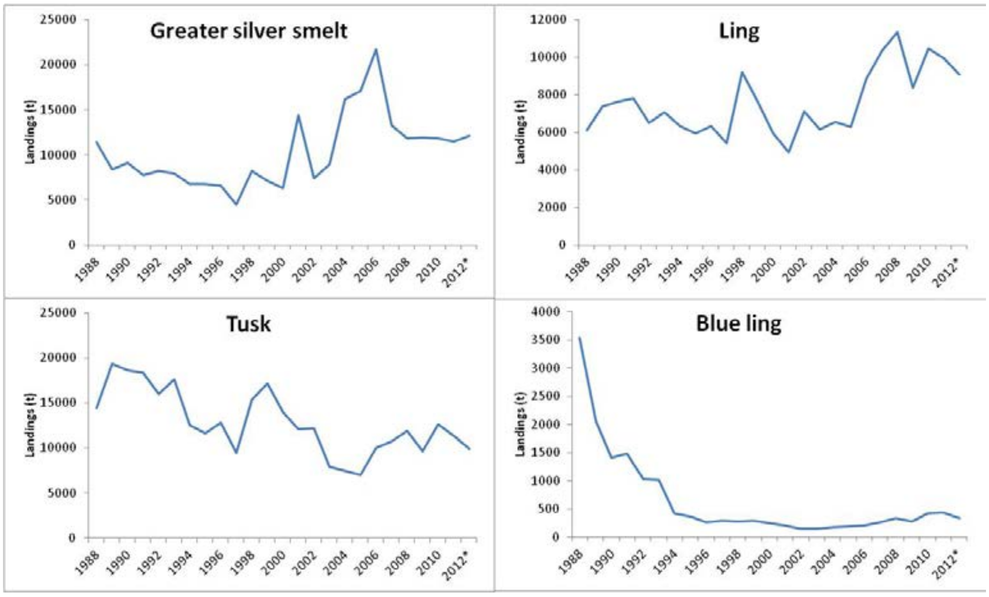


Figure 3.2.2. Trends in the landings of argentines, tusk, ling and blue ling in Subareas I and II. Landings are in different scales. * Preliminary data.

3.3 Stocks and fisheries of the Faroes

3.3.1 Fisheries overview

Fisheries in Faroese waters (Division Vb)

The fishery around the Faroe Islands has for centuries been an almost free international fishery involving several countries. Up to 1959, all vessels were allowed to fish around the Faroes outside the 3 nm zone. During the 1960s, the fisheries zone was gradually expanded, and in 1977 an EEZ of 200 nm was introduced in the Faroe area. The demersal fishery by foreign nations has since decreased and Faroese vessels now take most of the catches. The main fisheries in Faroese waters are mixed-species, demersal fisheries and single-species, pelagic fisheries. The demersal fisheries are mainly conducted by Faroese vessels, but vessels from other nations are still participating like Norwegian longliners and EU trawlers licensed through bilateral and multilateral agreements. Due to a dispute on mackerel regulations, no such bilateral agreement has been in force between the Faroes and Norway and EU for 2011 onwards. The major part of the pelagic fisheries is conducted by foreign vessels through similar agreements.

3.3.2 Trends in fisheries

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

The main deep-water fleet consists of about 13 otter board trawlers with engines larger than 2000 Hp. They have traditionally targeted saithe, redfish *(Sebastes spp.)*, Greenland halibut, blue ling and to a lesser degree black scabbardfish *(Aphanopus carbo)* and roundnose grenadier *(Coryphaenoides rupestris)*. There has been an increased effort in Faroese waters as the deep-water fleet has reduced its effort in other areas. This has resulted in increased effort on black scabbardfish, roundnose grenadier and blue ling in Vb with a corresponding increase in the landings of these species. However, due to poor economic conditions especially the very high fuel prices, the number of vessels has declined in the most recent years and the effort towards deep-water species has declined further due to a switch to pair-trawling targeting mainly saithe.

The traditional longline fleet fishing ling, tusk and blue ling consist of 24 longliners larger than 110 GRT; they are mainly targeting cod and haddock and in years where the availability of these species is high and market conditions satisfactory, they spend very little effort in deep water. There has been a more directed fishery of ling and tusk in 2011 and 2012 because of lower availability of cod and haddock.

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

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

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

3.3.3 Technical interaction

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

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

	Year	Longliners <110 GRT	Longliners >110 GRT	OB trawlers <1000 HP	OB trawlers >1000 HP	Pair-trawlers <1000 HP	Pair-trawlers >1000 HP	Others
Ling	2007	9	48	2	19	5	15	2
	2008	8	65	1	8	3	10	5
	2009	3	56	1	3	5	30	2
	2010	3	68	1	2	4	21	1
	2011	7	58	1	1	3	27	3
	2012	4	61	0	2	5	25	3
Blue ling	2007	0	16	0	83	+	+	1
	2008	0	24	0	69	0	1	5
	2009	0	29	0	64	1	2	4
	2010	0	21	0	73	1	4	1
	2011	3	42	3	34	4	14	0
	2012	4	66	0	12	1	14	3
Tusk	2007	9	74	1	10	1	3	2
	2008	9	81	0	6	1	2	1
	2009	4	80	0	5	1	8	1
	2010	3	88	0	3	1	5	0
	2011	7	85	1	2	1	4	0
	2012	4	90	0	1	1	5	0

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

3.3.4 Ecosystem considerations

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

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

No new information was presented to the working group.

3.3.5 Management measures

Since 1 June 1996, a management system based on a combination of area closures and individual transferable effort quotas in days within fleet categories have been in force. The individual transferable effort quotas apply to 1) the longliners less than 110 GRT, the jiggers, and the single trawlers less than 400 HP, 2) the pair trawlers and 3) the longliners greater than 110 GRT. One fishing day by longliners less than 100 GRT is considered equivalent to two fishing days for jiggers in the same gear category. Longliners less than 110 GRT could therefore double their allocation by converting to jigging. The allocation of number of fishing days is based on areas shallower than about 200 m. Holders of individual transferable effort quotas who fish in deeper waters can fish for three days for each day allocated. The single trawlers greater than 400 HP are not regulated through number of fishing days, but the numbers of fishing licences have been settled for this fleet as well as for the gillnetters and they are regulated by depth of fishing as well. Trawlers are not allowed to fish within the 12 nautical mile limit and large areas on the shelf are closed to them. Inside the 6 nautical miles limit only longliners less than 110 GRT and jiggers less than 110 GRT are allowed to fish. The Faroe Bank shallower than 200 m is closed to all trawl and gillnet fisheries. From 2011 onwards, the otter-board trawler fleet larger than 400 HP has been included in the day effort system and most of them have now been included into category 2), the pair trawlers, since they have switched to pair trawling.

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

As mentioned above, vessels from other nations are licensed to fish in Faroese waters through bilateral and multilateral agreements. Only Norway and EU have permission to fish deep-water species. From 2011 onwards, no such agreement has been in force due to a dispute on mackerel regulations. As no agreement was reached between the Faroe Islands and European Union, no fishing quota was attributed to EU vessels in 2011. This seems to remain the same in 2012. This has significant impact on deep-water catch in Division Vb where EU vessels allowed a quota of 2700 t of ling and blue ling (against which a bycatch of roundnose grenadier and black scabbardfish of 952 tonnes could be counted). The main impact of the absence of the EU-Faroe Islands agreement in 2011 was on French catches of blue ling in Divisions Vb.

Table 3.3.1. Deep-sea landings in Division Vb.

SPECIES	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
ALFONSINOS (*Beryx* spp.)			5		4			1					
ARGENTINES (*Argentina silus*)	287	227	2888	60	1443	1063	960	12286	9498	8433	17570	8214	5209
BLUE LING (*Molva dypterigia*)	9526	5264	4799	2962	4702	2836	1644	2440	1602	2798	2584	2932	2524
BLACK SCABBARDFISH (*Aphanopus carbo*)		166	419	152	33	287	160	424	186	68	180	172	311
BLUEMOUTH (*Helicolenus dactylopterus*)												64	16
DEEP WATER CARDINAL FISH (*Epigonus telescopus*)							4	3	8	8		8	2
GREATER FORKBEARD (*Phycis blennoides*)	2	1	38	53	49	27	4	9	7	7	8	34	32
LING (*Molva molva*)	4488	4652	3857	4512	3614	2856	3622	4070	4896	5657	5359	5238	4109
MORIDAE				5								1	3
ORANGE ROUGHY (*Hoplostethus atlanticus*)			22	48	13	37	170	420	79	18	3	5	155
RABBITFISHES (Chimaerids)								1				3	54
ROUGHHEAD GRENADIER (*Macrourus berglax*)										6	9	99	1
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	1	258	1549	2311	3817	1681	668	1223	1078	1112	1667	1996	1791
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)													
SHARKS, VARIOUS			140	78	164	478	192	262	380	308	433	470	409
SILVER SCABBARDFISH (*Lepidopus caudatus*)													
SMOOTHHEADS (Alepocephalidae)													
TUSK (*Brosme brosme*)	5665	5122	6181	6266	5391	3439	4316	3978	3310	3319	2710	3964	2700
WRECKFISH (*Polyprion americanus*)													

Table 3.3.1. Continued. Deep-sea landings in Division Vb.

SPECIES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ALFONSINOS (*Beryx* spp.)					2		0	0	0	0		
ARGENTINES (*Argentina silus*)	10081	7471	6558	5310	7013	12559	14126	14592	14228	15609	15071	9854
BLUE LING (*Molva dypterigia*)	2116	2024	3815	2700	2516	2850	3296	2060	1136	1684	1115	1010
BLACK SCABBARDFISH (*Aphanopus carbo*)	879	1744	1635	869	553	783	789	1868	1067	840	395	416
BLUEMOUTH (*Helicolenus dactylopterus*)				3	0		0	1				
DEEP WATER CARDINAL FISH (*Epigonus telescopus*)	7		2	1	0		0	0				
GREATER FORKBEARD (*Phycis blennoides*)	102	149	73	50	46	39	56	45	22	60		0
LING (*Molva molva*)	4609	4139	5453	6039	5849	5213	4731	4747	4630	6101	4784	6003
MORIDAE	100	19	8	1	1	5	8	4	1	11	5	5
ORANGE ROUGHY (*Hoplostethus atlanticus*)	5	1	5	7	13	0	1	0	2	0		
RABBITFISHES (Chimaerids)	96	64	61	100	63	62	78	49	6	5		
ROUGHHEAD GRENADIER (*Macrourus berglax*)	4	3	12	10	6	10	5	3		1		
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	2016	1031	1532	1575	1837	1775	1700	1112	446	369	56	16
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)												
SHARKS, VARIOUS	543					303	663	509	462	173	87	300
SILVER SCABBARDFISH (*Lepidopus caudatus*)												
SMOOTHHEADS (Alepocephalidae)				6	1		0	4				
TUSK (*Brosme brosme*)	3993	3003	3292	3643	3632	3876	3775	3750	3265	4981	3282	3793
WRECKFISH (*Polyprion americanus*)							0	0				

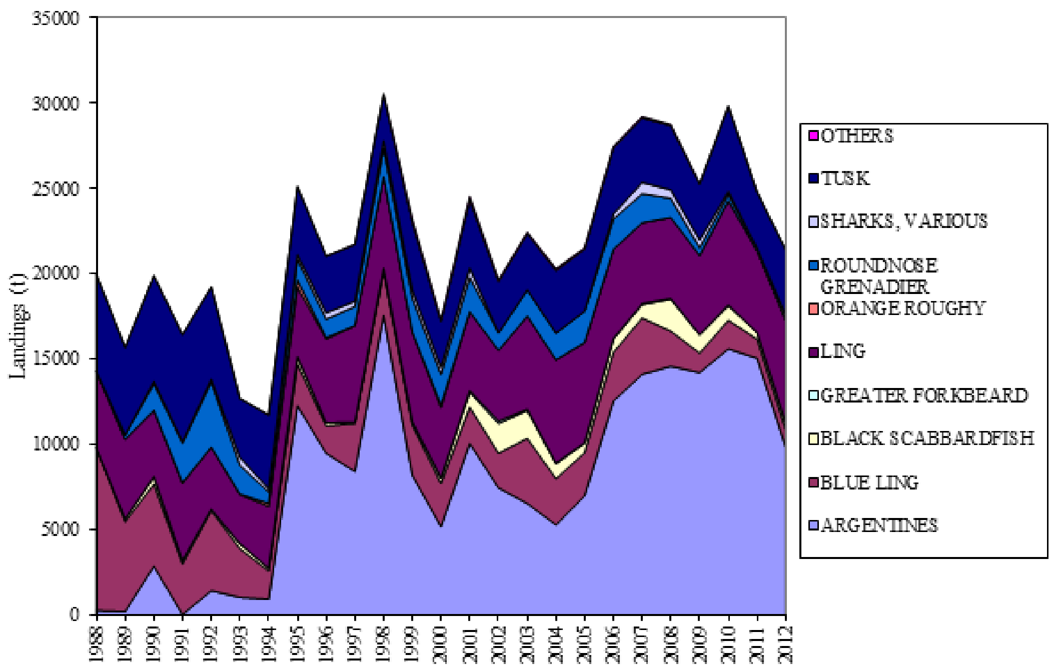


Figure 3.3.1. Annual landings of major deep-water species in Faroese waters (Vb) (1988–2012).

3.4 Stocks and fisheries of the Celtic Seas

3.4.1 Fisheries overview

Deep-water trawl fisheries are conducted in ICES Subareas VI and VII, principally by French, Irish, Spanish and Scottish vessels. Until 2012, French vessels have operated a mixed deep-water fishery mainly targeting roundnose grenadier, black scabbardfish, blue ling and siki sharks on the continental slope and offshore banks of Subarea VI and VII. In the 1990s about 45 vessels from this fleet each landed more than 50 t of deep-water species (defined as species from Annex 1 of EC regulation 2347/2002) but this decreased in the 2000s to ten vessels in 2011. The reduction by three vessels in 2011 is partly due the wreck of one vessel and the absence of agreement between the Faroe Island and the EU in 2011. Blue ling was the main target species from the early 1970s to the late 1980s, then fishing for roundnose grenadier, black scabbardfish and siki sharks developed. Some vessels from the same fleet also conducted a targeted fishery for orange roughy mainly in 1991–1992 in Division VIa and until mid-2000s in Subarea VII. Since 2003, the management (mainly TACs) has modified the fishing strategy of this fleet pushing it towards a more mixed activity between deep-water and shelf fishing.

The Irish deep-water fisheries included a mixed fishery based on the flat grounds for black scabbard, roundnose grenadier and siki sharks and a targeted orange roughy fishery on aggregations and mounds. Both fisheries have now ceased.

A number of Scottish vessels target monkfish (*Lophius* spp) on the upper continental slope and down to 1000 m of Subarea VIa and on the Rockall Bank. This fishery has a bycatch of deep-water species including ling, blue ling and siki sharks and a small number of these vessels occasionally fish in deeper water targeting roundnose grenadier and black scabbardfish.

Spanish trawlers targeting hake in Subarea VII and VI (on Porcupine, Rockall and Great Sole Banks) have a bycatch of deep-water species including ling, blue ling, greater forkbeard and blackbelly rosefish.

A fleet of 29 Spanish bottom freezer trawlers have fished in the international waters of the Hatton Bank (ICES XIIb and VIb1) over the past years, but their presence is discontinuous. A total of ten trawlers fished at Hatton in 2011 from January to October, but their number varied among months, ranging from one to nine ships and peaking in summer. Vessels conduct fishing trips of variable duration. According to scientific observer data, fishing is mostly conducted from 1000 to 1400 m. Roundnose grenadier and Baird's smoothhead (3–12 000 t per year in 1997–2011) are the most important species in the catches. Black scabbardfish (peaked at 5100 t in 2006 and has decreased since to 150 t in 2011, preliminary estimate) and blue ling (peaked at 1500 t in 2002, has decreased since to 60 t in 2011, preliminary estimate) are also caught in significant amounts. Historical data on the catch and effort of this fleet have been problematic, and the EG considered that there was misreporting of species. For example, quantities of roughhead grenadier up to 5000 t per year were reported while this species is not known to occur. Significant improvement of the data available to ICES has been made in recent years and some inconsistencies have been resolved. However, effort data, and catch and effort data by ICES rectangle have not been available.

A fleet of UK registered gillnetters operated in deep-water of Subareas VI and VII targeting hake, monkfish and deep-water sharks, this fishery was stopped or seriously reduced from 2006 as a result of regulation of deep-water gillnetting at depth below 600 m (see below, management measures).

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

There has been a UK trap fishery for deep-water red crab *Chaceon affinis* in *S*ubarea VI and VII, but this is now ceased.

3.4.2 Trends in fisheries

Total landings with time of deep-water species from Subareas VI and VII are given in Table 3.4.1. The large decrease in 2003 was the result of the introduction of EU TACs for deep-water species. There are concerns that the actual reduction in landings for countries to comply with their application of the regulation may have been slow.

Landings in 2012 should be considered preliminary.

3.4.3 Technical interactions

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

Although considered as deep-water species by WGDEEP, the depth range of ling, tusk and greater forkbeard in Subareas VI and VII extends onto the continental shelf and large quantities of these species are caught by a number of fleets and a variety of gears. Juveniles of some of the species considered by this WG are distributed in relatively shallow water and so are caught and discarded by other fisheries. This particularly applies to blackbelly rosefish, which is discarded in large quantities by vessels fishing on the continental shelf in Division VIa and on the Rockall Bank in Subarea VII, and to greater forkbeard in Subarea VII. Before the collapse of the stock, blackspot seabream also occurred on the shelf and juveniles were coastal in the summer (Lorance, 2011).

The Spanish fleet fishing on the Hatton Bank is not exclusive to this area and also works on a variety of grounds in the NE and NW Atlantic.

3.4.4 Ecosystem considerations

3.4.4.1 Aspects of the ecoregion description relevant to the deep-water

The Rockall Trough lies in Subarea VI to the west of Scotland and Ireland and is bounded to the north by the Wyville Ridge at a depth of about 500 m. This latter feature is a major faunal barrier and there is little similarity between the fish assemblages on either side of the ridge (Bergstad *et al.*, 1999; Gordon, 2001). To the west and northwest, the Rockall Trough is separated from the Icelandic basin by the Rockall Plateau and a chain of northern banks including the Rosemary, Bill Bailey and Hatton. To the west of Ireland the slope on the western edge of the Porcupine Bank is steep, while to the south, the Porcupine Seabight has more gentle slopes. The fish populations have been relatively well described in this region compared with other deep-water areas (e.g. Gordon and Duncan, 1985a and b; Gordon, 1986; Gordon and Bergstad, 1992). At any depth between about 400 and 1500 m there may be between 40 and 50 demersal species present depending on gear type. Maximum species diversity occurs between 1000–1500 m before declining markedly with depth.

Deep-water sharks, which demonstrate a greater diversity on the slope compared with continental shelf at temperate latitudes, are important predators and their removal through targeted fisheries and bycatch in trawl fisheries for other species such as roundnose grenadier is likely to have a major impact on the ecosystem. Although at a worldwide scale there are more shark species in shallow waters than at slope depths, in the northeast Atlantic and the Mediterranean the species richness of demersal sharks is higher along the slope (35 deep-water species vs. 22 occurring on the shelf). In contrast, ray species are more numerous on the shelf. Rays are caught is small numbers by deep-waters fisheries. As rather rare species they may be severely impacted by fishing but this is difficult to assess because they would require high sampling intensity. Lastly, chimaeras (five species) form a third group of *Chondrichthyans*, whose life-history and population dynamics are poorly known and which occur only in deep water.

Some deep-water species are slow growing, long-lived, late maturing and have low fecundity. Orange roughy is so far the most extreme example of the slow growing species.

Some other deep-water species such as greater forkbeard and black scabbardfish are much faster growing and blue ling is considered to have a typical gadoid life history. Therefore, deep-water species display a wide diversity of life-history characteristics.

Cold-water corals (CWCs), large sponges and the associated communities are termed Vulnerable Marine Ecosystems (VMEs). Information on known locations and the impact of fishing on VMEs, primarily CWCs, is compiled and updated by WGDEC. No exhaustive description of the distribution of VMEs exists. *Lophelia pertusa* is found on the continental slopes off Norway, Iceland, Faroes, the UK, France, Spain and Portugal as well as the Mid-Atlantic Ridge (e.g. Rogers, 1999). To the west of Scotland, *L. Pertusa* occurs from depths as shallow as 130 m down to 2000 m (Grehan *et al*., 2005; Duineveld *et al*., 2012). A dense and diverse range of megafauna are associated with *Lophelia* reefs. This includes fixed (anthipatarians, gorgonians, sponges) and mobile invertebrates (echinoderms, crustaceans). The species richness of macrofauna associated to coral reefs has been found to be up to three times higher than on surrounding sedimentary seabed (Mortensen *et al*., 1995). Several species of deep-water fish occur associated with corals, some in more abundance than in surrounding non-coral areas, but the functional links between fish and coral are still to be fully elucidated. However, it is accepted that structurally complex habitats such as corals, offer a greater diversity of food and physical shelter to fish and other macrofauna.

Other deep-water biogenic habitats with structures that stand proud of the seabed include sponge and xenophyophore fields, seafans and seapens (octocorals). Any long-lived sessile organisms that stand proud of the seabed will be highly vulnerable to destruction by towed demersal fishing gear.

3.4.4.2 Activity and pressure

Fishing has a stronger impact on species with low population productivity (Jennings *et al*., 1998; Jennings *et al*., 1999), making them particularly vulnerable to over-exploitation. This applies to both the target and non-target species. A large proportion of deep-water trawl catches can consist of unpalatable species and numerous small species, including juveniles of the target species, which are usually discarded. Based upon 55 hauls, Allain *et al*. (2003) estimated that discards represented 25 to 68% of the total catch in weight of the French mixed trawl fishery for deep-water species, depending on depth. In recent year, discards were estimated at 20–25 % of the total catch, based on the larger DCF sampling. The two reasons for the difference are the reduced fishing depth in recent years that imply a smaller proportion of smoothheads (*Alepocephalus* spp.) in the catch and the distribution of the fishery now more restricted to the West of Scotland while data from Allain *et al*. (2003) came from 47°N (west of France) or 59°N (North of Scotland).

The Baird's smoothhead (*Alepocephalus bairdii*) and the greater argentine (*Argentina silus*) made together more than 50% of the discards in weight in 2011 in the French trawl fishery (Dubé *et al*., 2012). However; a large number of other non-marketable benthopelagic species are discarded. The survival of these discards is unknown, but considered to be virtually zero because of fragility of these species and the effects of pressure changes during retrieval (Gordon, 2001). Therefore such fisheries tend to reduce the biomass and abundance of the whole fish community biomass.

The effects of fishing on the benthic habitat relates to the physical disturbance by the gear used. This includes the removal of physical features, reduction in complexity of habitat structure and resuspension of sediment. Benthic fauna in deep waters are understood to be diverse but of low productivity. Little information is available on the effects of trawling on deep-sea soft sediment habitats. Cryer *et al*., 2002 used a suite of multivariate analyses to infer that trawling probably changes benthic community structure and reduces biodiversity over broad spatial scales on the continental slope in a similar fashion to coastal systems. More attention has been paid to biogenic habitat that occurs along the slope, mainly the cold-water corals (CWC), which, in the Northeast Atlantic include the azooxanthellate scleractinarian corals *Lophelia pertusa*, *Madrepora oculata*, *Solenosmilia variabilis*, *Desmophyllum cristagalli,* and *Enallopsammia rostrata*. The main reef building species is *L. pertusa*. The other coral species often occur in association with *L. pertusa* and none has been found forming reefs without *L. pertusa* being present.

There are a number of documented reports of damage to *Lophelia* reefs in various parts of the Northeast Atlantic by trawl gear where trawl scars and coral rubble have been observed (e.g. Hall-Spencer *et al.*, 2002). Damage can also be caused on a smaller scale by static gears such as gillnets and longlines (Grehan *et al*., 2003; Durán-Muñoz *et al*., 2011). The degree of this damage depends on fishing effort (ICES, 2007b). The recovery rates for damaged coral are extremely slow (Risk *et al*., 2002).

In Divisions VI, VII and XIIb there are a number of known areas of cold-water corals. These include the shelf break to the west and north of Scotland, Rockall Bank, Hatton Bank and the Porcupine Bank. The best known site is the Darwin Mounds, located at 1000 m to the south of the Wyville Thompson Ridge. Some of these areas have been heavily impacted by deep-water trawling activities (Hall-Spencer, 2002; Grehan *et al*., 2003). A number of areas on Rockall and Hatton Banks have been closed to fishing with gears in contact with the seafloor (Figure 4.7.3).

Seamounts are widely recognized to be areas of high productivity where dense aggregations of fish can occur. The special hydrographic conditions and good availability of hard bottom are favourable for sessile suspension-feeders, which often dominate the community on seamounts (Genin *et al*., 1986). Within ICES area VI there are three documented large seamounts; Rosemary, Anton Dohrn and Hebrides Terrace. The first two of these have summits above the daytime depth of the deep scattering layer. These seamounts have been exploited from 1990 and the early 2000s. As physical structure, seamounts per se are not threatened by fishing. Threats and impacts are most relevant to the biological communities associated with seamounts rather than the physical structure of the feature itself (OSPAR Commission, 2010).

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

3.4.4.3 State

A study of the impacts of deep-water fishing to the west of Britain using historical survey data found some evidence of changes in size spectra and a decline in species diversity between pre- and post-exploitation data, but the scarce and unbalanced nature of the time-series hampered firm conclusions (Basson *et al*., 2001). A presence/absence analyses indicated a very likely decline in the abundance of the Portuguese dogfish since the 1980s.

The DEEPFISH project carried out trophic web modelling using Ecopath with Ecosym (EwE). The model reflected well the reported declining trend in biomass for most fish species since the onset of fishing. The model was used to make predictions on the future of the fishery if fishing is sustained at the 2009 levels to 2020. The model suggests that current TACs should lead to recovery of some species (roundnose grenadier, deep-water sharks), while for others the TAC would need to be lowered further still (black scabbard-fish). For other species (blue ling, orange roughy) results were unreliable. In order to demonstrate the benefits of taking an ecosystem view of the fishery, the model was used to investigate interactions between fish and fisheries in the model area (Howell *et al*., 2009; Heymans *et al*., 2011).

In the Porcupine Seabight (Subarea VII) recent studies of the changes of the deep-water fish community suggested that the abundance in number in the early 2000s was reduced to 50% of pre-exploitation period (1977–1989) abundance and that the abundance decrease extended deeper that the depth range of fishing activities (Bailey *et al*., 2009). This latter observation reported as an "unexpected phenomenon" was further explained by the spreading of the decrease number of exploited populations to the whole depth and area of distribution of these populations (Priede *et al*., 2010). This latter phenomenon is indeed an expected effect, it is the "sink" effect of fishing in a particular area and the contrary of the "spillover effect" expected from MPAs (e.g. Forcada *et al*., 2009). In a further paper, the decline in the fish community biomass, at fished depth in the same area, between the pre- and post-exploitation period was estimated to 36% (Godbold *et al*., 2012). This level of change is actually lower that the roughly 50% of virgin biomass that can be expected for communities exploited at MSY level, in an ideal situation of a balanced exploitation where all population would be affected proportionally to their resilience/vulnerability (Garcia *et al*., 2012).

3.4.5 Management measures

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

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

Council Regulation (EC) No 51/2006 banned the use of gillnets by Community vessels at depths greater than 200 m in ICES Divisions VIa,b and VIIb,c,j,k. In 2006 a derogation was introduced allowing the setting of gillnets with mesh sizes between 120 and 150 mm down to depths of 600 m. In 2008, this measure was extended to cover Subareas III and IV.

Landings of the main deep-water species caught in Subareas VI and VII are managed by EU TACs since 2003 for black scabbardfish, argentine, tusk, blue ling, ling, roundnose grenadier, orange roughy and blackspot seabream (EC regulation n° 2340/20024 of the council of 16 December 2002). In 2005, TACs were introduced for deep-water sharks and greater forkbeard (EC regulation n° 2270/2004 of the council of 22 December 2004). TACs are revised every second year. They were reduced at each revision (for 2005/2006, 2007/2008 and 2009/2010). Zero TACs are currently set for orange roughy and for deep-sea sharks from 2010.

EU-TACs for ling since 2005 and for blue ling and greater silver smelt since 2009 in Subareas, II, IV, V, VI and VII are set within the annual TAC regulation because the TAC level depends upon annual negotiations between The Faroe Islands, Norway and EU.

From 2009, in order to protect the spawning aggregations of blue ling in the ICES Subarea VIa, some areas have been defined were fishing for blue ling is strongly limited (vessels should not keep more than 6 t of blue ling per trip) from 1st of March to May 31.

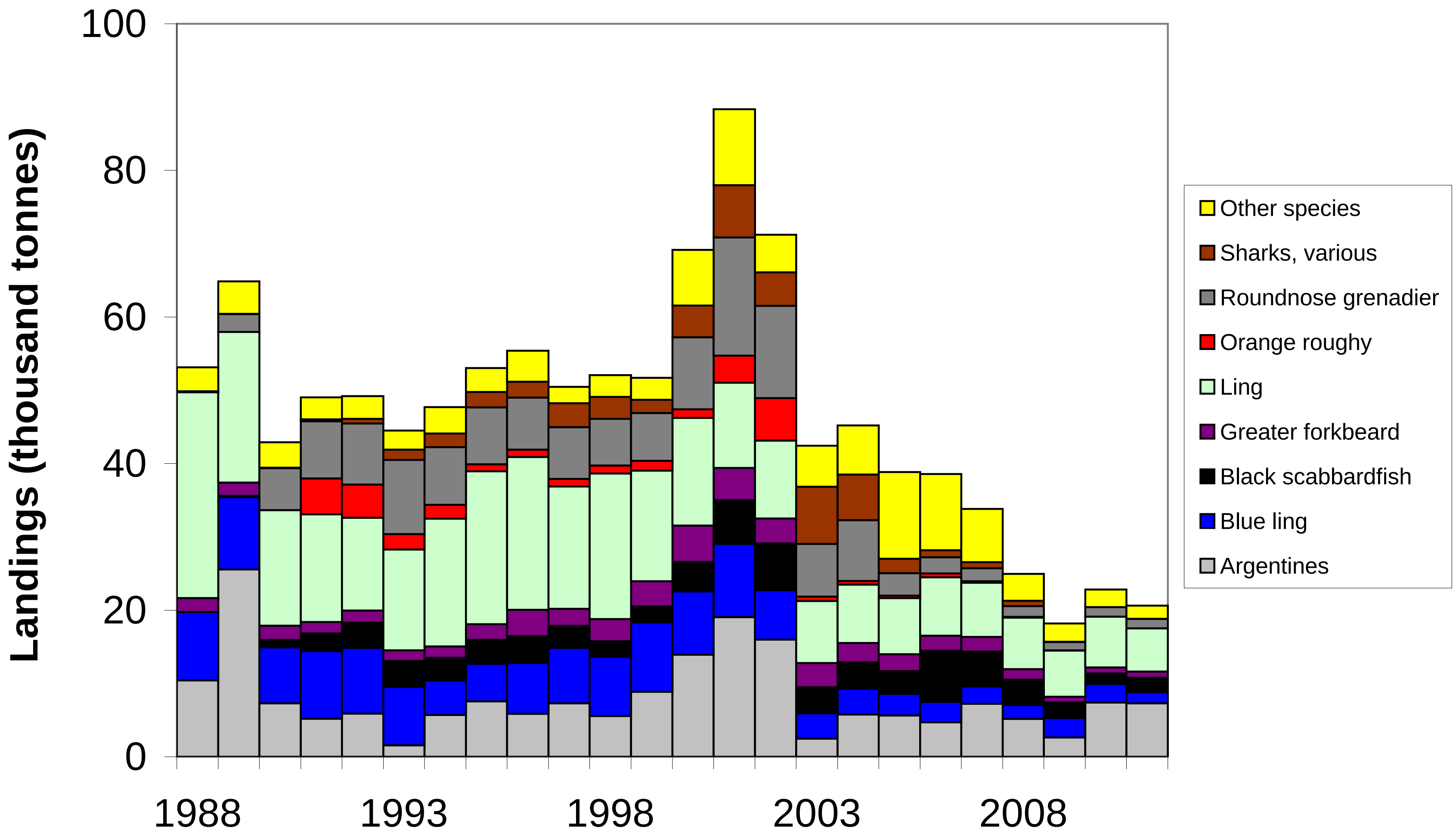


Figure 3.4.1. Landings of deep-water species from Subareas VI and VII.

Table 3.4.1. Deep-water species landings (tonnes) in Division VI and VII.

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Alfonsinos		12	8		3	1	5	3	178	25	81	75	133	186	95	84	64	70	78	65	50	7	13	
Argentines	10438	25559	7294	5197	5906	1577	5707	7546	5863	7301	5555	8856	13919	19049	15975	2476	5761	5619	4683	7233	5171	2627	7405	7279
Blue ling	9316	9850	7628	9223	8957	7953	4673	5130	6929	7569	8098	9475	8636	10013	6729	3460	3522	2965	2800	2352	1880	2660	2515	1550
Black scabbardfish	0	184	1034	2401	3436	3530	3098	3275	3678	2996	2100	2178	4038	5932	6407	3571	3623	3112	6971	4761	3476	2128	1435	1948
Bluemouth		127	100	128	159	152	117	71	87	88	145	354	332	279	196	397	433	307	219	320	257	108	75	
Deep water cardinal fish						30	217	91	45	49	115	258	302	393	985	1078	873	687	413	224	24	10	10	
Greater forkbeard	1898	1815	1921	1574	1640	1462	1571	2138	3590	2335	3040	3430	4967	4405	3417	3287	2606	2290	2081	1995	1418	796	824	843
Ling	28092	20545	15766	14684	12671	13763	17439	20856	20838	16668	19863	15087	14685	11631	10613	8445	7959	7683	7964	7419	7034	6280	6941	5915
Moridae				1	25							20	159	194	159	327	71	63	111	64	57		1	
Orange roughy		8	17	4908	4523	2097	1901	947	995	1039	1071	1337	1158	3692	5788	622	523	302	522	184	123	18	0	0
Rabbitfish							2					236	404	797	570	469	444	571	325	391	370	47	31	
Roughhead grenadier						18	5	4	13	12	10	34	11	45	12	11	33	1488	2003	1180	128	210	11	
Roundnose grenadier	32	2440	5730	7793	8338	10121	7860	7767	7095	7070	6364	6538	9815	16127	12596	7185	8297	3088	2179	1759	1460	1149	1312	1278
Blackspot seabream	252	189	134	123	40	22	10	11	29	56	17	23	20	52	25	40	55	41	63	130	63	61	62	22
Sharks, various	85	40	43	254	639	1392	1864	2099	2176	3240	3023	1791	4347	7144	4573	7781	6231	1973	966	837	732	15	0	0
Silver scabbardfish						2						18	17	6	1			57	377	88	40	44	32	
Smoothheads				31	17								978	5305	260	393	2657	5978	4966	2565	896	295	511	
Tusk	3002	4086	3216	2719	2817	2378	3233	3085	2417	1832	2240	1647	4532	2725	1817	1713	1375	1736	1639	1398	1643	1715	1638	1792
Wreckfish	7		2	10	15				83		12	14	14	17	9	2	2			2	3	8	3	
Deep-water red crab								10	1365	187	347	335	688	355	993	1083	661	810	204	836	125			

3.5 Stocks and fisheries of the North Sea (IIIa and IV)

3.5.1 Fisheries overview

The main fisheries currently catching deep-sea species in the IIIa and IV are:

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

3.5.2 Trends in fisheries

An overview of total landings is shown in Figure 3.5.1 and Table 3.5.1.

Table 3.5.2 gives an overview of the 2011 landings by country and subareas.

The fishery for roundnose grenadier in Skagerrak

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

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

The development of this fishery during the recent decade has been remarkable considering the small area. From a level of around 2000 t up to 2002, taken by a mainly a single vessel, total landings increased to nearly 12 000 t in 2005. Landings decreased, however, in 2006 to around 2300 tons due to catch restrictions following a revised EU Norway agreement aimed at this fishery. A total of only 2–3 vessels participated significantly in the fishery during the period of peak catches, 2002–2005. Since 2007 there has been no directed fishery for roundnose grenadier in Division IIIa, not because of the catch restrictions introduced in 2006 or signs of stock decline, but because the remaining single fisher retired without any successors.

3.5.3 Technical interactions

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

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

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

3.5.4 Ecosystem considerations

The deep waters of Division IIIa and Subarea IV are small and geographically isolated from other deep-sea areas. It is likely that the deep-water fauna in this region, such as roundnose grenadier, constitute separate stocks to those in the North Atlantic (Bergstad, 1990; Bergstad and Gordon, 1994; Mauchline *et al*., 1994; Bergstad *et al*., 2003), and could therefore be particularly vulnerable to localized population depletion through heavy exploitation, see Section 10.3.

There are a number sites in the northeast Skagerrak where the cold-water coral, *Lophelia pertusa* are known from and recent observations have suggested that some have been destroyed or severely damaged by trawling activities in relatively recent times (Lundälv and Jonsson, 2003). This damage was thought likely to be caused by trawling for *Pandalus borealis*.

No new information was provided to the working group.

3.5.5 Management measures

Management of fisheries in IIIa

ICES Subdivision IIIa is shared between the EU and Norway. However, according to the trilateral treaty between Denmark, Norway and Sweden (Skagerrak Treaty) fishing vessels from each of the three countries may operate freely in each country's waters. The Skagerrak treaty of 1966 is expire in summer 2012. Normally, bilateral EU-Norway agreements on the shares of TACs for the exploited fish stocks are the basis for further national management of the fisheries in IIIa. The special case of the management of the Danish fishery for roundnose grenadier in IIIa and the development of this fishery in 2006 and 2007 is described in Section 10.3.

Management of fisheries in IV

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

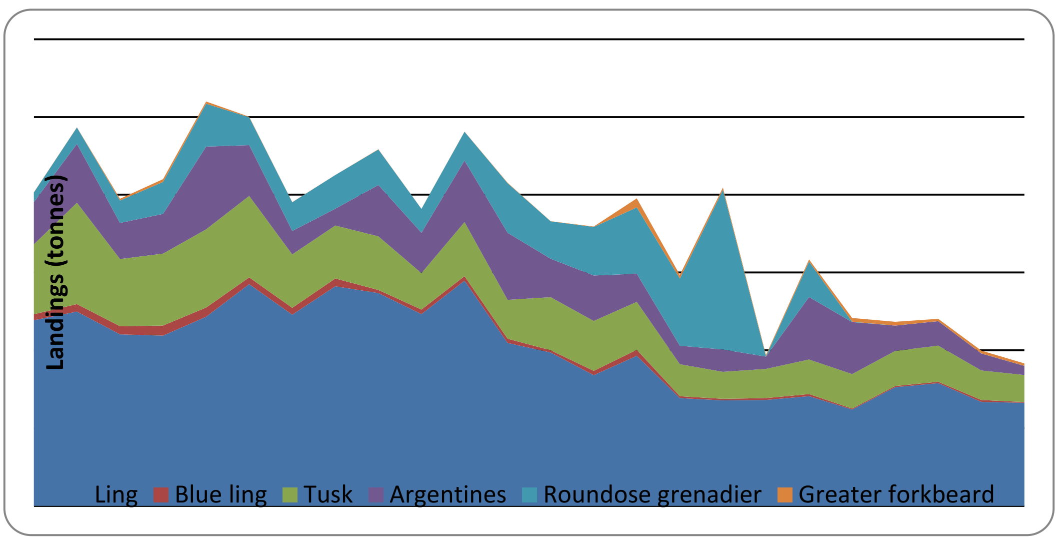


Figure 3.5.1. Overview of deep-sea species landings, over 1988–2011 (tonnes).

Table 3.5.1. Landings of Deep-sea species in Division III and IV, 1997–2011.

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

Table 3.5.1. Continued.

Species	2010	2011
ALFONSINOS (*Beryx* spp.)		
ARGENTINES (*Argentina silus*)	1081	585
BLUE LING (*Molva dypterigia*)	124	50
BLACK SCABBARDFISH (*Aphanopus carbo*)		
BLUEMOUTH (*Helicolenus dactylopterus*)		
GREATER FORKBEARD (*Phycis blennoides*)	182	159
LING (*Molva molva*)	6609	5998
MORIDAE		
ORANGE ROUGHY (*Hoplostethus atlanticus*)		
RABBITFISHES (Chimaerids)	22	6
ROUGHHEAD GRENADIER (*Macrourus berglax*)		
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	8	2
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)		
SHARKS, VARIOUS	1	
SILVER SCABBARDFISH (*Lepidopus caudatus*)		
SMOOTHHEADS (*Alepocephalidae*)		
TUSK (*Brosme brosme*)	2282	1666
WRECKFISH (*Polyprion americanus*)		

Table 3.5.2 Landings (t) by country, division and species in 2011 for Division IIIa and Subarea IV.

Country	Division	Greater Silver smelt	Blue Ling	Ling	Roundnose Grenadier	Tusk	Witch Flounder	Lantern sharks	Rabbitfish	Sharks	Greater forkbeard	Others
DK	III a											
	IV a											
	IV b											
	IV c											
UK-E+W												
	IVa			28		6						
	IVb											
	IVc											
UK-Scot												
	IVa		1	1976	2	72						
	IVb			10								
	IVc											
FRO												
	IVa											
	IVb											
	IVc											
NOR												
	IIIa			52		13			2			
	IVa	585	35	3757		1469			2		145	
	IVb		11	83		95			2		14	
	IVc											
FRA												
	IVa		1	43	6	3			0		3	
	IVb				0	1			0		1	
	IVc			0								
		585	50	5998	2	1666			6		159	

3.6 Stocks and fisheries of the South European Atlantic Shelf

3.6.1 Fisheries overview

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

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

The **French trawler fishery** mainly target demersal and pelagic species on the shelf with a small bycatch of deep-water species such as bluemouth and greater forkbeard. To the north of Subarea VIII, **a small handline fishery** targeting mainly bass and pollock (*Pollachius pollachius*) has a bycatch of red (blackspot) seabream. Until 2009, some landings of orange roughy caught to the north of Subarea VIII have occurred, from artisanal trawlers targeting this species. This activity was stopped in 2010 due to zero quota.

In ICES Subarea IX on the contrary there is a main directed **Portuguese longline fishery** for black scabbard fish (*Aphanopus carbo*) with a bycatch (now discarded since the introduction of zero EU TAC in 2010) of the deep-water sharks, and also and **Spanish longline** (Voracera) fishery for *Pagellus bogaraveo*. There is also a bottom-trawl fishery at the southern part of the Portuguese continental coastal, targeting crustaceans some on deeper grounds such as *Nephrops norvegicus* and *Aristeus antennatus* with some bycatch of deep-water species.

Unlike former years, the official Spanish landings in 2012 have been estimated from the logbooks rather than from the sale sheets. This means that landings of artisanal fleets (mainly small gillnetters and liners) are not included in the official Spanish landings reported this year to the WG. This change in reporting procedure has resulted in significant apparentchanges in the landings of theses subareas compared to the historical series in former years, especially for several species (p.e. *Helicolenus dactylopterus, Epigonus telescopus, Lepidopus caudatus, Polyprion americanus* and *Pagellus bogaraveo*).

3.6.2 Trends in fisheries

Although since 1988 from six to 17 deep species are usually landed in Areas VIII and IX, the catches of *Aphanopus carbo* (49.3%) *Lepidopus caudatus* (12.8%) *Pagellus bogaraveo* (9.7%), *Molva molva* (5.2%), *Phycis blennoides* (4.3%), *Polyprion americanus* (4.1%), *Beryx* spp (1.8%), *Helicolenus dactylopterus* (5.6%) and *Argentina sphiraena* (2.7%) represent on average the 95.4% of total subareas' landings.

Since 1988 on average 7011 t of these species are landed from these subareas. The most important peak was observed in 1995 (12 678 t) due to an increase of *L. caudatus* landings in Subarea IX (Table 3.6.1).

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

Aphanopus carbo and *Lepidopus caudatus* are the main species landed in both subareas combined, but it is worthy of remark that most of *A. carbo* and *L. caudatus* landings come from Subarea IX. Landings of Black scabbard fish never has been lower than 2400 t/year, and in 1993 reached its higher value (4524 t). Since this year the trend indicates a decrease until 2000, and after this year the average landings have been 3112 t/year.

The trend of silver scabbard fish landings is very variable along the period 1988–2006. Landings of this species have been always lower than black scabbardfish ones, except in 1995 in which 5672 t were reached. In 2000 only 16 t were reported but the landings of this species were increased to 902 t in 2011 and decreased again strongly in 2012 to 36 t (Figure 3.6.1).

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

Since the collapse of the Bay of Biscay stock in the early 1980s, the main landings of red seabream since 1988 come from Subarea IX. In European Atlantic Shelf from 1988 to 1998 the landings rank between 666 and 1175 t (on average 958 t), and from 2000 to 2012 the total landings average 596 t. However landings since 2009 decreased to a 59%.

Almost the 100% of total landings of ling come from Subarea VIII. The series shows a continuous decrease of catches from 1991 to 1994. Since this year a clear increase is observed, and in 1998 the peak of the series (1799 t) is raised. However, since the peak in 1998 landings of this species have been decreased strongly reaching only 54 t in 2011 and 203 in 2012 (Figure 3.6.1).

Geater forkbeard (*Phycis blennoides*), wreckfish (*Polyprion americanus*) and alfonsinos (*Beryx* spp.)

Since 1998 the 97% of greater forkbeard landings in Southern European Atlantic shelf belongs to Subarea VIII. The landings in the combined areas show a clear increase from 1988 to 1998 and, after the peak in 1998, the landings in 2012 have been decreased until 41 t.

The wreckfish landings do not show a clear trend, in 1994 shows a peak of 440 t but since this year the trend in landings is negative until 2004. Since this year the wreckfish shows an important increase in the landings, reaching the peak of the series with 504 ton in 2007. But in 2010 and 2011 decreased until 110 t and 112 t respectively and in 2012 increased until 256 t.

The most important landings of alfonsinos in Subareas VIII and IX ware recorded in since 1995. From 1995 to 2004 increase of landing trends is observed but since 2008 landings maintained below 100 t/year (Table 3.6.1).

3.6.3 Technical interactions

An update of information of gear interaction of Spanish fleets fishing deep-water species during the period 2005–2012 is shown in Table 3.6.2.

3.6.4 Ecosystem considerations

There is a need to evaluate the scale of impacts of lost and abandoned gillnets and trammelnets in Subareas VIII and IX.

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

No new information is available to the WG.

3.6.5 Management measures

In 2011 and 2012 TACs for the most of deep-water species were the same or set at lower levels than previous years. TACs 0 adopted in 2010 for some species as orange roughy in Subareas I, II, III, IV, V, VIII, IX, X, XI, XII and XIV, and deep-water sharks in V, VI, VII, VIII, IX and X, is still maintained for 2011 and 2012 (Council Regulation (EU) No 1225/2010). The ban on deep-water gillnetting in depths greater than 600 m does not apply to Subareas VIII and IX. There are no TACs or quotas for deep-water crab in Subareas VIII and IX.

Table 3.6.1. Overview of landings in Subareas VIII and IX.

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
ALFONSINOS (*Beryx* spp.)			1		1		2	82	88	135	269	201	167	229	237	109	280
ARGENTINES (*Argentina silus*)															346	80	23
BLUE LING (*Molva dypterigia*)										14	33	4	4	6	29	22	22
BLACK SCABBARDFISH (*Aphanopus carbo*)	2602	3473	3274	3979	4398	4524	3434	4272	3689	3555	3152	2752	2404	2767	2725	2664	2502
BLUEMOUTH (*Helicolenus dactylopterus*)		2	5	12	11	8	4			1	3	29	33	34	18	124	135
DEEP WATER CARDINAL FISH (*Epigonus telescopus*)												3	5	4	8	5	10
GREATER FORKBEARD (*Phycis blennoides*)	81	145	234	130	179	395	320	384	456	361	665	377	411	494	489	422	482
LING (*Molva molva*)	1028	1221	1372	1139	802	510	85	845	1041	1034	1799	451	331	577	439	450	527
MORIDAE								83	52	88			26	20	8	12	11
ORANGE ROUGHY (*Hoplostethus atlanticus*)	0	0	0	0	83	68	31	7	22	24	15	40	52	20	20	31	43
RABBITFISHES (Chimaerids)												2	2	7	6	2	6
ROUGHHEAD GRENADIER (*Macrourus berglax*)																	
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)			5	1	12	18	5		1		20	16	5	7	3	2	2
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)	826	948	906	666	921	1175	1135	939	1001	1036	981	647	691	553	489	560	574
SILVER SCABBARDFISH (*Lepidopus caudatus*)	2666	1385	584	808	1374	2397	1054	5672	1237	1725	966	3069	16	706	1832	1681	854
SMOOTHHEADS (*Alepocephalidae*)										7							
TUSK (*Brosme brosme*)	1										1						
WRECKFISH (*Polyprion americanus*)	198	284	163	194	270	350	410	394	294	222	238	144	123	167	156	243	141
DEEP-WATER RED CRAB (*Chaceon* spp)*																	
LESSER SILVER SMELT (*Argentina sphiraena*)**																131	189

Table 3.6.1 Continued. Overview of landings in Subareas VIII and IX.

Species	2005	2006	2007	2008	2009	2010	2011	2012*
ALFONSINOS (*Beryx* spp.)	191	94	71	101	65	40	60	79
ARGENTINES (*Argentina silus*)	202		1	11	1	0	1	7
BLUE LING (*Molva dypterigia*)	61	351	36	56	16	7	234	281
BLACK SCABBARDFISH (*Aphanopus carbo*)	2770	2726	3480	3644	3612	3454	2797	2738
BLUEMOUTH (*Helicolenus dactylopterus*)	206	279	356	345	240	120	309	1332
DEEP WATER CARDINAL FISH (*Epigonus telescopus*)	9	11	6	320	134	1	128	2
GREATER FORKBEARD (*Phycis blennoides*)	337	316	166	562	206	69	61	41
LING (*Molva molva*)	487	355	321	296	328	169	54	203
MORIDAE	15	9	18	9	6	4	18	6
ORANGE ROUGHY (*Hoplostethus atlanticus*)	27	43	1	9	17	8	1	29
RABBITFISHES (Chimaerids)	5	10	3	3	1	0	0	1
ROUGHHEAD GRENADIER (*Macrourus berglax*)		3	0	0	0	0	0	0
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	7	28	11	5	2	1	1	0
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)	584	656	718	751	809	548	475	336
SILVER SCABBARDFISH (*Lepidopus caudatus*)	526	620	654	846	931	829	902	36
SMOOTHHEADS (*Alepocephalidae*)				0	0	0	0	0
TUSK (*Brosme brosme*)		1	0	0	0	4	0	0
WRECKFISH (*Polyprion americanus*)	196	333	504	317	313	110	115	256
DEEP WATER RED CRAB (*Chaceon* spp)		305	83	0	0	0	0	0
LESSER SILVER SMELT (*Argentina sphiraena*)	223	264	180	244	153	103	137	23

*** preliminary**

Table 3.6.2. Quantitative description of fishing gears and landings (t) interaction of Spanish fleets in Subareas VIII and IX.

landings (ton)		2005		2006		2007		2008		2009		2010		2011		2012	
Species	Gear	VIII	IX	VIII	IX	VIII	IX	VIII	VIII	IX	IX	VIII	IX	VIII	IX	VIII	IX
Argentina sphyraena	LLS	0												0	0		
	GNS			0		0			0								
	OTB	32	0	261	3	184	1	237	1	2		103		115	1	22	
	Others	0	4	0										20			0
Beryx spp.	LLS	21		26	3	47	1	4		4	5		0	20	3	30	
	GNS	35		13		9	1	1		1	5		0	13	4	28	6
	OTB	19		7	2	3	4	5	1	3			0	1	1	2	0
	Others	62	6	1	2	0											
Lepidopus caudatus	LLS		449		563		645		842		894				813	0	7
	GNS											785		1		1	
	OTB		0		0		3				4			0	13	0	0
	Others	0	59		51		0		0			44		0	0	0	
Molva molva	LLS	47		48		32		34		0			0	34		149	
	GNS	16		8		7		1		0			16	3		42	
	OTB	12		17	0	8	1	8		1			4	9		9	
	Others	66	0	0										1		1	
Pagellus bogaraveo	LLS	44	334	28	369	83	404	20	439	16	594		0	39	258	80	6
	GNS	6		7		17	2	4	1	7		379	0	62	0	3	6
	OTB	16	2	21	4	47	1	15	3	1	0		0	16	0	18	20
	Others	24	29	1	66	2		2		0			2	5	1	1	3
Phycis spp.	LLS	148	0	80	1	294	3	20	14	20	5	2	1	173	7	2	0
	GNS	8	0	21	1	41	4	3	29	1	4	1	8	18	5	0	0
	OTB	97	39	84	28	113	55	56	0	58	53	0	15	38	34	13	6
	Others	0	18	0	42	0	0	0			0	20		6	14	0	0
Polyprion americanus	LLS	15	0	2	1	42	6	2	3	1	5		0	3	3	75	1
	GNS	0		0		2	6	0	0	0	4	1	0	0	1	20	0
	OTB	0	1	0	3	0	5	1	0	0	1				1	3	0
	Others	0	5	0	10							3			2	0	

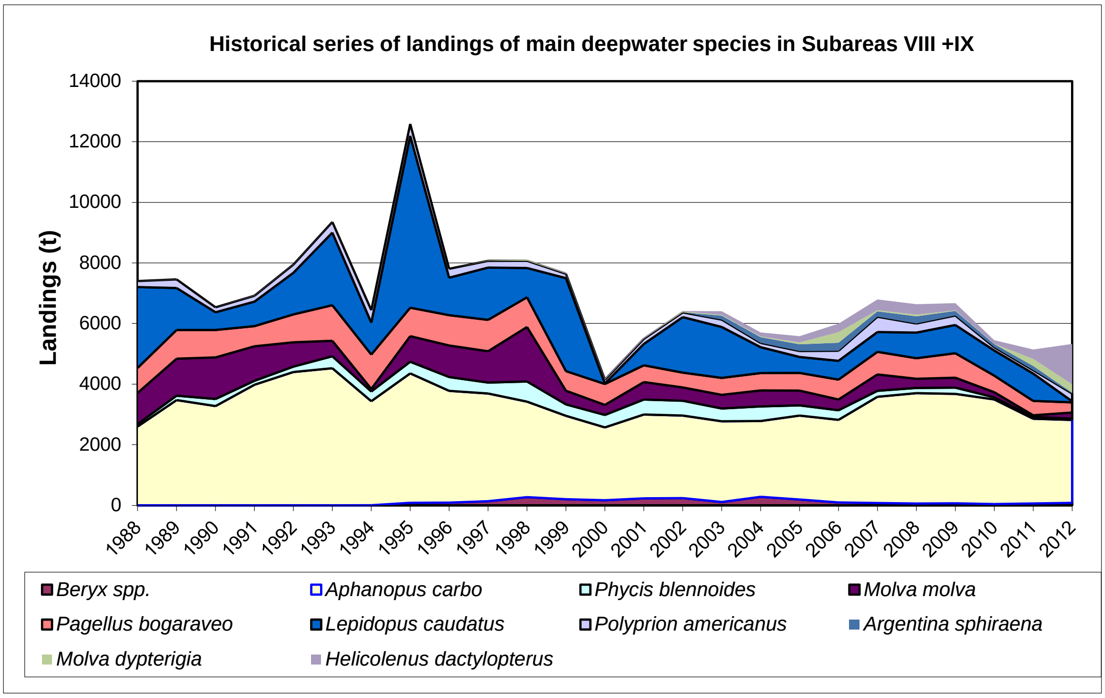


Figure 3.6.1. Historical series of the ten main species landed in combined Subareas VIII and IX since 1988.

3.7 Stocks and fisheries of the Oceanic Northeast Atlantic

3.7.1 Fisheries overview

The Mid-Atlantic Ridge (MAR) is the spreading zone between the Eurasian and American plate. The ridge is continually being formed as the two plates spread at a rate of about 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 4.7.1).

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 4.7.1) by Russian, Icelandic, Faroese, Polish, Latvian and Spanish vessels.

3.7.2 Trends in fisheries

Azores EEZ

Since the mid-1990s the landings of deep-water species show a decreasing tendency (Figure 4.7.2 and Table 4.7.2), reflecting the change in the fleet behaviour towards targeting blackspot seabream.

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 3 miles from the islands coast. As a consequence, the smaller boats that operate in this area have changed their gears to several types of handlines, which may have increased the pressure on some species. The deep-water bottom longline is at present mostly a seamount fishery. 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 five or six years. 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.

Mid-Atlantic Ridge

The greatest annual catch of roundnose grenadier (almost 30 000 t) on the MAR was taken by the Soviet Union in 1975, fluctuating in subsequent years between 2800 to 22 800 t. The fishery for grenadier declined after the dissolution of the Soviet Union in 1992. In the last 15 years, there has been a sporadic fishery (Figure 4.7.1) 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. Total catch of roundnose grenadier in this fishery in 2011 was 3366 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 4.7.1). 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 Sub area 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. 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 2009–2011).

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 scabbard-fish 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 4.7.2). 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.

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 4.7.3). However, an increase is observed for the last three years mainly on the roundnose grenadier.

3.7.3 Technical interactions

Azores EEZ

The fishery is multispecies and so technological interactions are observed. In the past the bycatch of this fishery was considered insignificant, according to a pilot study conducted in 2004 (ICES, 2006). However, reported discards from observers 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 seabream and wreck fish, among others, are also discarded. These changes may be probably due to the management measures introduced, particularly the TAC/quotas, minimum size and fishing area restrictions that changed the fleet behaviour on targeting, expanding the fishing areas 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.

3.7.4 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, brittle stars, sea lilies and a variety of corals such as the reef-building cold-water coral *Lophelia pertusa*. This benthic habitat supports elevated levels of biomass in the form of aggregations of fish such as 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.

3.7.5 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 seabream, 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.

NEAFC also introduced VME encounter protocols in the regulatory area and these are augmented in new bottom fishing areas by observer coverage and impact assessments.

Table 4.7.2. Overview of landings in Subareas X (a1,a2,b), XII (c, a1) (does not include information from XIIb, Western Hatton Bank) and XIVb2.

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ALFONSINOS (*Beryx* spp.)	631	550	983	229	175	229	199	243	172	139	157	192	211	250	312	245	232	213
ARGENTINES (*Argentina silus*)		1			2					4								
BLUE LING (*Molva dypterigia*)	602	814	438	451	1363	607	675	1270	1069	644	35	65	1				0	9
BLACK SCABBARDFISH (*Aphanopus carbo*)	304	455	203	253	224	357	134	1062	502	384	198	73		80	162	129?	163	470
BLUEMOUTH (*Helicolenus dactylopterus*)	589	483	410	381	340	452	301	280	338	282	190	209	275	281	267	213	231	190
DEEP WATER CARDINAL FISH (*Epigonus telescopus*)						3		14	16	21	4	10	7	7	7	5	5	4
GREATER FORKBEARD (*Phycis blennoides*)	75	47	32	39	41	100	91	63	56	46	1	134	201	18	26	14	11	6
LING (*Molva molva*)	50	2	9	2	2	7	59	8	19		2				1			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	117	139
RABBITFISHES (Chimaerids)			32	42	115	48	79	98	81	128	193				22			
ROUGHHEAD GRENADIER (*Macrourus berglax*)					3	7	10	7	2	28	8	8			6		0	16
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	644	1739	8622	11979	9696	8602	7926	11 468	10 805	10 748	513	86	2	13	5	1691	3247	9202
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)	1096	1036	1012	1114	1222	947	1034	1193	1068	1075	1383	958	1070	1089	1042	687	624	613
SHARKS, VARIOUS	1385	1264	891	1051	50	1069	1208	35	25	6	14	104	63	12	1	7	5	
SILVER SCABBARDFISH (*Lepidopus caudatus*)	789	815	1115	1186	86	28	14	10	25	29	31	35	55	63	64	68	148	271
SMOOTHHEADS (*Alepocephalidae*)																		
TUSK (*Brosme brosme*)	18	158	30	1	1	5	52	27	83	16	66.26	64	19		2	107	0	29
WRECKFISH (*Polyprion americanus*)	240	240	177	139	133	268	229	283	270	189	279	497	664	513	382	238	266	226

Table 4.7.1. Summary data on seamount fisheries on the MAR.

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

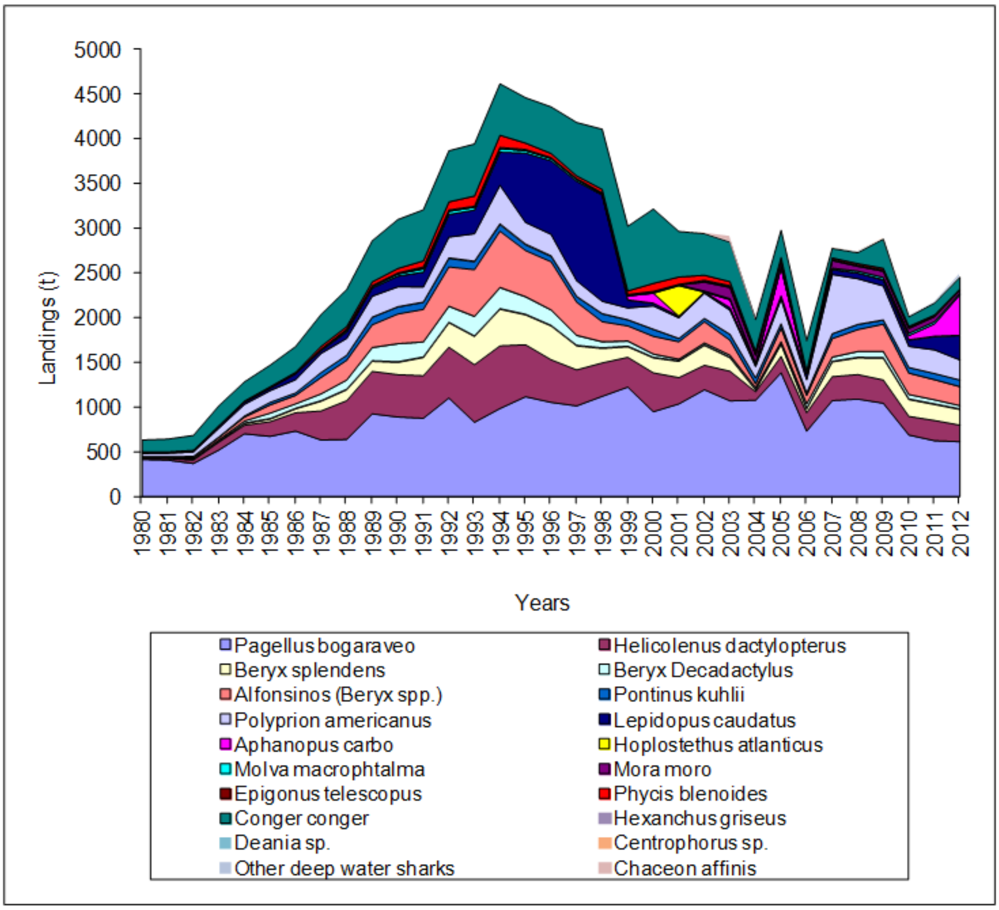


Figure 4.7.2. Annual landings of major deep-water species in Azores from hook and line fishery (1980–2011).

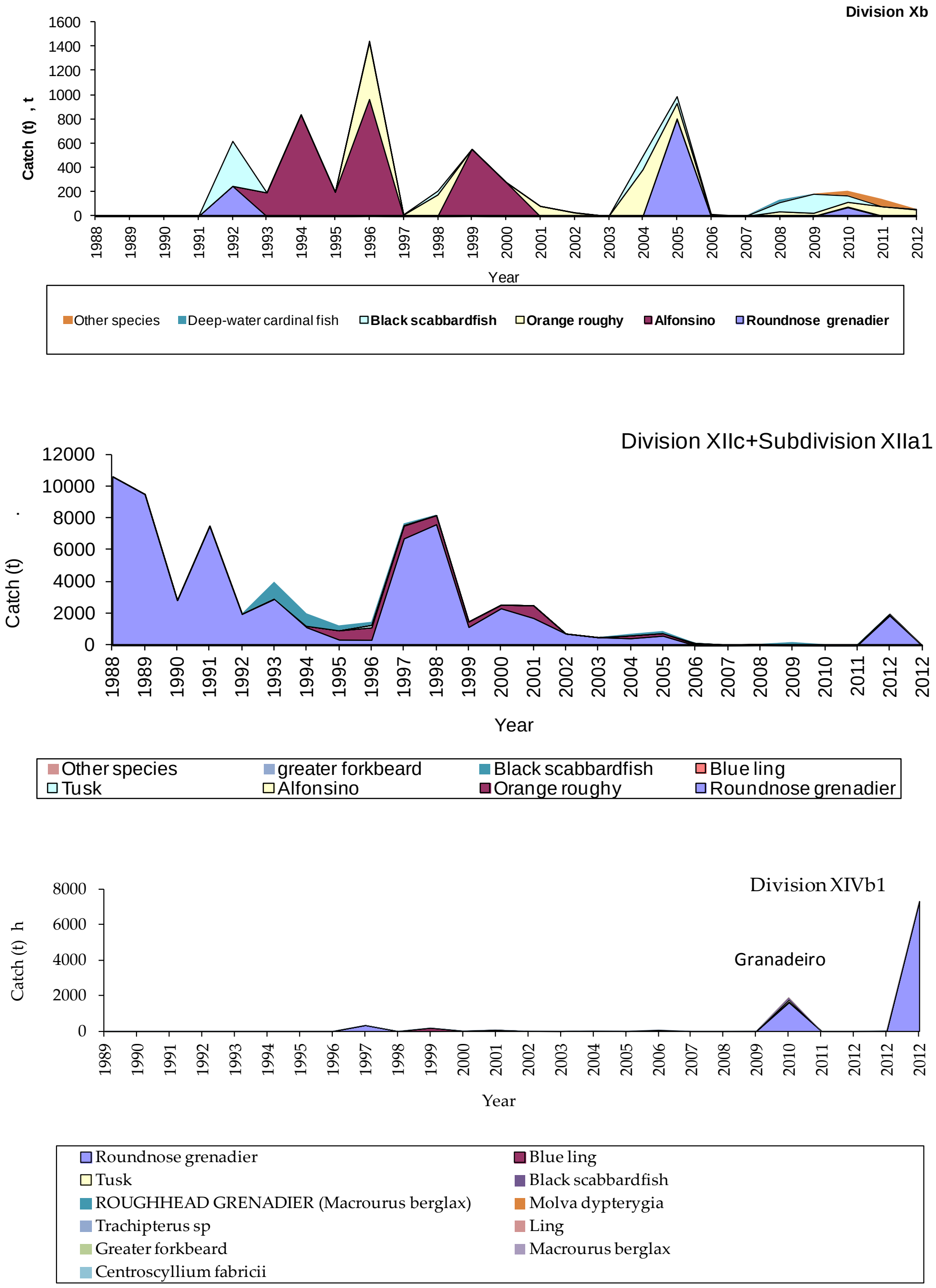


Figure 4.7.1. Annual catch of major deep-water species on MAR in 1988–2011.

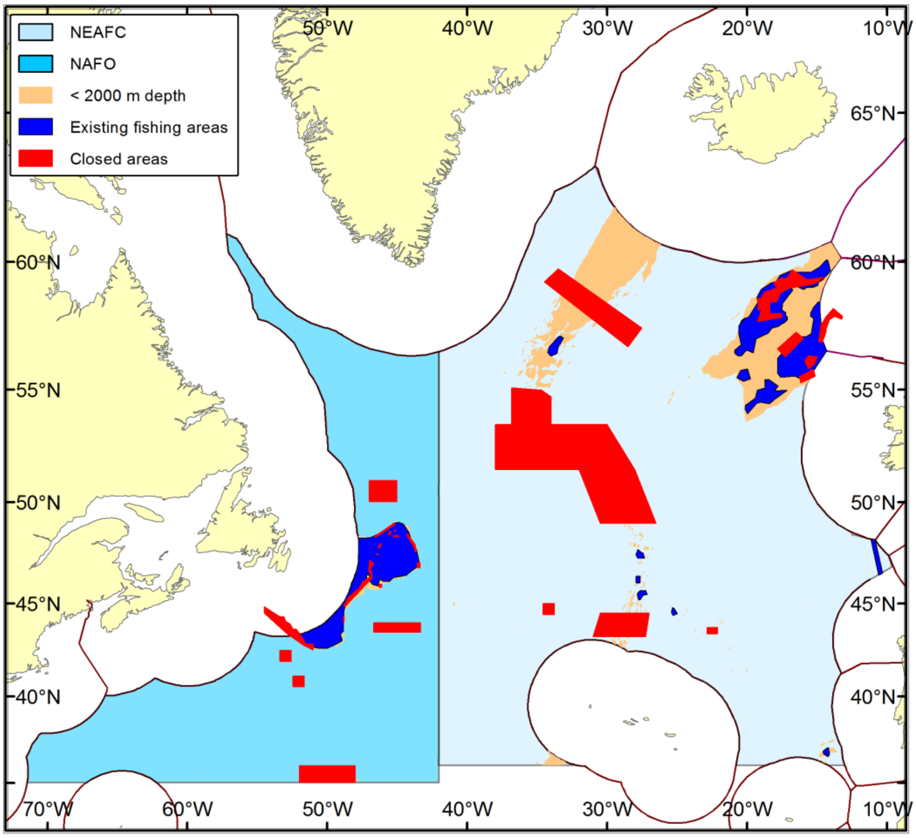


Figure 4.7.3. RFMO regulatory areas of Mid Atlantic Ridge, and closures introduced by NEAFC and NAFO (red) (from WD Bergstad and Høines, 2011).

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

4.1 Stock description and management units

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

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

4.2 Ling (*Molva Molva*) in Division Vb

4.2.1 The fishery

A general description of the fisheries in this area is provided in the Faroe overview in Section 3.3. The fishery for ling in Vb has changed in 2011 and 2012 as the Norwegian longliners are not allowed to fish in Faroese waters due to the mackerel allocation. The Faroese are landing almost all the catches and do also utilize the fishing areas that the Norwegian longliners used to fish. Around 60–75% of the ling in Vb was caught by Faroese longliners in 2010–2012 and the rest mainly by trawlers (25–35%). The longline fisheries are mainly on the slope on the Faroe Plateau and some of it is on the Faroe Bank area (Figure 4.2.1). Ling is also caught as bycatch by trawlers mainly fishing saithe on the Faroe Plateau (Figure 4.2.2).

4.2.2 Landings trends

Landings data for this stock are available from 1904 onwards; landing statistics for ling by nation for the period 1988–2012 are given in Tables 4.2.1–4.2.3 and total landings data from 1950 onwards are shown in Figure 4.2.3. Total landings in Division Vb have in general been very stable since the 1970s varying between about 4000 and 7000 tonnes. In the period from 1990–2005 about 20% of the catch were fished in area Vb2, and in the period 2006–2012 this has decreased to about 10%. The preliminary landings of ling in 2012 are 6003 tonnes, of which the Faroes caught 5886 tonnes (98%). The reason for this is the fact that due to a dispute on mackerel allocation, no bilateral agreement on fishing rights between the Faroes and Norway and EU could be made for 2011 and 2012.

4.2.3 ICES Advice

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 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. Other nations are regulated by TACs. Details on management measures in Faroese waters are given in the Faroe overview in Section 3.3.5.

4.2.5 Data available

Data on length, gutted weights 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 a reduction in resources at the Faroe Marine Research Institute (FAMRI), the level of otolith sampling of ling has been rather poor from 2007 which makes it difficult to perform an age-based assessment (like XSA) because the number of otoliths is so small that it is 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. In addition, there are also data available on catch, effort and mean length from Norwegian longliners fishing in Faroese waters. A three year project on ling and tusk started in January 2013 at FAMRI which hopefully can give some additional information to the WG next year.

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 there in addition is a ban on discarding in Vb, incentives for illegal discarding are believed to be low. The landings statistics are therefore regarded as being adequate for assessment purposes.

4.2.5.2 Length compositions

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

4.2.5.3 Catch-at-age

Catch-at-age data were provided for Faroese landings in Vb 1996–2011 and raised with other nations' landings (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. The age distribution in the sampling of commercial landings from longliners and trawlers are presented in Figures 4.2.9–4.2.10.

4.2.5.4 Weight-at-age

Mean weight-at-age data are provided for the Faroese fishery in Vb from 1996–2012 (Table 4.2.5).

4.2.5.5 Maturity and natural mortality

No new data.

4.2.5.6 Catch, effort and research vessel data

Commercial cpue series

There are catch per unit of effort (cpue) data available for three commercial series, the Faroese longliners, the Faroese pair trawlers and Norwegian longliners fishing in Vb. The Faroese cpue data for the period 1986–2012, are from five longliners (GRT>110) and 6–10 pair trawlers (HP>1000). The effort obtained from the logbooks is 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 Faroese longliner series were from sets where they catch ling and the catch of ling and tusk combined represented more than 50% of the total catch and depth was >150 m. The bycatch series for ling from the Faroese pair trawlers >1000 HP was limited to hauls where they catch ling and the catch of saithe is more than 60% of the total catch in the haul.

A general linear model (GLM) was used to standardize all the cpue series (kg/h or kg/1000 hooks) for the commercial fleet where the independent variables were the following: vessel (actually the pair ID for the pair trawlers, otter board trawlers or longliners), month (January–April, May–August, September–December), fishing area (Vb1, Vb2) and year. The dependent variable was the logtransformed kg per hour or kg/1000 hooks measure for each trawl haul or longline setting, which was back-transformed prior to use. The reason for this selection of hauls/settings was to try to get a series that represents changes in stock abundance.

The cpue data from Norwegian longliners fishing in Vb are described in the stock annex for ling in IIa and were standardized (Section 4.1 ling in I and II; Helle and Pennington, WD WGDEEP 2013). The Norwegian and Faroese longliners are comparable and both have ling (and tusk) as target species.

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. These series have so far not been used for tuning because no age data are available.

The abundance indices from the groundfish surveys are standardized according to number of stations in each stratum and weighted with strata area for all the different strata.

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

4.2.6 Data analyses

Length distributions from the two groundfish surveys in Division Vb displayed high interanual variation in mean length, which may partly be explained by occasional high abundance of individuals smaller than 60 cm (Figures 4.2.4–4.2.5).

Mean length in the length distribution from commercial catches from Faroese longliners and trawlers showed an increase in mean length from 2007-2011 (Figure 4.2.6–4.2.7). The mean length in length distributions for the Norwegian longliners fishing in

Faroese waters, in the period 2003–2009 were about 87 cm. The Faroese trawlers have a slightly higher mean length in the catches as the Faroese longliners.

Cpue trends

Information on abundance trends can be derived from the cpue data from the Faroese longliners (Figure 4.2.11), Norwegian longliners fishing in Vb (Figure 4.2.12), from the Faroese pair trawlers (bycatch; Figure 4.2.13) and from the Faroese groundfish surveys (Figure 4.2.14).

The Faroese longline cpue series and the Faroese trawl bycatch cpue series have indicate a positive trend since 2001, but the Norwegian longline series indicate a levelling off for the period 2000–2008. There are very few data from Norwegian longliners in 2009–2012.

The two survey cpue series indicate a stable situation since the late 1990s and an increase in recent years. This is supported by the length distributions indicating improved recruitment (Figures 4.2.4–4.2.5).

A potential recruitment index was calculated from the two surveys as the number of ling smaller than 60 cm (Figures 4.2.15–4.2.16). This shows evidence on increasing recruitment in recent years, but a decrease in 2012.

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

No new XSA assessment was done this year due to the very small number of otolith samples of ling in Vb in the period from 2007 to present. Comment from one of the reviewer in 2010 was that modern statistical catch-at-age models could be used to incorporate highly valuable survey biomass indices, even though no age data are available. This has not been done yet.

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 years. The available dataseries do not cover the entire period of the fishery (back to the early 1900s; see Figure 4.2.3 for landings since 1950) and no information is available on stock levels prior to 1986. There is evidence of increased recruitment from 2004 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. The exploitation is influenced by regulations aimed at other groundfish species, e.g. cod, haddock, and saithe. The fisheries by other nations are regulated by TACs.

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

The assessment of the stock is based on trends in indices of abundance from surveys and commercial cpue. No forecasts are available. However, there are some indications of increased recruitment and an increase in adult biomass. If these are correct then the same effort may yield an increase in catches in 2013 and 2014.

Additionally, considering that exploitation is unknown, ICES advises that effort should decrease by a further 20% as a precautionary buffer.

Additional considerations

The only species-specific management for the Faroese fisheries of ling in Division Vb is the recommended minimum landing size (60 cm), but this does not appear to be enforced. The exploitation is influenced by regulations aimed at other groundfish species, e.g. cod, haddock, and saithe. The fisheries by other nations are regulated by TACs.

Table 4.2.1. Ling in Vb1. Nominal landings (1988–2011).

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			0		0		5569

***Preliminary.**

(1) Includes Vb2.

(2) Greenland 2006–2012.

Table 4.2.2. Ling in Vb2. Nominal landings (1988–2011).

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		0	434

***Preliminary.**

Table 4.2.3. Ling in Vb. Nominal landings (1988–2011).

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*	5569	434	6003

***Preliminary.**

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

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

Table 4.2.5. Ling Vb. Mean weight (kg) at age in the commercial catches.

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
4	1.05	0.60	1.16	1.07	1.32	1.06	1.20	0.81	1.10	0.86	0.73	0.82		0.83			
5	1.84	1.15	1.20	1.09	1.83	1.12	1.51	1.19	1.50	1.12	0.98	1.09	1.28	1.26	1.11	1.11	0.93
6	2.56	1.78	1.80	2.22	2.62	1.92	1.96	2.09	2.05	1.79	1.54	1.61	2.12	1.63	1.84	1.84	1.80
7	3.38	2.40	2.44	2.37	3.14	2.60	2.89	2.72	2.72	2.59	2.18	2.21	3.00	2.55	2.73	2.73	2.71
8	4.03	3.22	3.13	3.12	4.05	3.64	3.87	3.50	3.57	3.59	2.98	3.01	4.61	3.19	3.43	3.43	3.37
9	5.18	4.06	4.02	4.08	5.06	5.17	5.47	4.04	4.71	4.79	3.95	3.97	5.68	4.10	4.35	4.35	4.39
10	7.52	5.16	5.02	5.48	6.28	6.59	8.24	5.48	6.23	6.35	5.12	5.15	5.54	5.49	5.88	5.88	5.98
11	9.51	7.06	6.45	6.23	7.60	7.52	5.20	6.22	8.19	7.73	6.48	6.57		7.74	7.84	7.84	5.97
12+	12.55	9.06	8.56	8.12	10.27	10.10	11.43	10.02	10.85	9.65	10.16	9.80		9.41	10.17	10.17	9.189

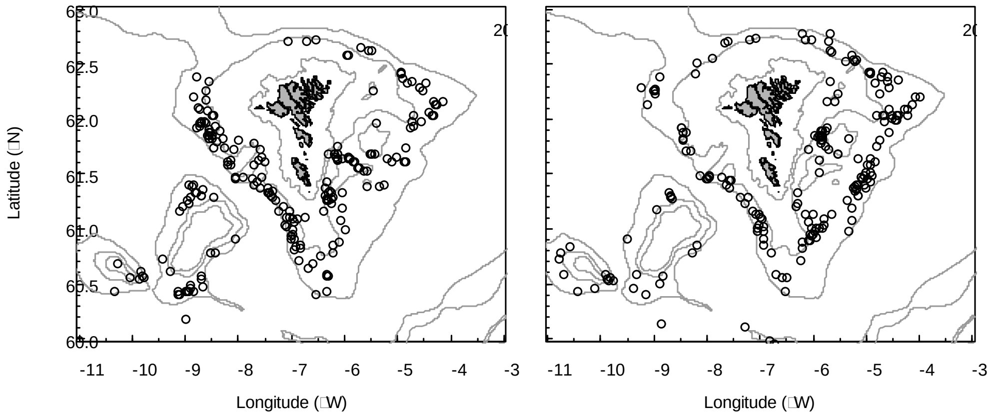


Figure 4.2.1. Ling in Vb. Longline positions in 2010 and 2012 for five selected longliners where ling is in catch and tusk+ling >50% of the total catch.

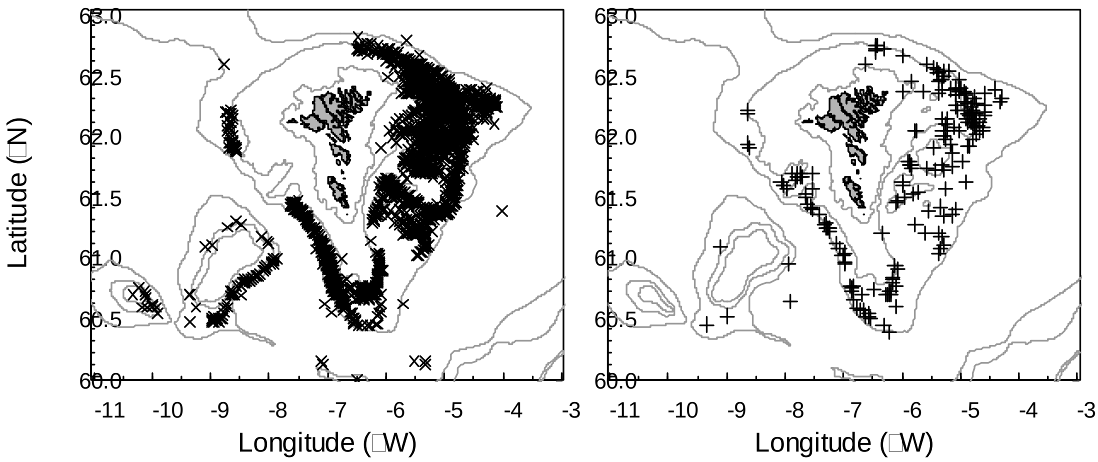


Figure 4.2.2. Ling in Vb. Distribution of hauls with a) ling in catch and >60% saithe of the total catch and b) trawl hauls with more than 20% ling in 2010.

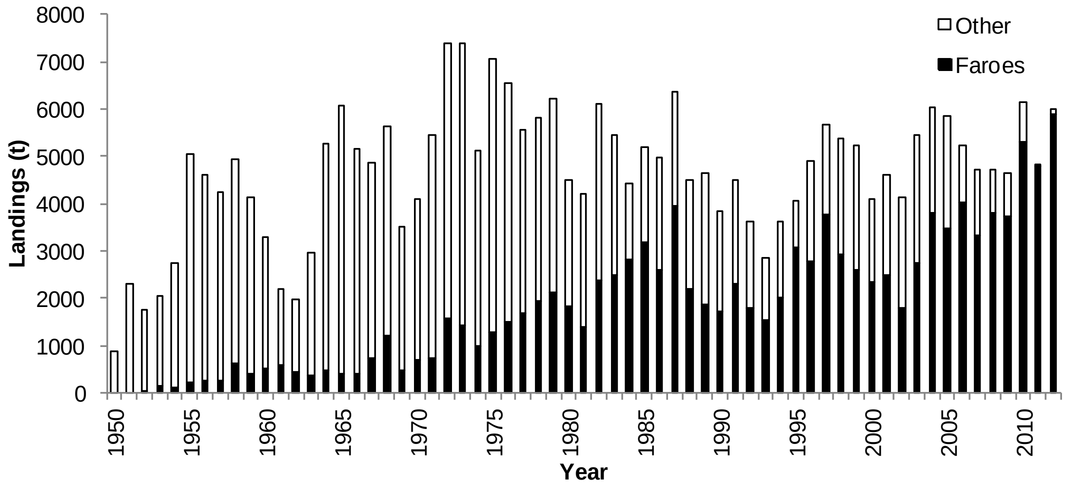


Figure 4.2.3. Ling in Vb. Total international landings since 1950.

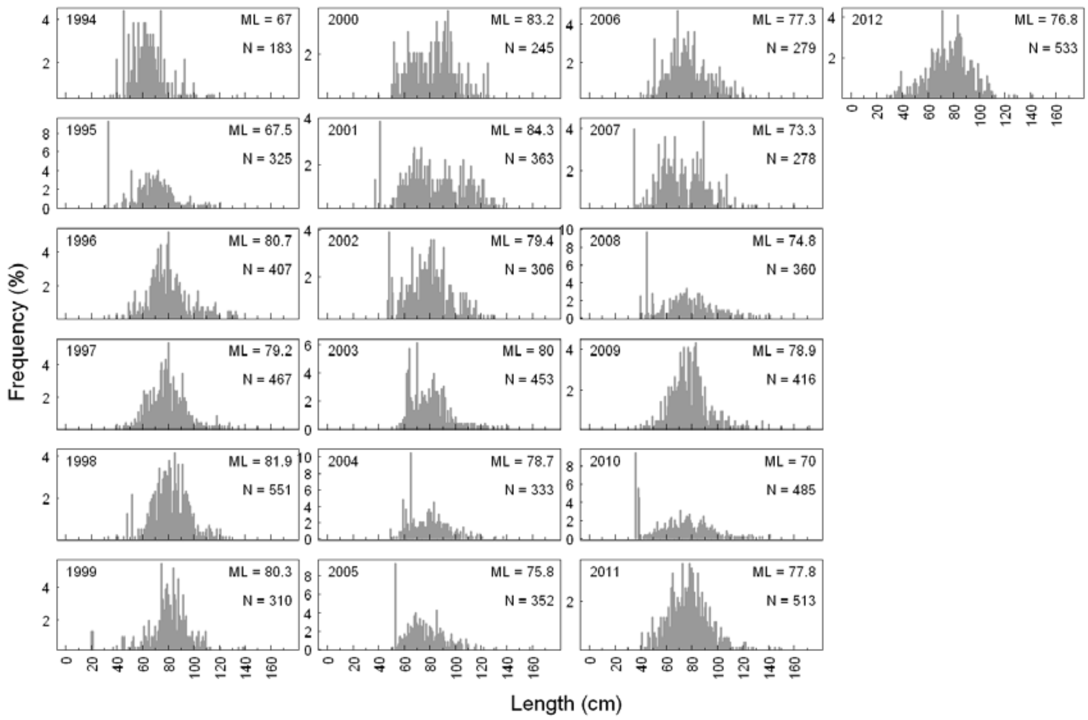


Figure 4.2.4. Ling in Vb. Length distribution from the spring groundfish survey ML- mean length, N- number of calculated length measures. The small ling are often sampled from a subsample of the total catch, so the values are multiplied to total catch.

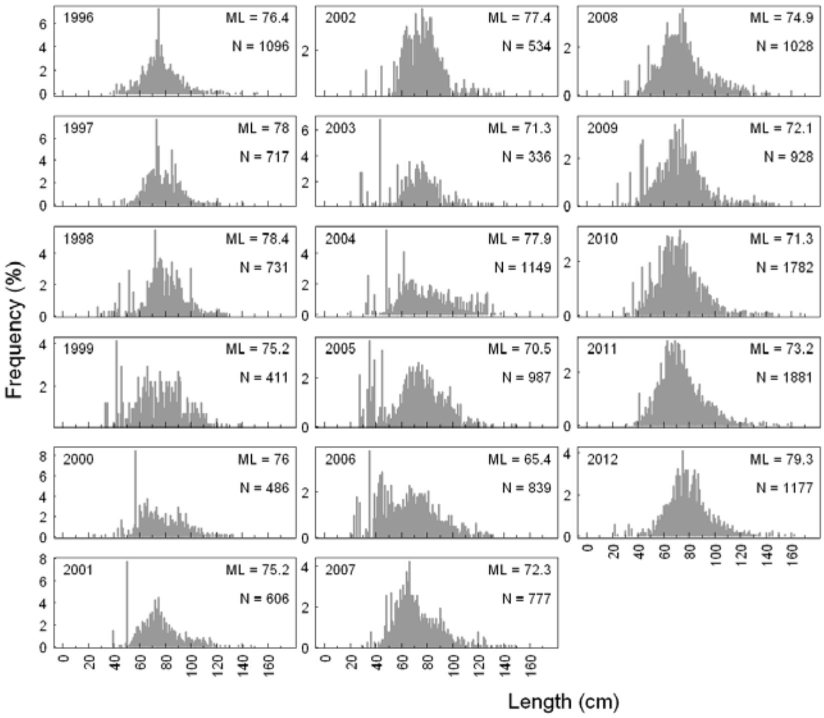


Figure 4.2.5. Ling in Vb. Length distribution from the summer groundfish survey. ML- mean length, N- number of calculated length measures. The small ling are often sampled from a sub-sample of the total catch, so the values are multiplied to total catch.

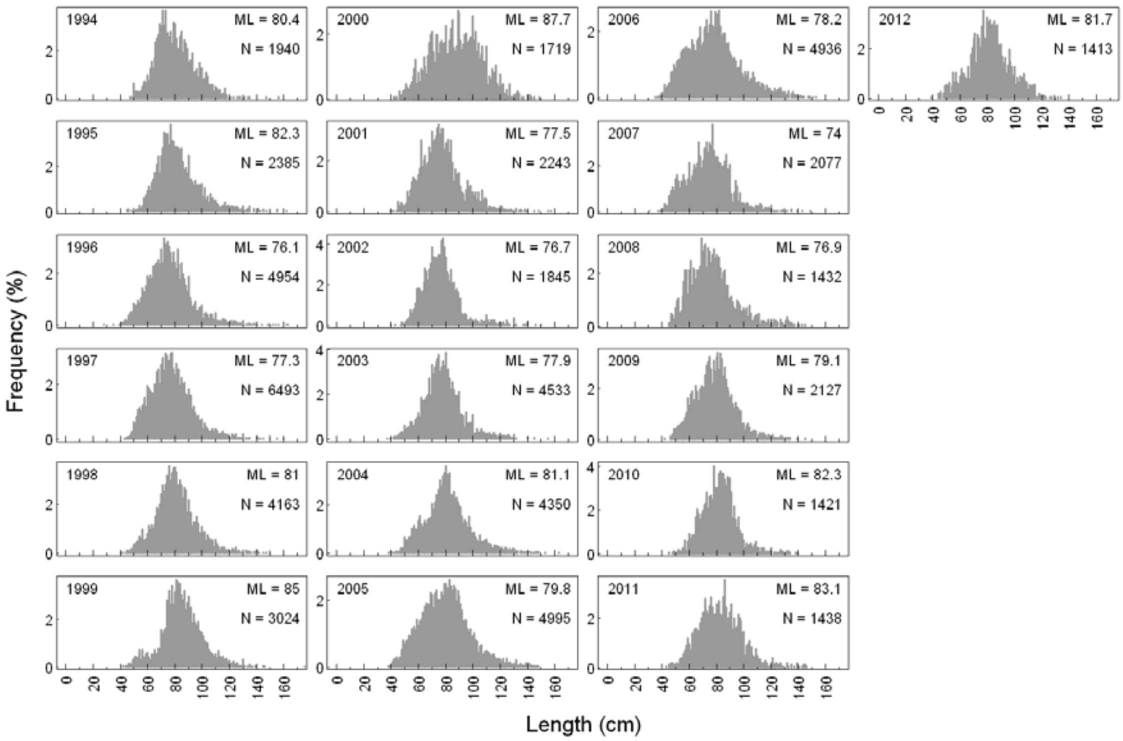


Figure 4.2.6. Ling in Vb. Length distribution in the sampling of the landings from Faroese long-liners (>110 GRT). ML- mean length, N- number sampled.

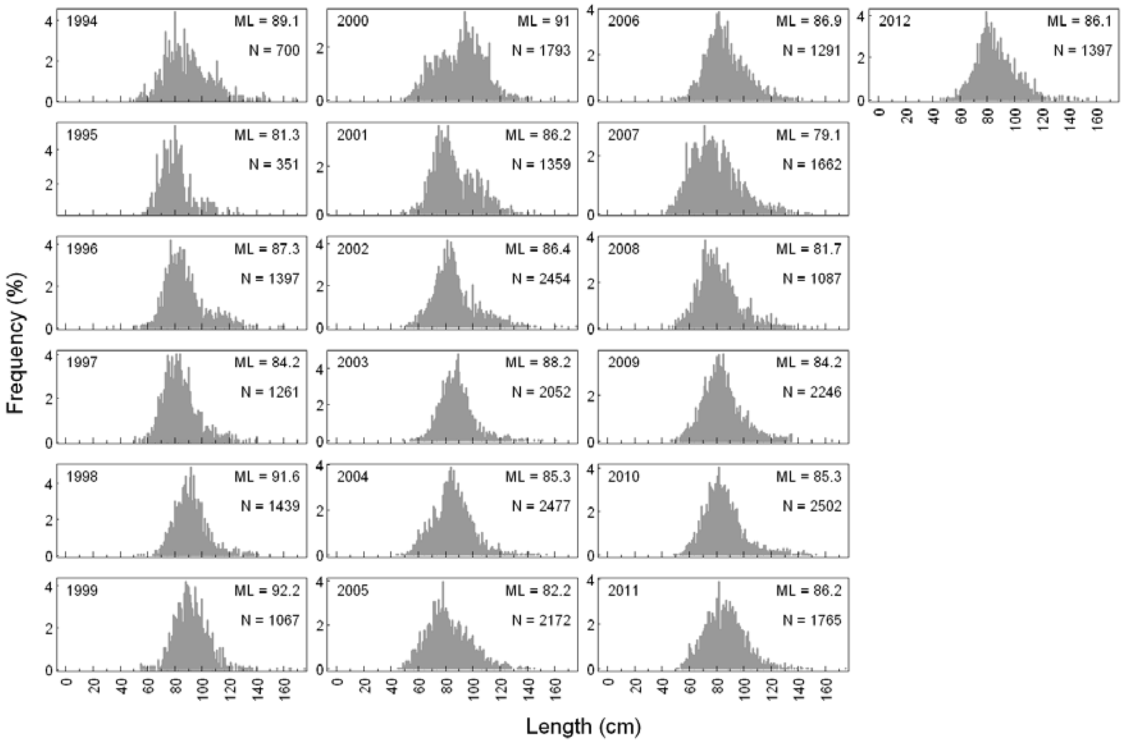


Figure 4.2.7. Ling in Vb. Length distribution in the sampling of the landings from Faroese trawlers (>1000 HP). ML- mean length, N- number sampled.

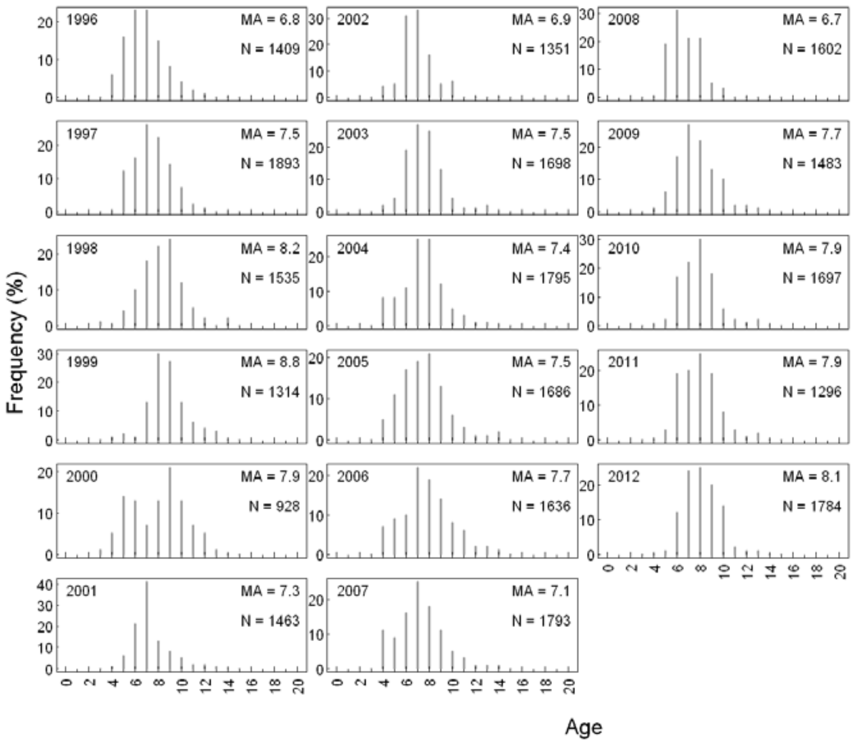


Figure 4.2.8. Ling Vb. Age distribution from the catch (MA- mean age, N- catch in number).

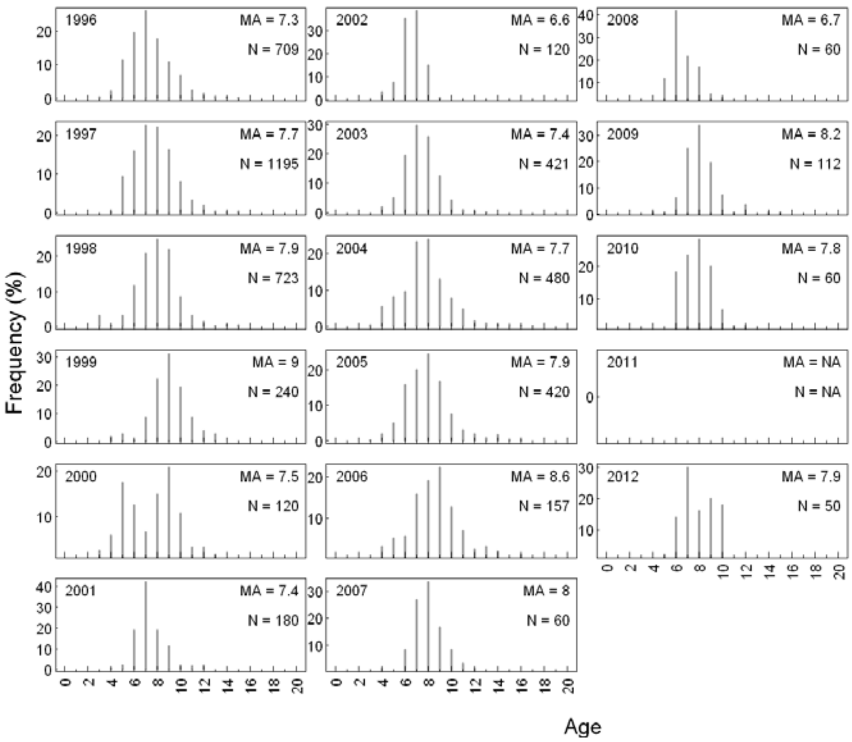


Figure 4.2.9. Ling in Vb. Age distribution in the landings from Faroese longliners (>110 GRT) (MA- mean age, N- number sampled).

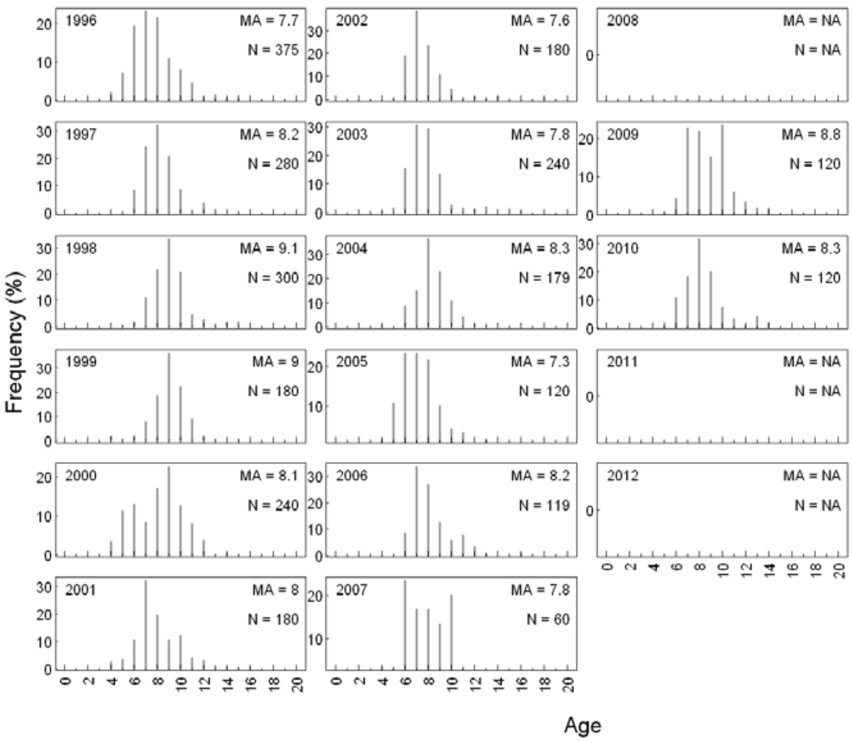


Figure 4.2.10. Ling in Vb. Age distribution in the landings from Faroese trawlers (>1000 HP) (MA- mean age, N- number sampled).

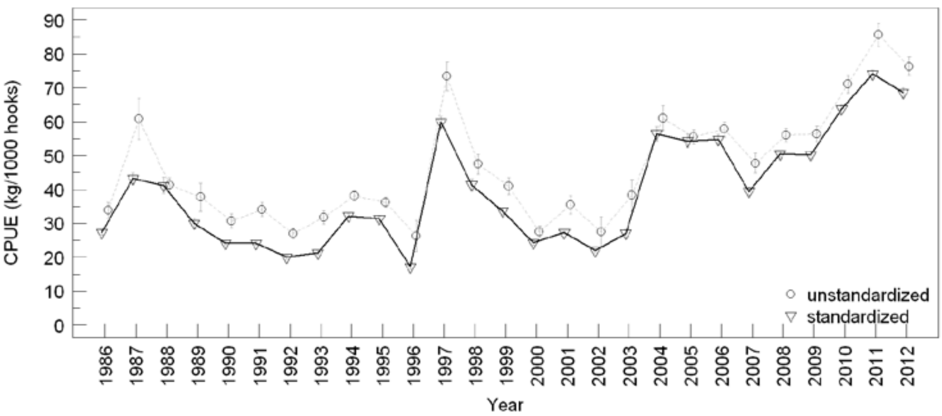


Figure 4.2.11. Ling in Vb. Standardized cpue (kg/1000 hooks) from Faroese longliners (>110 GRT) fishing in Faroese waters. The stippled line is mean from unstandardized data and the black line is mean for standardized data for settings where ling was caught, ling+tusk>60% of the total catch and the depth was deeper than 150 m. The error bars are SE.

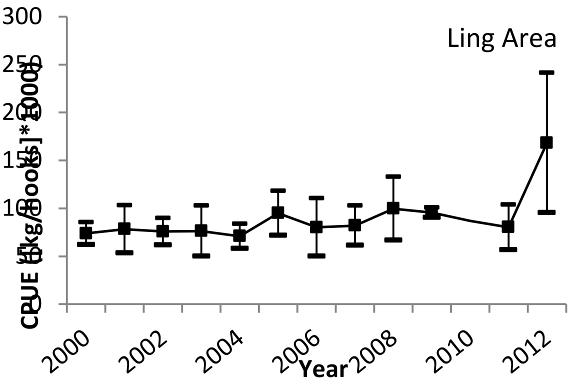


Figure 4.2.12. Ling in Vb. The standardized cpue ([kg/hook] x1000) for ling from Norwegian longliners fishing in Vb for the period 2000 through 2012. The bars denote the estimated two standard errors. Note that there are very few data sinze 2009 (WD Helle and Pennington, WGDEEP 2013).

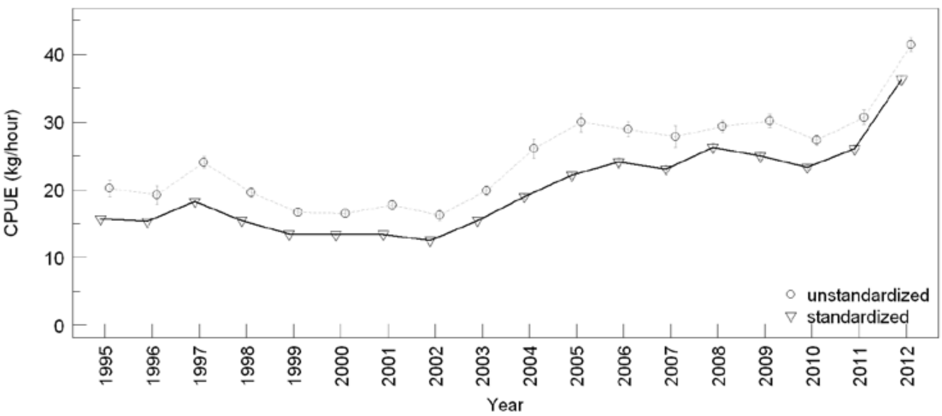


Figure 4.2.13. Ling in Vb. Standardized cpue (kg/h) from Faroese pair trawlers (bycatch series). The stippled line is mean from unstandardized data and the black line is mean for standardized data for hauls where ling was caught and saithe >60% of the total catch. The error bars are SE.

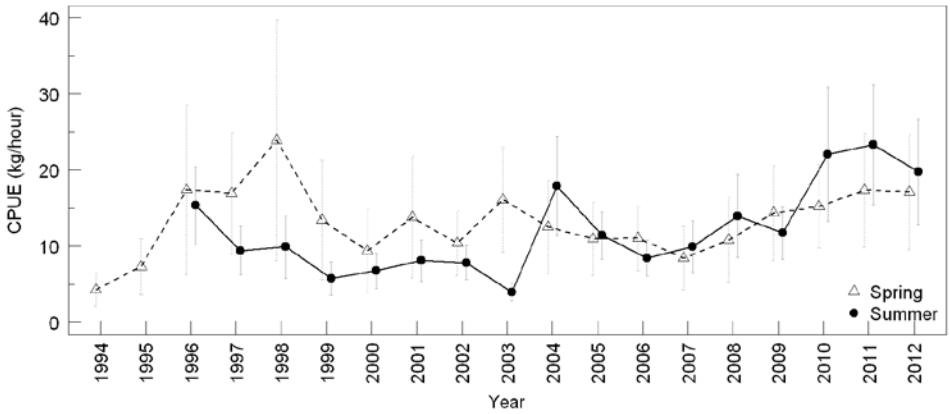


Figure 4.2.14. Ling in Vb. Standardized cpue (kg/h) in the two annual Faroese groundfish surveys on the Faroe Plateau. The error bars are SE.

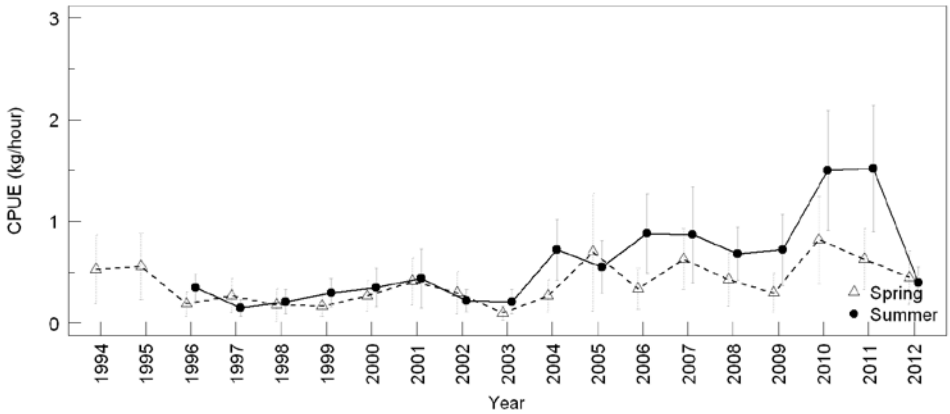


Figure 4.2.16. Ling in Vb. Standardized recruitment indices from the surveys as biomass of ling smaller than 60 cm.

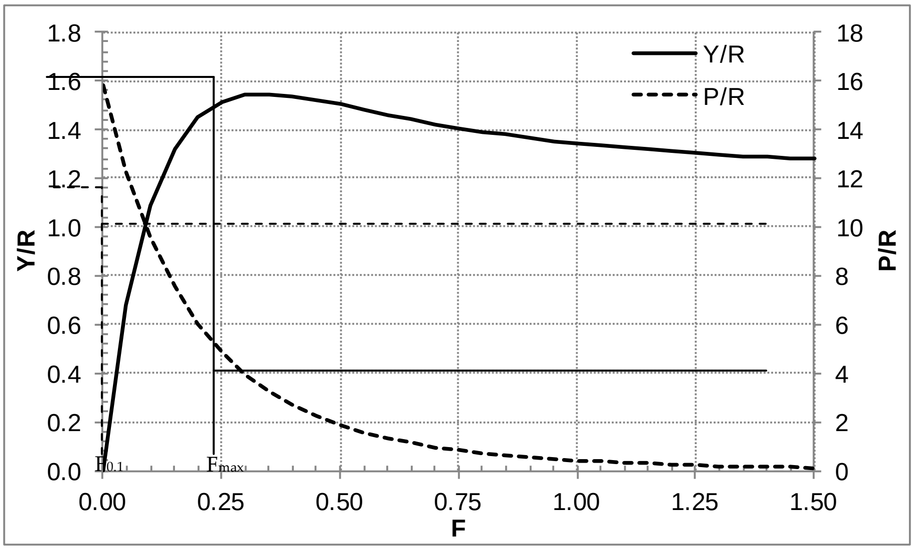


Figure 4.2.17. YPR analysis indicating F_{max} to be around 0.33.

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

4.3.1 The fishery

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

4.3.2 Landings trends

Landing statistics by nation in the period 1988–2012 are in Tables 4.3.1a–d. During the period 2000–2005 the landings varied between 5000 and 7000 t, which are slightly lower than catches as in the preceding decade. In 2007, 2008 and 2010 the landings increased to over 10 000 t. Preliminary landings for 2012 are 9343 t. Total international landings in areas I and II are given in Figure 4.3.1 and 4.3.2. Norwegian 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 2012 there were only 36 vessels above 21 m in the fishery.

4.3.3 ICES Advice

Advice for 2013 and 2014: Based on the ICES approach for data-limited stocks, ICES advises that there should be a 20% reduction in effort.

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 quota for the EU for bycatch species such as ling and tusk in Norwegian waters of Areas I and II is in 2013 set to 5000 t. There is no minimum landing size in the Norwegian EEZ.

The quota for ling only in EU and international waters was set at 36 t in 2013.

4.3.5 Data available

4.3.5.1 Landings and discards

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

4.3.5.2 Length compositions

Figure 4.3.3 shows plots of the length distribution in Areas I and II for the period 2001 to 2012. This shows that the median length in Area I has varied slightly, while the length in Area IIa has been very stable.

Length measurements for a small number of individuals are given in Alexandrov and Vinnichenko, WD 2013.

4.3.5.3 Age compositions

No new data were presented.

4.3.5.4 Weight-at-age

No new data were presented.

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 2000–2012 for Norwegian longliners is presented in Figure 4.3.4. No research vessel data are available.

4.3.6 Data analyses

To calculate a standardized cpue that is adjusted for technological changes, information about vessel type and behaviour, baiting machines, swivels, main line, hooks and bait were collected (Detailed description of the model is given in Helle and Pennington, WD 2013).

The number of longliners has declined in recent years (Figure 4.3.5.), from 72 to 36 in the period 2000–2012. The numbers of fishing days per vessel in Area IIa have remained relatively stable during the last few years with a slight decrease in 2012 (Table 4.3.2). During the period 2000 to 2012 the main technological change in Subareas I and II was that the number of hooks per day increased from 31 000 hooks to 37 000 hooks (Figure 4.3.6).

The number of hooks set by each vessel when ling were caught varied considerably from vessel to vessel, but it does not appear that average catch of ling per 1000 hooks varied significantly with the number of hooks set. In particular the catch rate increased more or less linearly with increasing numbers of hooks. Therefore, it was decided that no nonlinear adjustment is needed for the number of hooks set for estimating a cpue series for ling. No other changes or variability in the longline fishery over the years appeared to affect noticeably the catchability of the fleet.

4.3.6.1 Calculating a cpue series based on data characteristics

Not all the longliners have ling as their primary target species. Rather than select individual catches that are deemed to have targeted ling longline vessels were selected that appear to have often targeted ling in a particular year. For vessels that caught ling between one and a 100 days during a year, the average catch per vessel was significantly correlated (Pr = 0.00) with the number of days the vessel caught ling (Figure 4.3.7 upper pane), while there was no significant correlation (Pr =0.47) for vessels that caught ling on more than 100 days (Figure 4.3.7 lower pane).

Since if vessels were actually “surveying” the same segment of the ling population, then the average daily catch per vessel should not increase with “sample size” (i.e. days fished). Based on this analogy, it was decided to estimate a cpue series for ling based only on vessels that caught ling on 100 or more days during a year and since the vessels generally did not “survey” the same regions, it was decided that the unweighted estimator (Equation 2 in Helle and Pennington, WD 2013) was most likely the appropriate estimator.

4.3.6.2 Biological reference points

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

4.3.6.3 Comments on the assessment

The estimated cpue series for ling based on vessels that caught ling a 100 or more times during a year indicate that the ling population has been rather stable over the last twelve years. The main difference between the old way and the new standardized ways of calculating the cpue series is that the uncertainty associated with the super-population based estimates is larger, as would be expected, than if it is assumed that the "true" cpue for the entire fleet is proportional to the actual population.

The use of a super-population model to estimate the precision of the ling cpue series is straightforward and intuitive. In general, model-based inferences based on super-population models have many applications based on a wide range of models; for example, making valid inferences based on generalized linear models, GLM, (Särndal, *et al*., 1992).

4.3.7 Management considerations

Increased catches since 2006 do not appear to have had a detrimental effect on the stock given that cpue has remained stable over the period.

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

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

***Preliminary.**

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

Year	Norway	Iceland	Scotland	Faroes	Total
2012	1				1

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	9764			19			9799
2012*	21	6	9	8330		7	45		3	8421

***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

***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	10 395	128	10 580
2011	128	9799	171	10 099
2012	158	8919	266	9343

*** Preliminary.**

Table 4.3.2. Average number of fishing days per longline vessel in Asea IIa for the period 2000–2012.

Ling	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
IIa	23	40	50	40	37	51	54	65	52	65	70	73	59

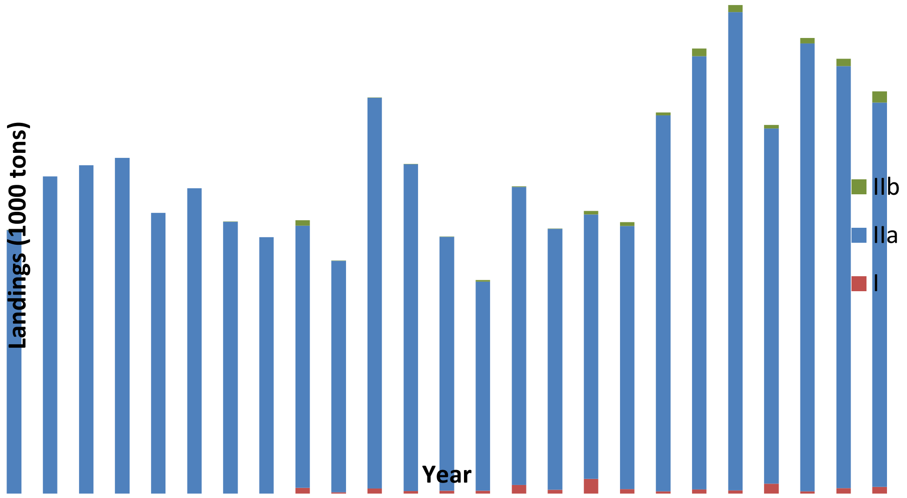


Figure 4.3.1. Total international landings of ling in Subareas I and II.

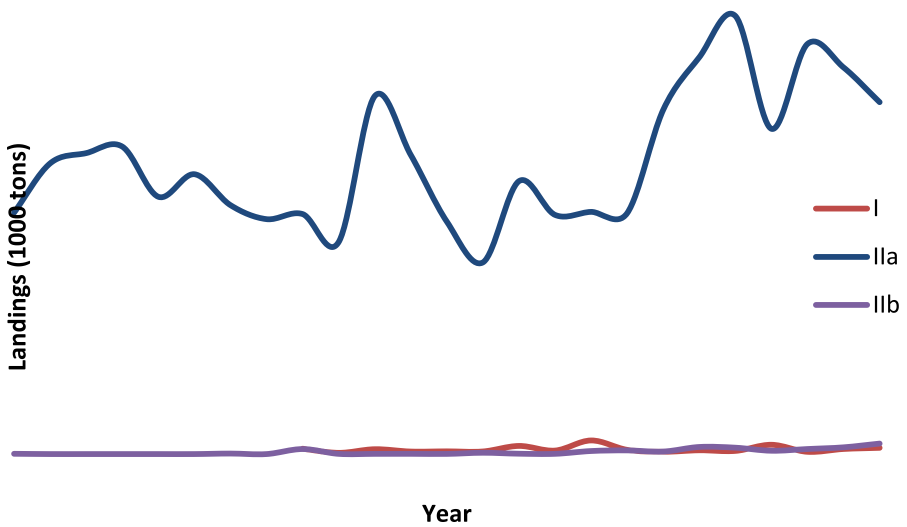
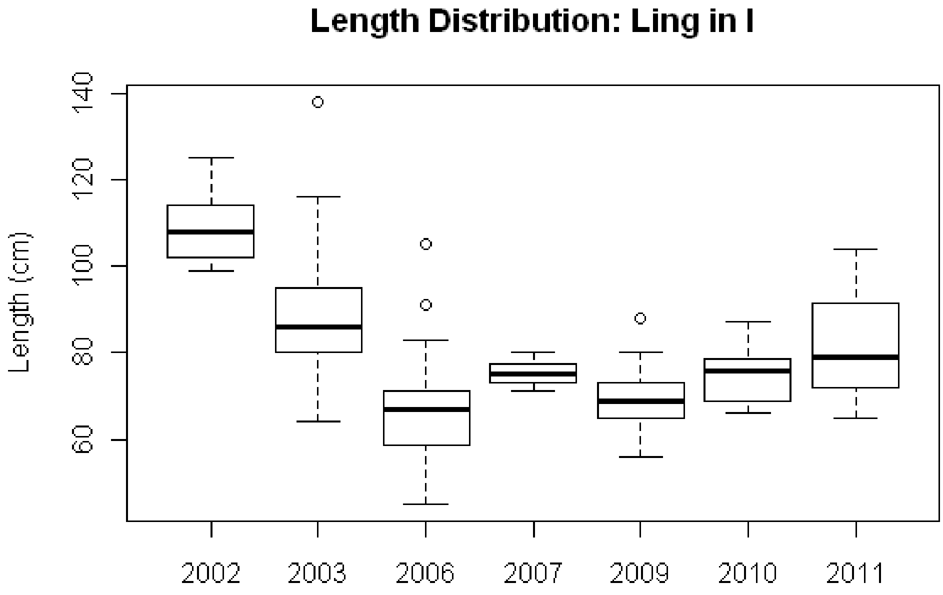


Figure 4.3.2. Total landings of ling in Areas I and II in each area for the period 1988–2011.



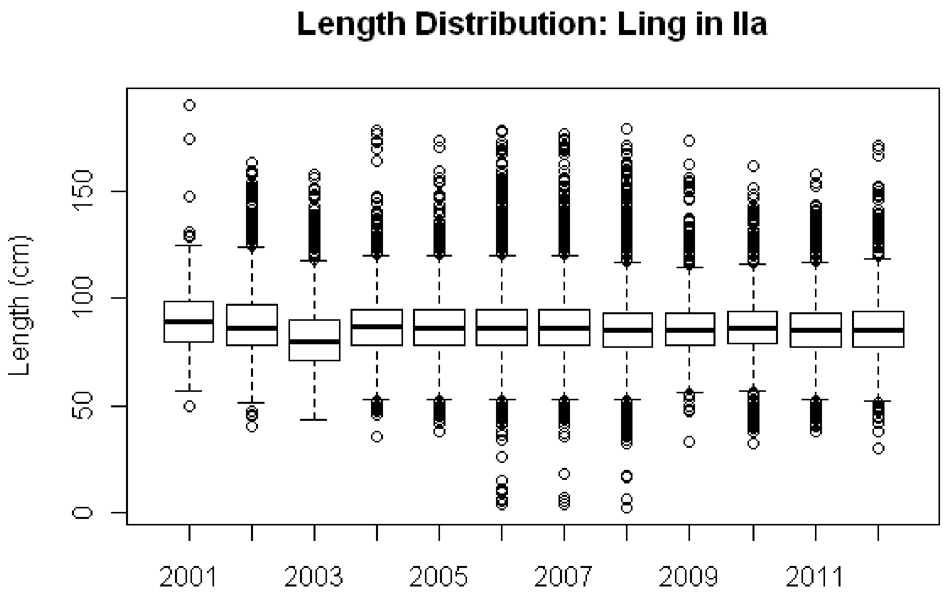


Figure 4.3.3. Plots of the length distribution in Areas I and II for the period 2001 to 2012.

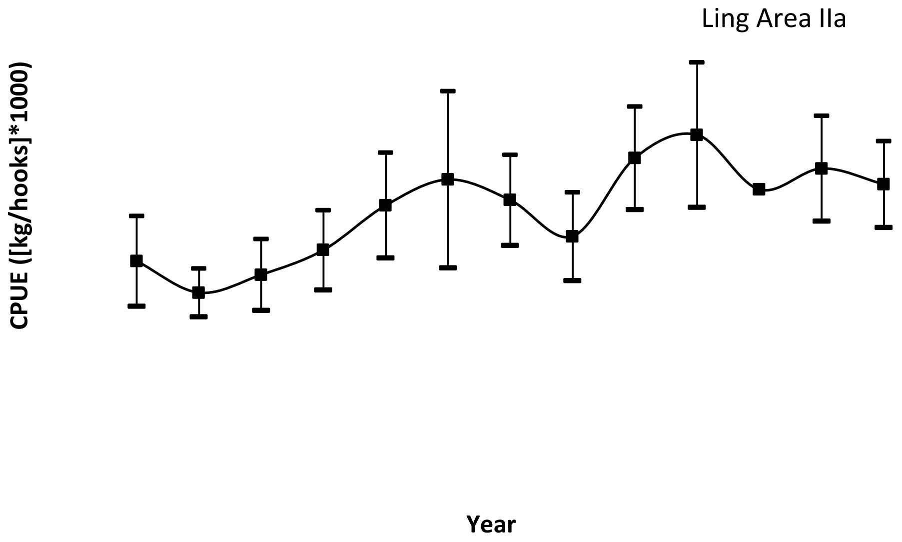


Figure 4.3.4. Ling in IIa. Estimates of cpue (kg/1000 hooks) based on skipper's logbooks 2000–2012. The bars denote the 95% confidence interval.

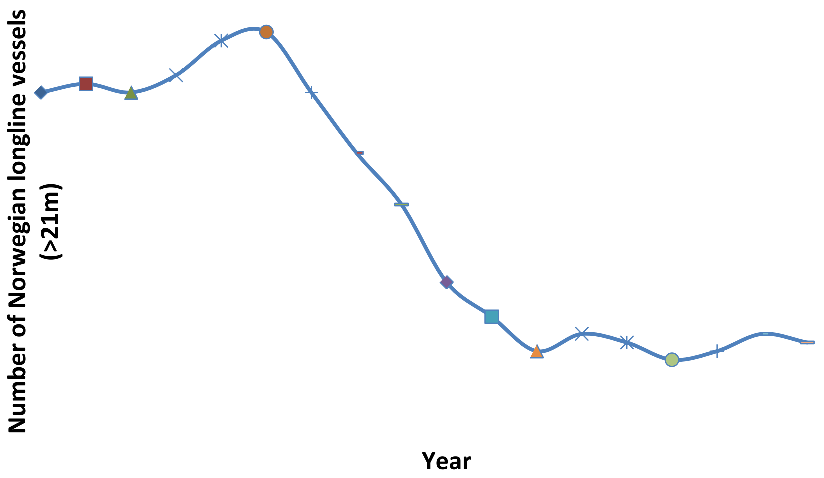


Figure 4.3.5. Change in number of vessels in the Norwegian longliner fleet during the period 1995–2012 (vessels exceeding 21 m that landed 8 t or more of ling, blue ling and tusk in a given year).

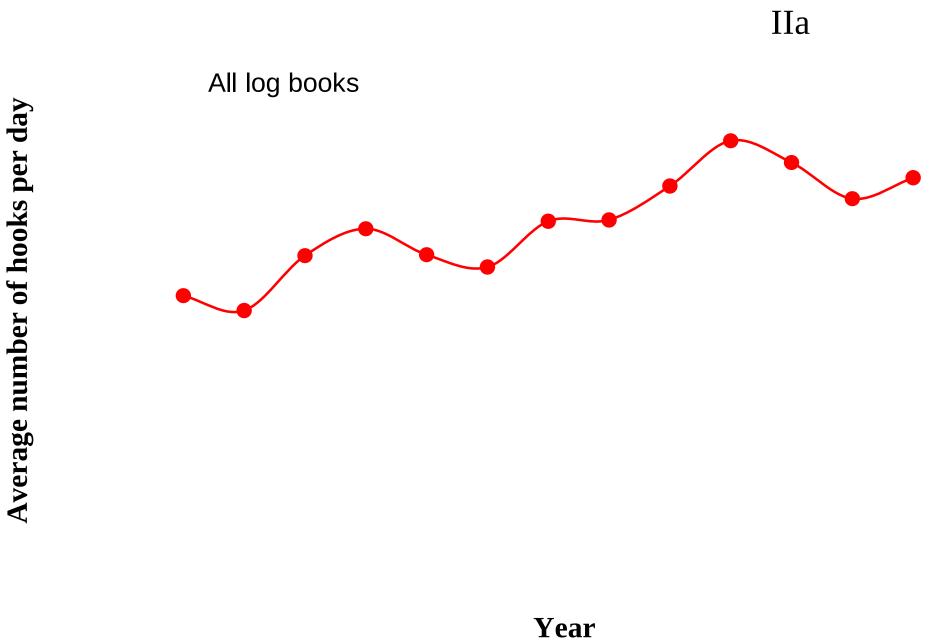
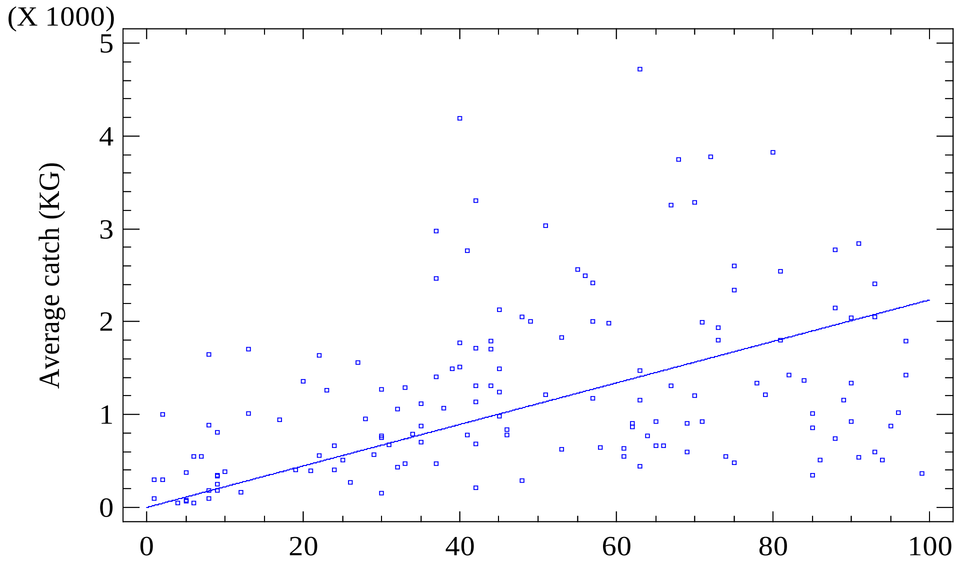
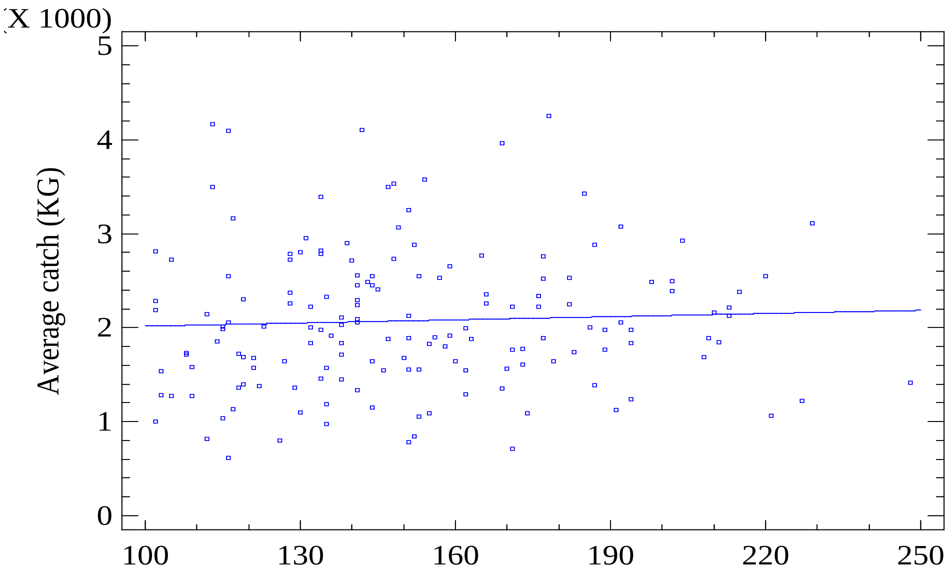


Figure 4.3.6. Average number of hooks the Norwegian longliner fleet used per day in ICES Sub-area IIa for the years 2000–2012 in the fishery for tusk, ling and blue ling.



The number of days a vessel caught ling during a year.



The number of days a vessel caught ling during a year.

Figure 4.3.7. The average catch of ling per day by a vessel versus the number of days the vessel caught ling: for vessels that caught ling on less than 100 days (upper pane) and for those that caught ling on a hundred or more days. The data are all years combined.

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 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

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).

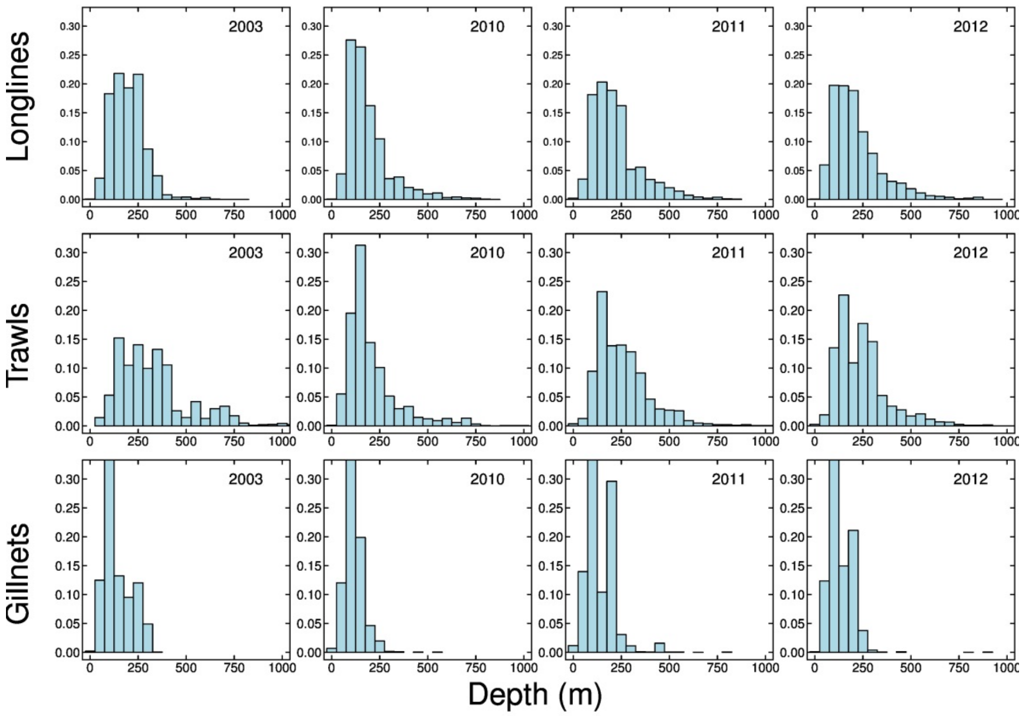


Figure 4.4.1. Ling in Va. Depth distribution of ling catches from longlines, trawls and gillnets from Icelandic logbooks.

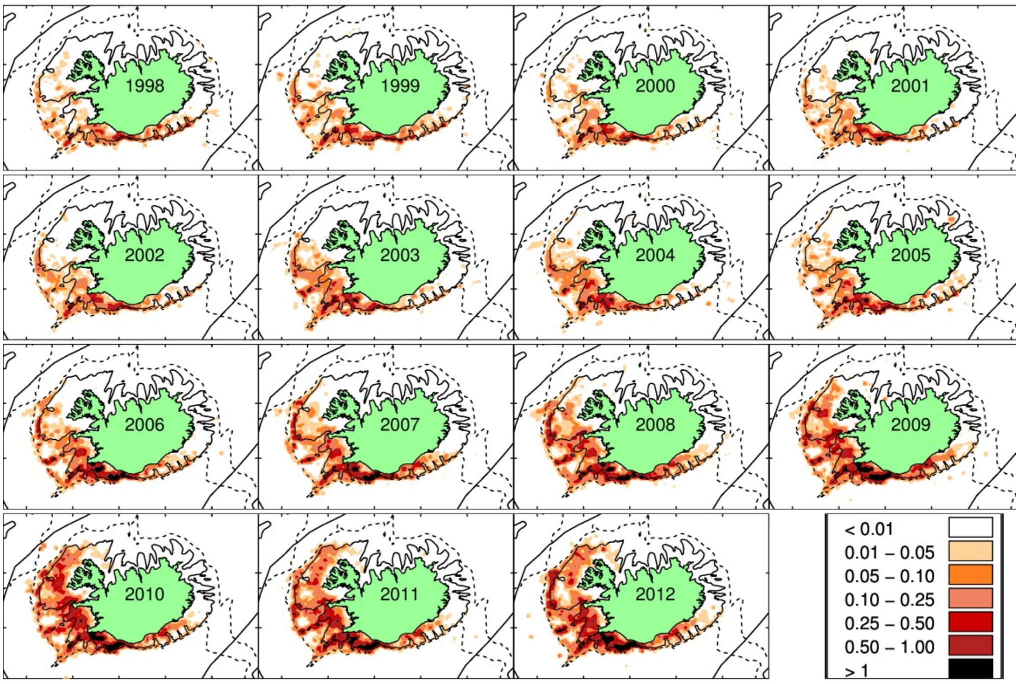


Figure 4.4.2. Ling in Va. Geographical distribution (tonnes/square mile) of the Icelandic ling fishery since 1998 as reported in logbooks by the Icelandic fleet. All gears combined.

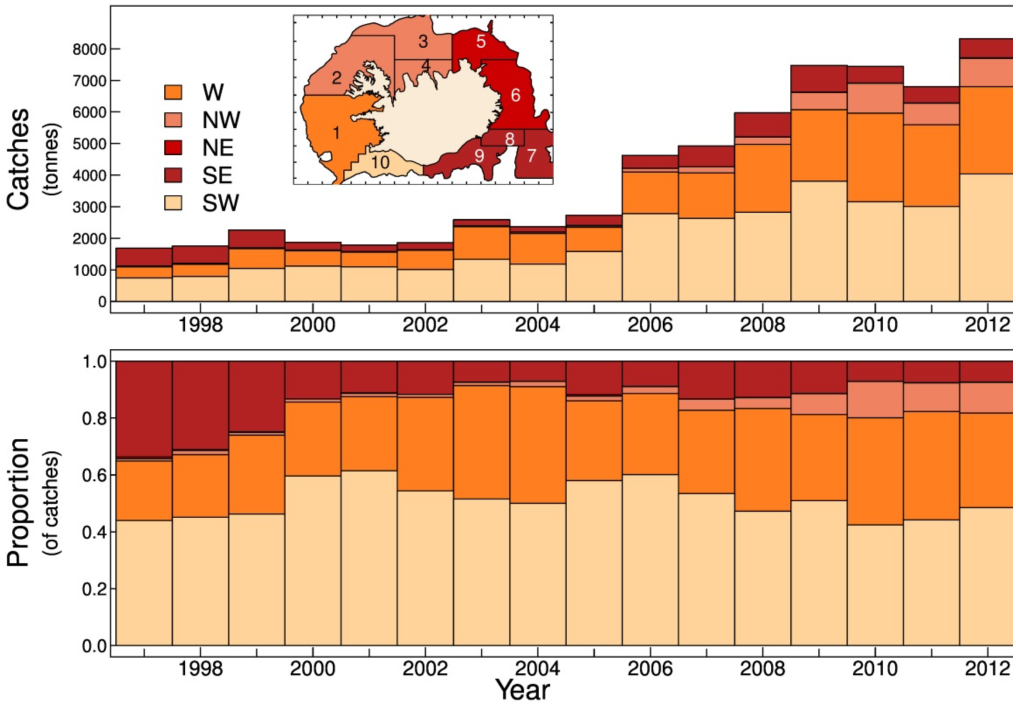


Figure 4.4.3. Ling in Va. Changes in spatial distribution of ling catches as recorded in Icelandic logbooks.

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 thousand tonnes in 2010. In 2011 catches decreased somewhat to around 9600 tonnes but reached 12 thousand tonnes in 2012. This 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 2013 and 2014 states: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 12 000 tonnes.

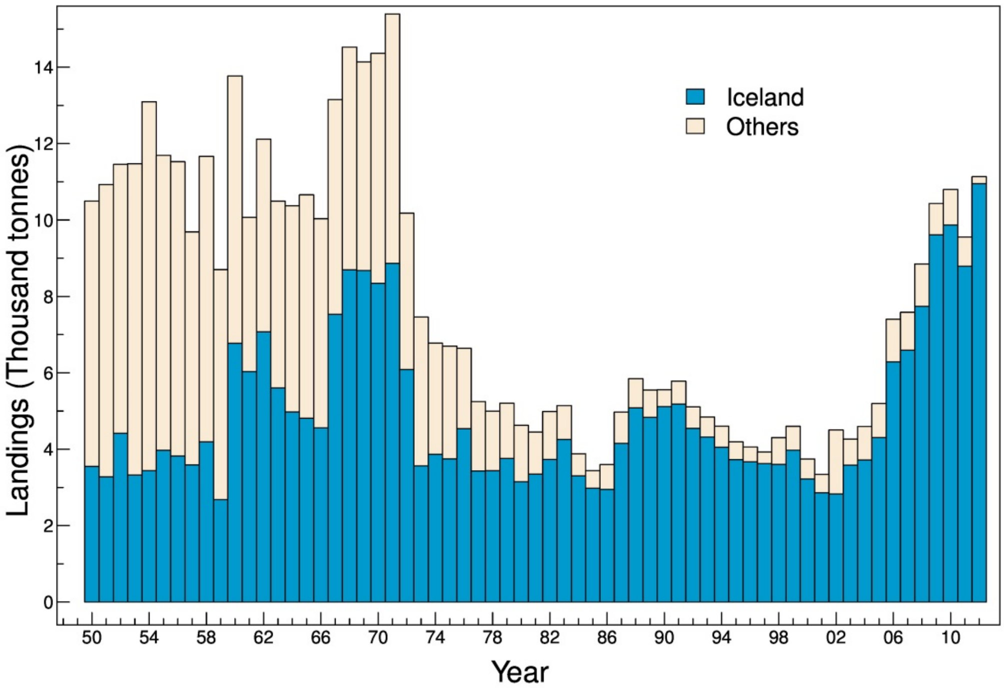


Figure 4.4.4. Ling in Va. Nominal landings.

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 was less in the 2010/2011 (35%) and 2011/2012 (24%) fishing years than in the 2009/2010 fishing year (53%). 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 tusk 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.

In the 2010/2011 and 2011/2012 fishing years 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 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.

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 o 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	

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

(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	10390
2010	7322	57	0	2345	9724
2011	7248	0	150	1995	9393
2012	12770	85	150	2748	15753

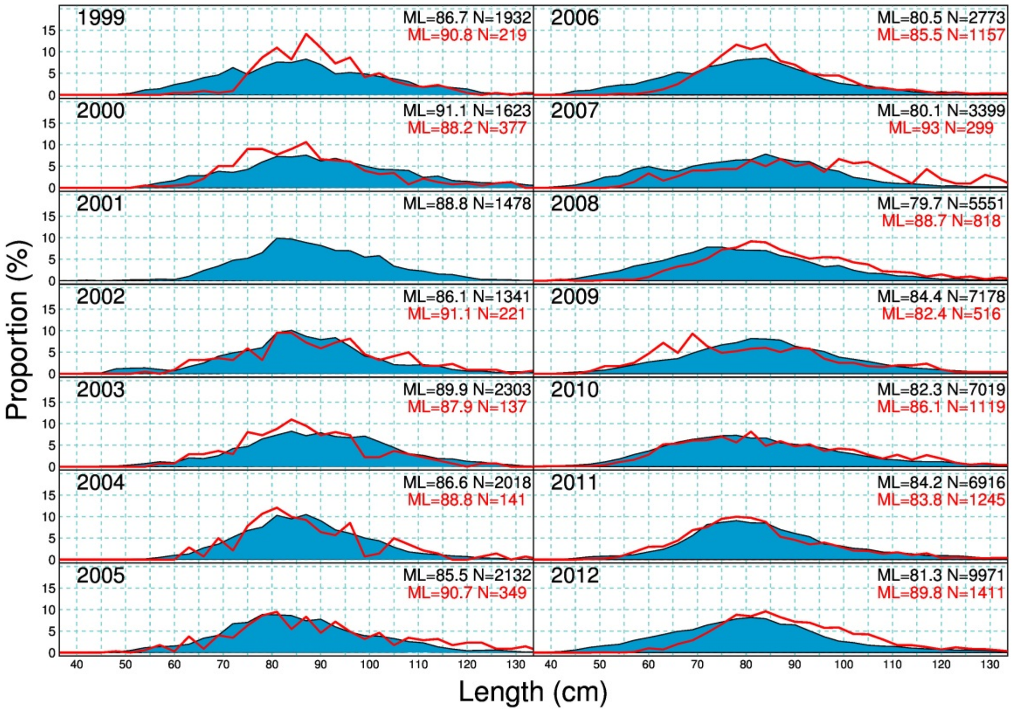


Figure 4.4.5. Ling in Va. Length distributions from the Icelandic longline fleet (blue area) and trawls (red lines).

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). Limited progress has been made since 2010. Now aged otoliths are available from the 2005, 2010 to 2012 spring surveys and from 2012 from commercial catches (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 Icelandic spring survey and commercial catches.

Year	Spring survey	Longlines	Trawls
2005	122		
2010	245	46	
2011	543		
2012	553	440	149

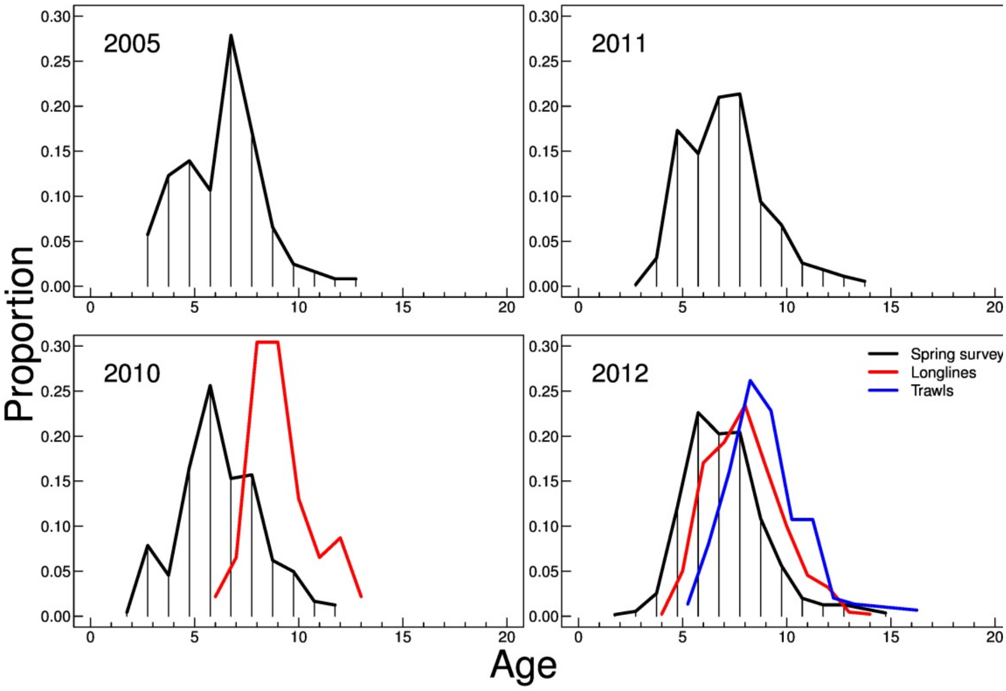


Figure 4.4.6. Ling in Va. Age distribution of ling in the Icelandic spring survey and commercial catches (raw data).

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.

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.

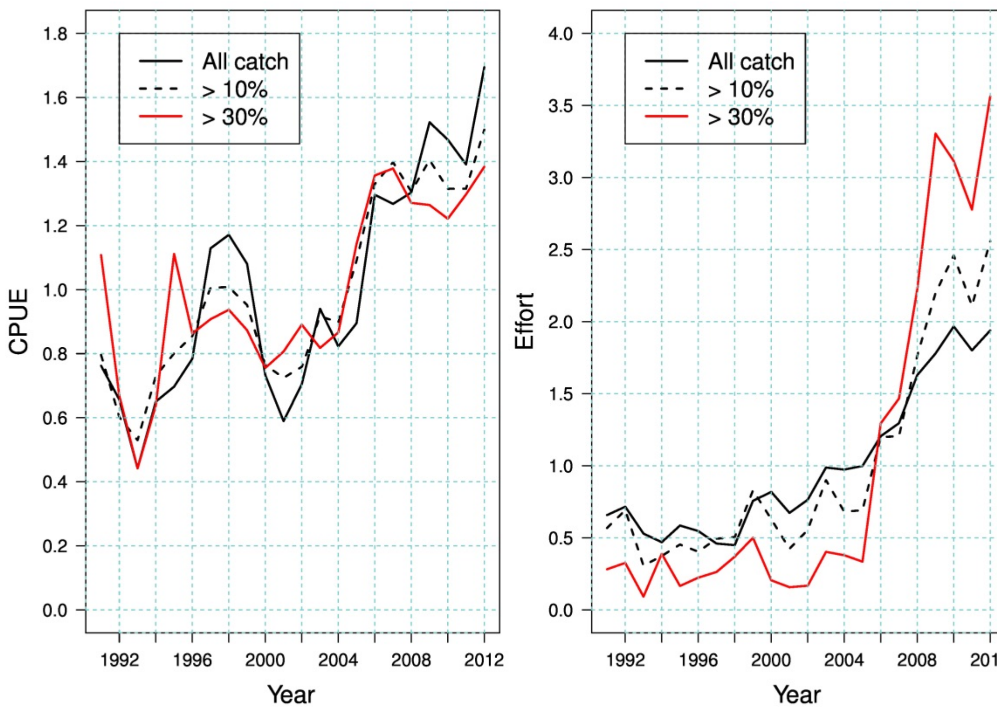


Figure 4.4.7. Ling in Va. Index of raw cpue (sum(yield)/sum(effort)) and effort (number of hooks) of ling from the Icelandic longline fishery based on logbooks 1991–2012. The criteria for the calculations were all sets where ling was reported in the logbooks and where ling composed at least 10% and 30% 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.

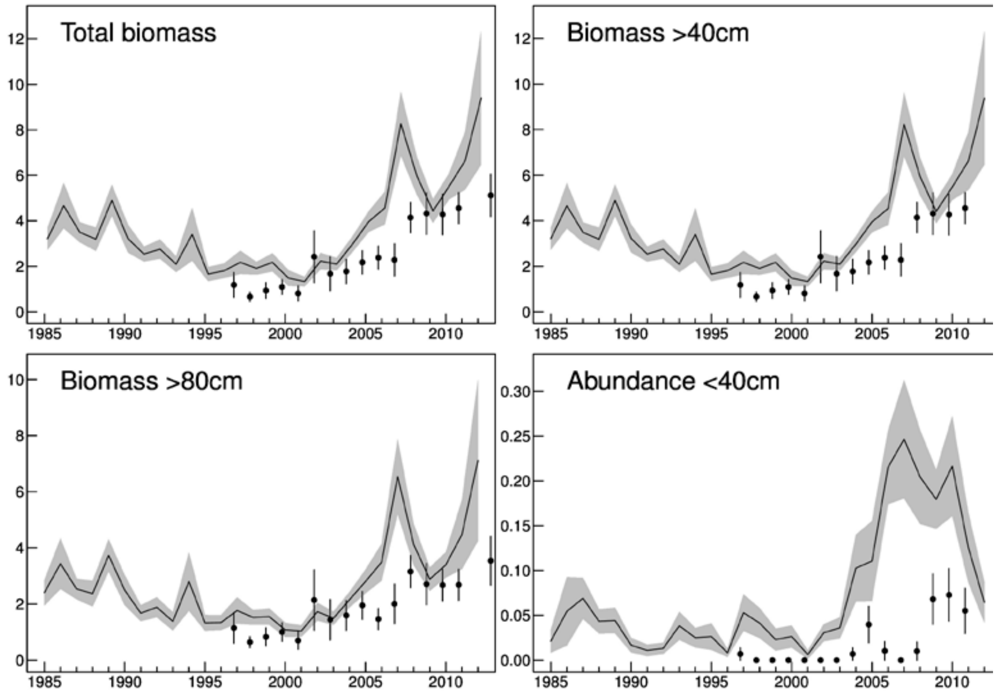


Figure 4.4.8. Ling in Va. Shown are a) Total biomass indices, b) biomass indices larger than 40 cm, c) biomass indices larger than 80 cm and d) abundance indices smaller than 40 cm. The lines with shades show the spring survey index from 1985 and the points with the vertical lines show the autumn survey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

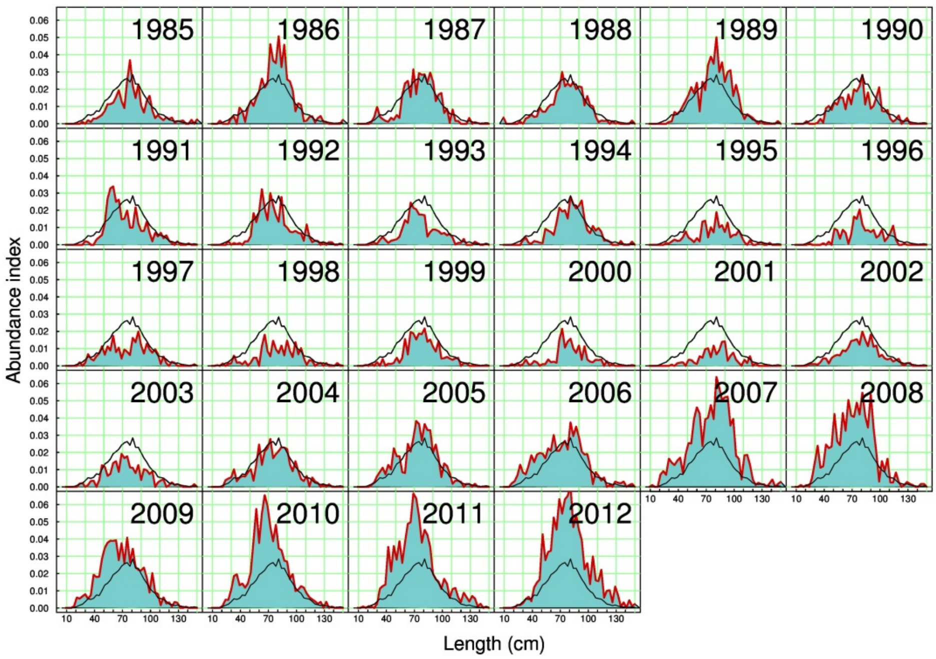


Figure 4.4.9. Ling in Va. Abundance indices by length (3 cm grouping) from the spring survey since 1985. Black line is the average over the whole period.

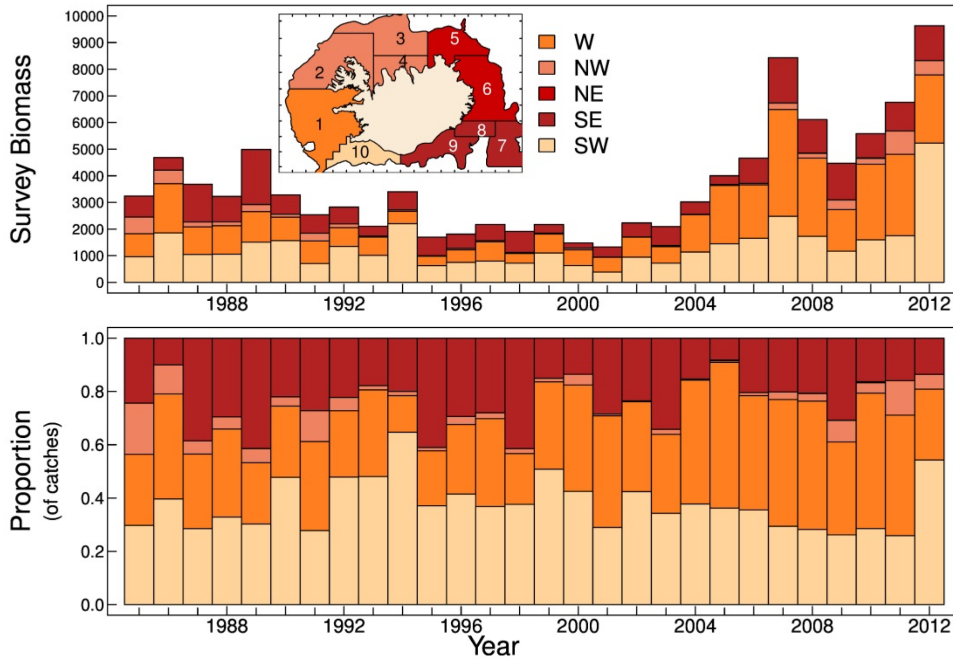


Figure 4.4.10. Ling in Va. Estimated survey biomass in the spring survey by year from different parts of the continental shelf (upper figure) and as proportions of the total (lower figure).

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 theirs 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 2012 the indices increased again to similar levels in 2012 as observed in 2007. 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 but is still higher than observed before 2004 (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 suggested that it 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 inter annual 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 except the autumn survey biomass indices where still increasing in most recent years. 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.

Due to the above mentioned problems with the cpue series and the overall consistency in the survey indices, the Working Group has concluded that the fishery-independent data are the best indicator of stock trends of ling.

The relative changes relative fishing mortality (F_{proxy} = Yield/Survey biomass) for ling in Va (Figure 4.4.12) indicates that F_{proxy} increased in the period from 1985 until 1991 and was at similar levels until 2002. F_{proxy} then decreased until 2007 by 50% but 2007 being a high value in the spring survey. However in 2009 the F_{proxy} seems to have increased sharply again to a similar level as it was highest in the late 1990s early 2000s. Due to the high index from the spring survey, together with slight decrease in catches, F_{proxy} in 2012 is now around 65% of what was observed in 1991 to 2002.

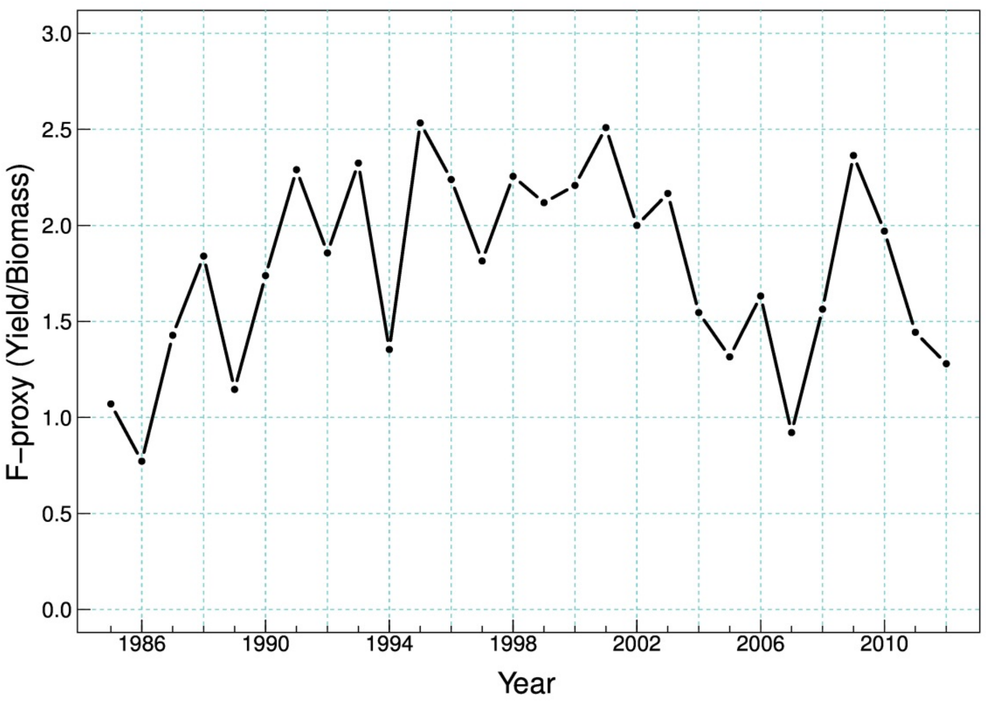


Figure 4.4.11. Ling in Va. Estimates of trends in relative fishing mortality (Yield/Survey biomass [>39 cm]).

Analytical assessment

An exploratory stock assessment for ling in Va using the Gadget model was presented at the WGDEEP-2011 and 2012 meetings. The Gadget model can be viewed as general framework for utilizing all available data and as such can detect inconsistencies in the data often ignored in other models which make much stronger assumptions about stock dynamics such as stock production models. In general the exploratory Gadget model did seem to capture the main trends in the data. The model was not run before or at the WGDEEP-2013 meeting.

At the 2012 ICES ASC a presentation titled "Evaluating trade-offs for multispecies management procedures for exploited marine populations using bootstrap for highly disparate datasets" the aim of the study was to develop a framework for the evaluation of various harvest control rules-for both tusk and ling Va. Furthermore the aim was to assess the performance of allocating quota according to F_{MAX}. In order to address this there was a need to address the uncertainty in the models. The results of this exercise for ling showed that the model could capture the trends in the data but absolute values for the key estimates were not staple, i.e. the model would be indicative of trends (Figure 4.4.12). It is expected that further work will be carried out before the 2014 WKDEEP-2014 benchmark meeting which will hopefully result in a more staple model.

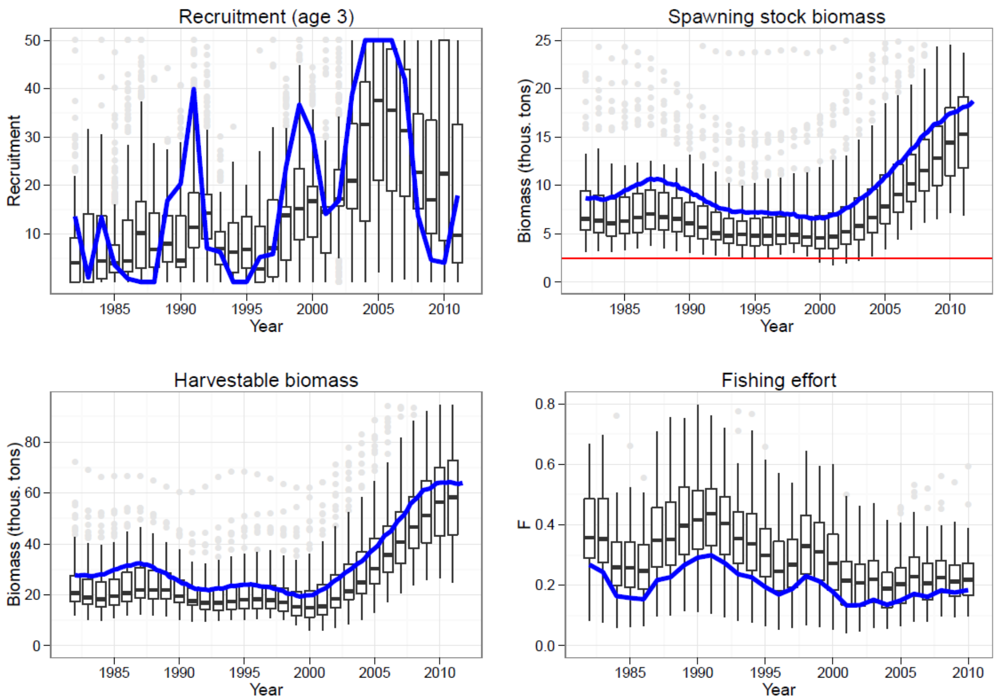


Figure 4.4.12. Ling in Va. Results of fitting Gadget to 100 bootstrap samples of ling data (box-plots) and the results of the base model i.e. using the base data (blue line). The graph is from a talk presented at the 2012 ICES ASC by Elvarsson and Thordarson.

4.4.7 Comments on the assessment

4.4.7.1 Management considerations

Management advice for deep-water species is not required this year.

4.4.8 Response to technical minutes

The comments by the RG are mostly on the Gadget model and will be valuable in the preparation for the upcoming benchmark of ling in Va. They will not be addressed further here.

The reviewer complains about the structure of the section. His comments are well founded however this structure of the report is in convention with the arcane format of ICES reports and would require much effort on many levels to change. The stock coordinator for ling in Va agrees with the reviewer on this point, but he is just a tiny little cog in the large ICES mechanism.

Technical comments

1) Missing data in Table 4.4.3. Mistake by the stock coordinator.

2) It is not clear how species conversion causes overshoot of TAC. The RG asks if TAC from one species can be changed to another species. The short answer is "yes".

3) The RG wants more elaboration on the shortcomings of the cpue. The stock coordinator could do that by ranting for many pages, however the EG has been trying to limit the number of pages of the report and having the report only containing highly relevant information.

4) The RG would like to have units on the survey indices. The comment on the units for survey biomass is a frequent question but it has to be pointed out that it is an index and as such should not have any units as the q from the survey is unknown (but is estimated in Gadget, where it varies depending on length groups).

Table 4.4.6. Ling in Va.

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	10 952	248	0	12 011

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 1988–2012, 42% of the total landings were in Area IV, 31% in Area VI, and 26% in Area VI.

In Subarea VII the Divisions b, c, and g–k provide most of the landings of ling. Norwegian landings, and some of Irish and Spanish 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 bycatches in various fisheries.

4.5.2 Landings trends

Landing statistics by nation in the period 1988–2012 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 when the landings have been stable. When Areas III–IV are pooled, the total landings averaged around 32 000 t in 1988–1998 and then declined to an average of around 15 000 t in 2003–2012. The decline has been simultaneous in the main Areas IV, VI and VII, but Area VII has had a greater reduction in landings than in Areas IV and VI.

4.5.3 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 10 800 tonnes.

4.5.4 Management

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

EU TACs for ling in 2013 are:

EU waters of Subarea IV	2428 t
Subarea VI, VII, VIII, IX, X, XII, XIV	8024 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.

There is no species-specific regulation in the Norwegian EEZ, but a TAC is negotiated for Norwegian vessels fishing in EU waters. The quota of ling for Norway in the EU zone s for 2013 is, 6140 t. The quota for the EU in Norwegian waters in Area IV in 2013 is 850 t.

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 has been reported from some fleets by Spain, Ireland and Scotland.

Length compositions

Average fish length in Areas IVa, VIa, VIb from the Norwegian longline reference fleet from 2001 to 2012 are shown in Figure 4.5.3.

Age compositions

No new data were presented.

4.5.5.2 Weight-at-age

No new information on weight-at-age.

4.5.5.3 Maturity and natural mortality

No new data were presented.

Catch, effort and research vessel data

Commercial cpues

A standardised commercial cpue by the Norwegian longline reference fleet was presented to WGDEEP 2013:

Catch and effort data for Norwegian longliners for IV, VIa and VIb were updated for the period 2000 up to 2012 (Table 4.5.3, Figure 4.5.5). For the standardised Norwegian cpue, data was available from official logbooks from 2000 onwards. Vessels were selected which annually caugth ling in more than 100 days in a targeted fishery. Further details on the methodology can be found in the Ling I&II chapter and the working document Helle and Pennigton, 2013.

4.5.6 Data analyses

Discard data

Discarding rates are relatively low for most Irish fleets and the Scottish observerver fleet (below <20% for most fleets as reported by Ireland and Scotland, Anom 2011; SISP, 2011). Spanish estimates of ling discard rates have increased from 2007 levels, and have been reported as ca. 30% tons for 2011 in Areas VI and VII.

Length data analysis

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

Commercial cpue dataseries:

For the Norwegian longline fleet, for which a standardised cpue was presented, the following obervations were made and summarised in WD Helle and Pennington, 2013a and 2013b:

- The overall number of longliners declined ca. twofold from the late nineties to 2012, while the catch per vessel increased (Figure 4.5.4.);
- 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 (Table 4.5.3);
- The average number of hooks increased in IVa and VIa (Figure 4.5.5);
- There was a linear relationship between the number of hooks and the average catch of ling (see WD and/or Ling I&II);
- No other changes or variability in the longline fishery over the years appeared to affect noticeably the catchability of the fleet;
- For vessels that caught ling between one and a 100 days during a year, the average catch per vessel was significantly correlated (Pr = 0.00) with the

number of days the vessel caught ling, while there was no significant correlation (Pr =0.47) for vessels that caught ling on more than 100 days.

Hence a cpue was calculated for vessels which only caught ling on 100 or more days during a year.

4.5.7 Comments on the assessment

The standardised cpue time-series of the Norwegian longliners shows similar trends to 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). Error bars are higher due the way the uncertainty was calculated based on the super-population model. This assumes that the actual vessels providing data are random samples from a conceptual "super-population" of longline vessels.

4.5.8 Management considerations

The cpues from the commercial vessels either indicate a stable or an increasing trend in the last years.

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**

***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	7412
2010*		433	-	62	40		3914		28		1921	6398
2011		541		90	62		3790	8	18		1999	**6508**
2012*		419		86	47		4588	6	28		1822	**6996**

***Preliminary.**

[(1)] Includes IVb 1988–1993.

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	0	10	83	25	7	8		**190**

***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
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

Year	Belgium	Denmark	Faroes	France [1]	Germany	Ireland	Norway	Spain[2]	E&W	IOM	N.I.	Scot.	Total
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

***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	13		13	1089	3			218		**1396**

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

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**

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*	48	1	39	230	369	1		246	**934**

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

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		230	1	164	2			7	**411**

***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	79	<1	59	<1	**166**

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

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		549	2.4	516		214	138			56	**1498**

***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*		338		201	2		**541**

LING IX

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

Table 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**

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**

***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	7424	314	2324	2635		48	131	363	106	673	186		1	3	14 357
2010	142	6398	201	3256	2691		16	326	294	69	848	134		0	3	14 093
2011	140	6508	211	2999	1259		28	208	425	155	936	201		1	3	13 074
2012*	144	6996	190	3655	1396		14	934	411	166	1498	541		4	106	16 056

***Preliminary.**

Table 4.5.3. Average number of fishing days per longline vessel in Areas IIa for the period 2000–2012.

Ling	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
IIIa	+			1					1	1			
IVa	19	22	29	20	22	25	38	27	25	49	3	21	26
IVb	1	+		1				3				3	1
VIa	13	13	11	12	14	23	13	10	9	7		8	5
VIb	4	5	7	4	5	8	7	6	2	2	7	4	5
VIIc	3	1			1	+		1					1

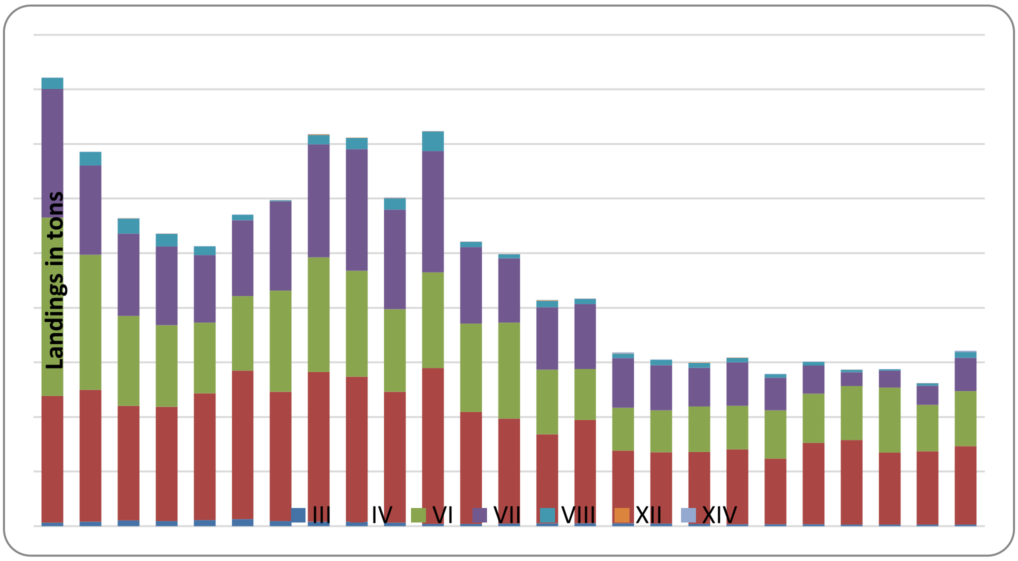


Figure 4.5.1. International landings. Ling in other areas.

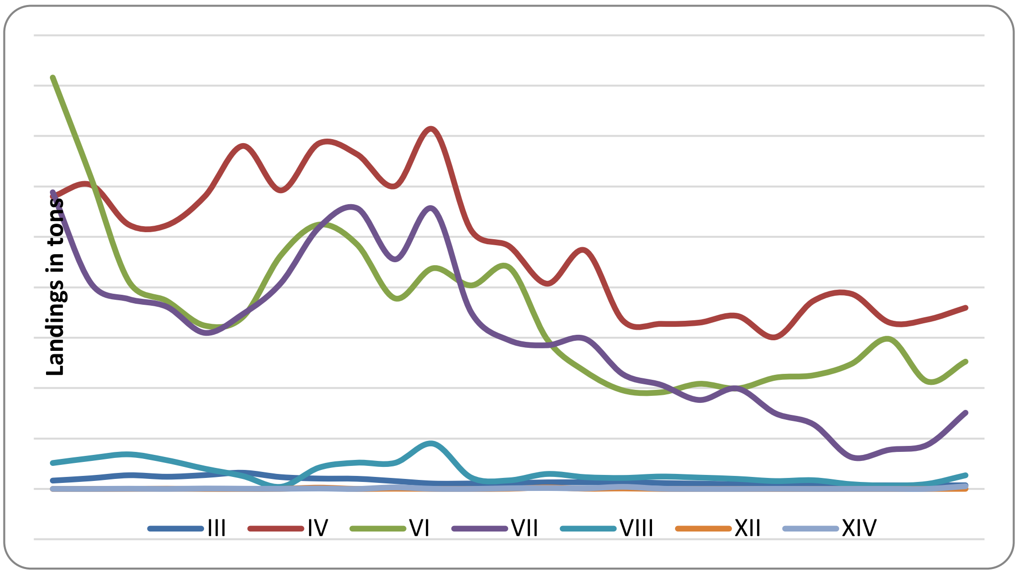
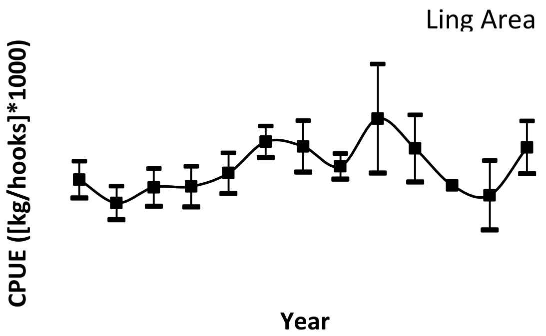
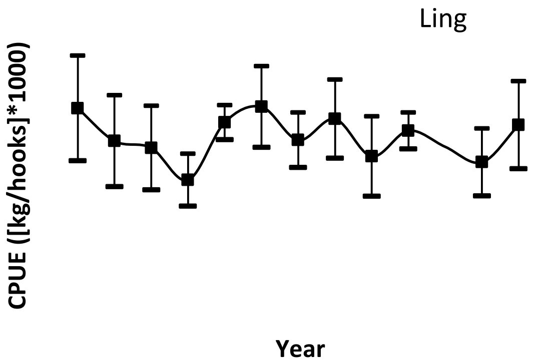
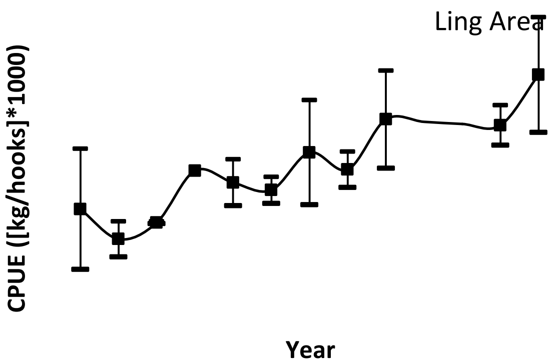


Figure 4.5.2. International landings. Ling in other areas.


Ling Area
CPUE ([kg/hooks]*1000)
Year


Ling
CPUE ([kg/hooks]*1000)
Year


Ling Area
CPUE ([kg/hooks]*1000)
Year

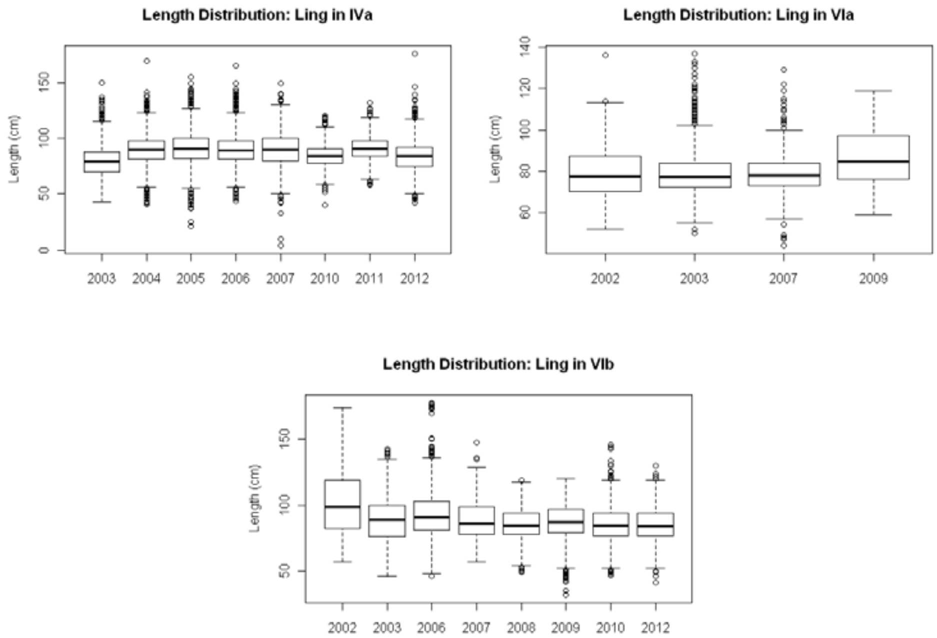


Figure 4.5.3. Box and whisker plots of length distribution of the Norwegian longline reference fleet in IVa, VIa and VIb.

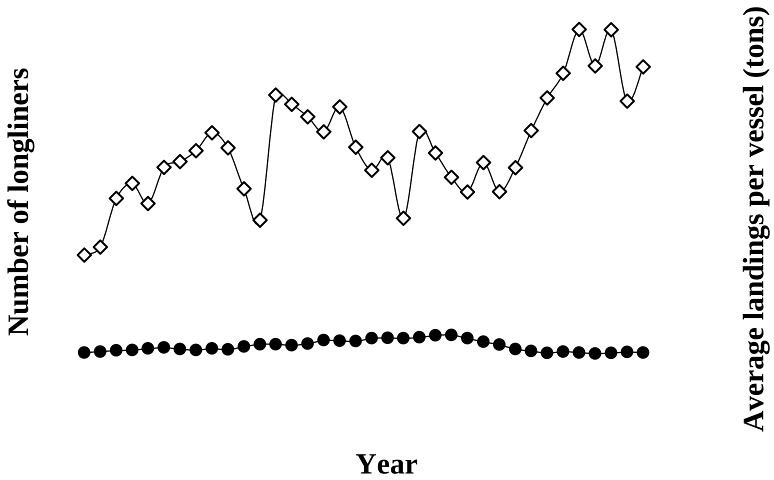


Figure 4.5.4. The number of longliners (filled circles) and average landings per vessel of ling and tusk (open diamonds) in the period 1977–2012.

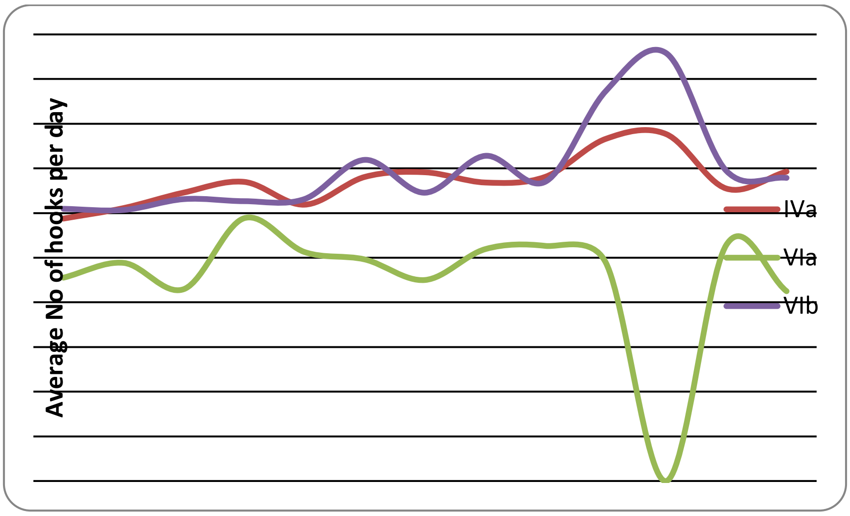


Figure 4.5.5. Average number of hooks the Norwegian longliner fleet used per day in IVa, VIa and VIb for the years 2000–2012 for the fishery for tusk, ling and blue ling.

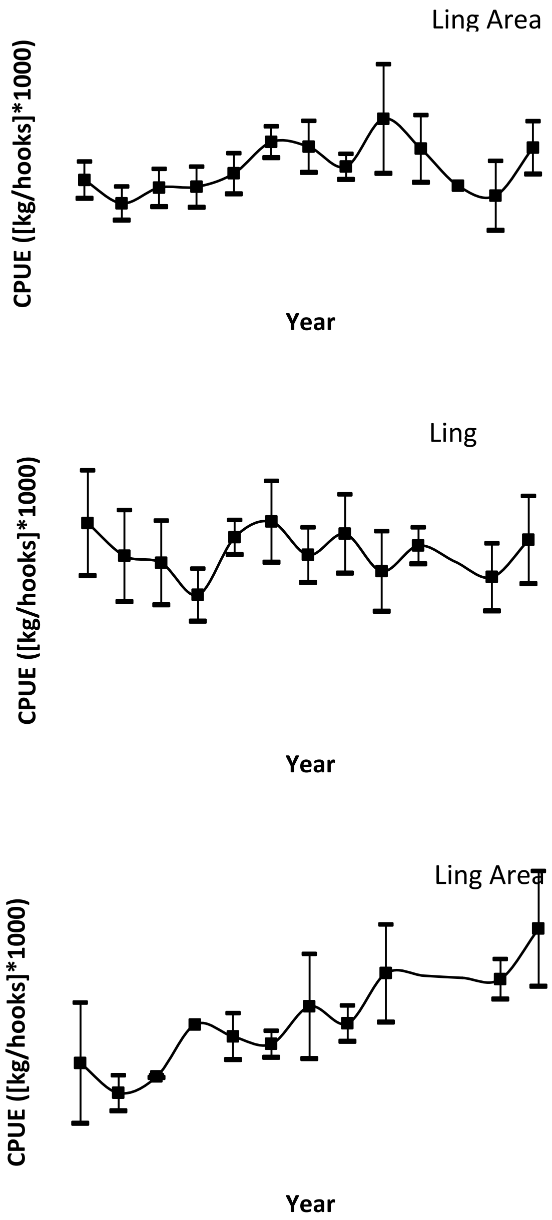


Figure 4.5.6. Cpue series for ling for the period 2000–2012 based only on vessels that caught ling on 100 or more days. The bars denote the estimated two standard errors.

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). Landings from Norway from the 1950s and 1960s might have been from Subareas I and II. German landings from the 1960s were mainly reported in Statlant from ICES Division Va and Vb, landings in the 1960s might have come from the same area.

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 5.1.2. 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.

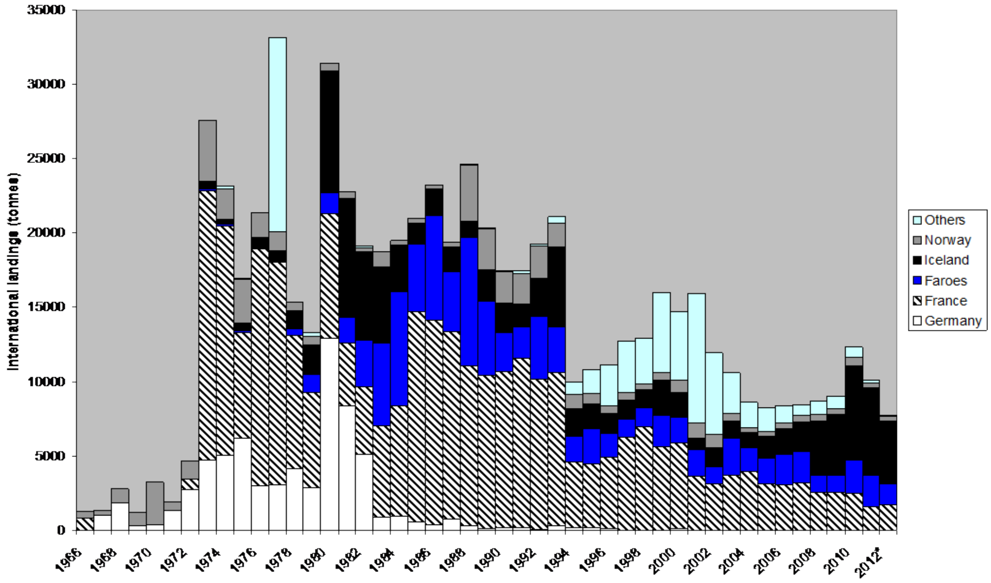


Figure 5.1.1. Total international landings of blue ling in the Northeast Atlantic 1966–2012.

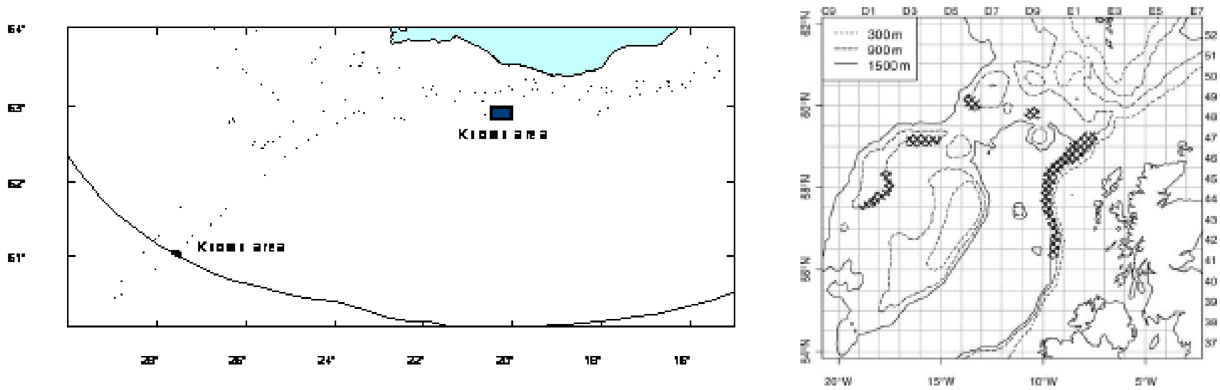


Figure 5.1.2. Known spawning areas of blue ling in Icelandic water (a) and to the West of Scotland (b, from Large *et al.*, 2010).

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 1996, to 2012 (Figures 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 northwestern area, but more likely because of an increase in effort or reporting.

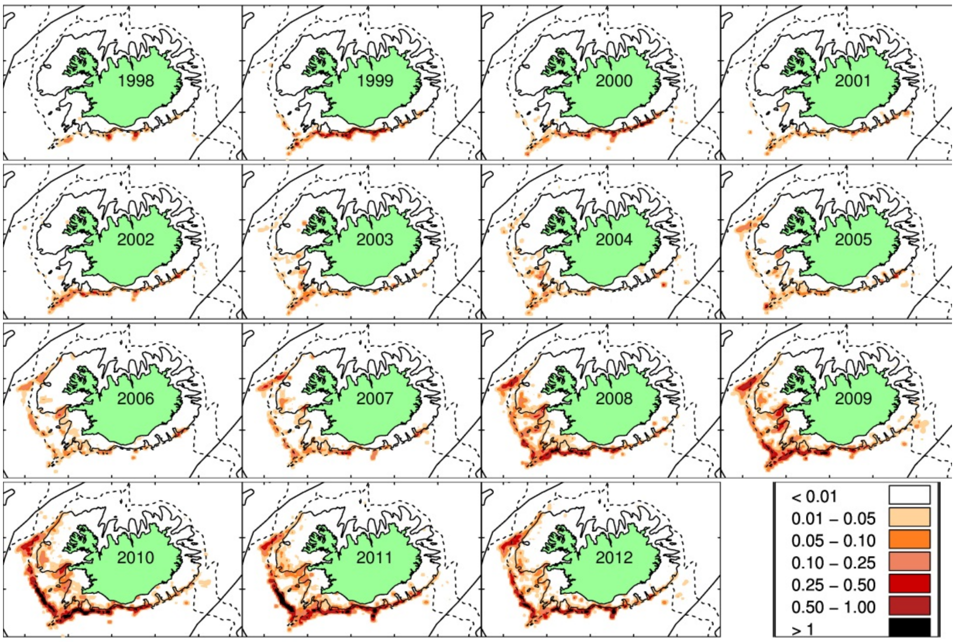


Figure 5.2.1. Blue ling in Va and XIV. Geographical distribution (tonnes/square mile) of the Icelandic blue line fishery since 1998 as reported in logbooks. All gear types combined.

Before 2008 the majority of the catches of blue ling in Va were by trawlers, as bycatch in fisheries targeting cod, haddock 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 has been 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. In 2012 the proportion of longline catches decreased to 58%. At the same time longliners have started fishing at deeper waters than before 2008 but 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.

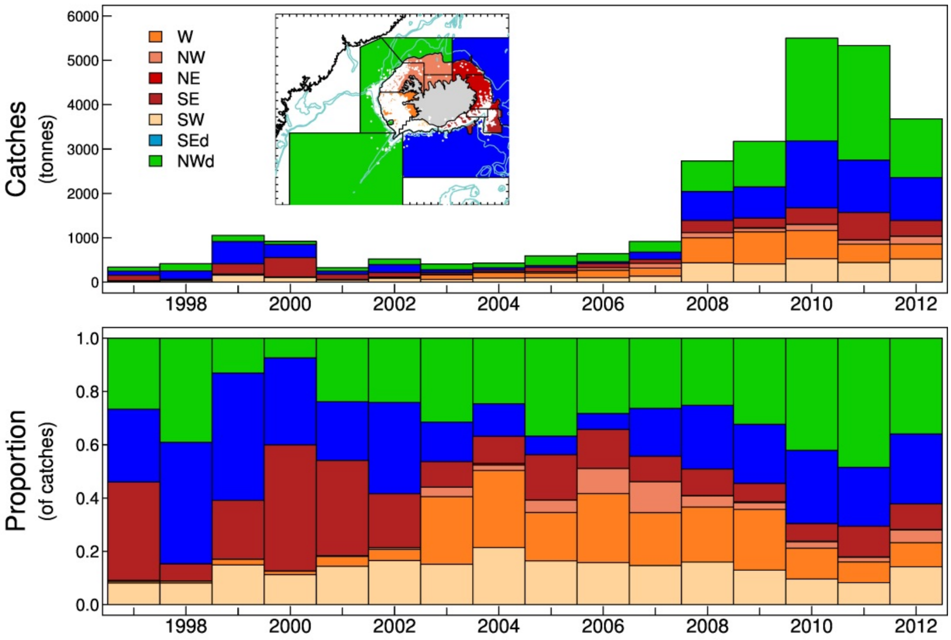


Figure 5.2.2. Blue ling in Va and XIV. Spatial distribution of reported catches in Va in tonnes (upper) and as annual proportions (lower). The inserted map shows the area division and locations of operations in 2011 (hauls and lines) as white points.

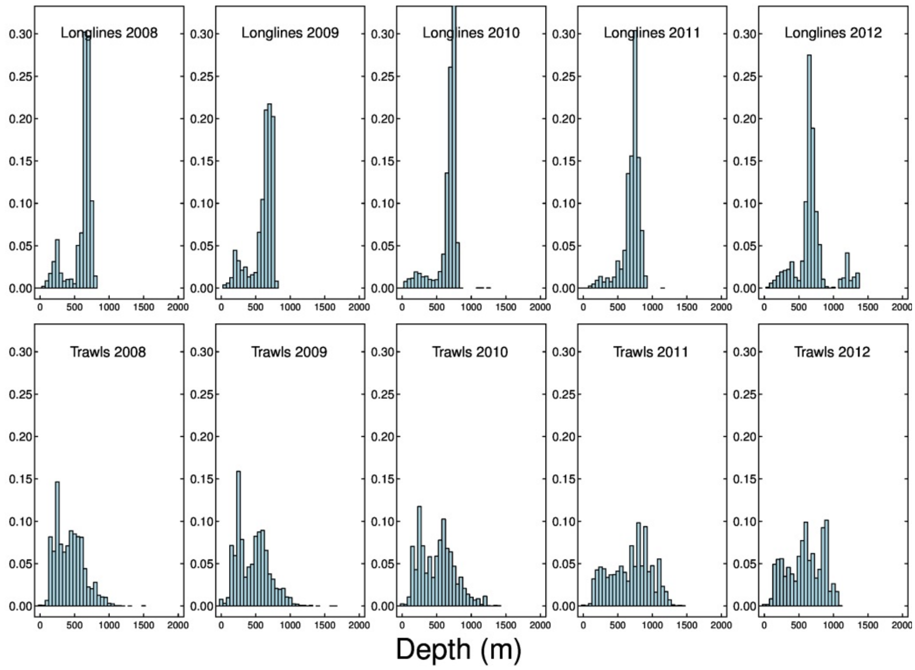


Figure 5.2.3. Blue ling in Va and XIV. Depth distribution of longlines (upper row) and trawls (lower row) catches in Va according to logbook entries.

5.2.2 Landings trends

The preliminary total landings in Va 2012 were 4410 t of which the Icelandic fleet caught 4207 t. (Table 5.2.1 and Figure 5.2.4). Catches of blue ling in Va increased by more than by 370% between 2006 and 2010, the main part of this increases can be attributed to increased targeting of blue ling by the longline fleet, catches in Va decreased in 2011 and 2012 compared to 2010 or by around 2500 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 2012 were 9 t.

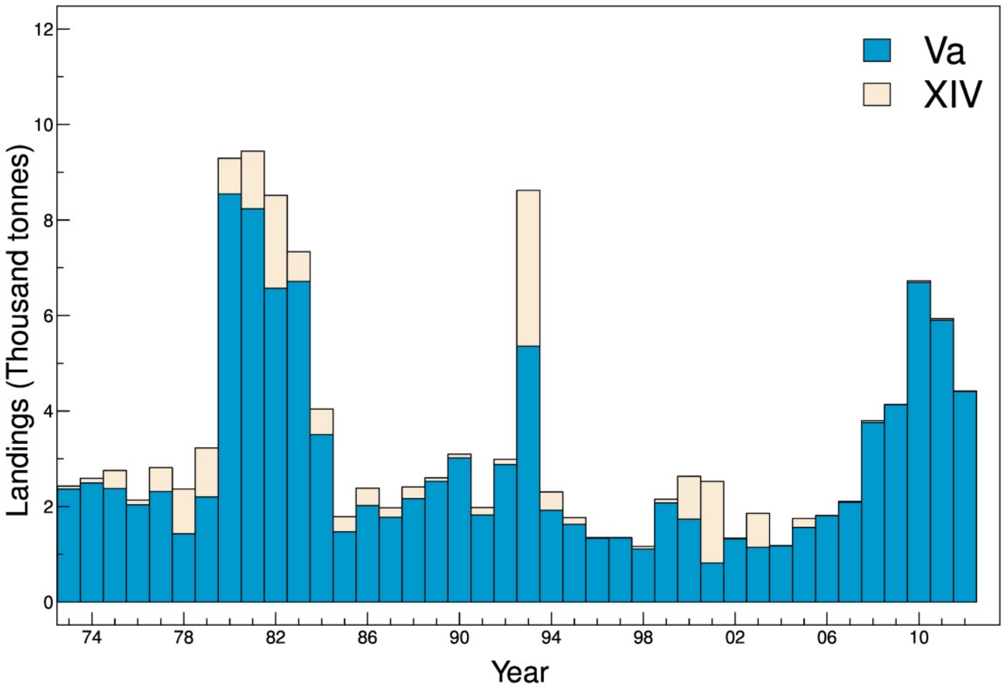


Figure 5.2.4. Blue ling in Va and XIV. Nominal landings.

5.2.3 ICES Advice

The ICES advice for 2013 and 2014 is: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 3100 tonnes. Area closures to protect spawning aggregations should be maintained and expanded as appropriate.

5.2.4 Management

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

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 subjected to TAC constraints 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 1997–2012 are shown in Figure 5.2.5. Mean length from trawls has varied from about 75cm to 86 cm in the period without any obvious trend. On average mean length from longlines is higher than from trawls.

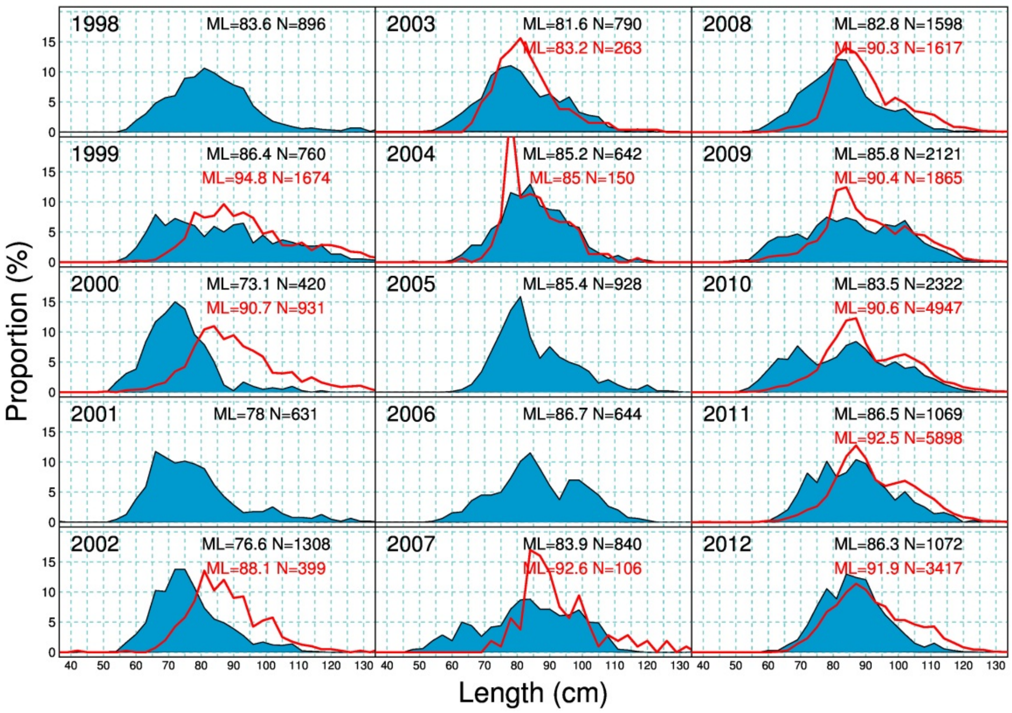


Figure 5.2.5. Blue ling in Va and XIV. Length distribution of blue ling from trawls (blue area) and longlines (red lines) of the Icelandic fleet in Va since 1997. The number of measured fish (N) and mean length (ML) is also given.

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, but have decreased from their peak in 2010. No marked changes are observed from trawls since 2000.

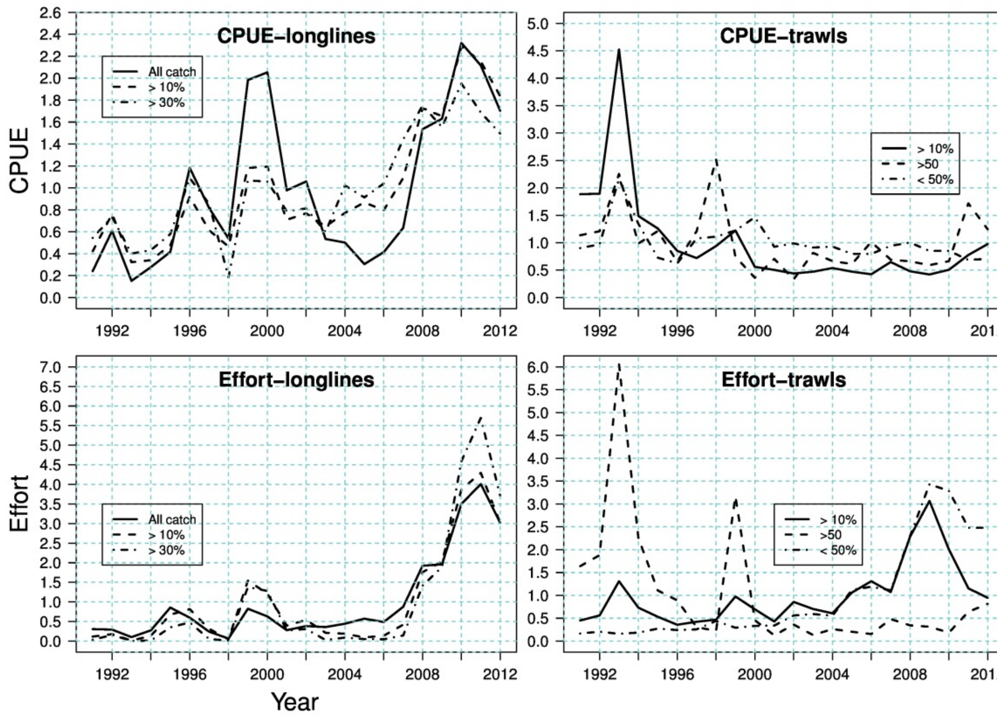


Figure 5.2.6. Blue ling in Va and XIV. Nominal cpue and effort from longlines and trawls in Va based on logbook data where blue ling was either recorded in catches or above certain level.

Time-series stratified abundance and biomass indices from the spring and autumn trawl surveys are shown in Figure 5.2.7 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.

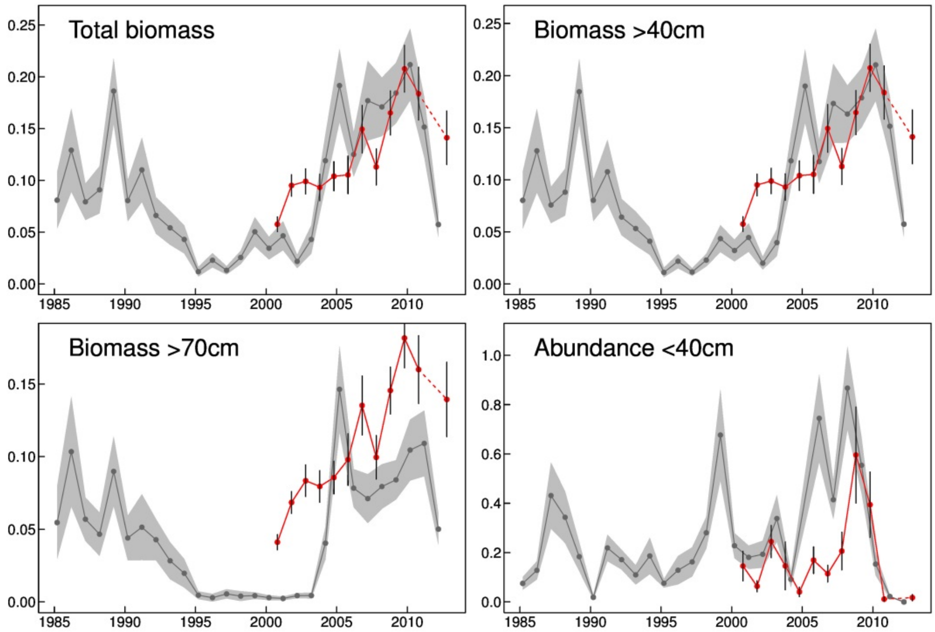


Figure 5.2.7. Blue ling in Va and XIV. Abundance indices for blue ling in the Icelandic spring survey since 1985 (line and shaded area) and the autumn survey since 2000 (red points and vertical lines). A) total biomass index, b) biomass of 40 cm and larger c) biomass of 70 cm and larger, d) abundance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

5.2.6 Data analyses

Landings and sampling

Catches from the Icelandic longline fleet have increased rapidly in recent years resulting in a rapid expansion of the fishing area and change in the selectivity of the fishery even though there are some indications in 2012 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 caught or 27%, but longliners 4138 tonnes or 70%. As longliners take on average larger blue ling (Figure 5.2.5) this will have resulted in an overall change in the selection pattern. Total catches by the Icelandic fleet decreased between 2010 and 2012 and this decrease is mainly the result of decrease in trawls in 2011 but in longlines in 2012. The expansion of the longline fleet to deeper waters 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).

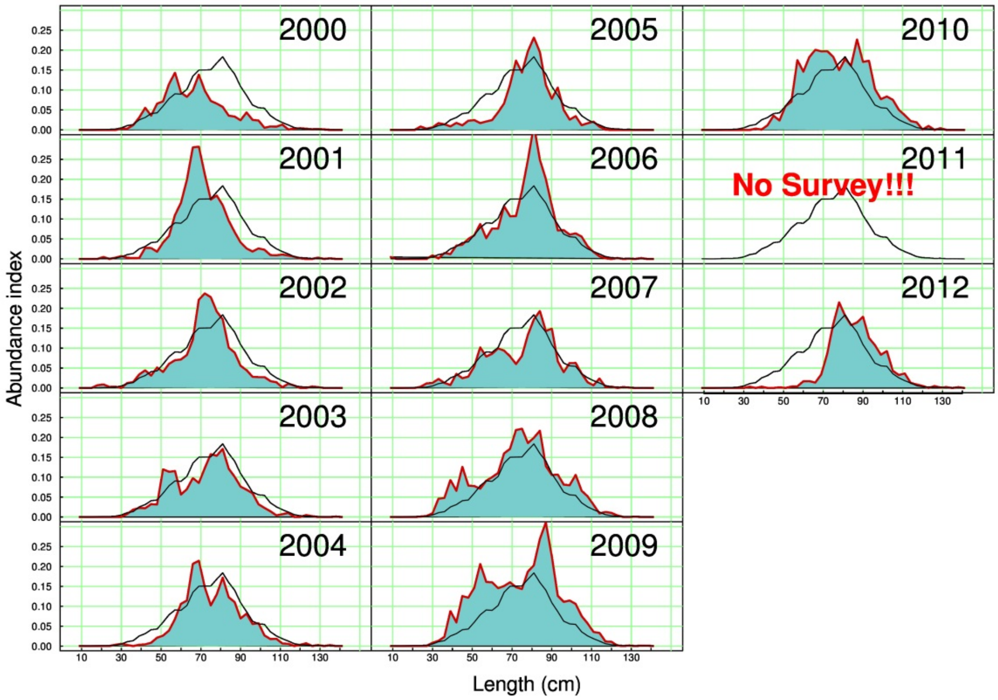


Figure 5.2.8. Blue ling in Va and XIV. Length distributions from the Icelandic autumn survey since 2000. Black line is the average by length over the whole survey period.

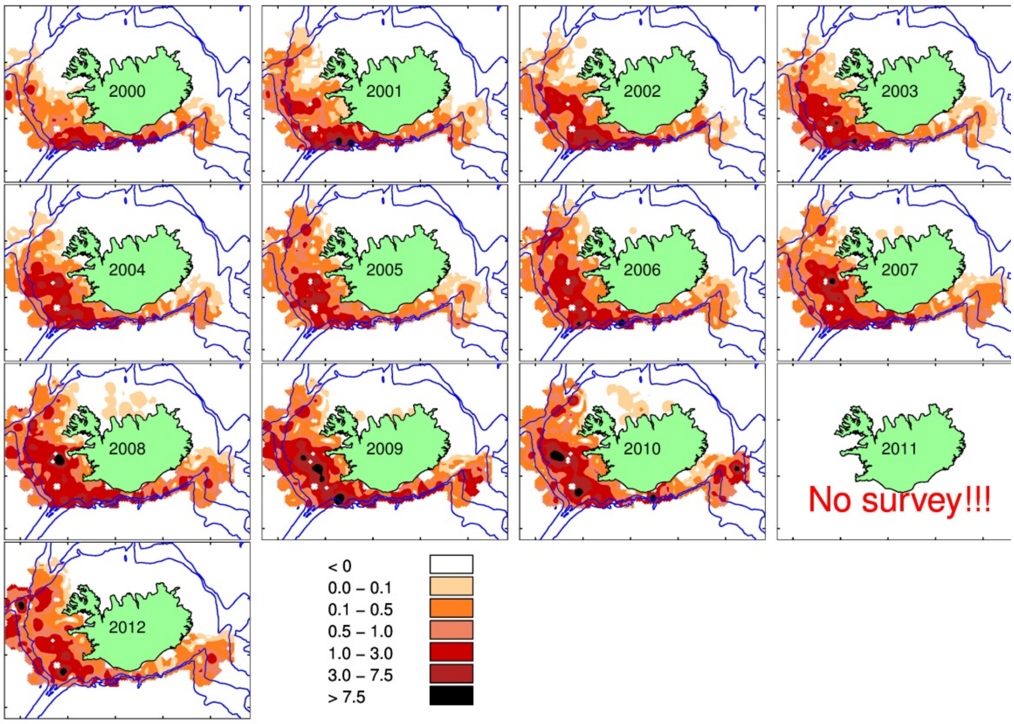


Figure 5.2.9. Blue ling in Va and XIV. Spatial distribution from the Icelandic autumn survey.

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 decrease in cpue from longlines. 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 is does not cover the depths were largest abundance of blue ling occur. It is however not driven by isolated large catches at a few survey stations.

Biomass indices from the spring survey were relatively high in 1985 to 1991 with great interannual variation but decreased rapidly until 1995 and remained low until 2003 (Figure 5.2.7). A rapid increase followed with the total biomass index increasing fourfold in 2005. The biomass indices remained at their highest observed values in 2005 to 2011, however in 2012 there is a rapid decrease and the total biomass index declined by a factor of three between 2011and 2012. Very similar trend is observed in the juvenile index (abundance of blue ling less than 40 cm) except for a spike in the juvenile index in 1999 and that the index fell in 2010 rather than 2012.

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). Since 2010 the index has decreased but is still high relative to the time-series. A large increase or more than 200% in the recruitment index was observed in 2008 but in the 2010 and 2012 autumn survey it had decreased again to its lowest observed value (Figure 5.2.7 and 5.2.8). Due to industrial action only part of the autumn survey was conducted in 2011.

Relative fishing mortality (F_{proxy} = Yield/Survey biomass) derived from the autumn survey (+40 cm) indicates that fishing mortality may have increased by more than 200% between 2007–2010 (Figure 5.2.10). Since then there are indications that it may have decreased by 50% in 2012, to similar levels as observed in 2008 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).

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. The EG agreed that the exploratory Gadget assessment presented at the meeting was promising and the estimates from the model could possibly become part of the assessment of blue ling in Va and XIVb or even the basis for advice in the future. However there are several issues with the model that need closer examination and these are tied to the assumptions of growth and selectivity of the fleets in the model. The temporal trends of the estimates of the model (biomass, recruitment and fishing mortality) were relatively stable but the levels of these estimates vary given different model specifications. Updated results of the model were not presented at WGDEEP 2013.

5.2.7 Comments on the assessment

None.

5.2.8 Management considerations

Management advice for deep-water species is not required this year.

5.2.9 Response to technical minutes

The comments by the RG were constructive and justified in most ways. The will prove valuable in coming years.

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	101	0	3653	4		3758
2009	87	0	4132	4	0	4233
2010	515	0	6377	8	0	6900
2011	594	0	5903	2	0	6499
2012[1)]	201	0	4207	2	0	4410

[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	TOTAL
1973	0	50	0	10	0	0	0	0	60
1974	0	90	0	6	0	0	0	0	96
1975	0	285	0	90	3	0	0	0	378
1976	0	65	0	21	0	0	0	13	99
1977	0	491	0	0	0	0	0	6	497
1978	0	933	0	0	4	0	0	0	937
1979	0	1026	0	0	0	0	0	0	1026
1980	0	746	0	0	0	0	0	0	746
1981	0	1206	0	0	0	0	0	0	1206
1982	0	1946	0	0	0	0	0	0	1946
1983	0	621	0	0	0	0	0	0	621
1984	0	537	0	0	0	0	0	0	537
1985	0	315	0	0	0	0	0	0	315
1986	214	149	0	0	0	0	0	0	363
1987	0	199	0	0	0	0	0	0	199
1988	21	218	3	0	0	0	0	0	242
1989	13	58	0	0	0	0	0	0	71
1990	0	64	5	0	0	0	0	10	79
1991	0	105	5	0	0	0	0	45	155
1992	0	27	2	0	50	0	0	32	111
1993	0	16	0	3124	103	0	0	22	3265
1994	1	15	0	300	11	0	0	57	384
1995	0	5	0	117	0	0	0	19	141
1996	0	12	0	0	0	0	0	2	14
1997	1	1	0	0	0	0	0	2	4
1998	48	1	0	0	1	0	0	6	56
1999	0	0	0	0	1	0	66	7	74
2000	0	1	0	4	0	0	889	2	896
2001	1	0	0	11	61	0	1631	6	1710
2002	0	0	0	11	1	0	0	0	12
2003	0	0	0	0	36	0	670	5	711
2004	0	0	0	0	1	0	0	7	8
2005	2	0	0	0	1	0	176	8	187
2006	0	0	0	0	3	1	0	0	4
2007	19	0	0	0	1	0	0	0	20
2008	0.5	0	0	0	40	0	0	0	41
2009	0	0	0	0	3	0	0	4	7
2010	1	0	0	0	8	0	25	0	34
2011	0.05			0	2	0	0	1	3
2012	0	0	0	0	9	0	0	0	9

[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

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 bycatches in other fisheries.

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

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 with a reduction to around 1500 t in 2011–2012, mainly due to the absence of agreement between the Faroe Islands and the EU.

The landings from Subarea VI peaked at about 18 000 t in 1973 and fluctuated throughout the 1980s within the range of 5000–10 000 t and have since gradually declined to less than 1500 t or in 2011 and 1800 t or more in 2012 owing to unallocated landings in VIb. In recent year reducing EU TACs have been the main driver of the catch level.

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

5.3.3 ICES Advice

The ICES advices for 2013 and 2014 is based on the ICES approach for DLS stocks and states that (1) catches should be no higher than 3900 t in 2013; (2) existing management measures should be continued and (3) spatial management to prevent targeted fishing on spawning aggregations should be expanded to cover spawning areas in Division VIb.

Although it is phrased for 2013 only, the advice is entitled "advice for 2013 and 2014" and the table of catch corresponding to the advice includes the 3900 t for both 2013 and 2014.

5.3.4 Management

Prior to 2009, EU deep-water TACs were set on a biennial basis; however from 2009 onwards, annual TACs will be applied for the components of this stock in Vb and in VI and VII. From 2009 the EU TAC includes quota for Norway and the Faroe Islands. The Faroe Island 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 and 2012.

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.

				Quota included in EU TAC			EU quota in Vb (1) Faroese waters
Year	Area	ICES advice	EU TAC	EU	Norway	Faroe	
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		2375	???	0	0
2014	Vb, VI, VII	3900					

(1) TAC for ling and blue ling, against which a maximum bycatch of 1080 and 952 tonnes in 2009 and 2010 respectively of roundnose grenadier and black scabbard fish can be counted.

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.

There is minimum landing size of 70 cm for blue ling landings in Faroese waters.

5.3.5 Data availability

5.3.5.1 Landings and discards

Landings data were updated.

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

Spanish Observer on-board 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.

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 were provided. In both survey higher numbers of small blue ling 40–60 cm were caught in 2012 than in previous years (Figures 5.3.3 and 5.3.4).

Time-series (1984–2011, excluding 1985 and 1986) of the length composition of French trawl landings of blue ling are given in Figure 5.3.5. The trends in annual and quarterly mean length are shown in Figure 5.3.6.

5.3.5.3 Age compositions

French quarterly age–length keys from DCF sampling in 2009, 2010 and first half of 2011 were available. Archive age–length keys from years 1988–1994 were also mined.

5.3.5.4 Weight-at-age

No new data.

5.3.5.5 Maturity and natural mortality

No new data.

5.3.5.6 Catch, effort and RV data

A standardised time-series of cpue from the Faroese trawler fleet was provided (Figure 5.3.7).

The standardized lpue from haul-by-haul data provided by the French industry skipper tallybooks (see stock annex) was updated (Figure 5.3.8–5.3.10). This index is based upon five small areas (Figure 5.3.8). In 2011–2012, there was no fishing in Areas new6 and new5 and little in ref5 from vessels providing tallybook data. As a consequence the index was calculated for two out of the five areas used in previous years.

The standardized lpue from French EU logbooks was updated (Figure 5.3.13).

The time-series from the Scottish survey was not updated in 2012.

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

Standardized time-series from the Faroese spring and summer surveys were provided (Figure 5.3.16). The number of small (<80 cm) and large (>80 cm) blue ling caught were also available (Figure (5.3.17).

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 (Figure 5.3.3–5.3.4). Recruitment inputs are visible in some years, e.g. 2007.

Mean length in French trawl landings (Figure 5.3.5) shows a strong decline until the mid-1990s followed by an increasing trend over 1995–2011, with some low levels in some years reflecting recruitment pulses.

French trawl abundance data, based on haul-by-haul data from fisher tallybooks, is available for years 2000–2011 (Figure 5.3.10). This index represents abundance in the small areas (Figure 5.3.8) that are fished. Some of these areas have not been fished by vessels contributing to the tallybook data in recent years and therefore the index has been recalculated to exclude these areas for the entire time-series. Hauls carried out from March to May in areas regulated to protect spawning areas since 2009 were excluded from all the time-series in order to prevent the index to be impacted by this management measure. The index suggests an abundance increase since 2004, larger lpue values are estimated before 2004 but have larger confidence intervals.

Biomass indices from French logbooks

The diagnostic plot of the model was correct (Figure 5.3.11). There were few data in the small areas new6, new5 and ref5 so that these areas mainly introduce noise and were exclude from the modelling. Times-series for the two other areas suggest a strong decline from 1987 to 1990, i.e. at the start of fishing for the deeper species such as roundnose grenadier and black scabbardfish species (Figure 5.3.13). The index remained low afterwards with an increase in recent years. The strong decrease over a few years is likely to reflect a shift in fishing rather than an actual strong drop in abundance. In the 1980s, blue ling was mainly a directed fishery and probably made up more than 50% of the landing of most trips, then, there was a shift in fishing strategy in the late 1980s and blue ling became mainly a bycatch of deep-water fishing for roundnose grenadier black scabbardfish and sharks. The model estimated rat rather stable lpues in 1990s to 2006 followed by an increase in recent years. However, the logbook data do not include information to control important factors such as fishing depth. The model is however useful to locate the major change in fishing strategy between 1987 and 1990.

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 index used all hauls from 200 to 500 m and is stratified.

Multiyear catch curve (MYCC) model

A Multiyear catch curve (MYCC) model developed as part of the EU-DEEPFISHMAN project and applied to blue ling (Trenkel *et al*., 2012, see stock annex). The model was used for assessment and advice in 2012, no new assessment with this model was presented in 2013. The model will be proposed as benchmark model.

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

No new assessment in 2013. Model proposed for benchmark in 2014.

Space-time modelling

Blue ling is considered sensitive to local depletion (Large *et al*., 2010). Only one such case, in Icelandic waters, was clearly reported by Magnússon and Magnússon (1995) who described the depletion of a spawning aggregation within a few years.

Possible local depletion effects in the fishing area for blue ling to the West of Scotland where investigated by Augustin *et al*. (2012). This analysis used the French tallybook data and applied a novel three dimensional tensor product of a soap film smooth of space with a penalized regression spline of time allowing to account for the complex boundary of blue ling habitat, driven primarily by bottom depth.

The model was a generalised additive mixed model (GAMM) as followed:

Log(μi)=f1(durationi)+f2(depthi,yeari)+f3(depthi)+f4(monthi)
+f5(depthi,monthi)+f6(northi,easti,yeari)+f7(powerk(i))

where μi = E(y_i) and y_i is catch in haul i from a Tweedie distribution with variance $\phi\mu_i^p$. $k(i)$ indexes the vessel that made the i^{th} haul and $f_{1\text{-}6}$ are smooth functions of the covariate associated with each haul. The geographic coordinates northing and easting are longitude and latitude projected onto a square grid using the universal transverse mercator projection. f_7 is a linear function of vessel engine power (see Augustin *et al*., 2012, for a complete description of the model).

The model showed a spatial distribution with a generally higher blue ling density in northern areas and some localised areas of higher density (Figure 6.3.18). The smooth used allows for accurate estimation of the spatial distribution (compare bottom right panel with a standard spline in Figure 6.3.18 to all other panel with the three-dimensional tensor).

This space–time model did not show evidence of recent local depletion of blue ling to the West of Scotland over the period 2000–2010. This does not imply that no such effect occurred in the past when the fishing mortality was much higher, but applies to the current fishery. Prediction made for the same small areas as the standardised lpues showed and increasing time-trend in particular in Areas new6, new5 and ref5 that have not been fished in recent years. Prediction were also made for the spawning areas that have been regulated since 2009 and also showed an increase abundance (Figure)

5.3.7 Comments on assessment

The space–time model is not meant to be used on a regular basis, in particular in the current context where the fishing mortality is low and the stock is rebuilding.

5.3.8 Management considerations

The space-time modelling presented here brings a complement to assessments carried out in 2012 by showing that there is no ongoing change in the spatial distribution of the stock, in particular no sequential depletion occurred over 2000–2010.

Table 5.3.1a. Landings of blue ling in Subdivision 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	21232
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
2007	1220	1166		212	8		36	2642
2008	642	865		35			110	1652

Year	Faroes	France(1)	Germany(1)	Norway(2)	E & W(1)	Ireland	Russia (1)	Total
2009	523	325					0	848
2010	840	464		49		0	0	1353
2011	838	312		0		0	0	1150
2012*	799	422		8		0	5	1234

***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 (1)	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	132
2002	318	21	140	161
2003	1386	84	120	204
2004	710	6	68	784
2005	609	14	68	691
2006	647	34	16	697
2007	632	6	16	654
2008	317	0	91	408
2009	444	8	161	613
2010	656	10	225	891
2011	319	0	0	319
2012*	211	0		211

***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
2010	43	1937			86	223		134		2423
2011*	10	1136			93	10		74		1323
2012*	5	1170			86	6		47		1314

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

1997			138	331		6	65	562	1				1103
1998			76	469		13	190	287	122	11			1168
1999			204	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					6
2012*				3		3						711	717

(1) included in VIa.

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*	18	0	21	5	0	0	0	44

*** 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	2116	9178	835	12 129
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*	1445	2031	44	3520

*** Preliminary.**

Table 5.3.3. Summary of GAM model statistics.

Approximate significance of smooth terms:

	edf	Ref.d.f.	F	p-value
s(haul duration)	6.687	6.687	1524	<2e-16 ***

R-sq.(adj) = 0.484

Deviance explained = 53.8%

REML score = 2.7183e+05

Scale est. = 0.88572

n = 37 296

Family: Tweedie(2) (equivallent to gamma)

Link function: log

Formula:

Zvar ~ s(DURE, bs = "cr") + factor(Vessel.id) + factor(Month) + factor(rectangle) + year:area

Parametric Terms

Table 6.1.4. Estimated values of exploitable biomass from FL_{aspm} from 1966to 2011.

	d.f.	F	p-value
factor(Vessel.id)	70	62.73	<2e-16
factor(Month)	11	986.44	<2e-16
factor(rectangle)	48	26.24	<2e-16
year:area	103	18.82	<2e-16

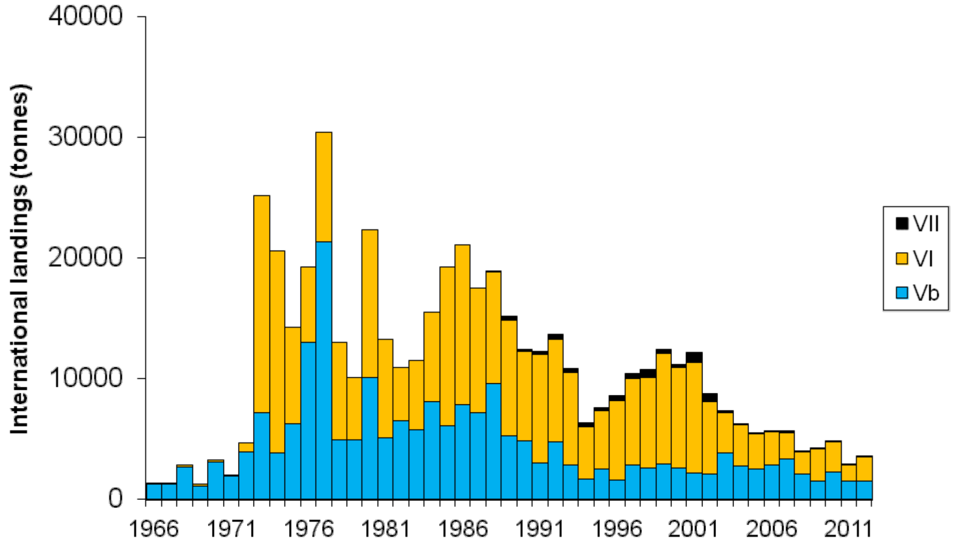


Figure 5.3.1. Trends in total international landings for southern blue ling (Vb, VI, VII).

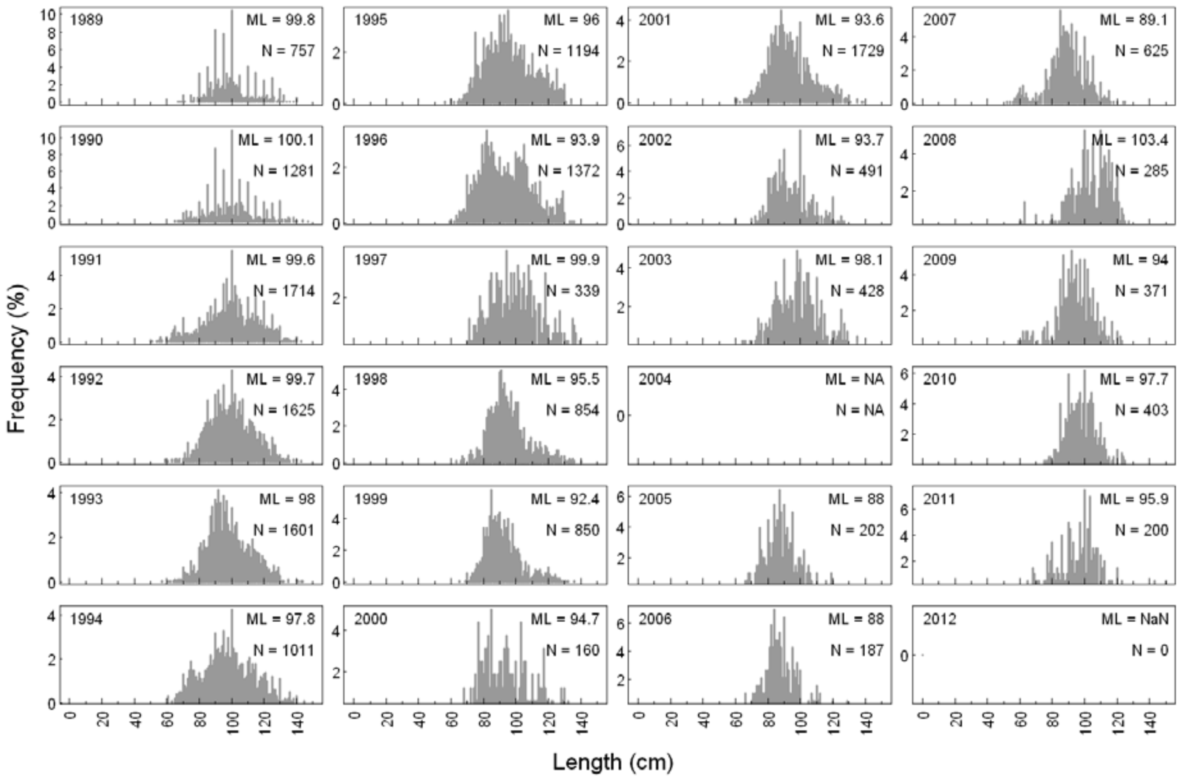


Figure 5.3.2. Blue ling in Vb (Faroes). Length distribution in the landings from Faroese otter-board trawlers >1000 HP (No sampling in 2004).

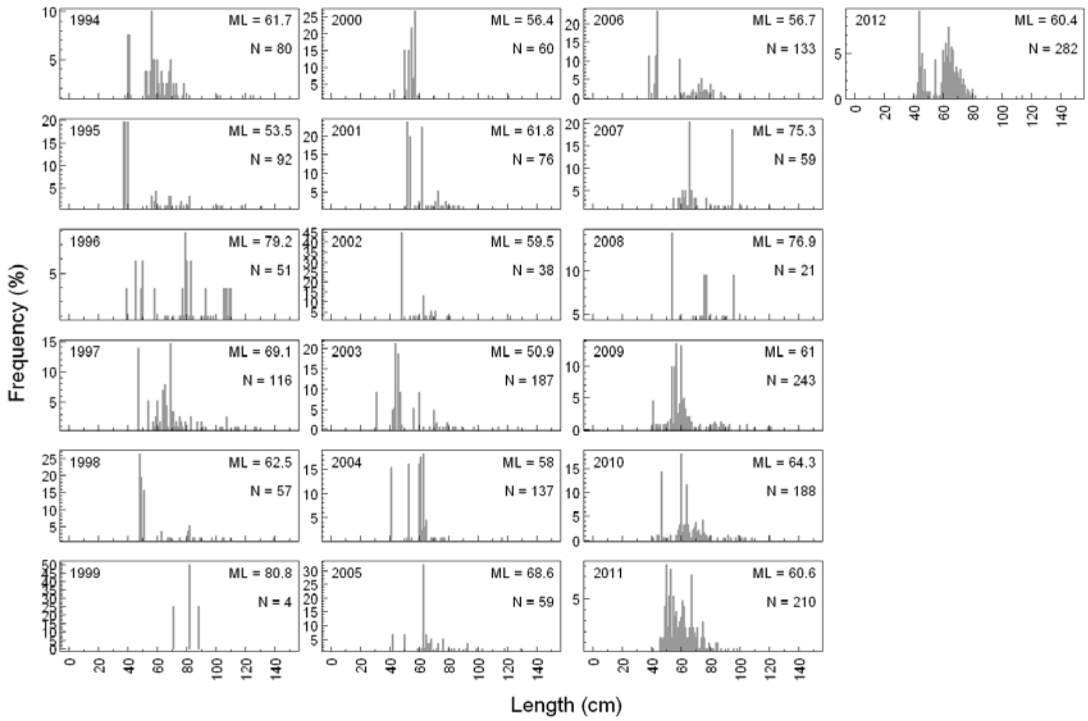


Figure 5.3.3. Length distribution of blue ling in the spring groundfish Faroese survey

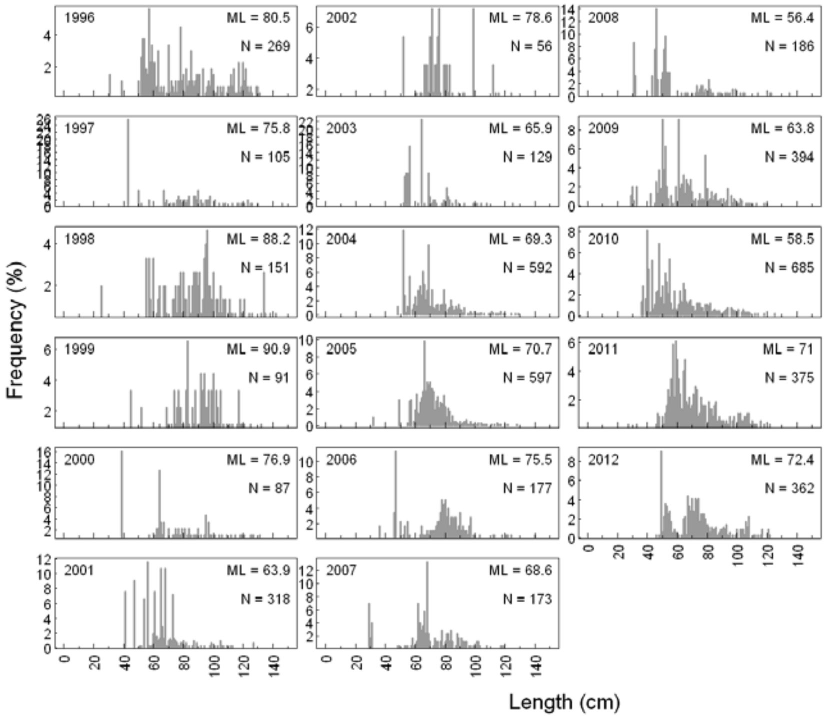


Figure 5.3.4. Length distribution of blue ling in the summer groundfish Faroese survey.

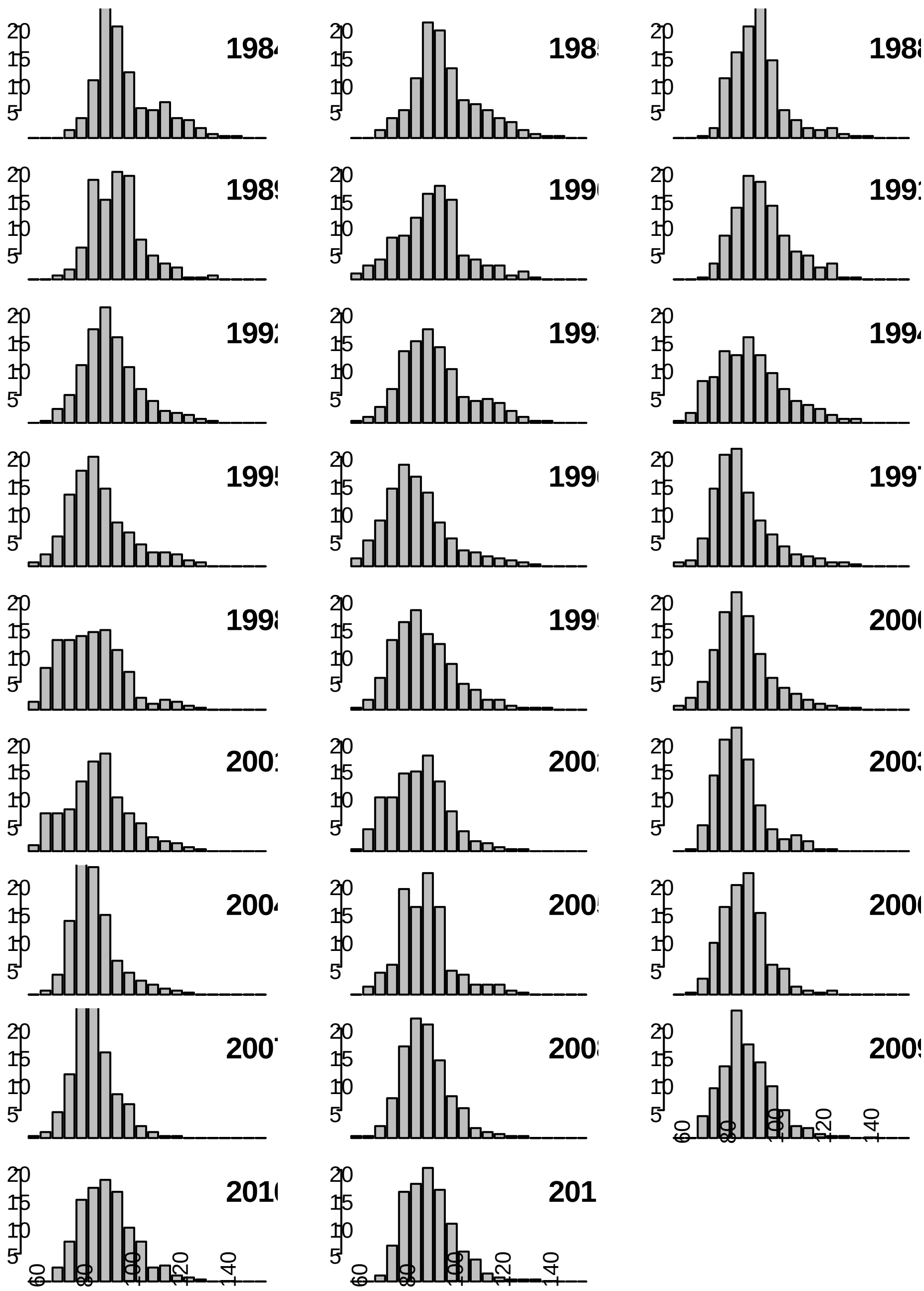


Figure 5.3.5. Length distribution1984–2011 of the landings of blue ling from French otter fishing. (for legibility, small numbers below 60 cm, occurring in a few years only, were cut off).

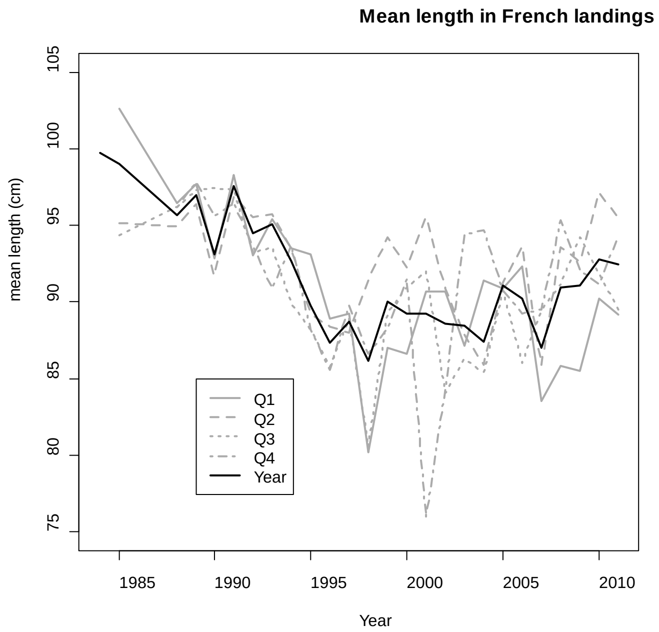


Figure 5.3.6. Quarterly mean length in French trawl landings.

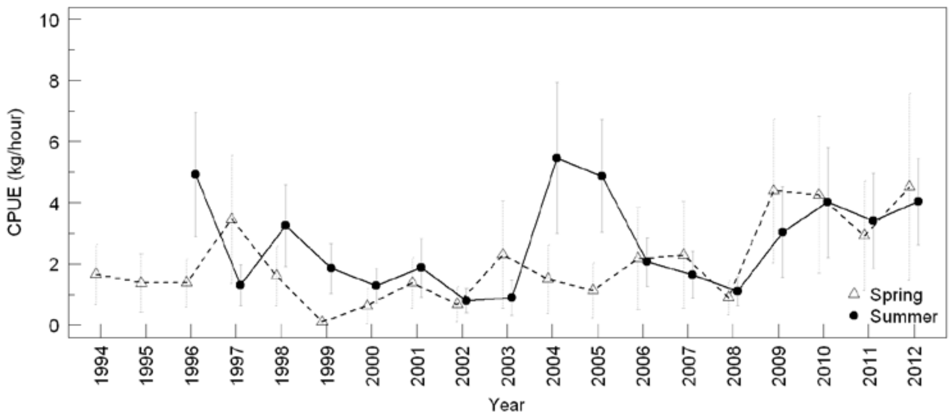


Figure 5.3.7. Blue ling in Vb, Standardised cpue from Faroese trawlers in the bank area west of the Faroes (DB–DG, 9–14.)

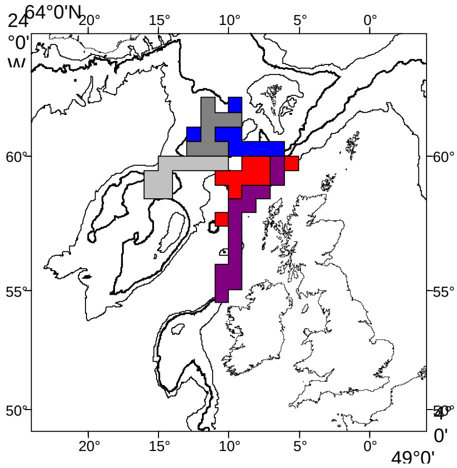


Figure 5.3.8. Areas used to calculate French lpues for blue ling: .dark grey: new grounds in Vb (new5); light grey: new grounds in VI (new6); red: others in VI (other6); purple: edge in VI (edge6); blue: reference grounds in Vb (ref5). Depth contours are 200, 1000 and 2000 m.

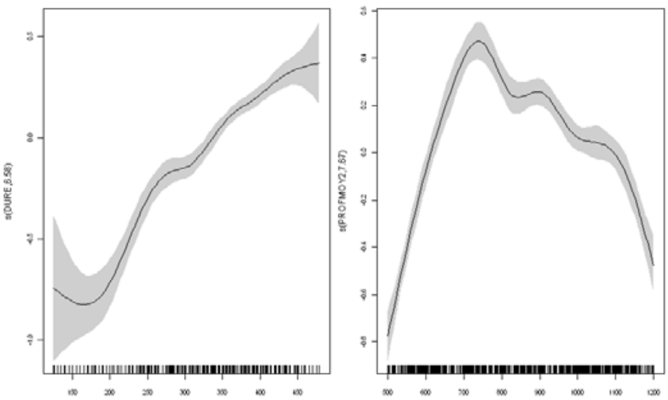


Figure 5.3.9. Haul duration and depth effect, GAM model for the tallybook index.

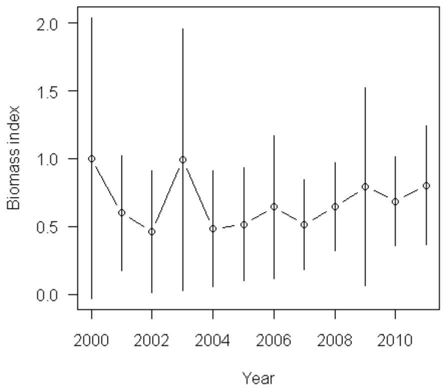


Figure 6. 3.10. Trends in annual mean lpue of blue ling by area, from French trawl tallybook data, (See stock).

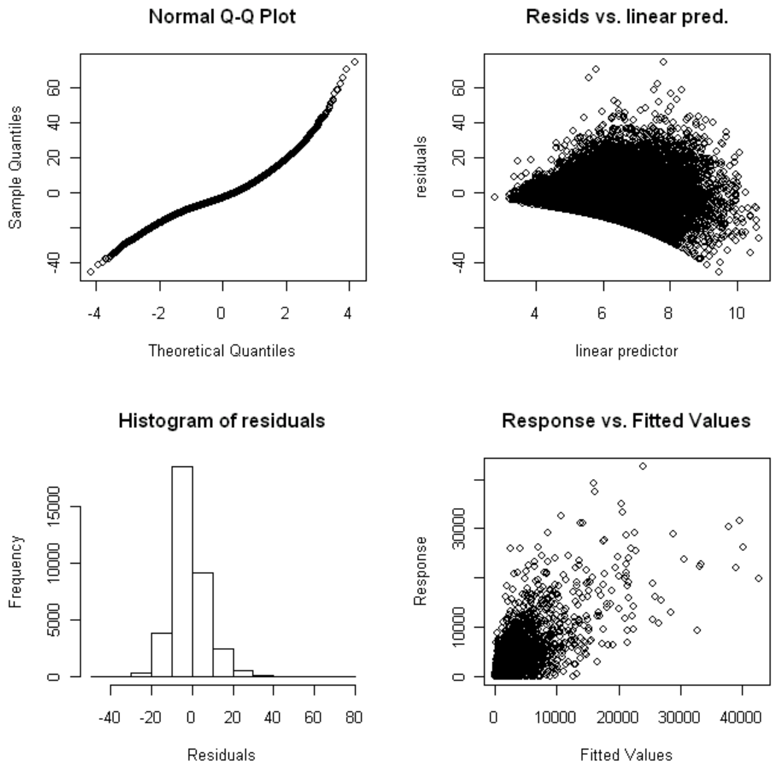


Figure 5.3.11. Diagnostic plot of the GAM model of blue ling catch per fishing subtrip in the logbook data.

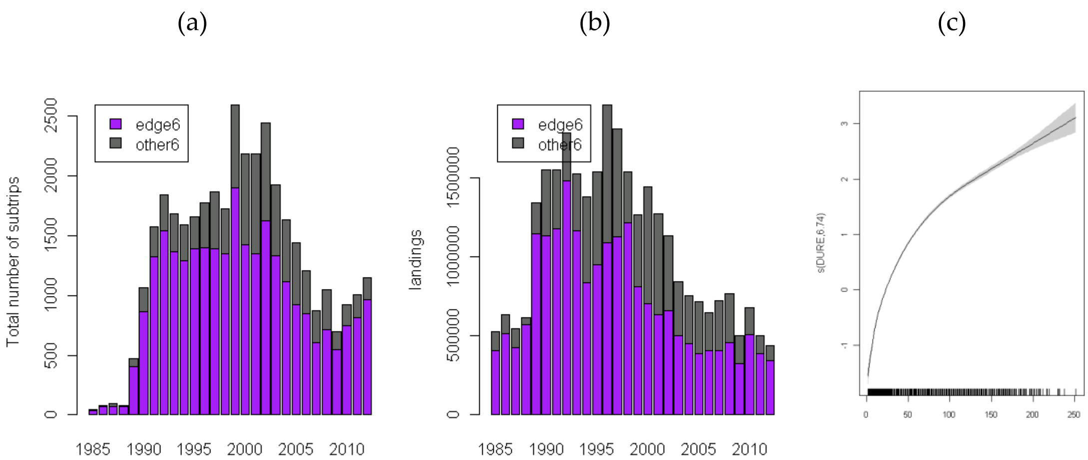


Figure 5.3.12. Standardized logbook cpue index (a)number of logbook records and (b) total landings (kgs) in modelled subtrips is the small areas edge 6 and other 6 and (c) effect of the subtrip duration variable (ticks along the x-axis depict the distribution of data, long subtrips of several days correspond to logbook record in the 1980s, subtrip duration in hours).

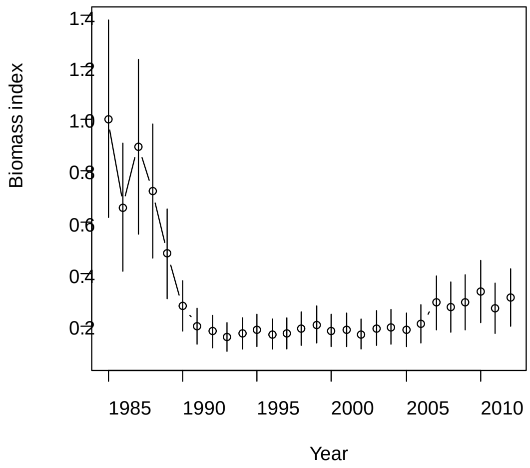


Figure 5.3.13. Combined standardised lpue trends from logbook data.

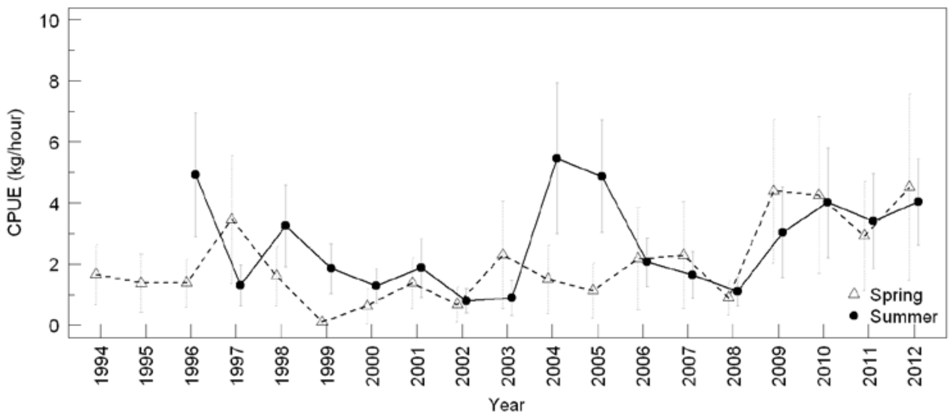


Figure 5.3.16. Biomass indices in the spring and summer Faroese surveys for haul deeper than 200 m.

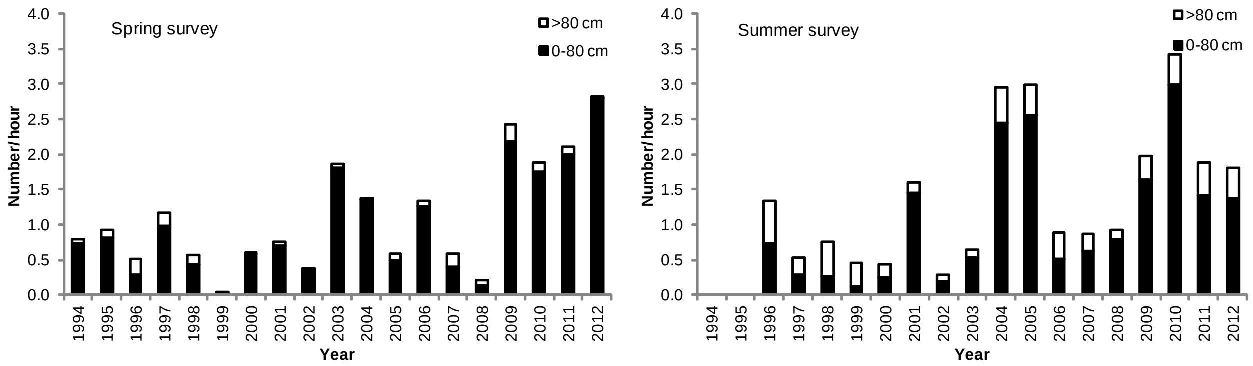


Figure 5.3.17. Number of small (<80 cm) and adult (>80 cm) blue ling caught in the spring (left) and summer (right) Faroese surveys.

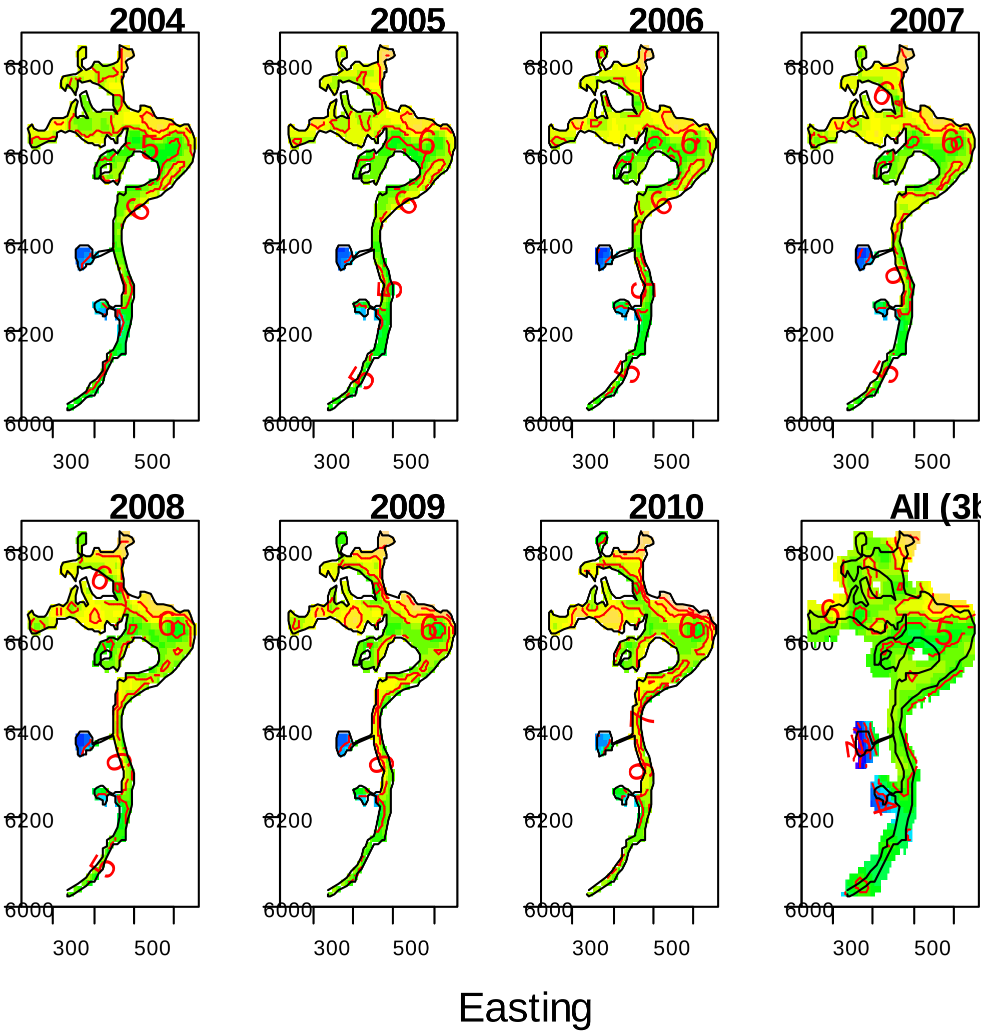


Figure 6.3.18. Spatial distribution of the blue ling biomass estimated by the space–time model per year 2004–2010. The bottom right panel shows the estimated spatial distribution for all years combined with a model using a standard thin plate regression spline smooth, which does some averaging accross the natural boundary of blue ling distribution.

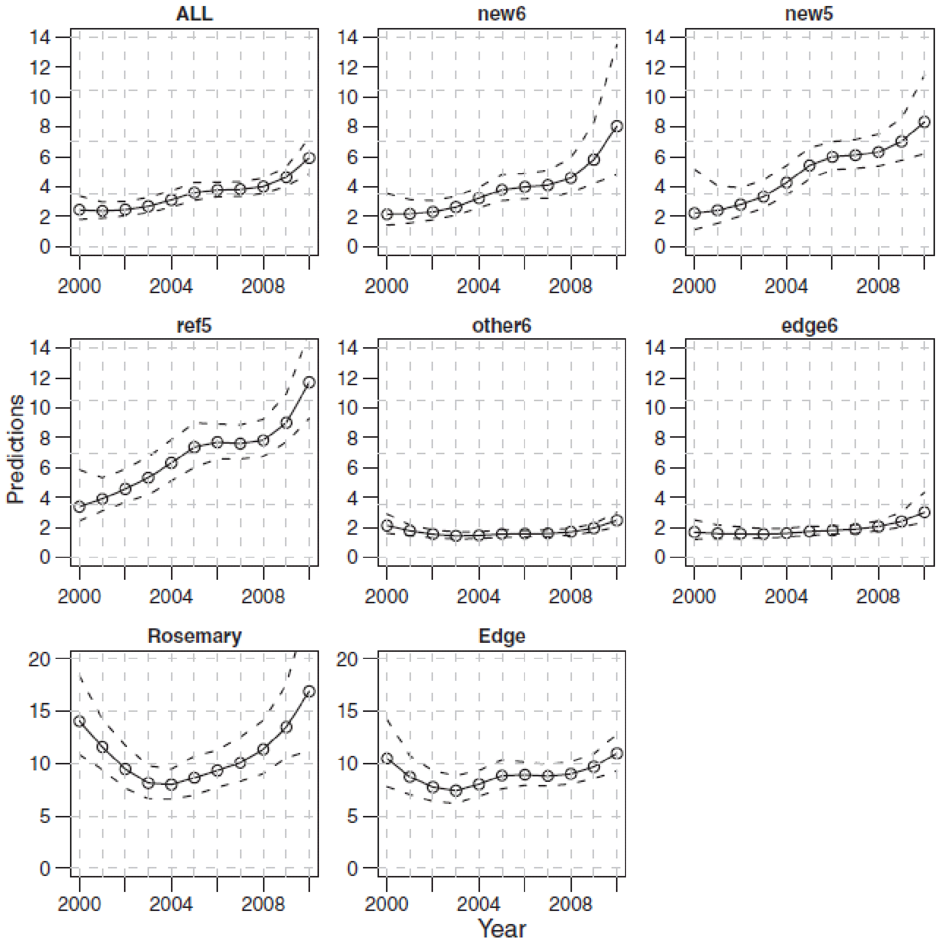


Figure 5.3.19. Time trends of median haul landings in 100 kg by area (ALL areas, new6, new5, ref5, other6 and edge6) and for two spawning areas. Time trends were predicted by fishing area for January in each year for haul duration of 6 h, a depth of 850 m and a vessel power of 1850 kWatt. For spawning areas, predictions were made for the peak of the spawning period (April) and otherwise with the same fixed values as the other predictions. The dashed lines are 95% Bayesian credible intervals.

5.4 Blue ling (*Molva Dypterygia*) in I, II, IIIa, IV, VIII, IX, X, XII

5.4.1 The fishery

The directed fishery on spawning aggregations for blue ling on Hatton Bank (Division XIIb) and Division IIa is no longer conducted and blue ling is now taken as bycatch only in other fisheries in these areas. Blue ling has been an important bycatch in trawl fisheries for mixed deep-water species on Hatton Bank (Division XIIb). There has also been a small bycatch in the longline fisheries in Division IIa. Recently, Faroese and Norwegian vessels have caught blue ling in this area with longlines and nets. In other areas blue ling is taken in small quantities. Small reported landings in Subareas VIII, IX and X are now ascribed to the closely related Spanish ling (*Molva macropthalma*) and blue ling is not known to occur to any significant level in these subareas.

5.4.2 Landings trends

Landings data are presented in Table 5.4.0a–f and Figures 5.4.1–3. Landings of blue ling from other areas are presently at a low level. During the whole time-series, around 90% or more of the total landings were taken in Subareas II, IV and XII combined. Recently, most of the landings come from Subarea IIa. For all areas a decline has been seen since 1993 and for each area the landings have been below 500 tonnes in recent years.

5.4.3 ICES Advice

The ICES advice for 2011 and 2012 is:

"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 2012 TAC for EU vessels in international waters of XIIb was set to 815 tonnes. TACs for vessels in EU waters and international waters of Vb, VI and VII were set to 1882 tonnes; of this a quota for Norwegian vessels was set to 150 tonnes to be fished in IIa, Vb, VI and VII.

5.4.5 Data availability

5.4.5.1 Landings and discards

Landings data are demonstrated in Table 5.4.1. No discard data is 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

No data analytical assessments were carried out.

The assessment for this stock is based on landing trends. The landings are now less than 25% of the mean landings from the years 1988–1993 (the period with stable landings). Since 2004 the landings have been stable at a low level (Figures 5.4.1–5.4.3).

There is an increase in landings from Area II as a result of a 36% increase in Faroese landings from this area. However, the overall landings are decreasing for this stock.

The increase in Division IIIa in 2004 (2.5 times increase from 2004–2005) comes from increased Danish landings from the 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 landings 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 others are minor but there is some evidence of a persistent decline in Subarea IV.

Advice given in 2012 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.

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

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

Year	Iceland	Norway	FRANCE	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

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	5			142		1			336

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

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

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

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

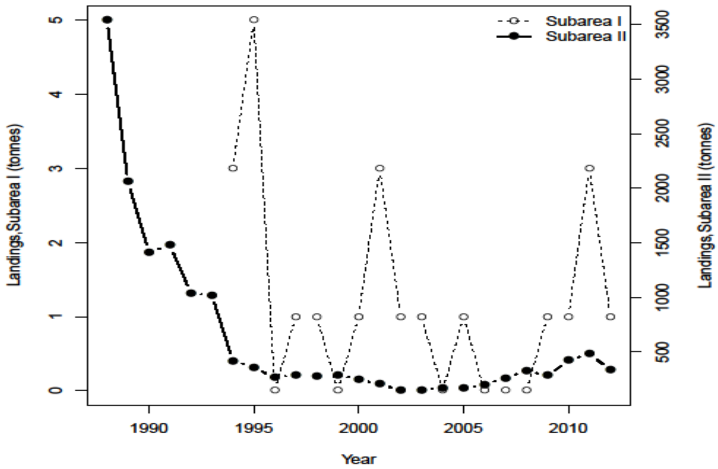


Figure 5.4.1. Landings of blue ling in Subareas I and II.

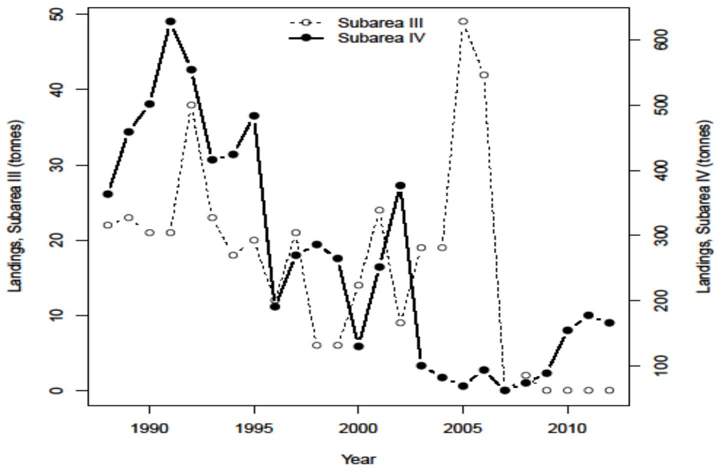


Figure 5.4.2. Landings of blue ling in Subareas III and IV.

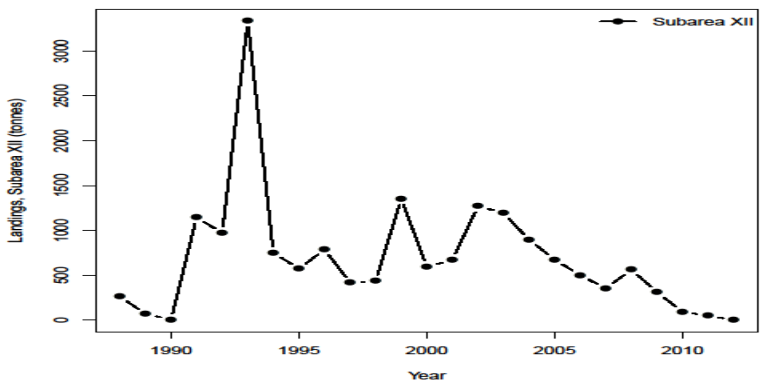


Figure 5.4.3. Landings of blue ling in Subarea XII.

6 Tusk (*Brosme brosme*) in the Northeast Atlantic

6.1 Stock description and management units

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

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

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

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 (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 boats reporting catches and their landings.

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

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 and less than 600 meters by trawlers (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 (Figure 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.

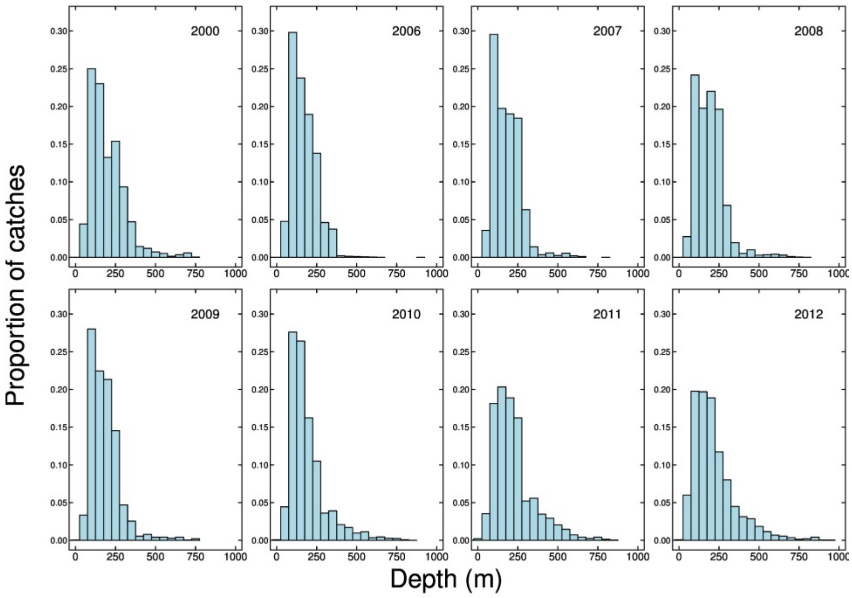


Figure 6.2.1. Tusk in Va and XIV. Depth distribution of longline catches in Va according to logbooks.

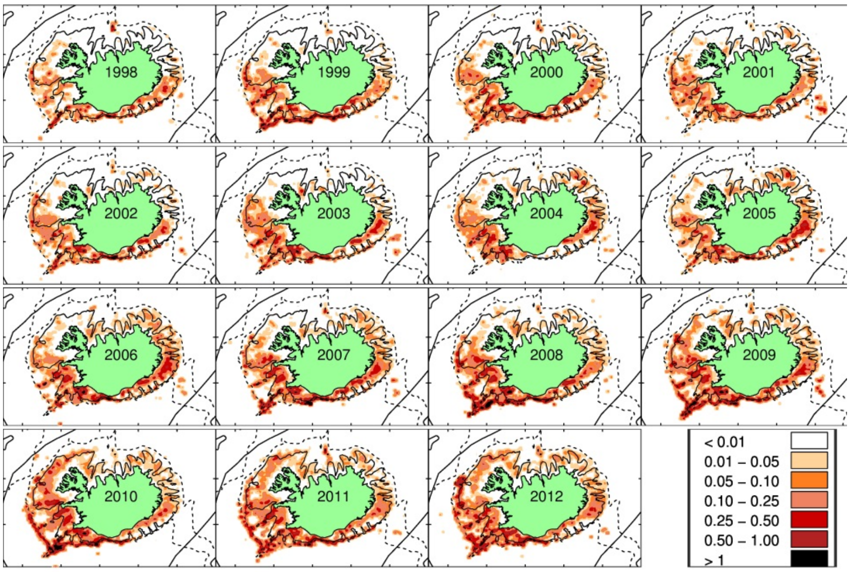


Figure 6.2.2. Tusk in Va and XIV. Geographical distribution (tonnes/square mile) of the Icelandic fishery since 1998 as reported in logbooks. All gears combined.

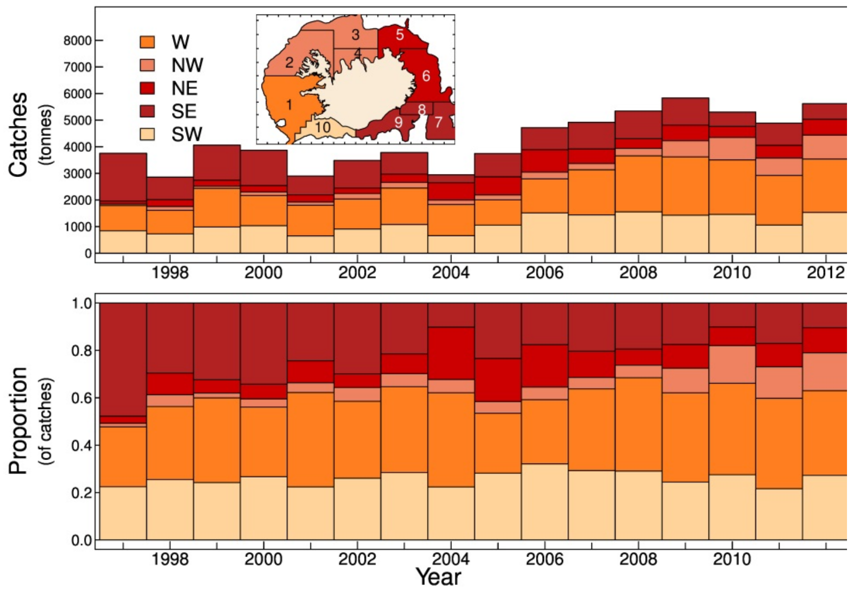


Figure 6.2.3. Tusk in Va and XIV. Changes in spatial distribution of the Icelandic fishery in 1996–2012 as reported in logbooks. All gears combined.

6.2.1.1 Landings trends

The total annual landings from ICES Division Va were around 7700 tonnes in 2012 (Table 6.2.7). This is contrary to the trend in landings from 2000 in which the annual landings gradually increased in Va to around 9000 tonnes in 2010 (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 6.2.7).

Landings in XIV have always been low compared to Va, rarely exceeding 100 t. (Table 6.2.8).

6.2.1.2 ICES Advice

The latest Advice from ICES in May 2012 states: ICES advises that, based on the MSY approach, catches should be no more than 6700 t.

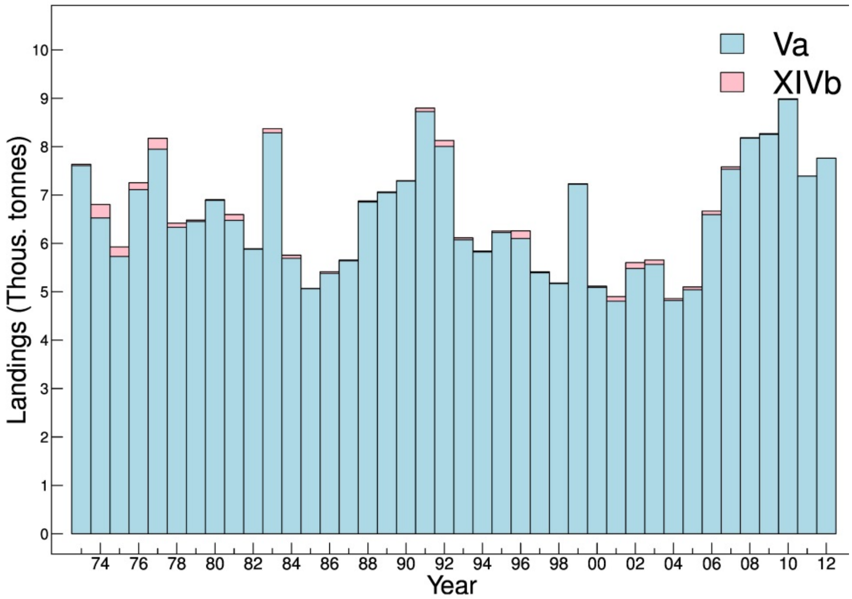


Figure 6.2.4. Tusk in Va and XIV. Nominal landings in Va and XIV (source STATLANT).

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 by 30–40% (Table 6.2.2).

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 in the quota years 2001/2002 to 2011/2012.

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	

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

Table 6.2.3 gives an overview of the composition of the total landings by Icelandic vessels in Va of tusk. In general there is always something left of last year's quota (column 3 in Table 6.2.3). This indicates that the holders of tusk 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 except in 2011/2012 (columns 6 and 7 in Table 6.2.3). This fishing in excess of the 'available' TAC is then met with converting TAC from other species to tusk quota. This was 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 l0.9 tonnes of tusk were converted to other species (column 8).

In the 2010/2011 and 2011/2012 fishing years the TAC allocated to Icelandic vessels (column 1 in Table 6.2.3) is lower than the total TAC set by the MII (National TAC column in Table 6.2.2). 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 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.

Table 6.2.3. Tusk in Va and XIV. Overview of TAC composition of landings in Va (Thous. tonnes)

QUOTA year	SET TAC	OTHER TAC	P.Y. TAC	VESSEL Tr.	EFF. TAC	LAND.	TAC - Land	SPECIES Tr	TAC left	TAC moved	CONF.	U.TAC n.-tr.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2001/2002	4.5	0.001	0	0	4.501	3.483	1.018	-0.623	0.394	0.296	0.003	0.101
2002/2003	3.5	0.001	0.296	0	3.797	3.735	0.063	0.168	0.231	0.188	0.001	0.045
2003/2004	3.5	0.001	0.188	0	3.689	3.37	0.319	0.223	0.542	0.496	0.002	0.048
2004/2005	3.5	0.001	0.496	0	3.997	3.516	0.48	-0.136	0.344	0.289	0.001	0.057
2005/2006	3.5	0.001	0.289	0	3.789	4.664	-0.875	1.017	0.142	0.114	0.005	0.033
2006/2007	5	0.001	0.114	0	5.115	6.306	-1.19	1.645	0.454	0.445	0.003	0.012
2007/2008	5.5	0.001	0.445	0	5.947	6.097	-0.15	0.74	0.59	0.538	0	0.052
2008/2009	5.5	0.001	0.538	0	6.039	7.059	-1.02	1.228	0.207	0.205	0.002	0.005
2009/2010	5.5	0.003	0.205	0	5.709	6.965	-1.257	1.332	0.076	0.056	0.002	0.021
2010/2011	5.4	0.001	0.051	0	5.452	5.545	-0.093	0.235	0.142	0.131	0.001	0.013
2011/2012	6.3	0.001	0.131	0	6.432	5.347	1.085	-0.914	0.171	0.149	0.002	0.025

(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 3 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.

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) (WGDEEP2011; WD-02). 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 6.2.4. 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 Figure 6.2.5 (abundance) and 6.2.6 (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 6.2.4. 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**
1984	3	332	0	0	0	0
1985	4	572	0	0	0	0
1986	2	517	1	191	3	205
1987	4	774	0	0	5	153
1988	0	0	2	159	0	0
1991	4	869	0	0	16	3512
1992	4	720	0	0	0	0
1993	7	1620	0	0	0	0
1994	15	2792	0	0	0	0
1995	16	3034	1	4	2	35
1996	14	4136	0	0	0	0
1997	10	2849	0	0	2	600
1998	13	3277	0	0	0	0
1999	24	3805	0	0	0	0
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

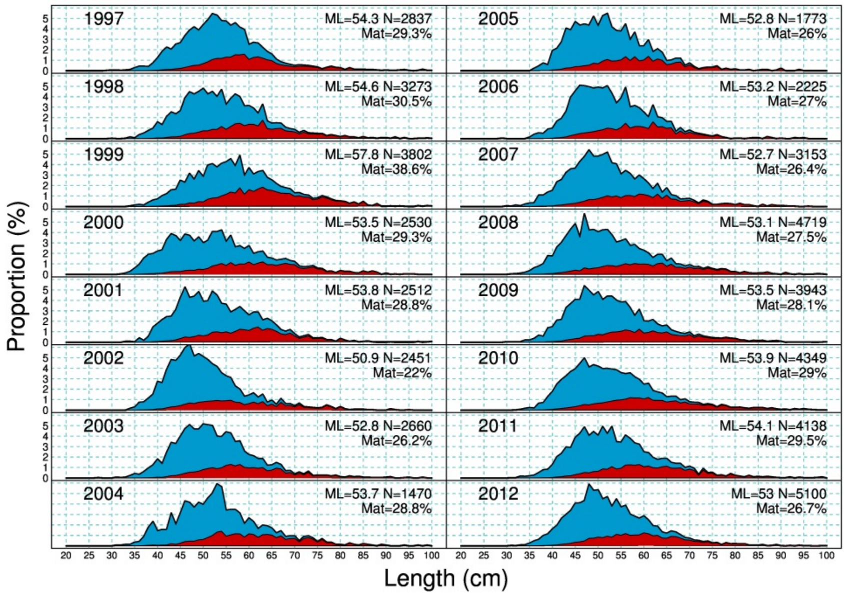


Figure 6.2.5. Tusk in Va and XIV. Length distributions from Icelandic commercial longline catches in abundance. Blue areas are immature tusk and red represent mature tusk. Small numbers to the right refer to mean length (ML).

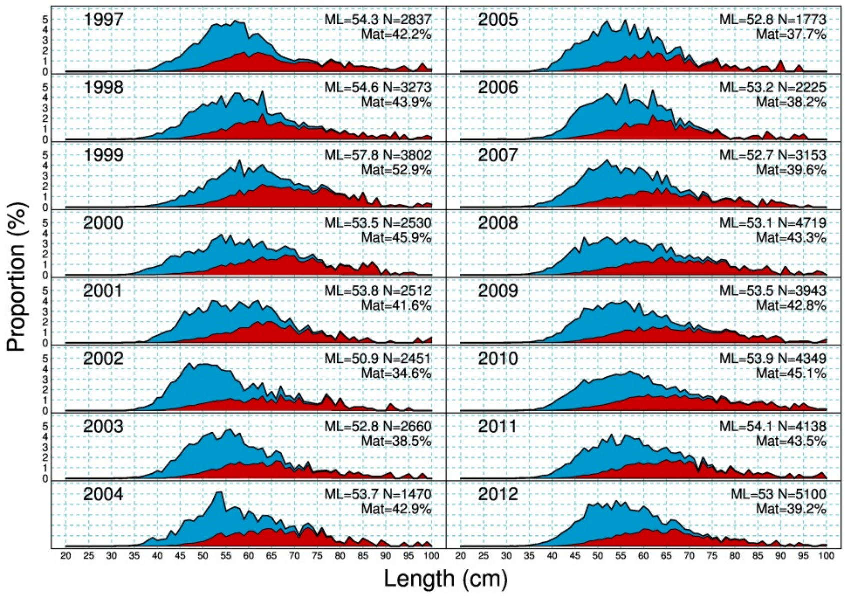


Figure 6.2.6. Tusk in Va and XIV. Length distributions from Icelandic commercial longline catches in biomass. Blue areas are immature tusk and red represent mature tusk. Small numbers to the right refer to mean length (ML).

6.2.2.3 Age compositions

Table 6.2.5 gives an overview of otolith sampling intensity by gear types in 1984 to 2011 in Va. Since 2010 considerable effort has been put into ageing tusk otoliths, so now aged otoliths are available from 1984, 1995, 2008–2012 (Figure 6.2.7 and Table 6.2.5). The ageing is used as input data for the Gadget assessment. It is expected that the effort in ageing of tusk will continue.

No data are available from XIV.

Table 6.2.5. Tusk in Va and XIV. Number of available otoliths from Icelandic (Va) commercial catches and the number of aged otoliths from longlines.

YEAR	LONGLINE		GILLNETS		TRAWLS		AGED
	Samples	**Measured**	**Samples**	**Measured**	**Samples**	**Measured**	
1984	1	100	0	0	0	0	91
1985	3	216	0	0	0	0	0
1994	9	947	0	0	0	0	0
1995	12	1004	0	0	0	0	508
1996	12	1199	0	0	0	0	0
1997	10	981	0	0	2	200	0
1998	13	1227	0	0	0	0	0
1999	24	1350	0	0	0	0	0
2000	17	849	0	0	0	0	0
2001	17	849	0	0	1	50	0
2002	17	851	0	0	0	0	0
2003	18	900	0	0	0	0	0
2004	10	500	0	0	1	50	0
2005	12	600	0	0	0	0	0
2006	15	750	0	0	3	150	0
2007	22	1100	2	67	1	50	0
2008	32	1600	0	0	0	0	600
2009	27	1350	0	0	0	0	1090
2010	29	1449	0	0	0	0	1373
2011	28	1400	0	0	0	0	1255
2012	34	1700	0	0	1	50	1112

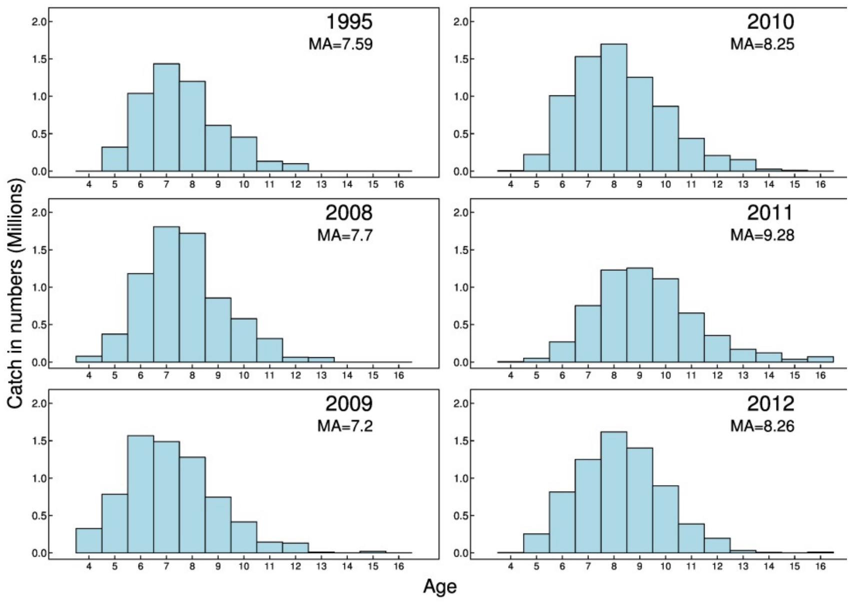


Figure 6.2.6. Tusk in Va and XIV. Catch in numbers in Va.

6.2.3 Weight-at-age

Weight-at-age data from Va are limited to 1995, 2008–2011 (Figure 6.2.7).

No data are available from XIV.

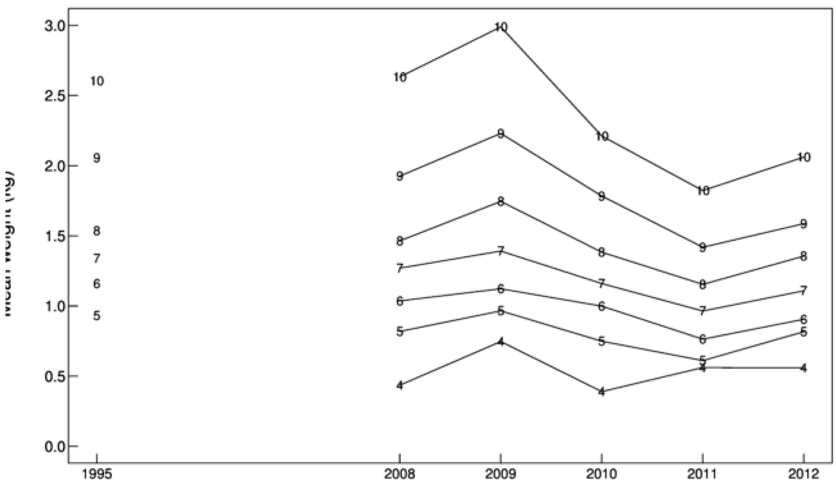


Figure 6.2.7. Tusk in Va and XIV. Changes in mean weight-at-age from commercial catches in Va.

6.2.3.1 Maturity and natural mortality

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

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

No data are available for XIV.

6.2.3.2 Catch, effort and research vessel data

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

Figure 6.2.9 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.

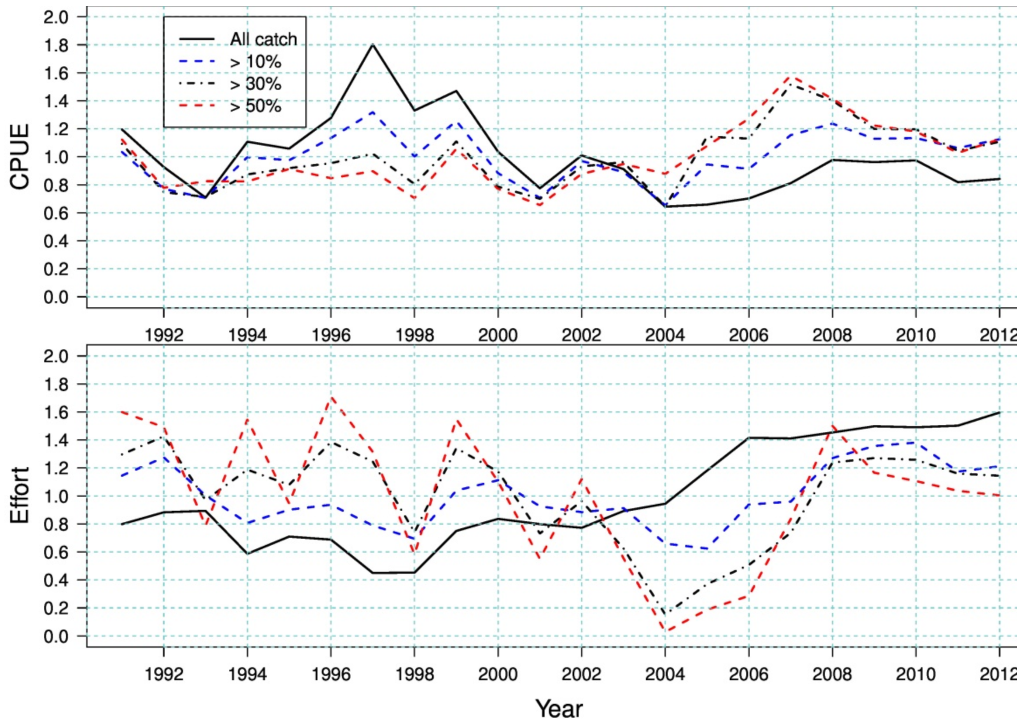


Figure 6.2.9. Nominal cpue and effort from the Icelandic longline fishery for catches where tusk composed different percentages of the total catch in each set.

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: WKDEEP 2010, WD:TUSK-01). 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 ground-fish surveys is given in the stock annex. Figure 6.2.10 shows both a recruitment index and the trends in various biomass indices all of which have been increasing in recent years. Survey length distributions are shown in Figures 6.2.11 (abundance) and changes in spatial distribution in Figure 6.2.12.

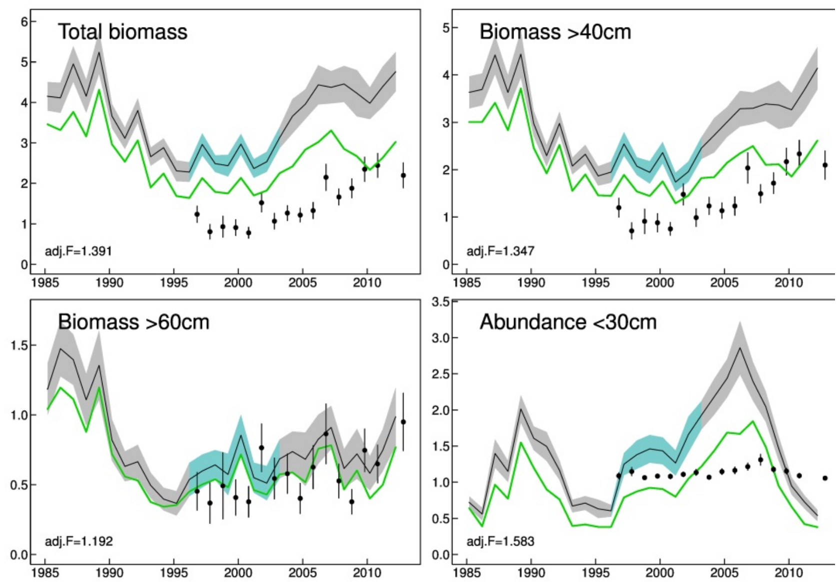


Figure 6.2.10. Tusk in Va and XIV. Indices in the Spring Survey (March) 1985 and onwards (line shaded area) and the Autumn Survey (October) 1996 and onwards (No Autumn survey in 2011). Green line is the index excluding the Faroe-Iceland Ridge.

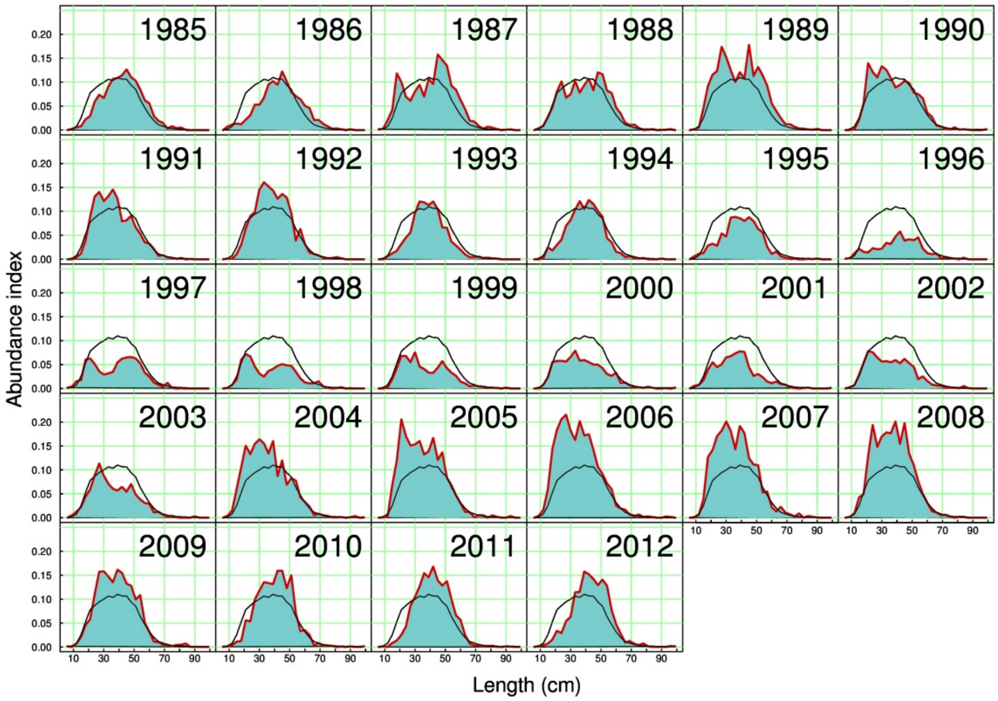


Figure 6.2.11. Tusk in Va and XIV. Length disaggregated abundance indices from the Spring Survey (March) 1985 and onwards. Black line is the average over the whole period.

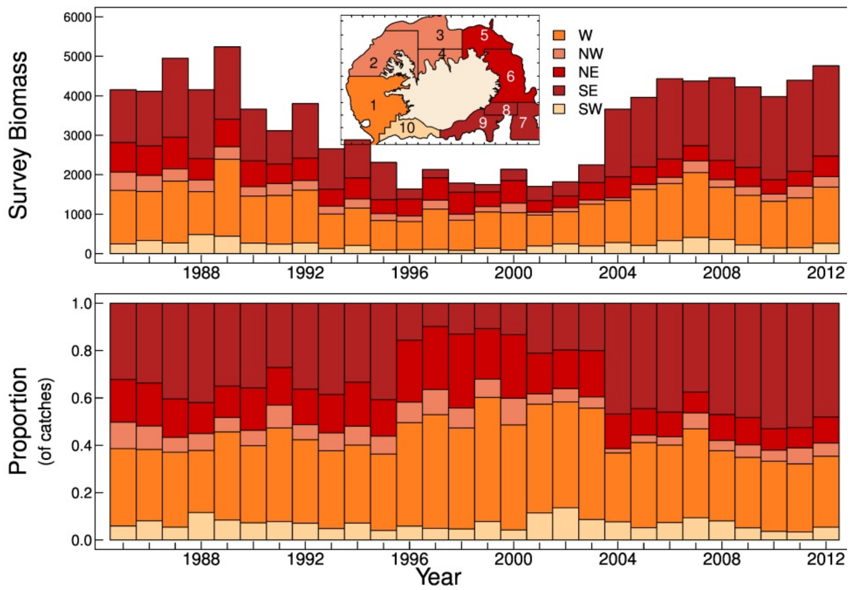


Figure 6.2.12. Tusk in Va and XIV. Estimated survey biomass in the Spring Survey (March) by year from different parts of the continental shelf (upper panel) and as a proportion of the total (lower panel).

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.

6.2.4 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 7800 tonnes in 2012. This decrease is mainly because of reductions in landings by the Icelandic longline fleet (around 1 kt) and to a lesser extent Faroese and Norwegian landings (Table 6.2.7). This has resulted in less overshoot of landings relative to set TAC (Tables 6.2.2 and 6.2.3) and species conversions in the ITQ system in the 2011/2012 fishing year 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 6.2.5). According to the available length distributions and information on maturity only around 29% of catches in abundance and 44% in biomass are mature (Figures 6.2.5 and 6.2.6). 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 distribution for 2012 appears similar as observed in 2010 (Figure 6.2.6). 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 6.2.9).

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) are at their highest levels since the late eighties when they peaked (Figure 6.2.10). However the index of tusk larger than 60 cm (spawning–stock biomass index) has not increased by similar factors as the other two biomass indices in spite of having increased for the last two years. The index of juvenile abundance (<30 cm) has decreased by a factor of 6 since 2005 when it peaked. The index excluding the Faroe-Iceland Ridge shows similar trends as described above. The result 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).

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). Last year 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). The weights were similar to those as-signed in 2012 except for si2039 component which is the juvenile index in the Gadget model. The overall likelihood score was 7281 of which the survey index components accounted for 3.54%, the age and length data from the survey for around 28% and the data from commercial catches for 69% (Table 6.2.6). It can therefore be stated that the model follows the survey data considerably better than the commercial catch data.

Table 6.2.6. 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.
	2012	**2013**	**score**	**score**
bounds	*10.00*	10.00	0	0
understocking	*1.00*	1.00	0	0
si2039	*20.41*	48.11	90.88	1.25
si4069	*19.76*	21.29	108.54	1.49
si70110	*3.33*	3.18	58.13	0.80
ldist.catch	*0.10*	0.11	2450.62	33.66
ldist.survey	*0.06*	0.06	869.68	11.94
alkeys.catch	*0.34*	0.34	2561.80	35.18
alkeys.survey	*0.22*	0.22	1141.38	15.68
Sum			7281.03	

The various likelihood components have different effect on the estimates. In Figure 6.2.13 estimates of recruitment, biomass and fishing mortality are presented when each of the likelihood components in the re-iterative procedure is given increased weight (See stock annex for details) along with corresponding estimates from the final run. The result from the survey data (ldist.survey and alkeys.survey) is closest to the final run. The data from commercial catches (alkeys.catch and ldist.catch) give very different result, higher recruitment and SSB but much lower fishing mortality than the final run. The survey indices show to a limited extend a similar trend as the final run but in estimates they are closer to the catch data. This indicates that the final run is mostly dominated by the survey data.

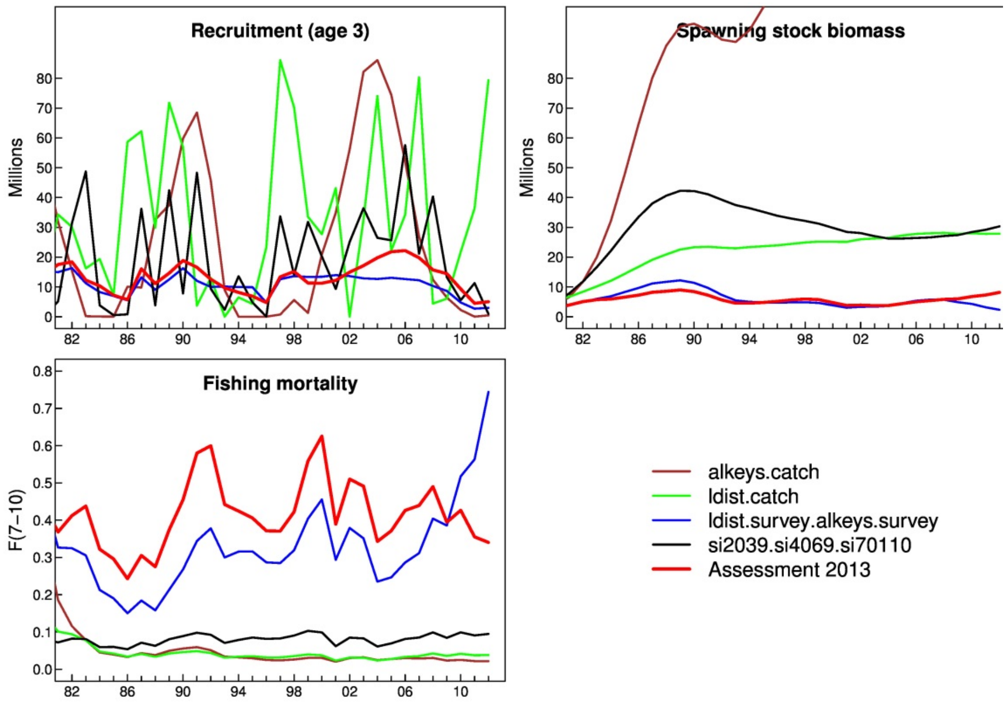


Figure 6.2.13. Tusk in Va and XIV. Population estimates when increasing the weight of individual likelihood components. The results of the final run are shown as a red line.

Observed and predicted proportions by fleets: Overall the fit of the predicted proportional length distributions is close to the observed distributions (Figures 6.2.14 and 6.2.15). In general for the commercial catch distributions the fit is better at the end of the time-series (Figure 6.2.14). 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.

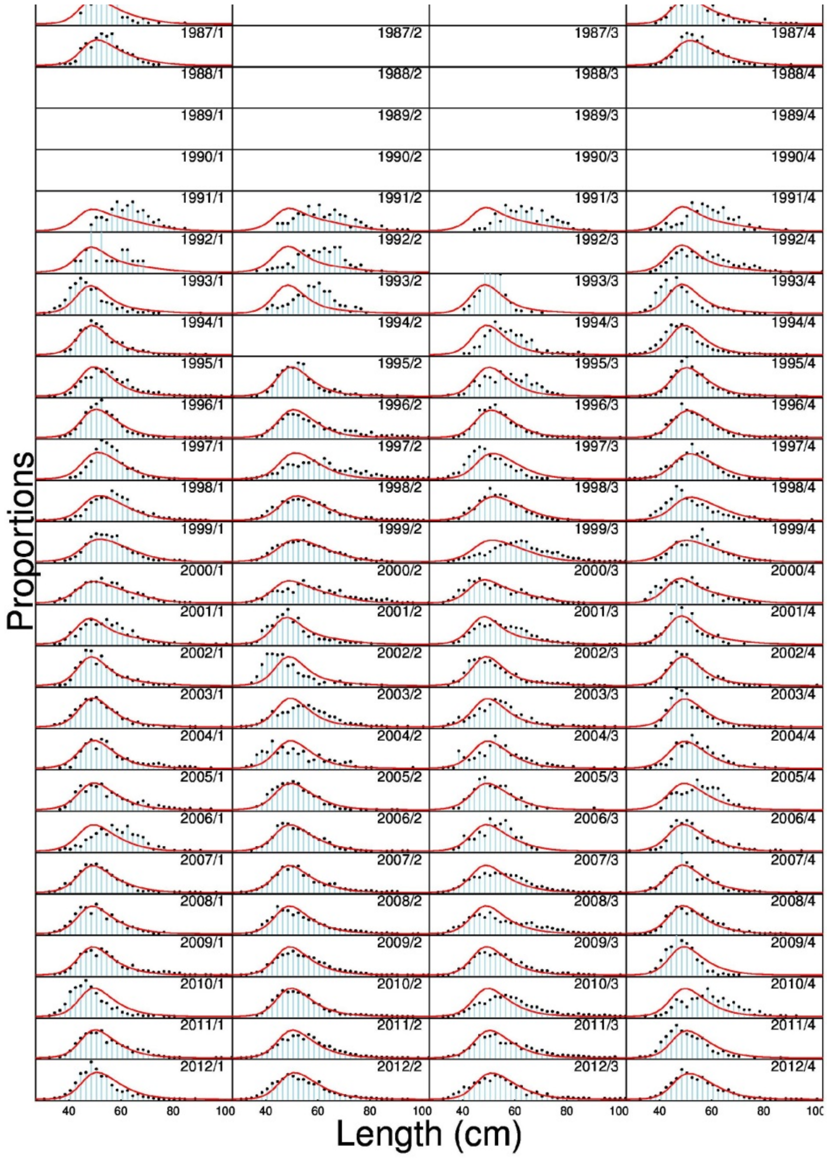


Figure 6.2.14. Tusk in Va and XIV. Proportional fit (red line) to observed length distributions (points and blue bars) from commercial catches (longlines) by year and quarter from Gadget.

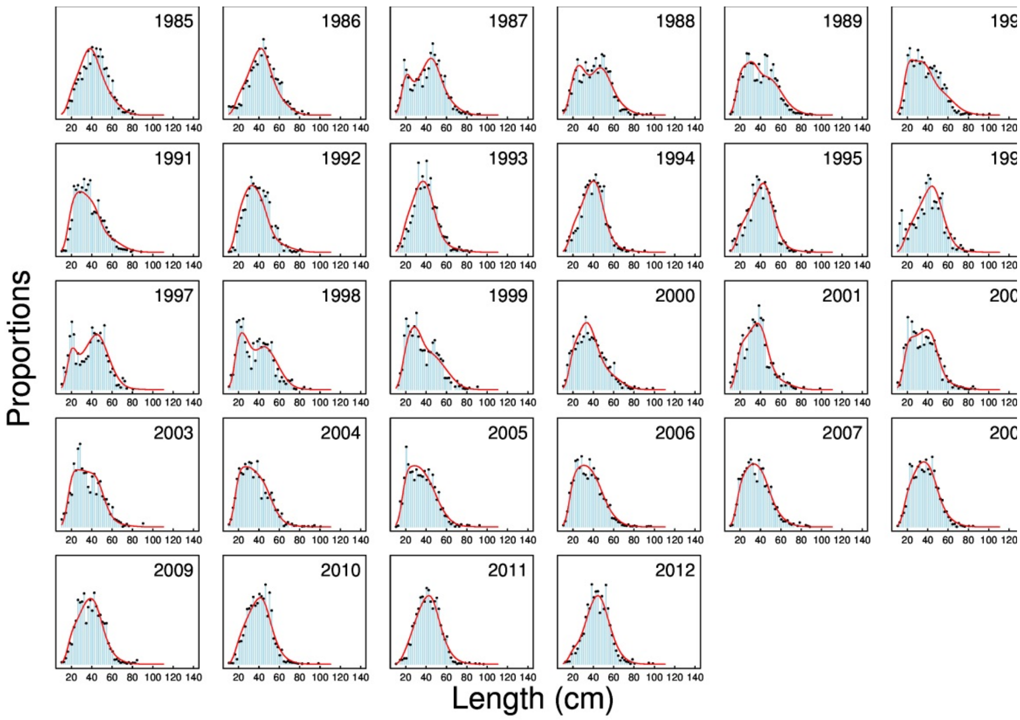


Figure 6.2.15. Tusk in Va and XIV Fit (red line) to observed length distributions (points and blue bars) from the Icelandic Spring survey by year from Gadget.

Model fit: In Figure 6.2.16 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 dis-aggregated abundance indices and predictions are converted to biomass and summed over the length intervals is good; however the model is predicting slightly lower biomass than the survey indicates in the terminal year (Figure 6.2.16).

Retrospective analysis: Compared to last year's assessment there is an downward revision of SSB but a slight upward revision of recruitment in 2012. Similarly fishing mortality was estimated at slightly lower level in 2011 than now**.** Overall the perception of the stock does not change markedly 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.

Retrospective analysis may be misleading for this model as data is 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.

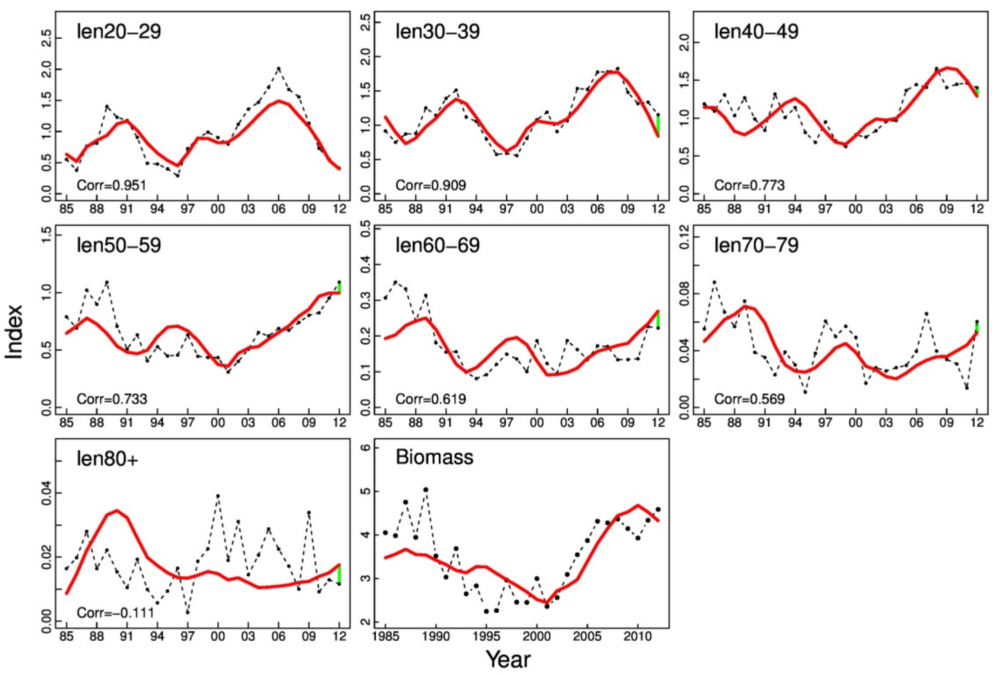


Figure 6.2.16. Tusk in Va and XIV. Gadget fit to indices from disaggregated abundance by length indices from the spring survey and to summed-up biomass.

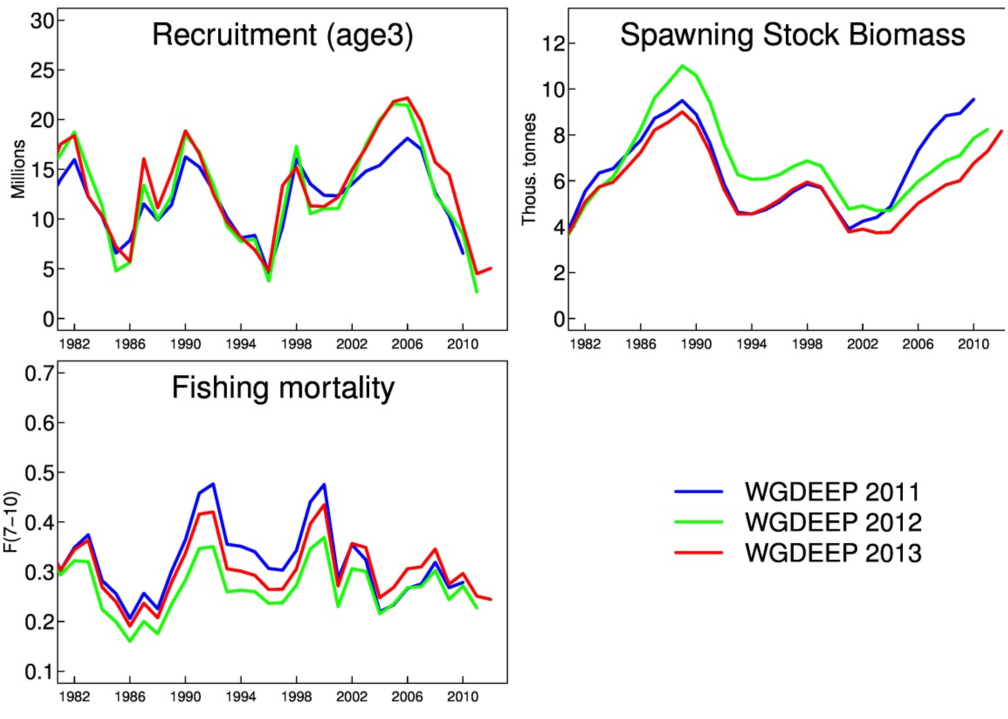


Figure 6.2.17. Tusk in Va and XIV. Historical retrospective analysis of the Gadget runs presented at WGDEEP 2011 to 2013.

Results

The results are presented in Table 6.2.9. and Figure 6.2.18. As stated above the perception of the stock does not change markedly from last year. Recruitment peaked in 2005 to 2006 but has decreased and is estimated in 2011 to have been the lowest observed. The slightly higher recruitment estimate in 2012 is not backed by much data as the Icelandic spring survey for 2013 has not finished at the time of WGDEEP 2013. Spawning–stock biomass has increased since 2005 and is now estimated close to the highest SSB estimate in the time-series in 1989. Harvestable biomass is estimated at its highest level in the time-series. Fishing mortality for the main age groups in the fishery (F_{7-10}) has decreased from 0.35 in 2008 to 0.24 in 2012. Fishing mortality for fully selected tusk (F13–16) shows the same trend at a higher level. Estimates of total biomass show a decrease since 2009. Estimates of selection curves are similar to those estimated last year (Figure 6.2.19).

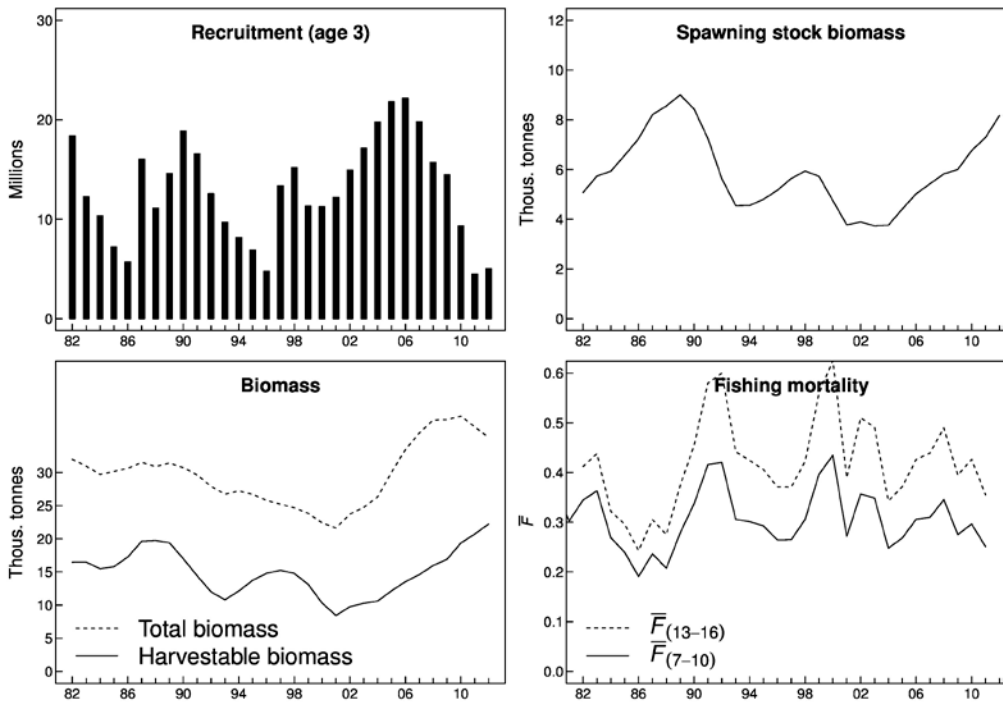


Figure 6.2.18. Tusk in Va and XIV. Estimates of recruitment, biomass, harvestable biomass and fishing mortality for tusk as fully recruited into the fishery i.e. selection is 1 on a logistic selection curve (broken line) and for the age groups most important in the fishery i.e. ages 7 to 10 (solid line).

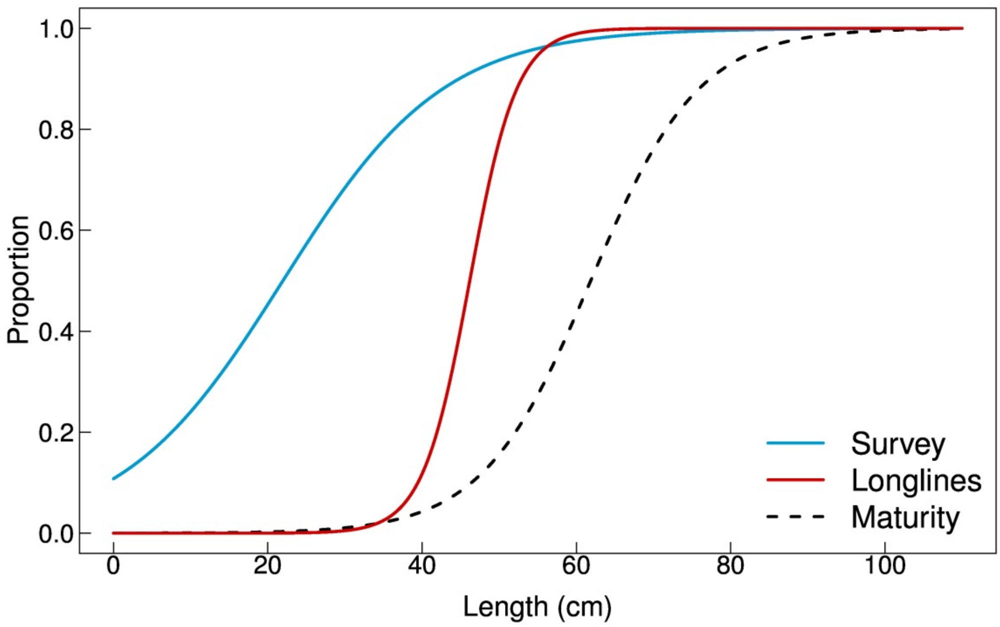


Figure 6.2.19. Tusk in Va and XIV. Estimated selection curves from Gadget and for comparison the maturity ogive (black broken line) used for estimation of SSB.

Reference points

In last year's report reference points were estimated using the estimates from the Gadget model using yield per recruit analysis and by fitting a 'Hockey-stick' SSB-R relationship to these estimates. This work was preliminary as there were on estimates of uncertainty for the Gadget model available. In the analysis it was assumed that the CV for SSB was 20%. At the 2012 ICES ASC in Bergen, Norway results from a bootstrap approach for estimating uncertainty in Gadget models was presented using tusk and ling in Va as case study. An extract of that work in relation to reference points is given below.

Bootstrapping of input data for Gadget models: At the 2012 ICES ASC a presentation titled "Evaluating trade-offs for multispecies management procedures for exploited marine populations using bootstrap for highly disparate datasets" the aim of the study was to develop a framework for the evaluation of various harvest control rules for both tusk and ling Va. Furthermore the aim was to assess the performance of allocating quota according to F_{MAX}. In order to address this there was a need to address the uncertainty in the models.

Typical uncertainty estimates in stock assessment models are based on Hessian based methods. However, these methods assume several conditions are satisfied for statistical inference. I.e. the model needs to be correct, observations need to be normally distributed and variance assumptions i.e. homoscedasticity and knowledge of the ratios of variances in individual datasets, need to be appropriate. One can therefore not assume a priori that Hessian-based inference methods yield reasonable results.

Alternative to the Hessian based methods include some forms of bootstrap. However the challenge in the bootstrap approach is to define the proper sampling unit.

Resampling entire fish samples (as is done by Singh *et al.*, 2011) can potentially be used to account for intra–haul correlation but considering samples as units may, however, not be quite enough, since fish at close geographic locations will also tend to be similar.

The bootstrap approach used here, which was first introduced in Taylor *et al*. (2012), is based on independent geographical units, chosen in order to reduce intra-unit correlations. So within each unit a set of data, such as length distributions and age–length distributions, is aggregated. To create a bootstrap dataset, the data from each chosen unit is aggregated according to the desired dimensions. Then finally the model was fitted to each of 100 bootstrap datasets created. The estimates obtained from the bootstrap runs were then used for calculation of uncertainty of F_{MAX} and SSB.

Yield-per-recruit is calculated by following one year class of million fishes for 19 years through the fisheries calculating total yield from the year class as function of fishing mortality of fully recruited fish. In the model, the selection of the fisheries is length based so only the largest individuals of recruiting year classes are caught reducing mean weight of the survivors, more as fishing mortality is increased. This is to be contrasted with age-based yield-per-recruit where the same weights-at-age are assumed in the landings independent of the fishing mortality even when the catch weights are much higher than the mean weight in the stock. In simulations in Gadget the fishing mortality is defined as the fishing mortality when selection is one on the S-shaped selection curve. Therefore the age groups that make up the average fishing mortality may not be the main age groups in the fishery. Therefore in the past fishing mortality for tusk has been presented for age groups 13 to 16. However it would be more prudent to present it for the age groups most dominant in the fishery and these age groups are ages 7 to 10. This has been commented upon by RGs in the past and therefore the analysis is presented based on F for ages 7 to 10. According to the analysis $F_{0.1}$=0.15, F_{MAX}=0.24, this is the same estimate of F_{MAX} as in last year's assessment. However the maximum yield is now estimated at 504 g compared to 558 g in last year's assessment (Figure 6.2.20). 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 last year 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 6.2.20). According to the bootstrap results the estimated CV for F_{MAX} is 3% indicating that the 95% confidence interval of F_{MAX} is between 0.226 and 0.255.

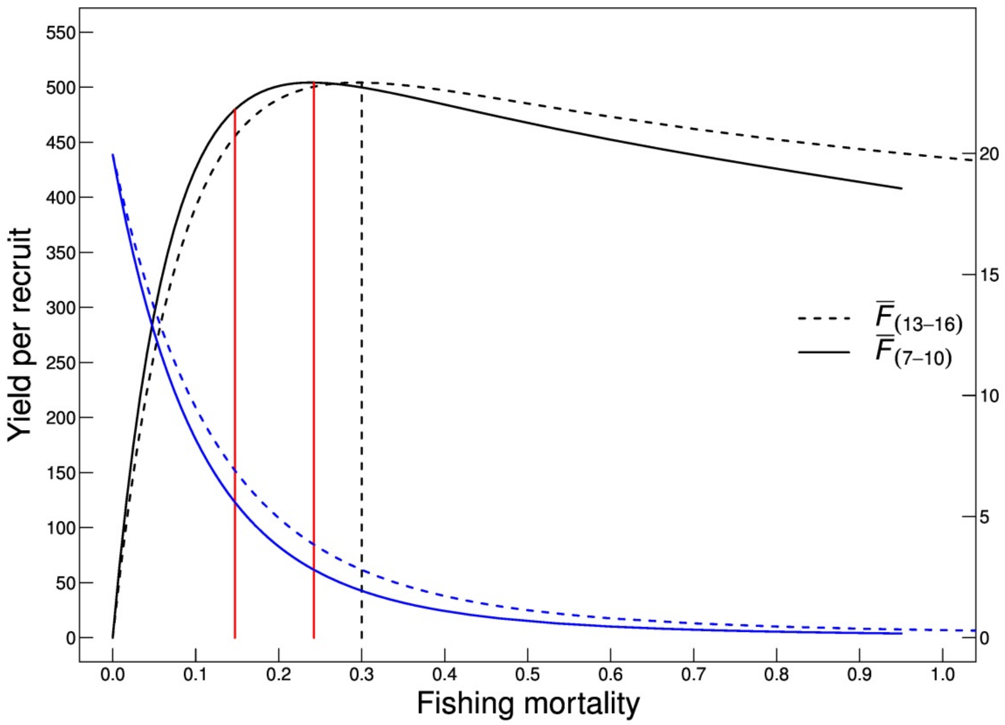


Figure 6.2.20. Tusk in Va and XIV. Estimates of yield per recruit and S/R analysis using Gadget. The results are presented for the main age groups in the fishery (7 to 10) and for historical comparison for ages 13–16 or fully recruited to the fishery.

At WGDEEP 2012 $B_{Trigger}$ was estimated by fitting a 'Hockey-stick' to estimates of spawning–stock biomass and recruitment using the *segreg* function in FLR (FLCore). Additionally $B_{Trigger}$ was set as a value where there is 95% probability of being over B_{loss}, assuming B_{loss} is the lowest estimate of SSB in the time-series. At the time there was no estimate of uncertainty of SSB from Gadget so as an initial guess it was assumed to be 20%. Therefore $B_{Trigger}$ = Bloss*exp(1.645*0.20). The segmented regression estimated the breaking point at 4.5 kt which at the time was the lowest estimate of SSB in the time-series. This resulted in a $B_{Trigger}$ candidate of 6.5 kt. This may not be a suitable candidate as 13 of 25 datapoints in the SSB time-series were below this point and there were no indications of repaired recruitment. Actually recruitment increased during this period. Additionally it should be noted that fishing mortality of tusk in Va has been low in the time-series, compared to many other stocks and the mean fishing mortality is 0.3 (range 0.19–0.43) which is actually not far from F_{MAX} of 0.24. Additionally to that, in the current assessment the lowest value of SSB in the time-series is 3.7 kt. Therefore a candidate for $B_{Trigger}$ should be set at a lower level possibly.

In the bootstrap runs the lowest estimate of SSB in each run has a median of 4.8 kt with a range of 3.1 to 7.5 kt (Figure 6.2.21). Given that there have been no sign of overexploitation in the time-series a possible candidate for $B_{Trigger}$ might be the 5% quantile of the distribution of lowest estimates of SSB. That would set $B_{Trigger}$ at 3.4 kt.

The results presented above should be viewed as a work in progress, especially for $B_{Trigger}$ and should not be taken at face value. Further work is expected to take place which may alter the estimates somewhat.

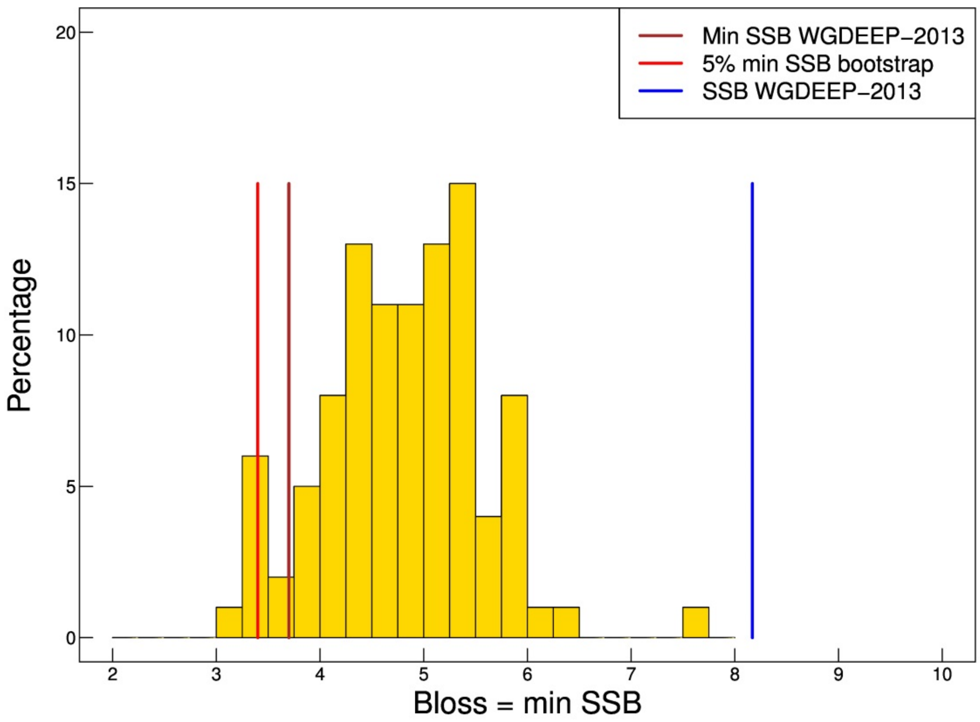


Figure 6.2.21. Tusk in Va and XIV. Distribution of lowest estimates of SSB in each of the 100 bootstrap runs (yellow bars), the red line is the 5% quantile of the distribution, brown line is the lowest estimate of SSB in this year's assessment and the blue line represents SSB estimate for 2012.

Projections

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

- Recruitment (age 3) set as equal to mean recruitment in 2010 to 2012. Does not affect the projected catch level in 2013 to 2014.
- Catches in 2013 were set equal to catches in 2012 in the first quarter but for quarters 2 to 4 catches were set at F_{MAX}.

The projections were run to 2018 for $F_{MAX} = 0.24$ (Table 6.2.8). According to the projections SSB will peak in 2014, however total biomass has already started to decrease and harvestable biomass peaked in 2013. Catch levels decrease after 2014 from 7 kt to 4.4 kt in 2018.

6.2.5 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 slightly improved recruitment estimated in 2012 is not backed by observations in the Icelandic spring survey nor in the commercial catch data. It may simply be an artefact in the model. The inclusion of the 2013 Spring survey may alter this estimate. Therefore the group stresses the need for WGDEEP to take place in April rather than in March as the spring survey takes place in March.

6.2.6 Management considerations

All the signs from commercial catch data and surveys indicate that tusk in Va and XIV is at present in a good state. This is confirmed in the Gadget assessment. However the drop in recruitment since 2005–2006 will result in decrease in sustainable catches from those proposed for the fishing year 2012/2014 of 7000 tonnes to catches being considerably lower than 5000 tonnes in 2018.

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.

6.2.7 Response to technical minutes

The comments were mainly complementary and the RG agreed with the changes made to the assessment method by the EG, the largest being the inclusion of the Faroe-Iceland Ridge and the change in natural mortality from 0.2 to 0.15. The technical comments are mainly on typos and are well received. The comment on the units for survey biomass is a frequent question but it has to be pointed out that it is an index and as such should not have any units as the q from the survey is unknown (but estimated in Gadget, where it varies depending on length groups).

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

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

Table 6.2.8. Tusk in Va and XIV. Nominal landings by nations in XIV.

Year	Faroe	Germany	Iceland	Norway	Russia	Spain	UK	Total
1973	16	9	0	0	0	0	2	27
1974	259	2	15	0	0	0	1	277
1975	29	17	13	138	0	0	0	197
1976	0	5	89	47	0	0	1	142
1977	167	16	0	40	0	0	1	224
1978	0	47	0	38	0	0	0	85
1979	0	27	0	0	0	0	0	27
1980	0	13	0	0	0	0	0	13
1981	110	10	0	0	0	0	0	120
1982	0	10	0	0	0	0	0	10
1983	74	11	0	0	0	0	0	85
1984	0	5	0	58	0	0	0	63
1985	0	4	0	0	0	0	0	4
1986	33	2	0	0	0	0	0	35
1987	13	2	0	0	0	0	0	15
1988	19	2	0	0	0	0	0	21
1989	13	1	0	0	0	0	0	14
1990	0	2	0	7	0	0	0	9
1991	0	2	0	68	0	0	1	71
1992	0	0	3	120	0	0	0	123
1993	0	0	1	39	0	0	0	40
1994	0	0	0	16	0	0	0	16
1995	0	0	0	30	0	0	0	30
1996	0	0	0	157	0	0	0	157
1997	0	0	10	9	0	0	0	19
1998	0	0	0	12	0	0	0	12
1999	0	0	0	8	0	0	0	8
2000	0	0	11	11	0	3	0	25
2001	3	0	20	69	0	0	0	92
2002	4	0	86	30	0	0	0	120
2003	0	0	2	88	0	0	0	90
2004	0	0	0	40	0	0	0	40
2005	7	0	0	41	8	0	0	56
2006	3	0	0	19	51	0	0	73
2007	0	0	0	40	6	0	0	46
2008	0.2	0	0	7	0	0	0	7.2
2009	0	0	0	5	11	0	0	16
2010	7	0	0	5	0	0	0	12
2011	0	0	0	24	0	0	0	24
2012				46				

Table 6.2.9. 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 2013 to 2018 are shown in italics.

YEAR	BIOMASS	HARVESTABLE biomass	SSB	RECRUITMENT (age 3)	CATCH	$F_{(7-10)}$
1982	31.997	15.953	5.077	18.403	5.880	0.34
1983	30.974	15.924	5.739	12.265	8.287	0.36
1984	29.729	15.026	5.934	10.347	5.692	0.27
1985	30.161	15.445	6.573	7.225	5.065	0.24
1986	30.647	16.758	7.243	5.723	5.381	0.19
1987	31.513	18.999	8.210	16.063	5.645	0.24
1988	30.910	19.191	8.557	11.130	6.865	0.21
1989	31.422	18.975	9.004	14.616	7.077	0.28
1990	30.733	16.705	8.433	18.865	7.292	0.34
1991	29.635	14.145	7.244	16.582	8.733	0.42
1992	27.915	11.691	5.632	12.584	8.010	0.42
1993	26.735	10.494	4.550	9.702	6.059	0.31
1994	27.219	11.706	4.555	8.167	5.828	0.30
1995	26.714	13.204	4.802	6.901	6.231	0.29
1996	25.788	14.240	5.167	4.763	6.241	0.26
1997	25.228	14.756	5.639	13.370	5.759	0.26
1998	24.679	14.370	5.940	15.186	5.146	0.31
1999	23.840	12.804	5.728	11.323	7.290	0.40
2000	22.409	10.112	4.750	11.263	6.240	0.43
2001	21.640	8.262	3.773	12.196	4.526	0.27
2002	23.724	9.421	3.894	14.946	5.249	0.36
2003	24.736	9.885	3.733	17.155	5.315	0.35
2004	26.330	10.233	3.761	19.781	4.655	0.25
2005	30.006	11.770	4.411	21.808	4.820	0.27
2006	33.454	13.118	5.024	22.179	6.602	0.31
2007	35.955	14.141	5.428	19.813	7.594	0.31
2008	37.920	15.441	5.826	15.718	8.175	0.35
2009	37.979	16.319	6.002	14.466	8.253	0.28
2010	38.507	18.659	6.764	9.329	8.986	0.30
2011	36.888	19.968	7.291	4.500	7.391	0.25
2012	35.286	21.488	8.167	5.041	7.762	0.24
2013	*32.786*	*21.984*	*8.905*	*6.290*	*7.187*	*0.24*
2014	*29.979*	*21.491*	*9.432*	*6.290*	*6.964*	*0.24*
2015	*27.050*	*19.765*	*9.522*	*6.290*	*6.306*	*0.24*
2016	*24.414*	*17.385*	*9.195*	*6.290*	*5.586*	*0.24*
2017	*22.263*	*15.136*	*8.558*	*6.290*	*4.946*	*0.24*
2018	*20.329*	*13.394*	*7.761*	*6.290*	*4.442*	*na*

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 1988–2012 are 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. Norway reported 17 tonnes in Area XIVb1 and the Faroe Islands, 1 tonne.

6.3.3 ICES Advice

Advice for 2013 and 2014 : 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 recommends that in 2009–2011 the effort in areas beyond national jurisdiction shall not exceed 65 per cent 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

***Preliminary.**

TUSK XIVb1

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

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	1	17	18

***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 2012 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 1988–2012 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 (Figure 6.5.1).

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 2013 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 2013 is set at 353 t.

NEAFC recommended in 2009 that the effort in the NEAFC regulatory area shall not exceed 65 per cent 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. Discard data was available from the Basque Country (Spain) OTB and PTB. The estimates are total annual estimated discards (tons); Table 6.5.2.

6.4.5.2 Length compositions

Figure 6.5.2 shows the length distribution of tusk provided by the Norwegian reference fleet for the period 2003–2012. The length in this period fluctuated without any obvious trend (no data was available for 2011).

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 2000–2012. 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, WD, 2013). The number of longliners has declined from 72 to 36 during the period 2000–2012. 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 2000 and 2012 this had declined to 4 (Helle and Pennington, WD, 2013). 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. This increase in the number of hooks may be due to poor data quality as the vessels were changing from paper to electronic logbooks. In 2011 and 2012 when the quality of the data was very good the number of hooks per day was at the same level as in the period (2000–2008) (Figure 6.5.3).

Table 6.5.3 gives estimates of cpue and standard errors and number of fishing days, which are based on the Norwegian official logbooks.

The unstandardized 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).

Biological reference points

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

6.4.7 Comments on the assessment

The Norwegian longline cpue series based on the logbook is not standardized but a project with the aim of creating a standardized cpue has been started. This project is a cooperation between the IMR, Mørefosrking Marin and Runde Environmental Centre. The first step, that of mapping the changes in the distribution of the longline fishery, has begun, and an overview of the project is presented in a Hareide and Helle, WD 9, 2012.

A standardized cpue will be presented in 2014.

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

***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

***Preliminary.**

Table 6.5.2. Basque Country (Spain) OTB and PTB. Total anual estimated discards (ton) by ICES Division VI and year.

Division	2003	2005	2008	2009
VI	38	3	169	69

Table 6.5.3. Estimated mean cpue ([kg/hook]x1000) based on logbook data along with its standard error (*se*) and number of catches sampled for tusk in Subarea VIb.

Tusk	Area	VIB
2000	cpue	76,8
	n	222
	se	2,0
2001	cpue	50,6
	n	132
	se	2,0
2002	cpue	55,2
	n	149
	se	1,7
2003	cpue	44,9
	n	94
	se	2,1
2004	cpue	62,7
	n	111
	se	2,4
2005	cpue	72,5
	n	136
	se	2,7
2006	cpue	41,2
	n	138
	se	3,4
2007	cpue	26,1
	n	135
	se	2,4
2008	cpue	29,6
	n	35
	se	6,16
2009	cpue	17.9
	n	27
	se	8.94
2010	cpue	32,9
	n	53
	se	7.4
2011	cpue	29.9
	n	132
	se	1,4
2012	cpue	30.1
	se	158

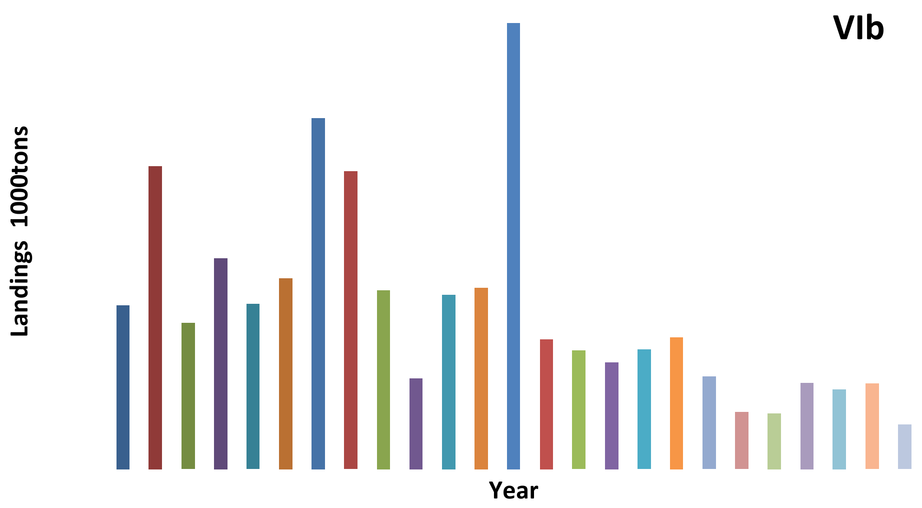


Figure 6.5.1. Trend with time in international landings of tusk from Subarea VIb.

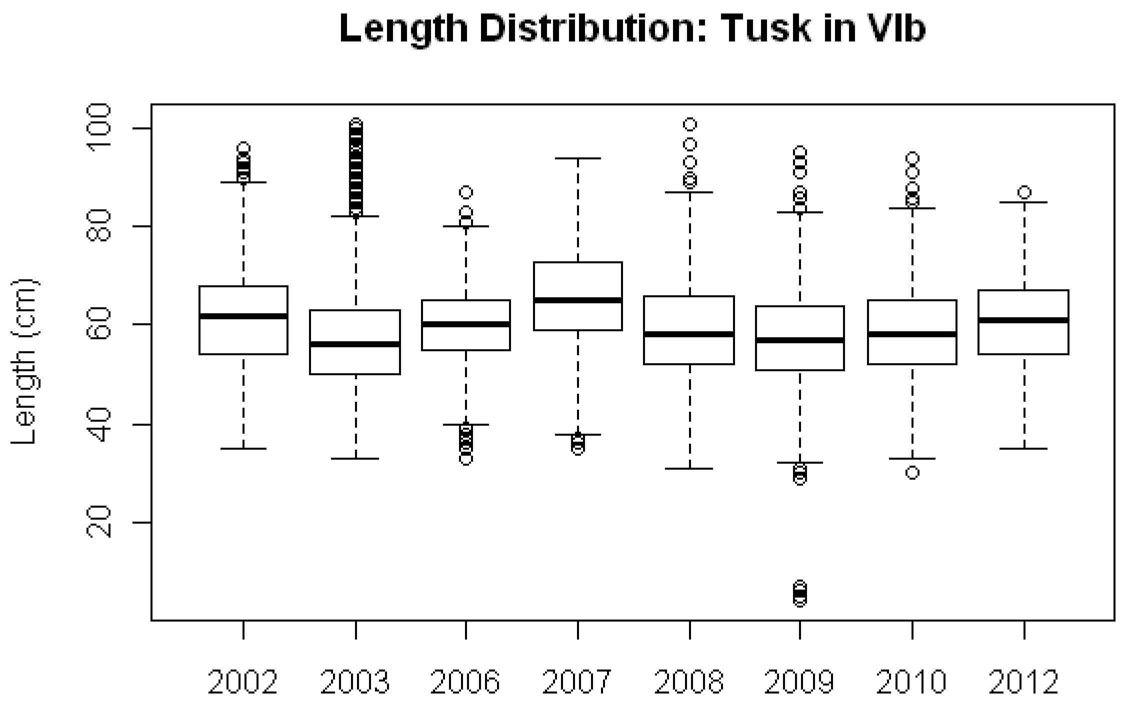


Figure 6.5.2. The length distribution of tusk provided by the Norwegian reference fleet for the period 2003–2012 (no data were available for 2011).

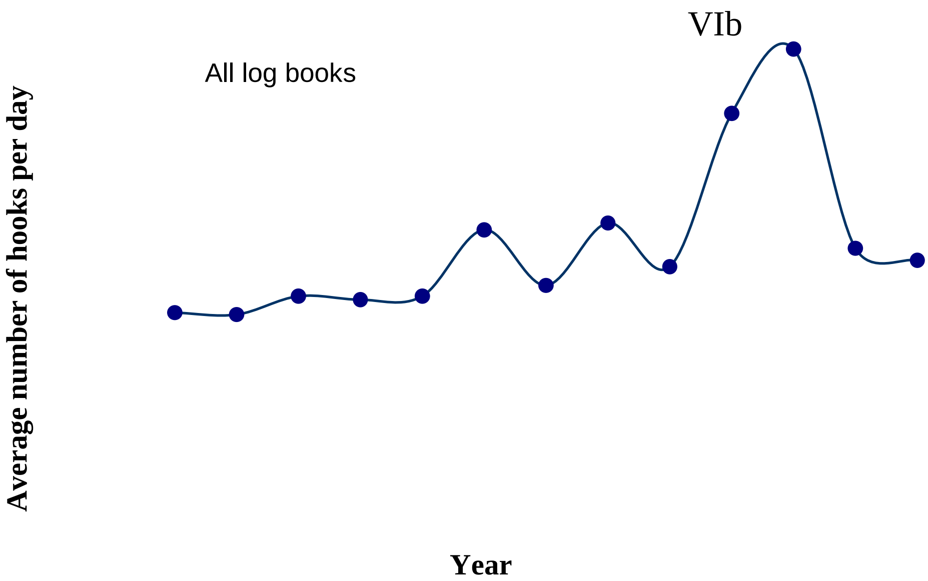


Figure 6.5.3. Average number of hooks the Norwegian longliner fleet used per day in each of the ICES Subarea VIb for the years 2000–2012 in the fishery for tusk, ling and blue ling.

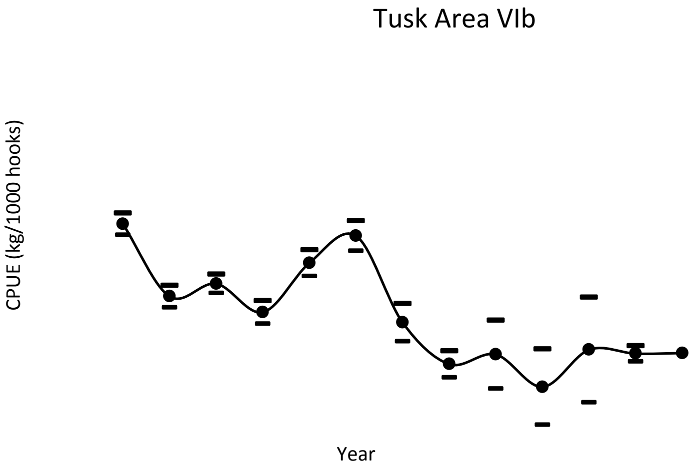


Figure 6.5.4. Estimated mean cpue([kg/hook]x1000) based on data from the logbooks for tusk in ICES Subarea VIb for the years 2000–2012. The bars denote the 95% confidence interval.

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

6.5.1 The fishery

Tusk has been caught, primarily as a bycatch in the ling and cod fisheries, in these subareas. Currently, the major fisheries in Subareas I and II are the Norwegian longline and gillnet fisheries, but there are also bycatches by other gears, e.g. trawls and handlines. Of the Norwegian landings, usually around 85% is taken by longlines, 10% by gillnets and the remainder by a variety of other gears. Other nations catch tusk as a bycatch in trawl and longline fisheries.

Russian landings (88 t) from Subdivisions IIa and IIb in 2012 were mainly taken as bycatch in longline fisheries.

6.5.2 Landings trends

Landing statistics by nation in the period 1988–2012 are given in Table 6.3.1a–d. Landings declined from 1989 to 2005, after this the landings decreased (Figures 6.3.1 and 6.3.2). The preliminary landings for 2012 are 10 379 t which is at about the same level as previous years.

6.5.3 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 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 specific licence. The quota for the EU in Areas I and II in the Norwegian zone for bycatch species such as ling and tusk is in 2012 set to 5000 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 2013.

6.5.5 Data available

6.5.5.1 Landings and discards

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

6.5.5.2 Length compositions

Figure 6.3.3 shows the length distribution of tusk provided by the Norwegian reference fleet for the period 2001–2012. The length in this period fluctuated without any obvious trend The length composition from Russian commercial and research bottom-trawl catches from 2011 is shown in Figure 6.3.4.

6.5.5.3 Age compositions

No age compositions were available.

6.5.5.4 Weight-at-age

No data were presented.

6.5.5.5 Maturity and natural mortality

No data were presented.

6.5.5.6 Catch, effort and research vessel data

Catch and effort data for Norwegian longliners were presented (Figure 6.3.5; Table 6.3.2). No research vessel data were available.

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2012. 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.

An analysis based on these data is in Helle and Pennington, WD, 2013.

6.5.6 Data analyses

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

The only source of information on abundance trends was the unstandardized cpue series from the Norwegian longliners presented by Helle and Pennington (WD12, 2013). The number of longliners has declined in recent years (Figure 6.3.5), from 72 to 36 in the period 2000–2012. The numbers of fishing days per vessel has remained relatively stable during the last years (Helle, WD, 2013). The number of hooks set per day increased from 32 000–37 000 over the period 2000–2012 (Figure 6.3.6).

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 analysis was carried out. A further analysis will be carried out next year when a standardised index is available.

Biological reference points

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

Table 6.3.2 and Figure 6.3.7 gives estimates of cpue based on the Norwegian official logbooks.

6.5.7 Comments on the assessment

The Norwegian lingline cpue series based on the logbook is not standardized but a project with the aim of creating a standardized cpue has been started. This project is a cooperation between the IMR, Mørefosrking Marin and Runde Environmental Centre. The first step, that of mapping the changes in the distribution of the longline fishery, has begun, and an overview of the project is presented in a Hareide and Helle, WD 2012.

A standardized cpue will be presented in 2014.

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 steadily increase over the period. Current catch levels are considered to be appropriate. The size of the longline fleet fishing for tusk is likely to decrease because of greater access to quotas for Arcto-Norwegian cod.

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

***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		8741	2		48		1	8862

*** 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

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	10 379

***Preliminary.**

Table 6.3.2. Estimated mean cpue ([kg/hook]x1000) of tusk in Subarea I and II based on logbook data. Standard error (se) and number of catches sampled (n) is also given.

Tusk	Area	I	IIA	IIB
2000	cpue	21,6	59,5	4,1
	n	189	1678	8
	se	2,1	0,7	10,4
2001	cpue	18,8	52,5	10,8
	n	53	1959	17
	se	3,2	0,5	5,6
2002	cpue	4,2	47	
	n	115	1809	
	se	2,0	0,5	
2003	cpue	11,9	40,1	5,3
	n	141	1473	5
	se	1,7	0,5	9,0
2004	cpue	3,8	36,1	2,2
	n	122	1096	20
	se	2,2	0,8	5,6
2005	cpue	3,5	49,5	2,7
	n	73	1060	12
	se	3,7	1,0	9,2
2006	cpue	7,8	56,3	5,62
	n	18	1145	6
	se	9,5	1,2	16,4
2007	cpue	7,95	53,1	2,85
	n	108	1853	19
	se	2,7	0,7	6,4
2008	cpue	6,78	57,5	8,02
	n	32	1247	68
	se	6,38	1,03	4,42
2009	cpue	3.76	57.6	2
	n	78	1195	26
	se	5.26	1.34	9.11
2010	cpue	11,7	76,3	1,56
	n	42	959	17
	se	8,3	1,7	13,1
2011	cpue	13,8	63,2	5,16
	n	411	3622	123
	se	0,8	0,3	1,5
2012	cpue	8.4	59.9	6.1
	n	307	2817	157

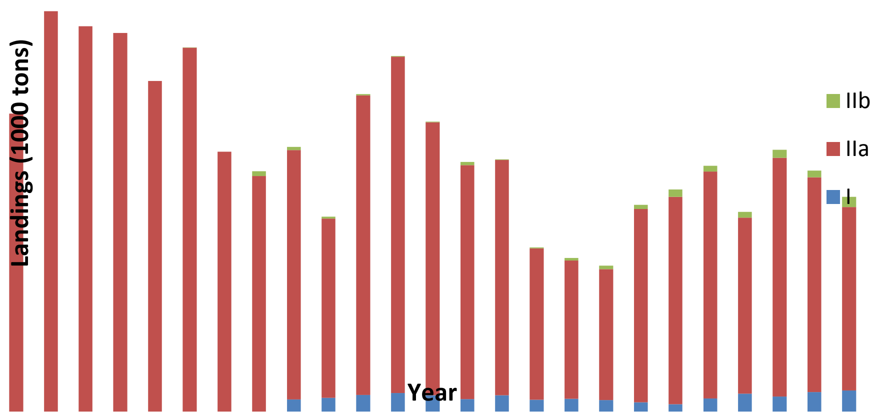


Figure 6.3.1.Total landings of tusk in Areas I and II for the period 1988–2012.

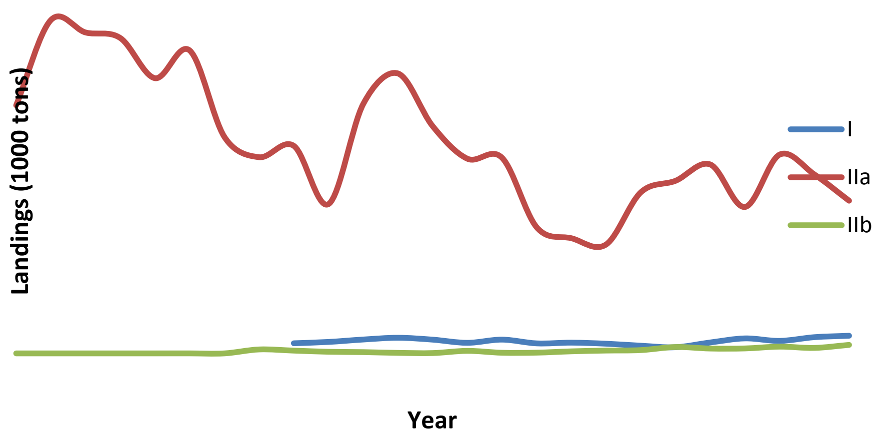


Figure 6.3.2. Total landings of tusk in Areas I and II in each area for the period 1988–2012.

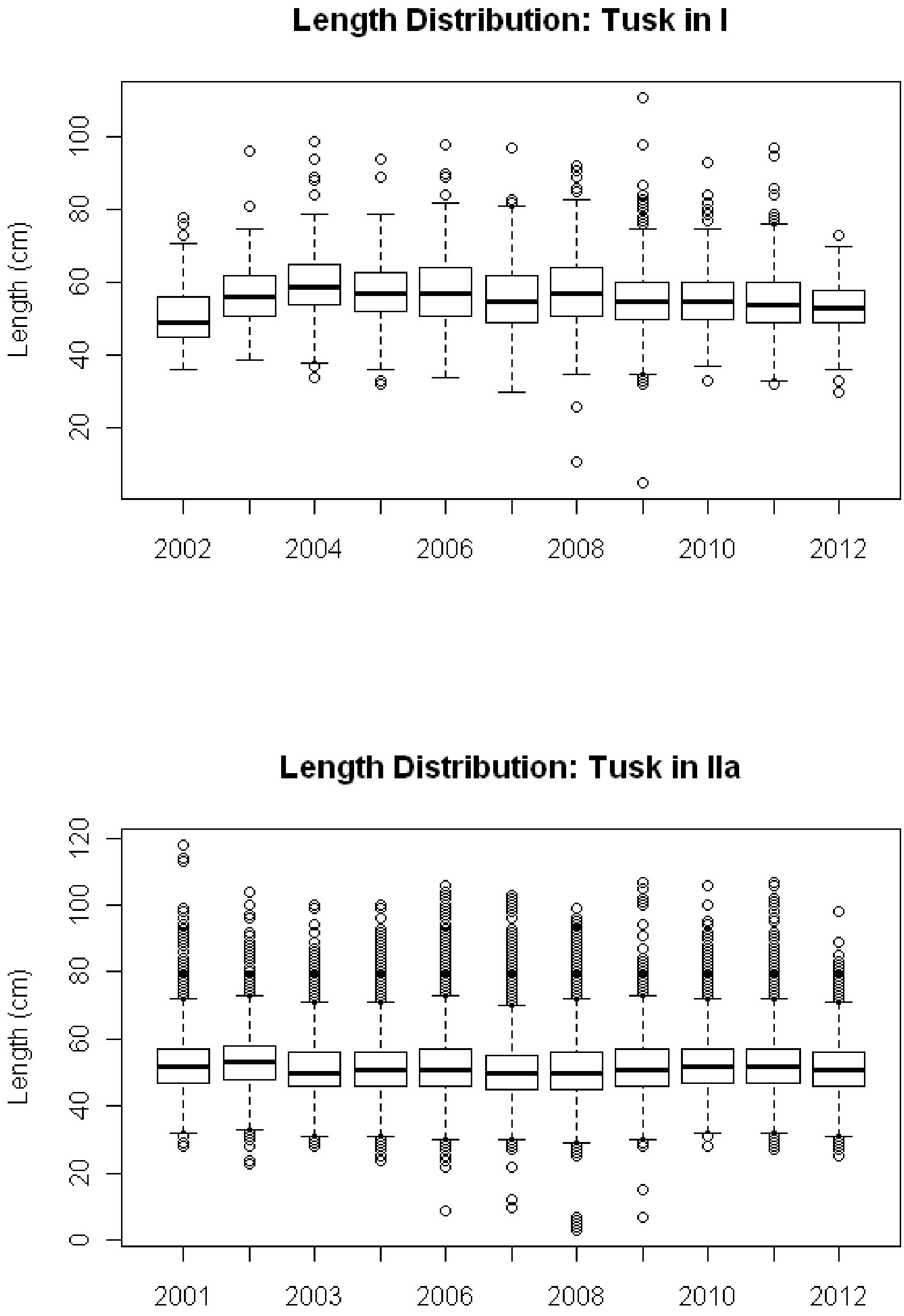


Figure 6.3.3. The length distribution of tusk provided by the Norwegian reference fleet for the period 2001–2012.

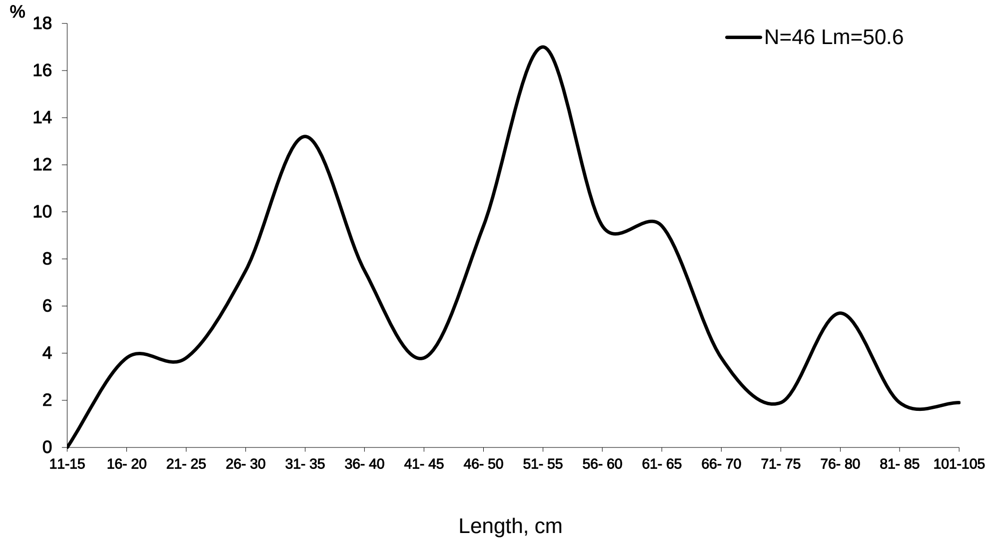


Figure 6.3.4. Length composition of Tusk from commercial and research bottom trawl catches in Norwegian Sea in February–December 2011.

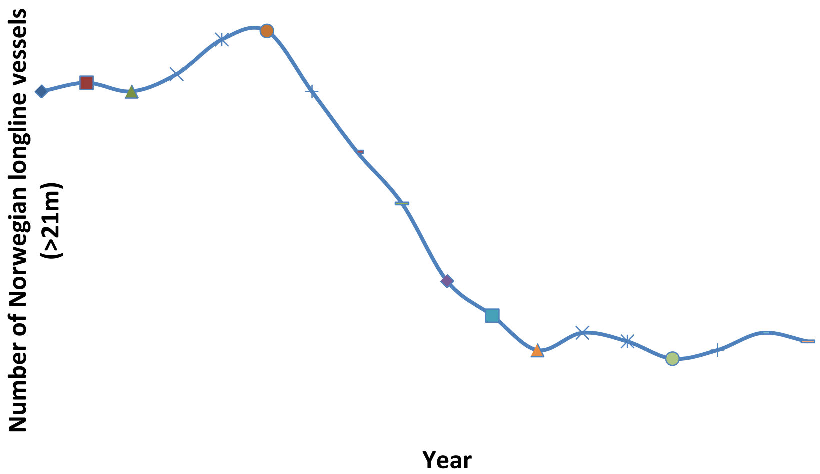


Figure 6.3.5. Change in number of vessels in the Norwegian longliner fleet during the period 1995–2012 (vessels exceeding 21 m). This list only includes vessels that landed 8 t or more of ling, blue ling and tusk in a given year.

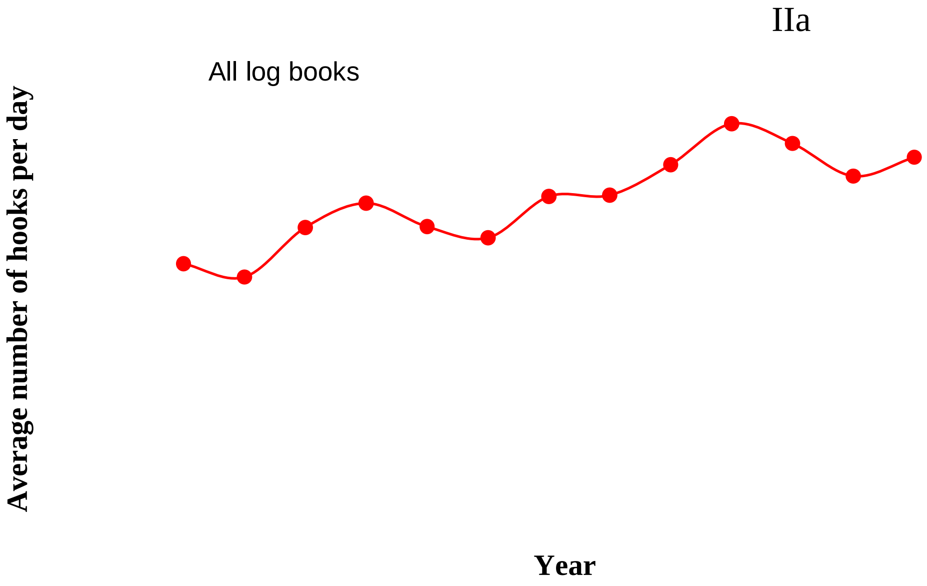


Figure 6.3.6. Average number of hooks the Norwegian longliner fleet used per day in each of the ICES Subarea IIa for the years 2000–2012 in the fishery for tusk, ling and blue ling.

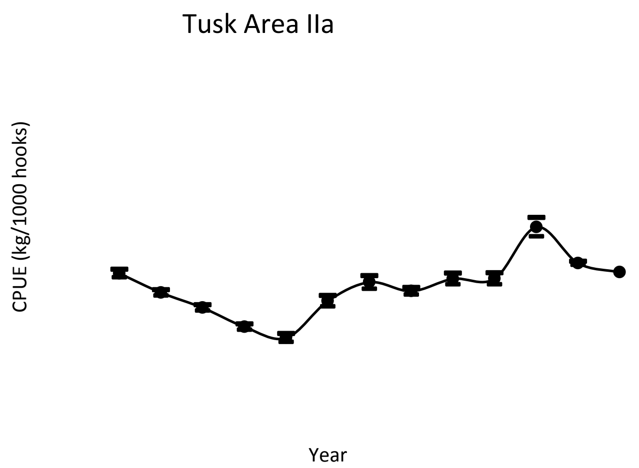


Figure 6.3.7. Estimates of cpue (kg/1000 hooks) of tusk based on skipper's logbooks 2000–2012. The bars denote the 95% confidence interval.

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

A general description of the fisheries in these areas are in the overviews in Sections 3.3., 3.4, 3.5 and 3.6.

Tusk is a bycatch species in the trawl, gillnet and longline fisheries in these sub-areas/divisions. Norway has traditionally landed the dominant proportion of the total landings. Around 90% of the Norwegian and Faroese landings are taken by long-liners.

When landings from Areas III–IV and VIa–XII are pooled over the period 1988–2012, 36% of the landings have been in Area IV, 46% in Area Vb, and 15% in Area VIa.

The fishery for tusk in Vb changed in 2011 because the Norwegian longliners were not allowed to fish in Faroese waters due to the mackerel allocation. The Faroese are now landing almost all the catches and are fishing in areas where the Norwegian longliners used to fish. In spite of the ban, a catch of 102 tons from international waters in Vb was reported by Norway.

6.6.2 Landings trends

Landing statistics by nation during the period 1988–2012 are in Table 6.6.1 and are shown by year in Figure 6.6.1.

For all subareas/divisions, the catches have been relatively stable over the last five years except for Area Vb, which had a large increase in 2010 (Figure 6.6.2).

6.6.3 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.

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. Norway also has a licensing scheme in EU waters and in 2013 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 2013:

Subarea III:	24 t;
Subarea IV:	235t;
Subarea V, VI, VII (EU and international waters):	353 t.

NEAFC recommends that in 2009 the effort in areas beyond national jurisdictions shall not exceed 65 per cent 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 relevant fleets. No estimates of the quantity of discards for tusk were on hand. Both for the Norwegian and Faroese fleet, there is a ban on discarding, and incentives for illegal discarding are believed to be low. The landings statistics and logbooks are therefore regarded as being adequate for assessment purposes.

6.6.5.2 Length compositions

Figure 6.6.3 show the estimated length distribution for tusk in areas IVb, Vb and VIa based on data provided by the Norwegian reference fleet for the period 2001–2012.

Length distributions of the catches by the Faroese longliners and those for the spring and summer groundfish surveys in Vb were presented for the period 1995–2011 (Figures 6.6.4–6.6.6).

6.6.5.3 Age compositions

No age composition data were available.

6.6.5.4 Weight-at-age

No data were presented.

6.6.5.5 Maturity and natural mortality

No new data were presented.

6.6.5.6 Catch, effort and research vessel data

Catch and effort data for Norwegian and Faroese longliners were presented. Cpue indices from the Faroese groundfish surveys were also presented.

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2012. 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. In 2011 and 2012 the quality improved considerably as data from the entire fleet were available.

An unstandardized cpue series for the period 2000–2012 is presented in Figure 6.6.7.

Data from Faroese spring and summer surveys are available for the period 1994 onwards (Figure 6.6.8).

A standardized cpue series for the Faroese longliners (>100 GRT) for the period 1987–2012 was also available (Figure 6.6.9).

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, has varied slightly with no obvious trend (Figure 6.6.3).

Faroese data from Area Vb show that the mean length in the spring and summer groundfish surveys varied between 43 to 53 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 commercial landing size, are based on a subsample from the total catch and thereafter multiplied up to the total catch weight. There were few fish caught that were less than 30 cm, so there are no abundance indices (recruitment) for juvenile tusk from the spring survey.

The estimated mean lengths for the landings by longliners varied from 46 to 51 cm, and there was no apparent downward trend in mean lengths over time (Figure 6.6.4). The main catches had fish lengths that were between 40 and 60 cm.

Cpue trends

The abundance indices (cpue) for the Faroese groundfish surveys in Area Vb do not show the same trend as the longline cpue series (Figures 6.6.8 and 6.6.9). The cpue in 2012 is lower than the previous years for both the spring and summer surveys.

The Faroese commercial cpue is based on data from five longliners. To generate the series catches were selected that; caught tusk, the catch of tusk+ling was more than 60% of the total catch, and the catch was taken at a depth deeper than 200 m. The cpue series for the period 2005 to 2012 has been quite stable around, 50 kg/1000 hooks (Figure 6.6.9). The Norwegian unstandardized cpue series for Area Vb appears to be generally increasing. The estimate for 2012 is based on very few fishing days due to the ban from the traditional fishing grounds and, therefore, may not be representative of the entire area.

F**or Areas IVa and VIa** only the unstandardized cpue seres are available (Figure 6.6.7). These showed a stable or positive trend for Area IVa while there has been a large increase in cpue from about 49 kg/1000 hooks in 2003 to 160 kg/1000 hooks in 2012. In both these areas there are sufficient logbook data to estimate the cpue.

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 logbook is not standardized but a project with the aim of creating a standardized cpue has been started. This project is a cooperation between the IMR, Mørefosrking Marin and Runde Environmental Centre. The first step, that of documenting the changes in the distribution of the longline fishery, has begun, and an overview of the project is presented in a Hareide and Helle, WD 09, 2012.

A standardized cpue has already been made for ling and one for tusk will be presented in 2014.

6.6.8 Management considerations

Landings in all subareas have been stable since 2002. The cpue series both for the Faroes longline fishery in Vb and for the Norwegian longline fisheries in IVa, Vb and VIa show a stable or positive trend since 2003. However, in contrast to these longline cpue series, the cpue series based on the Faroese groundfish surveys in Area Vb indicate a decrease in 2012. Current catch levels are not cause for concern and WGDEEP would not consider a small increase to be detrimental.

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

***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

(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

(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

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)]	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			

(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

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*				

***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

***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*						2		2

***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

***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

***Preliminary.**

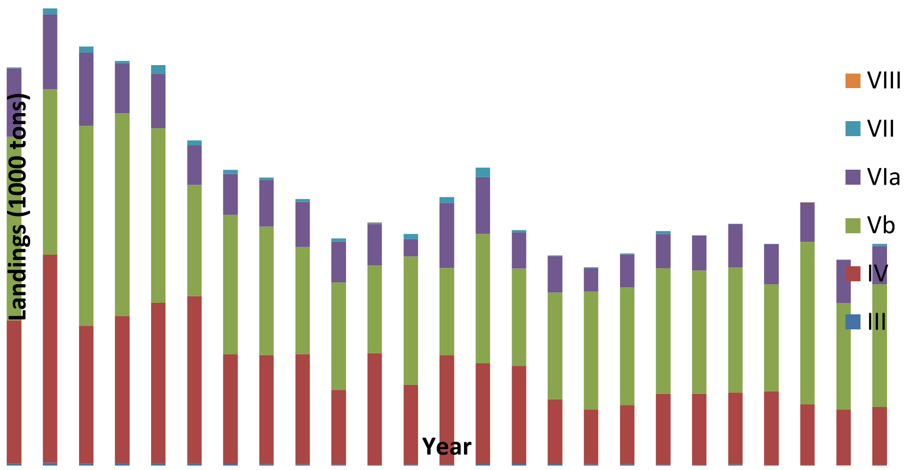


Figure 6.6.1. Landings of tusk per year for the period 1988–2011.

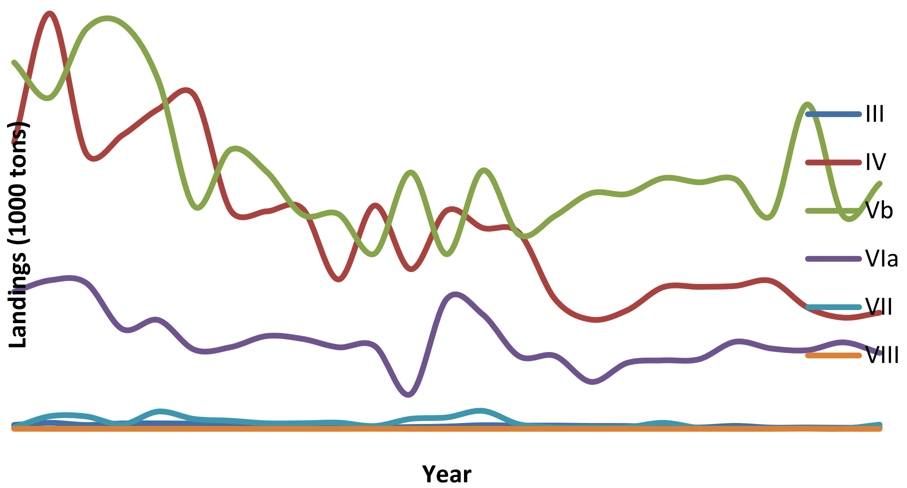
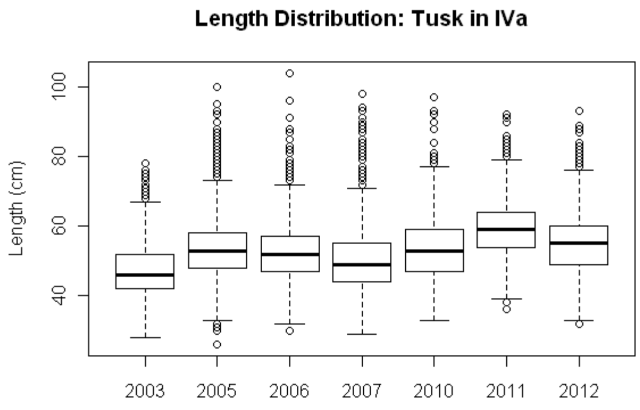
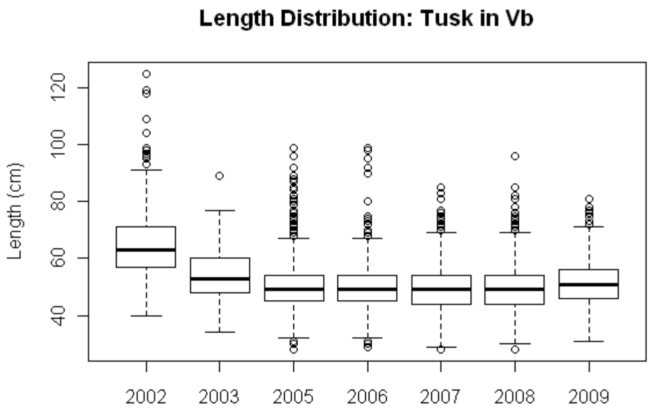


Figure 6.6.2. Landings of tusk in each area for the period 1988–2011.





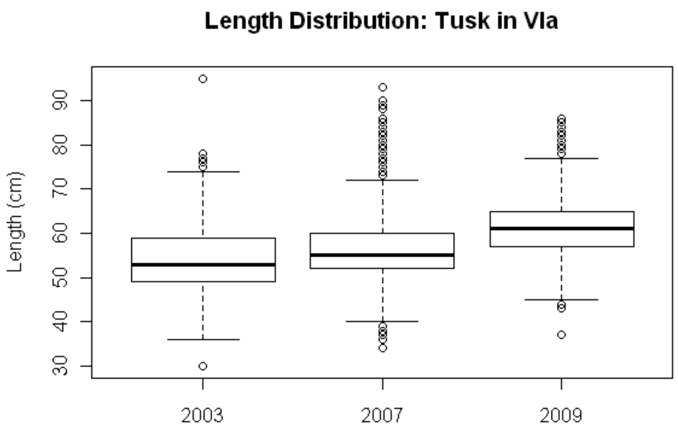


Figure 6.6.3. Plots of the length distribution in Areas IVa, Vb and VIa for the period 2001 to 2012 The plots are based on length data from the Norwegian reference fleet.

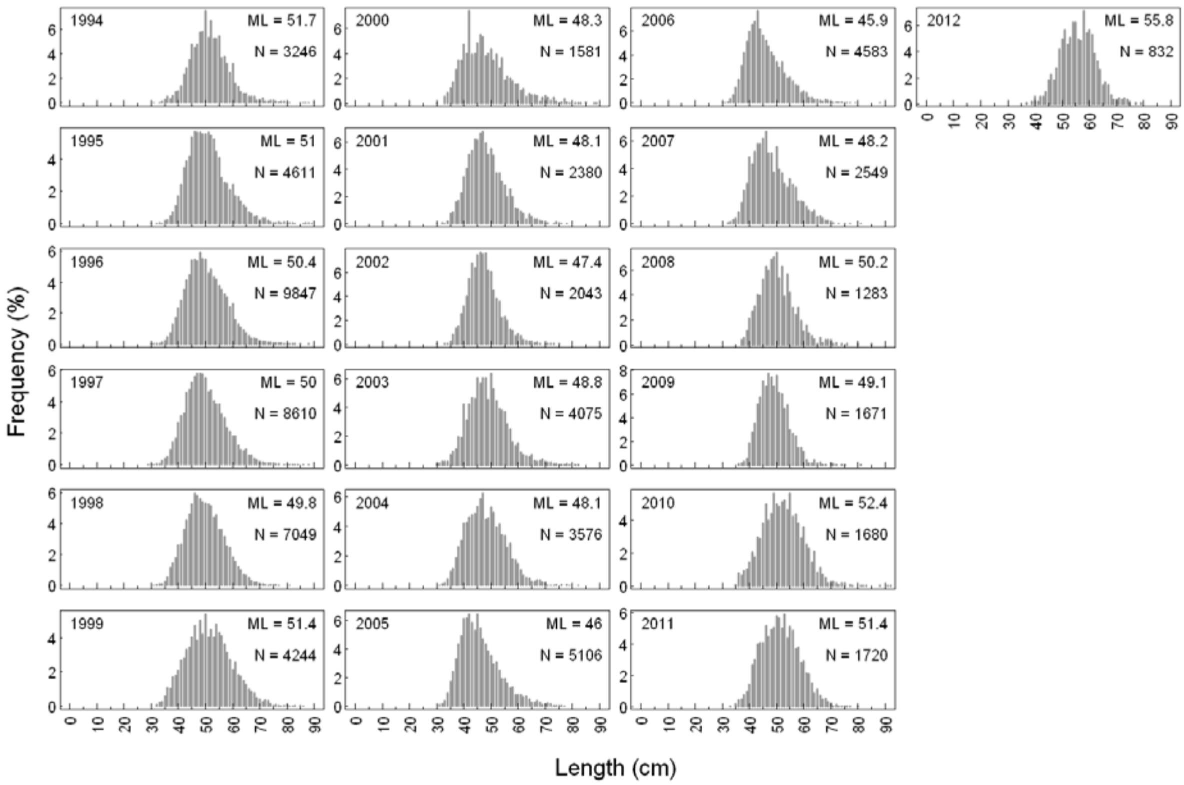


Figure 6.6.4. Tusk Vb. Length distributions for the fishery by longliners (>100 BRT).

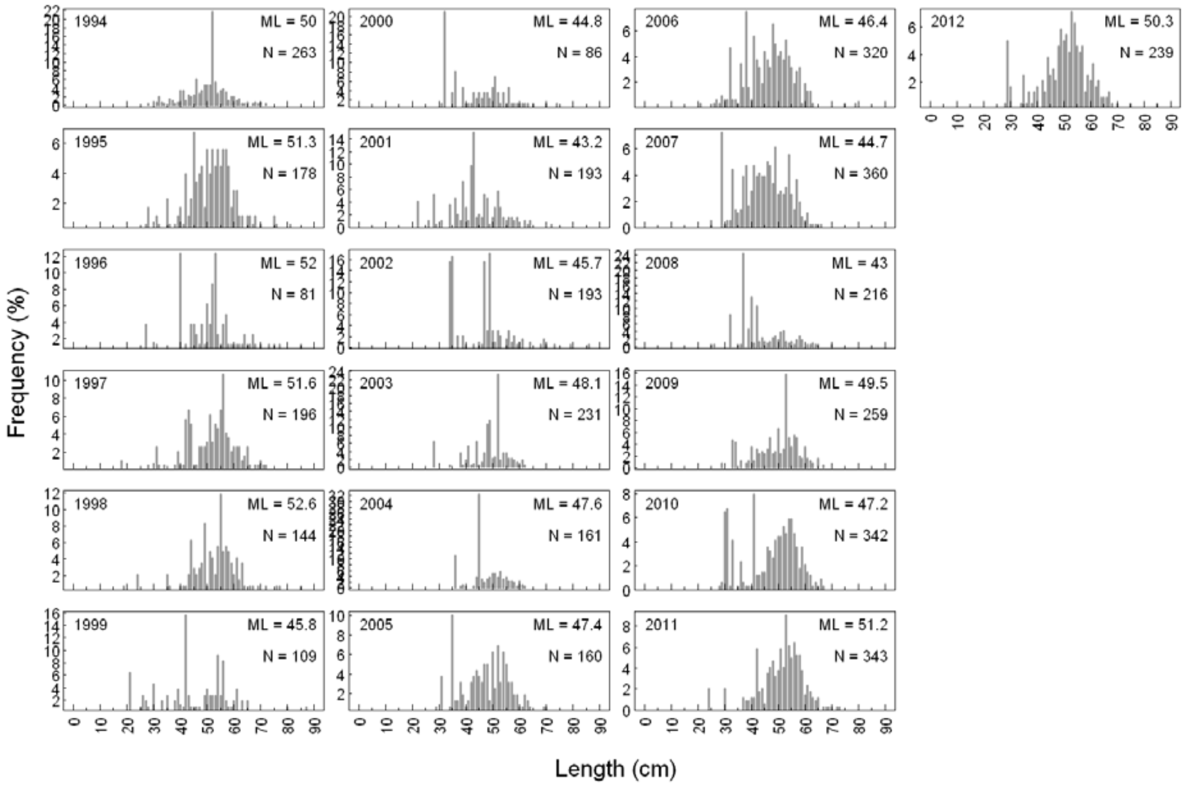


Figure 6.6.5. Tusk Vb. Length distributions for the spring groundfish surveys.

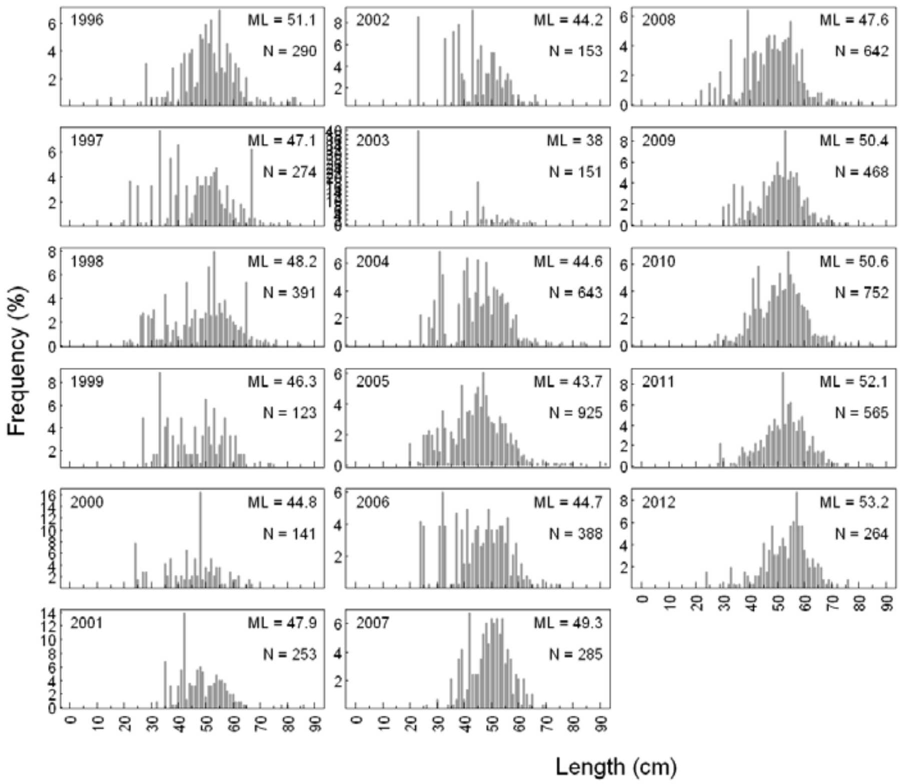
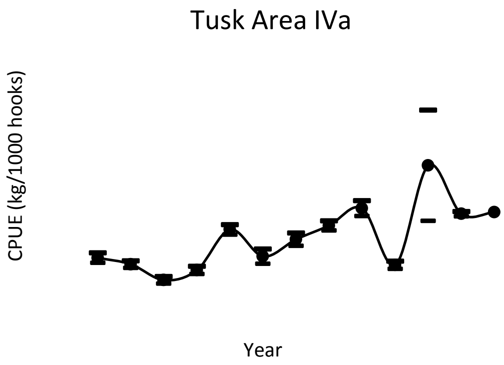
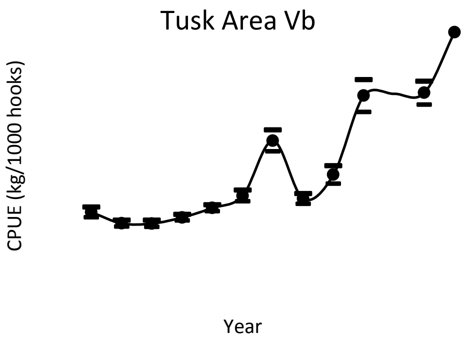


Figure 6.6.6. Tusk Vb. Length distributions for the summer groundfish surveys.





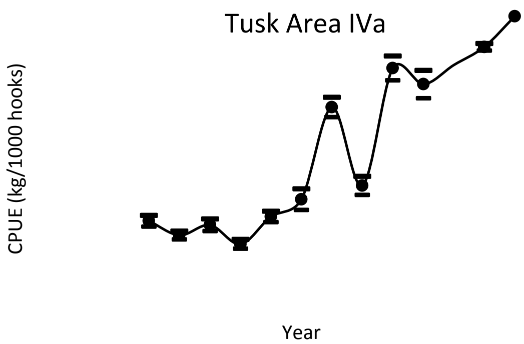


Figure 6.6.7. Estimates of cpue (kg/1000 hooks) of tusk for Subareas IVa ,Vb and VIa based on skippers' logbooks (during the period 2000–2012.The bars denote the 95% confidence interval.

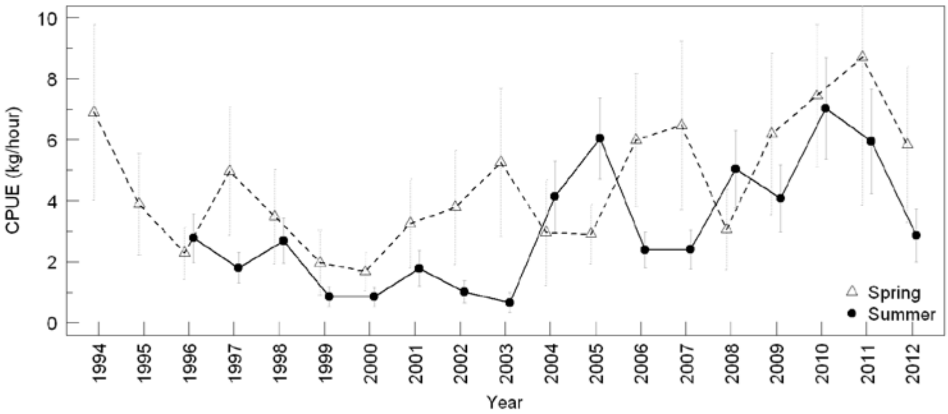


Figure 6.6.8. Tusk Vb. Cpue series based on groundfish surveys.

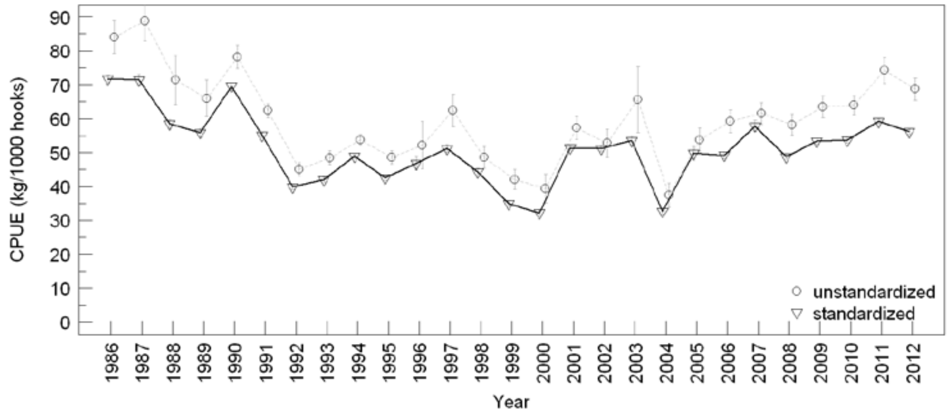


Figure 6.6.9. Tusk Vb. Standardized cpue for 4–5 longliners (<110 GRT) fishing in Faroese waters. Criteria: tusk was in the catch, ling+tusk >60% of total catch and the depth was >200 m.

7 Greater silver smelt

7.1 Stock description and management units

The current ICES structure for greater silver smelt is that ICES Subareas I, II, IV, VI, VII, VIII, IX, X, XII and XIV and Divisions IIIa and Vb, are treated as a single assessment unit. Only the greater argentine around Iceland (Division Va) is treated as a separate assessment unit.

During the WKDEEP 2010 meeting (Benchmark), acknowledged that there was considerable uncertainty over stock structure in the Northeast Atlantic and recommended for further appraisal:

- Oceanographic conditions;
- Genetic characteristics;
- Morphometric and meristic characters.

Landings of greater silver smelt in NE Atlantic are shown in Figure 7.1.1.

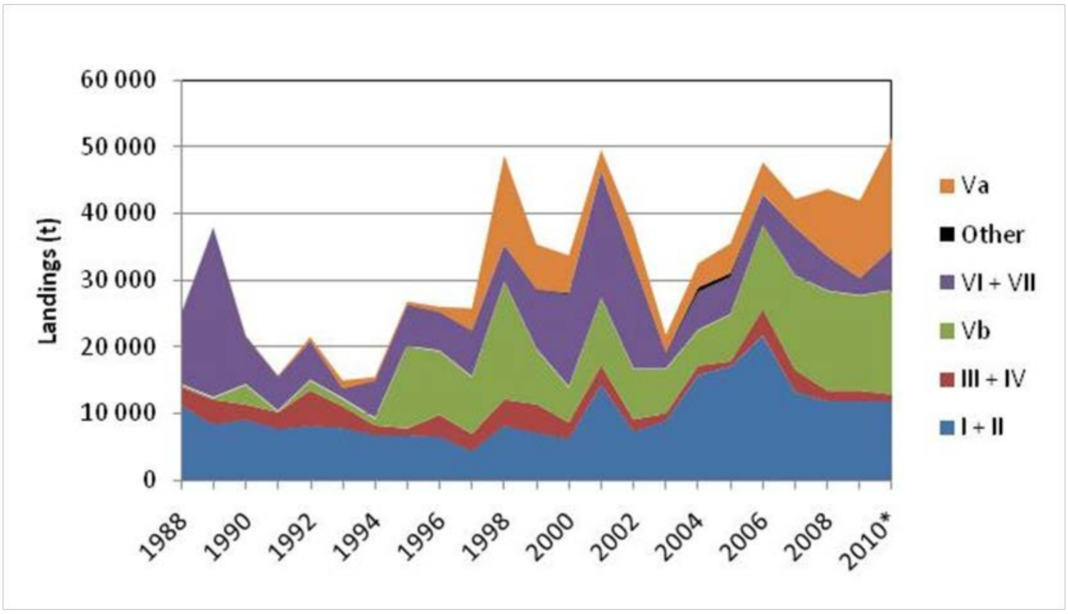


Figure 7.1.1. Landings of greater silver smelt in the NE Atlantic, by ICES areas.

7.2 Greater silver smelt (*Argentina silus*) in Division Va

7.2.1 The fishery

Greater silver smelt is mostly fished along the south and southwest coast of Iceland, at depths between 500 and 800 m. Greater silver smelt has been caught in bottom trawls for years as 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. 7.2.1).

7.2.1.1 Fleets

Since 1996 between 20–36 trawlers have annually reported catches of greater silver smelt in Va (Table 7.2.1). 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.

The number of hauls has varied greatly but the number of hauls seems to be increasing in recent years. Number of hauls peaked in 2010, similar number of hauls were reported in 2011 and 2012 as in 2009. 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 7.2.2).

Table 7.2.1. 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

7.2.1.1 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 7.2.2).

Table 7.2.2. 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	LING	BLUE LING	OTHER
	S. marinus	*S. mentella*	halibut			
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

Spatial distribution of catches through time

Spatial distribution of catches in 1996–2012 is presented in Figures 7.2.1 and 7.2.2. 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 northwestern 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 7.2.1 and 7.2.2).

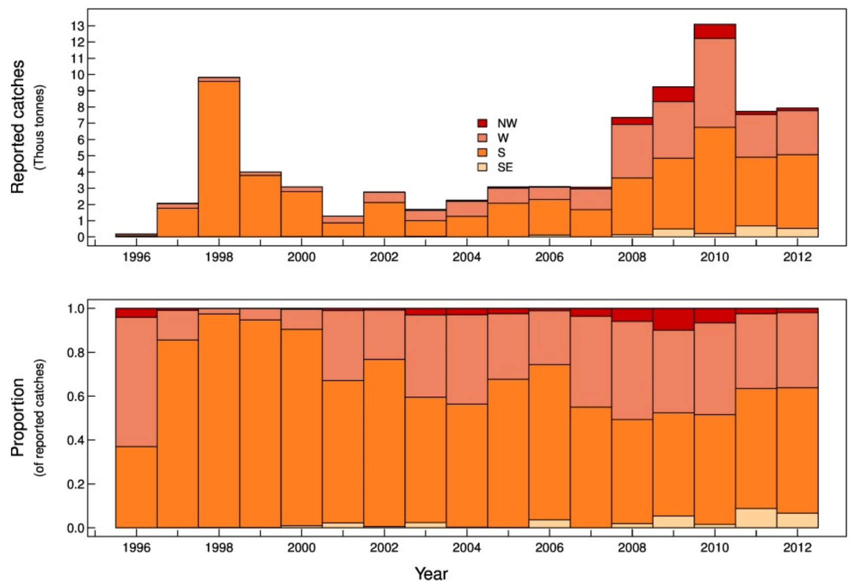


Figure 7.2.1. Greater silver smelt in Va. Catches defined by survey regions deeper than 400 m by year (See stock annex for details). Above are the catches on absolute scale and below in proportions.

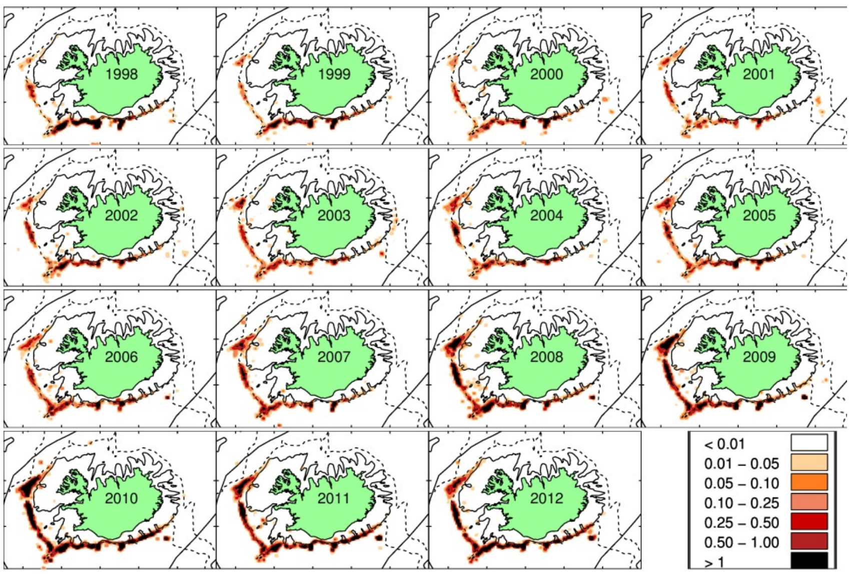


Figure 7.2.2. Greater silver smelt in Va. Spatial distribution of catches as reported in logbooks.

7.2.2 Landings trends

Landings of Greater Silver Smelt are presented in Table 7.2.1 and Figure 7.2.3. 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 2012 amounted to approximately 9300 tonnes.

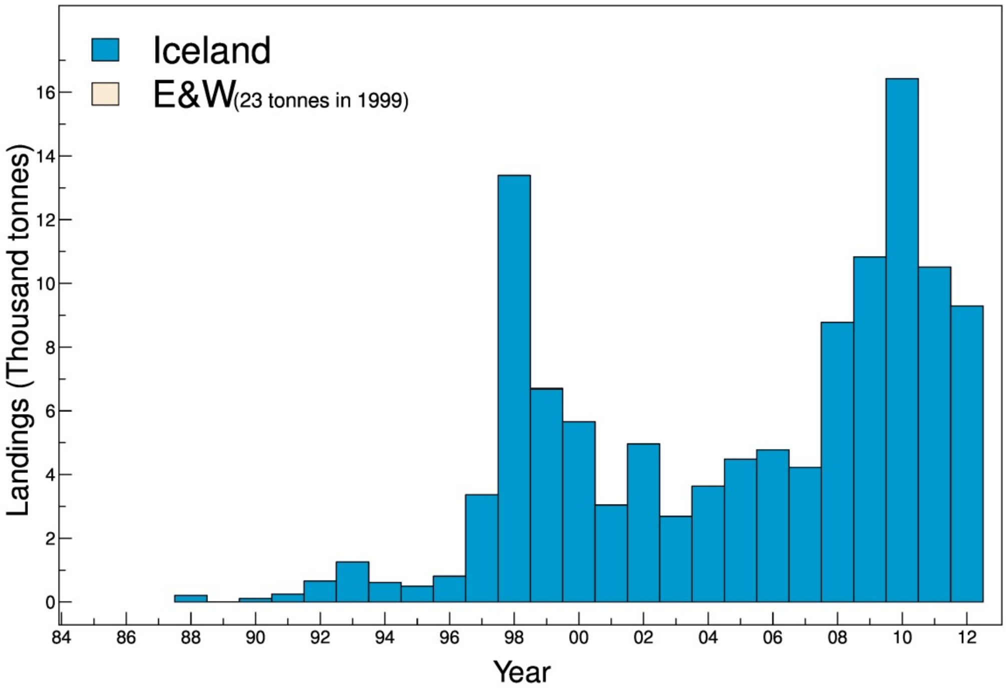


Figure 7.2.3. Greater silver smelt in Va. Nominal landings.

7.2.3 ICES Advice

The ICES advice for 2013 and 2014 is: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 3700 tonnes..

7.2.4 Management

The greater silver smelt fishery is at present not managed by quotas but rather as an exploratory fishery subject to licensing since 1997. Detailed description of regulations on the fishery of greater silver smelt in Va is given in the Stock Annex.

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).

7.2.5 Data available

7.2.5.1 Landings and discards

Landings by Icelandic vessels are given by the Icelandic Directorate of Fisheries. Discarding is banned in Icelandic waters and currently there is no available information on greater silver smelt discards. It is however likely that unknown quantities of greater silver smelt were discarded prior to 1996.

7.2.5.2 Length compositions

Table 7.2.3 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 7.2.4.

7.2.5.3 Age compositions

Table 7.2.3 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 7.2.5.

Table 7.2.3. 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

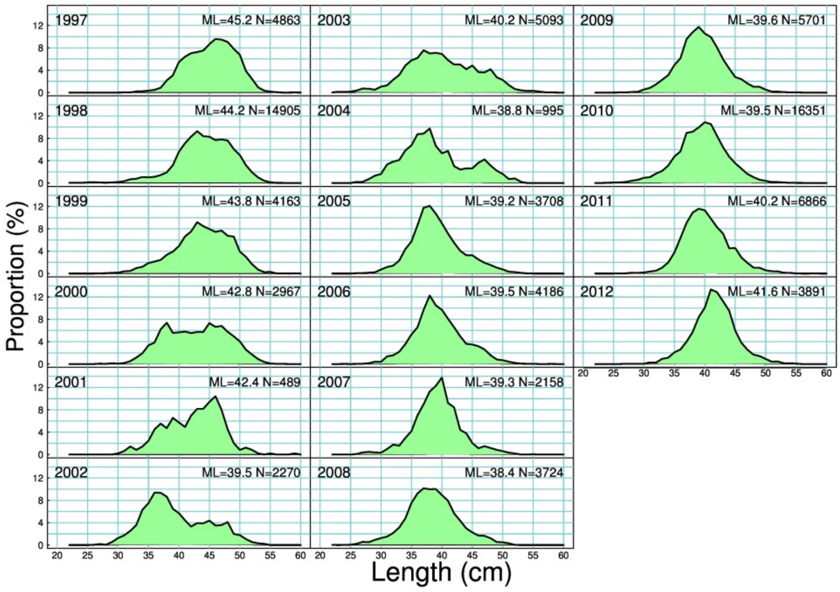


Figure 7.2.4. Greater silver smelt in Va. Length distributions from commercial catches.

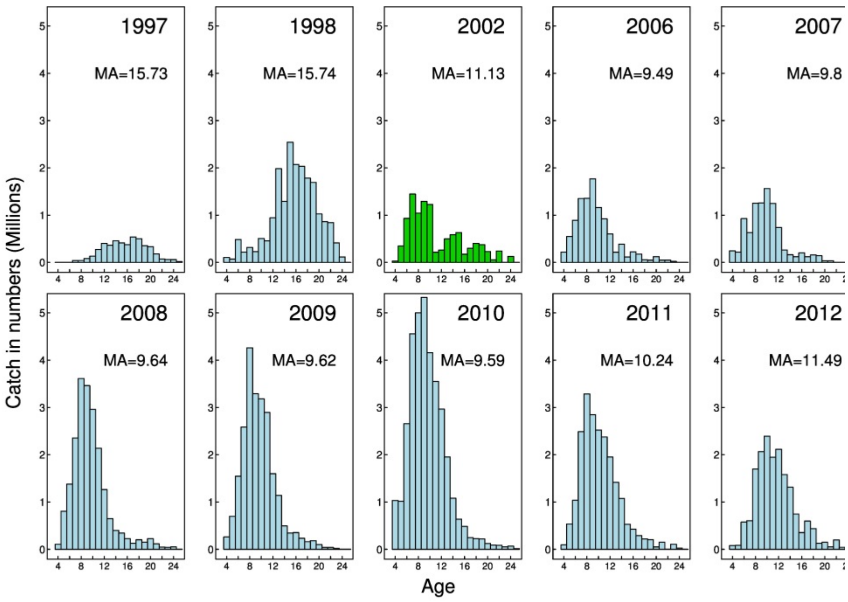


Figure. 7.2.5. Greater silver smelt in Va. Catch in numbers. Estimates for 2002 are based on limited number of aged otoliths (See Table 7.2.3).

7.2.5.4 Weight-at-age

No marked changes can be observed in mean weight-at-age from commercial catches between 1997–1998 and 2006–2012.

7.2.5.5 Maturity and natural mortality

Estimates of maturity ogives of greater silver smelt in Va were presented at the WKDEEP 2010 meeting for both age and length (WKDEEP-2010-GSS-04) using data collected in the Icelandic autumn survey (See 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 is mature.

No information exists on natural mortality of greater silver smelt in Va.

7.2.5.6 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 ground-fish survey is given in the stock annex for greater silver smelt in Va. The survey is considered representative of stock biomass of greater silver smelt since it was expanded in 2000. Figure 7.2.6 gives trend in biomass and juvenile abundance for the spring survey in 1985 to 2012 and for the autumn survey in 2000 to 2012. 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 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 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. The index for depth greater than 400 meters is assumed to be the best available indicator of the available biomass to the fishery (Figure 7.2.7).

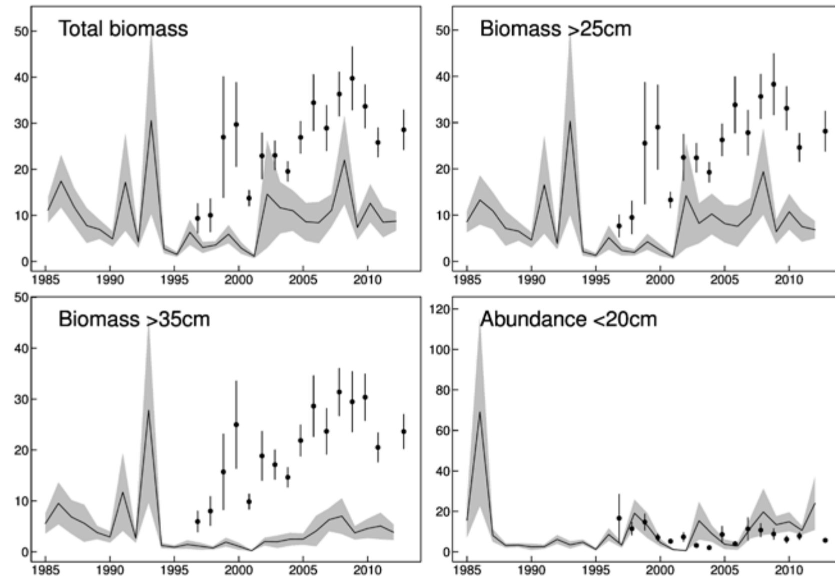


Figure 7.2.6. Greater silver smelt in Va. Indices from the Icelandic spring survey (black lines and shaded area) and from the autumn survey (dots and vertical lines). Vertical lines and shaded area represent +/- 1 standard error.

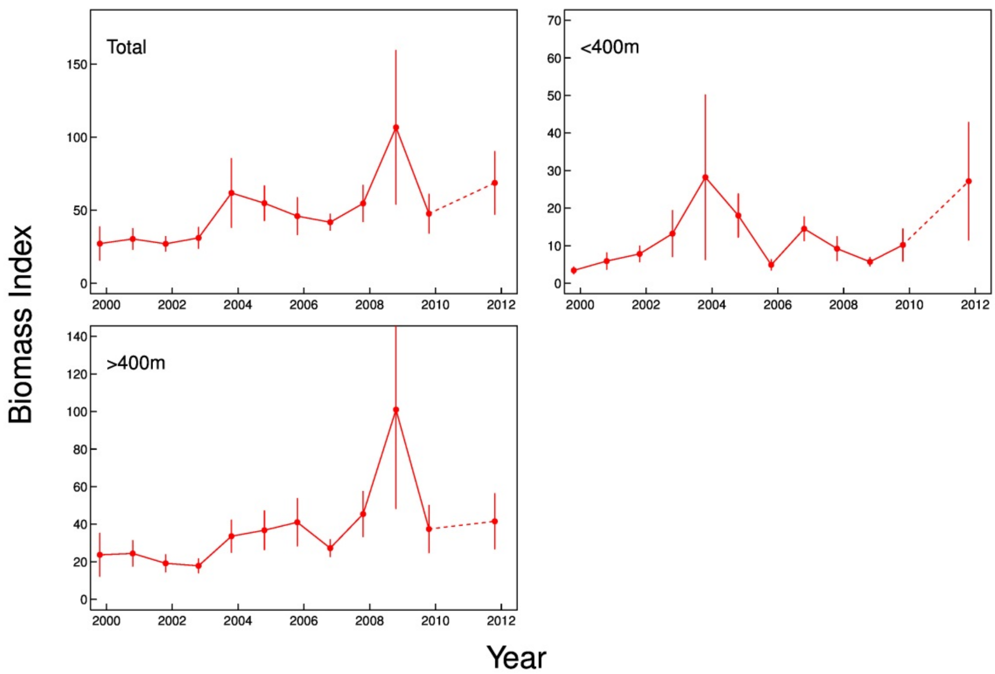


Figure 7.2.7. Greater silver smelt in Va. Index from the Icelandic autumn survey, divided by depth.

7.2.6 Data analyses

Spatial distribution of catches did not change markedly between 2011 and 2012 and fishing for greater silver smelt in the NW area seems to have stopped (Figures 7.2.1

and 7.2.2). 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 9000 tonnes in 2012 (Figure 7.2.3 and Table 7.2.4). 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 (Figure 7.2.4). 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 (Figure 7.2.5). The reason for this change is not known as there is no marked difference in the spatial distribution of the fishery.

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 survey have high CVs. The spring survey biomass indices are characterized by occasional spikes in the indices without any clear trend. 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 2010 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 (Figure 7.2.6).

The observed trends in the biomass indices from the autumn survey have a considerably different trends than those observed in the spring survey (Figure 7.2.6). 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 shows a slight increase in 2012, compared to 2010. In some sense the autumn survey has similar trends in juvenile abundance as the spring survey.

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 greater than 400 meters the autumn survey index for depth greater than 400 meters is considered the best indicator of available biomass to the fishery. This index does not seem to have changed much between 2010 and 2011 (Figure 7.2.7).

Changes in relative fishing mortality (F_{proxy} = Yield / Survey biomass) are presented in Figure 7.2.8. 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 because of decrease in catches as the index was at similar levels between the two years (Figure 7.2.7).

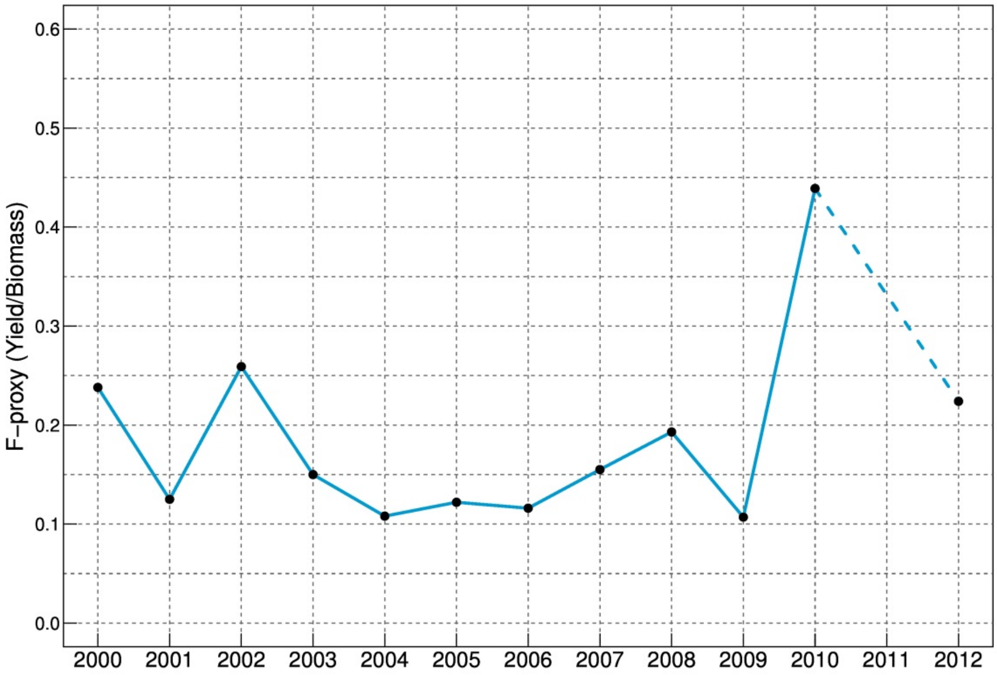


Figure 7.2.8. Greater silver smelt in Va. Changes in relative fishing mortality (F_{proxy}). The index used is the >400 m index from the Icelandic autumn survey.

Analytical assessment

An exploratory stock assessment of greater silver smelt in Va using the Gadget model was presented at the WGDEEP 2012 meeting. In general the model followed the trends observed in the survey data but the model seemed to be driven mainly by the age-structured data as it captured the shifts in the age distribution observed in the commercial catches. According to the model SSB increased from 18 kt in 1982 to little below 40 kt in 1998 when it decreased to similar levels in 1999 to 2003 as in 1982. This drop coincided with the start of the targeted fishery in the late nineties. In 2008 to 2010 the SSB had reached similar levels as in 1995 to 1997, a slight drop was observed in estimates of SSB in 2010. Estimates of fishing mortality for fully selected age groups (age 15 to 22) showed a rapid increase in 1997 to 1998 from virtually zero to 0.5 but then a decline to 2007. According to the forward projections from the model catch levels should have been set at 8.7 kt in 2013.

The Gadget model can be viewed as general framework for utilizing all available data and as such can detect inconsistencies in the data often ignored in other models which make much stronger assumptions about stock dynamics such as stock production models. In general the exploratory Gadget model did seem to capture the main trends in the data, i.e. trends in mean length and age but had problems with the survey indices. That does not have to come as a surprise due to the high CV in the indices. The model did seem to follow the age structured data quite well. The model was not run before or at the WGDEEP 2013 meeting in spite of it being promising further work is needed before its estimates can be used as basis for advice.

7.2.7 Comments on the assessment

Due to the industrial action in October 2011 which resulted in the autumn survey being cancelled after only surveying the western part of the survey area the assessment as described in the stock annex could not be conducted. Therefore WGDEEP 2012 decided to base the assessment on the available data (trends in length and age distributions, survey indices (spring and partial autumn survey), along with the results of the exploratory gadget assessment. This year results from the 2012 autumn survey do not indicate any significant changes in the biomass of the exploitable part of the stock.

7.2.8 Management considerations

Exploitation of greater silver smelt has been at high levels for the last five years. The evidence from the available data indicates that this high exploitation rate may be in excess of the stocks productivity but according to the available data i.e. indices, length and age distributions there are no marked changes in the last four to five years. However there is a need for more responsive management measures than have been used in the past.

7.2.9 Response to technical minutes

General comments: The main comment by the RG relate to lack of presentation of the Gadget model settings and results. In most ways the comment is fully justified. At the time of WGDEEP 2012 the model was (and still is) at an exploratory state but was 'upgraded' by the EG in response to the move by ACOM to have the assessment being run by other entities than the EG. Fortunately these plans of ACOM never materialized.

Technical comments

1) Table 7.2.3. Yes it refers to hauls where GSS was more than 50% of the catch.

2) The fishery is controlled by external factors and the EG therefore does not present estimates of cpue. The RG says that this argument holds true for many other stocks. The EG does not see the point with this comment.

3) The RG asks why the EG claims that the spring survey is not considered representative of total biomass but may be so for recruitment estimates. This is because the adult part of the GSS in Va (and elsewhere) is in deeper waters than is covered by the spring survey. The later part of this comment is on why in spite of small mesh sizes the commercial catch has no small fish in the catches. This is because fishing for GSS is banned in waters shallower than 400 meters.

4) Comment of 7.2.6 is on how selectivity is modelled in the Gadget model. The comment is mostly justified and will be taken into consideration in future attempts to estimate biomass of GSS in Va.

Conclusions: The RG is a bit surprised that the EG claims it could not follow the assessment procedure outlined in the SA. This comment appears similarly surprising to the EG as the main data used for the assessment (results of the 2011 autumn survey) were not available. The fact that GSS is long lived does not have any bearing on the fact that exploitation has increased rapidly in recent years, which has been of considerable concern to the EG and ACOM in recent years.

Table 7.2.4. Greater silver smelt in Va. Nominal landings in 1988–2012.

Year	Landings
1988	206
1989	8
1990	112
1991	247
1992	657
1993	1255
1994	613
1995	492
1996	808
1997	3367
1998	13 387
1999	6704
2000	5657
2001	3043
2002	4960
2003	2686
2004	3637
2005	4481
2006	4775
2007	4226
2008	8778
2009	10829
2010	16428
2011	10515
2012	9290

7.3 Greater silver smelt (*Argentina silus*) in I, II, IIIa, IV, Vb, VI, VII, VIII, IX, X, XII, XIV

7.3.1 The fishery

Significant fisheries occur in Subareas I to VII; other areas have only minor bycatch of this species. Presently the main actors in direct fisheries are Faroese fleets in Vb and VIa, Norwegian fleets in IIa2 and Dutch fleets in VIa. The Faroese and Norwegian landings in Areas Vb, VI, VII and IIa together have since 2005 represented 80–90% of the total landings from this stock; the Dutch landings from Area VI and VII represent most of the rest of the total landings.

The landings from Areas III and IV are minor; currently represented as bycatches from reduction fisheries targeting other species (mainly blue whiting and Norway pout). The Norwegian targeted human consumption fishery in IIIa that developed in the 1970s was always minor and has ceased. Officially reported landings from Division IVa and IIIa in 2011 and 2012 were 585 t and 350 t, respectively. Previously dockside estimates made by Norwegian inspectors estimated these additional landings to a few hundred tonnes per year, but currently there is some uncertainty with regards to the accuracy of the recording of landings from these mixed fisheries. Compared with the 1980s to mid-2000s, current relevant reduction fisheries are minor.

7.3.2 Landings trends

Preliminary figures for total landings in 2012 are 29 027 t (Tables 7.3.1 and 7.3.2, Figure 7.3.1). Landings in Area I and II, mainly conducted by Norway, were reduced in 2007 as a response to management to stabilise around 12 000 t and preliminary numbers for 2012 landings are at that level.

Landings in Vb increased rapidly from 2004 (5300 t) to 2006 (12 400 t) and further increased with landings in 2011 being 15 586 t. Preliminary numbers for landings in 2012 show substantial reduction to 9854 t. These landings are mainly from the Faroese directed fisheries. The reason for this change is believed to result from a shift in the fishery to other target species.

The landings in VI and VII were increased and had maximum of 19 049 t in 2001; then decreased again and have been between 5500 and 7500 since 2004. These landings mainly come from Faroese and Dutch fisheries. Preliminary landings in 2012 are 6065 t.

It should be noted that *Argentina sphyraena* may in some areas have been included in the landing figures.

7.3.3 ICES Advice

ICES advice in 2011was: "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 advises that catches should be no more than 31 300 tonnes.

7.3.4 Management

For a period after 1983 a precautionary unilateral annual TAC applied in IIa, but the landings never exceeded the quota and this regulation was abandoned in 1992. In 2007 a 12 000 tonnes TAC was introduced as a precautionary measure to reduce an increase in the fishery. This TAC has been the same 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.

There is no species-specific management of greater silver smelt in Vb, except minimum landing size (28 cm) and a licensing system. At present licenses are issued to three pairs of pair-trawlers.

The EU introduced TAC management in 2003. For 2010 the EU TAC is set to 6488 t (I and II = 111 t; III and IV = 1278 t; V, VI and VII = 5099 t) and for 2011 the EU TAC is set to 5979 t (I and II = 103 t; III and IV = 1176 t; V, VI and VII = 4691 t).

For 2012 the EU TAC is set to 5492 t which is a 8% decrease from 2011 level (I+II =95 t; III+IV = 108 t; V, VI, VII = 4316 t).

For 2013 the EU TAC is set to 5434 t which is close to the 2012 level (I+II =90 t; III+IV = 1028 t; V, VI, VII = 4316 t).

7.3.5 Data available

7.3.5.1 Landings and discards

Landings data are presented by area and countries (Tables 7.3.1 and 7.3.2, Figure 7.3.1).

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 was available on discards in Basque country and Spanish fisheries in Subareas VI–VII, and Divisions VIIIabcd and northern IXa (Table 7.3.3 and Figure 7.3.15). These estimates have been in the range 1000–4000 t since 2003. In 2010 and 2011 they were around 2000 t. Final estimates are not available for 2012. 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.

7.3.5.2 Length compositions

Length distributions from the Norwegian fisheries in IIa from 2009–2012 are presented in Figure 7.3.2.

Length compositions from Faroese commercial catches are presented in Figures 7.3.3. Mean length for the mature and immature greater silver smelt from the Faroese spring and summer surveys for cod, haddock and saithe are presented in Figure 7.3.12.

Recent investigations have revealed that survey catches from the Spanish Porcupine survey contain both *A. Silus* and *A. Sphyraena* (Figure 7.3.4). Length compositions from Spanish groundfish survey since 2009 to present split on species *A.silus*/*A.sphyraena* are presented in Figure 7.3.5. The size compositions of *Argentinas* spp. from Porcupine survey since 2001 is presented in Figure 7.3.22 (Velasco *et al.*, WD WGDEEP 2013). Length composition of Greater silver smelt from Russian commercial bottom trawl catches in the Faroese FZ in April-May 2012 are shown in Figure 7.3.13.

Length distributions from the Norwegian slope survey in March 2012 are shown in Figures and 7.3.18 and 7.3.19 (Hallfredsson and Heggebakken, WD ICES WGDEEP 2013).

Length distributions in samples from Spanish discards in Subareas VI–VII and Divisions VIIIabcd and northern IXa are shown in Figure 7.3.16.

7.3.5.3 Age compositions

Age compositions from Norwegian catches and Faroese landings are presented in Figures 7.3.7 and 7.3.6. Age distributions from the Norwegian slope survey in March 2012 are shown in Figures 7.3.20 and 7.3.21.

7.3.5.4 Weight-at-age

No new data on weight-at-age were presented.

7.3.5.5 Maturity and natural mortality

Maturity of greater silver smelt from Russian commercial bottom-trawl catches in the Faroese FZ in April–May 2012 are shown in Figure 7.3.14 No new data on natural mortality were presented.

7.3.5.6 Catch, effort and research vessel data

Cpue indices for greater silver smelt from the annual Faroese groundfish surveys for cod, haddock and saithe in Vb are shown in Figure 7.3.8. (Ofstad, WD01 WGDEEP 2013).

Logbooks from three pairs of pair trawlers (>1000 HP) fishing greater silver smelt in Faroese waters (Area Vb) are available. Standardised cpue indices for greater silver smelt from different pairs of pair trawlers are shown in Figure 7.3.9.

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*. Abundance and biomass indices from survey catches of mixed *A. silus* and *A. sphyraena* is presented in Figure 7.3.11.

An acoustical survey was conducted 17 March to 10 April in 2012 along the continental slope in Norwegian EEZ from 62-74° N (Hallfredsson and Heggebakken, WD ICES WGDEEP 2013). This survey is planned to run biennially and 2012 is the second time the survey is carried out. Highest densities of greater silver smelt in 2012 were found in similar areas as in 2009 on the continental slope off central Norway (Figure 7.3.17). Total acoustic biomass estimates 2009 and 2012 surveys are shown in Table 7.3.4.

7.3.6 Data analyses

Landings have increased from the whole stock area since 1994 but have been stable at level between 30 000–35 000 tonnes since 2007 for the main fisheries in Areas IIa, Vb and VI+VII. Size and age in catches have decreased but seem to have been stable recently. The Norwegian landings are around the TAC set to 12 000 tonnes. Landings trends in this period may therefore not be indicative of stock abundance.

Norwegian size and age distributions from fisheries (Figures 7.3.2 and 7.3.7) 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 7.3.3, 7.3.19 and 7.3.20) 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 (Figures 7.3.18 and 7.3.21).

The size compositions from Porcupine Bank have no obvious trend towards smaller fish but these data may by disturbed by the relative species composition *A. silus* and *A. sphyreana* (Figure 7.3.5).

Faroese length and age compositions from the landings have decreased since 1994–2000 and have been stable since then (Figures 7.3.3 and 7.3.6). The reason for the decrease in mean length 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 from the surveys into juvenile and mature individuals; to check if the trend in mean length changed over time (Figure 7.3.12). No change in trends for mean length is found for juveniles, while there is a slight decrease in mean length since the start of the series for mature fish.

For Subarea VII, abundances and biomass indices have been decreasing since 2002 and the species remains in low abundances compared with the high abundances found in the first years of the series (Figure 7.3.11).

The Faroese summer survey biomass index showed no strong trend between 1996 and 2011 (Figure 7.3.8). The survey cpue fluctuates. 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 the large changes in year values in the Faroese survey may be noise related. The relatively shallow depth range covered by the survey will likely result in poor sampling of adult fish as large individuals are generally found at greater depths.

There is an increasing trend across the time-series in the Faroese commercial cpue (Figure 7.3.9). The period from 1995 to 1997 can be treated as a "learning" period, i.e. the cpue is not believed to be proportional to abundance in those years.

7.3.7 Comments on the assessment

Advice is given every second year for this stock and last year's advice applies for present year.

New data from biennial survey in Norwegian waters are presented. These should be considered in next year's assessment.

7.3.8 Management considerations

Management advice for this stock was subject to further development after the 2012 WGDEEP meeting under the WKLIFE process.

The trends from Faroese analysis and those from the Porcupine bank are contradictory. However, the trends are not dramatic. Population characteristics from Norwegian fisheries data are not showing negative trends in recent years. Population characteristics from Norwegian fisheries 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 further estimates are needed before this can be fully interpreted as trend.

FAMRI has recommended a TAC of 18 thousand tons in Faroese waters of Vb for 2012, since the current assessment may not be stable enough to provide reliable estimates.

Response to technical minutes

Technical comments

Figure 7.3.12 text says no trend but it looks like a decrease in mean length since the start of the series for mature fish. This is now corrected.

7.3.6 Insufficient presentation of the input, conditioning, outputs and diagnostics of the XSA run. No exploratory XSA assessment is presented this year.

7.3.7 Please do not refer to figures in a WD, the report needs to stand as a body of evidence in its own right so transfer relevant figures. No references are now to figures in WDs.

Conclusions

The Vb indices indicate no decline in biomass in response to the fishery taking about 15 kt in that area. Although the mean age in the catch has reduced somewhat over time and the surveys show a decrease in mean length of mature fish over the same period, this may be expected as virgin biomass is exploited. It has not been possible to review the XSA exploratory assessment given what is presented in the report, so I cannot comment on the appropriateness or otherwise of the analyses. It is therefore not possible to comment on the sustainability of the current fishery, but precautionary considerations alone given the population productivity characteristics, would suggest that there is no basis for an expansion of the fishery. There are no indices for the Norwegian sea but the 2011 catch data show very few fish above ten years and the most recent years LFDs show very few fish above 35 cm, unless the fish are unavailable to the fishery or have a very different growth rate to those further south, this indicates heavy exploitation in this area. On the European shelf margin indices show a decrease in biomass and abundance; could the decrease be related to increased vigilance in separating Silus and Sphyrenea species? Here it is know that the species is discarded from other trawl fisheries and this is not quantified. Given the uncertainty in total exploitation and the slow turnover rate in the population this is a concern.

These valuable comments in conclusions from 2012 Deep-sea Stocks Review Group should be revisited by WGDEEP in next advice year for the stock 2014.

Table 7.3.1. Greater Silver Smelt I, II, IIIa, IV, Vb, VI, VII, VIII, IX, X, XII, XIV. WG estimates of landings in tonnes. *) landings in 2012 are preliminary.

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

Year	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Iceland	TOTAL
1988			11 332	5	14					11 351
1989			8367		23					8390
1990		5	9115							9120
1991			7741							7741
1992			8234							8234
1993			7913							7913
1994			6217			590				6807
1995	357		6418							6775
1996			6604							6604
1997			4463							4463
1998	40		8221							8261
1999			7145			18				7163
2000		3	6075		195	18	2			6293
2001			14 357		7	5				14 369
2002			7405			2				7407
2003		575	8345		7	2	4	4		8937
2004		4235	11 557		4					15 796
2005			17 063		16			14		17 093
2006			21 681		4					21 685
2007			13 272		1					13 273
2008			11 876							11 876
2009			11 929							11 929
2010			11 831				23			11 854
2011			11 476							11 476
2012*			12 002					114	18	12 134

Table 7.3.1. (continued).

Greater silver smelt (*Argentina silus*) III and IV

Year	Denmark	Faroes	France	Germany	Netherlands	Norway	Scotland	Sweden	Ireland	TOTAL
1988	1062			1		1655				2718
1989	1322				335	2128	1			3786
1990	737			13		1571				2321
1991	1421		1		3	1123	6			2554
1992	4449			1	70	698	101			5319
1993	2347				298	568	56			3269
1994	1480					4	24			1508
1995	1061					1	20			1082
1996	2695	370				213	22			3300
1997	1332			1		704	19	542		2598
1998	2716			128	250	434		427		3955
1999	3772		82		7	5	452		2	4313
2000	1806		270			32	78	273	12	2471
2001	1653		28			3	227	1011	3	2925
2002	1161					1	161	484	4	1811
2003	1119				42	6	20		1	1188
2004	1036			4	320	17	12		46	1435
2005	733			1	28	11			18	791
2006	548					3468				4016
2007	243					3100				3343
2008	23	58				1548				1629
2009	6					1566				1572
2010	47					1034	10			1091
2011						585				585
2012*					49	350				399

Table 7.3.1. (continued).

Greater silver smelt (*Argentina silus*) Vb

Year	Faroes	Russia/USSR	UK (Scot)	UK(EWN)	Ireland	France	Netherlands	Norway	TOTAL
1988	287								287
1989	111	116							227
1990	2885	3							2888
1991	59		1						60
1992	1439	4							1443
1993	1063								1063
1994	960								960
1995	5534	6752							12 286
1996	9495		3						9498
1997	8433								8433
1998	17 570								17 570
1999	8186		15	23		5			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

Table 7.3.1. (continued).

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

Year	Faroes	France	Germany	Ireland	Netherlands	Norway	E&W	Scotland	N.I.	Russia	Spain	TOTAL
1988				5454		4984						10 438
1989	188			6103	3715	12184	198	3171				25 559
1990	689		37	585	5871			112				7294
1991		7		453	4723			10	4			5197
1992		1		320	5118			467				5906
1993					1168			409				1577
1994			43	150	4137			1377				5707
1995	1597		357	6	4136			146				6242
1996			1394	295	3953			221				5863
1997			1496	1089	4695			20				7000
1998			463	405	4696							5564
1999		21	24	394	8188			387		5		9019
2000		17	482	4703	3689			4965		29	34	13 919
2001		12	189	7494	3658			7620		76		19 049
2002			150	7589	4010			4197		29		15 975
2003			164	95	1958			89		163	7	2476
2004		147	652	46	3359			526		12	19	5761
2005	103	10	131	1	5276			75		4	19	5619
2006	53				4630							4683
2007	254				6976	3						7233
2008	991				4176	3				1		5171
2009				0.5	2501	83		7		36		2627
2010	3060			580	3724	7	3	20		11		7405
2011	3655			0.1	3729	1		2				7279
2012	2801		538	0.2	3248	10	5	5		1		6608

Greater silver smelt (*Argentina silus*) VIII

Year	Netherlands	TOTAL
2002	195	195
2003	43	43
2004	23	23
2005	202	202
2006		
2007		
2008		
2009		
2010		
2011	1	1
2012*		

Table 7.3.1. (continued).

Greater silver smelt (*Argentina silus*) IX

Year	Nederlands	Portugal	TOTAL
2006			
2007	1		1
2008		0.5	0.5
2009		2	2
2010		2	2
2011		0.9	0.9
2012*		1.9	1.9

Table 7.3.1. (continued).

Greater silver smelt (*Argentina silus*) XII

Year	Faroes	Iceland	Russia	Netherlands	TOTAL
1988					
1989					
1990					
1991					
1992					
1993	6				6
1994					
1995					
1996	1				1
1997					
1998					
1999					
2000		2			2
2001					
2002					
2003					
2004			4	625	629
2005				362	362
2006					
2007					
2008					
2009					
2010					
2011					
2012*		31			31

Table 7.3.1. (continued).

Greater silver smelt (*Argentina silus*) XIV

Year	Norway	Iceland	TOTAL
1988			
1989			
1990	6		6
1991			
1992			
1993			
1994			
1995			
1996			
1997			
1998			
1999			
2000		217	217
2001	66		66
2002			
2003			
2004			
2005			
2007			
2008			
2009			
2010			
2011			
2012*			

Table 7.3.2. Greater silver smelt (*Argentina silus*) (all areas).

Year	I + II	III + IV	Vb	VI + VII	VIII	IX	XII	XIV	Total
1988	11 351	2718	287	10 438					24 794
1989	8390	3786	227	25 559					37 962
1990	9120	2321	2888	7294				6	21 629
1991	7741	2554	60	5197					15 552
1992	8234	5319	1443	5906					20 902
1993	7913	3269	1063	1577			6		13 828
1994	6807	1508	960	5707					14 982
1995	6775	1082	12 286	6242					26 385
1996	6604	3300	9498	5863			1		25 266
1997	4463	2598	8433	7000					22 494
1998	8261	3955	17 570	5564					35 350
1999	7163	4313	8229	9019			2		28 726
2000	6293	2471	5209	13 919				217	28 109
2001	14 369	2925	10 081	19 049				66	46 490
2002	7407	1811	7471	15 975	195				32 858
2003	8937	1188	6558	2476	43				19 203
2004	15 796	1435	5310	5761	23		629		28 953
2005	17 093	791	7013	5619	202		362		31 080
2006	21 685	4016	12 559	4683					42 943
2007	13 273	3343	14 126	7233					37 975
2008	11 876	1629	14 952	5171	10	0.5			33 638
2009	11 929	1572	14 228	2627		1.9			30 358
2010	11 843	1091	15 609	6247		2.9			34 793
2011	11 476	585	15 586	7387	1	0.9			35 036
2012*	12 134	399	9854	6608		1.9	31		29 027

Tabel 7.3.3. Discard of greter silver smelt in Basque country (AZTI) and Spanish fisheries (IEO).

AZTE											
species	**ICES area/division**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Argentina silus	VI	298	89	31	57	194	68	81	127	2	53
	VII	16	1	17	9	13					
	VIIIabd	282	7	242	36	3					
IEO											
Species	**ICES area/division**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	
Argentina silus	Subareas VI-VII	2211	2978	2149	1147	1823	2988	4028	1878	2048	
cv		*64*	*44*	*62*	*40*	*55*	*34*	*36*	*36*	*90*	
Argentina silus	Divisions VIIIc,	0		0	0	6	5	0	0		
cv	North IXa			*100*		*88*	*64*		*100*		

Table 7.3.4. Abundance estimates (t) for Greater silver smelt in Norwegian slope surveys Mars 2009 and 2012. For methods see Harbitz, WD ICES WKDEEP 2010.

	2009	2012
Lat < 70 deg, depth >500 m	77 272	33 468
Lat < 70 deg, depth <500 m	57 897	79 624
Lat > 70 deg, depth >500 m	1642	5310
Lat > 70 deg, depth <500 m	2447	2961
Total	139 258	121 363

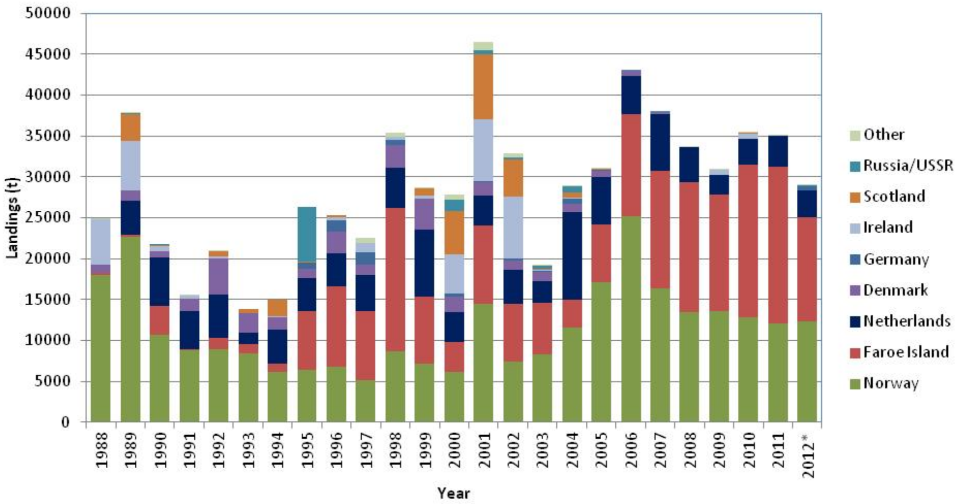


Figure 7.3.1. Total catches of greater silver smelt in I, II, IIIa, IV, Vb, VI, VII, VIII, IX, X, XII, and XIV by countries.

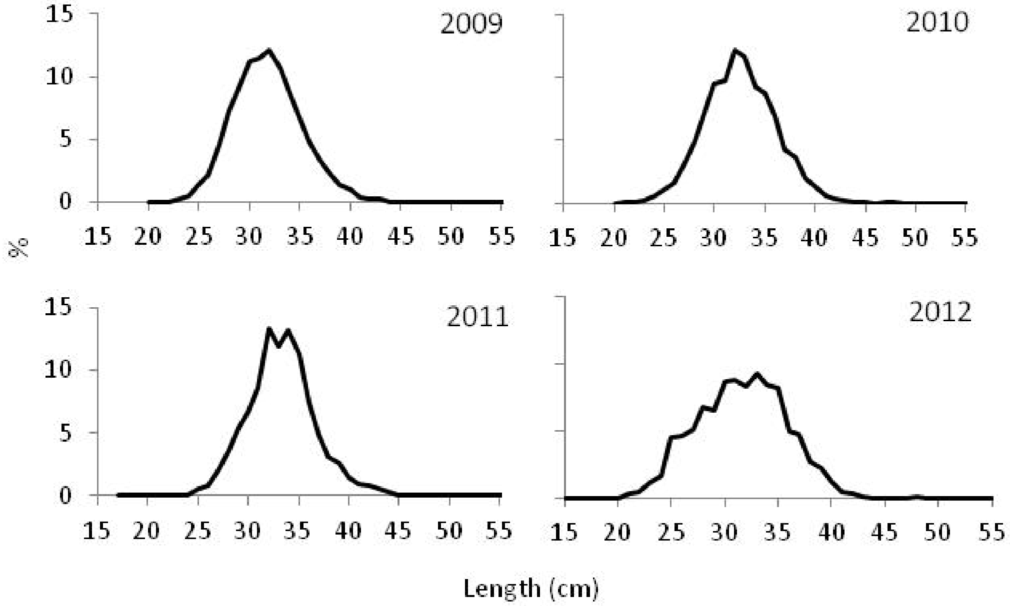


Figure 7.3.2. Ppercentage llength distributions from the Division IIa target fisheries. The distributions show percentage distribution for the sum of all samples per year, and are not weighted for spatial or temporal variation in catch. Thus they should not be used as fully representative distributions for the total commercial catch in a given year (Hallfredsson, 2013 WD, WGDEEP).

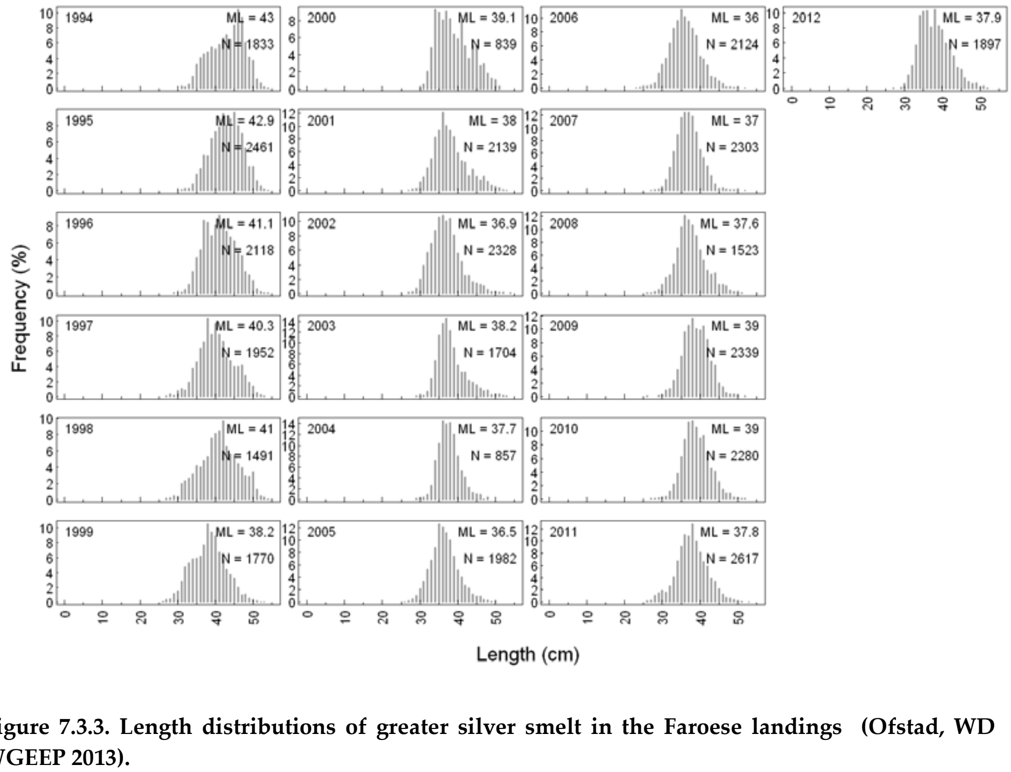


Figure 7.3.3. Length distributions of greater silver smelt in the Faroese landings (Ofstad, WD WGEEP 2013).

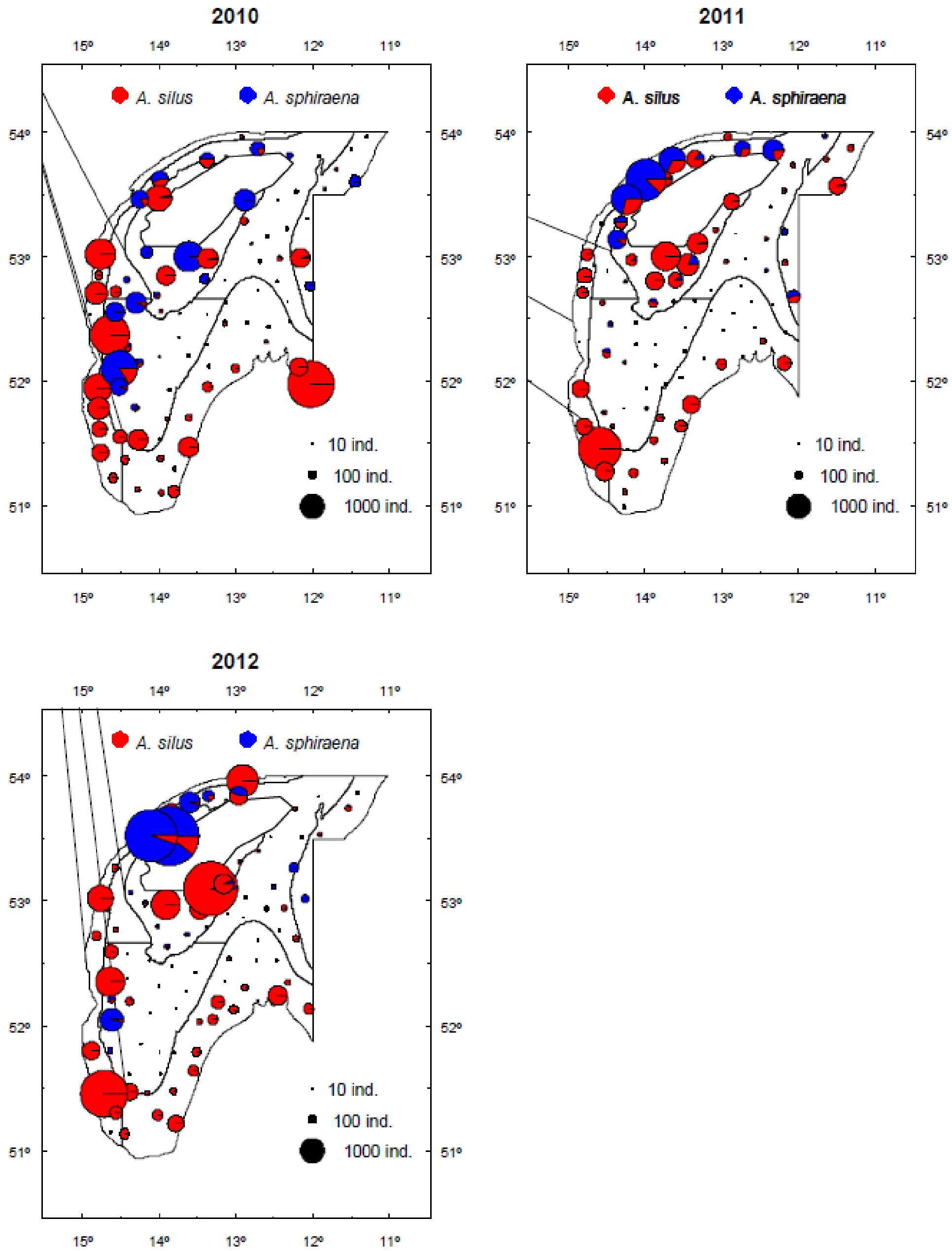


Figure 7.3.4. Distribution of *Argentina silus* and *A. sphyraena* by numbers during the 2010 Porcupine bank survey (Velasco *et al.*, 2013 WD, ICES WGDEEP 2013).

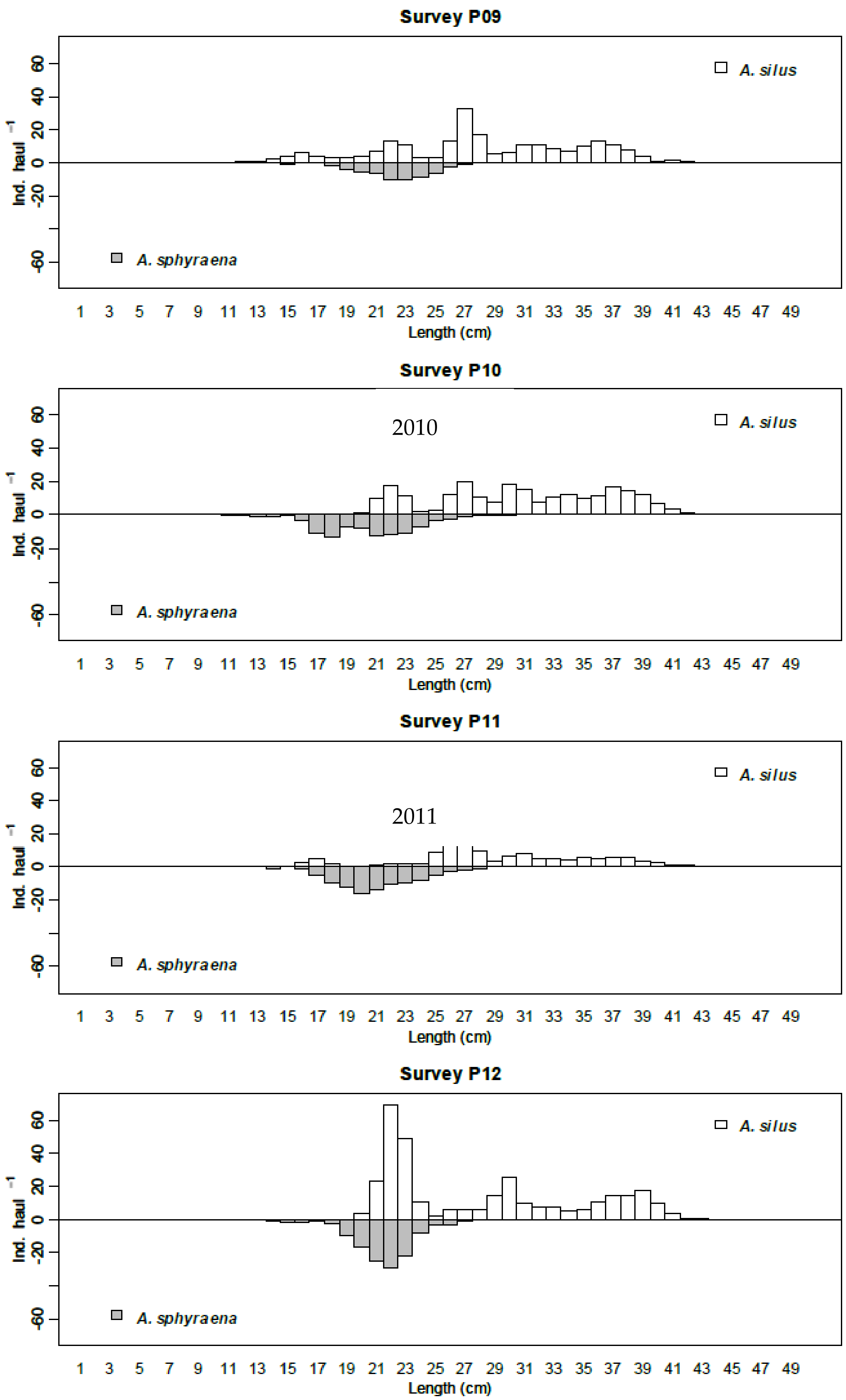


Figure 7.3.5. Mean stratified length distributions of *A. silus* and *A. sphyraena* in 2009–2012 in Spanish Porcupine surveys. (Velasco *et al.*, WD WGDEEP 2013).

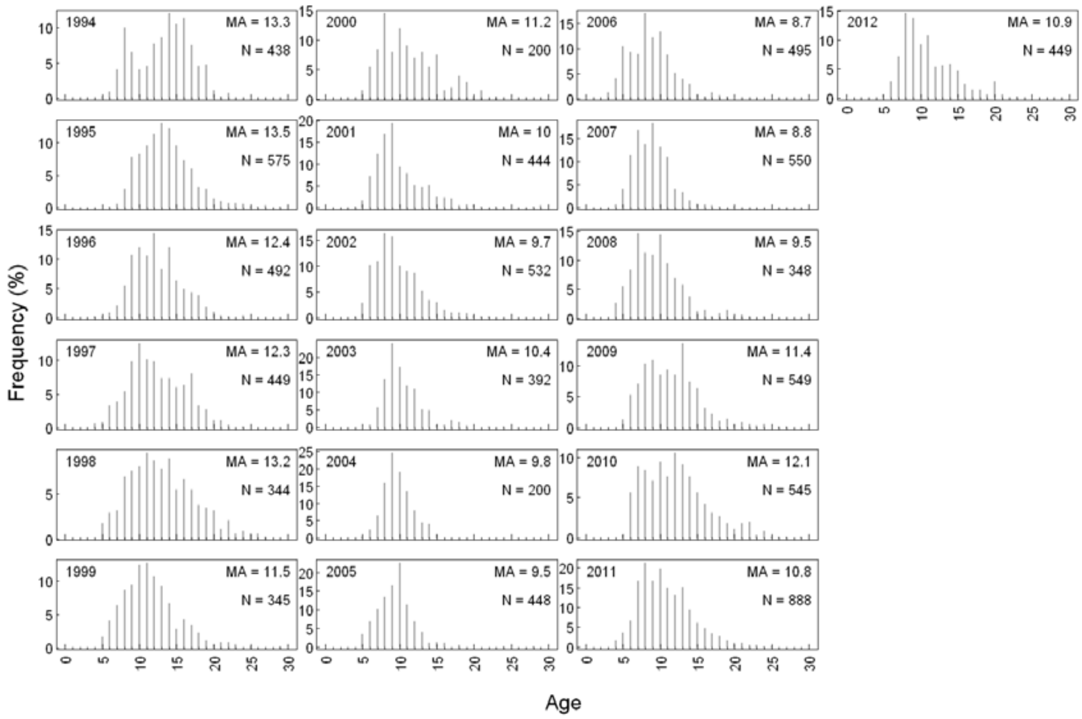


Figure 7.3.6. Age distributions of greater silver smelt in the Faroese landings 1994–2011 (Ofstad, 2013 WD, WGDEEP).

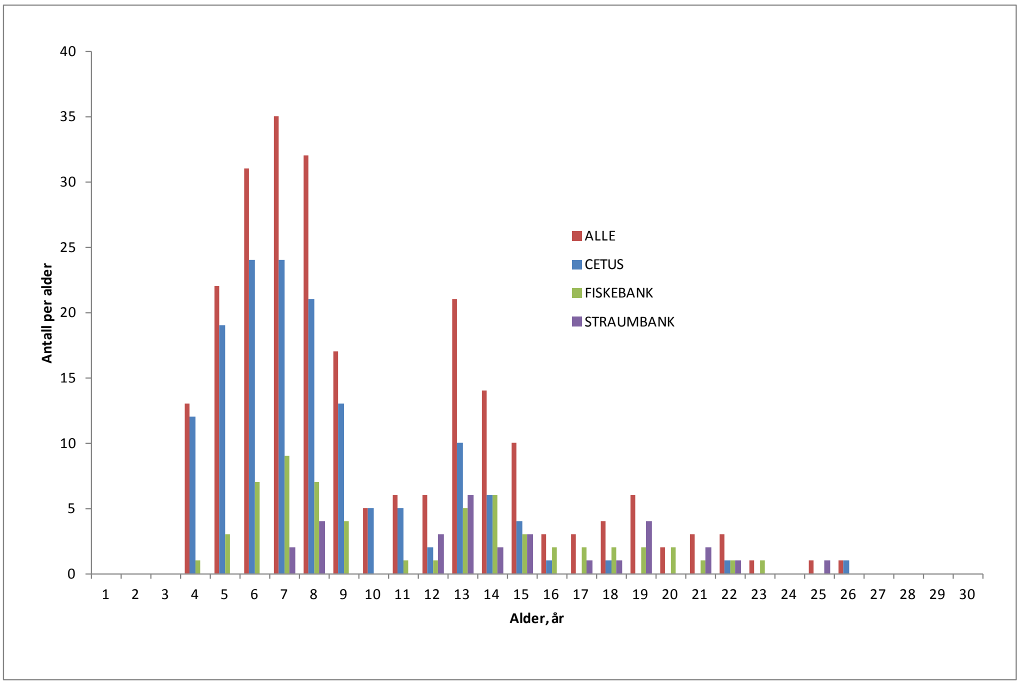


Figure 7.3.7. Age distributions of greater silver smelt from the Division IIa fisheries in 2011. These are data from individual samples (denoted by IMR serial number). Fishing areas are given in brackets (Hallfredsson, WD WGDEEP 2012).

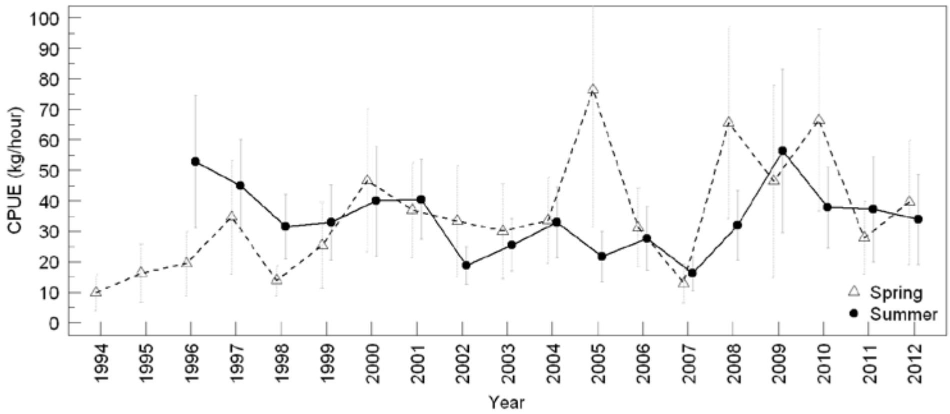


Figure 7.3.8. Standardized cpue from Faroese groundfish surveys. Arrows +- SE. (Ofstad, WD WGEEP 2013).

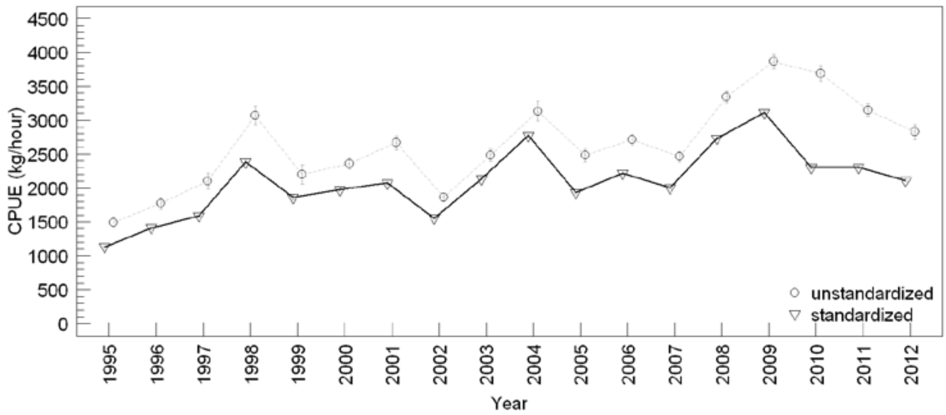


Figure 7.3.9. Standardized cpue from pair trawlers fishing greater silver smelt where catch of GSS is more than 50% of total catch in each haul (Ofstad, WD WGEEP 2013).

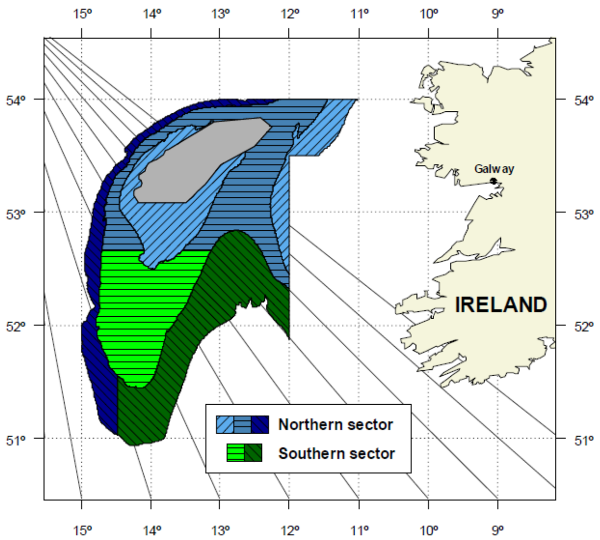


Figure 7.3.10. Stratification design used in Porcupine surveys from 2003. Depth strata are: A) shallower than 300 m, B) 301–450 m and C) 451–800 m. The grey area in the middle of Porcupine Bank corresponds to a large non-trawlable area, not considered for area measurements and stratification (Velasco *et al.*, 2013 WD, ICES WGDEEP 2013).

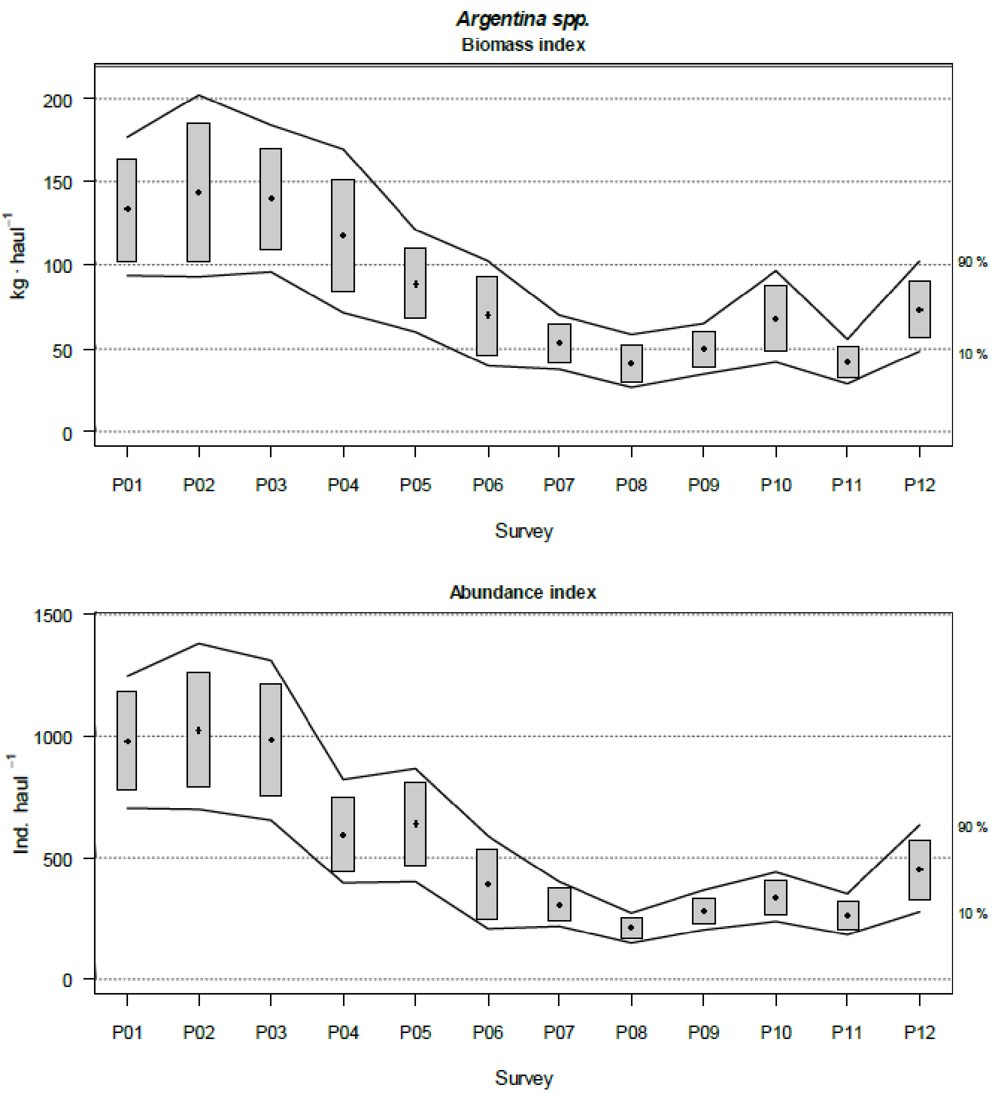


Figure 7.3.11. Changes in *Argentina* spp. (mainly *Argentina silus*) biomass and abundance indices during Porcupine Survey time-series. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000) (Velasco *et al.*, WD WGDEEP 2013).

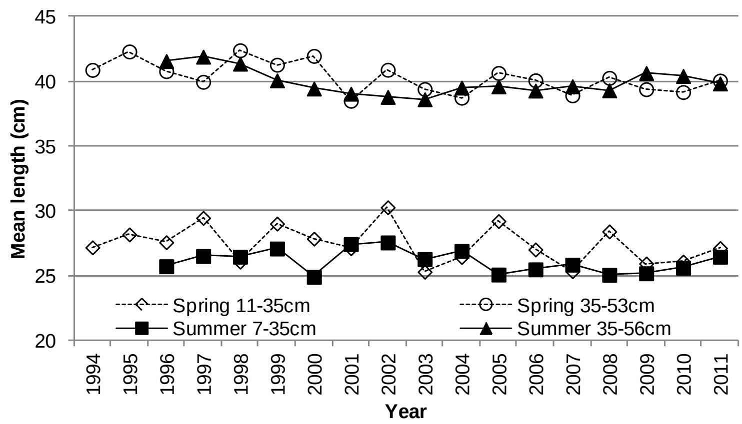


Figure 7.3.12. Mean length for juvenile (<35 cm) (top) and mature (>34.9 cm)(bottom) GSS from the groundfish surveys (Ofstad, WD WGEEP 2013).

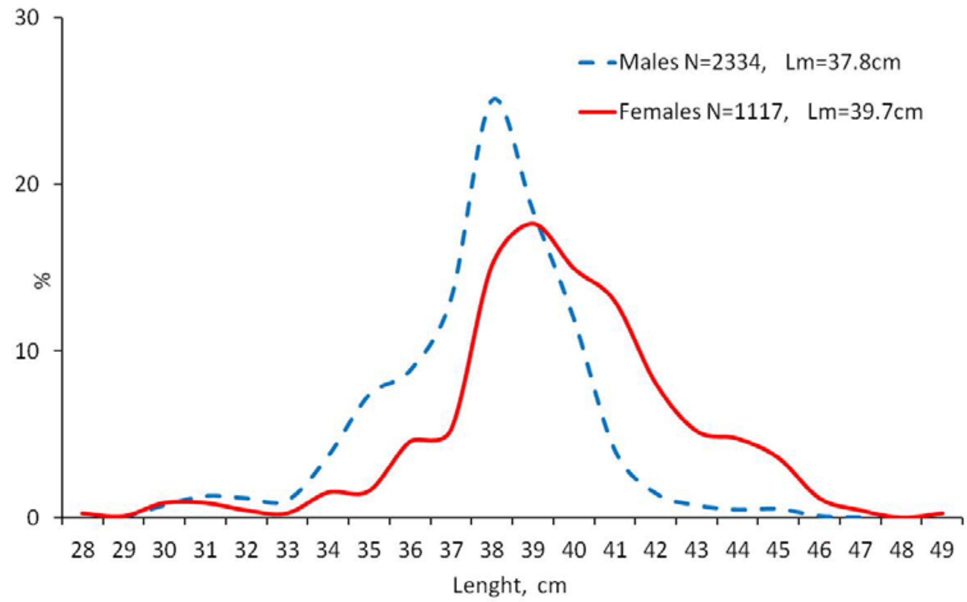


Figure 7.3.13. Length composition of greater silver smelt from Russian commercial bottom-trawl catches in the Faroese FZ in April–May 2012. Also shown are arrhythmic mean lengths (Lm).

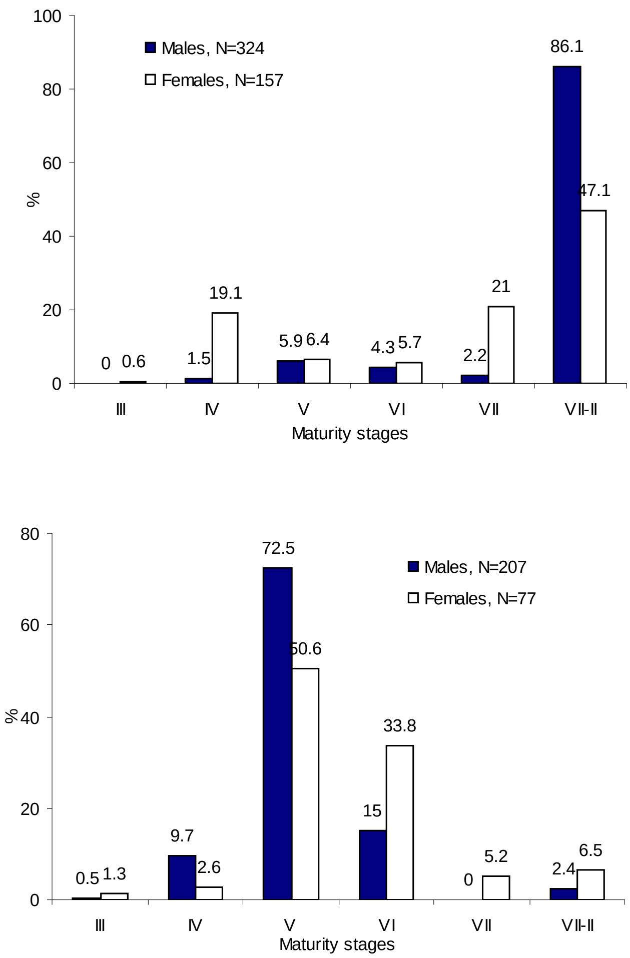


Figure 7.3.14. Maturity of greater silver smelt from Russian commercial bottom trawl catches in the Faroese FZ in April–May 2012 (upper panel- Lousy Bank, lower panel- Bill Bailey Bank).

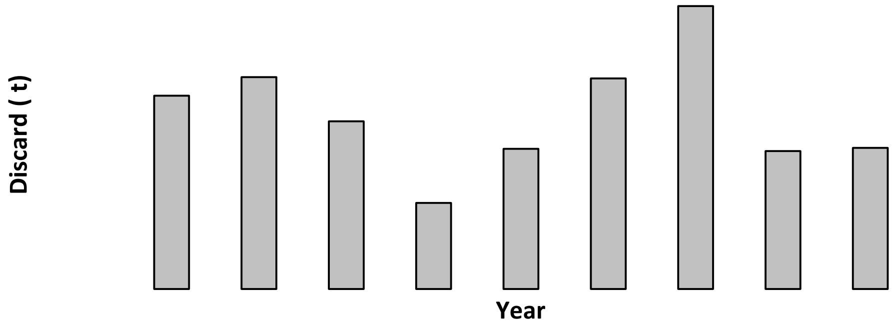


Figure 7.3.15. Estimated discard of greater silver smelt in Basque country (AZTI) and Spanish fisheries (IEO) in Subareas VI–VII, and Divisions VIIIabcd and northern IXa.

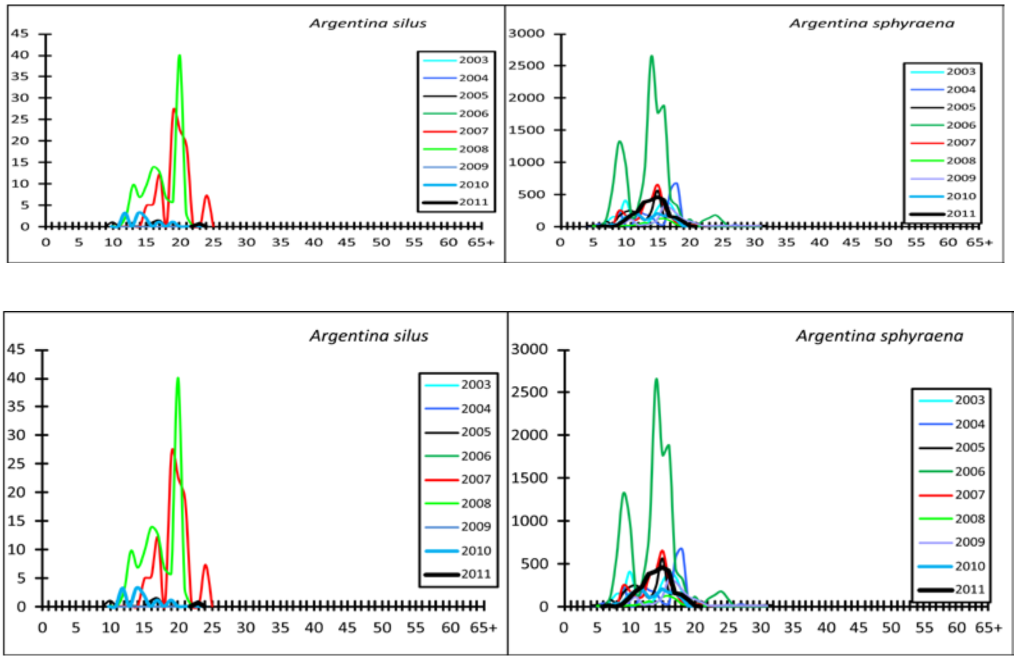


Figure 7.3.16. Length distributions in samples from Spanish discards in Subareas VI–VII (upper panels) and Divisions VIIIabcd and northern IXa (lower panels).

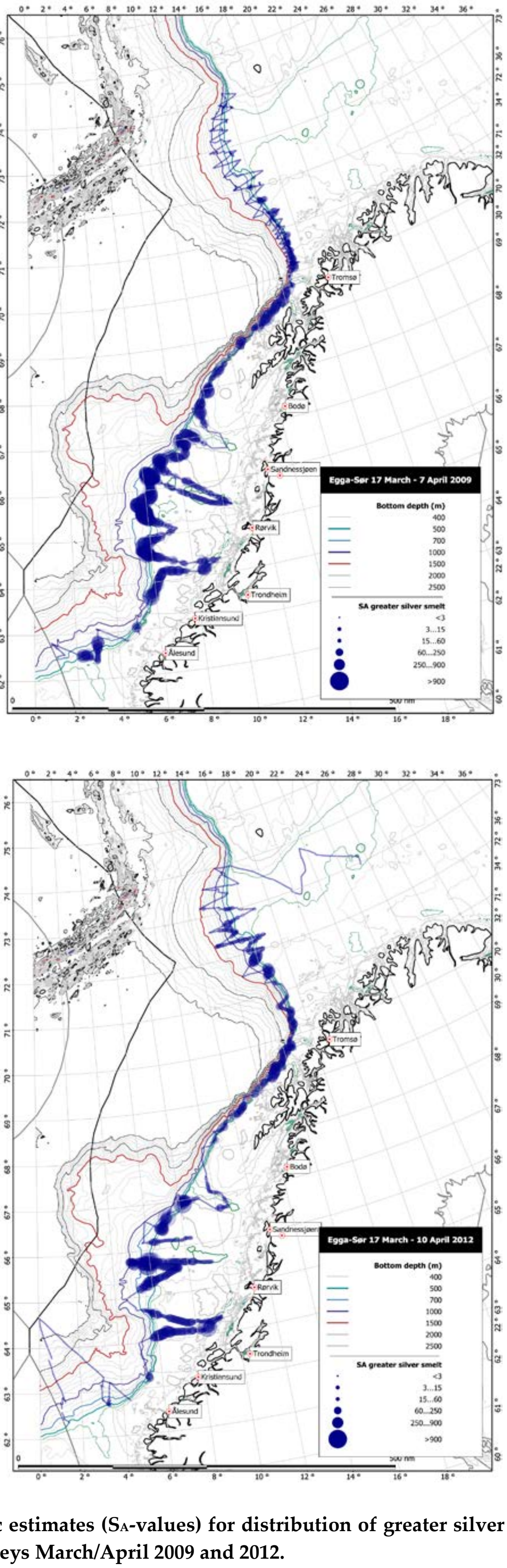


Figure 7.3.17. Acoustic estimates (SA-values) for distribution of greater silver smelt in Norwegian continental slope surveys March/April 2009 and 2012.

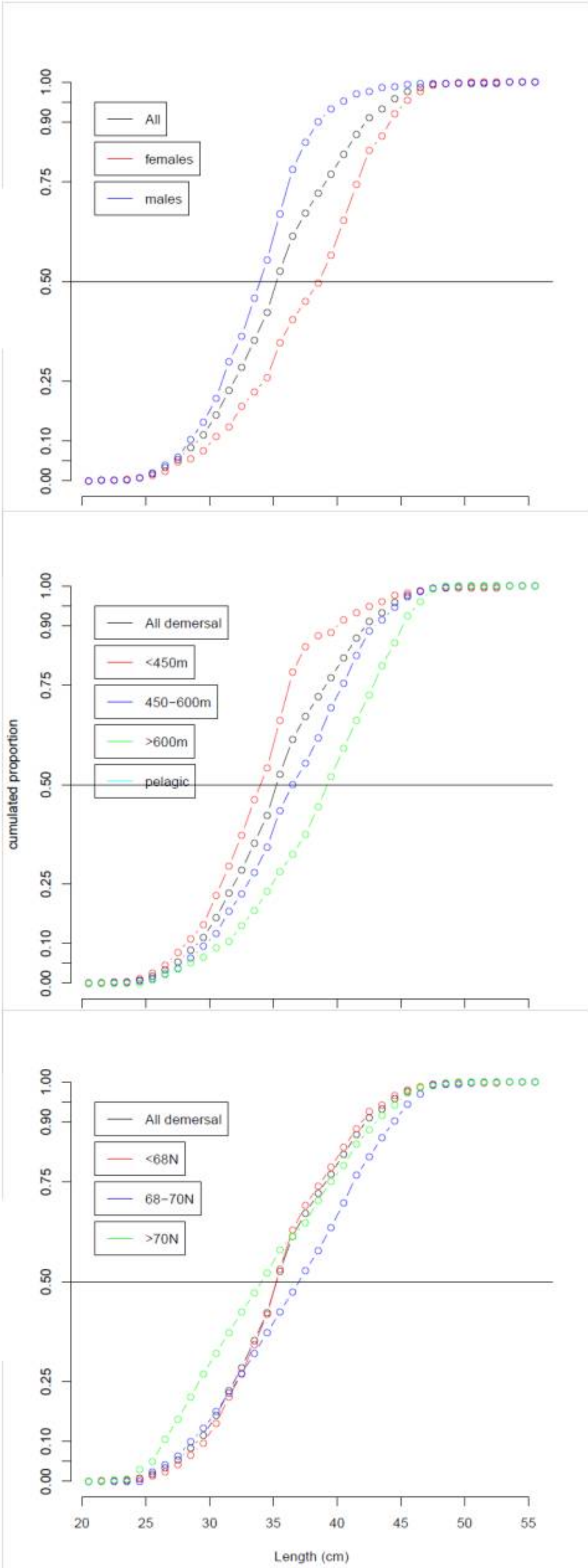


Figure 7.3.18. Cumulative length distribution for greater silver smelt in Norwegian slope survey March 2012 by sex, bottom depth and south–north latitude.

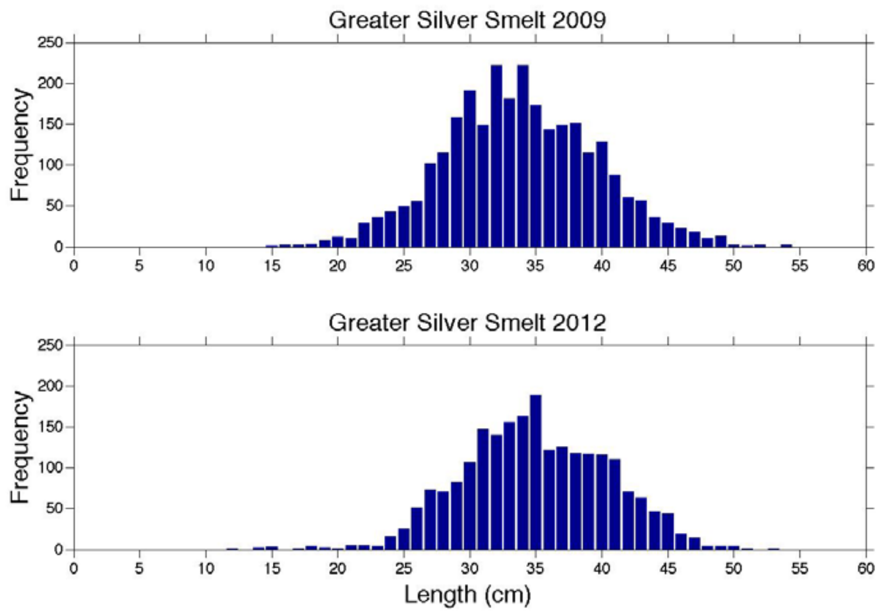


Figure 7.3.19. Length distributions for greater silver smelt in the Norwegian slope surveys March 2009 and 2012.

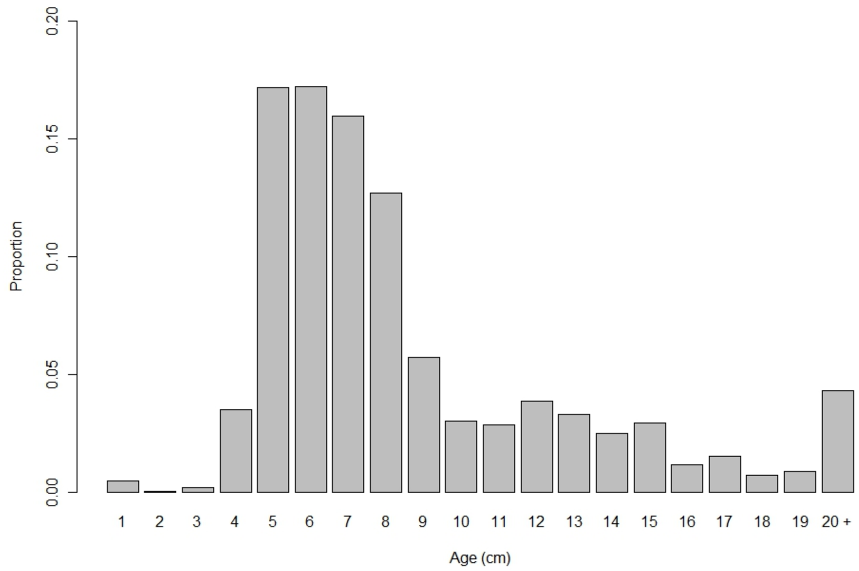


Figure 7.3.20. Age distribution for greater silver smelt in the Norwegian slope survey March 2012.

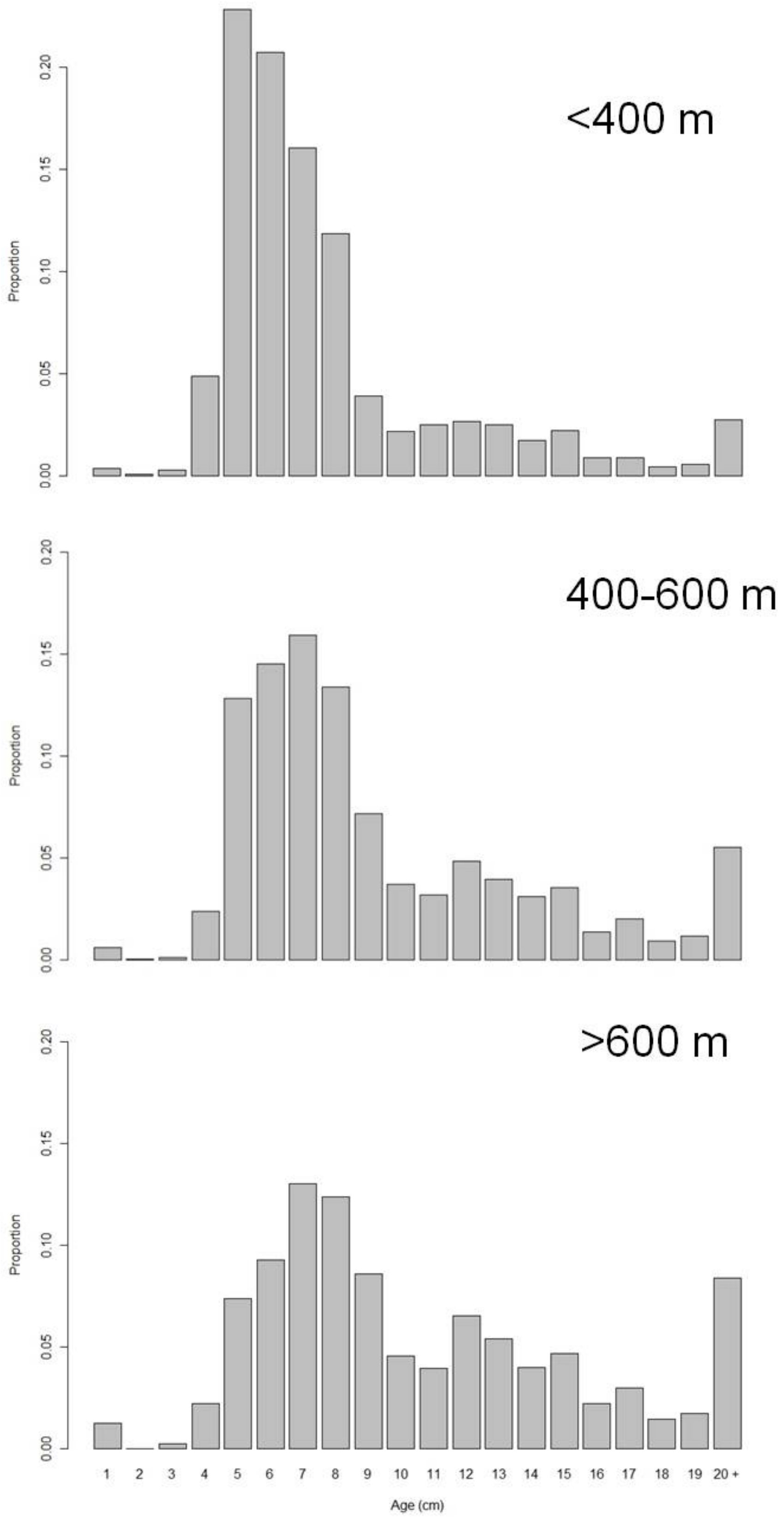


Figure 7.3.21. Age distribution for greater silver smelt in the Norwegian slope survey March 2012.

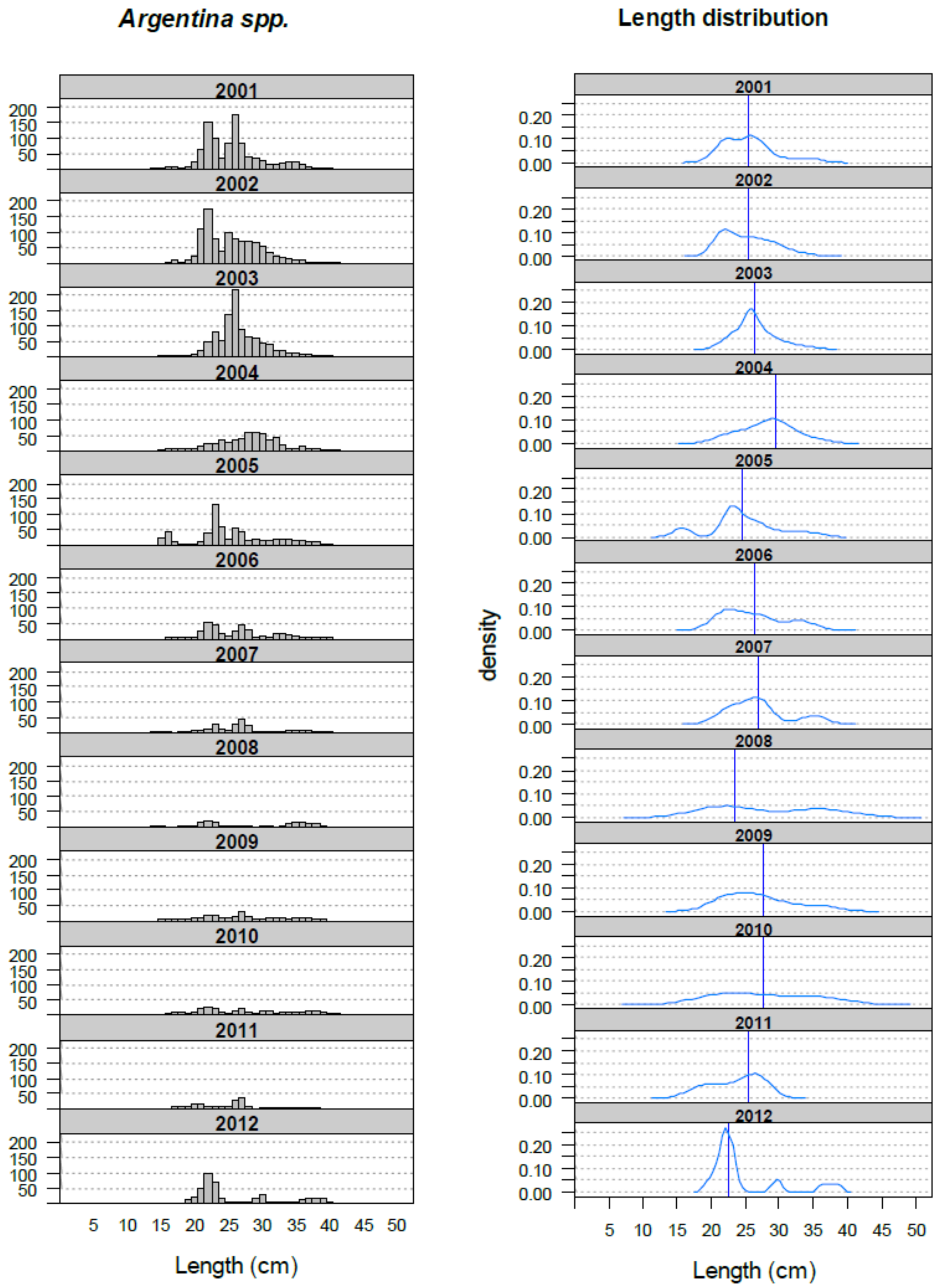


Figure 7.3.22. Mean stratified length distributions of *Argentina* spp. in Spanish Porcupine surveys.

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 9.1.1 shows the accumulated catch of orange roughy in the NEA in the different ICES areas for catches from 1991 to 2011.

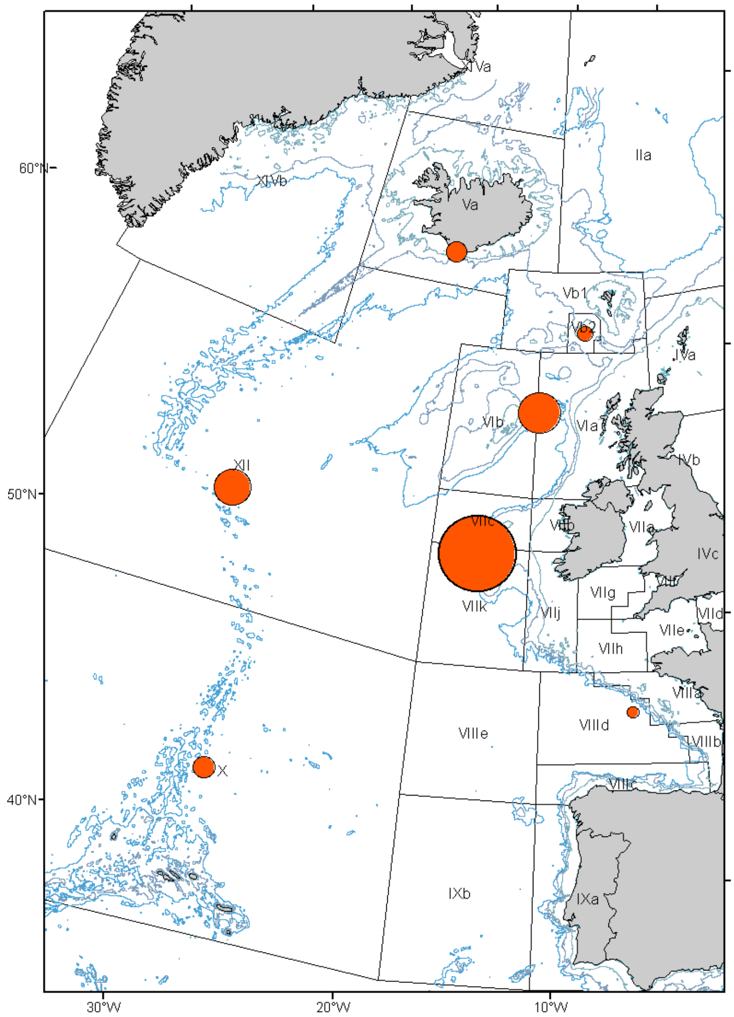


Figure 8.1.1. Fisheries for orange roughy by ICES areas in Northeast Atlantic. Size of circles reflects historic accumulated catch 1991–2011.

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 they have now effectively abandoned it.

8.2.2 Landings trends

Table 8.2.0 and Figure 8.2.1 show the landings data for orange roughy for ICES Subarea VI as reported to ICES or as reported to the working group. There were no catches of orange roughy in Area VI recorded in 2011. The cumulative catch in Area VI until 2012 was 7185 tons.

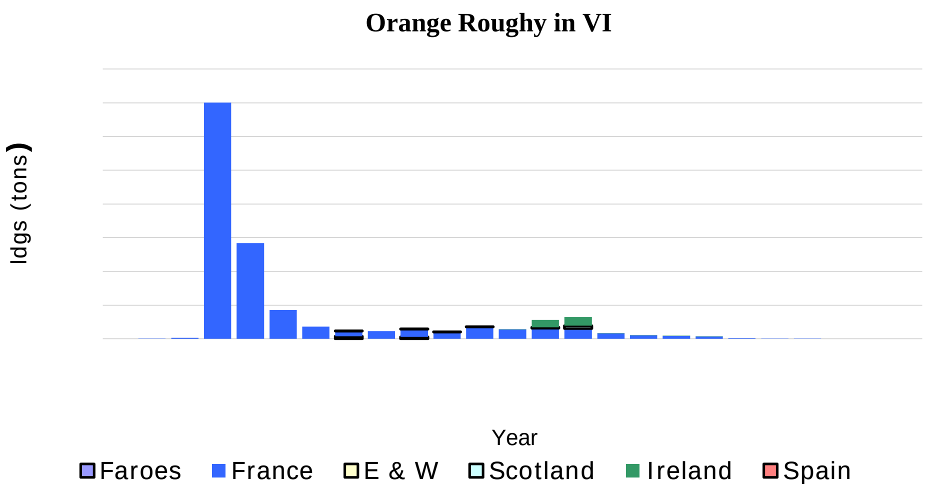


Figure 8.2.1. Time-series of orange roughy landings by country in ICES Area VI.

8.2.3 ICES Advice

The ICES advice for 2013 and 2014 is: 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.

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 VII since 2010.

Landings in relation to TAC are displayed in the table below.

		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

8.2.5 Data available

8.2.5.1 Landings and discards

Landings are in Table 8.2.0.

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 information. Available information can be found in the stock annex.

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 (<0.2%).

Due to the closure of the fishery in VI and VII there are limited fishery-dependant data to evaluate the status of the stocks. The Irish and Scottish deep-water trawl surveys provided information on the cpue of juveniles which was used for qualitative assessment in 2010. The Irish survey was discontinued in 2009 and the Scottish survey only partially covers VIa. Therefore, current monitoring programmes are insufficient to monitor the recovery of the stocks in VI and VII.

In order to allow stock recovery, careful monitoring of the spatial overlap of existing fisheries with the distribution of orange roughy, coupled with the collection of fisheries-dependant and independent data (observer programme and surveys) is required.

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

*** Preliminary.**

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.

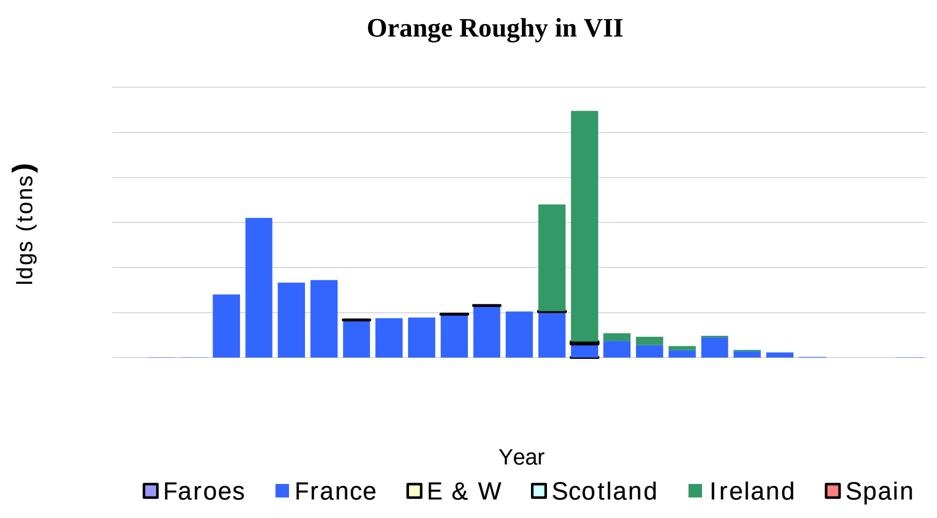


Figure 8.3.1. Time-series of orange roughy landings by country in ICES Subarea VII.

8.3.3 ICES Advice

The ICES advice for 2013 and 2014 is:. 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.

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:

		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

The TAC for orange roughy in VII is set to 0 t for 2013 and 2014.

8.3.5 Data available

8.3.5.1 Landings and discards

Landings are shown are in Table 8.3.0.

Onboard observed catch (landings and discards) by the French fleet operating in VI and VII in tonnes of roundnose grenadier, black scabbardfish, greater forkbeard, blue ling and deep-water shark (labelled deep-water species) and of orange roughy are shown in the table below:

	2004	2005	2006	2008	2009	2010	2011
Deep-water species	148	93	49	96	382	350	701
Orange roughy	16	1	2	0	9	0	1
Ratio	0.11	0.01	0.04	0.00	0.02	0	0.0014

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 Data analyses

See Section 8.2.6 for combined analysis on potential reference points for orange roughy in VI and VII.

8.3.7 Comments on the assessment

See Section 8.2.7.

8.3.8 Management considerations

See Section 8.2.8 for management considerations relating to orange roughy in VI and VII.

Table 8.3.1. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus,* by nation in Subarea VII.

Year	France	Spain	E & W	Ireland	Scotland	Faroes	Total
1988	-	-	-	-	-	-	0
1989	3	-	-	-	-	-	3
1990	2	-	-	-	-	-	2
1991	1406	-	-	-	-	-	1406
1992	3101	-	-	-	-	-	3101
1993	1668	-	-	-	-	-	1668
1994	1722	-	-	-	-	-	1722
1995	831	-	-	-	-	-	831
1996	879	-	-	-	-	-	879
1997	893	-	-	-	-	-	893
1998	963	6	-	-	-	-	969
1999	1157	4	-	-	-	-	1161
2000	1019	-	-	1		-	1020
2001	1022	-	1	2367	22	-	3412
2002	300		14	5114	33	4	5465
2003	369			172			541
2004	279			188			467
2005	165			90			255
2006	451			37			489
2007	145			28			164
2008	118						118
2009	15						15
2010	0						0
2011	0						0
2012	0						0

***Preliminary.**

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

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.

A Faroese exploratory trawl fishery is taking place in the Mid-Atlantic Ridge area. This fishery is mainly targeting orange roughy and black scabbard fishing ICES Areas X and XII.

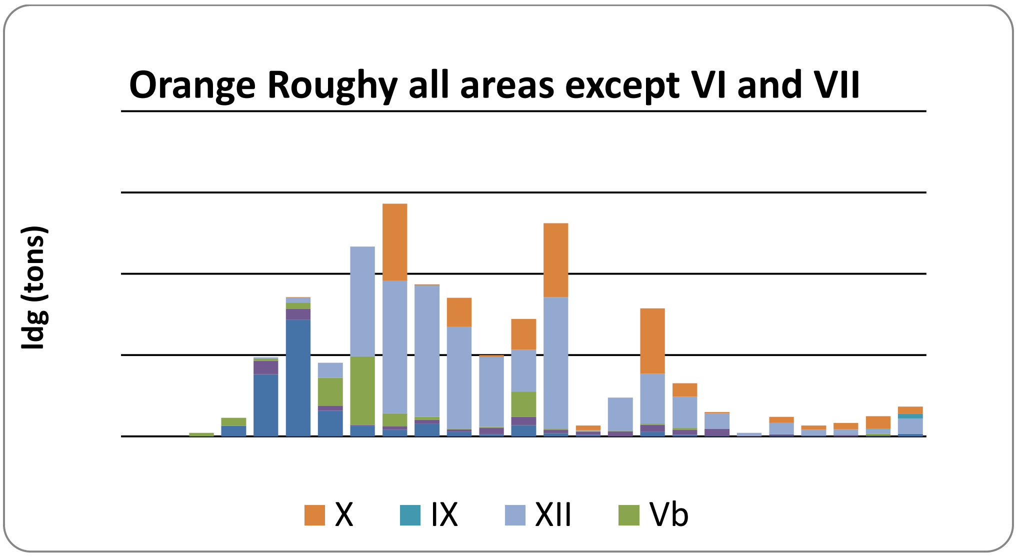


Figure 8.4.1. Time-series of orange roughy landings by in all areas (except VI and VII).

8.4.3 ICES Advice

The ICES advice for 2013 and 2014 is: 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.

8.4.4 Management measures

The EU TAC is set for 0 for 2013 and 2014. The TAC applies to Community waters and EC vessels in international waters. Landings in relation to EU TAC are shown in the table below. 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. There is no agreed TAC for orange roughy in the NEAFC regulatory area.

		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

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

New information on length frequencies and length–weight relationships have been provided by the Faroese exploratory fishery from 2008 to 2012 (Figure 8.4.2). Data suggests that mean length has remained similar over the years, but that there is less spread in the length distribution in the last years compared to 2008 and 2009. It is not known whether this is due to a change in the fishery (i.e. mesh size or different fishing locations) or a change in the population.

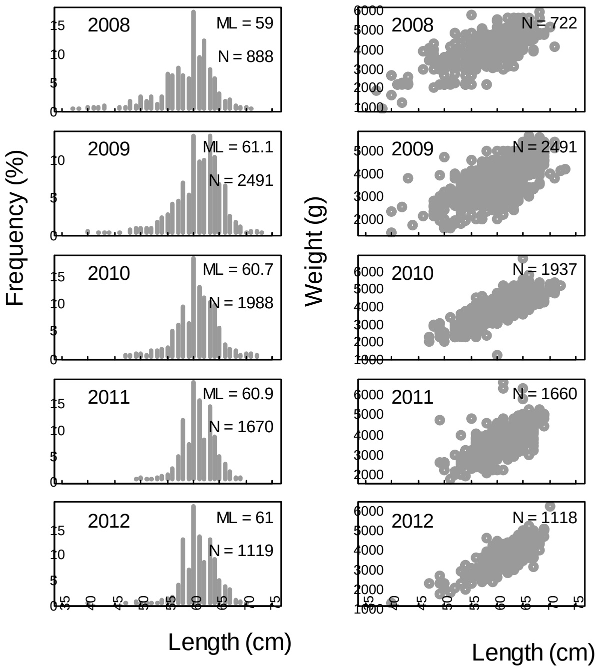


Figure 8.4.2. Orange roughy in X. Length distribution and length–weight relation of orange roughy caught in the Faroese fishery in X between 2008 and 2012.

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

No data.

8.4.6 Data analysis

Catch information and length distributions were provided from the Faroese exploratory fishery on the Mid-Atlantic Ridge. In order to evaluate the impact of this fishery on discrete orange roughy populations, data is required at the spatial resolution of single seamounts.

Methods on reference points could not be performed specifically on orange roughy in all areas. The DCAC method could be explored for the Mid-Atlantic Ridge (X and

XII) as the ratio for catch to virgin biomass is highly uncertain. There was insufficient data on life-history characteristics of orange roughy in all areas which would merit a separate analysis to the one performed on orange roughy in VI and VII.

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

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

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

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

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

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

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	83
2011	0	4	0	0	<1	77	27	108
2012		16	0	0	28	45	94	167
Total	21	1708	1016	545	35	2057	5648	11 015

***Preliminary.**

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 analyzes 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 (*Coryphaenoides rupestris*) 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 2011 and are preliminary for 2012.

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*). No new information has been presented on this issue. Catches of *Macrourus berglax* and *Trachyrincus scabrus* were almost absent from the catches since 2009. The situation is the same this year for the revised 2011 data. Provisional 2012 landings data show around 196 t of *Trachyrincus scabrus* in VI, 75 t in XIIb. 20 t and 526 t of *Macrourus berglax* were respectively reported in VI and XIIb.

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 1830 t in 2005 and then decreased to 74 t in 2011. In 2012, the provisional landings in Vb are 40 t. These landings are exclusively from French and Faroese trawlers (Table 10.2.0a–f).

In Subarea VI, the highest landings were observed in 2001 (close to 15 000 t) and have decreased to around 1470 t in 2011. Provisional landings are 2300 t in 2012. 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 2012, provisional landings are 27 t.

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 5470 t (provisional) in 2012. There were significant Faroese landings in the mid-1990s, but this fishery disappeared in the 2000s. 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 2007–2012.

The landings data are considered uncertain in Division XIIb, because unreported landings may occur in international waters. This is a serious issue for assessment considering the magnitude of the Spanish landings. In addition to this, all national landings data were not reported by new ICES divisions and some landings were allocated to divisions according to knowledge of the fisheries from the working group.

9.2.3 ICES Advice

The ICES advice for 2013 and 2014 is: "Based on the MSY approach, catches should be no more than 6000 t (4500 t for Division Vb and Subareas VI and VII, and 1500 t (the 2011 catch) for Division XIIb)."

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 4297 t for 2013 and 2014.

In Subareas VIII, IX, X, XII and XIV the TAC was set at 3581 t in 2013 and 3223 t for 2014. 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
	EU TAC	EU Landings	EU TAC	EU Landings XIIb	Landings Vb, VI, VII, 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	2383*	3979	5481*	7864*
2013	4297		3581		
2014	4297		3223		

*** provisional.**

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 roundnose grenadier is subject to a minimum size of 40 cm total length, other regulations that may apply to roundnose grenadier are detailed in the overview section.

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 programme: 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 seem quite consistent and stable in recent years. Based on 2004–2010 about 30% by weight and 50% by number of the catch of roundnose grenadier were discarded, because of small size. This figure is higher than in previous sampling where the discarding rate in the French fisheries was estimated slightly above 20% from sampling in 1997-1998 (Allain *et al*., 2003). The change may come from a combination of changes in the depth distribution of the fishing effort and a decrease in the abundance of larger fish as visible in the landings. However, 2011 data show a change in discards where only 30% of the individuals are discarded (12% in weight of the catch). This is linked to 1) a change of depth of the French fleet towards shallower waters and 2) attempts to avoid areas where discards are high. In 2012, the same situation occurred with 6% of the catch in weight being discarded.

Spanish Observer programme (Hatton Bank): discard data are available from the Spanish Observer Programme. For the period 2002–2010, *observers have cover*ed on average 18±9% (range 8–27%) of the fleet fishing days in Division VIb, and 10±8% (range 3–28%) in Division XIIb. Although occasionally the discards reached 19% of the total weight catch, they are negligible in most sampled months. Annual average discards range from 2 to 15% in weight in Division VIb and from 0 to 12% by weight in Division XIIb. Average discarding for the whole period is 5% by weight in both areas. These discards, however, correspond to undersized individuals. Discards data for 2011 are not presented as they are considered to be inaccurate but provided again for 2012.

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 9.2.1–9.2.6).

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 for the years 1998, 2000, 2002, 2004, 2005, 2006, 2007, 2008, 2009, 2011 and stats squares 41E0 through 45E0. No new data were available for this working group in 2012.

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

Haul by haul data from French skipper's personal tallybooks were updated for 2011 and 2012. 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 is 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 otter board 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, otter board 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.

Lpue from the Spanish commercial fleet in XIIb

Some basic lpue indices where 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

For France, the modal discarded length has remained constant (Figures 9.2.1–9.2.2) at around 12 cm while the average pre-anal length of the individuals in the landings has decreased from 20.8 cm in 1990 to 14.7 cm in 2012 (Figure 9.2.7).

Size–frequency data provided by Spain for the period 2002–2011 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 9.2.8). The modal length of discards is around 9.5 cm. Over the period 2002–2012, there is no apparent trend in size of discards. However for landed individuals, both the average size for male and female have decreased by 1 cm (from 15.5 cm to 14 cm for females and 13.5 to 12.4 cm for males) until 2009. Over the period 2009–2012, in both VI and XIIb, the mean length in landings has increased by 2 cm for both males and females. 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.

Trends in abundance indices

Marine Scotland Deep-water Science survey

The index does not show any trend in abundance (Figure 9.2.7). Data were not available at the time of the working group this year.

Lpue from the Faeroese commercial fleet

The cpue is stable for the period 2009–2010 although it is above average in 2011 and below average in 2012 (Figure 9.2.8).

Lpue from the Spanish commercial fleet

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 9.2.10–9.2.12) shows a decline from 2000 to 2003 and has been stable since then.

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 (1988–2012);
- Overall standardized abundances indices from the French tallybooks (2000–2012) based on rectangles (edge6, other6);
- Life-history parameters to provide initial estimates for the model (Figure 9.2.13).

Diagnostics plot are available on Figures 9.2.14–9.2.15 and indicates a good fit of the model. Outputs of the assessments are presented on Figure 9.2.16.

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 137 kt (+/-4 kt). The magnitude of this number is in line with estimates from previous working groups. Stock biomass in 2012 is around 54 kt (+/-12 kt). B_{MSY} is estimated to be 69 kt (+/-2 kt).

In 2012, the probability of this stock (Vb, VI, VII) to be above B_{MSY} is 11% and the probability to be below H_{MSY} is 96% (Table 9.2.2). Model outputs suggest that any TAC set below C_{MSY} (5620 t +/-510 tons) 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. 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, some additional exploratory assessments were carried out to take account of landings in XIIb and uncertainty regarding potential misreporting in VI and XIIb.

Each run has a name according to the spatial aggregation of landings data:

- 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.
- Run "Vb-VIinf-VII-XIIb" includes VI landings of *Macrourus berglax* and *Trachyrincus scabrous* to take account of misreported landings.
- Run "Vb-VIinf-VII-XIIbinf" includes VI and XIIb landings data of *Macrourus berglax* and *Trachyrincus scabrous*.
- Additional assessments were made considering short-term forecast and different management options in Vb, VI, VII (runs 1–4).

The various times-series used for those runs are listed in Table 9.2.1.

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 9.2.17). The weighting between indices relies on proportion of landings between the Vb,VI,VII regions and XIIb (Table 9.2.1).

Figure 9.2.18 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. 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 (+/-2 kt). Stock biomass in 2012 is around 82 kt (+/-16 kt). B_{MSY} is estimated to be 107 kt (+/-1 kt). From this run, the probability of this stock to be above B_{MSY} is 5% and 31% to be below H_{MSY}. Median C_{MSY} is estimated to be 9119 t (+/-852). 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, XIIb with inflated catches in VI and XIIb to account of Spanish misreporting of grenadier species (runs Vb-VIinf-VII and Vb-VIinf-VII-XIIbinf)

Two simulations were done: one in Vb, VI, VII with inflated landings in VI and one including as well inflated landings in XIIb. In both cases, the fit of the model was not as good as for the reference assessment despite using the same possibly because the assumption made on misreporting are not exactly reflected by the indices. The results are however within the same ranges than the reference assessment but with more uncertainty (Table 9.2.2).

For the Vb-VIinf-VII run, carrying capacity was estimated to be around 147 kt (+/-2 kt). Stock biomass in 2012 is around 61 kt (+/-13 kt). B_{msy} is estimated to be 74 kt (+/-1 kt). From this run, the probability of this stock to be above B_{MSY} is 17% and 99% to be below H_{MSY} (Figure 9.2.19).

For the Vb-VIinf-VII-XIIb run, carrying capacity was estimated to be around 217 kt (+/-2 kt). Stock biomass in 2012 is around 75 kt (+/-16 kt). B_{MSY} is estimated to be 108 kt (+/-1 kt). From this run, the probability of this stock to be above B_{MSY} is 3% and 20% to be below H_{MSY} (Figure 9.2.20).

In conclusion, the use of inflated landings does not lead to substantial changes in estimates of biomass and complicates the setup of the model leading to more uncertainties.

Short-term forecasts

Exploratory short-term forecasts in Vb, VI, VII (run 1 to 4)

Although the current assessment has been considered only as indicative of trends during the last benchmark (WKDEEP, 2010), as times-series of data become longer, the uncertainty of the model outputs decrease over time. The Bayesian context also 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 2013–2019. For 2013, the landings were considered to be equal to the current TAC in Vb, VI, VII. For the following years, several catch options were considered:

- Run 1: *Status quo* catch: TAC_y remains constant over time according to the TAC set by EU for 2013 and 2014. TAC in 2014 is then used each following years.
- Run 2: TAC_y constant but equals to 85% the TAC of the previous year.
- Run 3: TAC_y follows the ICES WKFRAME3 approach.
- Run 4: Closure of the fishery (TAC_y=0).

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},

$$TAC_y = H_{msy} \cdot B_{y-1}$$

Corresponding TACs are showed in Figure 9.2.21. Run 3 (WKFRAME approach) is the only scenario where TAC is increasing.

Results are shown in Figure 9.2.22. In all cases, biomass increases toward B_{MSY} and even over as landings are all below C_{MSY} therefore the surplus production model is always in a situation where the population is growing. It is also necessary to consider that the distribution tails grow with time.

The fastest run to reach the B_{MSY} cap is run 4 which is trivial as the fishery is closed followed by run 2 and 1. Run 3 is the one with the slowest rebuilding trajectories but with the highest landings which is the most sustainable for both the fishermen. As this run is proportional to biomass estimates over B_{MSY}, it is natural that the harvest rate quickly reaches the H_{MSY} cap. For runs 1 and 2, the ratios decrease because TAC remains constant and biomass increases. Harvest rates in run 4 stays to zero because of the lack of landings.

For all runs, the resulting distributions of total biomass have increasing probabilities of being above B_{MSY} over time. In 2013, assuming the TAC will be taken completely, the probability of being above B_{MSY} will be 13% (against 9% for 2012). By 2019, a closure of the fishery would give a probability of 87% of being above B_{MSY} while run 3 and its TAC based on WKFRAME would be at 35%. A progressive reduction of TAC of 15% each year (Run 2) would allow the median biomass to reach B_{MSY} by 2019. A closure would allow reaching such a level by 2016. Overall, following EU TAC or WKFRAME rules allows a recovery of the stock while maintaining fishing activity.

The slow recovery towards MSY suggests that any management plan, forecast should probably span over a decade.

P ($B>B_{MSY}$)	Simulation	2012	2013	2014	2015	2016	2017	2018	2019
Run 1	EU TAC	0.093	0.131	0.150	0.180	0.197	0.241	0.264	0.296
Run 2	0.85 * TAC	0.093	0.131	0.165	0.202	0.276	0.364	0.466	0.545
Run 3	WKFRAME	0.093	0.131	0.168	0.202	0.248	0.280	0.332	0.348
Run 4	closure	0.093	0.131	0.225	0.365	0.537	0.698	0.808	0.878

Harvest rates on the contrary are in all cases below H_{MSY} and the probability of being below H_{MSY} increases through time except for the WKFRAME approach.

P ($H<H_{MSY}$)	Simulation	2012	2013	2014	2015	2016	2017	2018	2019
Run 1	EU TAC	0.965	0.505	0.536	0.543	0.556	0.571	0.590	0.608
Run 2	0.85 * TAC	0.965	0.505	0.724	0.877	0.948	0.980	0.987	0.993
Run 3	WKFRAME	0.965	0.505	0.822	0.784	0.728	0.714	0.677	0.627
Run 4	closure	0.965	0.505	1.000	1.000	1.000	1.000	1.000	1.000

This work has been extended to Vb, VI, VII, XIIb with additional set TACs for management options. Forecasts have been done up to 2019. Results are presented in Tables 9.2.3 and 9.2.4. The results with XIIb added do not contradict the analysis in Vb, VI, VII as biomass also increases for any option chosen as long as it is below C_{MSY} (5620 t +/-510 in Vb, VI, VII and 9119 t +/-852 in Vb, VI, VII, XIIb).

9.2.7 Management considerations

The harvest rate for roundnose grenadier appears to be below H_{MSY} in Vb, VI, VII and slightly over H_{MSY} 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	24	0	0	0	0	0	40

*** 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	Unallocated	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**
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	997	0	0	0	0	0	0	258	1319	0	0	**2574**

*** 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*		27				27

*** Preliminary.**

Table 9.2.0d. Working group estimates of landings of roundnose grenadier from Subarea XIIb.

Year	Estonia	Faroes	France**	Germany	Iceland	Ireland	Lithuania	Spain	Unallocated	USSR/Russia	UK (E+W)	UK (Scotl.)	Norway	Total
1988														**0**
1989			0							52				**52**
1990			0											**0**
1991			14							158				**172**
1992			13											**13**
1993		263	26	39										**328**
1994		457	20	9										**486**
1995		359	285											**644**
1996		136	179		77			1136						**1528**
1997		138	111					1800						**2049**
1998		19	116					4262						**4397**
1999		29	287					8251		6				**8573**
2000		6	374	9				5791			9	6		**6195**
2001		2	159			3		5922				7	1	**6094**
2002			14				18	10 045			1	2		**10 080**
2003			539			1	31	11 663				1		**12 235**
2004		8	1693				120	10 880		91		4		**12 796**
2005	20	5	508				13	7804		81		350		**8782**
2006	27	1	85				6	4242						**4361**
2007	140	2	0				8	4108						**4258**
2008		0	0				3	2416		13				**2432**
2009								5335						**5335**
2010			1					2758						**2759**
2011		3						1575						**1578**
2012*		9						1521	5472					**7002**

*** Provisional. ** 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*	

*** 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	10 104	10 276
1992	3817	6782	1556	13	0	12 155	12 168
1993	1681	8205	1916	328	0	11 802	12 130
1994	668	5938	1922	486	0	8528	9014
1995	1223	6472	1295	644	0	8990	9634
1996	1078	6044	1051	1528	0	8173	9701
1997	1112	6032	1038	2049	0	8182	10 231
1998	1667	5207	1157	4397	0	8031	12 428
1999	1996	5642	896	8573	0	8534	17 107
2000	1791	8956	859	6195	0	11 606	17 801
2001	2016	14 773	1354	6094	208	18 143	24 445
2002	1031	11 538	1058	10 080	504	13 627	24 210
2003	1532	6598	587	12 235	952	8717	21 904
2004	1575	7729	568	12 796	0	9872	22 668
2005	1837	3694	246	8782	0	5777	14 558
2006	1775	2515	386	4361	0	4676	9037
2007	1700	1851	227	4258	0	3778	8036
2008	1112	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*	40	2574	27	7002	0	2383	12 026

*** Provisional.**

Table 9.2.1. Time-series of landings and lpues used for the reference and exploratory assessments.

	Landings 1988–2012				LPUE indices	Combined LPUES
Simulations	Ref	Vb-VIinf-VII	Vb-VI-VII-XIIb	Vb-VIinf-VII-XIIbinf	Ref	Vb, VI, VII, XIIb
					Vb-VIinf-VII	Vb-VIinf-VII-XIIbinf
1988	33	33	33	33	-	-
1989	2698	2698	2750	2750	-	-
1990	7279	7279	7279	7279	-	-
1991	10 104	10 104	10 276	10 276	-	-
1992	12 155	12 155	12 168	12 168	-	-
1993	11 802	11 802	12 130	12 130	-	-
1994	8528	8528	9014	9014	-	-
1995	8990	8990	9634	9634	-	-
1996	8173	8173	9701	9701	-	-
1997	8182	8182	10 231	10 231	-	-
1998	8031	8031	12 428	12 428	-	-
1999	8534	8534	17 107	17 107	-	-
2000	11 606	11 606	17 801	17 801	1	1
2001	18 143	18 143	24 445	24 445	0.946	0.946
2002	13 627	13 627	24 210	24 210	1.119	0.874
2003	8717	8717	21 904	21 904	0.569	0.962
2004	9872	9894	22 668	22 690	0.593	0.835
2005	5777	8346	14 558	17 128	0.601	0.582
2006	4676	8695	9037	13 056	0.473	0.463
2007	3778	8804	8036	13 062	0.679	0.574
2008	3102	4274	5534	6705	0.783	0.613
2009	4046	4046	9381	9381	0.769	0.767
2010	3461	3461	6220	6220	0.695	0.614
2011	1577	1579	3155	3169	0.750	0.539
2012	2383*	2599*	7864*	8465*	0.646	1.073

*** Provisional.**

**** Missing data replaced by the average from the previous and next year values.**

Table 9.2.2. Summary of results from the exploratory assessments.

Simulation	Year	Area Vb-VI-VII			Area Vb-VIinf-VII			Area Vb-VI-VII-XIIb			Area Vb-VIinf-VII-XIIb		
Median biomass	1988	137 397	+/-	3752	147 036	+/-	2136	214 585	+/-	1990	216 847	+/-	1786
+/- std dev	2012	53 840	+/-	12474	60 828	+/-	12 889	81 659	+/-	16 003	75 128	+/-	16 099
(tons)													
Average biomass	1988	136 593			147 297			214 563			216 761		
(tons)	2012	53 974			61 571			81 771			75 881		
Median B_{MSY}	2012	68 699	+/-	1876	73 518	+/-	1068	107 293	+/-	995	108 424	+/-	893
(tons)													
$P(B>B_{MSY})$	2012	0.11			0.17			0.05			0.03		
$P(H<H_{MSY})$	2012	0.96			0.99			0.31			0.2		
Target C_{MSY}	2012	5620	+/-	510	6117	+/-	589	9119	+/-	852	9510	+/-	851
(tons)													

Table 9.2.3. Probabilities of being above B_{MSY} in regards to different management options.

Areas V,VI,VII	2013	2014	2015	2016	2017	2018	2019
EU TAC	13%	15%	18%	20%	24%	26%	30%
85% TAC	13%	17%	20%	28%	36%	47%	55%
WKFRAME	13%	17%	20%	25%	28%	33%	35%
TAC=0t	13%	23%	37%	54%	70%	81%	88%
TAC=500t	13%	21%	35%	49%	61%	75%	84%
TAC=1000t	13%	20%	32%	45%	56%	70%	79%
TAC=2000t	13%	19%	27%	36%	47%	54%	63%
TAC=3000t	13%	17%	22%	28%	35%	43%	49%
TAC=4000t	13%	16%	19%	22%	26%	30%	34%
TAC=5000t	13%	15%	16%	17%	19%	20%	20%
TAC=6000t	13%	13%	13%	13%	14%	13%	14%
TAC=7000t	13%	11%	10%	9%	8%	8%	7%
TAC=8000t	13%	10%	8%	7%	5%	5%	5%

Areas V,VI,VII, XIIb	2013	2014	2015	2016	2017	2018	2019
EU TAC	7%	10%	13%	15%	19%	21%	24%
85% TAC	7%	10%	15%	22%	30%	39%	51%
WKFRAME	7%	12%	18%	22%	27%	30%	34%
TAC=0t	7%	19%	34%	54%	70%	80%	88%
TAC=500t	7%	19%	32%	50%	66%	77%	86%
TAC=1000t	7%	18%	30%	46%	63%	73%	83%
TAC=2000t	7%	16%	28%	40%	56%	67%	75%
TAC=3000t	7%	15%	25%	35%	46%	59%	67%
TAC=4000t	7%	14%	22%	30%	38%	49%	59%
TAC=5000t	7%	13%	19%	25%	32%	39%	47%
TAC=6000t	7%	12%	16%	21%	26%	31%	36%
TAC=7000t	7%	10%	14%	18%	21%	25%	28%
TAC=8000t	7%	9%	12%	14%	16%	19%	20%

Table 9.2.4. Probabilities of being below H_{MSY} in regards to different management options.

Areas V,VI,VII	2013	2014	2015	2016	2017	2018	2019
EU TAC	51%	54%	54%	56%	57%	59%	61%
85% TAC	51%	72%	88%	95%	98%	99%	99%
WKFRAME	51%	82%	78%	73%	71%	68%	63%
TAC=0t	51%	100%	100%	100%	100%	100%	100%
TAC=500t	51%	100%	100%	100%	100%	100%	100%
TAC=1000t	51%	100%	100%	100%	100%	100%	100%
TAC=2000t	51%	98%	98%	99%	99%	99%	99%
TAC=3000t	51%	89%	91%	93%	93%	94%	94%
TAC=4000t	51%	60%	65%	68%	70%	71%	72%
TAC=5000t	51%	33%	34%	35%	36%	38%	38%
TAC=6000t	51%	14%	14%	14%	15%	15%	16%
TAC=7000t	51%	5%	5%	5%	5%	6%	6%
TAC=8000t	51%	2%	2%	1%	2%	3%	5%

Areas V,VI,VII, XIIb	2013	2014	2015	2016	2017	2018	2019
EU TAC	33%	41%	43%	45%	48%	50%	52%
85% TAC	33%	60%	78%	89%	94%	98%	99%
WKFRAME	33%	82%	78%	73%	71%	68%	65%
TAC=0t	33%	100%	100%	100%	100%	100%	100%
TAC=500t	33%	100%	100%	100%	100%	100%	100%
TAC=1000t	33%	100%	100%	100%	100%	100%	100%
TAC=2000t	33%	100%	100%	100%	100%	100%	100%
TAC=3000t	33%	99%	99%	100%	100%	100%	100%
TAC=4000t	33%	95%	96%	97%	97%	97%	98%
TAC=5000t	33%	87%	88%	89%	91%	91%	92%
TAC=6000t	33%	72%	73%	75%	77%	79%	80%
TAC=7000t	33%	53%	56%	58%	60%	62%	63%
TAC=8000t	33%	33%	34%	36%	37%	38%	40%

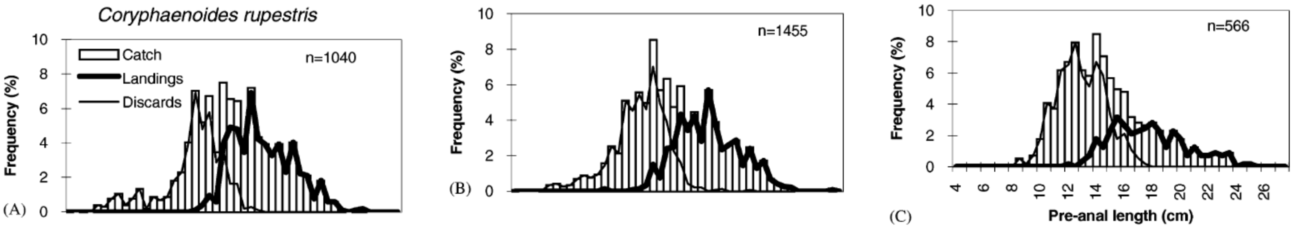


Figure 9.2.1. Length distribution of the discards and landings of roundnose grenadier in 1996–1997 by depth, left: 800–1000 m, centre: 100–1200 m, right: 1200–1400 m, sampled on board French vessels, (redrawn from Allain, 2003).

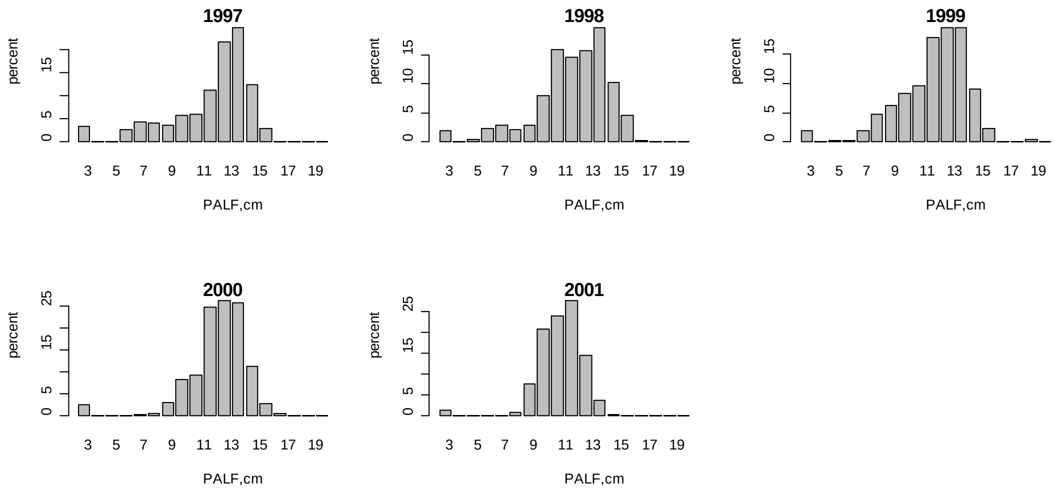


Figure 9.2.2. Length distribution of the discards of the French fleet, sampled on board French vessels by Scottish observers, 1997–2001.

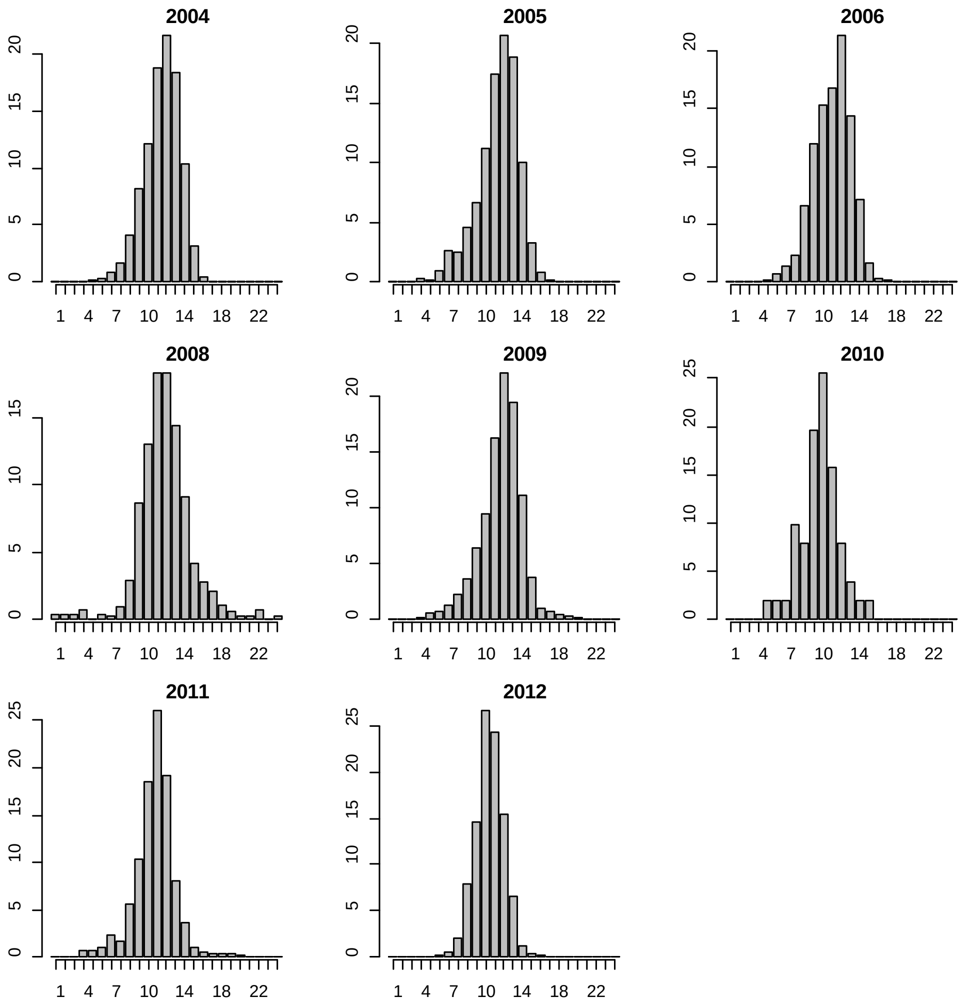


Figure 9.2.3. Sampling of the length distribution of discards of roundnose grenadier from the on-board observation program 2004–2012.

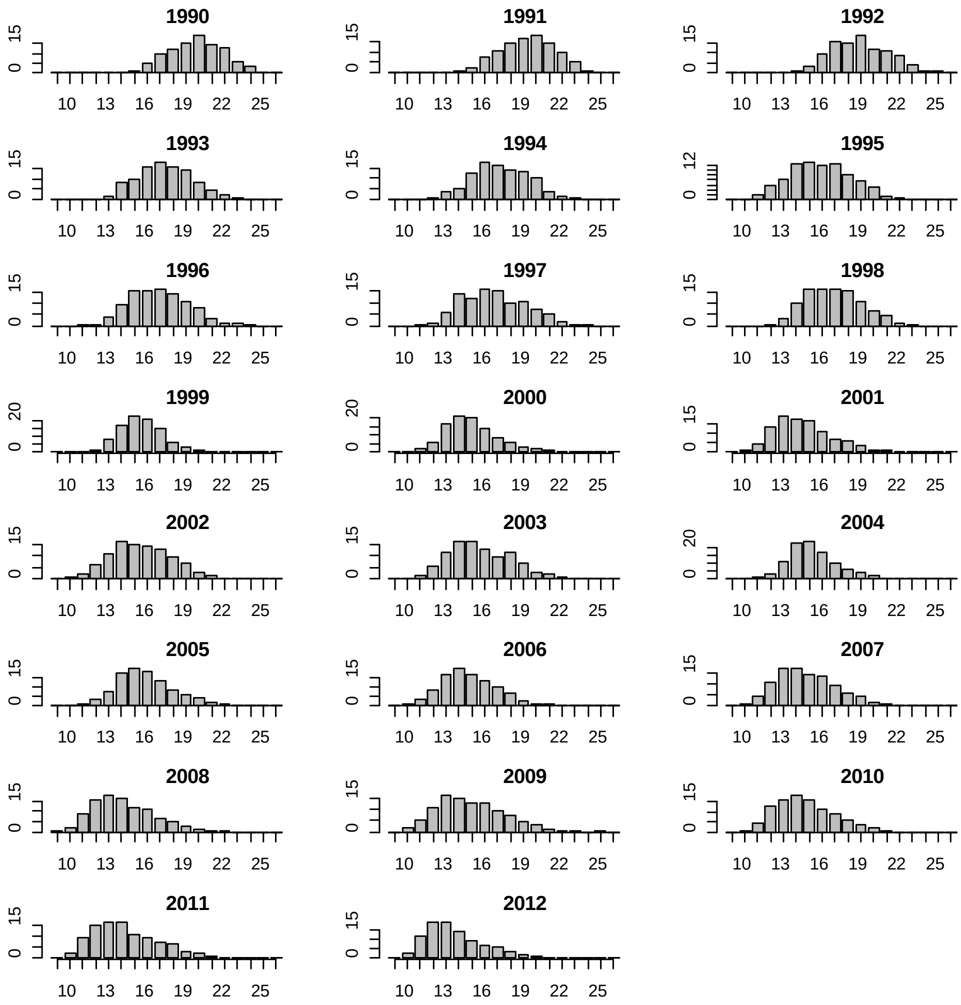


Figure 9.2.4. Length distribution (PAFL, cm) of the landings of the French fleet, sampled at fish markets, 1997–2012.

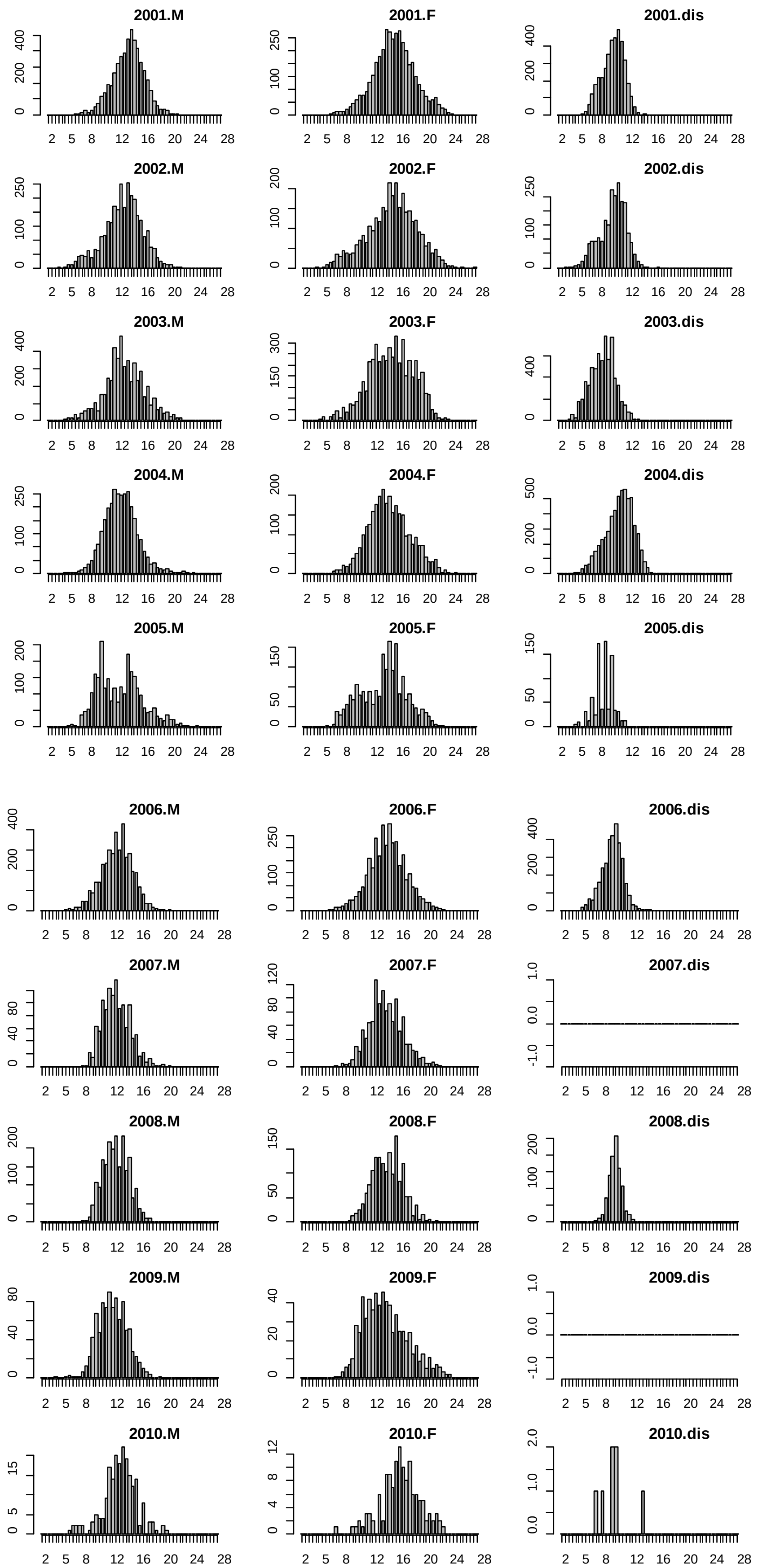


Figure 9.2.5. Length distribution of the landings by sex and discards of the Spanish fleet in Division VIb based from on-board observations, 2001–2012.

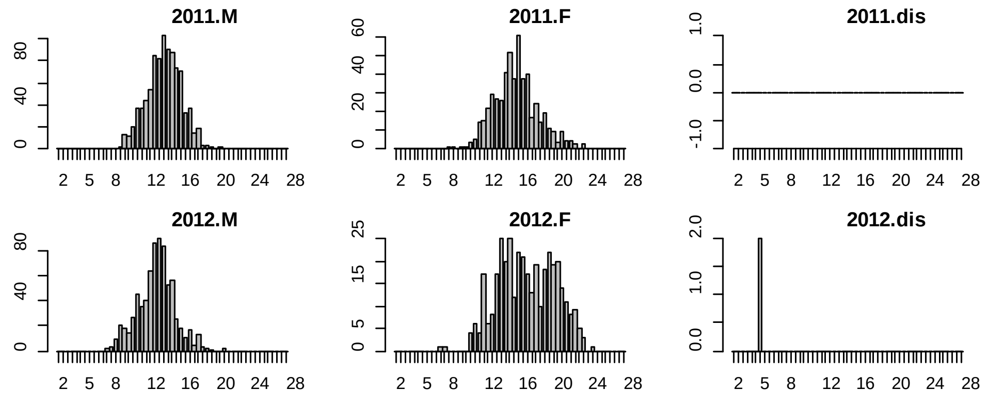


Figure 9.2.5. Length distribution of the landings by sex and discards of the Spanish fleet in Division VIb based from on-board observations, 2001–2012.

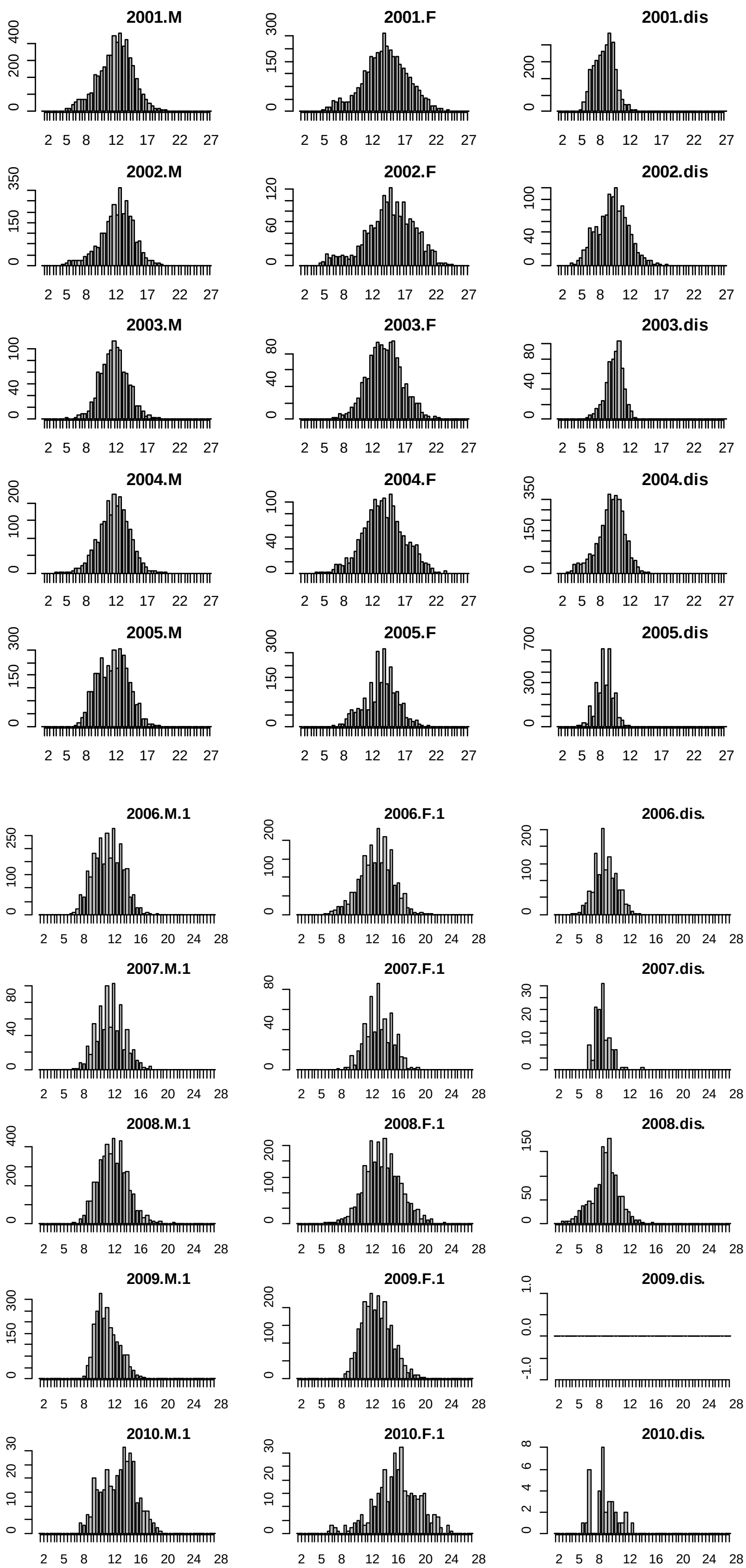


Figure 9.2.6. Length distribution of the landings by sex and discards of the Spanish fleet in Division XIIb based from on-board observations, 2001–2012.

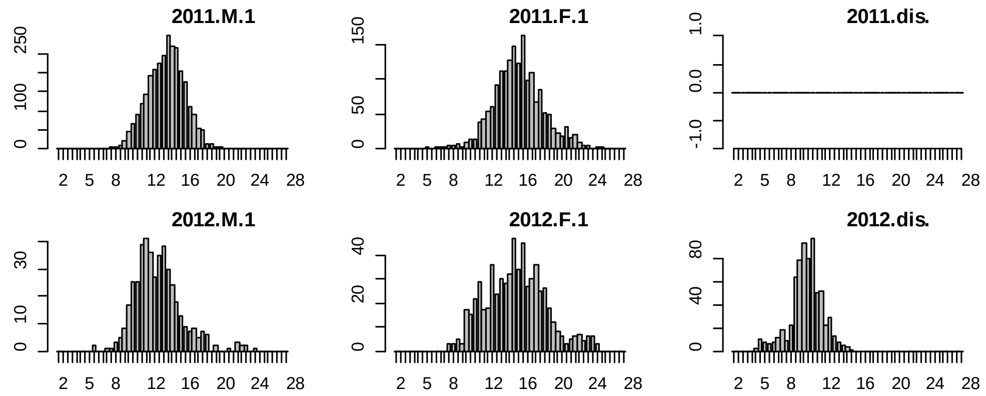


Figure 9.2.6. Length distribution of the landings by sex and discards of the Spanish fleet in Division XIIb based from on-board observations, 2001–2012.

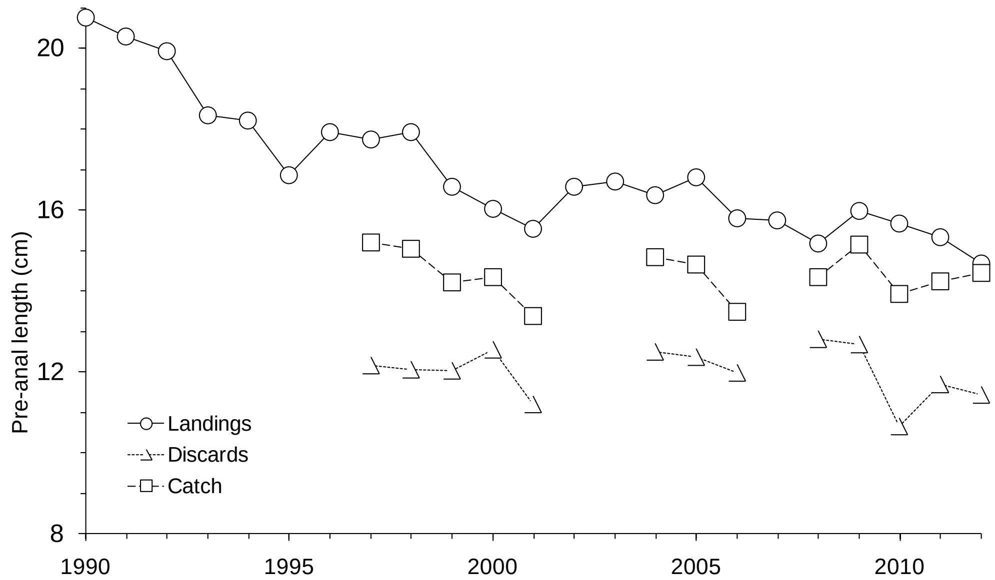


Figure 9.2.7. Evolution of the pre-anal length of roundnose grenadier in the French landings, catch and discards, 1990–2012.

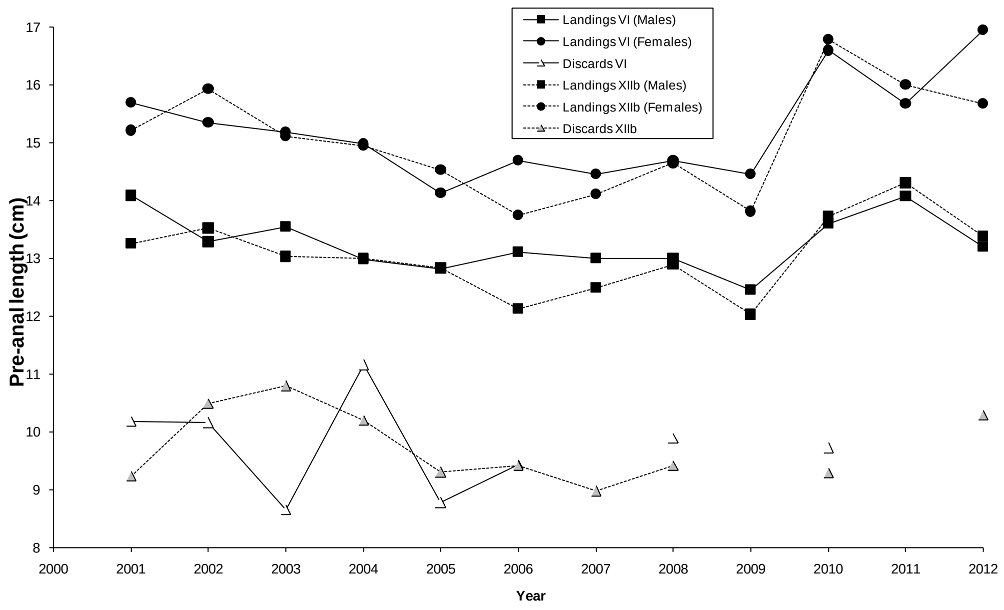


Figure 9.2.8. Evolution of the pre-anal length of roundnose grenadier in the Spanish landings and discards in Divisions VIb and XIIb, 2001–2012.

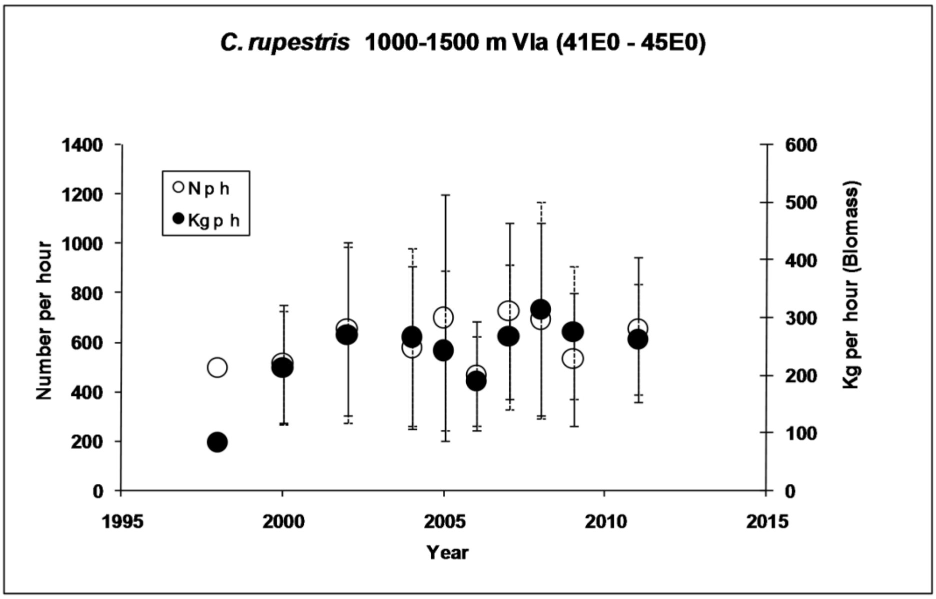


Figure 9.2.9. Abundance indices of roundnose grenadier according to Marine Scotland deep-water survey in VIa.

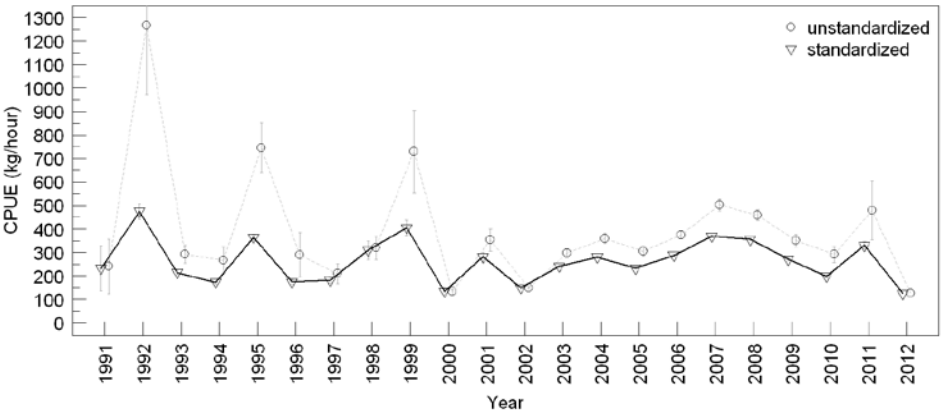


Figure 9.2.10. Roundnose grenadier in Vb. Cpue from otter-board trawlers. Criteria: >30% of roundnose grenadier in the catch.

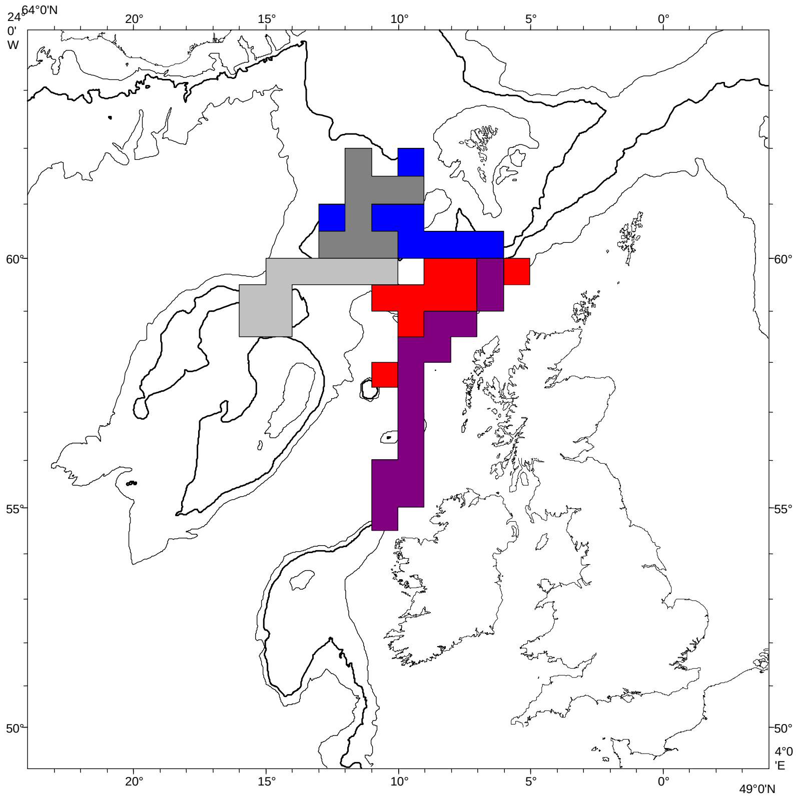


Figure 9.2.11. Reference areas (set of statistical rectangles) used to calculate French lpues (brown: New grounds in V (new5), grey new grounds in VI (new6); red: others in VI (other6); purple: edge in VI (edge6); blue: all grounds in VII (ref7). Depth contours are 200, 1000 and 2000 m.

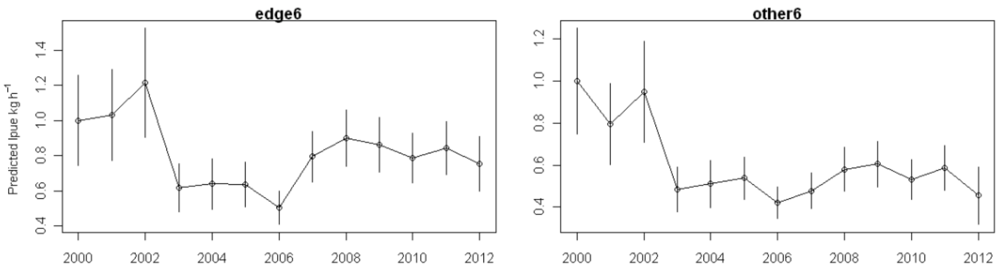


Figure 9.2.12. Lpue of French trawlers in two areas (labelled according to Biseau, 2006 WD) from tows targeting roundnose grenadier (defined as tows where the total catch include >10% of roundnose grenadier).

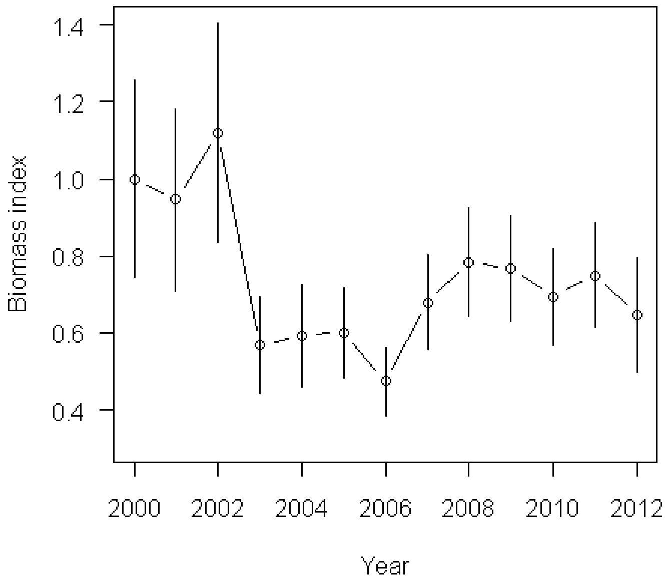


Figure 9.2.13. Time-series of abundance indices (calculated based upon the tallybook data). The grenadier abundance was predicted for the mean length of all tow carried out in every rectangle of the three small areas (edge6, other6 and ref5) and averaged across rectangle.

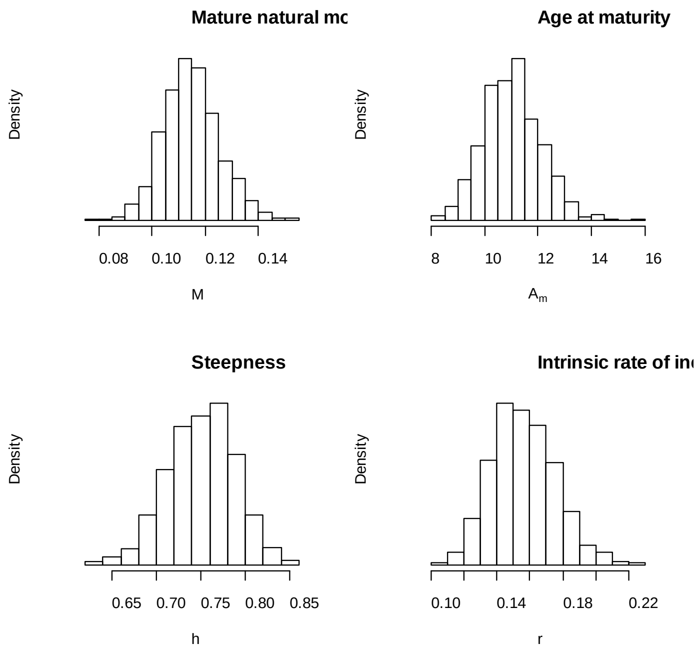


Figure 9.2.14. Distribution of initial life-history parameters used in the surplus production model.

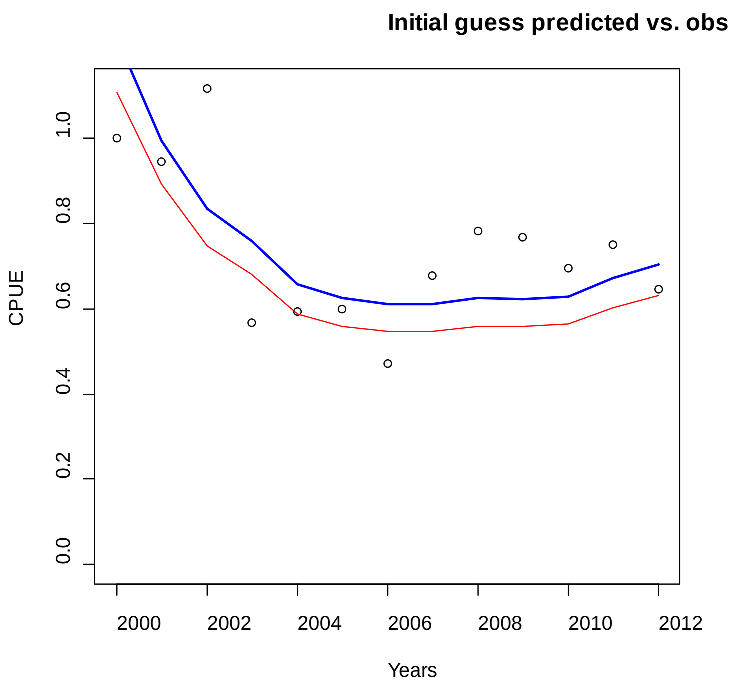


Figure 9.2.15. Predicted vs. initial guess vs. estimates of lpue for roundnose grenadier in Vb, VI, VII, based on commercial data.

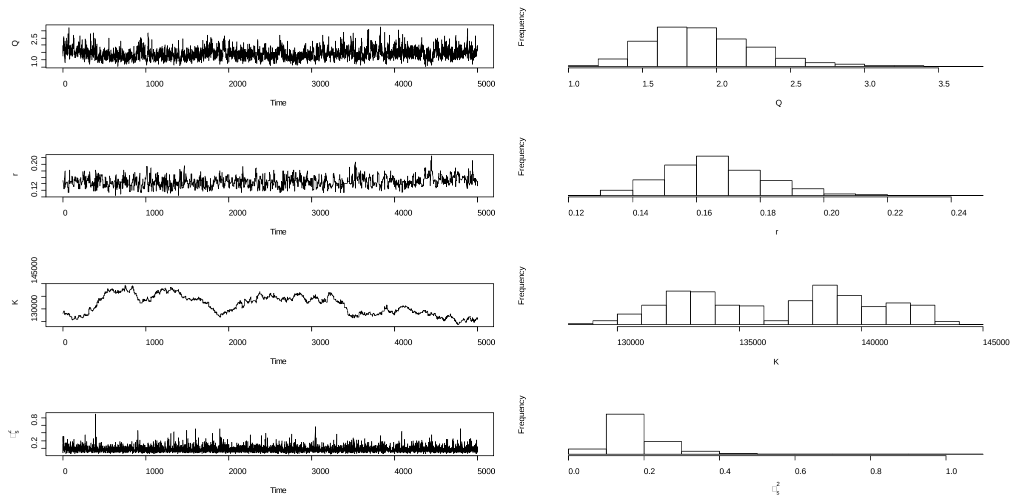


Figure 9.2.16. Diagnostic plots of the reference assessment on roundnose grenadier in Vb, VI, VII.

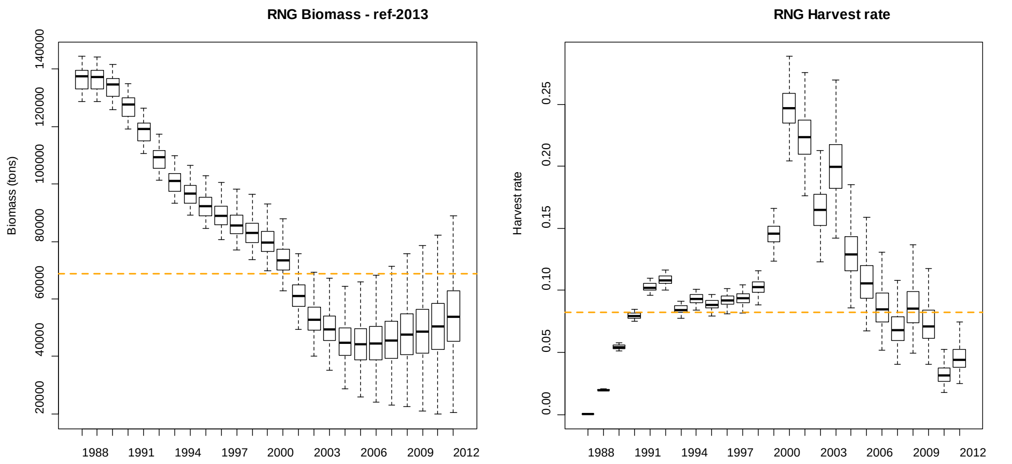


Figure 9.2.17. Estimated biomass and harvest rates from the reference simulation (Vb, VI, VII). Dotted lines are respectively B_{MSY} (left panel) and H_{MSY} levels (right panels).

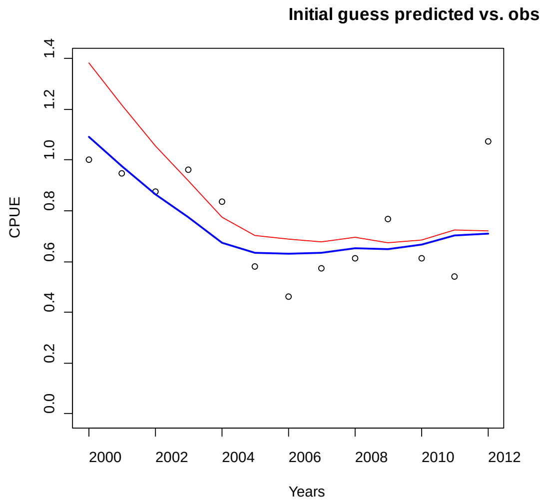


Figure 9.2.18. Predicted vs. initial guess vs. estimates of lpue for roundnose grenadier in Vb, VI, VII, XIIb based on commercial data.

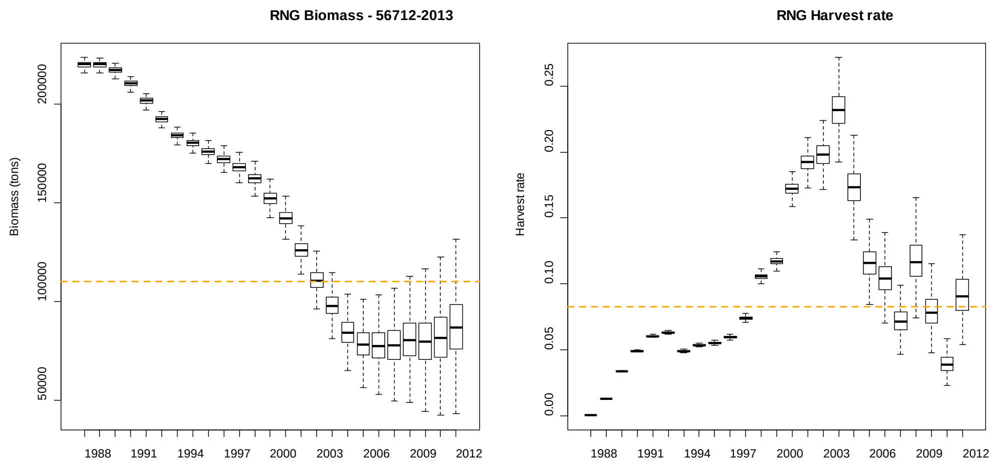


Figure 9.2.19. Estimated biomass and harvest rates using landings in Vb, VI, VII and XIIb.

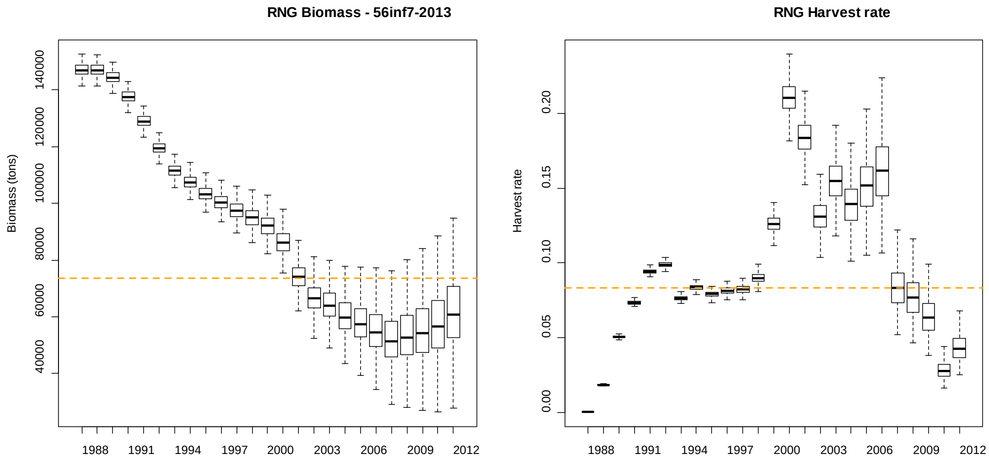


Figure 9.2.20. Estimated biomass and harvest rates using inflated Spanish landings in VI.

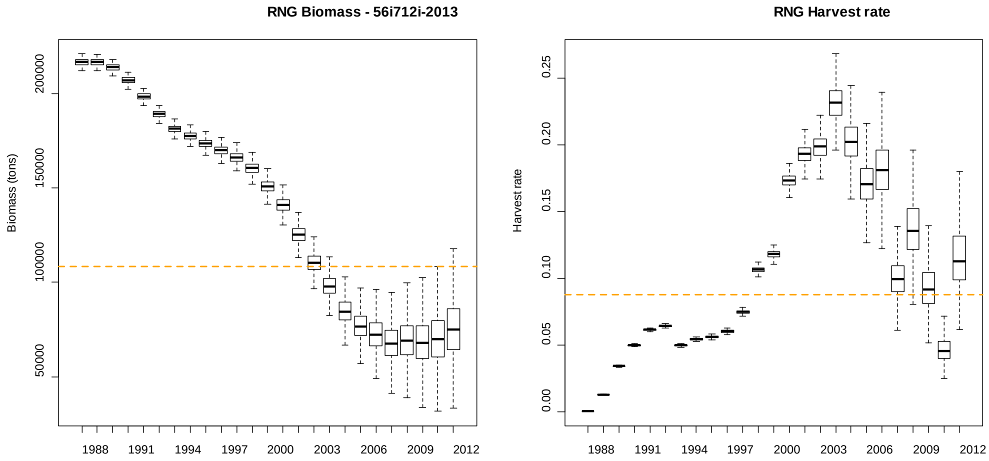


Figure 9.2.21. Estimated biomass and harvest rates in Vb, VI, VII, XIIb using inflated Spanish landings in VI and XIIb.

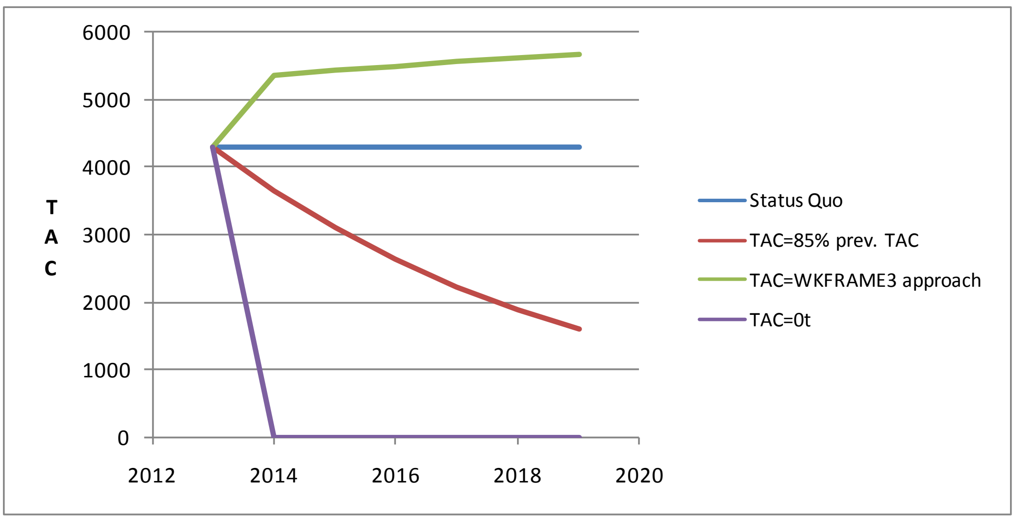


Figure 9.2.22. Evolution of TACs for the different runs.

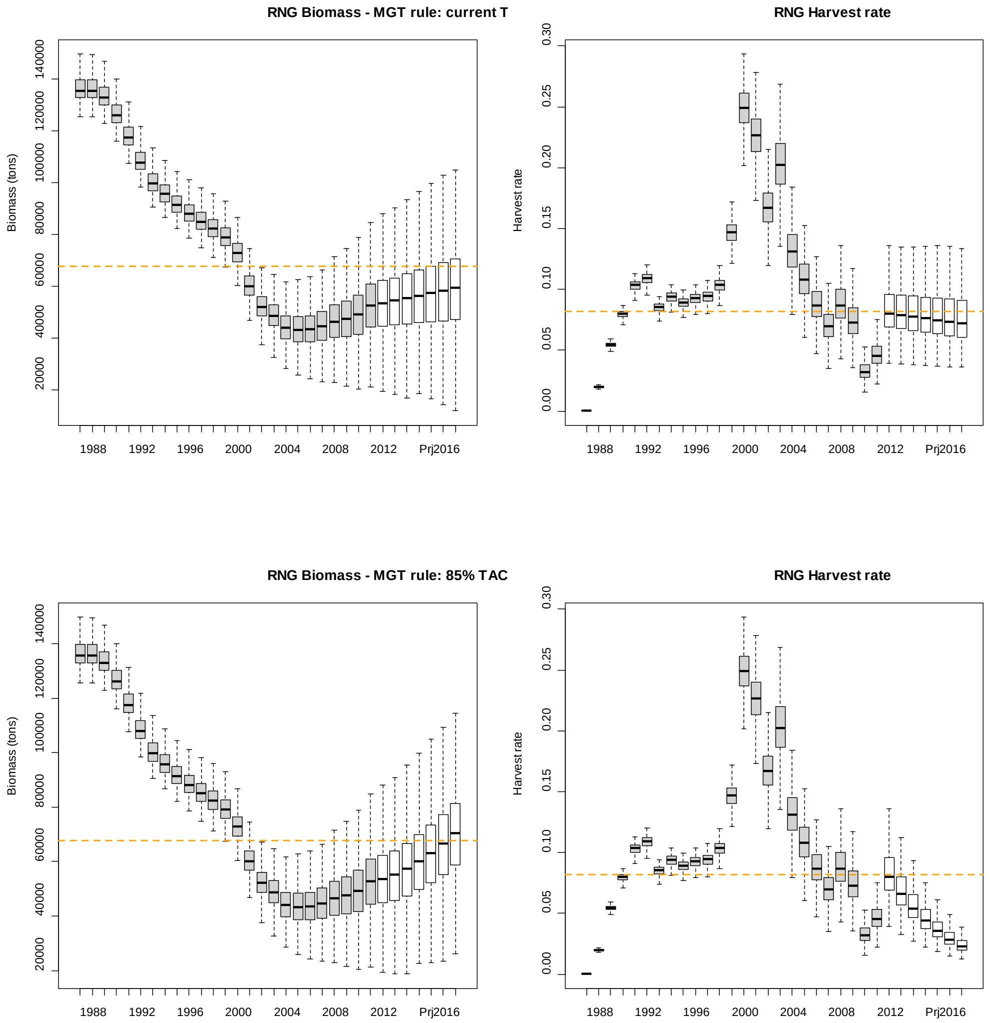


Figure 9.2.23. Simulation and short-term forecasts according to management options: (Run 1: *status quo*, Run 2: 85% of 2012 TAC, Run 3: closure, Run 4: TAC equals to $C_{MSY}*B_{y-1}/B_{MSY}$.

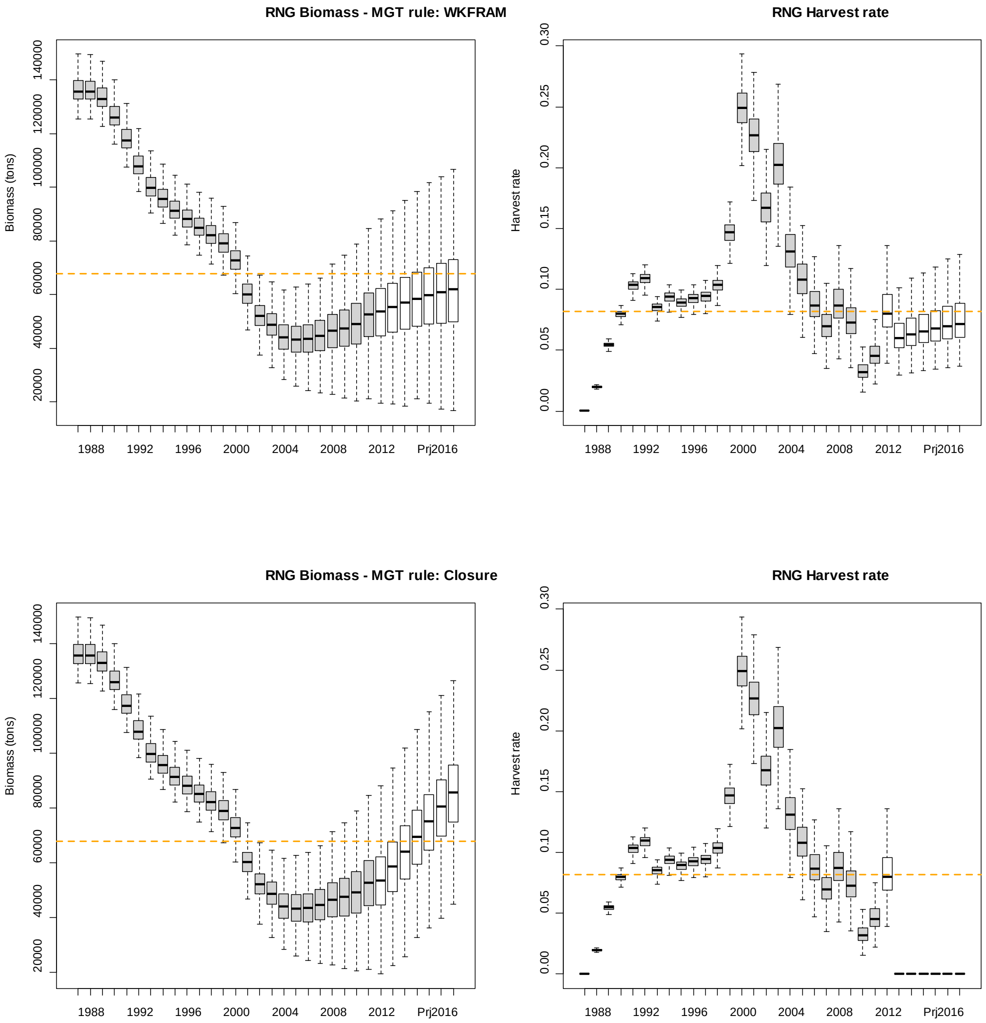


Figure 9.2.23. Simulation and short-term forecasts according to management options: (Run 1: *status quo*, Run 2: 85% of 2013 TAC, Run 3: WKFRAME approach, Run 4: Closure of the fishery.

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 1988–2011 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 2011 and 2012 is: “ICES advises to constrain catches to 1000 t. However, re-establishment of a fishery should be accompanied with a monitoring programme to assure exploitation consistent with MSY.”

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 1225/2010, fixing for 2011 and 2012 the fishing opportunities for EU vessels for fish stocks of certain deep-sea fish species, a TAC was set to 850 tonnes for EU vessels in EU waters and international waters of Subarea III, but outside Division IIIa. Pending consultations between EU and Norway, no directed fishery for roundnose grenadier is allowed in Division IIIa.

9.3.5 Data available

9.3.5.1 Length compositions

Since the directed fishery has stopped there are 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 data available.

9.3.5.3 Bycatch effort and cpue

WD 2013 gives information on estimated bycatch of roundnose grenadier in Norwegian shrimp fishery in ICES Division IVa and IIIa (Figure 9.3.2). The shrimp fishery in this area is mainly conducted shallower than found largest abundances of roundnose grenadier; and bycatch estimates was derived using the mean annual survey catches of grenadier (depth <400 m) and annual effort in the shrimp trawl fishery.

9.3.5.4 Survey indices

Catch rates in terms of biomass (kg/h) were calculated for stations 300 m and deeper from the Norwegian shrimp survey (Figure 9.3.3). Stations with zero catches were included, and the catches at non-zero stations were standardized by tow duration.

9.3.6 Data analyses

9.3.6.1 Trends in landings, effort and estimated bycatches

Collated information on landings and estimated bycatch data 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 is presented in ICES (2007) together with suggestive comments;

these cpue data do not provide any clear indications of stock development and status for the time of directed fishery.

Landings are now insignificant and represent bycatches from other fisheries. The estimated bycatches 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 very recent distributions from the Norwegian data contrast 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. 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 (WD2013).

The Danish and Norwegian length distributions 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 estimates of 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 recent decline appears to have continued and in 2013 both biomass and abundance were the lowest on record (WD 2013).

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.

9.3.8 Management considerations

The decline in abundance after 2005–2006 suggested by the Norwegian shrimp survey catch rates may 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 the same level as in the late 1980s and early 1990s, however, there is no suggestion of a new recruitment pulse as seen in the 1990s. 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, 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*		0		0

*** Preliminary data.**

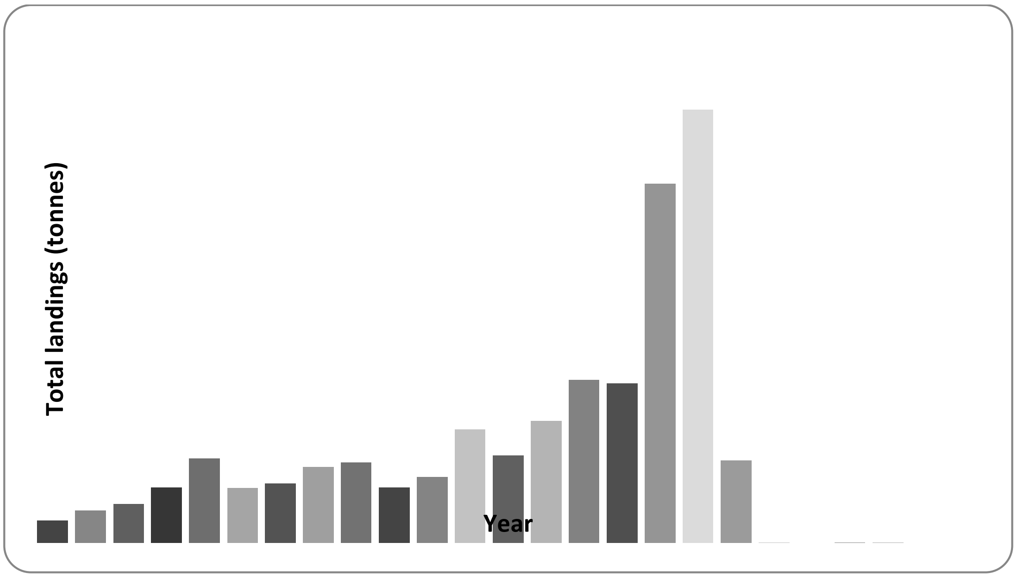
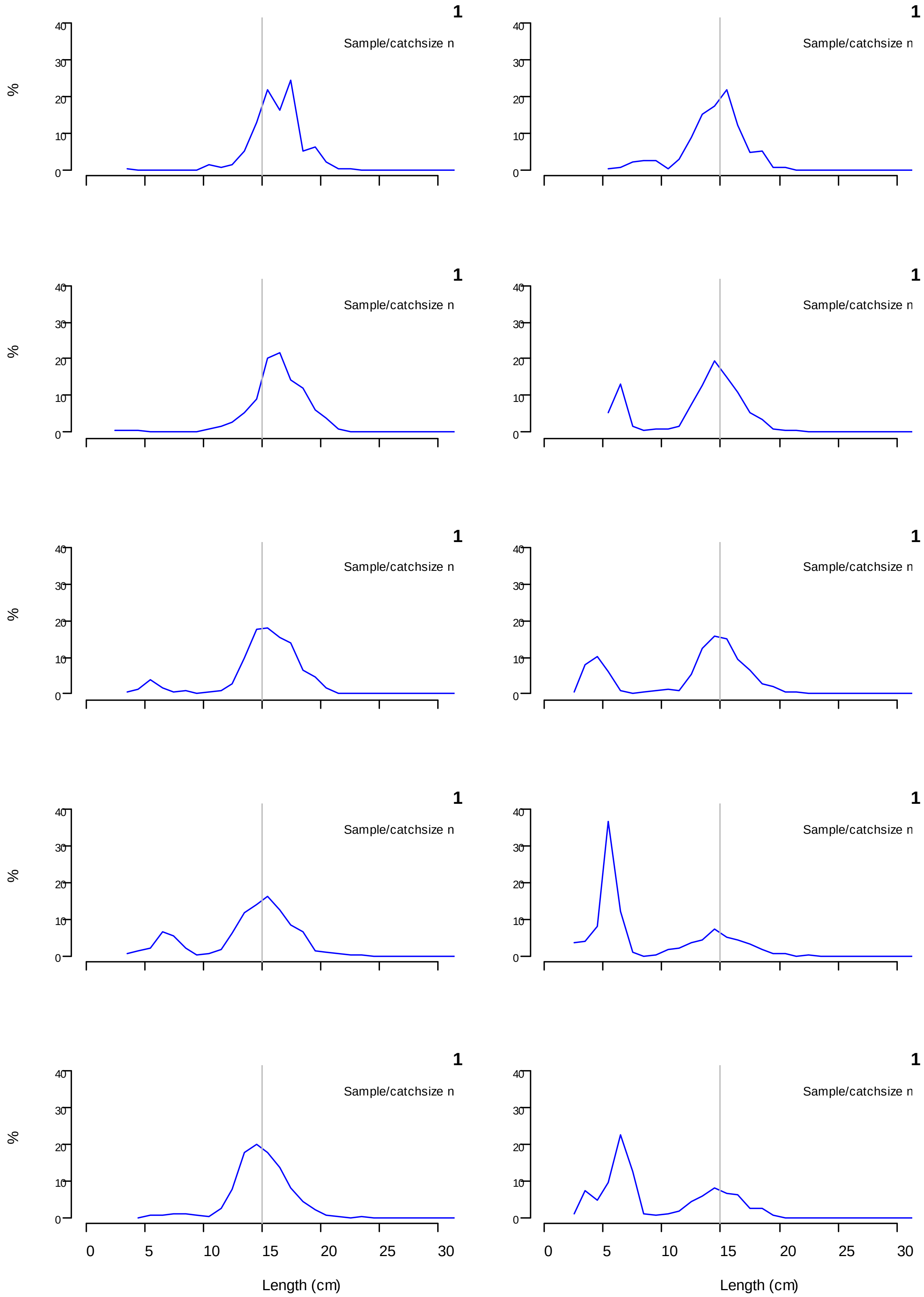
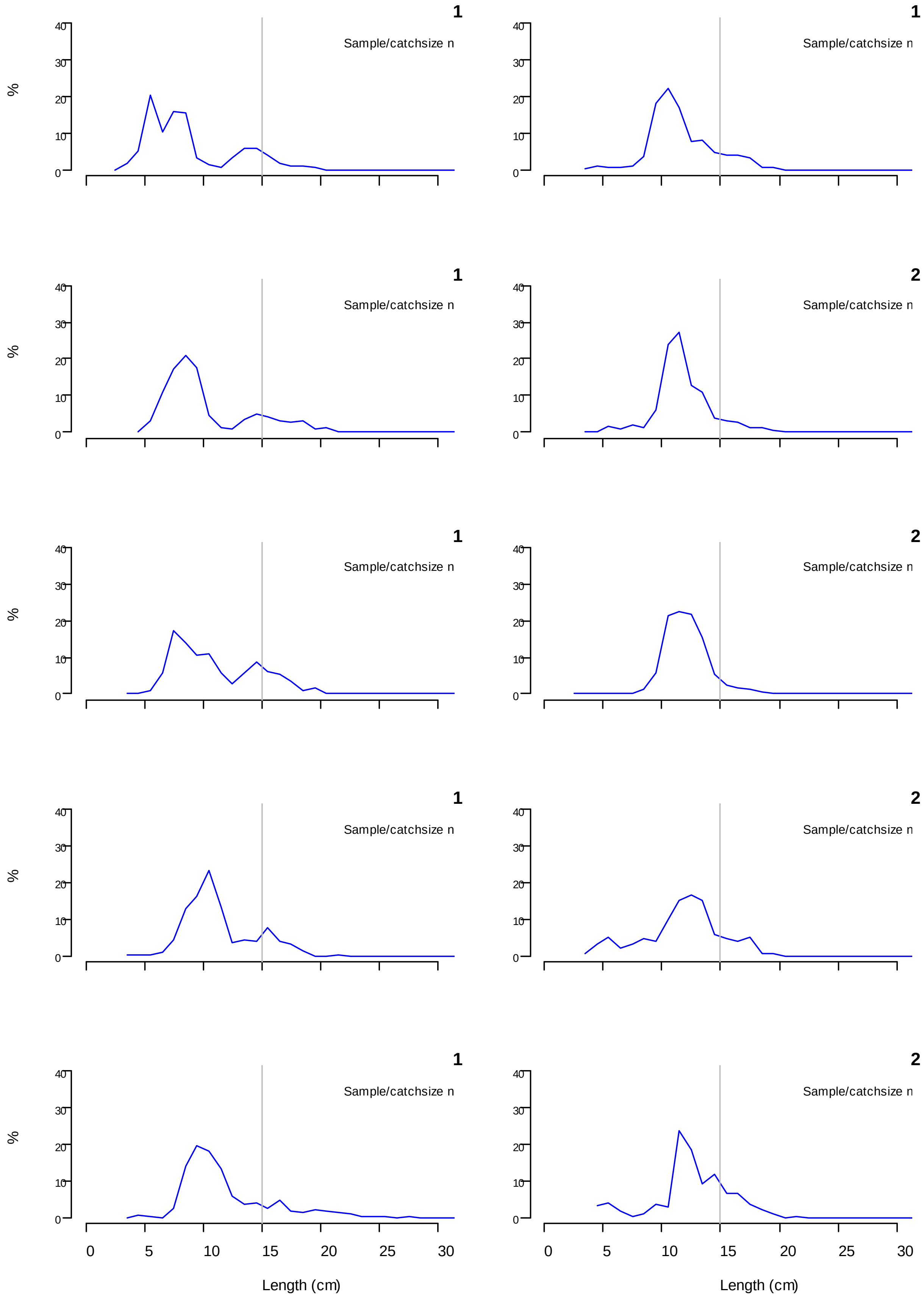


Figure 9.3.0. Landings of roundnose grenadier from Division IIIa. Landings from 2007–2012 are insignificant.


1
Sample/catchsize n
%
40
30
20
10
0
0
5
10
15
20
25
30
Length (cm)


1
Sample/catchsize n
1
Sample/catchsize n
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Length (cm)
Length (cm)

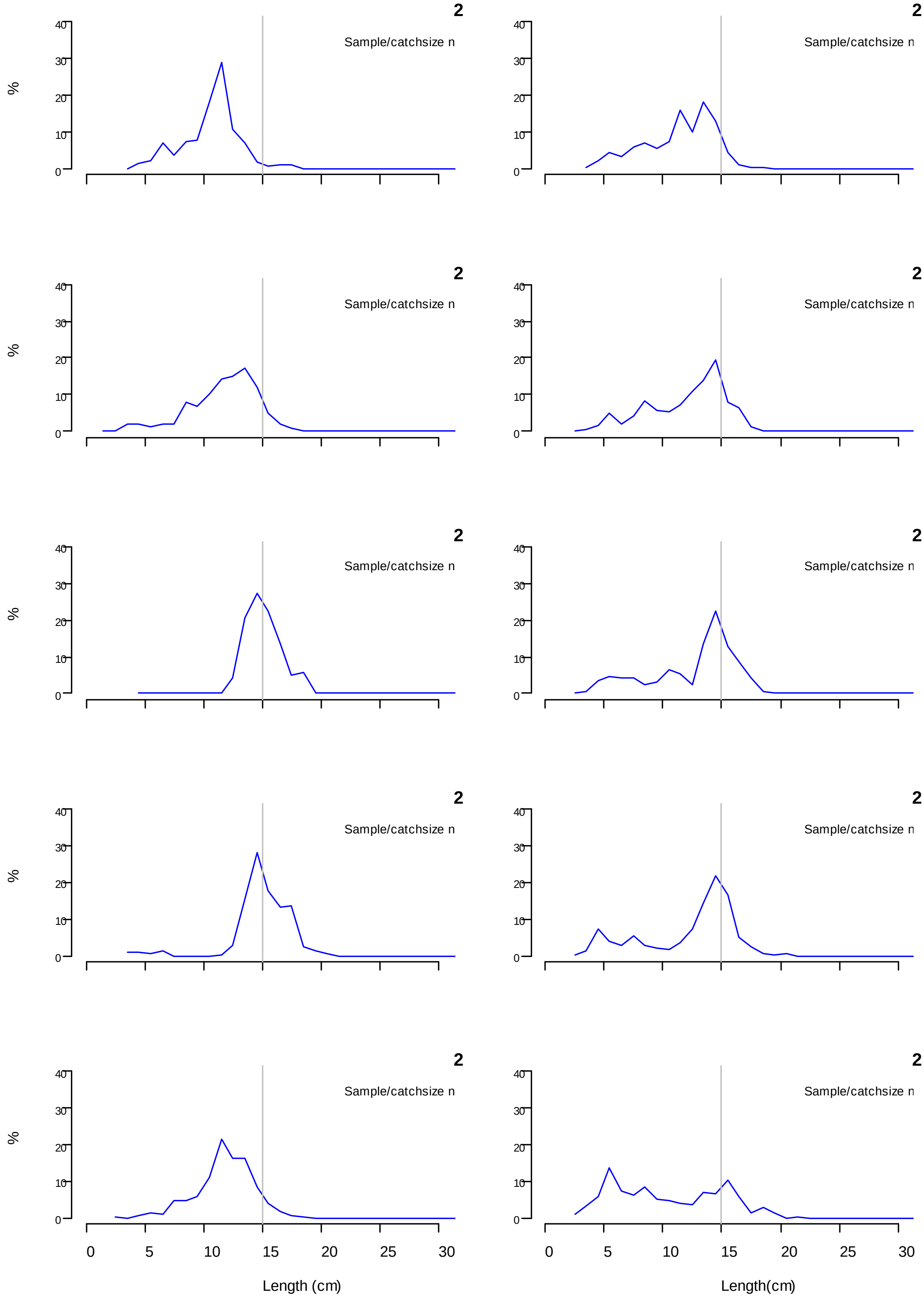

Figure 9.3.1. Length–frequency distributions for roundnose grenadier, 1984–2013. Data from Norwegian shrimp survey, all catches deeper than 300 m. Length is measured as pre-anal fin length in cm. The distributions are calculated as percent number of fish in each cm length interval standardized to total catch number and trawling distance for each station each year.

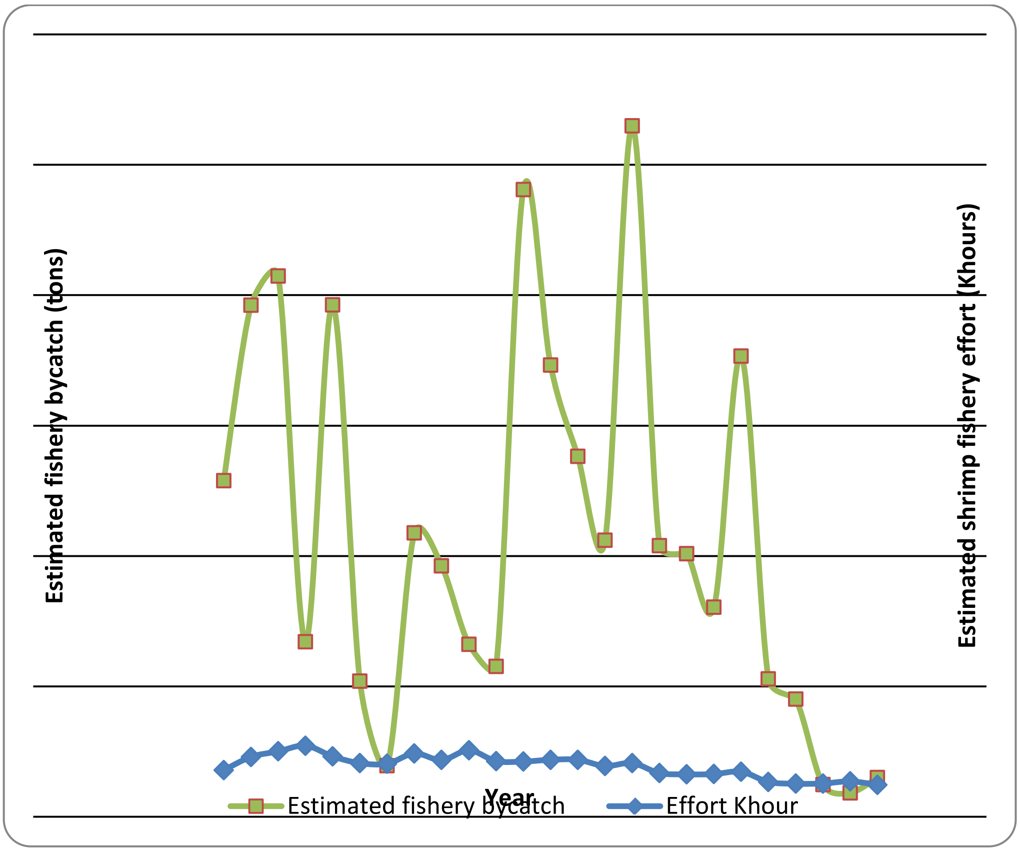

Figure 9.3.2. Estimated bycatch of roundnose grenadier in the Norwegian shrimp fishery in ICES Division IVa and IIIa, and the estimated commercial shrimp fishery effort in the same area. See text for explanation.

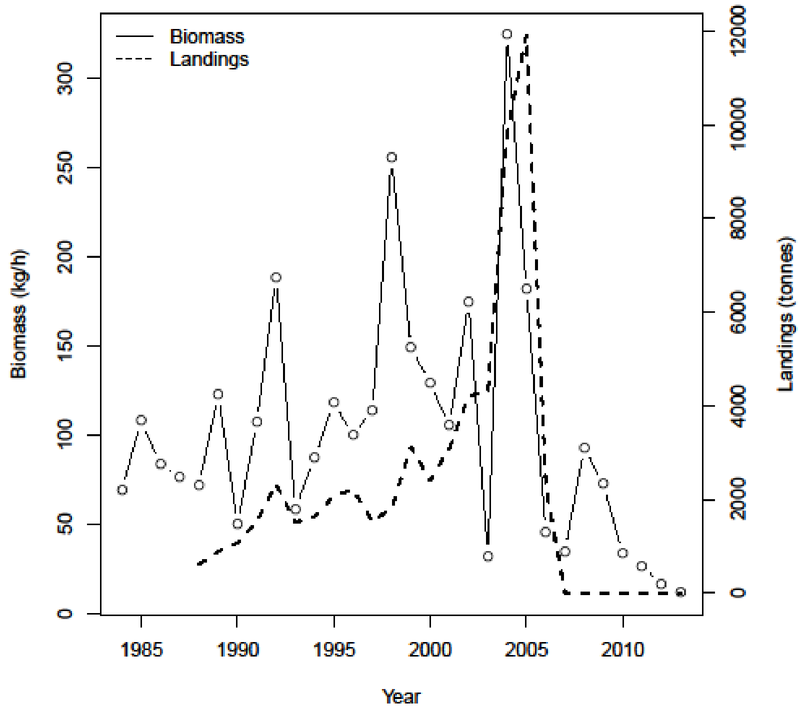

Figure 9.3.3. Survey catches rates (kg/h) of grenadier 1984–2013 (circles) and landings. Note: in 1984, 2003, 2006, and 2007 only a single or no trawls were made deeper than 400 m. Thus the primary grenadier habitat was not sampled.

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. The fishery is mainly conducted using pelagic trawls although on some seamounts it is possible to use bottom gear.

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 blue ling fishery.

There is no information about target fishery of roundnose grenadier on the MAR in 2006 and 2007. In 2008 and 2009 Russian trawlers made attempts at fishing with pelagic and bottom trawls in the southern part of the Division XIIc. Total catches were 30 t and 12 t respectively including 13 t and 5 t of roundnose grenadier.

In 2010 Spanish trawlers started new target fishery of grenadiers in the Division XIVb. Catches of macrouridae (*M. berglax* and *C. rupestris* combined) were 1618 t (according to official Data). In the same year Russian trawler caught 73 t roundnose grenadier during a short-term fishery (two days) in the southern part of the Division Xb.

In 2011 the scale of the Spanish fishery in Division XIVb1 substantially increased and its catch of roundnose grenadier amounted to 3246 t. According to official data in 2012 the total Spanish catch consisted of 1876 t. There was also unallocated bycatch of 7326 t. Thereby, total estimated catch in 2012 has reached 9202 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".

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). In the international waters there are NEAFC regulations of efforts in the fisheries for deep-water species.

9.4.2 Data available

9.4.2.1 Landings and discards

Data on catches 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 fishmeal processing. There is no information on discards by vessels of other countries.

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 curves in 2003 and 2010 are generally similar; however, in 2010 the number of small immature grenadier up to 50 cm in length was lower.

There are no biological data from MAR for 2012. In 2011 only juvenile individuals were occasionally caught by pelagic trawl during Redfish survey in the Irminger Sea at a depth 300–750 m. Total length of 15 specimens varied from 8 to 21 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 Figure 9.4.1. The data for 2000–2012 are presented together with data for the period 1973–1999. There are gaps in the cpue time-series due to lack of catch statistics for 1973 and 1982, and absence of target fisheries 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 the Russian fleet in 2003–2005 (Table 9.4.5). According to official data in 2012, the Spanish fleet worked on the MAR for 139 fishing days with average catch per fishing day of 13.5 t.

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 9.4.1). The cpue varied strongly, but generally declined in the 1978; 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 efforts data is available. It demonstrated a low level. If unallocated catches are taken into consideration the average catch would be 66.2 t/day. But, this information is only preliminary.

The most recent trawl acoustic survey was carried out by Russian R/V "Atlantida" in October 2010 in the southern part of fishing area (44–50° N), where 17 seamounts were surveyed (Figure 9.4.3). 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 9.4.4) as compared to 1970s–1980s, when it was mainly from 600 to 1200 m (Chuksin, 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 comparatively 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, permanent 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.

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.

9.4.4 Comments on the assessment

No analytical assessments were carried out.

9.4.5 Management considerations

WGDEEP considers that the advice given in 2010 is appropriate: "Fishery should not be allowed to expand and a reduction in catches should be considered". The basis for the quantitative advice given in 2012 based on the ICES DLS framework is considered to be weak and this advice requires further consideration. (See Section XX).

Table 9.4.1. Working group estimates of catch of roundnose grenadier from Subdivision Va1.

Year	USSR/ Russia	Total
1973	820	820
1974	12 561	12 561

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			
2010	73		73
2011			
2012[1]			

[1]–preliminary data.

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]	Total
1973	226				226
1974	5874				5874
1975	29 894				29 894
1976	4545				4545
1977	9347				9347
1978	12 310				12 310
1979	6145				6145
1980	17 419				17 419
1981	2954				2954
1982	12 472				12 472
1983	10 300				10 300
1984	6637				6637
1985	5793				5793
1986	22 842				22 842
1987	10 893				10 893
1988	10 606				10 606
1989	9495				9495
1990	2838				2838
1991	3214[1]		4296		7510[1]
1992	295		1684		1979
1993	473		2176	263	2912
1994			675	457	1132
1995				359	359
1996	208			136	344
1997	705	5867		138	6710
1998	812	6769		19	7600
1999	576	546		29	1151
2000	2325				2325
2001	1714			2	1716
2002	737				737
2003	510				510
2004	436			8	444
2005	600				600
2006				1	1
2007				2	2
2008	13				13
2009	5				5
2010					
2011					
2012[3]					

[1]– revised catch data [2]– official ICES data [3]– preliminary data.

Table 9.4.4. Working group estimates of catch of roundnose grenadier from Subdivision XIVb1.

Year	USSR/ Russia	Spain	Unallocated	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		1618[3]		1618[3]
2011		3247[1]		3247[1]
2012[4]		1876	7326	9202

[1]– revised catch data [2]– official ICES data [3]– *C. rupestris* and *M. berglax* combined [4]–preliminary data.

Table 9.4.5. Soviet/Russian and Spanish 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	
2010	Xb	2	
2011	XIIa1+XIIc, XIVb1, Xb		
2012[1]	XIVb1	139[2]	13.5[2]

[1] - preliminary data [2]– according to official Spanish data.

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	18086*	12 274
494-B		8227
495	977	1350
495-B	Not surveyed	241
496-A	Fish records are weak	1573
TOTAL	35099	59 364

*** – total for two seamounts.**

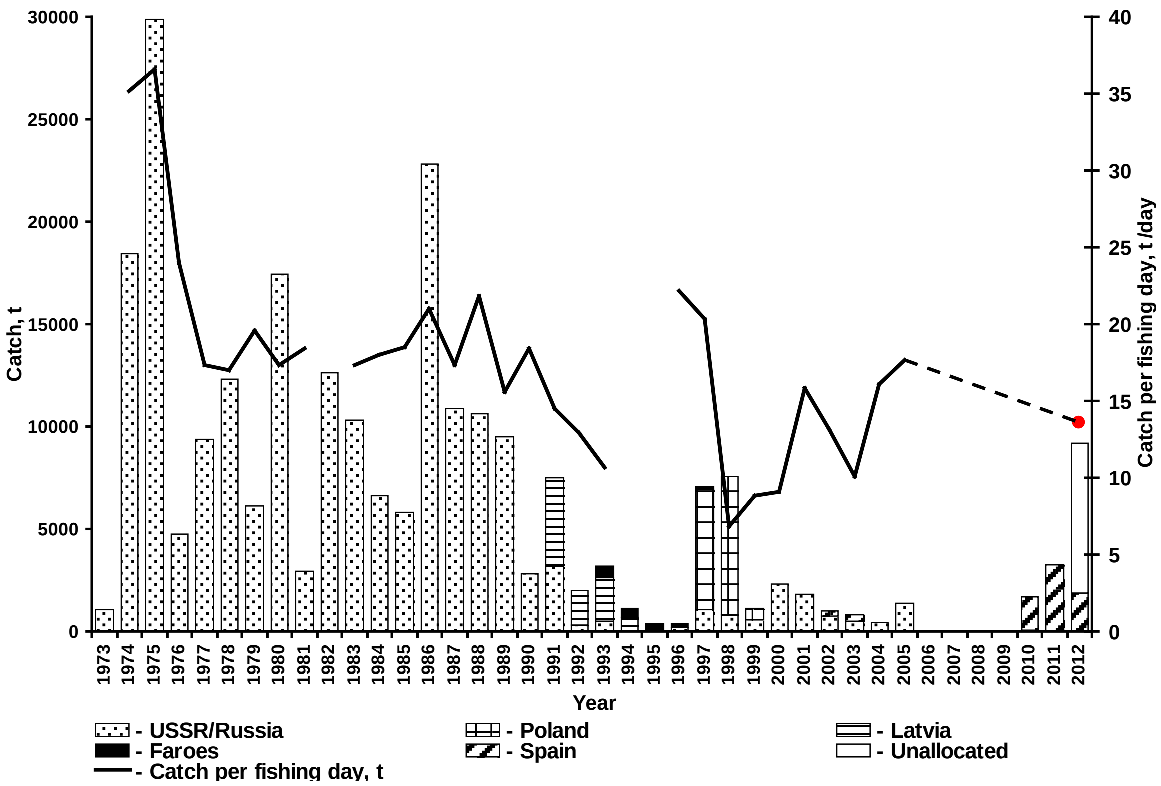


Figure 9.4.1. International catch in 1973–2012 ,Soviet/Russian and Spanish (red mark) cpue of roundnose grenadier on the MAR in 1973–2005.

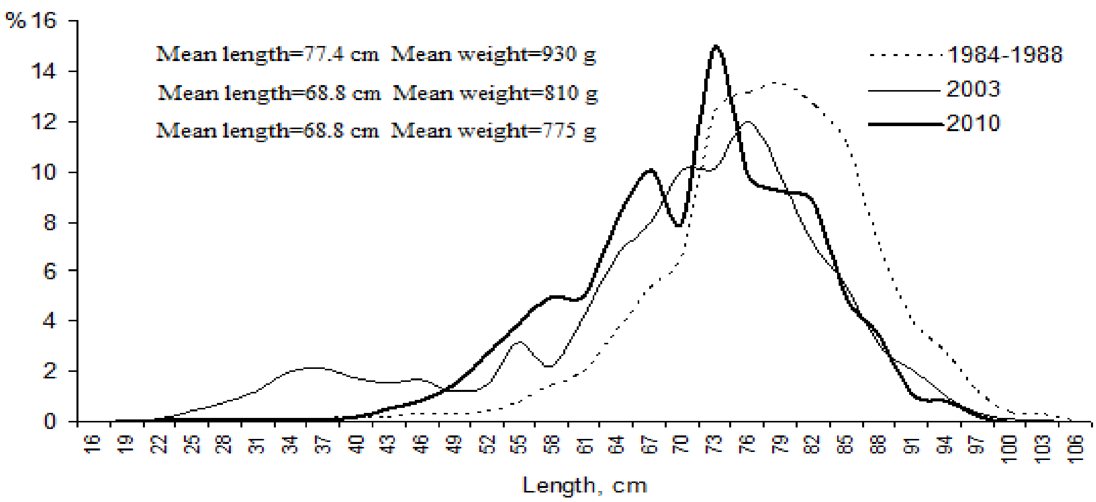


Figure 9.4.2. Total length composition of roundnose grenadier on the MAR in 1984–1988 (47–51°N), in 2003 (47–51°N) and in 2010 (47–50°N).

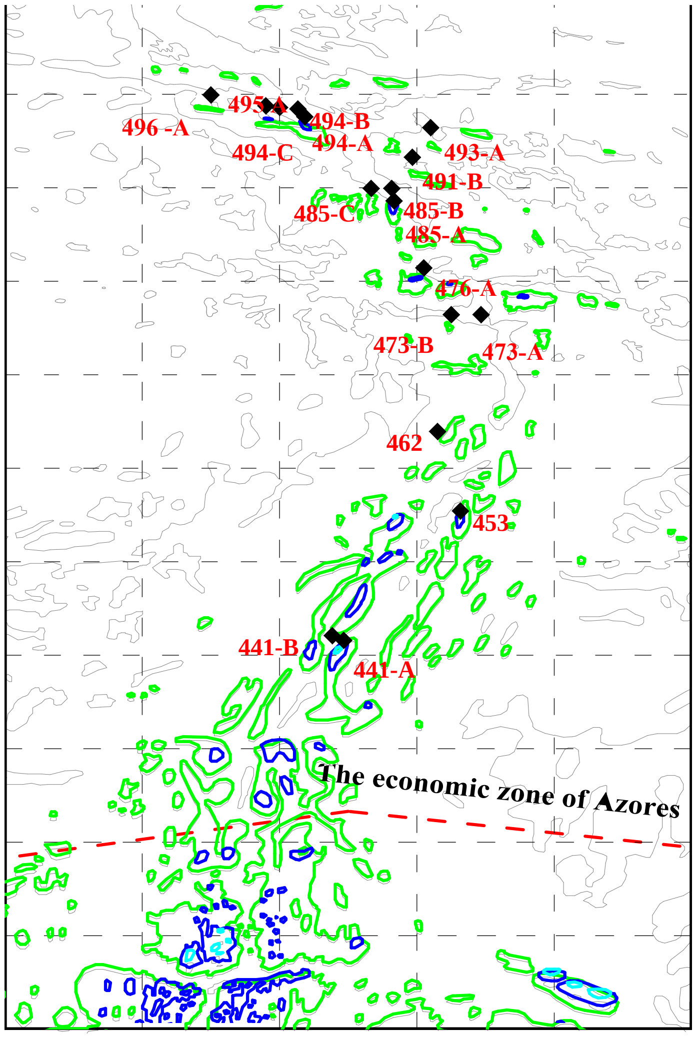


Figure 9.4.3. Location of seamounts surveyed at R/V "Atlantida" on the MAR in October 2010.

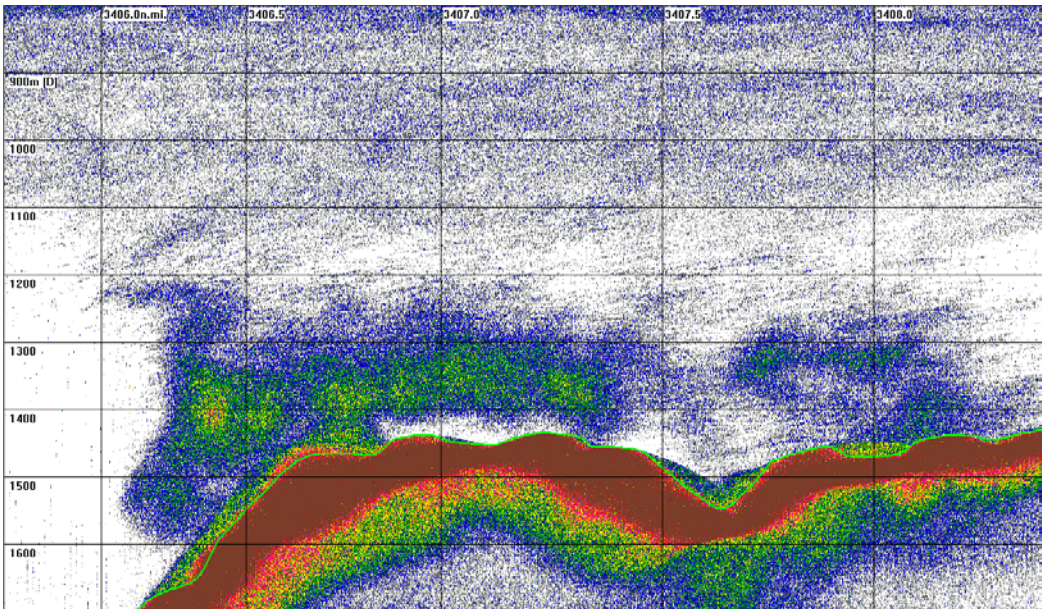


Figure 9.4.4. Echorecords of roundnose grenadier at the MAR seamount 494-A in October 2010.

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, catches of roundnose grenadier were insignificant.

9.5.1.1 Landings trends

Landing statistics by nations in the period 1990–2012 are presented in Tables 9.5.1–9.5.5.

In the Subareas I and II, the catch of roundnose grenadier in 2012 amounted to 5 t and was taken as bycatch by the Norwegian fleet. From 1990 catches varied from 0 to 106 t (Figure 9.5.1). France substantially contributed to the total catch in 1990–1992, when roundnose grenadier was taken as bycatch in the fisheries for saithe *Pollachius virens* and other gadoids. In 1997–1998, when total catch exceeded 100 t, the major contribution was made by Norway. Roundnose grenadier was partly taken in mixed deep-water fisheries; directed local fisheries in Norwegian fjords for this species also exist.

In Subarea IV, the catch of roundnose grenadier in 2012 comprised 14 t which was taken by the French and Norwegian fleets. During 1990–2012 total catches in this area varied between 0 and 521 t (Figure 9.5.2). The main contribution to the total catch in 1990–1994 (167–521 t) was made by the French fleet that conducted directed fishery in Division IVa off the Shetland Islands. Roundnose grenadier is caught as incidental bycatch in this area by Scottish vessels in insignificant amount as well. In this area, reported catch may include a high proportion of misreported roughhead grenadier.

During 1990–2012, the catches of roundnose grenadier within Icelandic waters (Division Va) varied from 2 to 398 t and were made by Iceland (Figure 9.5.3). Maximum catches were registered in 1992–1997 when 198–398 t were caught annually as bycatch in mixed deep-water fisheries. In recent years, roundnose grenadier catches from 16 to 81 t were taken in Icelandic waters as bycatch in trawl fisheries for Greenland halibut and redfish. In 2012 catch in Va amounted to 81 t.

Roundnose grenadier catches in Subareas VIII and IX during 1990–2012 were minor and amounted 0 to 28 t annually (Figure 9.5.4). The main contribution to the total catch was made by France. In 2012 catch from the subareas comprised less than 1 t.

Total catch in Greenland waters (Subdivision XIVb2) in 1990–2012 amounted to 2–126 t (Figure 9.5.5). There is no directed fishery for roundnose grenadier in these areas. The majority of catches is taken as bycatch by Greenland, Germany and Norway during Greenland halibut bottom-trawl fisheries.

9.5.1.2 ICES Advice

ICES advice for 2013 and 2014 was: " 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 (Table 9.5.6). In international waters there is 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 Tables 9.5.1–9.5.5. No discard data are available.

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 2012.

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 2012.

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 genadier from Subareas I and II.

Year	Faroes	Denmark	France	Germany	Norway	Russia/USSR	Germany	UK (E+W)	UK (Scot)	TOTAL
1990			32	2		12	3			49
1991			41	3	28					72
1992		1	22		29					52
1993			13		2					15
1994			3	12						15
1995			7							7
1996			2							2
1997	1		5		100					106
1998					87	13				100
1999					44	2				46
2000										0
2001								2		2
2002					11	1				12
2003					4					4
2004					27					27
2005			1		12					13
2006					6	2				8
2007					11	1				12
2008					10					10
2009					8					8
2010			5		17	6				27
2011			15		16					31
2012*					5					5

*** Preliminary data .**

Table 9.5.2. Working group estimates of landings of roundnose genadier from Subarea IV.

Year	France	Germany	Norway	UK (Scot)	Denmark	TOTAL
1990	370	2				372
1991	521	4				525
1992	421			4	1	426
1993	279	4				283
1994	185	2			25	212
1995	68	1		15		84
1996	59			5	7	71
1997	1			10		11
1998	35					35
1999	56		5			61
2000	2					2
2001	2				17	19
2002	11		1	26		38
2003	5		1	11		17
2004	5			1	371	377
2005	18		2			20
2006	7		4			11
2007	25		1			25
2008	1					1
2009	0					0
2010	27		2	0		30
2011	0		0	0		1
2012*	13		1			14

*** Preliminary data.**

Table 9.5.3. Working group estimates of landings of roundnose genadier 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

*** Preliminary data, ** includes other grenadiers from 1990 to 1996.**

Table 9.5.4. Working group estimates of landings of roundnose genadier 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

*** Preliminary data.**

Table 9.5.5. Working group estimates of landings of roundnose genadier from Division XIVb2.

Year	Faroes	Germany	Greenland	Iceland	Norway	UK (E+ W)	UK (Scot)	Russia	TOTAL
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

*** 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	49	372	7	5	47	0	480
1991	72	525	48	1	29	0	675
1992	52	426	210	12	31	0	731
1993	15	283	276	18	26	0	618
1994	15	212	210	5	15	0	457
1995	7	84	398	0	27	0	516
1996	2	71	140	1	25	0	242
1997	106	11	198	0	57	0	373
1998	100	35	120	20	126	0	402
1999	46	61	129	16	124	0	382
2000	0	2	54	5	57	0	118
2001	2	19	40	7	97	208	373
2002	12	38	60	3	47	504	664
2003	4	17	57	2	21	952	1 054
2004	27	377	181	2	30	0	617
2005	13	20	76	7	14	0	131
2006	8	11	62	28	53	0	162
2007	12	25	16	10	2	0	65
2008	10	1	29	8	12	0	60
2009	8		46	1	2		57
2010	27	30	59	1	40		157
2011	31	1	62	1	36		131
2012*	5	14	81	0	1		101

*** Preliminary data.**

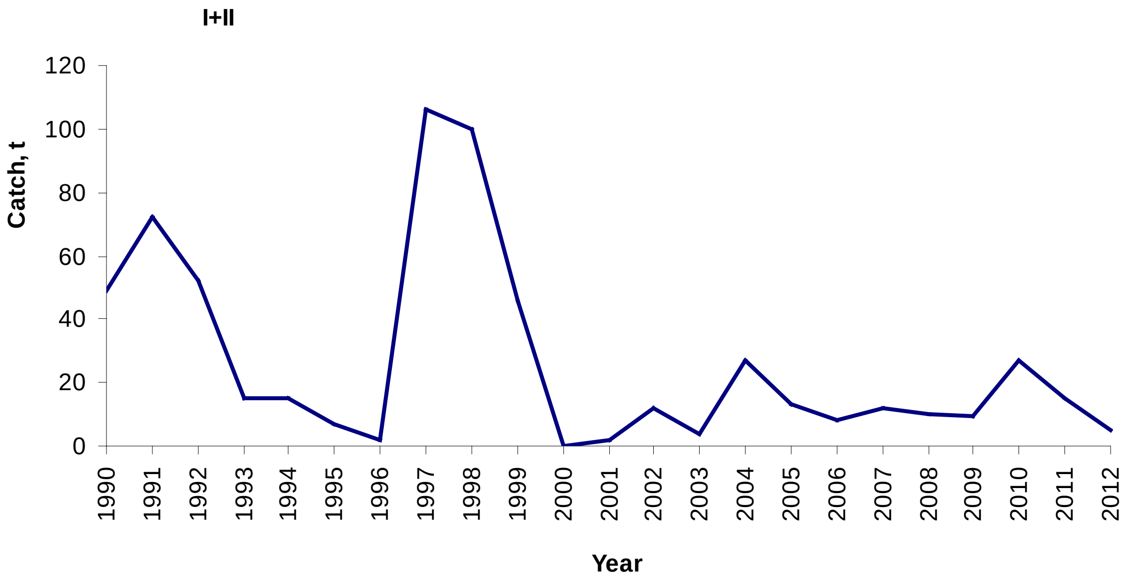


Figure 9.5.1. Roundnose grenadier catches in Subareas I and II, 1990–2012 (data for 2012 is preliminary).

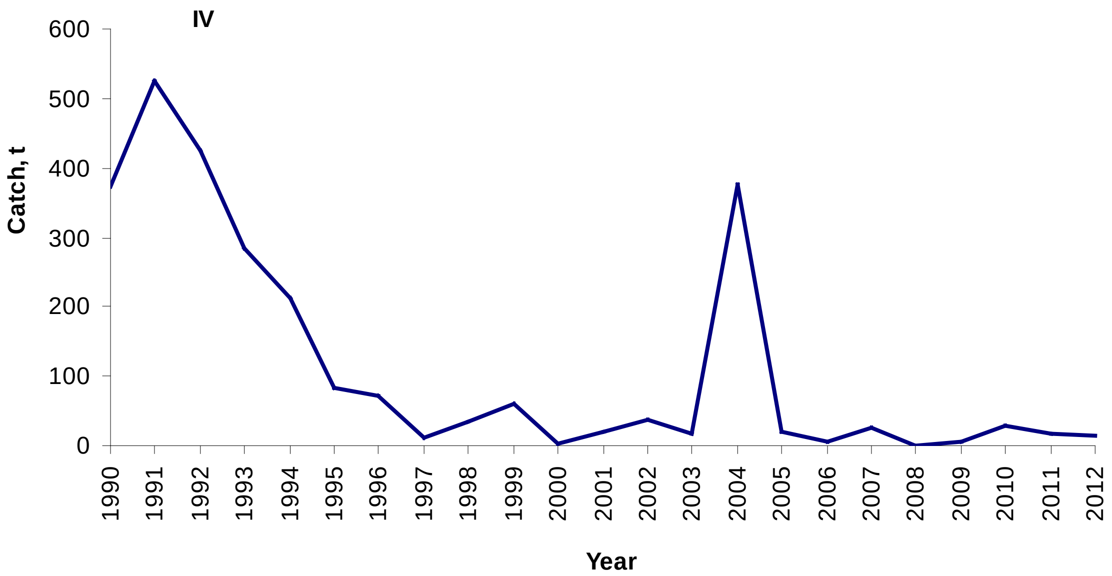


Figure 9.5.2. Roundnose grenadier catches in Subareas IV, 1990–2012 (data for 2012 is preliminary).

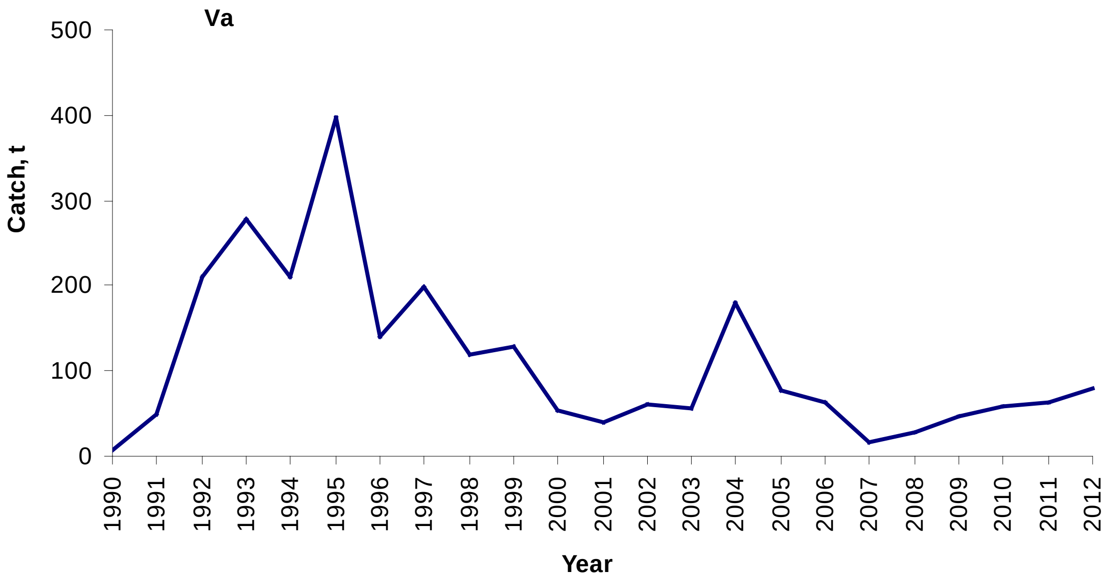


Figure 9.5.3. Roundnose grenadier catches in Division Va, 1990–2012 (data for 2012 is preliminary).

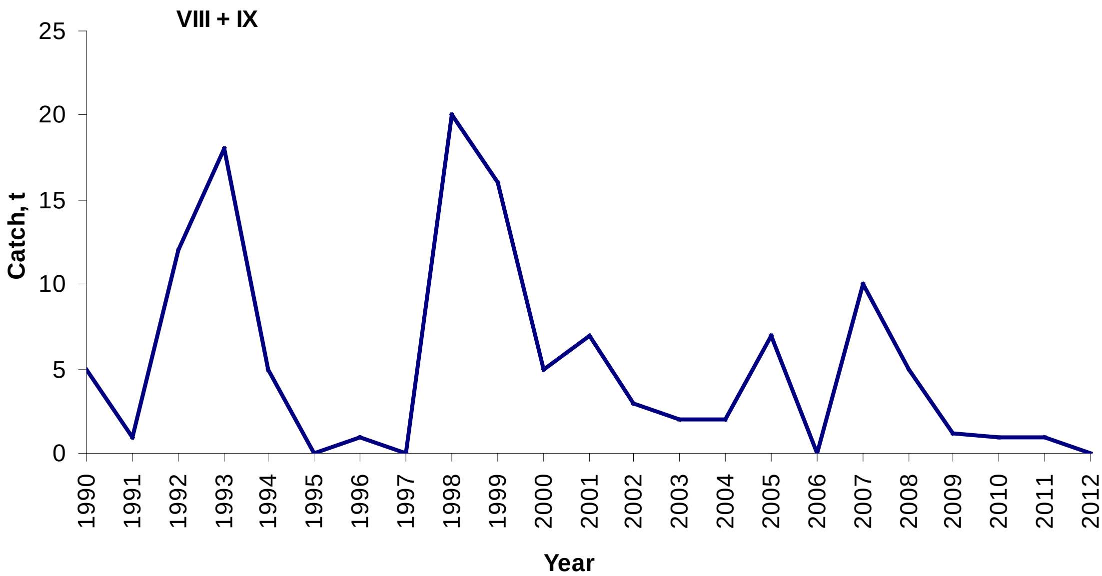


Figure 9.5.4. Roundnose grenadier catches in Subareas VIII–IX, 1990–2012 (data for 2012 is preliminary).

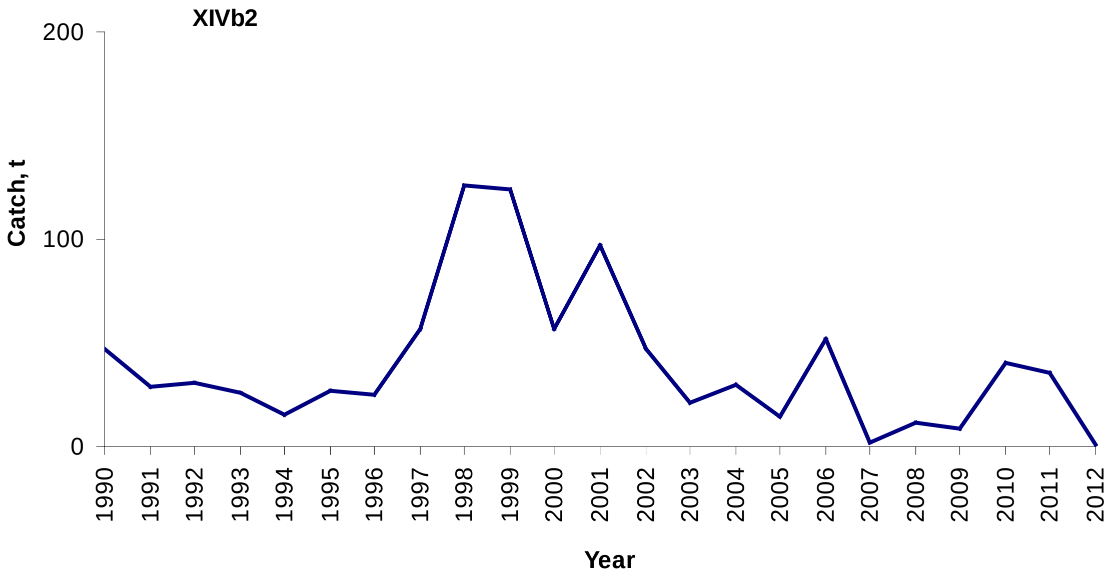


Figure 9.5.5. Roundnose grenadier catches in Subarea XIVb2, 1990–2012 (data for 2012 is preliminary).

10 Black scabbard fish (*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 occurs only sporadically north of the Scotland-Iceland-Greenland ridges. Juveniles are mesopelagic and adults are benthopelagic. It is admitted that the species life cycle is not completed in just one area and also that either small or large scale migrations occur seasonally. It has been postulated that fish caught to the west of the British Isles are pre-adults that migrate further south.

The stock structure is uncertain. Three management units are considered:

i) Northern (Divisions Vb and XIIb and Subareas VI and VII);

ii) Southern (Subareas VIII and IX);

iii) Other areas (Divisions IIIa and Va Subareas I, II, IV, X, and XIV).

The Northern component comprises fish exploited mainly by trawl fisheries while the southern component by a longline fishery in Subarea IXa. In other areas the species is exploited by both longliners and trawlers, but the overall landings are much lower than at the other two management units.

10.2 Black scabbard fish in Subareas Vb and XIIb and Divisions VI and VII

10.2.1 The fishery

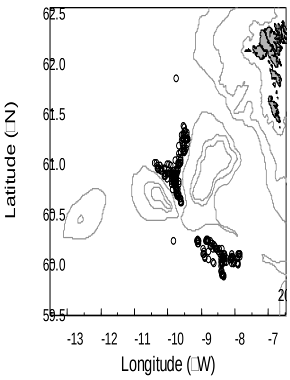


Figure10.2.1. Faroese main fishing grounds of black scabbardfish in Subarea Vb (fishing hauls in which the species contributed with more than 50% of the total catch).

In Subarea Vb black scabbardfish is fished by large trawlers and the main fishing area is on the slope around the Faroe Bank (Figure 10.2.1).

In 2013, 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 this assessment unit are described in the stock annex.

Total landings from the ICES Subareas Vb and Divisions VI, VII and XII show a markedly increasing trend from 1999 to 2002 followed by a decreasing trend till 2005 (Figure 10.2.1). In 2006 there was a peak in landings and then there was a decrease mainly due to continuous decreases of landings from ICES Divisions VI and VII (Figure 10.2.1). From 2009 till 2012 landings fluctuated around 4000 t and in 2012 landings from ICES Subarea XII have remarkably increased.

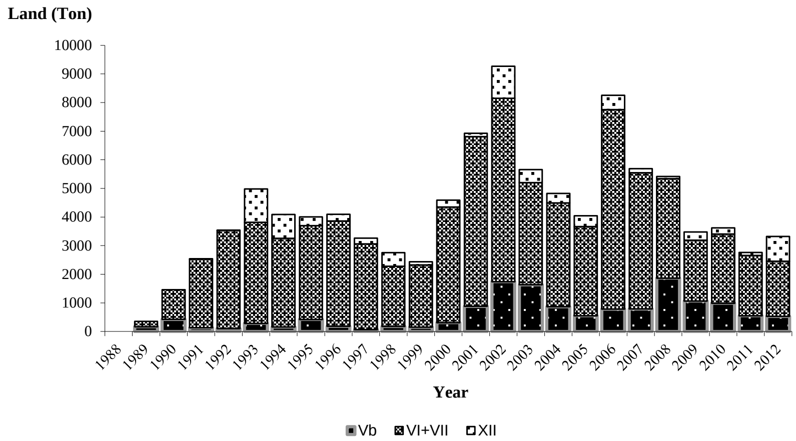


Figure10.2.1. Annual landings for ICES Subareas Vb and Divisions VI+VII and XII (2012 provisional data).

In earlier years French landings represent more than 75% of the northern component total landings. Between 2006 and 2010 French landing represent less than 50%. During that period both Faroese and Spanish landings increase their relative contribution for the landings (Figure 10.2.2). The situation altered after 2010, both in 2011 and 2012 French landings represent nearly 80% of the total landings which are mainly derived from ICES Subarea VI.

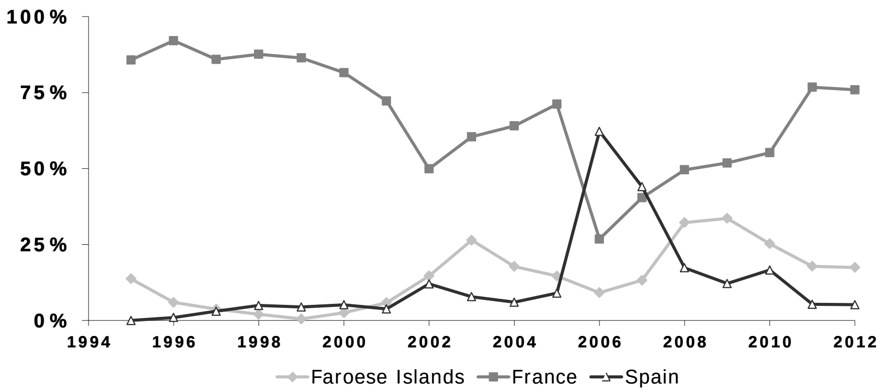


Figure 10.2.2. French, Spanish and Faroese relation contribution to the annual landings for Northern Component (NC).

10.2.2.1 ICES Advice

The ICES advice for 2013 and 2014, based on the ICES approach for data-limited stocks was: “catches should be no more than 4700 tonnes”.

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. Since 2007 bi-annual TACs were adopted. 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	2966
2011	2356	2269
2012*	2179	2016
2013	3051	

*** landing estimates are preliminary.**

10.2.4 Data available

10.2.4.1 Landings and discards

New 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 (Table 10.2.0). Excluding 2007 in ICES Subareas VI and VII, the annual discards of black scabbardfish were low.

Table 10.2.0. Raised discards estimates for the Spanish "fresh" fleet in ICES areas (these data not included information from the Basque country and from 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)	

10.2.4.2 Length compositions

No new length distributions of back scabbardfish have been provided.

10.2.4.3 Age compositions

No data on age data are available.

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 predominance of small and immature specimens.

10.2.4.6 Catch, effort and research vessel data

No new research survey data or effort information have been provided to the WG.

10.2.5 Data analyses

No data analyses were performed because this is not an advice year for this stock.

10.2.6 Management considerations

No management considerations are made because this is not an advice year for this stock. Note that in 2012 the management advice was given based on the use of the harvest control rule developed by WKLIFE 2012.

Table 10.2.1a. Landings of black scabbard fish from Division Vb. Working group estimates.

Year	Faroese Islands			France	Germany*		Scotland	E&W&NI	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	45	370		115	-	-	-	-	**530**

Table 10.2.1b. Landings of black scabbard fish 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	492		.	-		**492**
2007	-	134	0	.	-		**134**
2008	-	70	0	4	.		**74**
2009	-	127		-	.		**127**
2010	1	188	-	-	.		**189**
2011	1	82	-	-			**83**
2012	-	47	-	-		810	**857**

***STATLAND data.**

***STATLAND data from 1988 to 2011.**

Table 10.2.1b. Continued.

Year	Faroese Islands	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	8	-	-	-			.	**8**

*** STATLAND data.**

Table 10.2.1c. Landings of black scabbard fish 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	4647		**6526**
2007	-	1991	4	44	37	-	-	0	53	0	-	-	-	-	-	-	2374		**4503**
2008	-	2348	0	37	0	.	.	0	26	0	14	.	-	.	.	1	870		**3296**
2009	15	1609	1	39	0	.	.	0	80	0	.	.	.	.	.	-	295		**2040**
2010	-	1778	1	72		.	.	0	73	0	.	.			.	-	415		**2338**
2011	5	1791	3	31		-	-		1	0	.	.				-	65		**1895**
2012	-	1618	0	3		-	-		34	0						-	68	587	**2312**

Table 10.2.1d. Landings of black scabbard fish 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**
2012	-	-	15	41	0	5	55	6	-	-	-	-	-	12	**133**

Table 10.2.1e. Landings of black scabbard fish from Division VI and VII. Working group estimates.

YEAR	IRELAND	E&W&NI	TOTAL
1988			
1989			**0**
1990			**0**
1991			**0**
1992			**0**
1993	8		**8**
1994	3		**3**
1995			**0**
1996		1	**1**
1997	0	2	**2**
1998	0	1	**1**
1999	1	1	**2**
2000	59	40	**99**
2001	68	37	**105**
2002	1050	43	**1093**
2003	159	5	**164**
2004	293	2	**295**
2005	79	-	**79**
2006	-	-	**0**
2007	-	-	**0**
2008	-	-	**0**
2009	-	-	**0**
2010	-	-	**0**
2011	-	-	**0**
2012	-	-	**0**

10.3 Black scabbard fish 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 have a small marginal activity in Subarea VIII.

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).

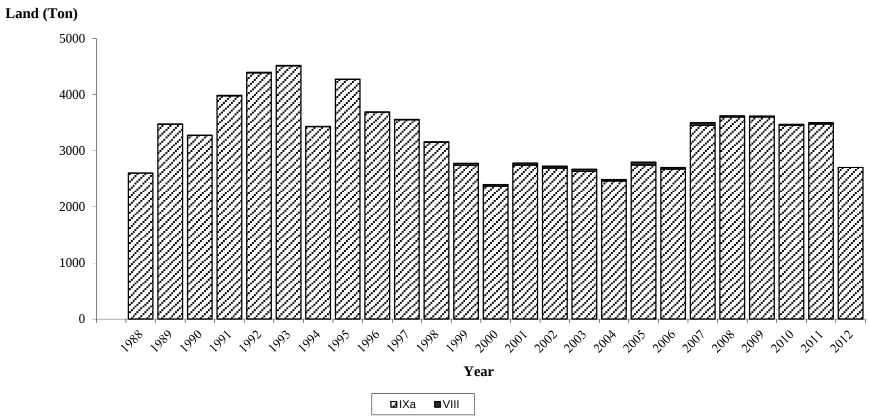


Figure 10.3.1. Annual landings for ICES Subareas VIII and Division IXa (2012 provisional data).

10.3.3 ICES Advice

The ICES advice for 2013 and 2014, based on the ICES approach for data-limited stocks was: "catches should be no more than 3700 tonnes".

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	2702	462
2013	3 700		

*** 2012 landing estimates are preliminary.**

10.3.5 Data available

10.3.5.1 Landings and discards

New information on the discards of deep-water species produced by the Portuguese on-board sampling programme (EU DCR/NP) between 2004 and 2012 was presented (Prista and Fernandes, 2013 WD). The working document presented also includes a description of the on-board sampling programme, the estimation algorithms and the data quality assurance procedures (Prista and Fernandes, 2013 WD). Sampling levels attained by onboard sampling programme in the deep-water set longlines that target black scabbardfish (LLS_DWS) between 2005 and 2012 are presented in Table 10.3.0.

Table 10.3.0. Sampling levels of the Portuguese on-board sampling programme in the Portuguese longline fleet LLS_DWS (2005–2012).

Year	Trips	Sets	Hours fished
2005	3	3	115
2006	6	5	197
2007	3	3	110
2008	4	4	157
2009	6	6	247
2010	9	9	373
2011	6	6	169
2012	9	9	380

For the 25 sets sampled on board LLS_DWS in 2008-2012, black scabbardfish was the major species discarded. However the discard rate of the species is negligible (~3.5% in number) and most of specimens discarded were damaged either because of shark or cetacean predation attacks.

10.3.5.2 Length compositions

Length–frequency distribution of the black scabbardfish landed at Sesimbra landing port (ICES IXa) by the Portuguese longline fleet is provided for 2012 (Farias *et al.*, 2013 WD). For 2012 the length distribution (Figure 10.3.2) is very similar to the one estimated for 2011 landings: the median (106 cm) is very close to the 2011 median value (105 cm).

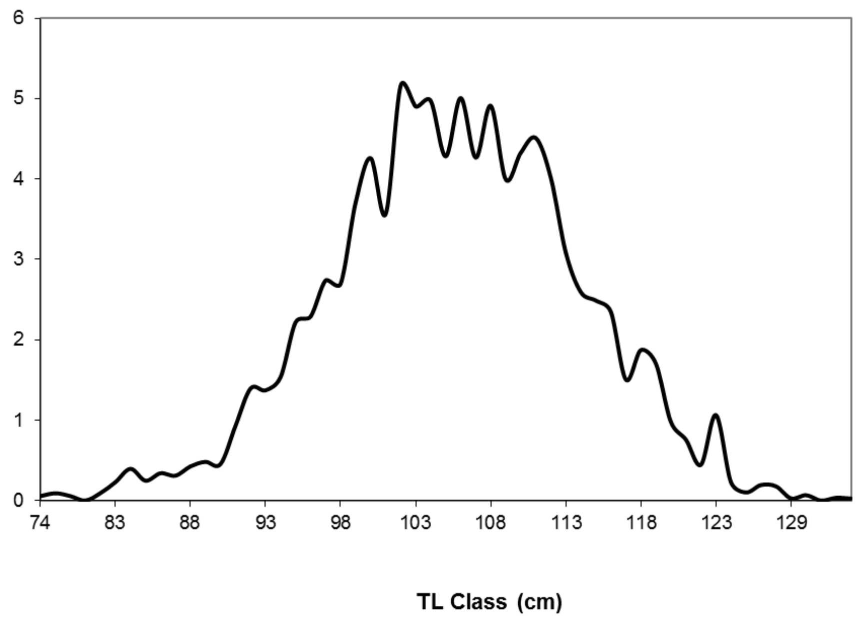


Figure 10.3.2. Length–frequency distribution of black scabbardfish extrapolated for 2012 sampled landings. The data was collected under the EU DCR/NP.

10.3.5.3 Age compositions

No new information on age has been provided to the WG.

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 only occurred in Madeira (Figueiredo *et al.*, 2003) and, in Canary Islands (Pajuelo *et al.*, 2008) and the northwest coast of Africa although it is possible that two different species may occur in these areas.

Black scabbardfish has a determinate fecundity strategy; the relative fecundity estimates ranged from 73 to 373 oocytes/female weight (g). Skipped spawning was also considered to occur; the percentages of non-reproductive females between 21% and 37% (Vieira *et al.*, 2009).

10.3.5.6 Catch, effort and research vessel data

No new data on effort have been presented.

10.3.6 Data analyses

No data analyses were performed because this is not an advice year for this stock.

10.3.7 Management considerations

No management considerations are made because this is not an advice year for this stock. Note that in 2012 the management advice was given based on the use of the harvest control rule developed by WKLIFE 2012.

Table 10.3.1a. Black scabbard fish 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	-	34	**2702**

Table 10.3.1b. Black scabbard fish 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	-	3	0	-	3	-	18	**24**

10.4 Black scabbard fish other areas (I, II, IIIa, IV, X, Va, XIV)

10.4.1 The fishery

This assessment unit is made up of diverse areas. In some of these areas fisheries have occurred sporadically or at very low levels, such as in I–IV. Those levels may just indicate that the species has a low occurrence in those areas. On the contrary, landings from other areas, particularly in X, indicate that the level of abundance of species appears to be significant.

No further information is available on the Faroese exploratory trawl fishery that is taking place in the Mid-Atlantic Ridge area, since 2008.

10.4.2 Landings trends

In ICES Subarea X landings have been variable but in recent years landings have increased, reaching 464 tonnes in 2012. Since 2010 Icelandic landings in ICES Subarea

Va have significantly increased, reaching 365 tonnes in 2012. The 111 tonnes reported in 2010 in ICES Division XIV is considered to be misreported.

10.4.3 ICES Advice

The ICES advice for 2013 and 2014 was: "Fisheries should not be allowed to expand until there is sufficient information showing that the fishery is sustainable."

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.

Both in 2009 and 2010 the TACs have been exceeded, particularly in the former year. 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	0
2013	9	

*** 2012 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 10.4.0a–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

No new information on length has been provided to the WG.

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

No new data were available.

10.4.5.6 Catch, effort and research vessel data

No new data were available.

10.4.6 Data analyses

In Subarea X, the commercial interest for the exploitation of the species has been increasing over time, but apart from the data presented for Faroese exploratory survey in 2008, the data available only refer to landings.

10.4.7 Comments on the assessment

Despite the variability on the overall landings data along years, the landing data available for different ICES subareas give evidence that the areas of major concentration of the species is at ICES Division X. This spatial aspect is consistent with the current perception on the spatial distribution of the species at NE Atlantic.

10.4.8 Management considerations

No management considerations are made because this is not an advice year for this stock.

Table 10.4.0a. Black scabbard fish other Areas II. Working group estimates of landings.

YEAR	FRANCE	FAROESE ISLANDS	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**

Table 10.4.0b. Black scabbard fish 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**

Table 10.4.0c. Black scabbard fish other Areas Va. Working group estimates of landings.

Year	Iceland	Total
1988	-	**0**
1989	-	**0**
1990	-	**0**
1991	-	**0**
1992	-	**0**
1993	0	**0**
1994	1	**1**
1995	+	**0**
1996	0	**0**
1997	1	**1**
1998	0	**0**
1999	6	**6**
2000	10	**10**
2001	5	**5**
2002	13	**13**
2003	14	**14**
2004	19	**19**
2005	19	**19**
2006	23	**23**
2007	1	**1**
2008	0	**0**
2009	15	**15**
2010	109	**109**
2011	172	**172**
2012	365	**365**

Table 10.4.0d. Black scabbard fish other Areas X. Working group estimates of landings.

YEAR	FAROESE ISLANDS	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**

Table 10.4.0f. Black scabbard fish other Areas XIV. Working group estimates of landings.

Year	Faroese Islands	Spain	Total
	XIVb		
1988	-	-	**0**
1989	-	-	**0**
1990	-	-	**0**
1991	-	-	**0**
1992	-	-	**0**
1993	-	-	**0**
1994	-	-	**0**
1995	-	-	**0**
1996	-	-	**0**
1997	-		**0**
1998	2		**2**
1999	-		**0**
2000	-	90	**90**
2001	-	0	**0**
2002		8	**8**
2003		2	**2**
2004			**0**
2005	0		**0**
2006	-		**0**
2007	0		**0**
2008	0		**0**
2009	0		**0**
2010		111	**111**
2011	0	-	**0**
2012	-	-	**0**

11 Greater forkbeard (*Phycis blennoides*) in all ecoregions

11.1 The fishery

Greater forkbeard is as a bycatch species in the traditional demersal trawl and longline mixed fisheries targeting species such as hake, megrim, monkfish, ling, and blue ling in Subareas VI, VII, VIII and IX.

Since 1988, 71% of landings have come from Subareas VI and VII. Spanish, French 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 20% of landings in this period come 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 Strait of Gibraltar by the longliner fleet targeting scabbardfish in Algeciras, Barbate and Conil. Portuguese landings of *P. blennoides* are scarce, but however important amounts of other 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 1% of total deep-water landings in the last three 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, IV and V only Norwegian landings are significant. The Norwegian longliners which fish in these areas catch *P. blennoides* as a bycatch in the ling fishery. The quantity of this bycatch depends on market price. After eight years without *P. blennoides* records, in 2002 the Norwegian fleet in Subareas I and II reported 315 t, since when the landings of this country have been reduced until 2011 to 107 t.

Trends in Division Vb show a peak in 2002 in which most of the landings were reported by Norwegian vessels. After this year the landings average around 49 t/year; however in 2001 Norway did not report any landings, and only 4 t were reported by France and UK(E+W). In last two years the Faoroese fleet became the most important country in landings in Vb and Va reaching 310 t in 2011.

Traditionally the most important landings in the Northeast Atlantic (VI and VII come from France, Norway, UK(Scotland) and Spain in some years of the series. Historical landings decreased since the peak of 4967 t in 2000 and they are specially low in 2009, 2010 and 2012 due to the low landings reported by Spain.

From 1998 to 2007, Subareas VIII and IX landed on average 467 t with a peak of 586 ton in 2007. Data of the Spanish fleet includes landings of *Phycis* spp, and in Table 11.0f an extra column shows also the Portuguese landings of *Phycis* spp. In 2009, 2010 and 2012 landings are the lowest of the series mainly due to the reduction of landings reported by Spain and the no landings of *Phycis* spp reported by Portugal.

In Subarea X landings peaked at 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).

Although many countries were involved in the fishery in former years, landings in Subarea XII are negligible since 2009 and only France reported 16 kg in 2012.

Spanish landings by subarea and gear from 2003 to 2011 are shown in Table 11.1. During this period, Spanish landings in Subareas VII and VIII came from OTB fleet (60%) and longline (33%) respectively.

11.3 ICES Advice

For 2013 and 2014 ICES advised; "Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 1000 tonnes".

The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch. The available surveys do not cover the entire distributional area of the stock. However, the surveys indicate stability in the last three years and so advice is based on the average catch over these years. Additionally, considering that exploitation is unknown, ICES advises that catches should decrease by 20% as a precautionary buffer. This results in catches of no more than 1000 t in 2013.

11.4 Management

Biannual EU TACs and landings in 2011 and 2012 by subarea are shown below. Because in some cases international landings were not available by species, these summary tables include landings of *Phycis* spp. The landings in 2011 and 2012 were well above the TAC in all subareas except X and XII. Note that landings in Subareas I, II, III and IV include Norwegian landings while only EU TACs are shown.

PHYCIS BLENNOIDES	EU TAC	TOTAL INTERNATIONAL LANDINGS	
Subarea	2011–2012	2011	2012*
I,II,III,IV	31	292	306
V,VI,VII	2028	1574	981
VIII, IX	267	785	519**
X,XII	54	11	6
Total	2380	4673	3825

***preliminary ** landings include *P. phycis*.**

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 discards

Landings are presented in Table 11.0a–h.

Preliminary estimates of discards from Basque Country (Spain) trawlers by subarea since 2003 are presented in Table 11.2. The estimates were made by taking onboard a subsample of the total discard of each haul and then extrapolated to the whole discard of the trip and to the total fleet for each year. Discarding of this species was negligible in Subareas VII and VIII; however in Subarea VI in 2008 the discards estimated were significant higher than landings reported by this fleet.

Estimated preliminary discards in weight and the length frequencies of discards from Spanish fisheries in Subareas VI, VII, VIII and North IXa are presented in Table 11.3 and Figure 11.2.

11.6.2 Length compositions

Figure 11.3 presents length–frequency distributions from 2001–2011 Spanish bottom-trawl surveys in on the Porcupine Bank (Velasco *et al.*, 2013). According to the author's analysis length distribution of greater forkbeard presents a shape similar to 2005–2006, with three different modes 16–18 cm, 26–30 cm, and 37–40 cm. The number of recruits (individuals smaller than 21 cm) is 7.8 per haul, that is the highest number after 2002, (14.2 ind./haul).

11.6.2.1 Age compositions

No new data available.

11.6.2.2 Weight-at-age

No new data available.

11.6.3 Maturity and natural mortality

No new data available.

11.6.4 Catch, effort and research vessel data

In 2012 four different surveys were used to derive biomass and mean length indices:

- Spanish bottom-trawl survey (DivisionsVIIc and VIIk). Biomass and abundance of greater forkbeard on the Porcupine Bank from 2001 to 2012 are presented in Figure 11.4.
- Itsasteka Basque Survey (Basque coast in the Division VIIIc). This survey covered a total of 7.21 km^2 in 23 fishing hauls and provided biomass indices until 400 m. Data of abundance for 2011 and 2012 are presented in the Table 11.4.
- French IBTS (Divisions VIIf,g,h,j;VIIIa, and VIId). Data of abundance and mean length of the catches have been provided for a series until 2011 (Figure 11.5).
- Irish IGFS (Divisions VIa South and VIIb). Abundance Indices (nº per hour and kg per hour) from the period 2005 to 2011. This survey provides abundance indices for the total catches and for individuals <32 cm by shelf and slope strata (Figure 11.6).

Effort (days at sea) of *Phycis* spp. from the Spanish fleet in 2012 is shown in Table 11.5.

Series of catches aggregated at the level of statistical rectangle have been provided to the WG from Basque trawlers and longliner logbooks (Figure 11.7).

11.7 Data analyses

The geographical representation of *Phycis blennoides* catches Spanish Porcupine survey in Figure 11.8 shows that forkbeard has spread almost uniformly along the bank, except the northwestern and southern parts of the central mound. Higher abundances seem to dwell in the southern and eastern part of the area. Greater forkbeard presents a remarkable increase in both biomass (20 kg/haul: 136% increase) and numbers (58 ind/haul: 98% increase). These results represent values closer to those of 2005–2006, that followed the pass of 2002 cohort. This recovery already was appointed in 2011, with an important increase in number (29.13 individuals per haul) that doubled the numbers found in the three previous years.

Itsasteka survey in a short series of data shows that greater forkbeard is found on the Basque coast (VIIIc) only in the stratas below 120 m, with a maximum abundance in 2012 (13.8 kg/km^2 and 6.5 kg/30 min) at depths between 201 and 400 m.

11.7.1 Exploratory assessment

No analytical assessment was presented in WGDEEP 2013.

11.7.2 Comments on the assessment

No analytical assessment was presented in WGDEEP 2013.

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 year after. That was especially noticeable in the preliminary landings reported for of all ecoregions in 2011 (1202 t) by the WGDEEP in 2012. After revision of these data in the WGDEEP 2013 landings increased by a factor of 2.21 reaching 2662 t. This differences between the preliminary and definitive data for a given year could led to misinterpret the analysis of the trend catches, affecting also the assessment of the stock and therefore (if there is) the biannual advice.

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	317	1257	785	11	0	2662
2012*	99	207	156	826	519	6	0	1813

***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	1							99

***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*	8	198		2		207

***preliminary.**

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	TOTAL
1988	2	0					2
1989	1	0					1
1990	10	28					38
1991	9	44					53
1992	16	33					49
1993	5	22					27
1994	4						4
1995	9						9
1996	7						7
1997	7	0					7
1998	4	4					8
1999	6	28	0				34
2000	4	26	1	0			32
2001	9	92	1	0			102
2002	10	133	5	0			149
2003	11	55	7	0			73
2004	9	37	2	2			50
2005	7	39		0,3			46
2006	8	26			6		39
2007	11	34	0	0	9	2	56
2008	10	20	0		4	11	45
2009	0	13	3		3	2	22
2010	2	45	3	1	11		61
2011	7				310		317
2012*	5	5			145		156

(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)	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*	311	9	225	86	1	194				826

[1]*Phycis* spp from 1988 to 2010.

[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)	PORTUGAL[2]	TOTAL
1988	7	29	74				423	533
1989	7	42	138				476	663
1990	16	50	218				530	814
1991	18	68	108				487	681
1992	9	91	162				440	702
1993	0	115	387				326	828
1994		136	320				286	742
1995	54	71	330				292	747
1996	25	45	429				315	814
1997	4	30	356				363	753
1998	3	38	656				384	1081
1999	8	41	361				263	673
2000	36	91	375				222	724
2001	36	83	453				154	727
2002	67	57	418				173	715
2003	28	45	387				200	661
2004	44	37	446				193	720
2005	58	22	312	0			127	519
2006	54	10	257				239	560
2007	32	14	510	0			30	586
2008	41	13	123				269	446
2009	8	13	183	0				203
2010	10	12	48			0		69
2011	13	13	295				464	785
2012*	24	6	24				466	519

***Preliminary.**

[1] *Phycis* spp from 1988 to 2012.

[2] *Phycis* spp and *P. phycis* not accounted in the total landings of the areas.

Table 11.0g. Greater forkbeard (*Phycis blennoides*) in Subarea X. Working group estimates of landings.

YEAR	PORTUGAL	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

***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

***Preliminary.**

Table 11.1. *Phycis* spp. Spanish landings (t) by Subarea and gear in the period 2003–2012.

Phycis spp			2003					2004		
Gear	VI	VII	VIII	IX	XII	VI	VII	VIII	IX	XII
LLS	64	359	103	5		1	157	242	0	
GNS		43	37	1			26	28	0	
OTB	66	541	167	34	71	57	891	112	32	34
Others	0	27	10	31					30	
			2005					2006		
Gear	VI	VII	VIII	IX	XII	VI	VII	VIII	IX	XII
LLS	1	180	148	0			376	80	1	
GNS		10	8	0			9	21	1	
OTB	146	699	97	39	3	37	653	84	28	
Others			0	18				0	42	
			2007					2008		
Gear	VI	VII	VIII	IX	XII	VI	VII	VIII	IX	XII
LLS		325	294	3			75	20	14	
GNS		2	41	4				3	29	
OTB	37	512	113	55		28	133	56	0	
Others			0	0				0		
			2009					2010		
Gear	VI	VII	VIII	IX	XII	VI	VII	VIII	IX	XII
LLS			20	5		2		0	1	
GNS			1	4		1			8	
OTB	9		58	53	37	0	21	2	15	
Others				0		20				
			2011					2012		
Gear	VI	VII	VIII	IX	XII	VI	VII	VIII	IX	XII
LLS	0	192	184	7				11		
GNS		1	19	5				1		
OTB	22	133	40	35		22	0	2	1	
Others			27	14				21	0	

Table 11.2. Landings and estimate of discards (tonnes) of *Phycis blennoides* by the Basque Country (Spain) OTB Fleet.

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
VI	Discard				7		372	13	7	3	1
	Landing	65	53	50	37	37	27	37	21	22	33
VII	Discard	0									
	Landing	13	17	27	4	5	0		2	0	4
VIII	Discard					0	0		7	2	8
	Landing	12	10	9	13	8	20	6	25	35	12

Table 11.3. Discard estimates (biomass (tonnes) and associated CV) of *Phycis blennoides* by the Spanish OTB in VI, VII, VIII and North IXa from 2003 to 2011.

		2003	2004	2005	2006	2007	2008	2009	2010	2011
VI, VII	biomass (ton)	914	586	3096	493	617	1175	513	436	1611
	CV	43	32	62	36	35	71	41	26	65
VIII, North Ixa	biomass (ton)	18	7	8	24	115	11	59	39	38
	CV	46	58	77	67	70	55	32	47	44

Table 11.4. Abundance indices of Greater forkbeard from Itsateka survey in the Basque coast (VIIIc). Abundance Biomass indices in kg/km² and kg/30 min haul.

	DEPTH STRATA			
	121–200 (m)		201–400 (m)	
year	(kg/km²)	Var.	(kg/km²)	Var.
2011	7,8	136,3	10,8	0,0
2012	10,4	163,3	13,8	64,1
	(kg/30 min)	Var.	(kg/30 min)	Var.
2011	5,0	57,5	5,6	0,6
2012	6,0	55,3	6,5	9,5

Table 11.5. Effort (fishing days) of *P. blennoides, P. Phycis* and *Phycis* spp by the Spanish fleets in 2012.

EFFORT (FISING DAYS) BY DIVISION							
	X	**XII**	**VI**	**VII**	**VIII**	**IX**	**Total**
Phycis blennoides	3	3	538	2710	3350	521	7125
Phycis phycis	17	45	23	1300	858	771	3014
Phycis spp				39	402	446	887
	20	**48**	**561**	**4049**	**4610**	**1738**	**11 026**

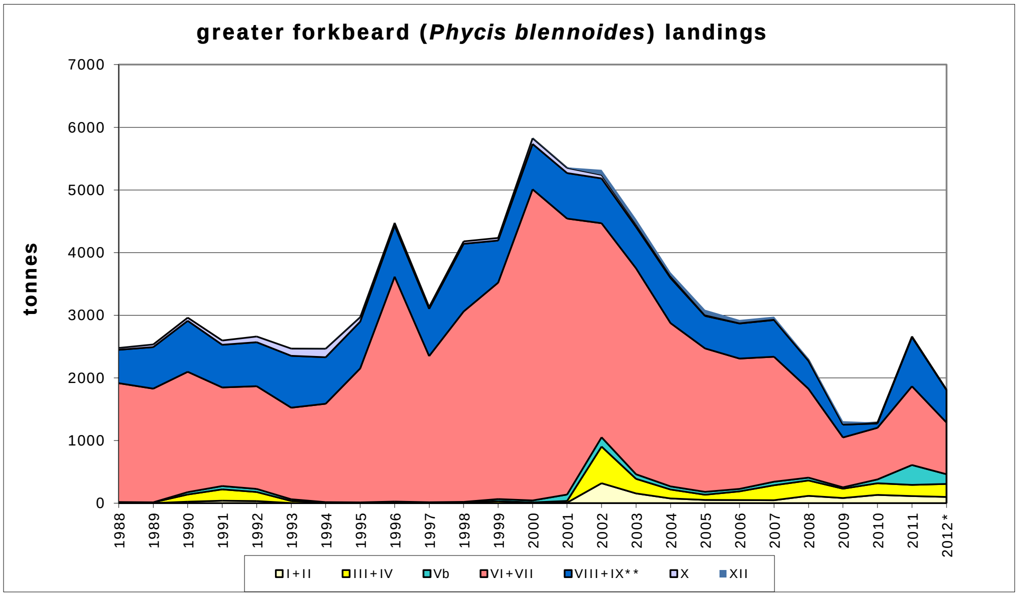


Figure 11.1. Greater forkbeard landing trends in all ICES subareas since 1988.

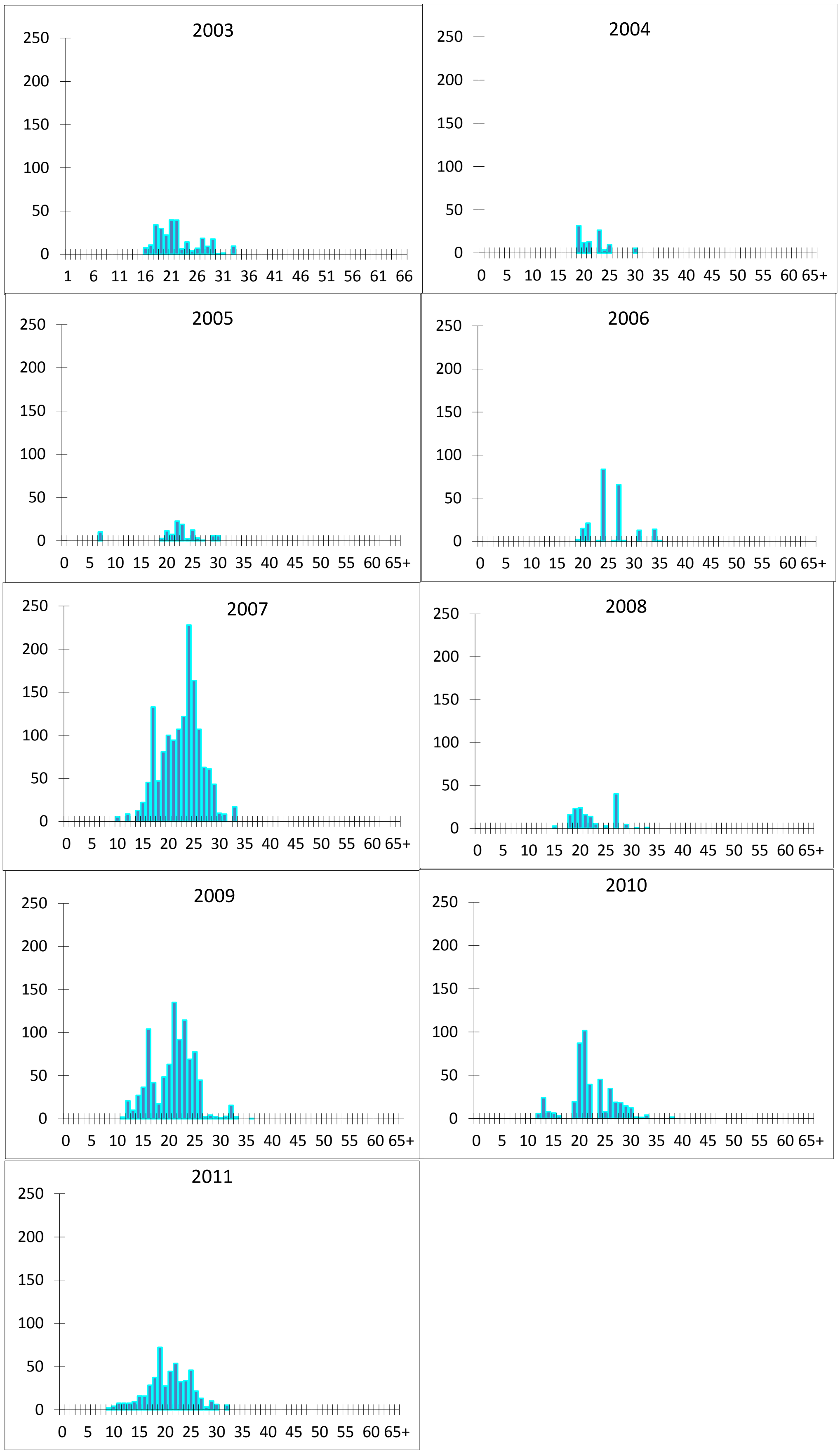


Figure 11.2a. Length frequencies of greater forkbeard discard of the Spanish fleet in VIIIc and IXa.

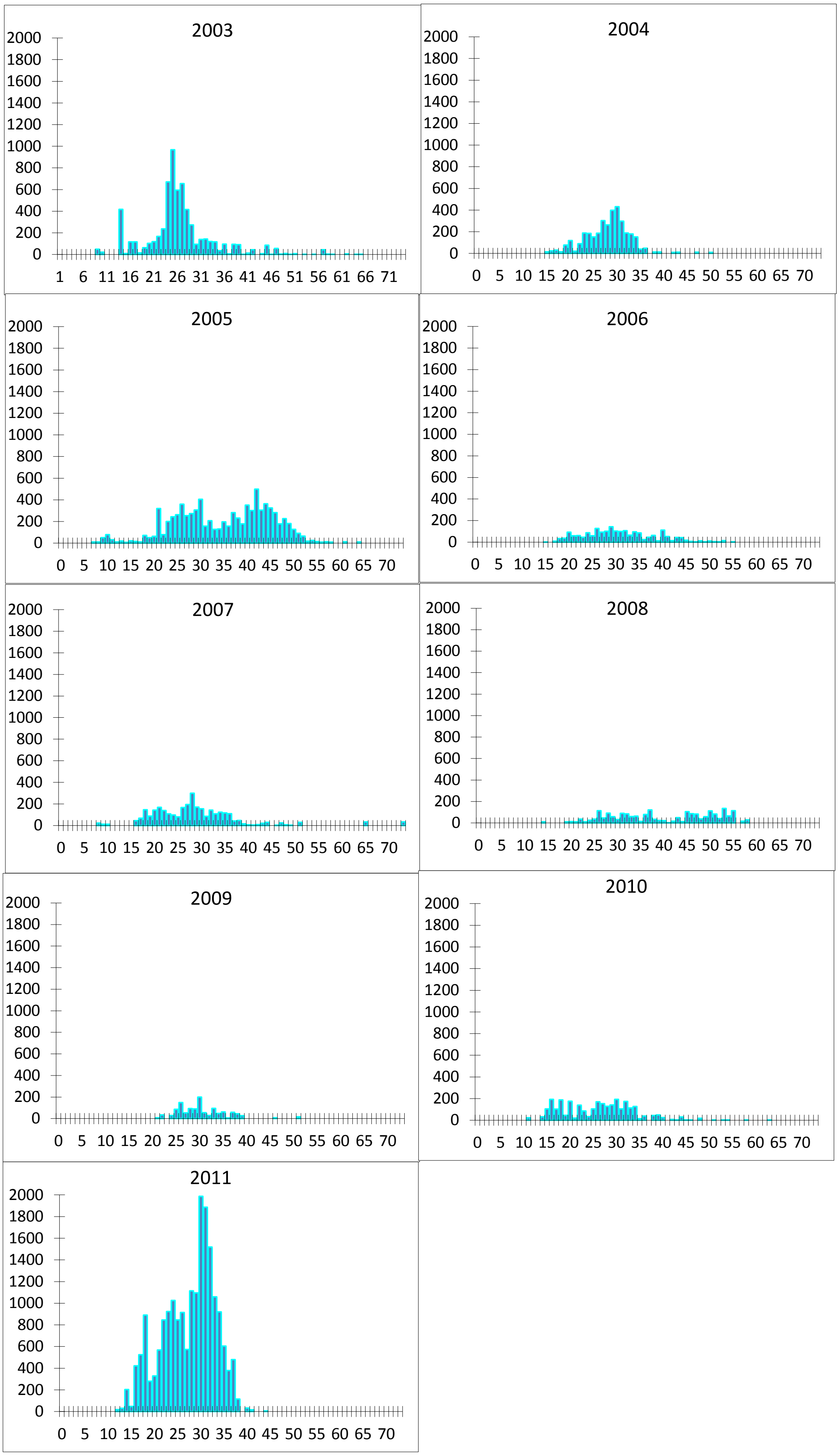


Figure 11.2b. Length frequencies of greater forkbeard discard of the Spanish fleet in VI and VII.

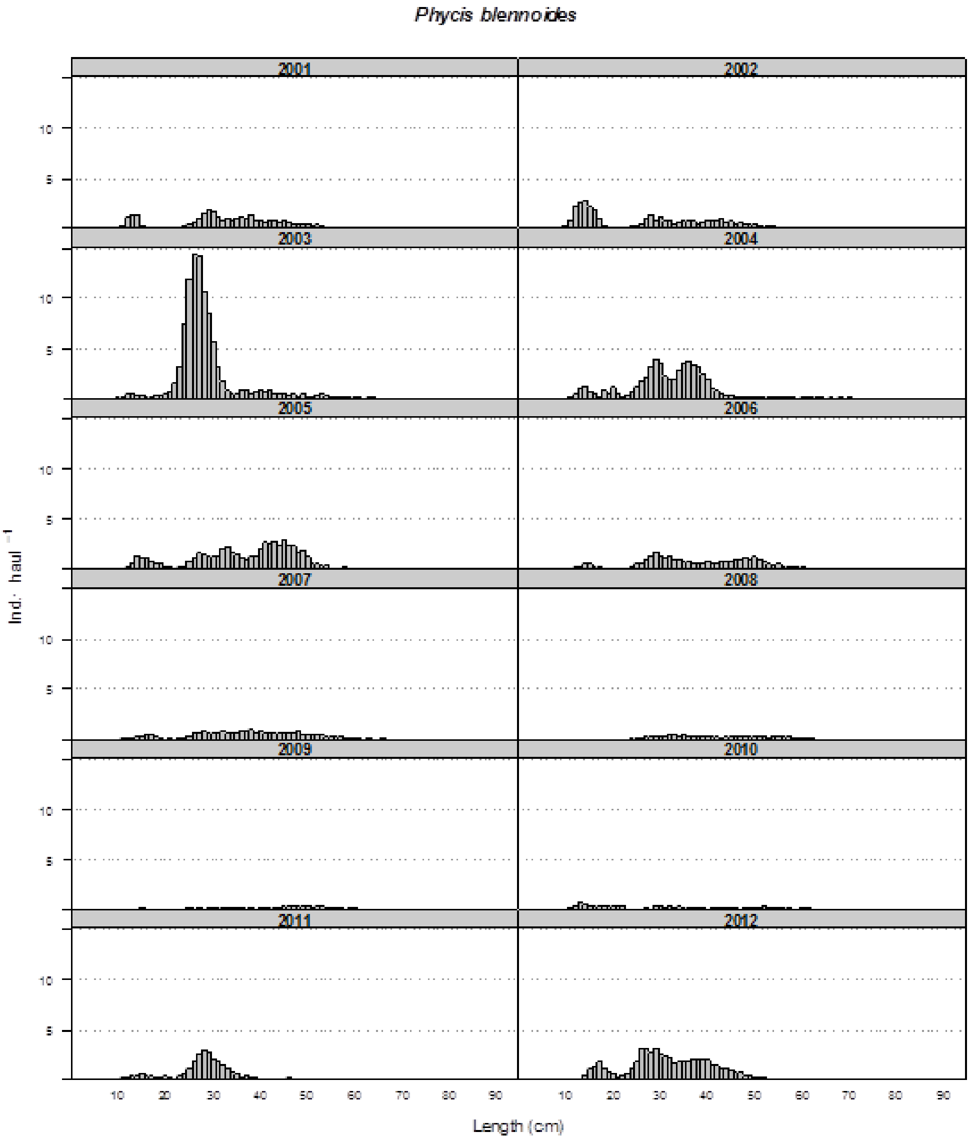


Figure 11.3. Mean stratified length distributions of *Phycis blennoides* in Spanish Porcupine surveys (2001–2012).

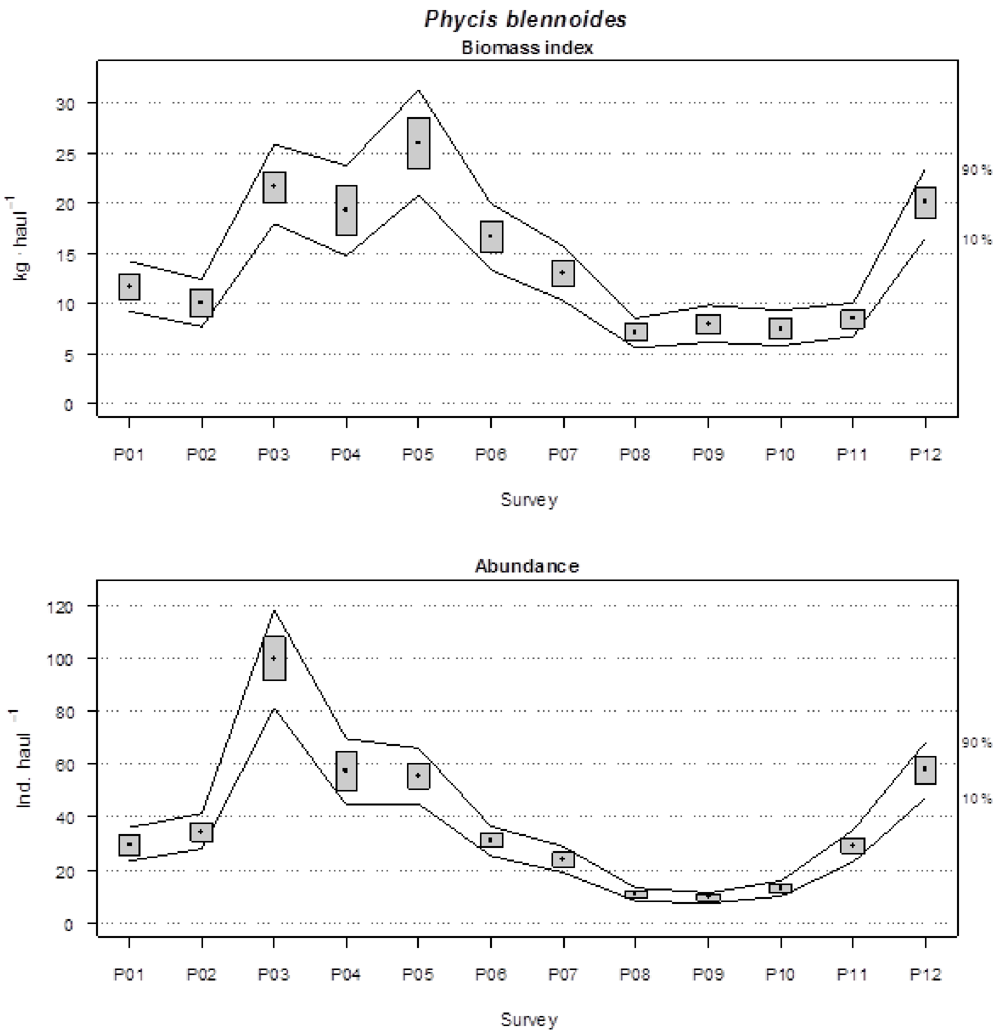


Figure 11.4. ***Phycis blennoides*** **biomass and abundance indices in Spanish Porcupine Survey time-series (2001–2012). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (a= 0.80, bootstrap iterations = 1000).**

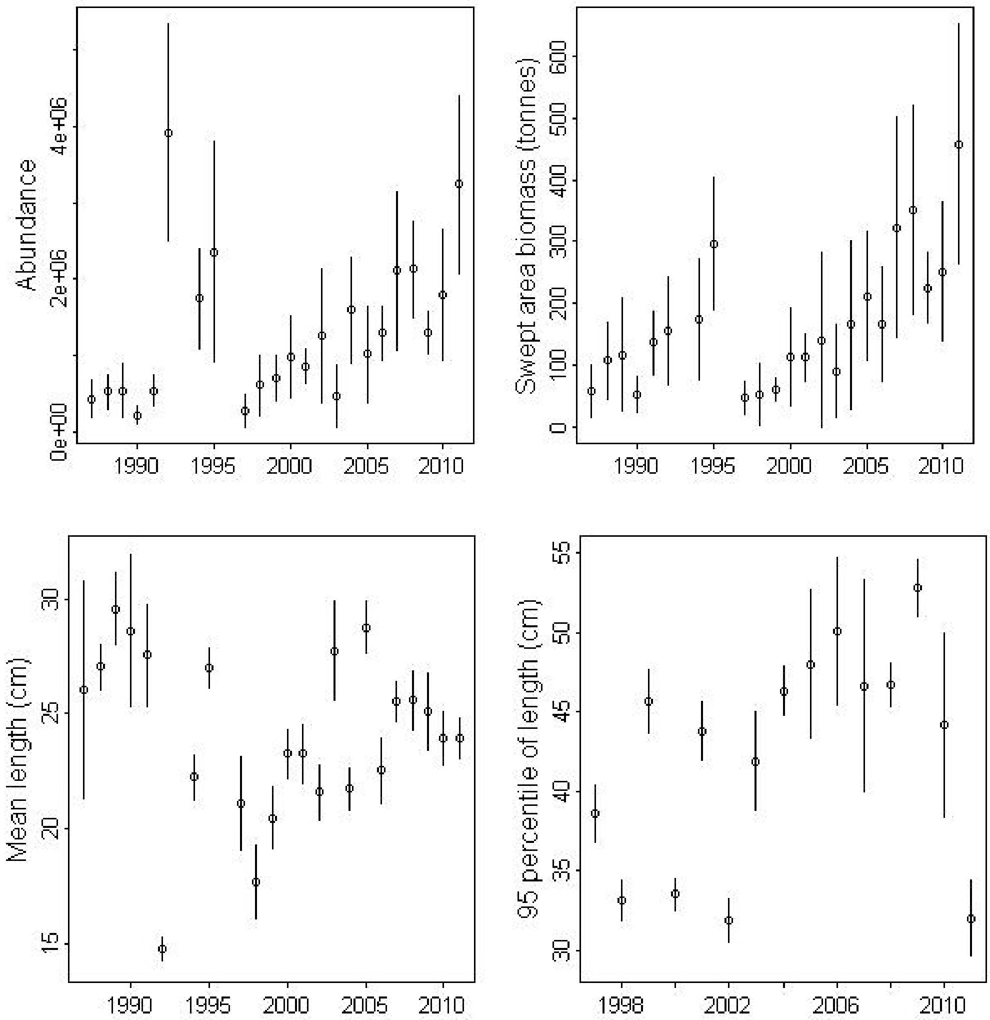


Figure 11.5. Greater forkbeard series of abundance, biomass mean length from the French IBTS survey in Celtic waters until 2011.

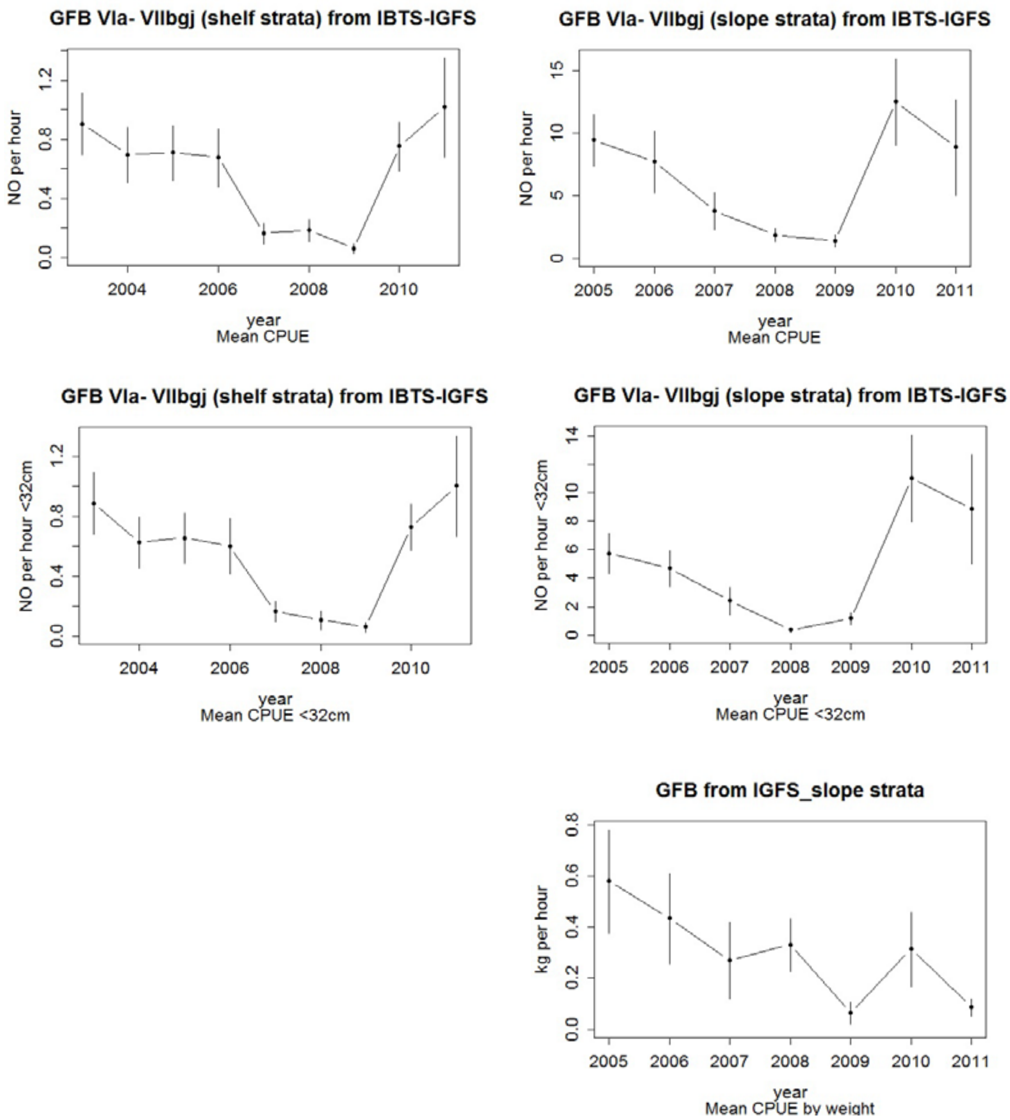


Figure 11.6. Abundance Indices (nº per hour and kg per hour) of total catches and for individuals <32 cm of the Irish IGFS Survey in the slope and shelf strata, from 2005 to 2011.

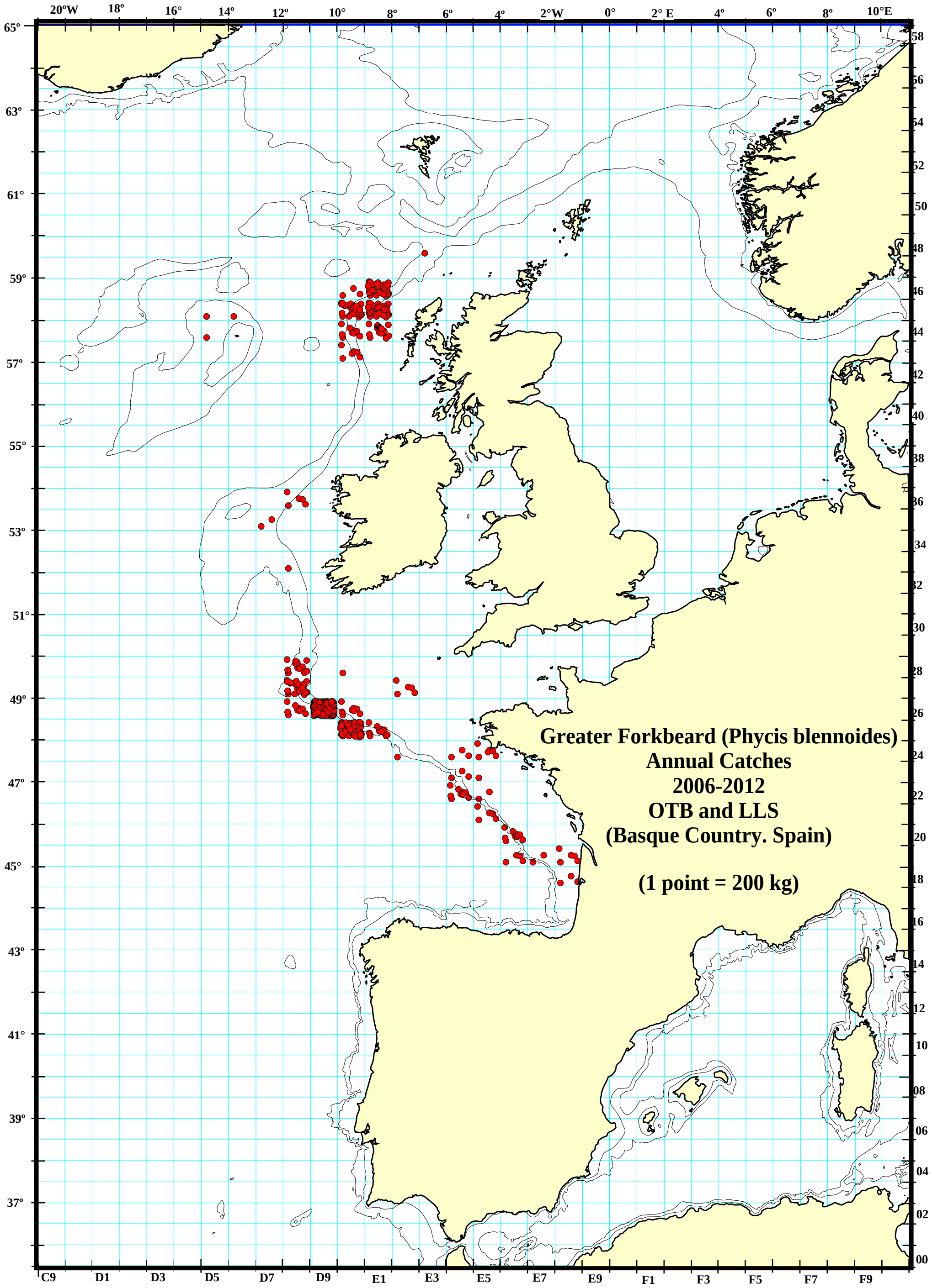


Figure 11.7. Greater forkbeard accumulated series of catches form the Basque Country (Spain) OTB and LLS fleets in the period 2006–2012.

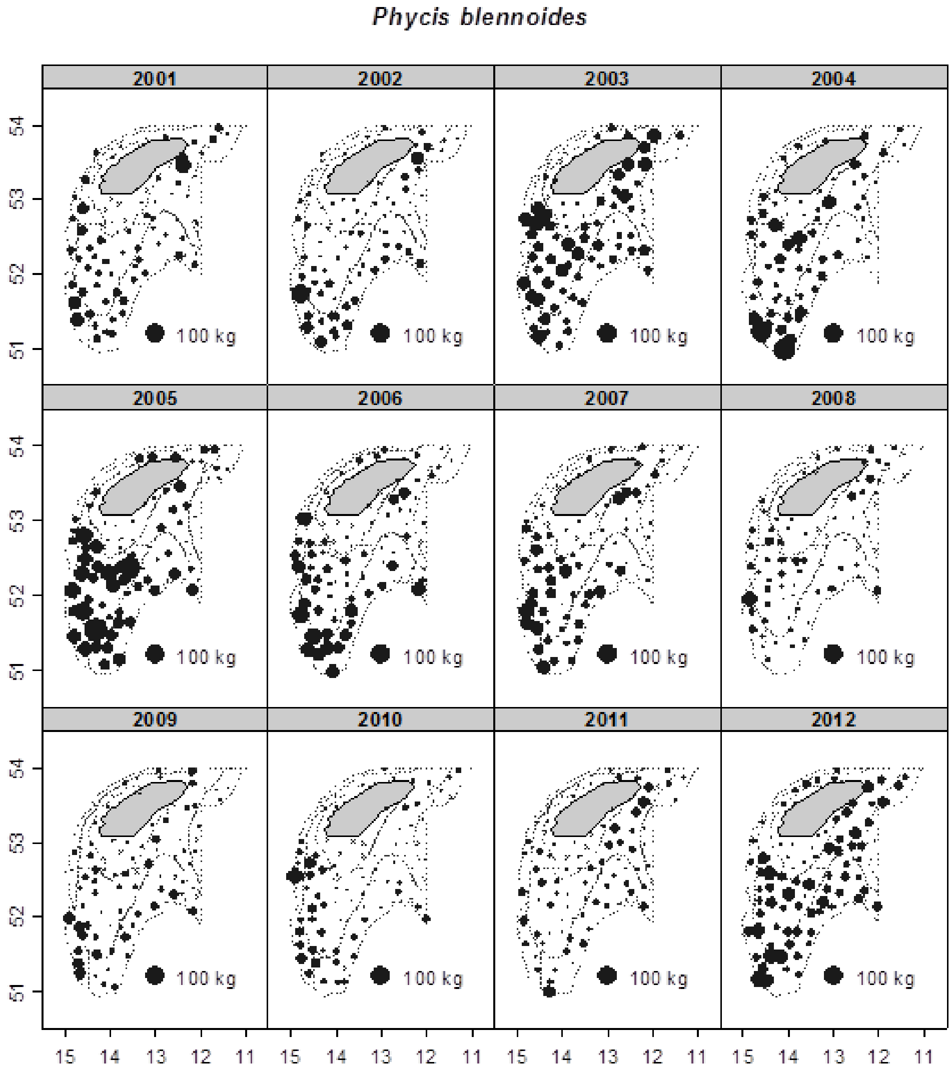


Figure 11.8. Geographic distribution of *Phycis blennoides* catches (kg/30 min haul) in Porcupine surveys between 2001 and 2012.

12 Alfonsinos/Golden eye perch (*Beryx* spp.) in all ecoregions

12.1 The fishery

Alfonsinos, *Beryx splendens* and *Beryx decadactylus*, are generally considered as by-catch species in the demersal trawl and longline mixed fisheries targeting deep-water species. For most of the fisheries, the catches of alfonsinos are reported under a single category, as *Beryx* spp.

The proportions of each species in the catches are not well known. Detailed landings data by species are available only for the Portuguese (Azores) longline fishery in Division Xa, where the landings of *B. decadactylus* averaged 18% of the catches of both species in the last thirteen 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. (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, 12.2, 12.3, 12.4 and 12.5. Total landings stabilize around 377 t since 2003.

12.3 ICES Advice

ICES Advice for 2013 and 2014 was: ”Catches should be no more than 280 tonnes”.

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 for 2011–2012 (EC. Reg. 1225/2010).

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 2014.

There are NEAFC regulations of effort in the fisheries for deep-water species and closed areas to protect vulnerable habitats.

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 resumed in the 2011 report. Annual longline discard estimates per set for the sampled trip vessels with alfonsinos catches (species combined) during the period 2004–2010 range from 25% to 32% (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 were updated. (WD Pinho *et al.*, 2013) These are resumed for both species in Figures 12.6 and 12.7 for the last ten years. Data for 2012 are not yet available.

Survey length compositions were updated for both species and are presented on Figures 12.8 and 12.9.

Annual mean length from the fishery and survey for both species were updated and are presented on Figures 12.10 to 12.13.

12.6.3 Age compositions

No information about age compositions of *Beryx* species was available during the WGDEEP meeting.

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 resumed on the 2010 report an there is 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. This will be done next year.

Abundance indices from the Azorean longline survey were updated and are presented for the golden eye perch (*Beryx decadactylus*) (Figure 12.14) and the alfonsinos (*Beryx splendens*) (Figure 12.15).

12.7 Data analyses

Total landings declined in the late 1990s and have since stabilised at about 370 tonnes (for the two species combined). Species-specific landings trends in the Azores fishery showed similar trends for both species.

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. For *B splendens* a reduction on the small fish (<20 cm) is observed on the landings 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.

Survey length compositions for *B decadactylus* and *B splendens* show that relatively low numbers of individuals of this species are caught on the survey on the sampled depth strata (50–600 m).

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 three 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.

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 aggregation behaviour, alfonsinos are considered to be easily over-exploited by trawl fishing; they can only sustain low rates of exploitation. Fisheries on such species should not be allowed to expand above current levels unless it can be demonstrated that such expansion is sustainable. To prevent wiping out entire sub-populations 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

***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

***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	18	0	32	0		22
2009	6	0	0	0	1	7
2010	12	0	0	0	1	13
2011	4	0	0	0	0	4
2012*	3	0	10	0	0	13

***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*	2	7	132	0	141
2012*	3	11	65	0	80

*** 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	199
2002	243	0	0		0	243
2003	172	0	0		0	172
2004	139	0	0		0	139
2005	157	0	0		0	157
2006	192	0	0		0	192
2007	211	0	0		0	211
2008	250	2	0	0	0	252
2009	311	1	0	0	0	312
2010	240	0	0	5	0	245
2011	226	0	0	5	0	231
2012*	213	10	0	0	0	222

*** 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

*** 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*		

*** 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		1776
1997			26	135	379	5		545
1998			81	268	229	0		579
1999			75	201	175	550		1001
2000			133	168	203	281		785
2001			180	228	199	0		607
2002			95	238	243	0		577
2003			84	105	172	0		361
2004			64	283	139	0		485
2005			70	195	157	0		422
2006			78	97	192	0		367
2007			65	120	211	0		396
2008	0	0	54	101	250	2		407
2009			10	61	311	1		383
2010	0	0	5	41	240	5		291
2011	0	0	4	141	226	5		375
2012*	0	0	13	80	213	10		315

***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

***Preliminary.**

Table 12.4. Annual percentage of *Beryx* spp. discarded by set in the Azores (ICES Division Xa) from the sampled trip vessels that caught and discard alfonsinos.

Species	2004	2005	2006	2007	2008	2009	2010
Beryx spp.	31,1	31,9	25,1	30,5	26,2	26,0	26,9

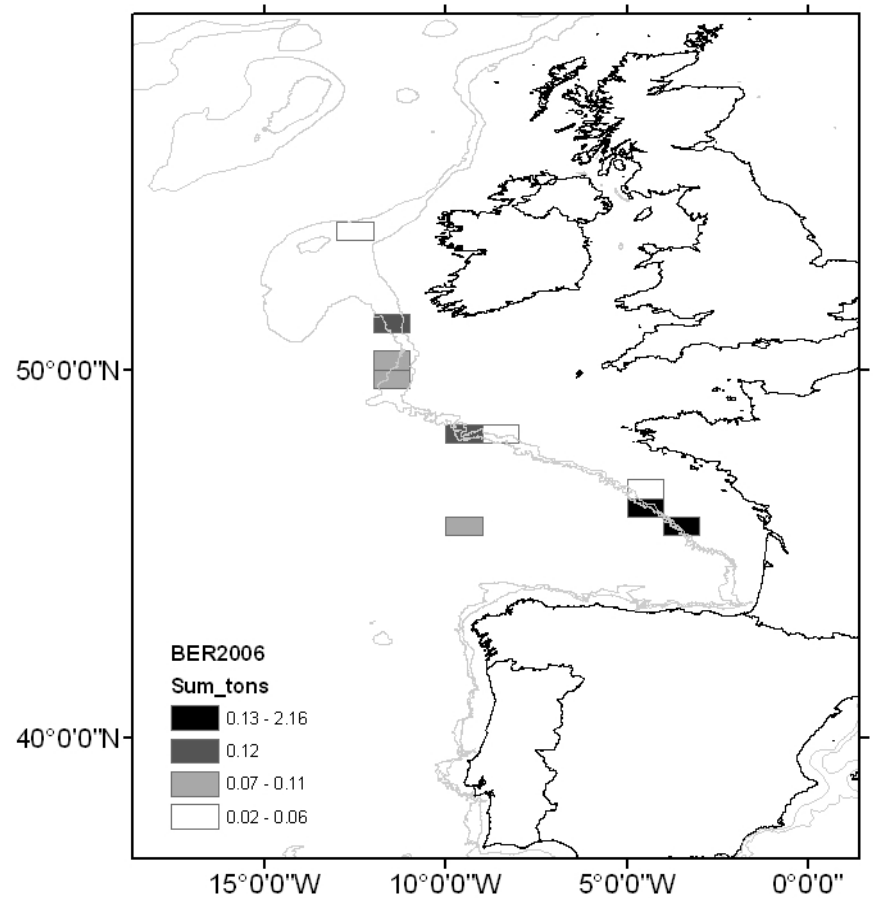


Figure 12.1. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2006.

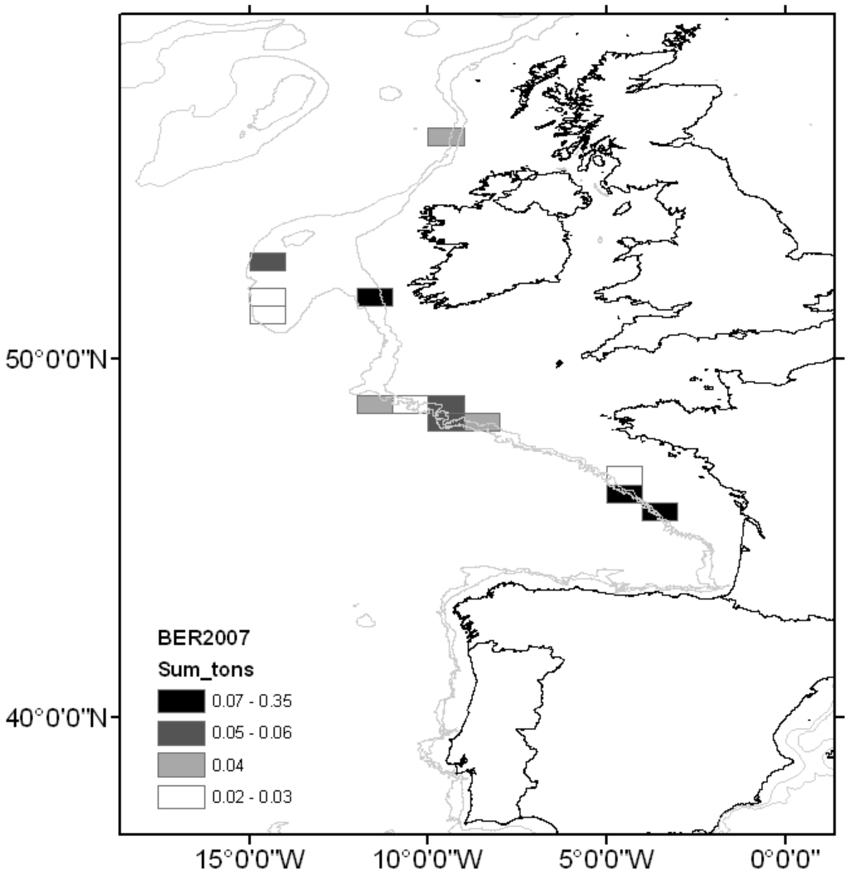


Figure 12.2. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2007.

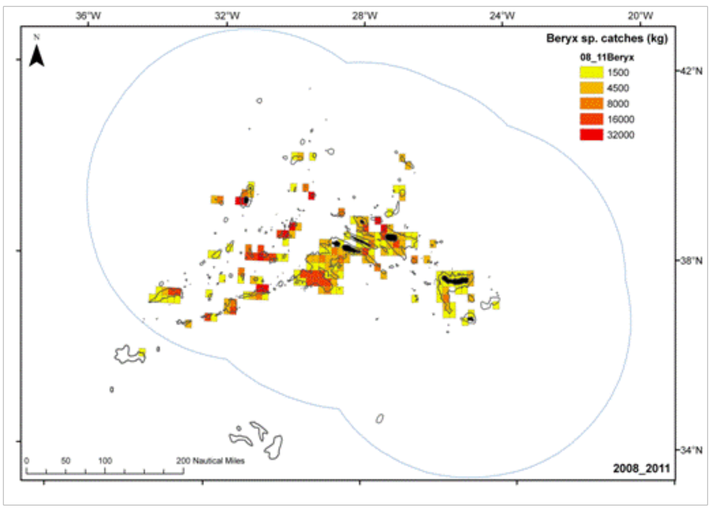


Figure 12.3. Catches of alfonsinos by Azores vessels, 2008–2011 (ICES, Xa2).

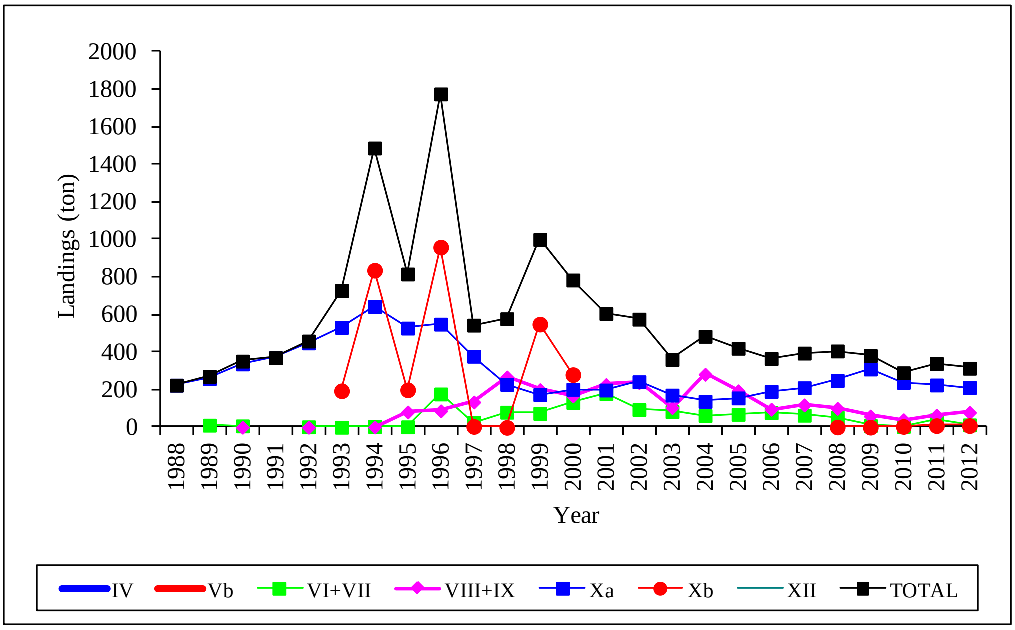


Figure 12.4. Reported landings for the alfonsinos, (*Beryx* spp), by ICES subareas/divisions.

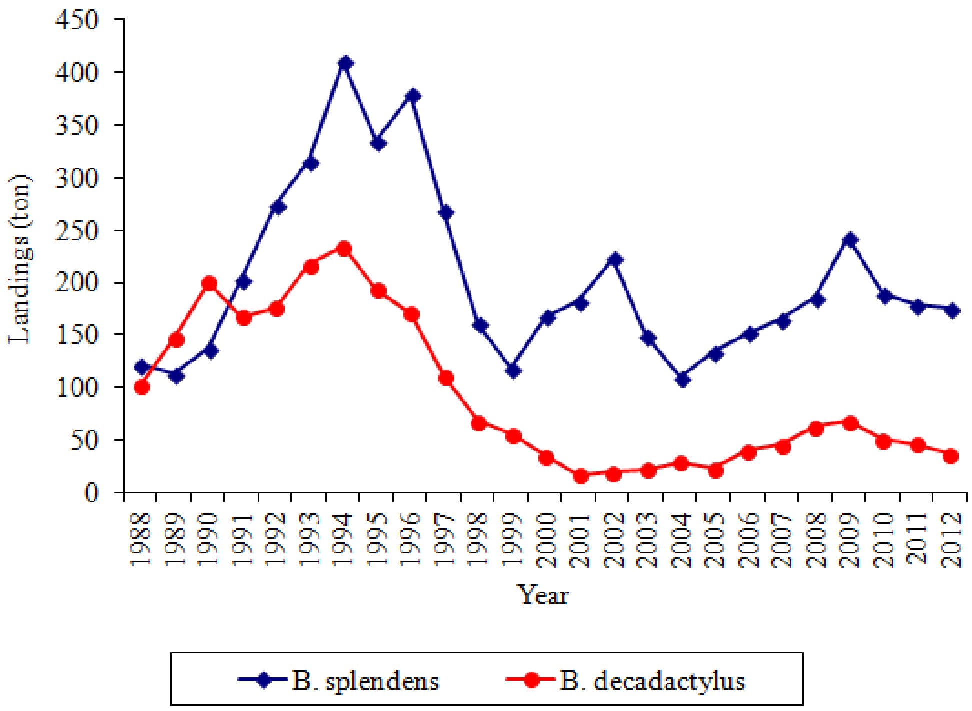


Figure 12.5. Landings of *Beryx splendens* and *B. decadactylus* in Azores (ICES Subarea X).

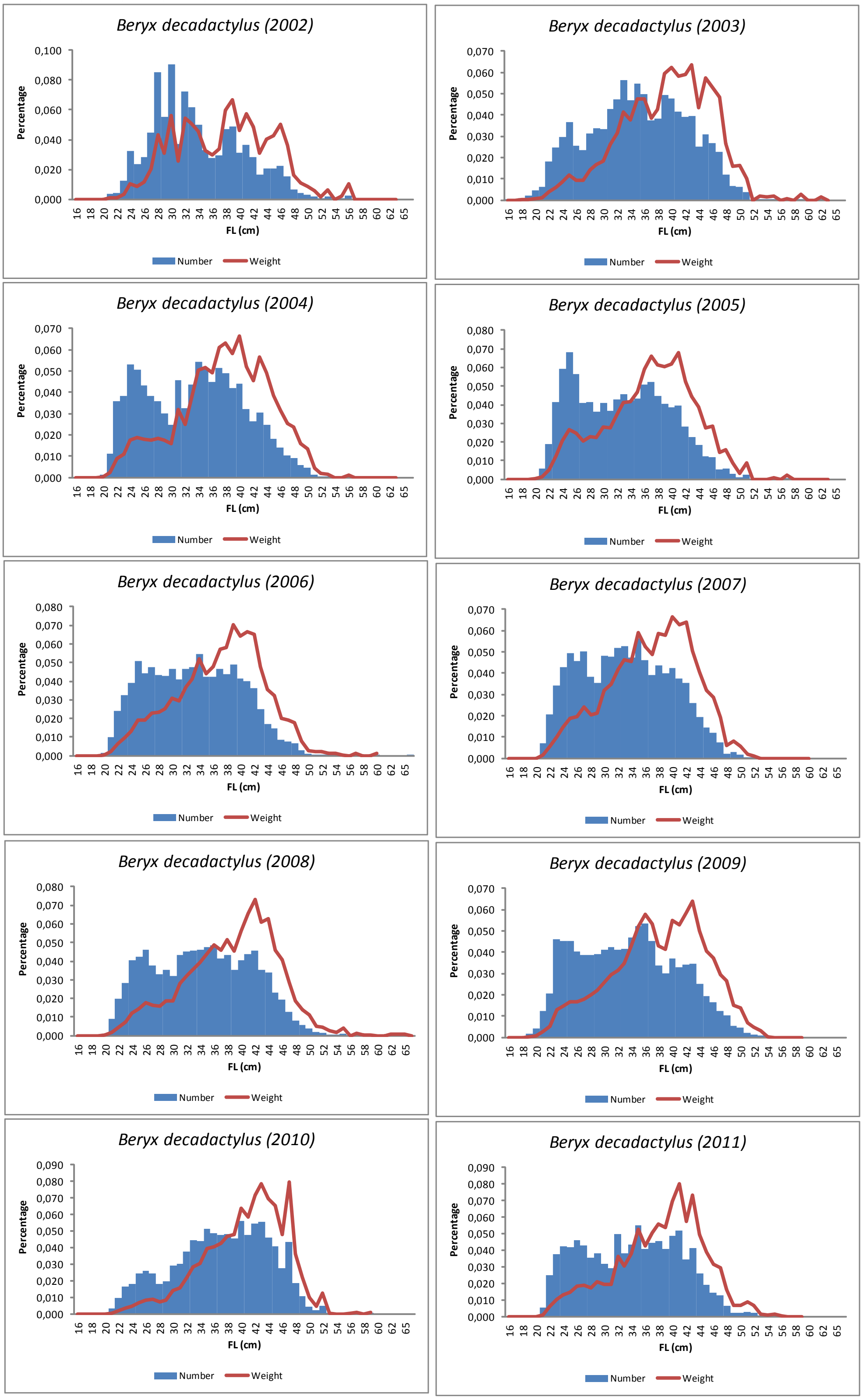


Figure 12.6. ***Beryx decadactylus*** **fishery length compositions by year from the Azorean fishery (ICES Subarea X).**

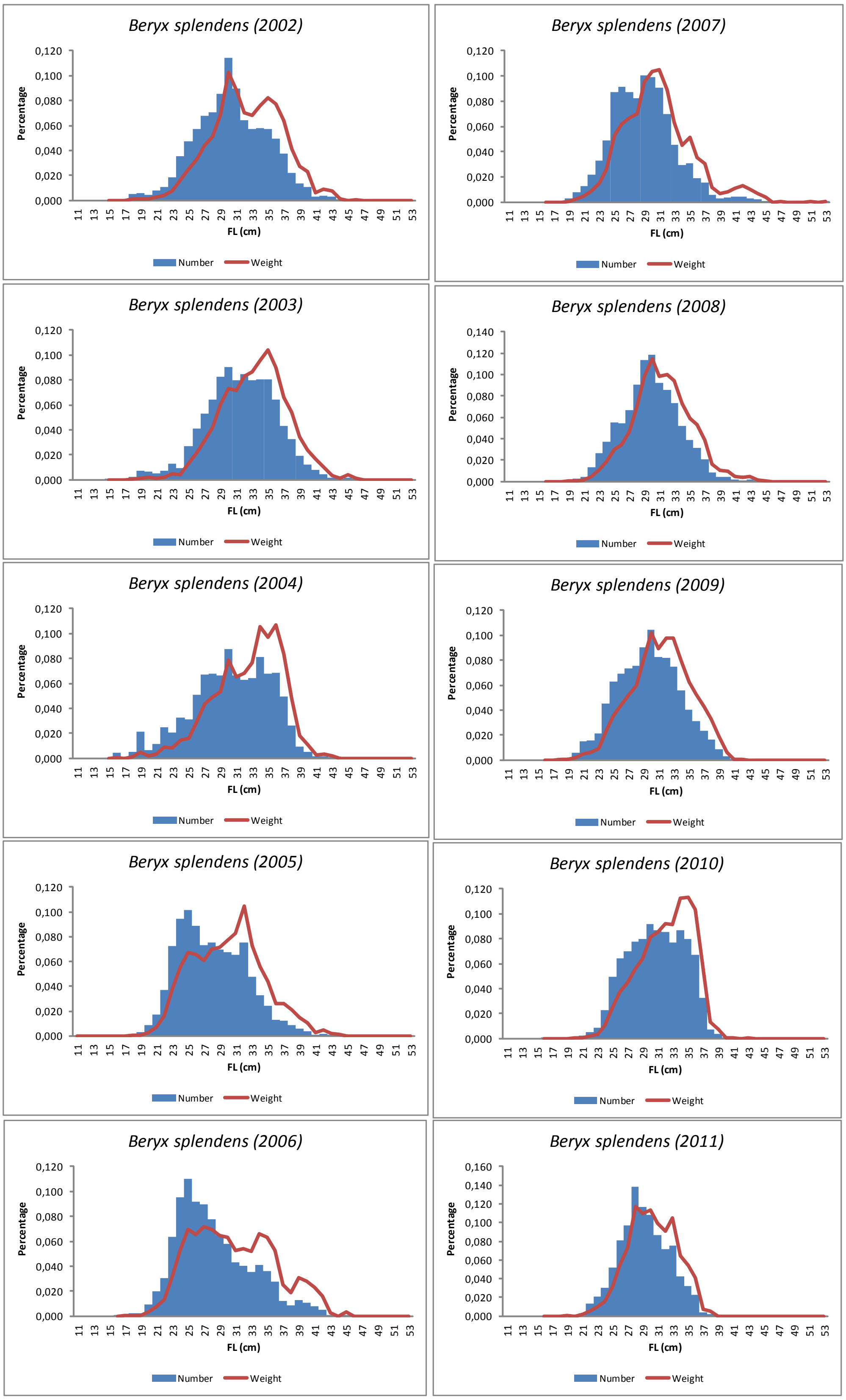


Figure 12.7. *Beryx splendens* survey length compositions, by year from the Azorean l (ICES Subarea X).

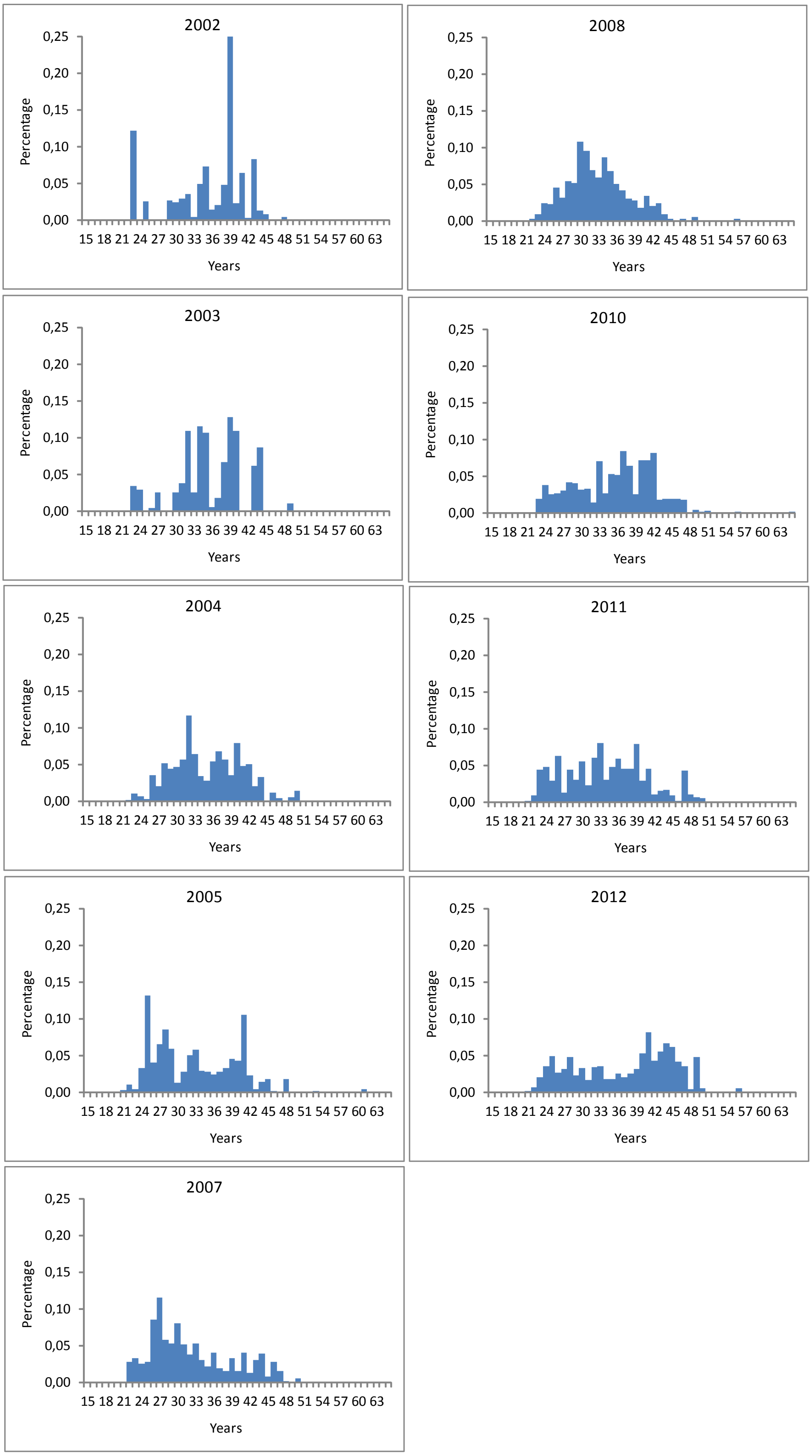


Figure 12.8. *Beryx decadactylus* survey length compositions by year from the Azores (ICES Subarea X).

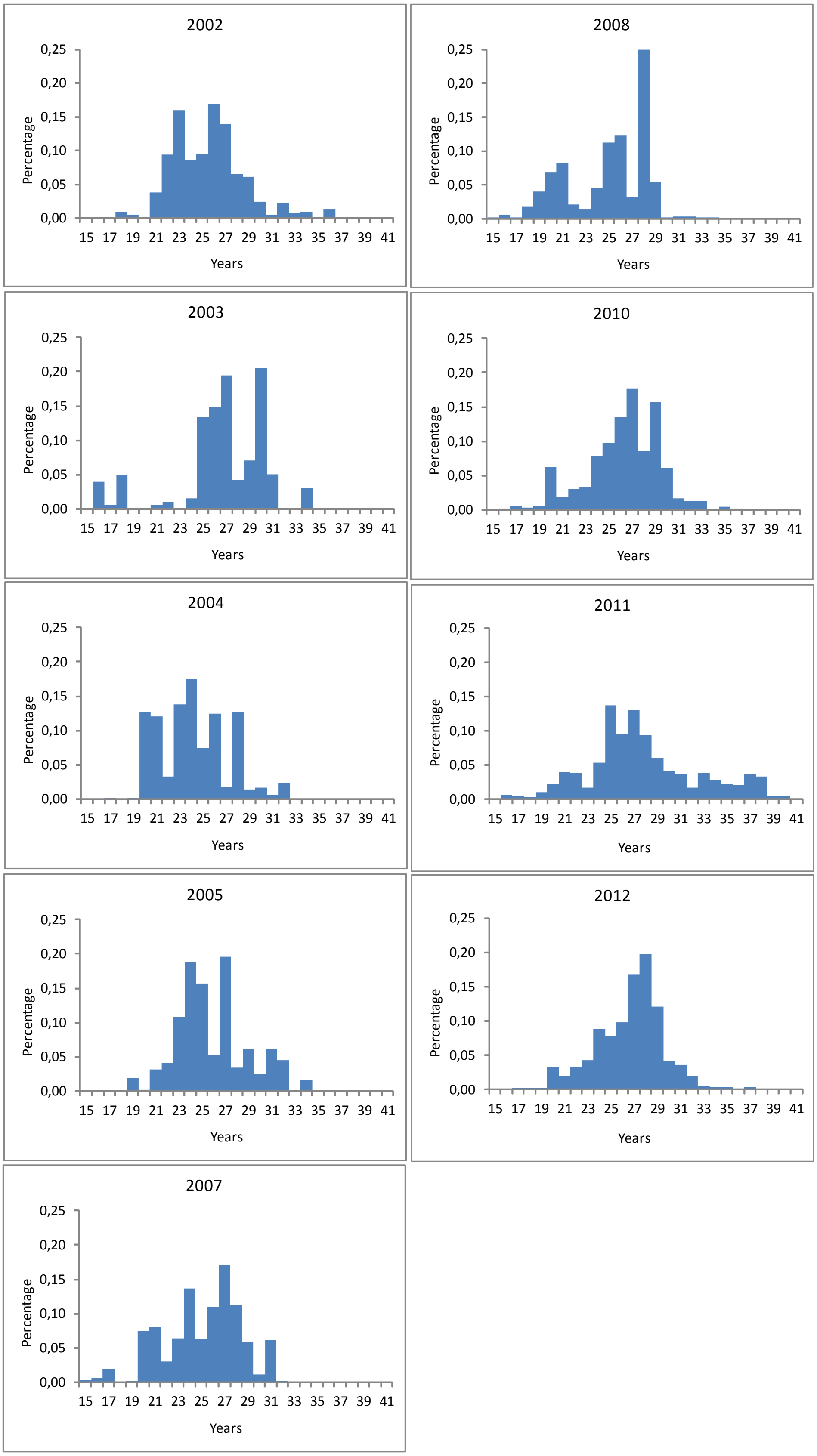


Figure 12.9. ***Beryx splendens*** **survey length compositions, by year from the Azores (ICES Subarea X).**

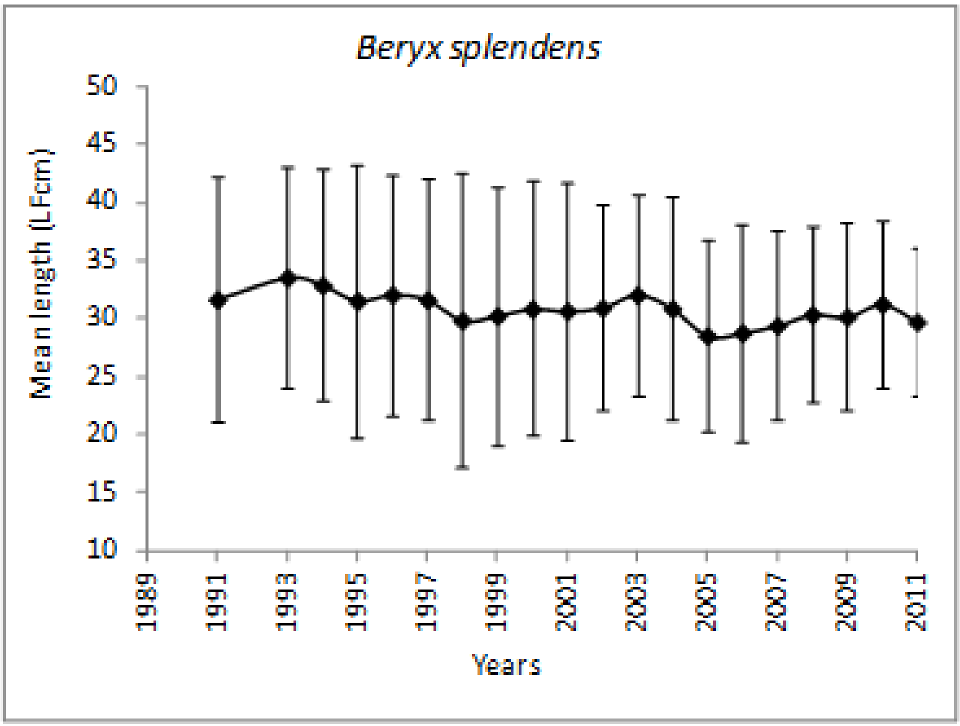


Figure 12.10. Annual mean length of *Beryx splendens* from the Azorean fishery (ICES Subarea X).Bars are 95% confidence interval.

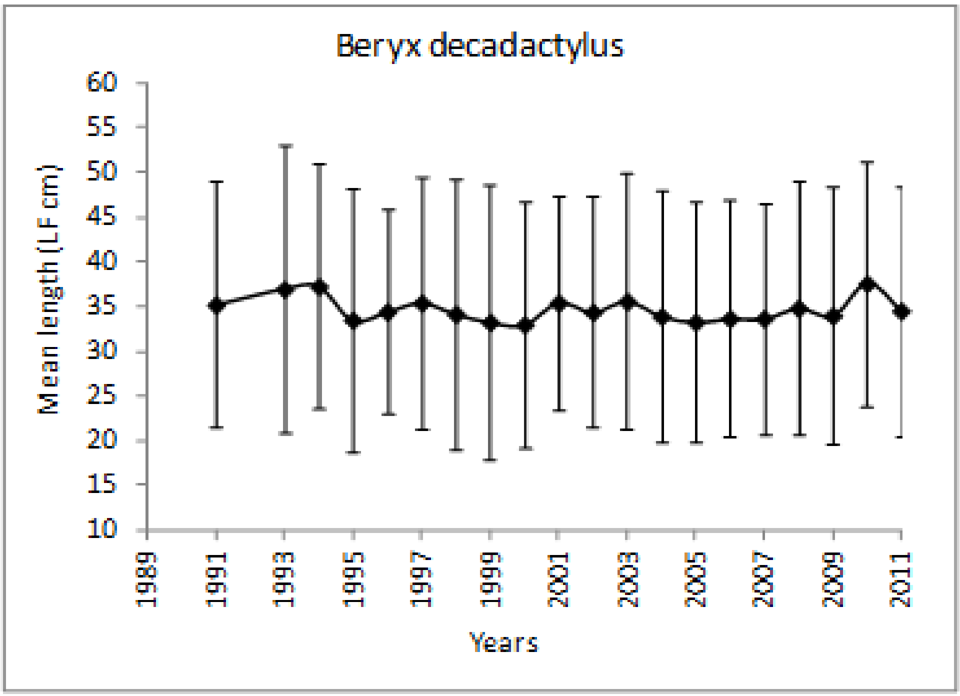


Figure 12.11. Annual mean length of *Beryx splendens* from the Azorean fishery (ICES Subarea X).Bars are 95% confidence interval.

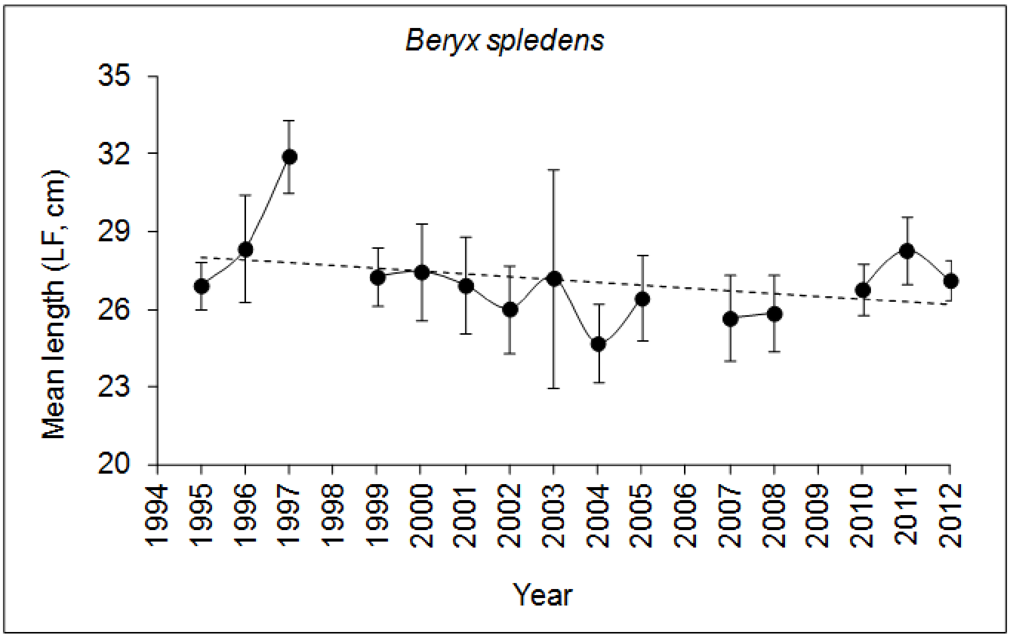


Figure 12.12. Annual mean length of *Beryx splendens* from the bottom longline survey (ICES Subarea X).Bars are 95% confidence interval.

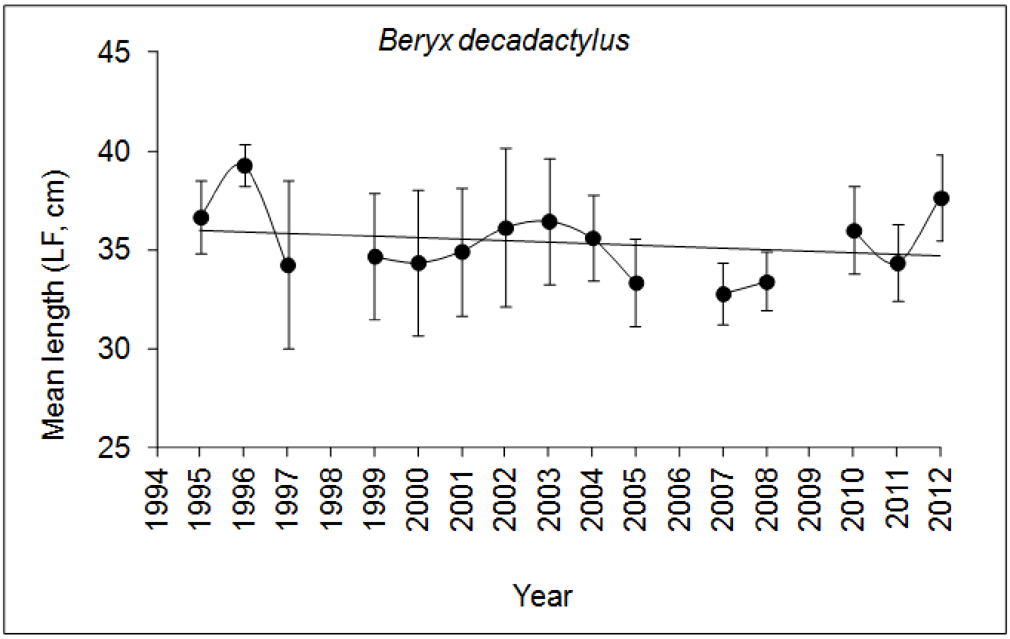


Figure 12.13. Annual mean length of *Beryx decadactylus* from the bottom longline survey (ICES Subarea X).Bars are 95% confidence interval.

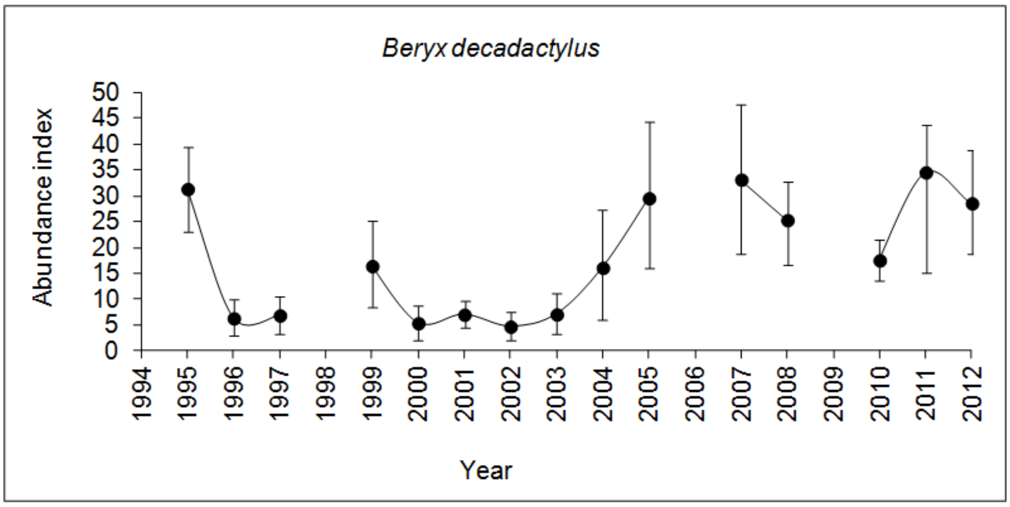


Figure 12.14. Annual bottom longline survey abundance index in number available for the golden eye perch (*B. decadactylus*) from the Azorean deep-water species surveys (ICES Subarea X).

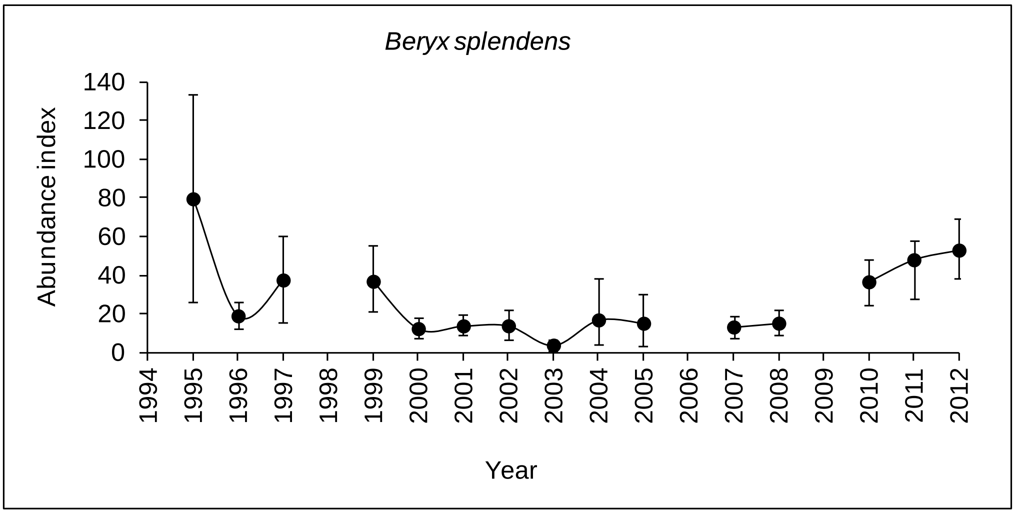


Figure 12.15. Annual bottom longline survey abundance index in number available for the alfonsinos (*Beryx splendens*) from the Azorean deep-water species surveys (ICES Subarea X).

13 Red (black spot) seabream (*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). This separation does not pre-suppose that there are three different stocks of red (blackspot) seabream, but it offers a better way of recording the available information.

The interrelationships of the (blackspot) seabream from Areas VI, VII, and VIII, and the northern part of Area IXa, and their migratory movements within these areas have been observed by tagging methods (Gueguen, 1974). However, there is no evidence of movement to the southern part of IXa where the main fishery currently occurs.

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) seabream in Subareas VI, VII & VIII

13.2.1 The fishery

This Section includes a description of the *Pagellus bogaraveo* in Subareas VI, VII, VIII by the Spanish, French, and UK fleets.

From the 1950s to the 1970s, red 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 (1988–2012), most of the estimated landings from the Subareas VI, VII and VIII were taken by Spain (67%), followed by France (19%), UK (13%) 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 68% and VI and VII 32% of total accumulated landings. At present the red seabream 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. For these three subareas combined, landings fell from more than 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 227 t in 2012.

13.2.3 ICES Advice

The 2012 The advice for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012): No directed fisheries, and measures should be put in place to reduce bycatch.

13.2.4 Management

The biannual EU TAC for the Subareas VI, VII and VIII was 215 t for the years 2011 and 2012. Like in 2007 and 2010 official combined landings for these subareas we above the TAC in 2012. A minimum landing size of 35 cm (total length) applies in 2010.

PAGELLUS BOGARAVEO	LANDINGS		TAC	TAC
Subarea	2011	2012	2011	2012
VI, VII, VIII	177	227	215	215

***preliminary.**

13.2.5 Data available

13.2.5.1 Landings and discards

A Spanish, French and UK extended landing-series of *P. bogaraveo* in Northeast Atlantic was updated in 2013 (Figure 13.2.1).

Information from observers in the Basque country OTB and pair-trawl fleets in Subareas VI, VII and VIII indicates that there were no discard for this species in the period 2003–2012.

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 a red 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 seabream is rarely caught in the northern surveys by French IBTS and Irish IGFS and in the Cantabrian Sea (VIIIc) by

Itsasteka and Northern Spanish Shelf bottom-trawl surveys, not at all in most years (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 allows to ascertain that the current survey is appropriate to detect and monitor a recovery of the stock if ever it happens.

13.2.6 Data analyses

No data analysis was carried out by the working group.

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.

13.2.7 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 in which juveniles occur. Recreational fisheries may be a significant proportion of the mortality.

The TAC was exceeded in 2007, 2010 and 2012.

Table 13.2.1a. Red seabream in Subareas VI and VII; WG estimates of landings by country.

YEAR	FRANCE*	IRELAND	SPAIN	UK (E & W)	CH. ISLANDS	TOTAL
1988	52	0	47	153	0	252
1989	44	0	69	76	0	189
1990	22	3	73	36	0	134
1991	13	10	30	56	14	123
1992	6	16	18	0	0	40
1993	5	7	10	0	0	22
1994	0	0	9	0	1	10
1995	0	6	5	0	0	11
1996	0	4	24	1	0	29
1997	0	20	0	36		56
1998	0	4	7	6		17
1999	2	8	0	15		25
2000	4	n.a.	3	13		20
2001	2	11	2	37		52
2002	4	0	9	13		25
2003	13	0	7	20		40
2004	33		4	18		55
2005	29		4	7		41
2006	36	0	8	19		63
2007	46	0	27	57		130
2008	39	0	2	22		63
2009	34	1	16	10		61
2010	22	0	40	1		62
2011	21		11	4		37
2012*	21		45	4		69

*** preliminary.**

Table 13.2.1b. Red seabream in Subarea VIII; WG estimates of landings by country.

YEAR	FRANCE*	SPAIN	ENGLAND [1]	TOTAL
1988	37	91	9	137
1989	31	234	7	272
1990	15	280	17	312
1991	10	124	0	134
1992	5	119	0	124
1993	3	172	0	175
1994	0	131	0	131
1995	0	110	0	110
1996	0	23	0	23
1997	18	7	0	25
1998	18	86	0	104
1999	13	84	0	97
2000	11	189	0	200
2001	8	168	0	176
2002	10	111	0	121
2003	6	83	0	89
2004	37	82	8	128
2005	28	90	0	118
2006	20	57	0	77
2007	44	149	1	193
2008	55	40	0	95
2009	5	137	0	142
2010	61	157	0	218
2011	19	122	0	141
2012*	56	102	0	158

[1] In 2005 England and Wales.

*** preliminary.**

Table 13.2.1c. Red seabream in Subareas VI, VII and VIII; WG estimates of landings by subarea.

YEAR	VI AND VII*	VIII*	TOTAL
1988	252	137	389
1989	189	272	461
1990	134	312	446
1991	123	134	257
1992	40	124	164
1993	22	175	197
1994	10	131	141
1995	11	110	121
1996	29	23	52
1997	56	25	81
1998	17	104	121
1999	25	97	122
2000	20	200	220
2001	52	176	227
2002	25	121	147
2003	40	89	129
2004	55	128	183
2005	41	118	158
2006	63	77	139
2007	130	193	324
2008	63	95	159
2009	61	142	203
2010	62	218	281
2011	37	141	177
2012*	69	158	227

*** preliminary.**

Table 13.2.2 Mean size and weight-at-age of red 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

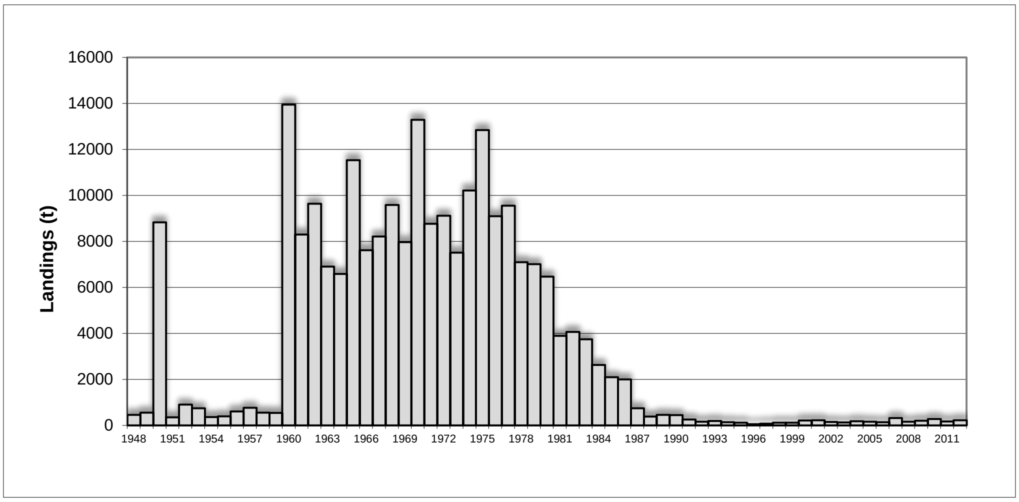


Figure 13.2.1. Historical series of red seabream landings from 1948 to 2102 in Northeast Atlantic (Subareas VI, VII and VIII).

Reference/Source (1) of reconstructed landings data for red seabream 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. ("seabreams") 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. ("seabreams") 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 1988–2012 WDDeep official data

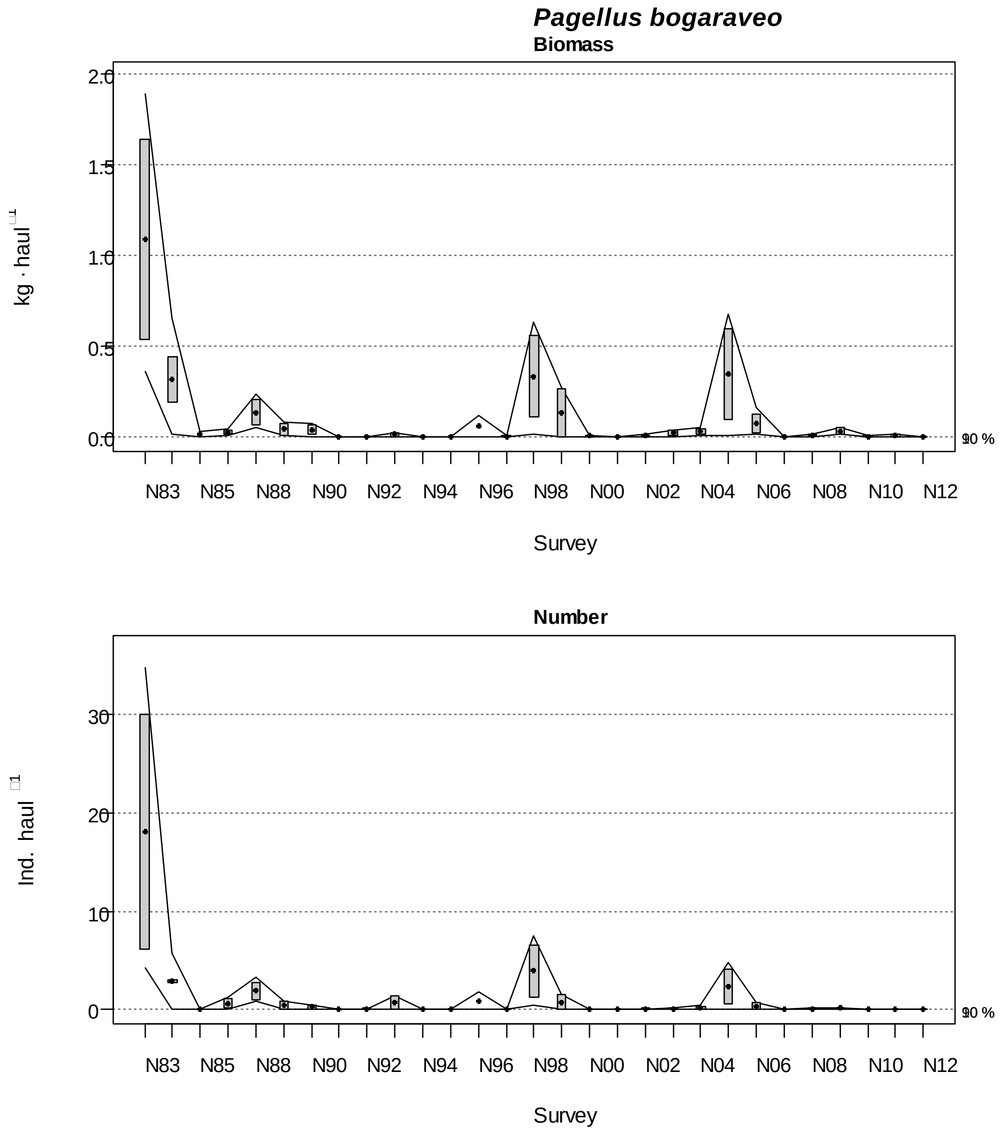


Figure 13.2.2. Evolution of blackspot seabream (*P. bogaraveo*) mean stratified abundance in Northern Spanish Shelf survey time-series (1983–2012, except in 1987).

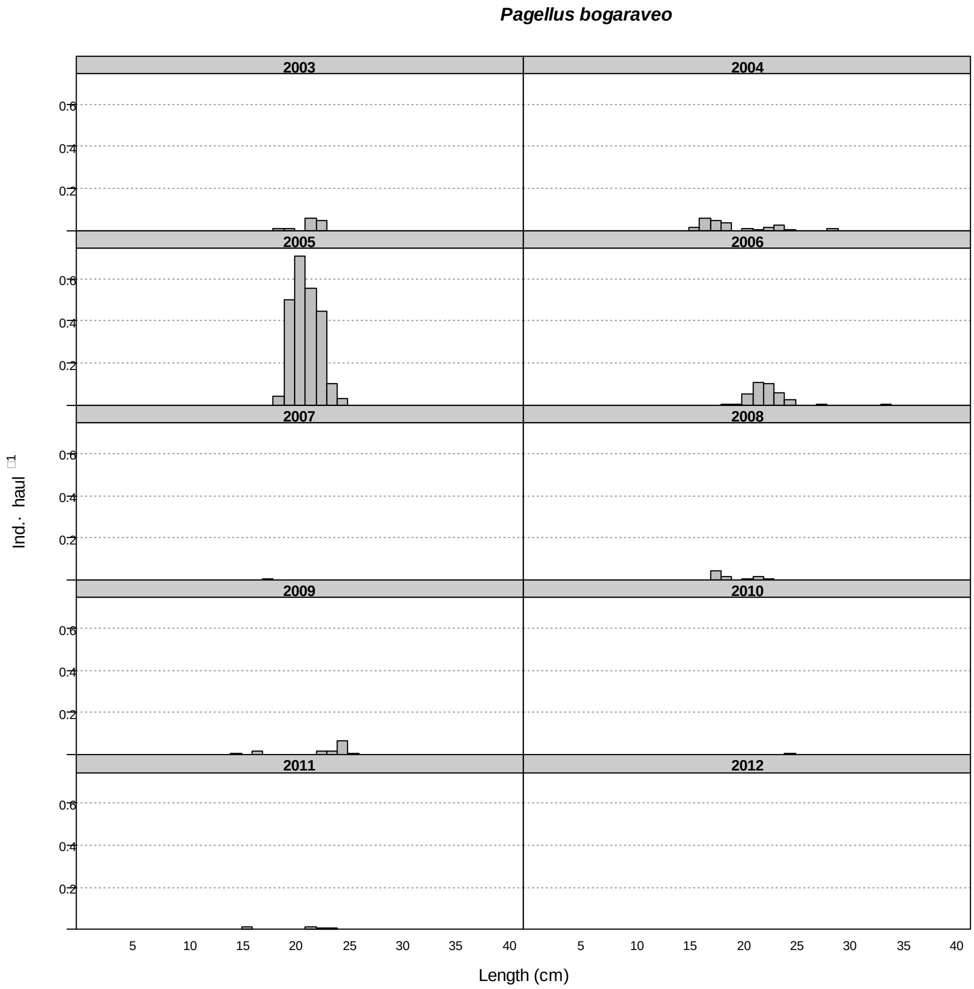


Figure 13.2.3. Mean stratified length distributions of blackspot seabream (*P. bogaraveo*) in Northern Spanish Shelf surveys (2003–2012).

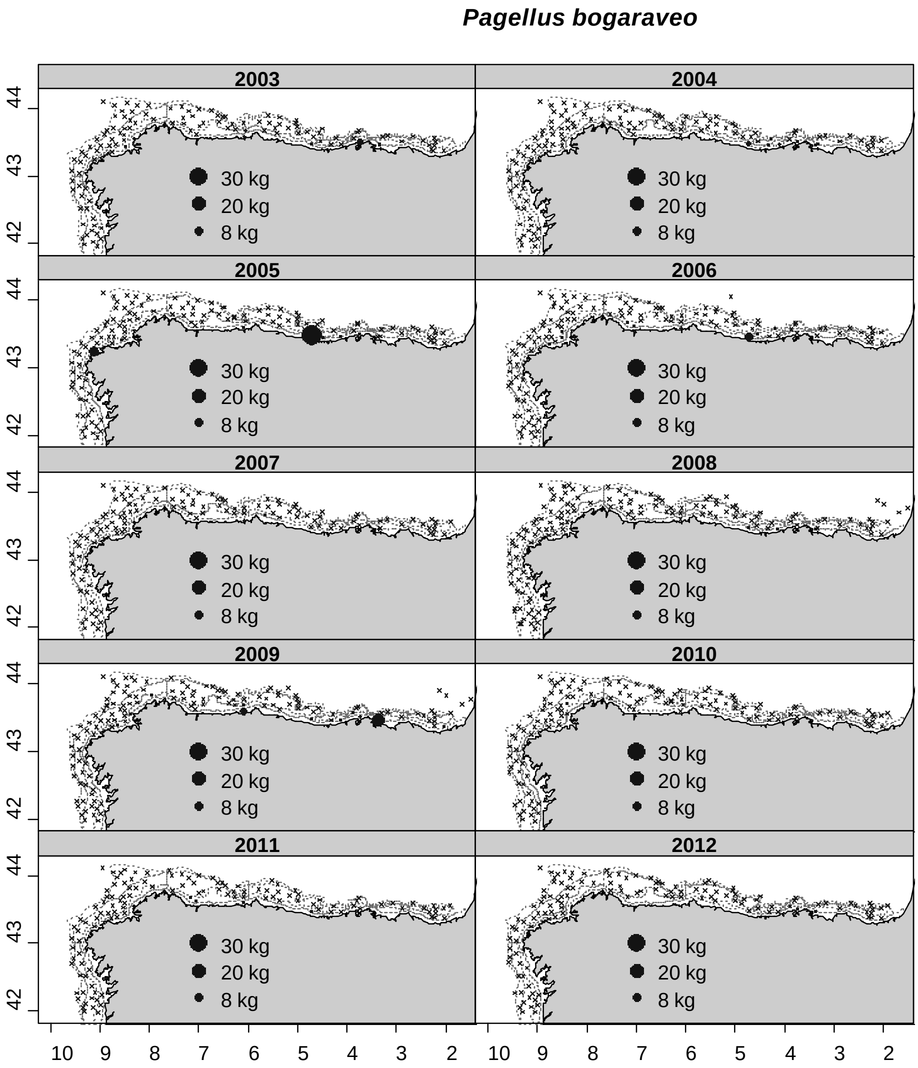


Figure 13.2.4. Catches in biomass of blackspot seabream on the Northern Spanish Shelf bottom-trawl surveys during the last decade: 2003–2012.

13.3 Red seabream (*Pagellus bogaraveo*) in Subarea IX

13.3.1 The fishery

Pagellus bogaraveo is caught by Spanish and Portuguese fleets in Subarea IX. Spanish landing data from this area are available from 1983, Portuguese data from 1988 and Morocco information from 2001 onwards. Catches in Subarea IX-most of them taken with lines correspond to Spain (64%), Morocco (21%) and Portugal (16%) 2009–2011. See general section for more clarifications about unallocated landings.

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.*, WDs to the WGDEEP 2013). Currently, about 80 boats are involved in the fishery. The fishing grounds are on both sides of the Strait of Gibraltar and quite close to the main ports (Tarifa and Algeciras). Fishing is carried out taking advantage of the turnover of the tides in depths from 200 to 400 fathoms with "*voracera*" gear, a mechanised handline. Since 2002 other artisanal boats have joined the red seabream fishery from Conil port, although they operate in other fishing grounds and use longlines. Nowadays, this section of the fleet counts about six boats. Landings are classified into categories due to the wide size range and to market demands. These categories have varied with time but from 1999 have remained the same in all ports.

Besides, since 2001 Moroccan longliners start fishing in the Strait of Gibraltar area. Around 102 boats are mainly based in Tangier and its mean technical characteristics are: 20 GRT, 160 CV and about eight years of age. 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 appropriate the inclusion of Morocco data because its fishery is carried out in the same area (Strait of Gibraltar). No updated information was presented in 2013.

The majority of deep-water species landings in mainland Portugal correspond to the artisanal fleet, which uses mainly longlines (I. Figueiredo, *pers. com*.).

13.3.1.1 Landing trends

The maximum catch in this period was obtained in 1993–1994 and 1997 (about 1000 t) and the minimum in 1983 (101 t), first year of data. Landings in 2009 amounted to a peak of 817 t, but decreased again till 283 t in 2012 (Figure 13.3.1).

13.3.2 Advice

The ICES advice for 2013 and 2014 is: “no increase in effort and that catches should be no more than 500 t.”

13.3.3 Management

Since 2003, TAC and Quotas have been applied to the *P. bogaraveo* fishery in Subarea IX. The following table shows a summary of *P. bogaraveo* TAC, which has always been far above the landings. TAC for 2011–2012 includes as well a minimum landing size of 35 cm, although 15% of the landings could be ≥30 cm. Besides, a maximum of 8% of each quota can be fished in EU waters and in international waters within Areas VI, VII and VIII. Nowadays, there is not minimum landing size adopted for the area.

P. bogaraveo	2005-2006		2007-2008		2009-2010		2011-2012	
ICES Subarea	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings
IX	1080	533–618	1080	681–677	918–780	817–630	780–780	487–275

13.3.4 Stock identity

Several tagging surveys (56 days at sea along 2001, 2002, 2004, 2006 and 2008) have been done in the Strait of Gibraltar area, where the majority of the fishery in IX takes place. 4500 fishes where tagged and till now 404 recaptures were notified. No significant movements are reported, although local migrations are also observed: feeding grounds are distributed along the entire Strait of Gibraltar and the species seems to remain in this area as a resident population (Gil, 2006). Recaptures of tagged fishes were also notified by Morocco fishers.

13.3.5 Data available

13.3.5.1 Landings and discards

Historical landing dataseries available to the working group has been described in the text of Section 13.3.1 and detailed in Figure 13.3.1. 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 null or negligible for most assessment purposes and mainly related with smallest samples.

13.3.5.2 Length compositions

Length frequencies of landings are only available for the Spanish "*voracera*" red seabream fishery in the Strait of Gibraltar (1983–2012). Figure 13.3.2 show the updated length distribution data (adapted from Gil *et al.*, WD to the WGDEEP 2013).

13.3.5.3 Age compositions

Figure 13.3.3 draws the size increment between tag and recapture dates from the twelve longest lived samples. In every case observed values are below than the expected in the VBGF functions from otolith readings (Gil *et al.*, WD to the WGDEEP 2013). It seems that readings may be underestimating the ages and some hyaline rings are uncounted and/or missing. Age and growth based on otolith readings should be revised and further work is needed.

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 13.3.3 shows new information from VMS analysis of the "*voracera*" fleet. Effort allocation was concentred in certain fishing grounds, both sides of the Gibraltar Strait.

Figure 13.3.4 updated lpue information, available only for the Strait of Gibraltar fishery (Gil *et al.*, WD to the WGDEEP 2013). Effort from sales sheets are not standardized and may be underestimated in some years because the effort unit chosen may be inappropriate. However the recent lpue decrease, even overestimated, shows a clear decline which is quite consistent with recent landings. Moreover, 2009–2011 lpue estimated from VMS analysis shows lower values but the same decreasing trend.

No survey data were available for the species in this subarea.

13.3.6 Data analyses

Figure 13.3.1 is clear enough. There was no evidence of the fishery sustainability at the recent levels. Mean length distribution and lpue decreasing trends may be considered as overexploited population signals.

13.3.7 Comments on the assessment

No assessment was attempted at the meeting.

13.3.8 Management considerations

A regime of TAC (780 t) was established for 2011 and 2012 for whole Subarea IX. Recent landings are well below the TAC level. The group recommends the adoption of a minimum landing size for the whole ICES Subarea IX and the re-establishment of the local management plan in the Strait of Gibraltar fisheries.

Fish ageing has an important role in fisheries assessment and management. The use of biased age estimation criterion may have important consequences.

Table 13.3.1. Red seabream (*Pagellus bogaraveo*) in Subarea IX: Working group estimates of landings (in tonnes).

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	96	259	154		509
2012*	143	35	n/a	105	283

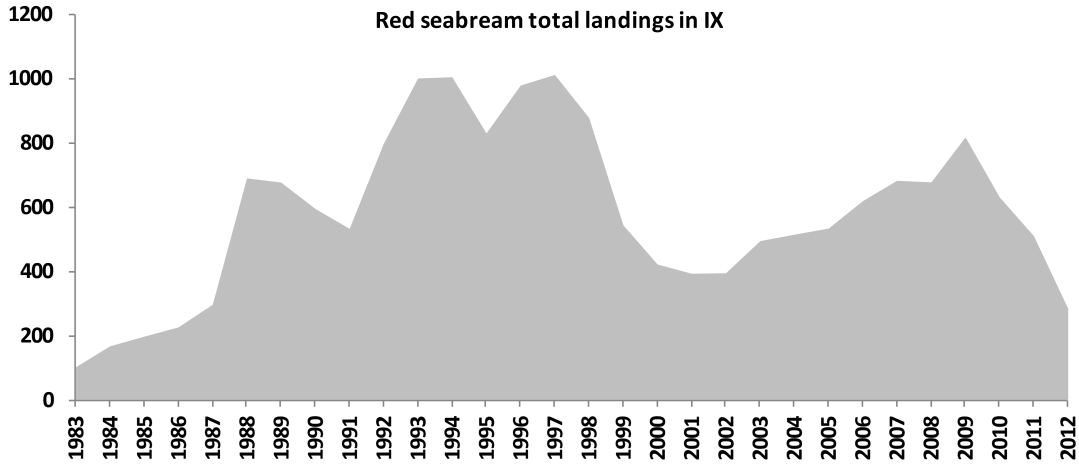


Figure 13.3.1. Red seabream in ICES Subarea IX: Total landings (2012 data are preliminary).

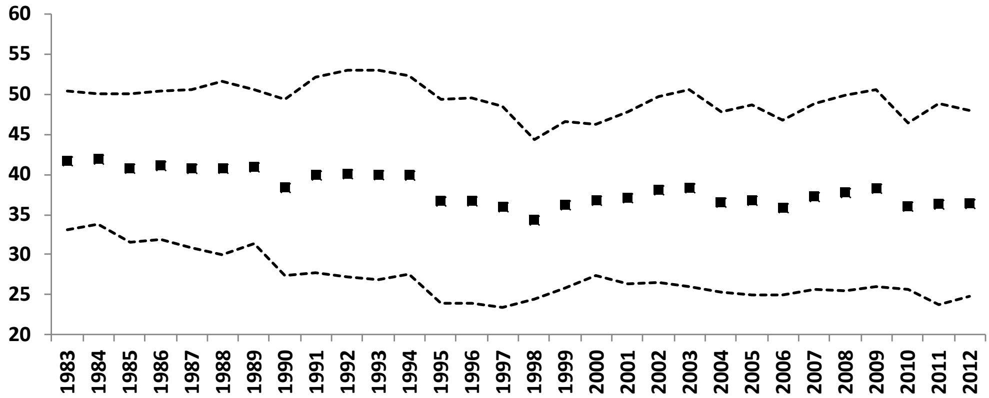


Figure 13.3.2. Spanish "*voracera*" Red seabream fishery of the Strait of Gibraltar (ICES Subarea IX): 1983–2012 landings mean length distribution (adapted from Gil *et al.*, WD).

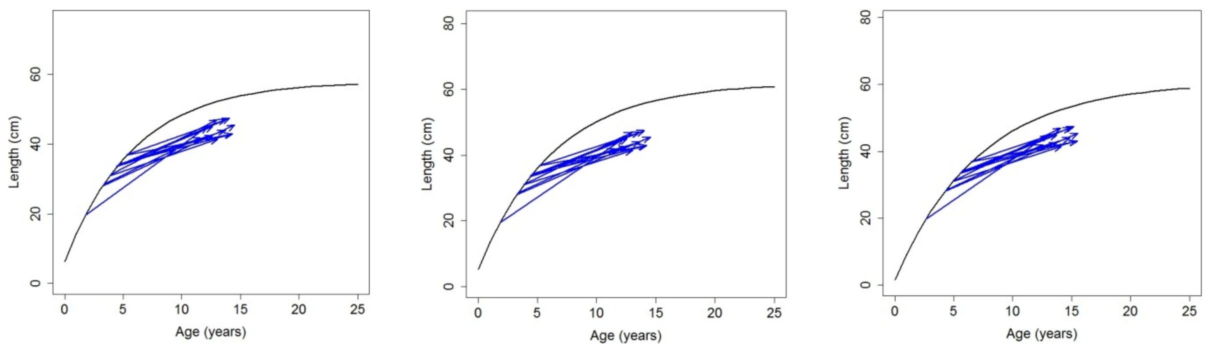


Figure 13.3.3. Red seabream of the Strait of Gibraltar: von Bertalanfy growth curves estimated from otolith readings. Straight lines correspond to the twelve long time at sea recaptures (Left: ALK 1997–1999; Center: ALK 2003–2009 FISHPARM soft. and Rigth: ALK 2003–2009 Bayesian fit). (from Gil *et al.*, WD).

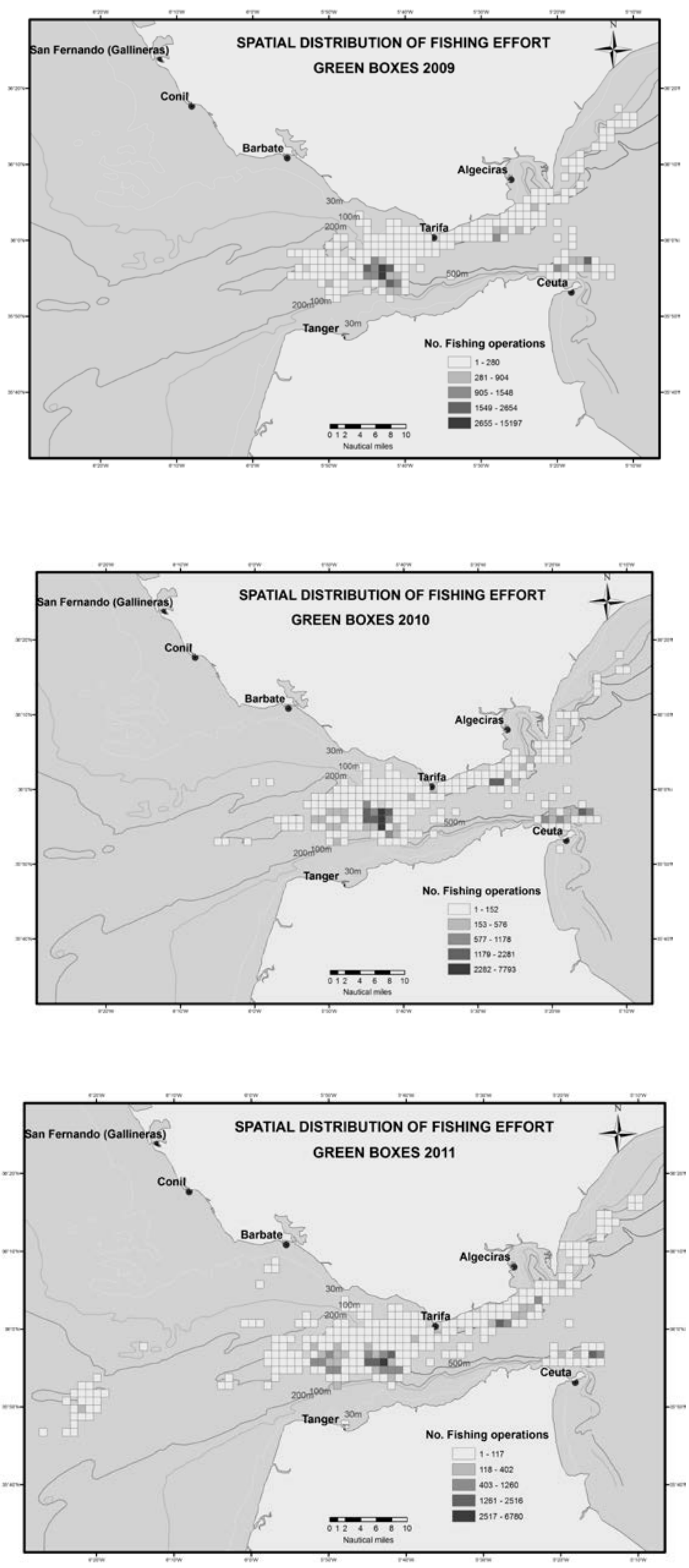


Figure 13.3.4. Spanish "*voracera*" Red seabream fishery of the Strait of Gibraltar (ICES Subarea IX): 2009–2011 effort allocation (from Gil *et al.*, WD).

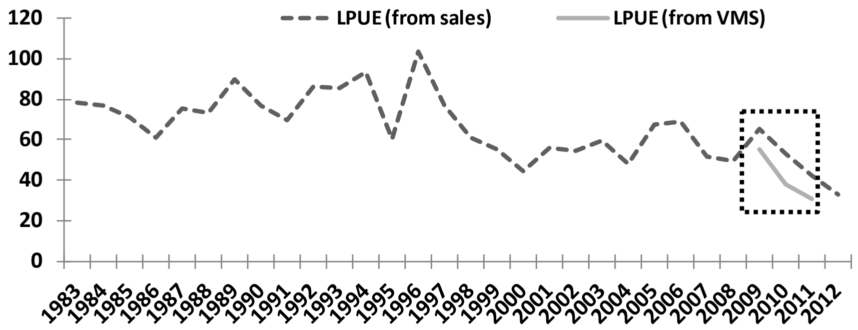


Figure 13.3.5. Spanish "voracera" Red seabream fishery of the Strait of Gibraltar (ICES Subarea IX): Estimated lpue using sales sheets or VMS data as effort unit (adapted from Gil *et al.*, WDs).

13.4 Red (blackspot) seabream (*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). 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. 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.*, 1995). 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.

13.4.1.1 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. During the last three years (2011–2013) the landings decreased significantly to 687 t, 624 t and 613 t which correspond to about 60%, 55% of the actual TAC (1136 t). In general a continuous decrease has been observed since 2005.

13.4.1.2 ICES Advice

The ICES advice for 2013 and 2014 is: "Catches should be no more than 400 tonnes."

13.4.1.3 Management

Under the European Union Common Fisheries policy a TAC was introduced in 2003 (EC. Reg. 2340/2002). TACs and landings are given below.

	Reg (CE) Nº. 2015/2006				Reg (CE) Nº. 1359/2008			
P. bogaraveo	**2007**		**2008**		**2009**		**2010**	
ICES Sub-Area	**TAC**	**Landings**	**TAC**	**Landings**	**TAC**	**Landings**	**TAC**	**Landings**
Xa2	**1136**	**1070**	**1136**	**1089**	**1136**	**1042**	**1136**	**1068**
	Reg (CE) Nº. 1225/2010				Reg (CE) Nº. 1262/2012			
P. bogaraveo	**2011**		**2012**		**2013**		**2014**	
ICES Sub-Area	**TAC**	**Landings**	**TAC**	**Landings**	**TAC**	**Landings**	**TAC**	**Landings**
Xa2	1136	624	1136	613	1022		920	

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 2014 to allow a multi-disciplinary research (ecological, oceanography and geological).

13.4.2 Data available

13.4.2.1 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.*, 2013). 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. On average about 5% of blackspot sea bream was discarded annually on sampled trips between 2004 and 2010.

13.4.2.2 Length compositions

Fishery length composition data is available for the period 1990 to 2011. Data for 2012 are not yet available to the working group. However data from 1990 to 1994 is based on low sampling coverage and so are not presented here. This data was presented to the group (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 1998–2000 and in 2005. This increase may relate to catchability factors or due to an expansion of the fishery to offshore areas and deeper depth strata.

13.4.2.3 Age compositions

No new information was presented to the group.

13.4.2.4 Weight-at-age

No new information was presented to the group.

13.4.2.5 Maturity, sex-ratio and natural mortality

Maturity and sex-ratio data were updated in accordance with the methods outlined in the stock annex.

13.4.2.6 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.

13.4.3 Data analyses

The fishery cpue has been variable but shows no overall trend (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 over the same period.

Survey indices from 1995 to 2012 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.

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.

Mean length of mature stock is around 37 cm (Figure 13.4.8) and immature about 25 cm (Figure 13.4.9). Variance of the estimates is high but the trends with time are stable.

No analytical assessments were carried out this year.

13.4.4 Management considerations

TACs should be consistent with catches in recent years.

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

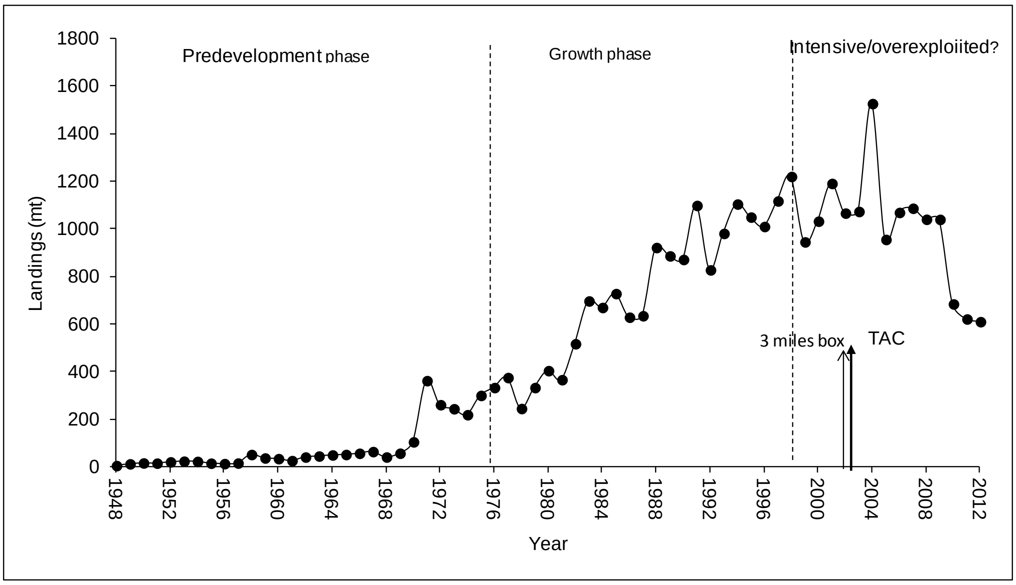


Figure 13.4.1. Historical landings of *Pagellus bogaraveo* from the Azores (ICES Area Xa2). Main technical management measures introduced to the fishery are also shown on the graph.

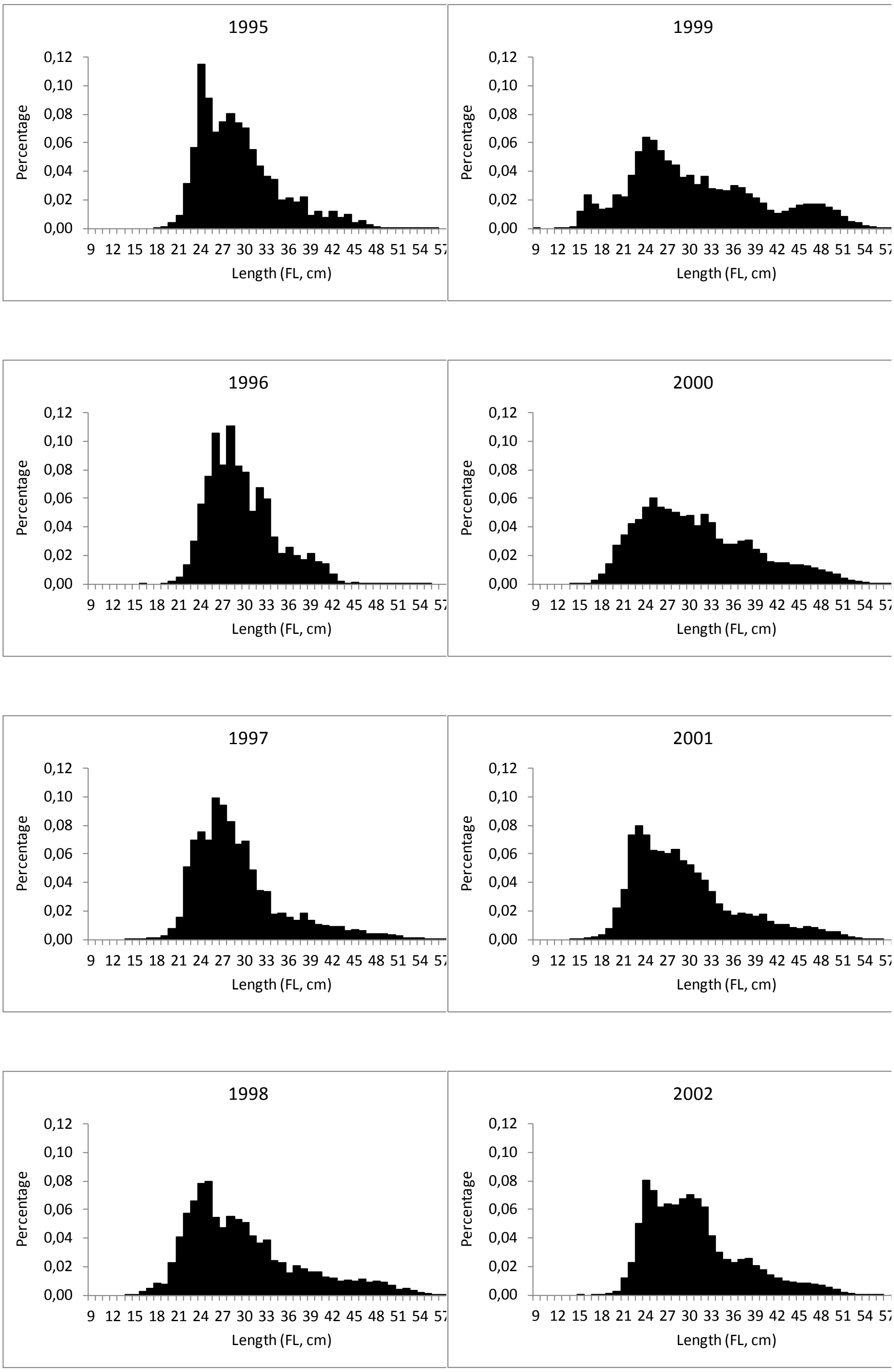


Figure 13.4.2. Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1995–2011 (ICES Area Xa2).

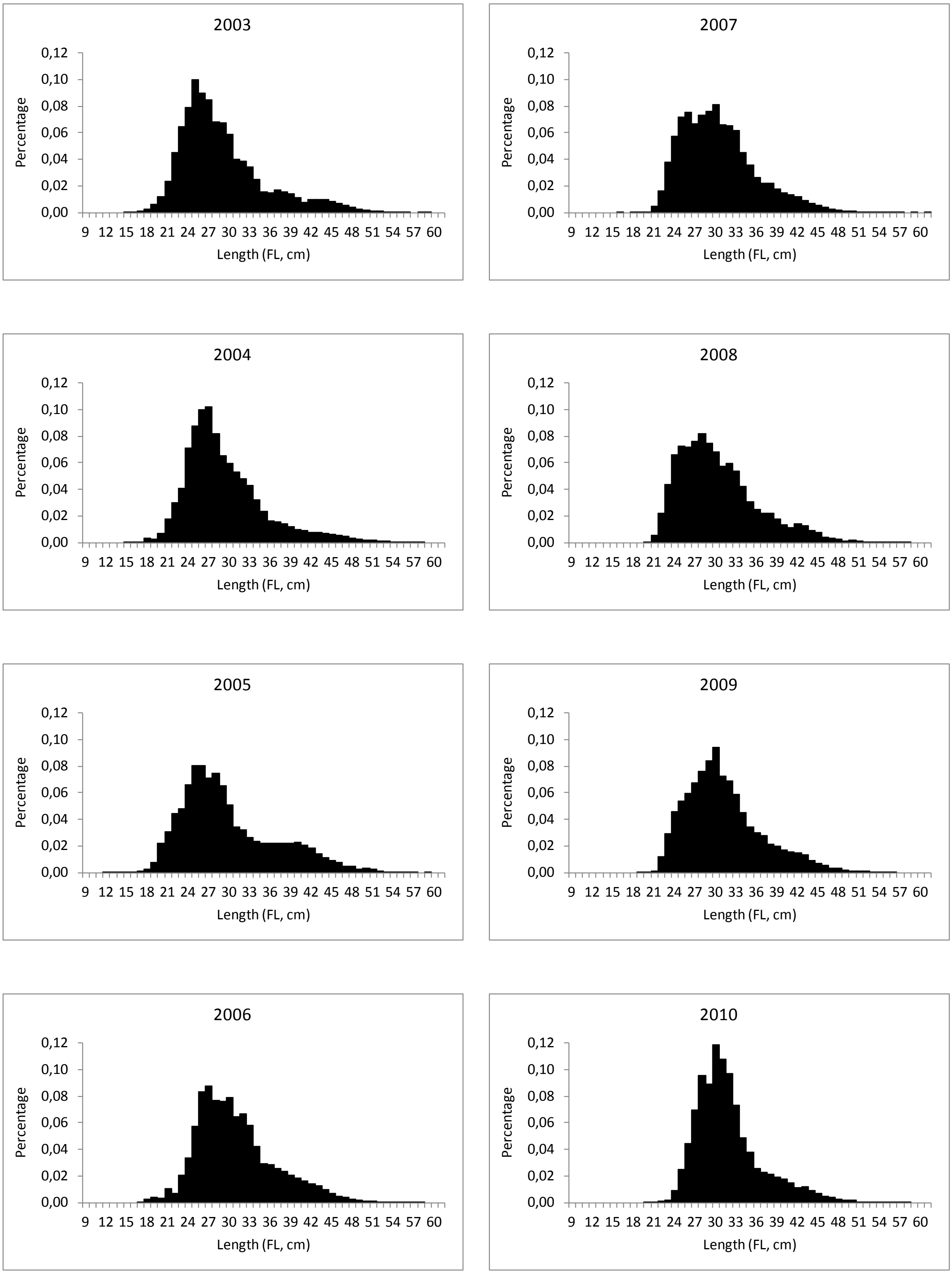


Figure 13.4.2.(cont.). Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1990–2011 (ICES Area Xa2).

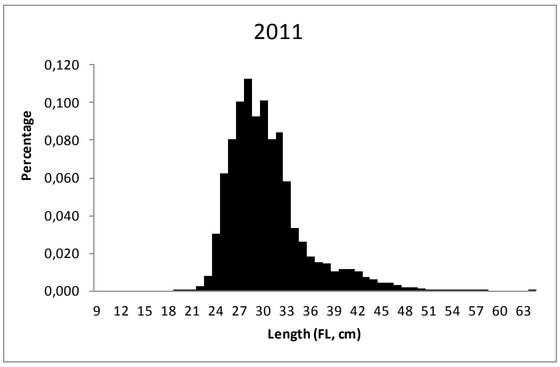


Figure 13.4.2. Cont.. Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1990–2011 (ICES Area Xa2).

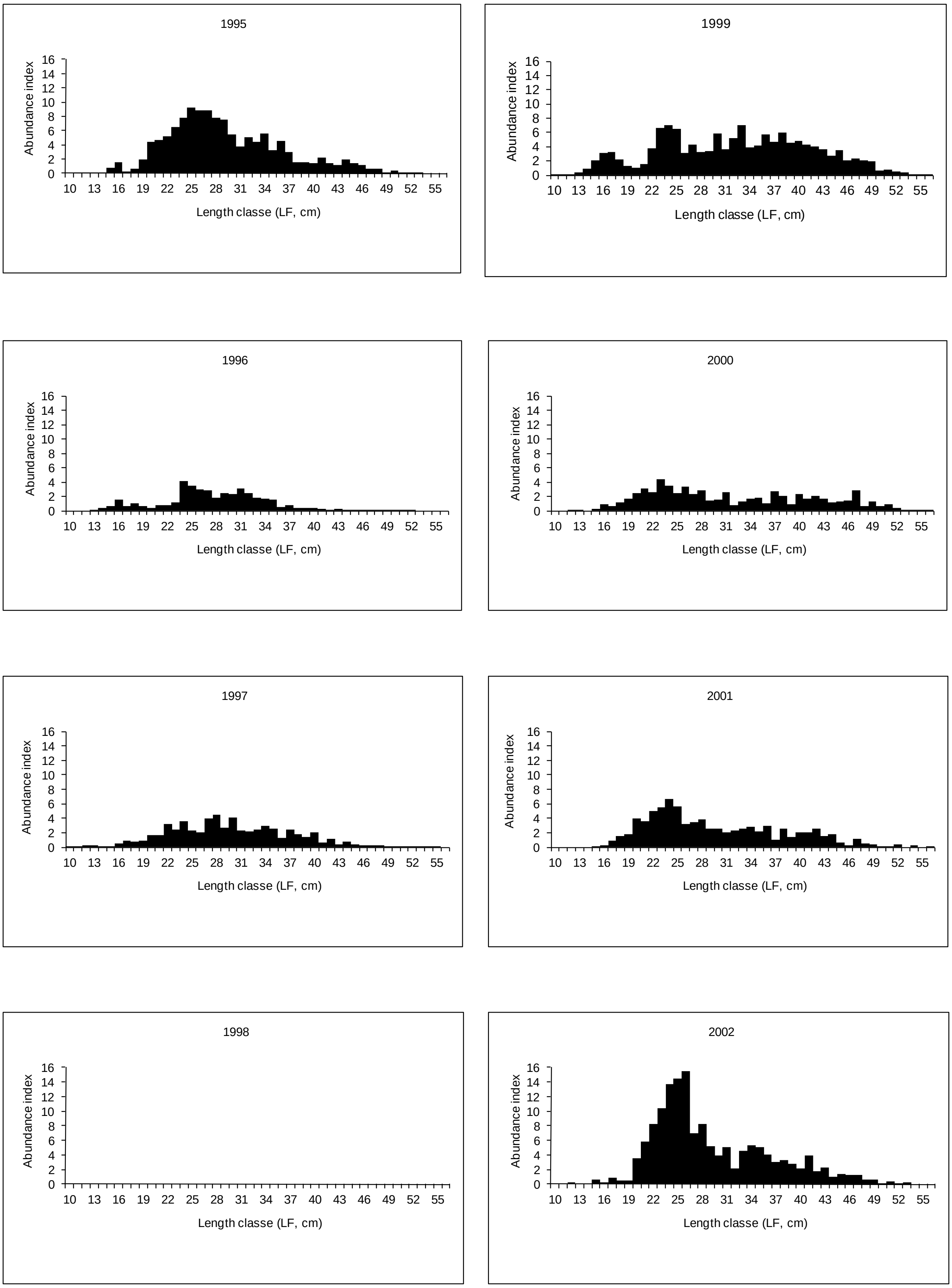


Figure 13.4.3. Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 1995–2002 (ICES Area Xa2).

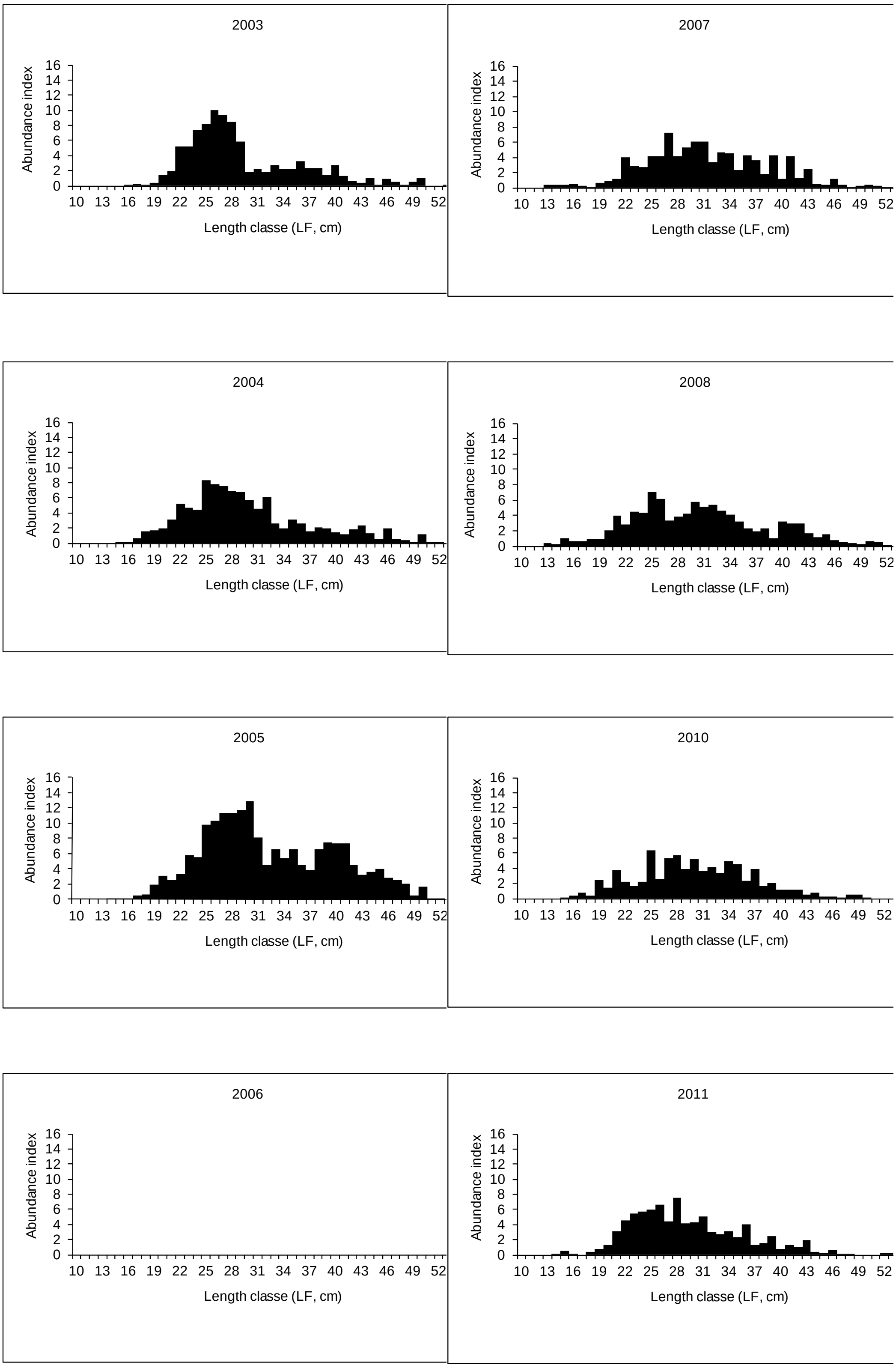


Figure 13.4.3. Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 2003–2012 (ICES Area Xa2).

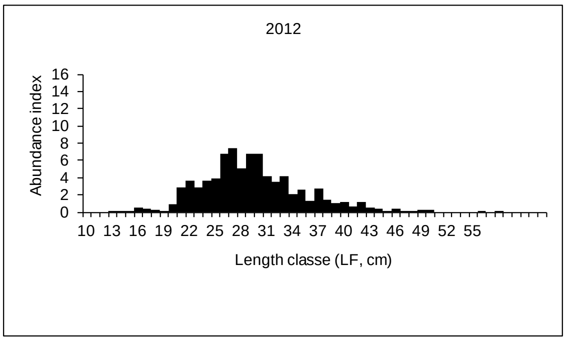


Figure 13.4.3. Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 2003–2012 (ICES Area Xa2).

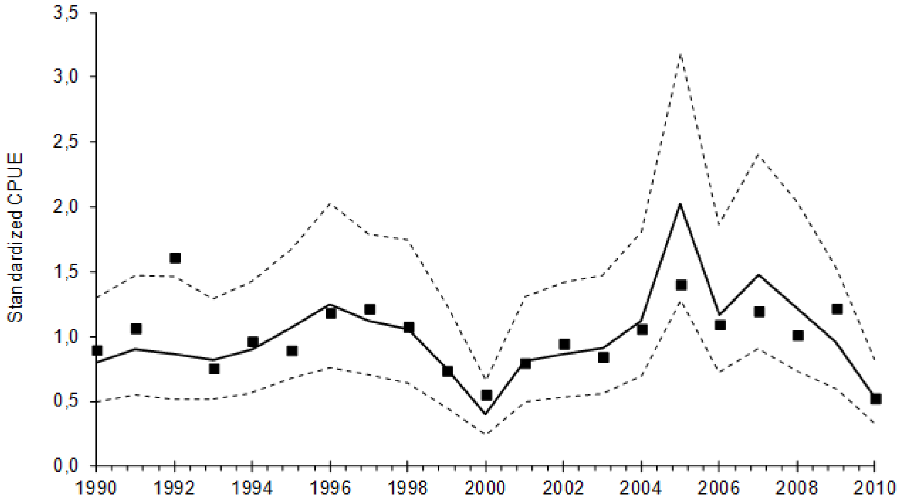


Figure 13.4.4. Standardized fishery catch rates of *Pagellus bogaraveo* from ICES Area Xa2. In the graph are shown the nominal cpue (squares), standardized cpue (solid line) and confidence intervals (dashed line).

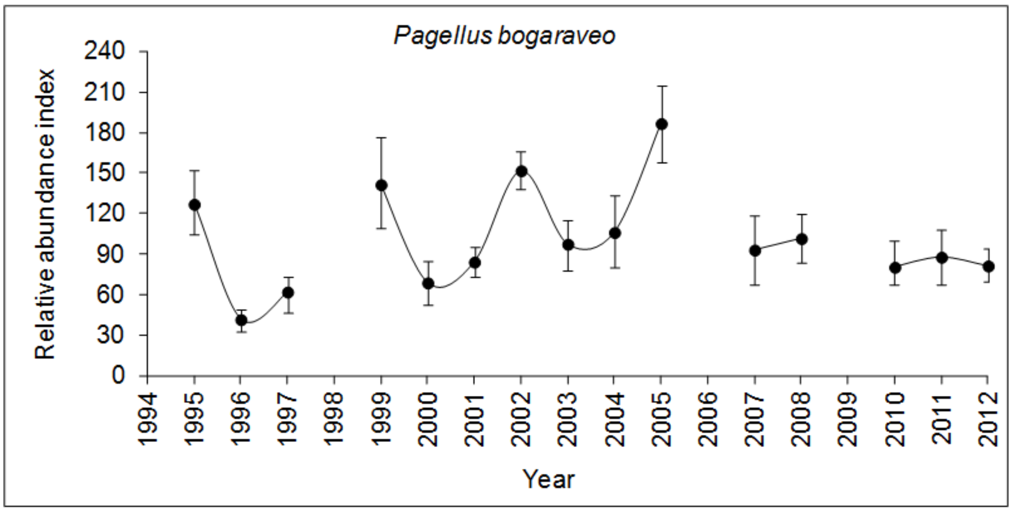


Figure 13.4.5. Annual abundance in number (Relative Population Number) and in weight (Relative Population Weight) of *Pagellus bogaraveo* from surveys for ICES Area Xa2.

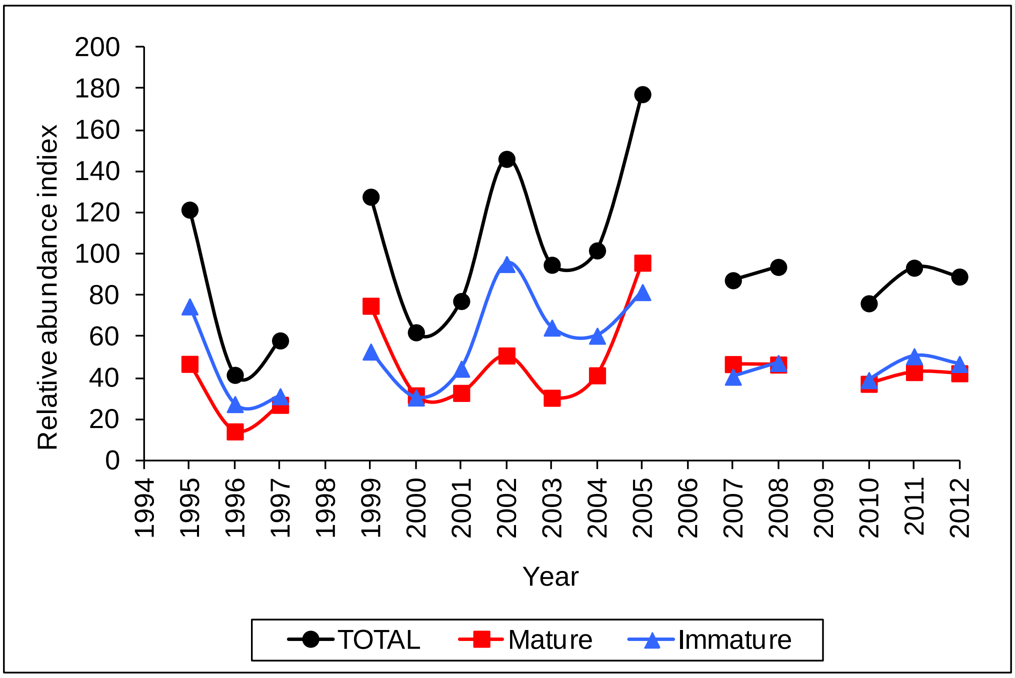


Figure 13.4.6. Survey abundance indices for mature and immature stock.

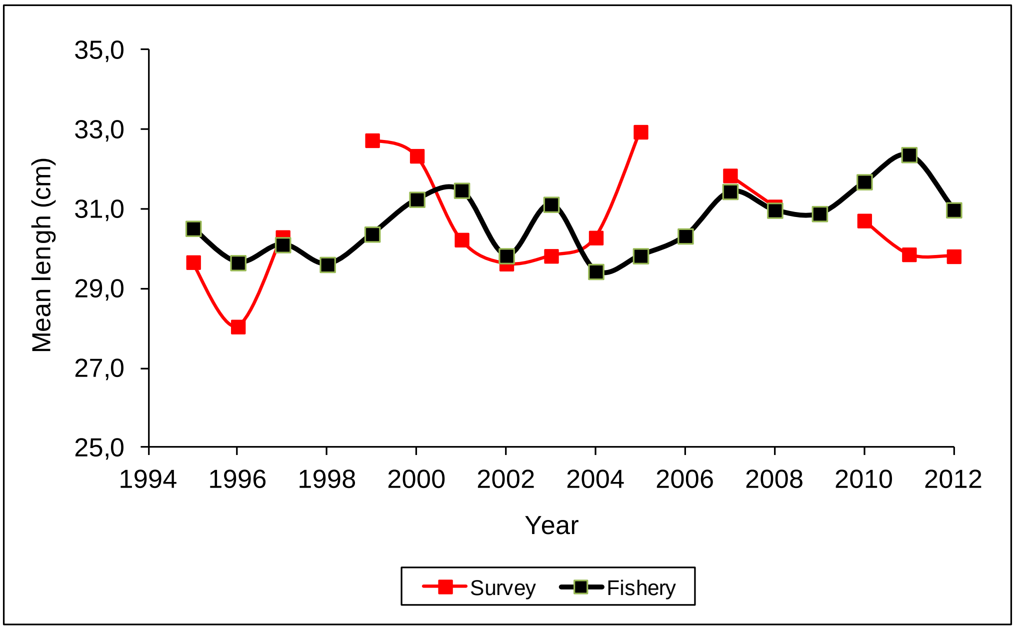


Figure 13.4.7. Annual mean length from the fishery (1990–2010) and from survey length compositions (1995–2008).

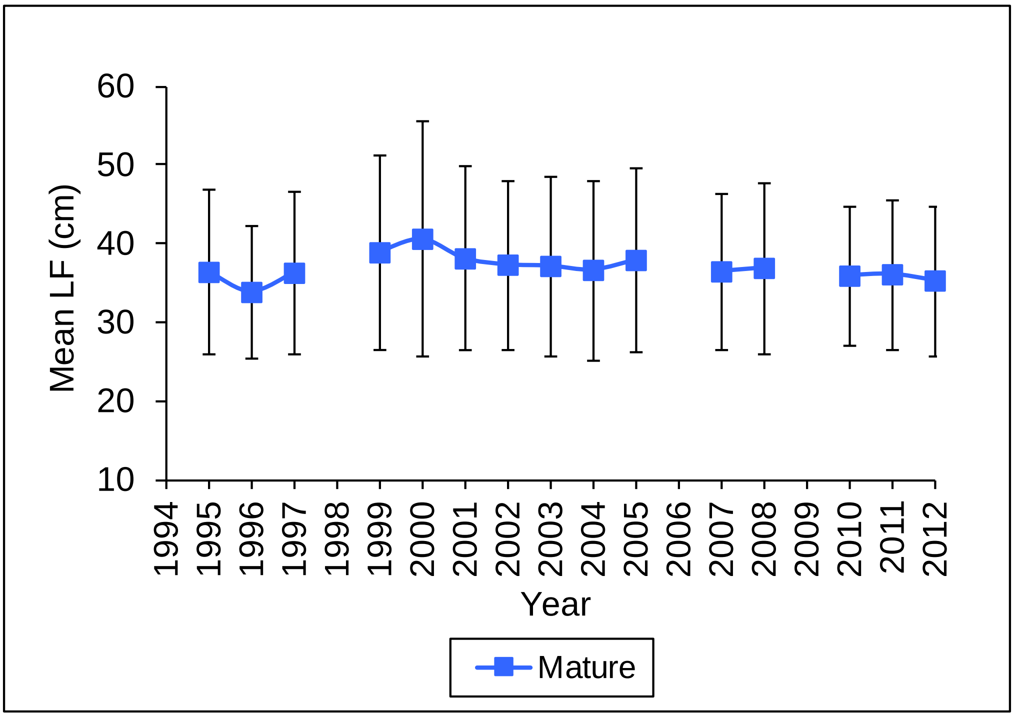


Figure 13.4.8. Annual mean length of mature individuals from the Azorean longline survey.

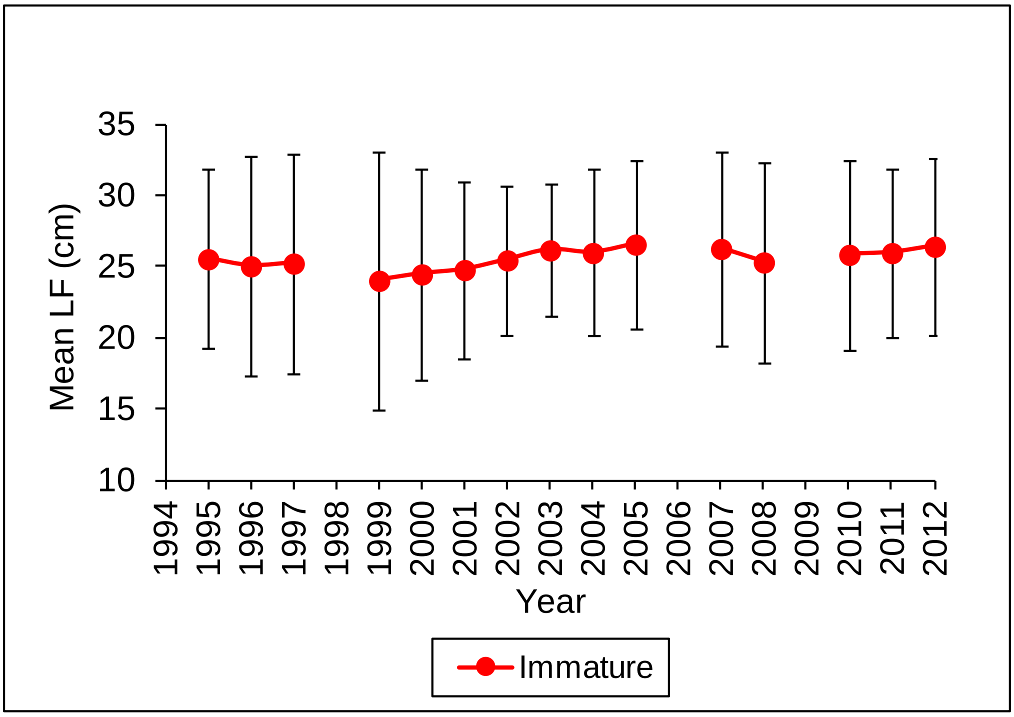


Figure 13.4.9. Annual mean length of mature individuals from the Azorean longline survey.

14 Other deep-water species in the Northeast Atlantic

14.1 The fisheries

The following species are considered in this chapter: roughhead grenadier (*Macrourus berglax*), 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*), bluemouth (*Helicolenus dactylopterus*), silver scabbard fish (*Lepidopus caudatus*), deep-water cardinal fish (*Epigonus telescopus*) and deep-water red crab (*Chaceon affinis*).

Roughhead grenadiers are predominantly taken as bycatch in trawl and longline fisheries targeting Greenland halibut in Subareas I and II but substantial catches have been reported in recent years from mixed trawl fisheries on the Hatton Bank. Since 2010, Spanish trawlers have reported significant landings of this species in subarea XIV. Mora, rabbitfish, smoothheads, bluemouth 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, bluemouth and silver scabbardfish are caught in targeted and mixed species longline fisheries in Subareas VIII, IX and X.

Deep-water red crab are caught in directed trap fisheries principally in Subareas VI and VII.

14.1.1 Landings trends

Landings are presented in Tables 14.1–14.9.

14.1.2 ICES Advice

ICES has not previously given specific advice on the management of any of the stocks considered in this chapter.

14.1.3 Management

No quotas 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.

14.2 Stock identity

No information available.

14.3 Data available

14.3.1 Landings and discards

Landings for all of these species are presented in Tables 14.1–14.9.

14.3.2 Length compositions

Updated length composition data on bluemouth from the Spanish survey on Porcupine Bank Figure 14.1.

Trends in mean length of bluemouth, silver scabbardfish, *Mora moro* and wreckfish in Azorean surveys are shown in Figures 14.2 to 14.5.

New information on length frequency and length–weight relationships for deep-water cardinal fish caught in Faroese exploratory fisheries in Subarea X are presented in Figure 14.6.

New data on length–frequency distribution of roughhead grenadier from Russian trawl fisheries in the Norwegian Sea (Divisions IIa and IIb) in 2011 are presented in Figure 14.7.

14.3.3 Age compositions

No new information.

14.3.4 Weight-at-age

No new information.

14.3.5 Maturity and natural mortality

No new information.

14.3.6 Catch, effort and research vessel data

A standardized abundance index for bluemouth in the Spanish Porcupine Bank Survey from 2001 to 2010 is shown in Figure 14.8. The geographic distribution of catch rates is given in Figure 14.19.

An update on abundance indices of bluemouth silver scabbard, *Mora moro* and wreckfish fish from the Portuguese survey at the Azores are given in Figures 14.10 to 14.13.

14.3.7 Data analysis

Standardised abundance indices for bluemouth in the Spanish Porcupine Bank Survey declined between 2005 and 2008 but have remained stable since then.

The standardized abundance index for bluemouth in the Azores longline survey shows no continuous trend between 1995 and 2008 but catch rates since 2010 have been low with 2011 being the lowest in the time-series (Figure 14.10). 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 *Mora moro* in the Azores longline survey fluctuated greatly with no overall trend between 1995 and 2011. There was been a slight declining trend in mean length between 1995 and 2008 but mean length in 2010 and 2011 returned to levels similar to the start of the series.

The cpue for wreckfish in the Azores longline survey fluctuated greatly with no overall trend between 1995 and 2011. Mean length showed no trend between 1995 and 2011. 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.

14.3.8 Comments on the assessment

None.

14.3.9 Management considerations

No advice was required for these stocks this year.

Table 14.1. Working group estimates of landings of roughhead grenadier (t). Data from 2012 are provisional.

Year	I and II	III and IV	Va	Vb	VI and VII	VIII	XII	XIV	TOTAL
1988									
1989									
1990	589								589
1991	829								829
1992	424	7							431
1993	136				18			52	206
1994	0				5			5	10
1995	1				4			2	7
1996	3	4	15		13				35
1997	21	5	4	6	12				48
1998	55	1	1	9	10			6	82
1999	0			99	38			14	151
2000	48	4	2	1	11		7		73
2001	94	10	1	4	45		10	26	190
2002	29	3	4	3	12	1	1143	53	1248
2003	77	2	33	12	11		225	33	393
2004	79	1	3	10	33		752	55	933
2005	77	39	5	6	1488		2205	40	3860
2006	78		7	10	2003	3	976	4	3081
2007	49		2	5	1180		420	15	1671
2008	55			3	128		73	3	262
2009	53		5		210		7	4	279
2010	45		22	1	11		1	422	502
2011	29		21		4		2	264	320
2012	54	2	16	1	195		526	2740	3534

Table 14.2. Working group estimates of landings of *Mora moro* and *Moridae* (t). Data from 2012 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

Table 14.3. Working group estimates of landings of rabbitfish (t) (*Chimaera monstrosa* and *Hydrolagus* spp.) Data from 2012 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	1	434		1064

Table 14.4. Working group estimates of landings of Baird's smoothhead (t). Data from 2010 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	12538	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				252		252
2012				472		472

Table 14.5. Working group estimates of landings of wreckfish (t). Data from 2012 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

Table 14.6. Working group estimates of landings of bluemouth (t). Data from 2012 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			64	193	214	281	752
2009			94	14	75	267	450
2010			69	6	6	213	294
2011			6	14	149	231	400
2012		2	22	944	1332	190	2490

Table 14.7. Working group estimates of landings of silver scabbardfish (t). Data from 2012 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

Table 14.8. Working group estimates of landings of deep-water cardinal fish (t). Data from 2012 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		2	4		22

Table 14.9. 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

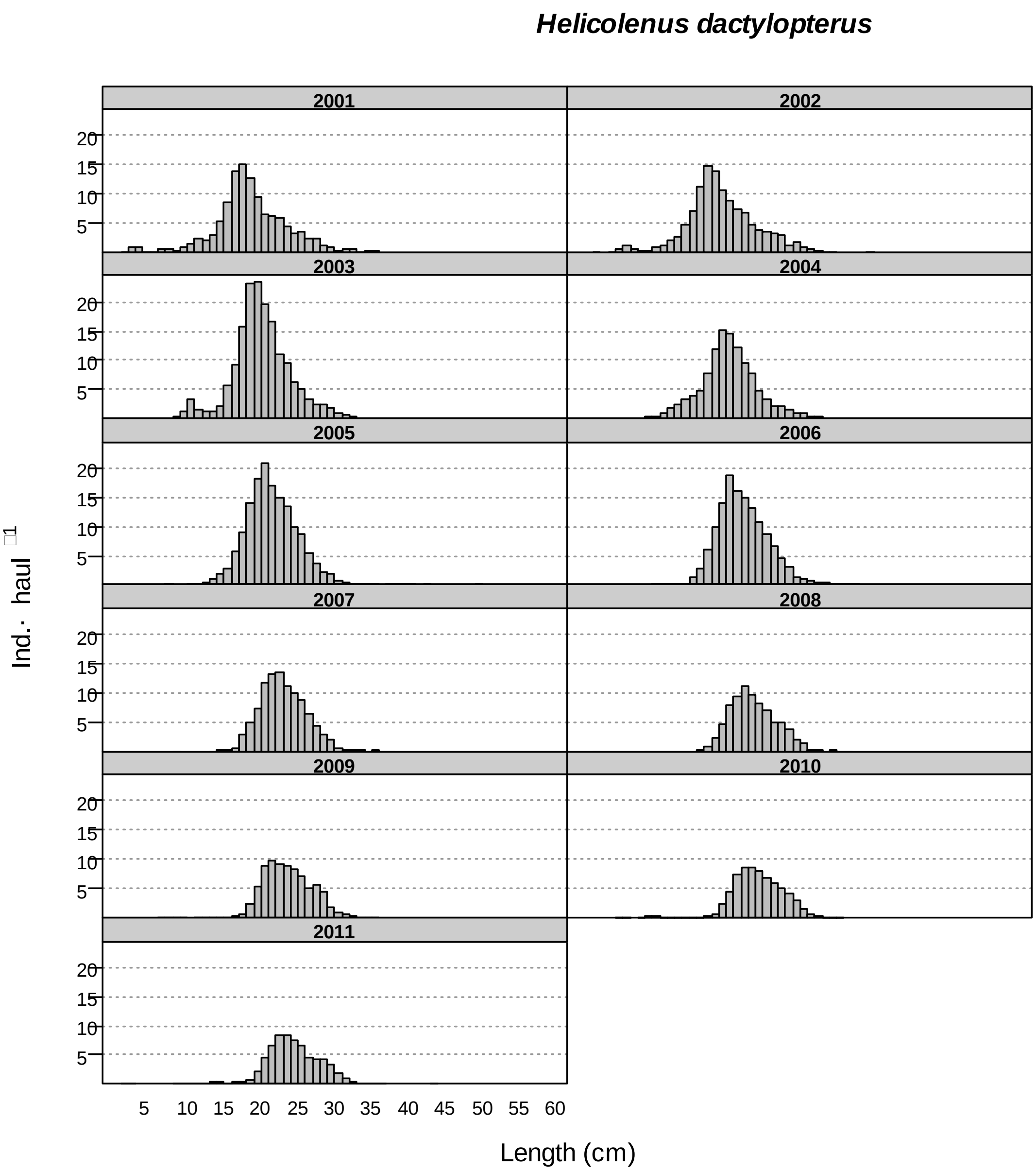


Figure 14.1. Mean stratified length distributions of *Helicolenus dactylopterus* in Spanish surveys on the Porcupine bank (2001–2011).

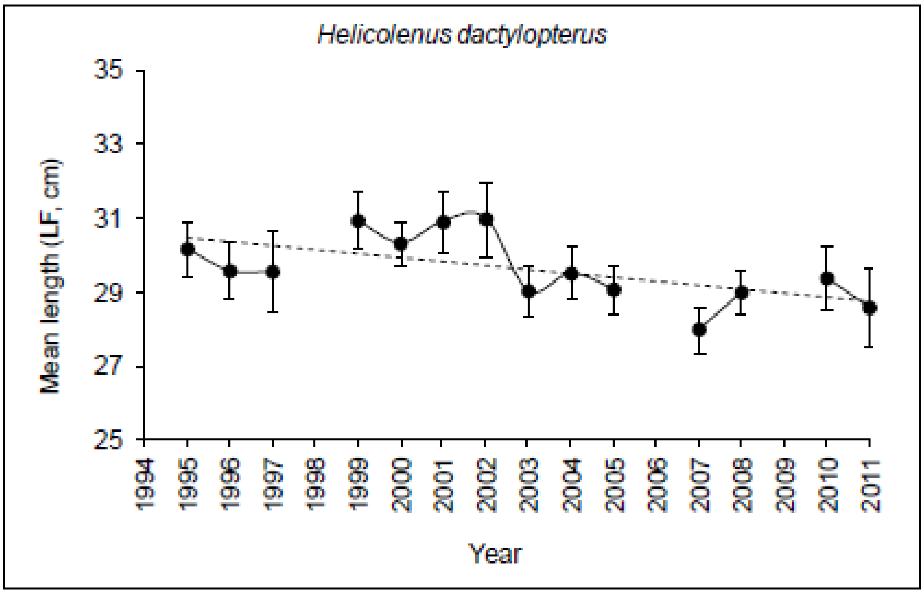


Figure 14.2. Mean length of bluemouth in Azores bottom longline survey 1995–2011.

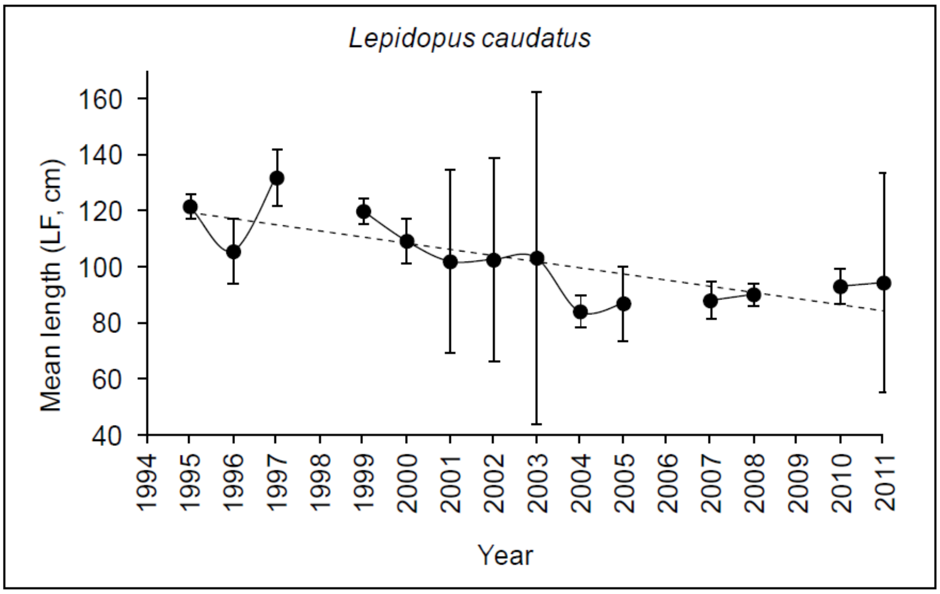


Figure 14.3. Mean length of silver scabbardfish in Azores bottom longline survey 1995–2011.

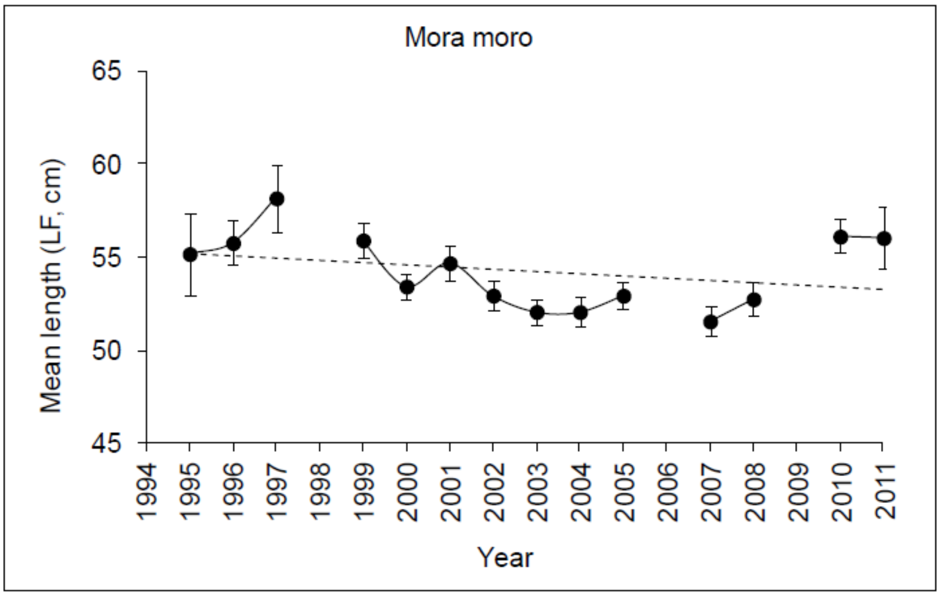


Figure 14.4. Mean length of *Mora moro* in Azores bottom longline survey 1995–2011.

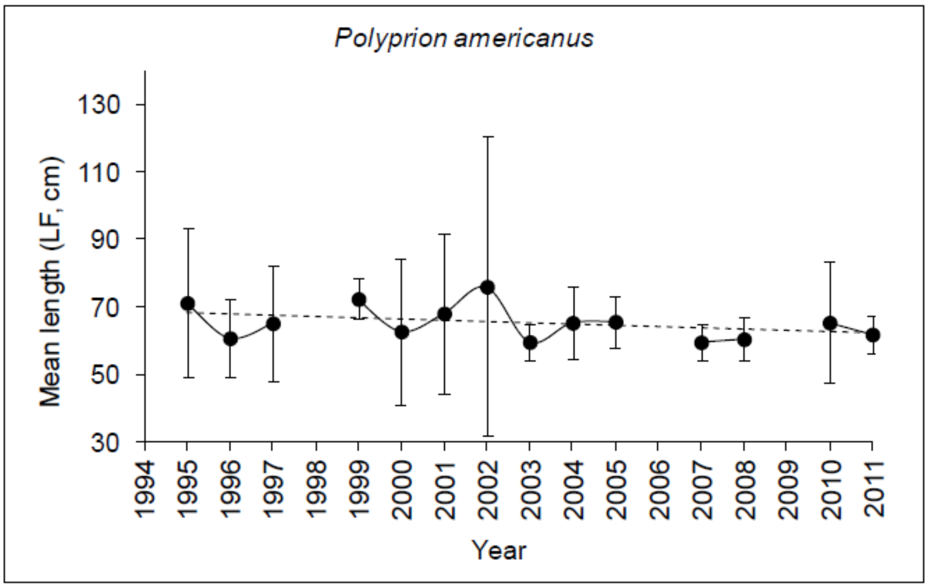


Figure 14.5. Mean length of wreckfish in Azores bottom longline survey 1995–2011.

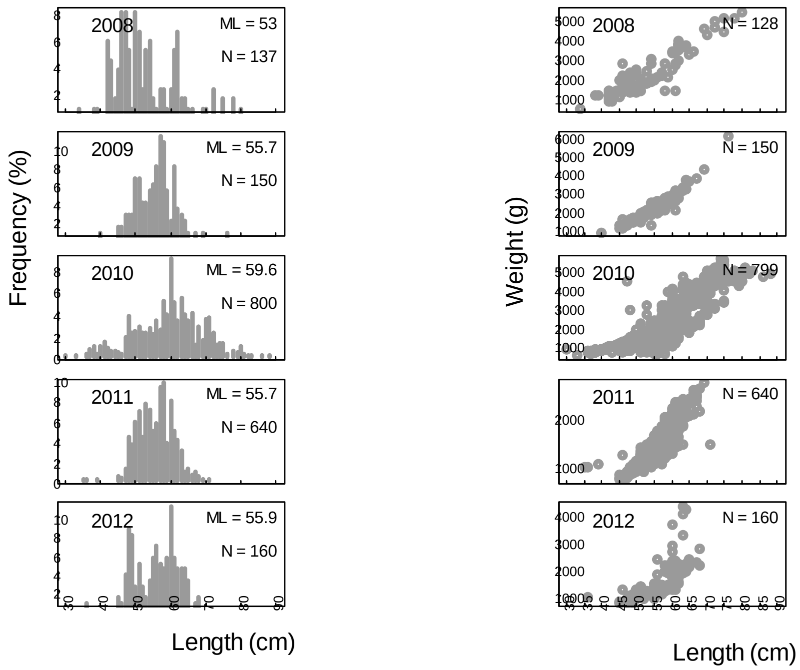


Figure 14.6. Deep water cardinal fish in Faroese exploratory fisheries in Subarea X. Length distribution and length–weight relation.

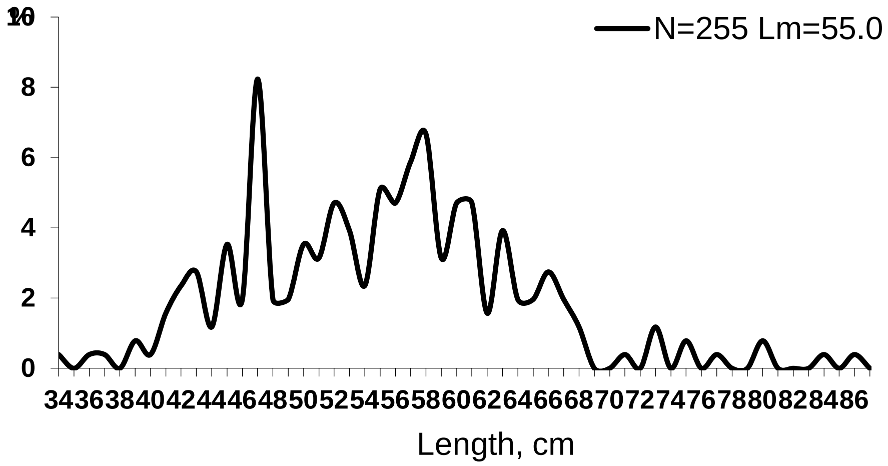


Figure 14.7. Length composition of roughhead grenadier from bottom-trawl catches in the Norwegian Sea in February–December 2011.

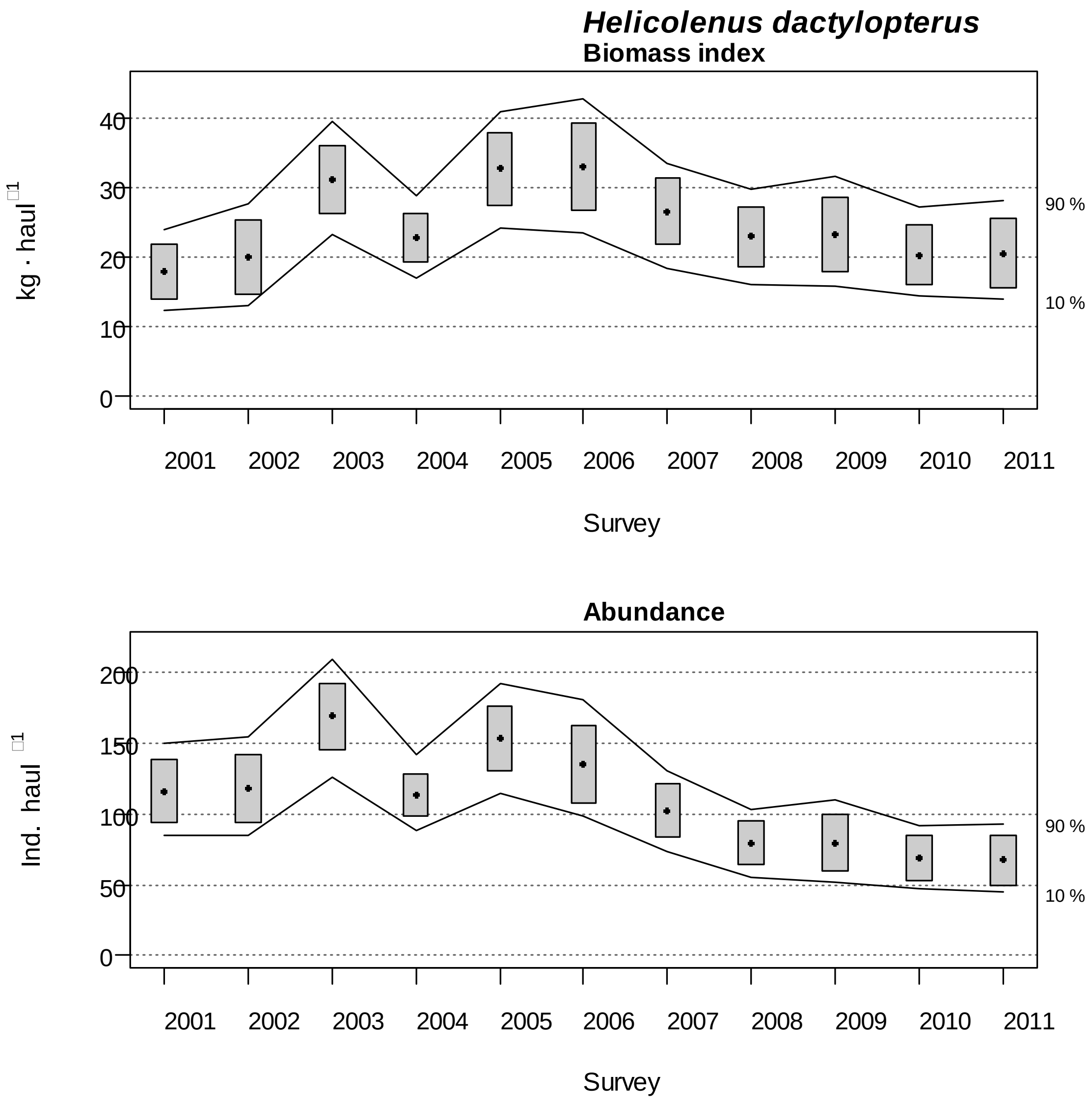


Figure 14.8. Changes in *Helicolenus dactylopterus* biomass and abundance indices during Porcupine Survey time-series (2001–2011). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals ($\alpha = 0.80$, bootstrap iterations = 1000).

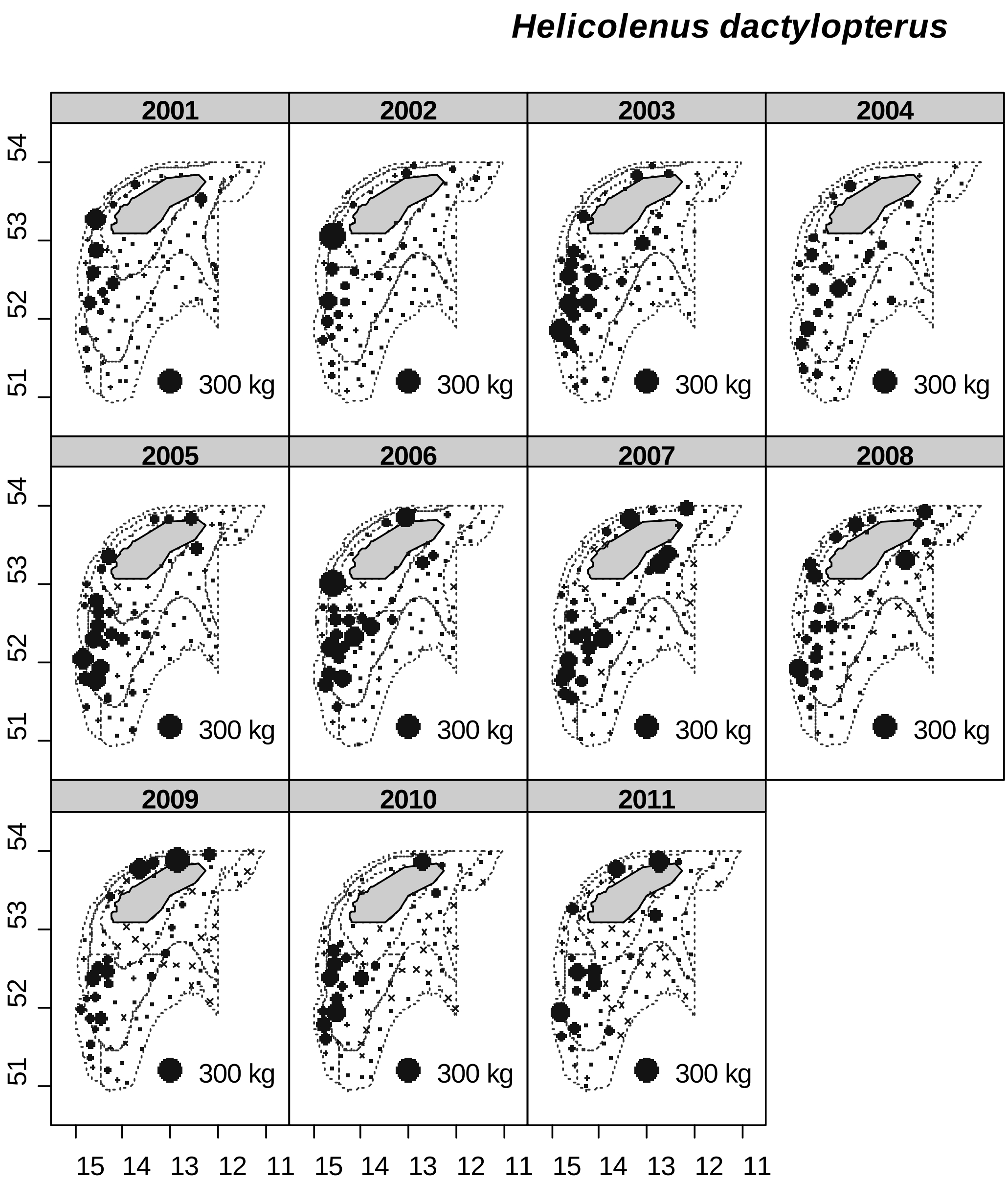


Figure 14.9. Geographic distribution of *Helicolenus dactylopterus* catches (kg/30 min haul) in Porcupine surveys (2001–2011).

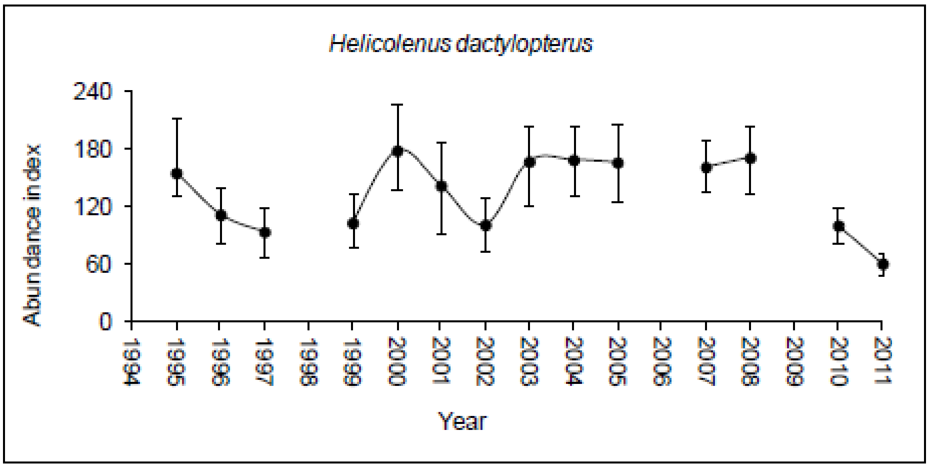


Figure 14.10. Annual bottom longline survey abundance index (number) for bluemouth in Azorean bottom longline surveys.

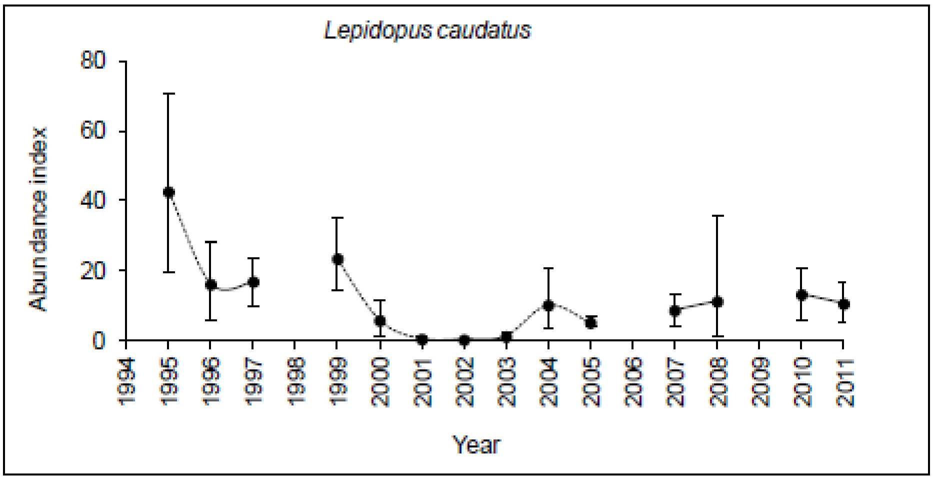


Figure 14.11. Annual bottom longline survey abundance index (numbers) for silver scabbardfish in Azorean bottom longline surveys.

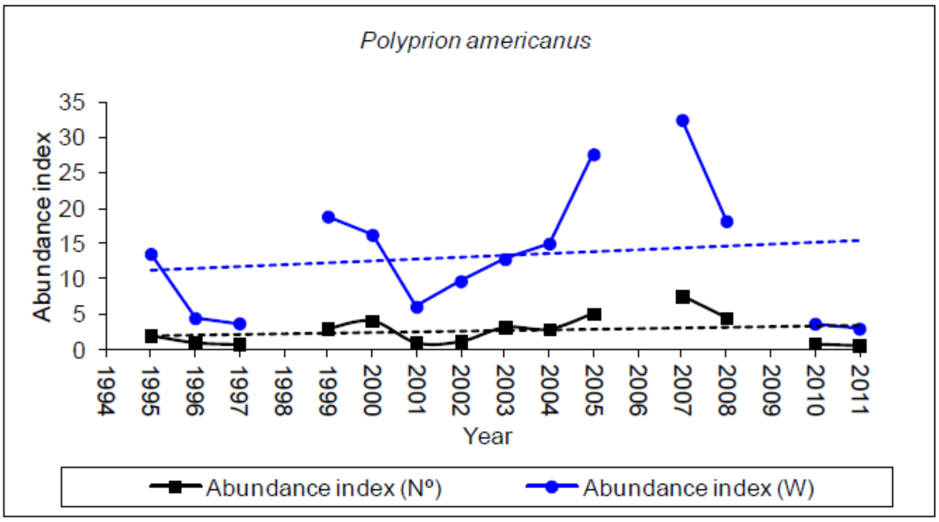


Figure 14.12. Annual bottom longline survey nominal cpue for wreckfish in Azorean bottom longline surveys.

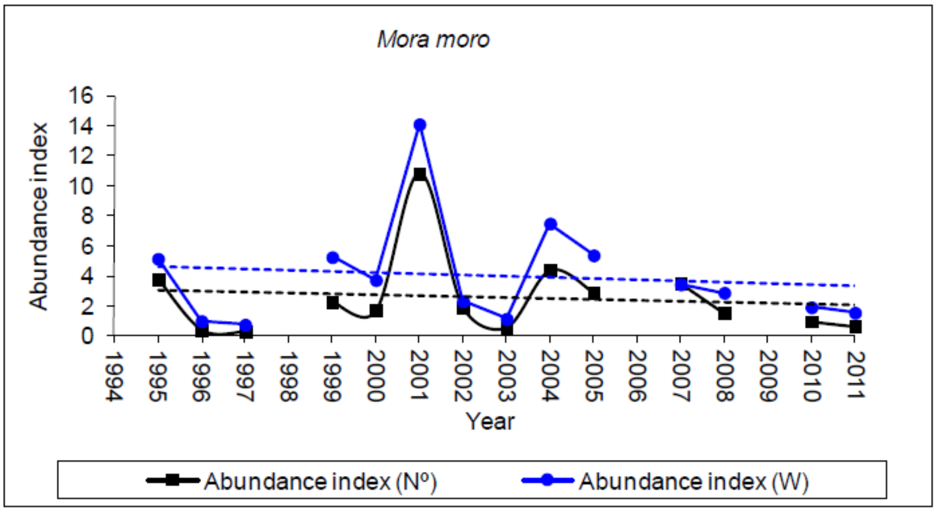


Figure 14.13. Annual bottom longline survey nominal cpue for *Mora moro* in Azorean bottom longline surveys.

15 ToR b) Evaluate the harvest control rule for data-limited stocks developed by WKLIFE2 and further develop methods to provide quantitative advice consistent with the MSY framework

The evaluation of the HCR by WGDEEP falls into two parts: a generic evaluation of the HCR and potential areas of concern relating to the generation of advice for data-limited stocks such as those assessed by WGDEEP, and specific comments on the application of the HCR to individual stocks assessed by WGDEEP in 2012. The former is outlined in Section 15.1 and the latter presented in Table 15.1.

To further develop methods to provide quantitative advice consistent with the MSY framework, WGDEEP has applied a new approach to Productivity Susceptibility Analysis (PSA) using orange roughy stocks to the west of the British Isles as a case study. This is described in Section 15.2

15.1 Generic comments on the HCR

Many of the concerns expressed by WGDEEP relate to the specifics of how the HCR was applied during the advice drafting process in 2012 rather than to the HCR itself. This may have resulted in part from inexperience in the application of the HCR on the part of the advice drafting group and from their relative lack of expert knowlege of the stocks. Additionally, the HCR has undergone continued development since the advice was drafted and the guidance available at that time was considerably less comprehensive than that available now.

A general concern underlying many of the comments is that the advice generated under method 3.1 is highly sensitive to the method used to identify trends in the survey/commercial cpue index. This is particularly problematical where the indicator series is noisy or where there is a strong trend in landings. The application of the default ratio of the average of most recent two years to the previous three could be greatly influenced by the occurrence of a single anomalously high or low point during that five year period. Methodology of the guidance document (Method 3.1, p15 on biomass trends) states that the number of years to average should account for interannual variability of the survey. This is an important point, and it is not clear if and how this was taken into consideration in 2012. Some guidance or a statistical "rule of thumb" would be useful to ensure a consistent approach between stocks. The same is true for taking precision of the survey estimates into account when comparing the two averages (as advised in method 3.1 p. 15).Again, it is not clear how this was done in 2012 and further guidance on this would help for consistency. Overall the interannual variability should be further considered when determining trends. If datapoints of consecutive years do not move unidirectionally, when are we sure we have significant trends? Trend detection methods such as Trenkel and Rochet, 2009 should be further explored and possibly applied in addition to ascertain trends.

Similarly, the period over which catches are averaged to derive the "*status quo*" catch can introduce considerable bias to the results, particularly if there is significant interannual variation or a strong directional trend. For example, landings of red (blackspot) seabream in Subarea IX showed a strong downward trend in landings over the most recent three years resulted in the mean over the period 2009–2011 being higher than the landings in 2011 so the TAC advised, even after the application a 20% reduction was a significant increase over the previous year catches. Selecting a shorter reference period (i.e. consider only landings from the last recent year) would have resulted in much lower TAC advice.

Another example is the roundnose grenadier in the Mid-Atlantic Ridge. Due to the advice (method 5.2), it was recommended to limit catch of 1350 t. But the value of catch in 2009, which was included into account was 5 t, in fact it was zero catch. Next value (in 2010) was combine catch of two species of grenadiers. The inclusion of these values in calculation of average catch is incorrect.

The DLS guidance report allows considerable discretion in the selection of appropriate reference periods and it is to be hoped that in the future, as more experience is gained in the application of the HCR and when the expert group have greater opportunity to feed into the process, such problems can be avoided. However, there is a perception that the flexibility of the current approach allows scientists to select a reference period that delivers a predetermined advice rather than being objective. If this perception is to be avoided, it will be necessary to provide clear guidance on how reference periods should be selected.

WGDEEP felt that a significant weakness of the HCR in general is that it promotes reliance on a single type of data rather than taking into consideration the full diversity of information that may be available. This is of concern for many of the stocks covered by WGDEEP for which, in many cases, several types of data may be available, none of which is entirely suitable to indicate trends for the entire management unit but which, when taken together, combine to give an impression of the state of the stock. In cases where there is no single data source that gives a reliable indication of the state of the stock, use of several diverse data types could give an overall picture, however, the HCR does not allow this. Where data quality is an issue, WGDEEP would appreciate some guidance on how differing sources of information should be evaluated in the process of selecting a method within the HCR.

Table 15.1 Working group review of the application of the HCR in 2012 to individual stocks assessed by WGDEEP.

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Ling Va	ICES advises that catches should be no more than 12 000 tonnes.	3.3	No	No	Survey trends-based assessment	March Icelandic groundfish survey and data from commercial catches	For this stock the F_{proxy} of 1.5 is applied as a factor of the average of the most recent survey biomass estimates (average of 2011 and 2012), resulting in catch advice of no more than 12 000 t. This catch advice is within 20% of the last three years' catch and a 20% precautionary buffer is not applied because the stock has increased by more than 50% in the last two years compared with the three preceding years.	Due to large fluctuations in the survey index the reference period may need to be changed on a regular basis for advice to not fluctuate too much. That basically means that this is just a formulation of 'expert judgement'. However this stock is set for benchmark in 2014 and may therefore have a full analytical assessment in the near future.
Ling Vb	ICES advises that there should be a 20% reduction in effort	3.2a	No	yes	Survey and commercial cpue trends-based assessment	Commercial longline from Norway and Faroese and two survey cpue from the Faroes	The assessment of the stock is based on trends in indices of abundance from surveys and commercial cpue. No forecasts are available. However, there are some indications of increased recruitment and an increase in adult biomass. If these are correct then the same effort may yield an increase in catches in 2013 and 2014. Additionally, considering that exploitation is unknown, ICES advises that effort should decrease by a further 20% as a precautionary buffer	Ling in Vb is not a data-limited stock. There are indices for biomass and recruitment, reliable landing data and catch per unit effort. The survey and catch indices show an increasing trend in the last three years and the landings have been varying around 4500-6000 t in the last ten years. The landings from Faroese vessels have increased and the landings from other nations have decreased because the lack of agreement about the mackerel. Even as the Faroese vessels have increased their effort there is no sign of that the total effort has increased. The advice should be that the effort should not increase as the fishery seems to be stable with the current effort

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Ling I, II	advises that catches should be no more than 10 800 tonnes	5.2	NA	yes				
Ling – Other stocks	ICES advises that catches should be no more than 10 800 tonnes	3.2a	No	yes	Cpue trends-based assessment	Commercial and survey cpues	The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch. These cpue series cover the major fishing areas (Divisions VIa, IVa, and VIb) and are interpreted as being either stable or increasing, implying that abundance is at least stable at the current volume of catch. Additionally, considering that exploitation is unknown, ICES advises that catches should decrease by a further 20% as a precautionary buffer. This results in catches of no more than 80% of the mean catch 2009–2011, i.e. 10 800 t in 2013.	Exploitation rate in the form of F_{proxy} has not been evaluated in last year's assessment, but data shows that there has been a decrease in landings in the last ten to 15 years. The advice states that "knowledge about the exploitation status also influences the advised catch", however at the same time the catch advice included a 20% reduction as a precautionary buffer "considering exploitation is unknown". This is despite stable to increasing trends in the cpue time-series and decreasing catches. It seems that this information is lost in the catch advice as only the last five years were taken into consideration in the harvest control rule, rather than looking at the dynamics over a longer time frame (eg 10–15 years).

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Blue ling Va, XIV	ICES advises that catches should be no more than 3100 tonnes.	3.3	No	No	Catch and survey trends-based assessment	Landings data from trawl fleets in Division Va and Subarea XIV and the Icelandic autumn survey	For this stock the F_{proxy} of 1.7 is applied as a factor to the 2010 biomass estimate of 1824, resulting in catch advice of no more than 3100 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 FMSY proxy. The 20% precautionary buffer is therefore not applied because the stock is above possible reference points and an $F_{MSY\ proxy}$ is used.	Due to fluctuations in the survey index the reference period may need to be changed on a regular basis for advice to not fluctuate to much. That basically means that this is just a formulation of 'expert judgement'.

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Blue ling Vb, VI, VII	ICES advises that catches should be no higher than 3900 t in 2013.	5.2	NA	No	Stock Reduction Analysis (SRA), a model fitted to catches and abundance indices; Multi-Year Catch Curves (MYCC), a model fitted to age composition and total catch in order to estimate annual total mortality (Z).	International landings 1966–2011; landings per unit of effort (lpue) from logbooks and French tallybooks; Faroese, Scottish, and Irish surveys; age composition of French landings (1988–1994 and 2009–2011).	Two independent stock assessment models return similar views that the stock was overexploited, with fishing mortality showing a peak in 2000 and then decreasing. These models indicate that stock abundance has been increasing since 2003 or 2004. The history of the exploitation is longer than most time-series of data, only landings time-series could be reconstructed back to 1966, i.e. early times of the fishery. The time-series of length distribution starts from the late 1980s and landings per unit of effort (lpue) from tallybook records in 2000. However, the SRA model provides an estimate of the biomass in the late 1960s when exploitation was very low. This estimate can be regarded as a virgin biomass estimate, a reference situation not usually available for demersal fish stocks. The stock abundance has increased by a factor of 1.7 since 2002 according to SRA, and 2.8 since 2004 according to MYCC. However, the absolute level is estimated at about 25% of the unexploited level according to SRA. Fishing mortality in the period 2008 to 2011 was well below all suggested FMSY proxy values. However, current biomass in relation to $B_{trigger}$ is unknown and there is a possibility that the stock is below this point. It would	

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
							therefore not be appropriate to allow F to increase to F_{MSY} until the biomass relative to $B_{trigger}$ can be assessed. Maintaining recent catches (average of landings 2008 to 2011) would be expected to result in increasing SSB. This would imply a catch of 3.9 kt in 2013.	

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Blue ling - Other stocks	directed fisheries for blue ling, and a reduction in bycatches should be considered until the scientific information is sufficient to prove the fishery sustainable.	5.3	NA	NA	Catch trends-based assessment	Landings in Divisions IIIa and Iva, and Subareas I, II, VIII, IX, and XII		
Tusk I,II	ICES advises that catches should be no more than 9040 t.	5.2	NA	yes	No assessment	No discard information is available.	For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented. The resulting limit should stay in place at least two years unless stock information shows a change that merits updating the advice. For this stock, ICES advises that catches should decrease by 20% compared to the average catch of the last three years, corresponding to catches of no more than 9040 t in 2013 and subsequent years.	

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Tusk Mid-Atlantic Ridge	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	NA	NA	No assessment.	Landings data	For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented. The resulting limit should stay in place for at least two years unless stock information shows a change that merits updating the advice. For this stock, since the current catches are around zero, ICES advises that catches should not increase unless there is evidence that this is sustainable. Occasional high bycatches should be avoided.	
Tusk VIb	ICES advises catches of no more than 350 t.	3.2	No	yes	Landings and cpue trends	Landings data and Norwegian longline cpue	For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted status quo catch. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch. There is an indication of stable abundance in the fishable biomass cpue from the commercial cpue index. This implies catches equal to the average catch of the last three years, corresponding to catches of no more than 440 t. Additionally, considering that exploitation is unknown, ICES advises that catches should decrease by a further 20% as a precautionary buffer. This results	

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
							in catches of no more than 350 t in 2013.	

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Tusk Other areas	ICES advises that catches should be no more than 8500 tonnes.	3.2	yes	no	Cpue trends-based assessment	Total landings series for all relevant fleets and cpue for Faroese trawl and longline and Norwegian longline	For the data-limited stock with abundance information from fishery-independent data ICES uses as harvest control rule the abundance index-adjusted status quo catch, which provides advice based on a comparison of the last two years of abundance data compared to the previous three years, combined with the catch data available from previous years. Knowledge on the exploitation status influences the impact of the biomass changes on the advised catch. For this stock the abundance is estimated to have increased by more than 20% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years). This implies an increase of catches of at most 20% compared to the average catch of the last three years, corresponding to catches of no more than 8500 t. As the exploitation is not detrimental to the stock (even though the exploitation status is unknown) and the biomass has increased more than 50%, no additional precautionary reduction is needed.	

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Great Silver Smelt Va	ICES advises that catches should be no more than 3700 tonnes	3.3	No	no	Catch- and survey-based assessment	Landings and survey indices, length–frequency data from commercial catches and survey indices	For this stock the F_{proxy} of 0.076 is applied as a factor to the 2010 biomass estimate, resulting in catch advice of no more than 3700 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.	Due to large fluctuations in the survey index the reference period may need to be changed on a regular basis for advice to not fluctuate too much. That basically means that this is just a formulation of 'expert judgement'. GSS is a difficult species in trawl survey due to its benthopelagic behaviour. It is therefore prudent to look at other data than just the index such as changes in age- and length-distributions and spatial changes in the fishery
Great Silver Smelt - Other stocks	ICES advises that catches should be no more than 31 300 tonnes	3.2	no	yes	Survey trends-based assessment	Summer index from the Faroese groundfish survey in Division Vb; the Spanish Porcupine groundfish survey	For this stock the abundance is estimated to have increased by 10% (a catch-weighted mean between the index for Division Vb and the one for Porcupine Bank) between 2007–2009 (average of the three years) and 2010–2011 (average of the two years). This implies an increase in catches of at most 10% in relation to last year's catch, corresponding to catches of no more than 39 115 t. Additionally, considering that exploitation is unknown, ICES advises that catches should decrease by a further 20% as a precautionary buffer. This results in catches of no more than 31 292 t in 2013.	The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or the stock overfished. There are at present no evident that can clearly tell if the greater silver smelt stock is low or overfished. The HCR advice is solely based on two survey indices. No attempt is made to consider the quality of these indices as proxy for the stock situation. None of the surveys are primarily targeting greater silver smelt and both surveys cover very limited part of horizontally very wide stock distribution. Additionally the Faroese ground gear survey has few deep stations and

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
								thus poorly covers the vertical distribution of greater silver smelt. The surveys might give somewhat better indications on the situations in a more limited area of two of the main fishing grounds, where these surveys respectively are conducted. An advice of 31 300 t based on the HCR gives an impression of quality and precision that is far from realistic.
Orange roughy	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	6.3	NA	NA	Catch trends-based assessment.	Information on landings by division or subarea and historical cpue information are available. Length frequencies are available from the Faroese exploratory fishery on the MAR.		

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Roundnose grenadier IIIa , IV	a fishery on this stock should not be allowed unless there is evidence that this is sustainable.	6.3	NA	NA	Catch trends-based assessment	The only information on this stock is landings of all relevant fleets, and cpue and mean length in the catch of the Danish fleet until 2006.	For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented. The resulting limit should stay in place for three years unless stock information shows a change that merits updating the advice. For this stock, since the current catches are around zero, ICES advises that a fishery on this stock should not be allowed unless there is evidence that this is sustainable	
Roundnose grenadier other areas	ICES advises that fisheries should not be allowed to expand from 120 t until there is evidence that this is sustainable	6.2	NA	no	Catch trends-based assessment	Landings data	For this stock, since catches are marginal and consist of bycatches, and there is no indication of high discard rates, ICES advises that catches should not exceed 120 t, the average catch from the last three years, unless there is evidence that this is sustainable.	

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Roundnose grenadier X, XII	ICES advises that catches should be no more than 1350 t.	5.2	NA	yes	Catch-based assessment.	Catch statistics	For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented. For this stock, ICES advises that 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.	
Black scabbardfish Vb, VI, VII, XII	ICES advises that catches should be no more than 4700 tonnes.	3.2	no	no	Commercial cpue trends-based assessment	Cpue from French trawl fleet and French commercial tally books	For this stock the abundance is estimated for both indices to have increased by 20% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years). The catches from last year are assumed to be equal to the landings in 2010 rather than 2011 as these are preliminary and are probably lacking some Spanish catches. Because exploitation is not detrimental to the stock, no additional precautionary reduction is needed. ICES advises that catches should be no more than 4700 t in 2013.	The advice for this component did not take into consideration the existence of a single stock in the NE Atlantic.

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Black scabbardfish VIII, IX	ICES advises that catches should be no more than 3700 tonnes	3.2	no	no	Catches and cpue trends-based assessment	Cpue from Portuguese longline fleet. Landings (1988–current year) by numbers, length distribution of the landings	the abundance is estimated to have increased by 5% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years). The catches from the last year are assumed to be equal to the landings in 2011. Considering that exploitation does not seem to be detrimental to the stock, ICES advises that catches should be no more than 3700 t in 2013.	The advice for this component did not take into conisderation the existence of a single stock in the NE Atlantic.
Black scabbardfish - Other stocks	Fisheries should not be allowed to expand until there is sufficient information showing that the fishery is sustainable.	2.1.3	NA	NA	Catch trends-based assessment	Landings		

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Greater forkbeard - All stocks	ICES advises that catches should be no more than 1000 tonnes.	3.2	no	yes	Survey trends-based assessment	Two surveys (Spanish Porcupine survey; Irish GF survey)	The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch. The available surveys do not cover the entire distributional area of the stock. However, the surveys indicate stability in the last three years and so advice is based on the average catch over these years. Additionally, considering that exploitation is unknown, ICES advises that catches should decrease by 20% as a precautionary buffer. This results in catches of no more than 1000 t in 2013.	The application of the precautionary buffe for this species is debatable as (1) Greater forkbeard is not a vulnerable species (2) it is mainly a bycatch species. The buffer may only generate discardsr
Beryx spp - All areas	catches should be no more than 280 tonnes	6.2	NA	yes	Landings.	Azorean longline survey abundance indices	catches should decrease by 20% in relation to the last three years' average catch, corresponding to catches of no more than 280 t in 2013. As three years is considered to be the minimum period required to see an effect of the precautionary buffer on the stock, no changes in the advice are expected before then unless the data clearly indicate otherwise.	

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Red Seabream IX	ICES advises no increase in effort and that catches should be no more than 500 t.	6.2	NA	yes	Catch trends-based assessment	Landings data for relevant fleets.	For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current exploitation is appropriate for the stock. For this stock, ICES advises that catches should decrease by 20% compared to the average catch of the last three years, corresponding to catches of no more than 500 t in 2013.	Seems to be not adequate. Landings decay more quickly than proposed HCR. So, that constraint nothing. Landings from 2012 don´t reach 300 t. 20% decrease of last year landings may be more appropiate till the sustainability of fisheries is proved.
Red Seabream X	ICES advises that catches should be no more than 400 tonnes	3.2	yes	yes	Cpue of fisheries-dependent and -independent trends-based assessment and survey length frequencies	Landings, longline fishery standardized cpue, longline survey abundance indices and survey length frequencies. Length frequencies in landings.	The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch. For this stock the abundance is estimated to have decreased by more than 20% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years). This implies a decrease of catches of at most 20% in relation to last year's catch, corresponding to catches of no more than 500 t. Additionally, considering that exploitation is unknown, ICES advises that catches should decrease by a further 20% as a precautionary buffer. This results in catches of no more than 400 t in 2013.	

STOCK	ADVICE FOR 2013	2012 DLS CATEGORY	UNCERTAINTY CAP	PRECAUTIONARY BUFFER	ASSESSMENT TYPE	INPUT DATA	BASIS FOR ADVICE	WGDEEP REVIEW
Red Seabream VI, VII, VIII	No directed fisheries, and measures should be put in place to reduce bycatch	6.3	NA	NA	Catch trends-based assessment	Landings for Subareas VI, VII, and VIII		Rebuilding plan to consider

15.2 PSA analysis

Productivity susceptibility analysis (PSA) is a semi quantitative approach that can be used in data poor situations, to evaluate the risk that fisheries pose to fish populations (Hobday *et al*., 2007; Patrick *et al*., 2010). PSA examines the attributes of a population to evaluate its vulnerability to a particular fishery. Initial PSA was carried out in WGDEEP 2010 to compare the productivity and susceptibility of several deep-water species to deep-water trawl fisheries in ICES Division 6 and 7 (ICES, 2010). This analysis was further developed in Watling *et al*., 2011. Productivity is the average of attributes which relate to life history characteristics and include age and size at maturity, maximum age and size, fecundity and reproductive strategy as well as trophic level. Susceptibility attributes consider the overlap of fishing effort with the population distribution and the encounterability, which is the likelihood of the population to encounter fishing gear that is deployed within its geographic distribution. This characteristic is based on two attributes, the adult habitat and bathymetry. The third and fourth susceptibility attributes comprise selectivity, which considers the potential of the gear to capture or retain a species, and post capture mortality.

In WGDEEP 2013, a new approach of PSA was presented (WD Dransfeld *et al*., 2013). In this study, PSA was applied to evaluate to what extent local orange roughy aggregations to the west of Britain and Ireland are vulnerable to deep-water fisheries between 2006 and 2011. The assumption was that the productivity of the populations was not changing within the timeframe of this analysis, but the susceptibility to recent and existing fisheries could be examined and evaluated. This approach was presented as a proposed management tool to monitor the susceptibility of vulnerable species to particular fisheries in data deficient situations. Details and methodology of the study are presented in the working document to WGDEEP 2013 (Dransfeld *et al*., 2013).

The susceptibility of orange roughy to current and historic fisheries was evaluated by carrying out a high resolution analysis of the spatial overlap between the distribution of the stock and the spatial foot print of recent and current deep-water fisheries (by VMS), using a grid size of ca. 1 nautical mile (0.03ºN*0.02ºW). The results showed that there was large overlap at the beginning of the study in 2006, when 60% of the biological distribution intersected with the extent of Irish and French deep-water fisheries. The spatial overlap between the known distribution of orange roughy and deep-water effort in VI and VII (Irish EEZ only) decreased over time to 17% in 2009 and was 25% in 2010 and 2011 (Figure 1). The cessation of a directed fishery and the adherence to management measures was reflected in the change of fishing positions which moved away from historic areas where directed fisheries were executed on bathymetric features such as mounds, ridges and canyons. This is particularly apparent on the western and southwestern Porcupine bank with its high concentrations of canyons and mounds which has been identified as areas of high orange roughy abundance. In addition there was an overall reduction in deep-water effort in the area (Figure 1). The fishery subsequently developed into a mixed fishery on flat fishing grounds targeting roundnose grenadier and black scabbard. The areas where these fisheries are still executed are the continental slope to the northwest of Ireland extending to the west of Scotland. Distribution maps of orange roughy and the deep-water fishing effort indicates that there is limited spatial overlap in this area.

As a consequence, the PSA score for availability decreased from 2006 to 2009. A change in fishing behaviour from targeted fisheries on spawning aggregations to mixed fisheries on slopes in 2007/2008 also decreased the encounterability score. Aggregated PSA scores range between 2.33 and 2.95 and there was a reduction in risk scores over time (Figure 2). Scores fell within the medium risk category for 2006 and decreased into the low risk category from 2007 onwards.

The new application of the productivity susceptibility analysis can provide a useful tool to evaluate the change of ecological risk a fishery is posing on a species. It allows visualising the response of fisheries to management measures and evaluating whether and how these result in a reduction in risk. In the case of orange roughy in the NEA, the study has shown that the risk of deep-water fisheries to the species has been drastically reduced in recent years as a combination of different management measures, but that some exposure to fishing pressure on the flat deep-water fishing grounds in ICES VI and VII cannot be ruled out.

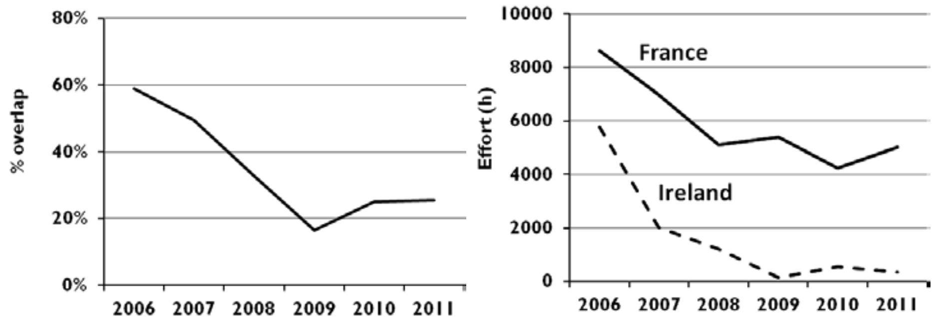


Figure 15.1. Change in spatial overlap of orange roughy and deep-water fisheries (proportion of orange roughy distribution area which intersected with VMS deep-water effort area at a resolution of 0.03ºlongitude *0.02ºlatitude, left panel); hours of Irish and French deep-water effort over time in the Irish EEZ, based on VMS data analysis (right panel).

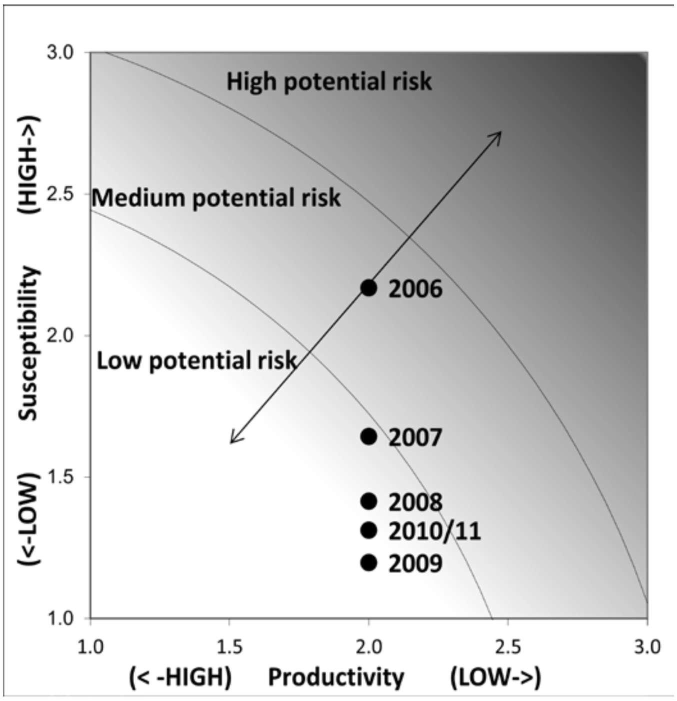


Figure15.2. The PSA plot: The x-axis gives average scores of the attributes that influence the productivity of orange roughy; the y-axis gives the scaled scores of attributes that influence the susceptibility of orange roughy to the impacts from deep-water fishing in the study area between 2006 and 2011. Productivity and susceptibility scores are used to calculated the euclidian distance and indicate the relative risk of the fishery to the species. The contour lines divide regions of equal risk levels according to Hobday *et al.* (2007).

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

NEAFC request

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.

16.1 Landings in the NEAFC regulatory area

Deep-water fisheries in the NEAFC Regulatory area occur in two main regions; the Oceanic Northeast Atlantic and the Celtic Seas ecoregion. Detailed descriptions of fisheries in these areas can be found in Sections 3.4 and 3.7 of this report.

Working group estimates of landings of deep-water species from the NEAFC Regulatory Area in 2012 are presented in Table 16.2. Unlike in previous years, in 2012, some significant unallocated landings in the NEAFC RA were known to the working group. Historic catches of deep-water fishes from 1989 to 2012 are given in Figure 16.2 and Table 16.2. It is not possible to provide equivalent data for fisheries in the Celtic Seas ecoregion as historic landings were not reported with sufficient spatial resolution to distinguish between EEZs and ABNJ.

Table 16.2 Working group estimates of landings of all deep-water species inside and outside EEZs

Stock	EEZ landings	NEAFC Regulatory Area landings	uncertain	location of NEAFC fisheries	ICES divisions	description of NEAFC fisheries
Ling Va	10 925	0	0	NA	NA	
Ling Vb	6003	0	Maybe some	North Hatton Bank	Vb1a	possibly very small catches in Vb1a
Ling I, II	9343	0	0	NA	NA	NA
Ling - Other stocks	16 056	0	0	NA		NA
Blue ling Va, XIV	4419	0	0	NA	NA	NA
Blue ling Vb, VI, VII	2809	711	0	Hatton Bank	VIb1	Unallocated landings in VIb

Stock	EEZ landings	NEAFC Regulatory Area landings	uncertain	location of NEAFC fisheries	ICES divisions	description of NEAFC fisheries
Blue ling - Other stocks	503	633	0	Hatton Bank.	XIIb	Landings in XIIb come from the same fishery and assessment unit as those in VIb. WGDEEP has recommended that the stock definition be reviewed and XIIb included in the Vb, VI and VII assessment unit. There were significant unallocated landings in XIIb in 2012
Tusk Va, XIV	6387	0	0			NA
Tusk I,II	103 79	0	0			NA
Tusk Mid-Atlantic Ridge	0	18	0	Mid Atlantic ridge	XII XIV	Sporadic small catches. Bycatch in fisheries for other species.
Tusk VIb	233	O	Maybe some	NA	NA	possibly very small catches in Vb1a
Tusk Other areas	6848	0	0	NA	NA	NA
Great Silver Smelt Va	9290	0	0	NA	NA	NA
Great Silver Smelt - Other stocks	29 027	0	0	NA	NA	NA
Orange roughy VI	0	0	0	NA	NA	NA
Orange roughy VII	0	0	0	NA	NA	NA
Orange roughy - Other stocks	0	167	0	Mid Atlantic ridge	X, XII	Directed fisheries
Roundnose grenadier - Vb, VI, VII, XIIb	3556	8579	0	Hatton Bank	Vib1 and XIIb	of which 6791 where categorised unallocated by WGDEEP. No unallocated in previous years

Stock	EEZ landings	NEAFC Regulatory Area landings	uncertain	location of NEAFC fisheries	ICES divisions	description of NEAFC fisheries
Roundnose grenadier IIIa , IV	0	0	0	NA	NA	NA
Roundnose grenadier other areas	101	0	0	NA	NA	NA
Roundnose grenadier X, XII	0	9202	0	NA	NA	of which 7326 where categorised unallocated by WGDEEP. No unallocated in previous years
Black scabbardfish Vb, VI, VII, XII	2396	1444	0	Hatton Bank	VIb1 XIIb	Of which 1397 t unallocated, insignificant fisheries in previous years
Black scabbardfish VIII, IX	2731	0	0	NA	NA	No catch in international waters
Black scabbardfish - Other stocks	823	4	0	Mid-Atlantic ridge	X, XII	Catches by Faroese vessels have been as high as 150t in recent years.
Greater forkbeard - All stocks	1813	0	0	NA	NA	NA
Beryx spp - All areas	305	10	0	Mid-Atlantic Ridge	Xb	Bycatch in trawl fisheries. Directed trawl fisheries existed in this area in the past
Red Seabream IX	283	0	0	NA	NA	Species does not occur in Division IX part of NEAFC RA (IXb1)
Red Seabream X	613	0	0	NA	NA	All fisheries are in Azores EEZ
Red Seabream VI, VII, VIII	227	0	0			Species does not occur in Division VI, VI and VIII part of NEAFC RA (VIIc1, VIIk1, VIIj1,VIIId2, VIIIe1)

16.2 Spawning aggregations in NEAFC regulatory area

Little information is available regarding the location of spawning aggregations in the NEAFC Regulatory area. There are many records of captures of fish of various species in spawning condition but these cannot be assumed to constitute aggregations as the species in question may be widespread spawners.

Blue ling is known to form discrete and predictable spawning aggregations including some in the NEAFC area. Available information on the location of blue ling spawning in the Northeast Atlantic was collated by Large *et al.*, 2010 and a separate piece of ICES advice to the European commission in 2009. 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 16.1. 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.

Known spawning areas in the NEAFC RA are located on the northeastern margins of Hatton Bank (VIb) and along the eastern and southern margins of Hatton Bank (VIb).

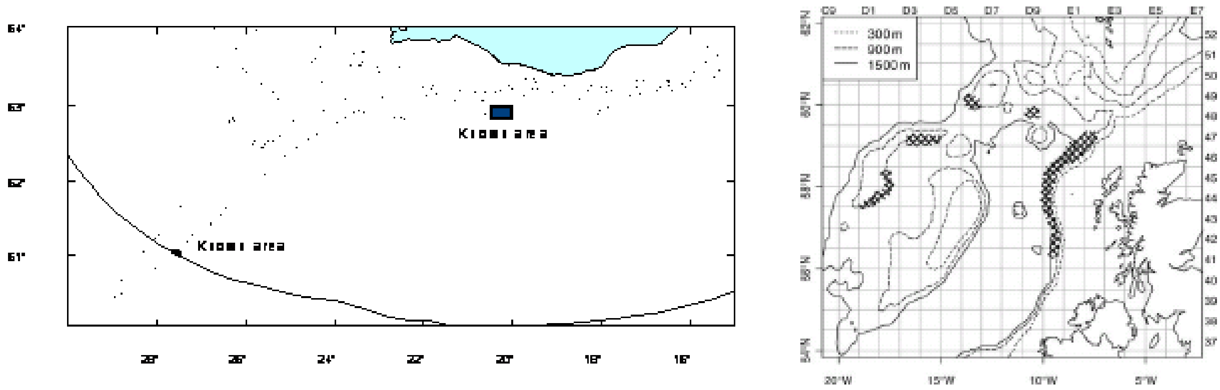
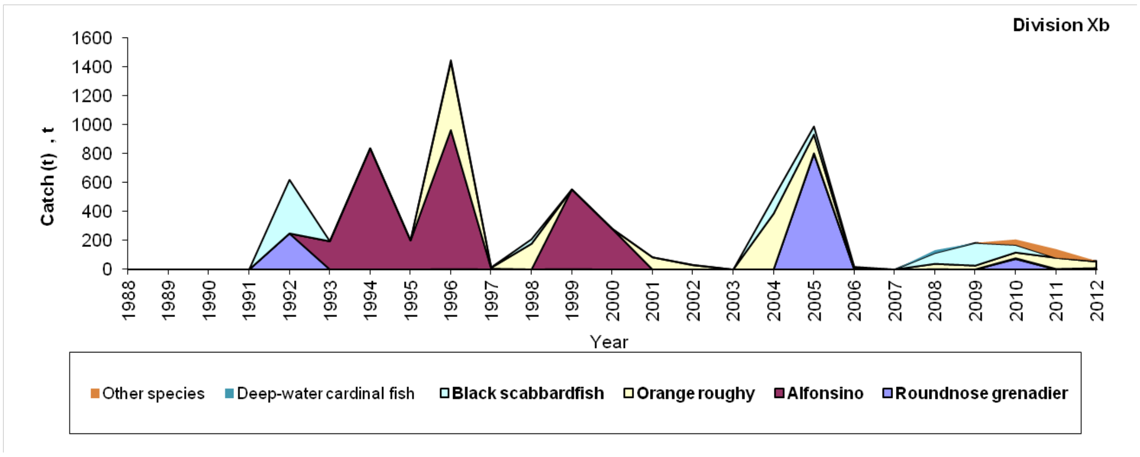
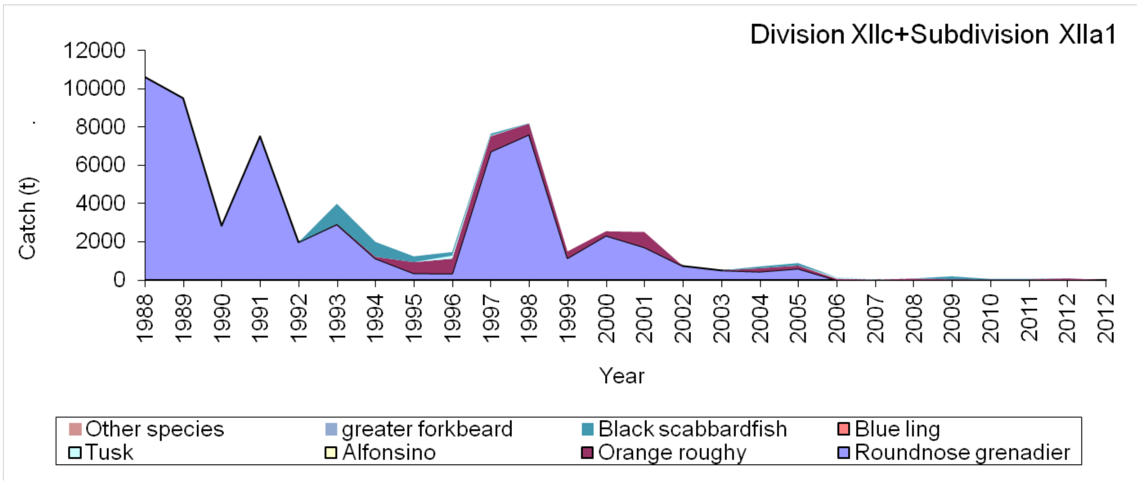


Figure 16.1. Known spawning areas of blue ling in Icelandic water (a) and to the West of Scotland (b, from Large *et al.*, 2010).





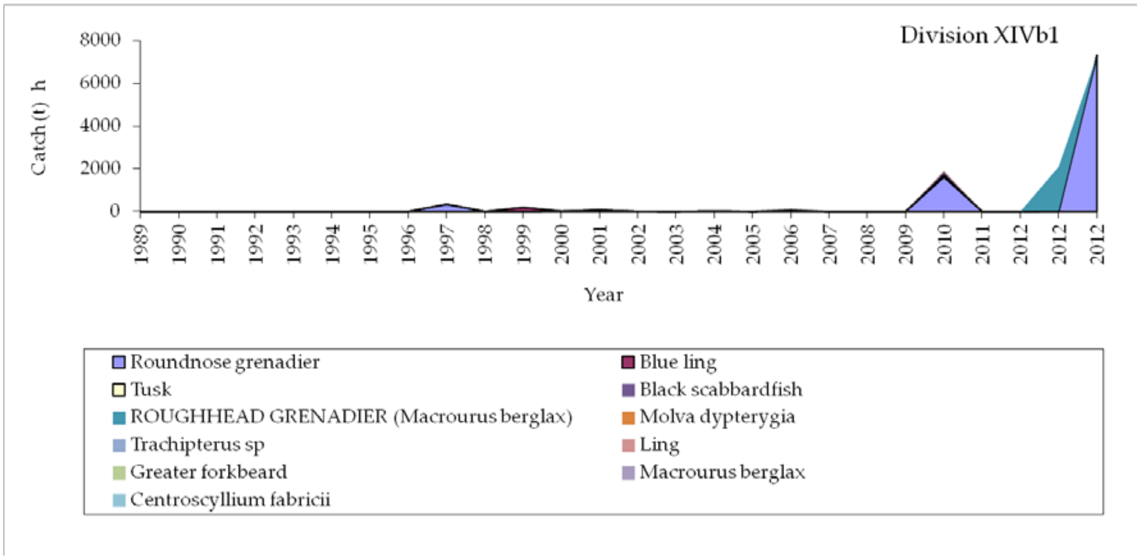


Figure 16.2 Catches of deep-water species by ICES division and subdivision in NEAFC waters of the Oceanic Northeast Atlantic 1989 to 2012.

Table 16.2. Landings of deep-water species from the NEAFC regulatory area in the Oceanic Northeast Atlantic (ICES Divisions Xb, XIIa+c and XIVb1).

SPECIES	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ALFONSINOS (*Beryx* spp.)	102	0	604	0	0	26	0	0	0	0	0	0	0	0	1	5	6	10
ARGENTINES (*Argentina silus*)		1			2					4								
BLUE LING (*Molva dypterigia*)	602	814	438	451	1363	607	675	1270	1069	644	35	65	1			47	0	641
BLACK SCABBARDFISH (*Aphanopus carbo*)	304	455	203	248	178	245	134	1062	411	382	0	18	0	80	157	191	24	862
BLUEMOUTH (*Helicolenus dactylopterus*)	0	0	0	0	0	11	0	0	0	0	0	0	1	0	0	0	0	0
DEEP WATER CARDINAL FISH (*Epigonus telescopus*)						3		0	1	15	0	0	0	0	0	0	0	0
GREATER FORKBEARD (*Phycis blennoides*)	4	2	2	1	0	9	8	6	11	9	0	119	184	0	6	0	0	0
LING (*Molva molva*)	50	2	9	2	2	7	59	8	19		2				1			0
MORIDAE						1	88	113	140	91	69	127	86	53	68	54	55	
ORANGE ROUGHY (*Hoplostethus atlanticus*)	676	1289	814	806	441	447	496	28	201	711	324	104	20	108	26	74	112	139
RABBITFISHES (*Chimaerids*)			32	42	115	48	79	98	81	128	193				22	0		434

SPECIES	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ROUGHHEAD GRENADIER (*Macrourus berglax*)					3	7	10	7	2	28	8	8			6	0	0	2618
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	644	1739	8622	11 979	9696	8602	7926	11 468	10 805	10 748	513	86	2	13	5	1691	0	14 319
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0
SHARKS, VARIOUS	1385	1264	891	1051	50	1069	1208	25	17	3	11	100	58	3	0	3	0	146
SILVER SCABBARDFISH (*Lepidopus caudatus*)	9	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	244
SMOOTHHEADS (*Alepocephalidae*)		230	3692	4643	6549	4146	3592	12 538	6883	4368	6872							
TUSK (*Brosme brosme*)	18	158	30	1	1	5	52	27	83	16	66	64	19		2	107	0	29
WRECKFISH (*Polyprion americanus*)	0	0	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0
Alepocephalus bairdii																		472
Antimora rostrata																		6
Apristurus sp																		3
Coelorinchus occa																		129
Harriotta																		12

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
raleighana																		
Hydrolagus mirabilis																		15
Hydrolagus sp																		2
Lepidion eques																		8
Lophius sp																		1
Nezumia bairdii																		1
Raja oxyrinchus																		2
Raja sp																		6
Rhinochimaera atlantica																		1
Spectrunculus grandis																		3
Trachyrincus murrayi																		53
Trachyrincus scabrus																		75
Urophycis sp																		3
	3794	5954	15 337	19 224	18 400	15 239	14 327	15 182	8918	6399	8093	691	380	257	294	2172	197	20 234

17 ToR g) propose a schedule of assessments to provide advice on a rolling basis over the period 2013–2015

ToR g) In order to support a rolling provision of advice, biennial or less frequency, the working group is asked to propose a schedule of assessments, to provide advice on a rolling basis over the period 2013–2015 for all the stocks in the group. The aim of this schedule should be to have advice every year for a subset of the stocks. The guidance from ACOM and WKLIFE should be considered in this regard. Considering the considerations of ACOM, WKLIFE and WKFREQ.

Recommendations on the timing and frequency of advice for deep-water stocks have been previously been made by ICES Workshop on Frequency of Assessments 2012 (WKFREQ) and the DeepFishMan project. WGDEEP has taken account of these recommendations, specific requirements resulting from national or international management requirements and, where relevant, other considerations relating to the availability of data and the biology of species to propose a schedule for advice. This is presented in the table below.

Stock	Deepfishman advice	WKFREQ advice	Management requirements	other consideration	WGDEEP recommendation
Ling Va	None	Frequency of advice is recommended to be dependent on MSE	Iceland Government may require annual advice	advice is dependent on the availability of March survey data in time for the WG. The dynamics of the stock are more likely to be similar to cod rather than typical deep-sea species.	Advice no less than every second year. Preferably annual
Ling Vb	None	Frequency of advice is recommended to be dependent on MSE	NA	advice is dependent on the availability of March survey data in time for the WG. The dynamics of the stock are more likely to be similar to cod rather than typical deep-sea species.	Advice no less than every second year. Preferably annual
Ling I, II	None	Frequency of advice is recommended to be dependent on MSE			Advice no less than every second year. Preferably annual
Ling - Other stocks	None	Frequency of advice is recommended to be dependent on MSE	EU TAC set every year	The dynamics of the stock are more likely to be similar to cod rather than typical deep-sea species.	Advice no less than every second year. Preferably annual
Blue ling Va, XIV	2 years		Iceland Government may require annual advice		Advice no less than every second year.
Blue ling Vb, VI, VII	2 years		Could be 1 year (part of the overall TAC regulation)		Advice no less than every second year.
Blue ling - Other stocks	2 years			depleted in Areas I and II. Assessment should monitor stock rebuilding.	every second year

Stock	Deepfishman advice	WKFREQ advice	Management requirements	other consideration	WGDEEP recommendation
Tusk Va, XIV	None	Frequency of advice is recommended to be dependent on MSE	Iceland Government may require annual advice	advice is dependent on the availability of March survey data in time for the WG. The dynamics of the stock are more likely to be similar to cod rather than typical deep-sea species.	Advice no less than every second year. Preferably annual
Tusk I,II	None	Frequency of advice is recommended to be dependent on MSE			Advice no less than every second year. Preferably annual
Tusk Mid-Atlantic Ridge	None			Small byctatch fishey	Advice every 5 years but monitor indicators (catch) and give new advcie if there is significant change.
Tusk VIb	None	Frequency of advice is recommended to be dependent on MSE	EU TAC set annually		Advice no less than every second year. Preferably annual
Tusk Other areas	None	Frequency of advice is recommended to be dependent on MSE	EU TAC set every year	The dynamics of the stock are more likely to be similar to cod rather than typical deep-sea species.	Advice no less than every second year. Preferably annual
Great Silver Smelt Va	2 years		Iceland Government may require annual advice		Advice no less than every second year.
Great Silver Smelt - Other stocks	2 years		TAC annually in Norway. TAC annually in EU. Annual advice in Faroe Island	Biennial survey in Norway in March.	Advice no less than every second year. Preferably annual

Stock	Deepfishman advice	WKFREQ advice	Management requirements	other consideration	WGDEEP recommendation
Orange roughy VI	5 years	potentially political sensitivity so would require more frequent assessment	EU TAC set every two years	Stock is depleted but TAC is now zero so very little new data for assessment	Advice every 5 years but monitor indicators (spatial distribution of fisheries relative to stock distribution, monitoring of bycatch) and give new advcie if there is significant change.
Orange roughy VII	5 years	potentially political sensitivity so would require more frequent assessment	EU TAC set every two years	TAC is now zero so very little new data for assessment . The fishery-dependent data do not allow stock assessment and there is no appropriate technology for fishery-independent assessement	Advice every 5 years but monitor indicators (spatial distribution of fisheries relative to stock distribution, monitoring of bycatch) and give new advcie if there is significant change.
Orange roughy - Other stocks	5 years	potentially political sensitivity so would require more frequent assessment	NEAFC regulations updated every two years	The fishery-dependent data do not allow stock assessment and there is no appropriate technology for fishery-independent assessment	Advice every 5 years but monitor indicators (catches and fine scale distribution of fisheries based on haul by haul data) and give new advcie if there is significant change.

Stock	Deepfishman advice	WKFREQ advice	Management requirements	other consideration	WGDEEP recommendation
Roundnose grenadier - Vb, VI, VII, XIIb	3 years		EU tAC set every second year	The dynamics of the stock do not suggest rapid recovery from exploitation	Advice every second year
Roundnose grenadier IIIa, IV	3 years		EU tAC set every second year	Currently small bycatch fishery	triggered by fishery and survey indicators
Roundnose grenadier other areas	3 years			Currently small bycatch fishery	triggered by landings indicators
Roundnose grenadier MAR	3 years		EU TAC set every second year		triggered by landings indicators
Black scabbardfish Vb, VI, VII, XII	2 years		EU TAC set every second year		Advice every second year
Black scabbardfish VIII, IX	2 years		EU TAC set every second year		Advice every second year
Black scabbardfish - Other stocks	2 years		EU TAC set every second year		monitor indicators (catches and fine scale distribution of fisheries based on haul by haul data) and give new advice if there is significant change.
Greater forkbeard - All stocks	2 years		EU TAC set every second year	discards are likey to be higher than landings in some years/areas	Advice every second year
Beryx spp - All areas	2 years		EU TAC set every second year		Advice every second year
Red Seabream IX	2 years		EU TAC set every second year		Advice every second year
Red Seabream X	2 years		EU TAC set every second year		Advice every second year

Stock	Deepfishman advice	WKFREQ advice	Management requirements	other consideration	WGDEEP recommendation
Red Seabream VI, VII, VIII	2 years			depleted, low levels of bycatch, landings are higher than TAC	Monitor indicators
Other species	2 years				
Deep-water sharks	5 years (based on life history)	Frequent (1 year) based on political sensitivity			

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Annex 2: Working documents

Annex 2 contains the working documents that were presented to WGDEEP 2013.

The ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP 2013).

Deep water species from the Azores: Fishery data resume for the WGDEEP report.

by

Mário Rui Pinho, Hugo Diogo and João Gil Pereira

Abstract

This document resumes and updates the fishery data from the Azores for the 2013 ICES working group WGDEEP. A summary description of the fishery is presented including information landings, spatial distribution of effort and catches, annual length compositions, mean lengths and mean weight in the catch for most important dee-water species.

1. Description of the Fishery

The Azores deep-water fishery is a multispecies and multigear fishery (Pinho and Menezes, 2005, 2009). 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 seems to change seasonally according abundance, species vulnerability and market (Pinho, 2003; Menezes et al, 2006). 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. 1). Few seamounts are explored outside the EEZ, being the most frequently visited those at south on CECAF areas (see Fig. 1). 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 1, 2).

Since the nineties the landings of most of the commercially important species start to decrease (Table 1, Fig. 3 and 4). 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. 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. 1 and 5). 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. However, a fishery targeting black scabardfish has been developing during the last two years with some vessels licensed for this deep-water species due to the stable prices secured by the regional government. An increase of 229%, relatively 2011, on the landings of this species was observed for 2012 (Table 1, Fig. 4).

Since 2000, 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. 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. The fishery has recently been also

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).
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.

2. Landings

The landings of the major deep-water species caught by the Azores fleet, for the period 1980 to 2012, are resumed in Table 1 and Figures 2-5. In the case of Blackspot seabream (*Pagellus bogaraveo*) the 2005 landings includes 270 t caught in CECAF area 34.2.0. The fishery has expanded to more offshore areas (Fig. 1, 2). Landings of almost all deep-water species show a decreasing trend since 1994 (Fig. 3 and 4) except for seabream (*Pagellus bogaraveo*) that start declining in 2005 (Fig. 4 and 5).

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 5. Landings of this species show a decrease trend since 2005, with a very significant reduction during the last three years being actually at the 613 ton corresponding about 55% of the 2012 TAC (Table 2). This result may be a consequence of possible depletion of seamounts areas.

3. Length compositions

Annual length compositions of some selected species are resumed on Fig.6-16. Annual mean length and mean weight in the catch for the most important species are presented at the Fig. 17 an 18 respectively. No specific trends are observed on the length compositions and mean length for most of the species. Mean weight in the catch show a decrease pattern for *Beryx splendens* and for bluemouth (*H. dactylopteurus*).

4. Fishery abundance index

Fishery abundance index was not updated. Standardized fishery abundance index is available for *Pagellus bogaraveo* until 2010. A significant decrease is observed on the cpue of this species since 2005 (Fig. 19). 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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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	0					
1998	5	68	161	672	+	381		14	+	1119	38	140	1187	0					
1999	46	56	119	723	+	340		10	+	1222	41	133	86	0					
2000	112	35	168	831	+	441		13	+	947	91	263	27	0					
2001	+	17	182	509	+	301	343	9	+	1034	83	232	14	0					
2002	+	20	223	465	14	280	+	13	100	1193	57	283	10	0	0		4		
2003	91	22	150	443	15	338	+	12	125	1068	45	270	25	0	7		6		49
2004	2	29	110	354	6	282	+	11	87	1075	37	189	29	0	2	1	1		13
2005	323	23	134	304	4	190	+	8	69	1383*	22	279	31	0	1	1	1		
2006	55	40	152	346	10	209	+	10	92	958	15	497	35	0	1	1	3		
2007	0,2	46	165	340	7	274	+	14	86	1063	17	662	55	0	1	0,3	3	1	
2008	0,2	63**	187**	349	7	281	+	22	53	1089	18	513	63	0	0,4	6	3	0,5	0,1
2009	5	68**	243**	326	7	267	+	26	68	1042	20	382	64	0	0,3	0	3	0,1	
2010	49	51	189	107	5	213	+	26	54	687	14	238	68	0	1	3	1	1,8	0
2011	139	47	179	133	5	231	+	25	55	624	11	266	148	0	0	0	0	4,6	0
2012	458	37	175	130	4	190	+	19	31	613	6	226	271	1	0	0	0	31,0	0

\+ landed as mixed species
** includes 270 t from CECAF 34.2.0

Table 2. Historical TAC´s for deep-water species of the Azores (ICES X).

Regulation	Species	Year	ICES Sub-Area	TAC	Landings
	P. bogaraveo	2003	X	1116	1068
	P. bogaraveo	2004	X	1116	1075
Reg 2270/2004	*P. bogaraveo*	2005	X	1116	1528
	P. bogaraveo	2006	X	1116	958
Reg 2015/2006	*P. bogaraveo*	2007	X	1116	1071
	P. bogaraveo	2008	X	1116	1089
Reg 1359/2008	*P. bogaraveo*	2009	X	1116	1042
	P. bogaraveo	2010	X	1116	687
Reg 1225/2010	*P. bogaraveo*	2011	X	1116	624
	P. bogaraveo	2012	X	1116	613
Reg 1262/22012	*P. bogaraveo*	2013	X	1004	
	P. bogaraveo	2014	X	920	
Reg 2270/2004	*Beryx sp*	2005	IX and X	214	202
	Beryx sp	2006	IX and X	214	212
Reg 2015/2006	*Beryx sp*	2007	IX and X	214	256
	Beryx sp	2008	IX and X	214	294
Reg 1359/2008	*Beryx sp*	2009	IX and X	214	354
	Beryx sp	2010	IX and X	214	272
Reg 1225/2010	*Beryx sp*	2011	IX and X	214	237
	Beryx sp	2012	IX and X	214	213
Reg 1262/22012	*Beryx sp*	2013	IX and X	203	
	Beryx sp	2014	IX and X	193	
	Aphanopus carbo	2003	IX and X	4000	2630
	Aphanopus carbo	2004	IX and X	4000	2463
Reg 2270/2004	Aphanopus carbo	2005	IX and X	3956	2746
	Aphanopus carbo	2006	IX and X	3956	2674
Reg 2015/2006	Aphanopus carbo	2007	IX and X	3956	3453
	Aphanopus carbo	2008	IX and X	3956	3602
Reg 1359/2008	Aphanopus carbo	2009	IX and X	3561	3601
	Aphanopus carbo	2010	IX and X	3561	3453
Reg 1225/2010	Aphanopus carbo	2011	IX and X	3561	2919
	Aphanopus carbo	2012	IX and X	3561	
Reg 1262/22012	Aphanopus carbo	2013	IX and X	3659	
	Aphanopus carbo	2014	IX and X	3659	
Reg 2270/2004	Phycis bleoides	2005	X	63	22
	Phycis bleoides	2006	X	63	15
Reg 2015/2006	Phycis bleoides	2007	X	63	17
	Phycis bleoides	2008	X	63	18
Reg 1359/2008	Phycis bleoides	2009	X	36	20
	Phycis bleoides	2010	X	36	14
Reg 1225/2010	Phycis bleoides	2011	X	36	11
	Phycis bleoides	2012	X	36	
Reg 1262/22012	Phycis bleoides	2013	X	36	
	Phycis bleoides	2014	X	36	
Reg 2270/2004	Deep-water sharks	2005	X	120 (1)	4
	Deep-water sharks	2006	X	120 (1)	4
Reg 2015/2006	Deep-water sharks	2007	X	20	4
	Deep-water sharks	2008	X	20	9
Reg 1359/2008	Deep-water sharks	2009	X	10	4
	Deep-water sharks	2010	X	0	4
Reg 1225/2010	Deep-water sharks	2011	X	0	0
	Deep-water sharks	2012	X	0	0
Reg 1262/22012	Deep-water sharks	2013	X	0	0
Reg 1225/2010	Hoplostethus atlanticus	2010-12	X	0	0
Reg 1262/22012	Hoplostethus atlanticus	2013-14	X	0	0

(1) Reg. 860/2005

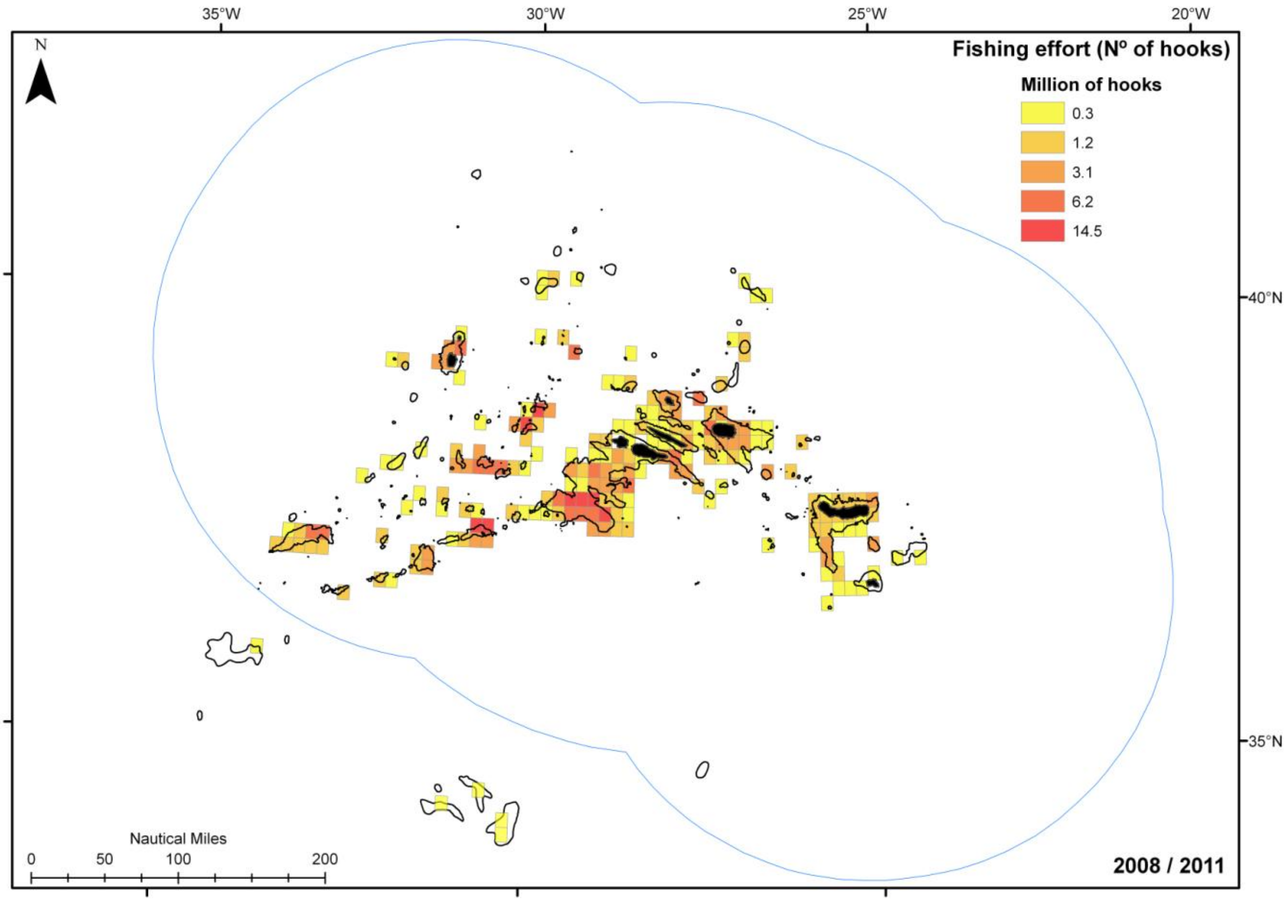

Figure 1. Fishing effort of demersal/deep-water species by area from the Azorean fishery (ICES Xa2) for the period 2008-2011. Black (islands); Colors represents the proportional fishing effort (habitat until 700m depth); Blue box (EEZ).

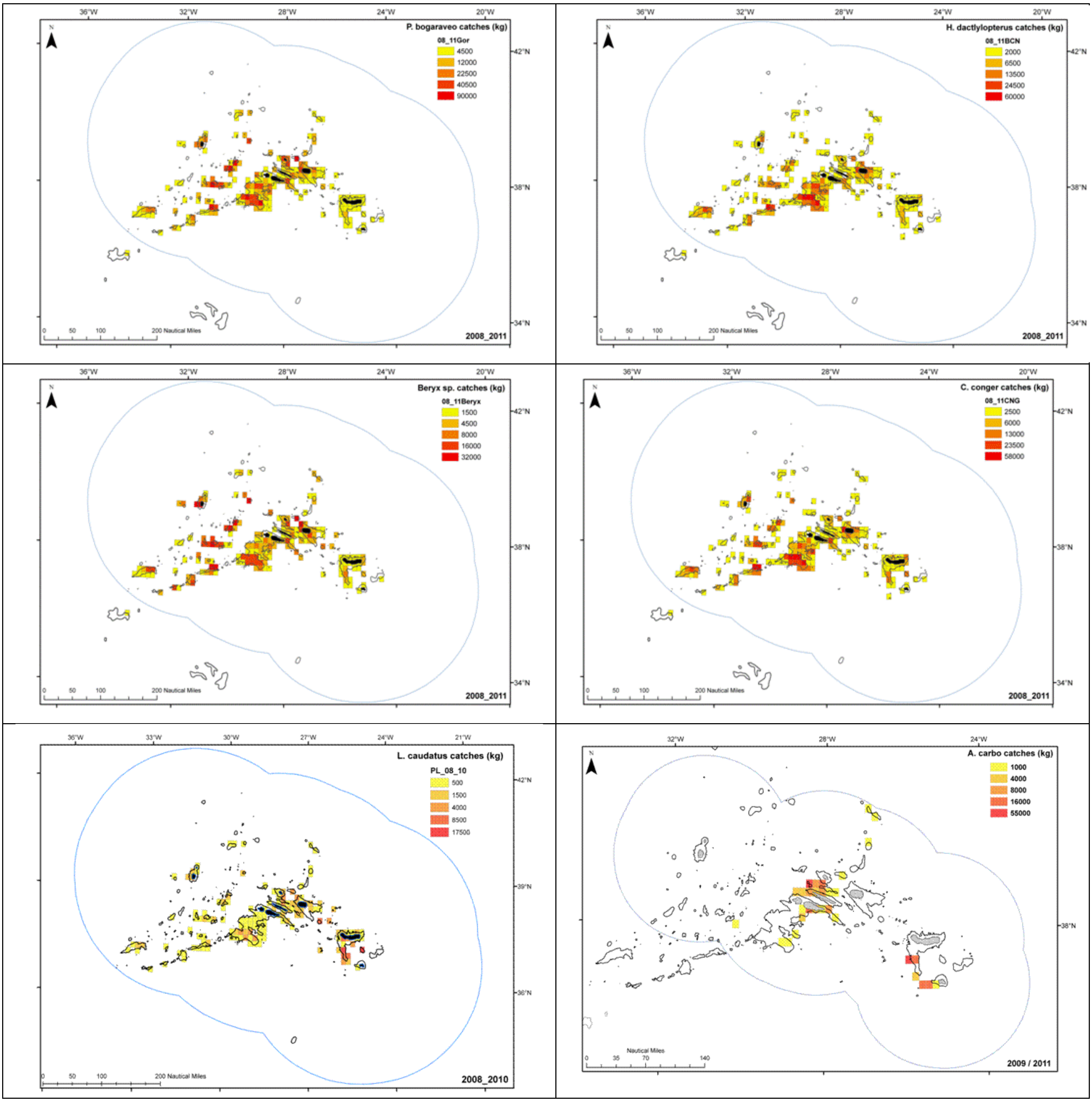

Figure 2. Cumulative catches for selected demersal/deep-water species by area from the Azorean fisheries (ICES Xa2) for the period 2008-2011. Grey (islands); Colors represents the level of catches intensity (habitat until 700m depth); Blue box (EEZ).

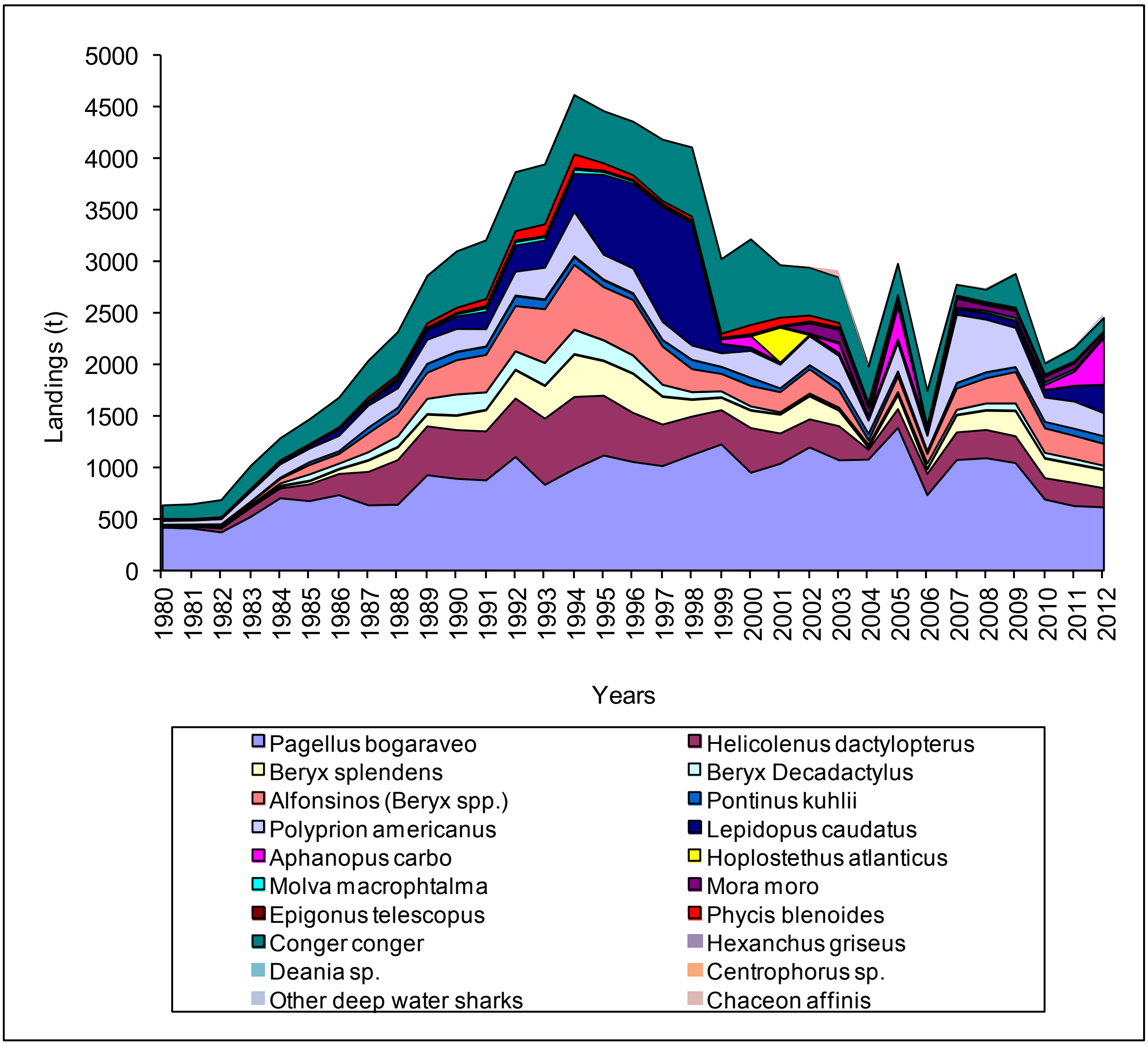

Figure 3. Overview of the deep-water species landings from the Azores (ICES Xa2).

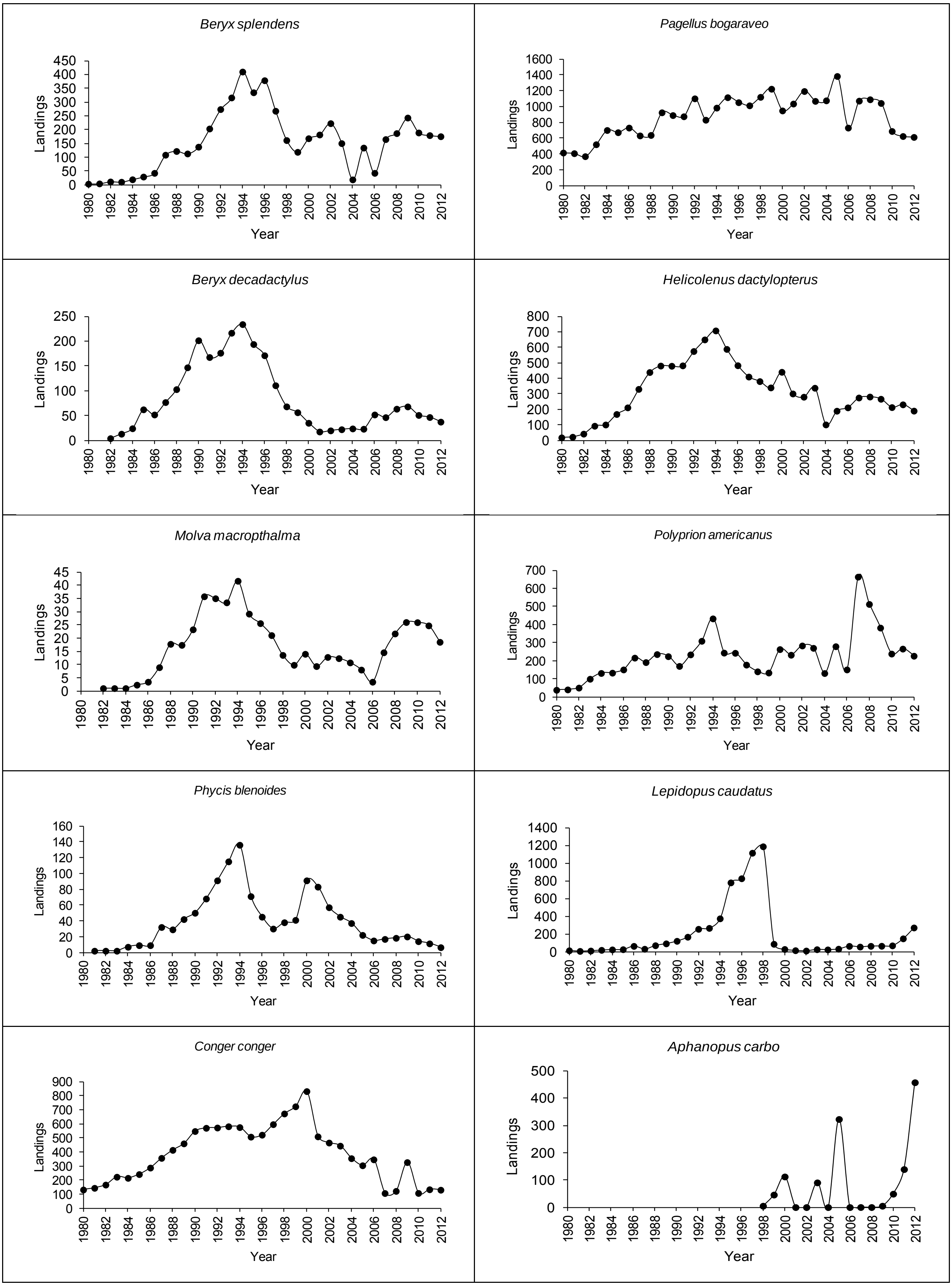

Figure 4. Annual landings of major demersal/deep-water species of the Azores (1980-2012).

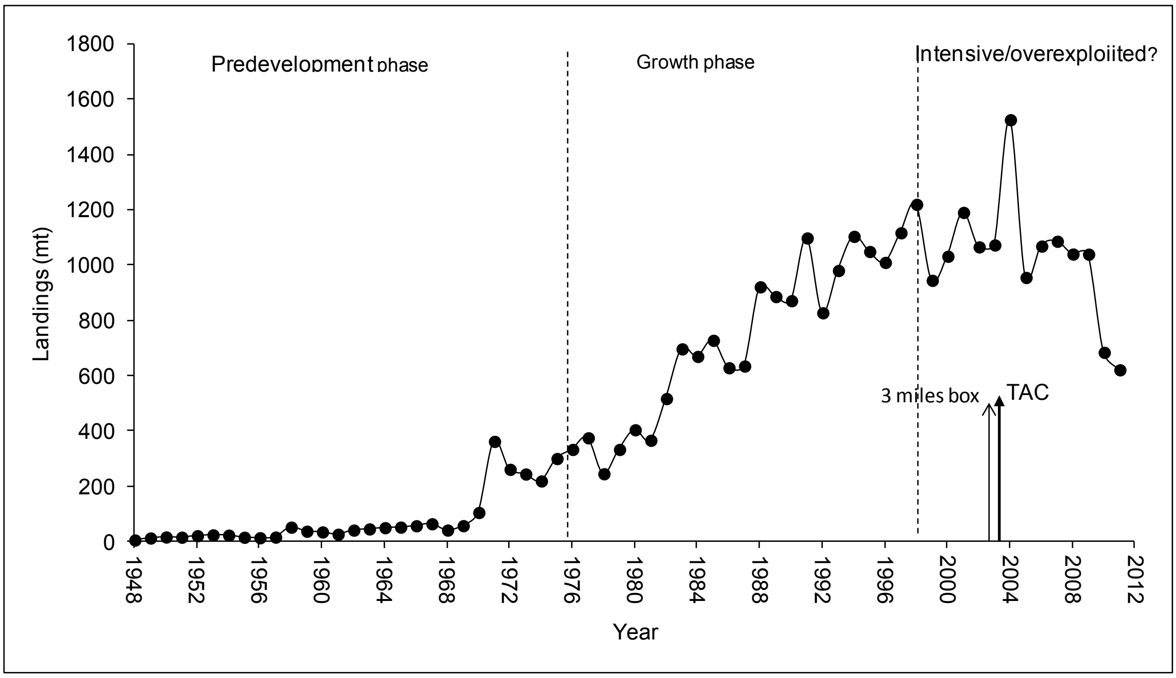

Figure 5. Historical development of the Azorean red (blackspot) seabream (*Pagellus bogaraveo*) fishery (ICES, Xa2). Important management measures are represented on the graph.

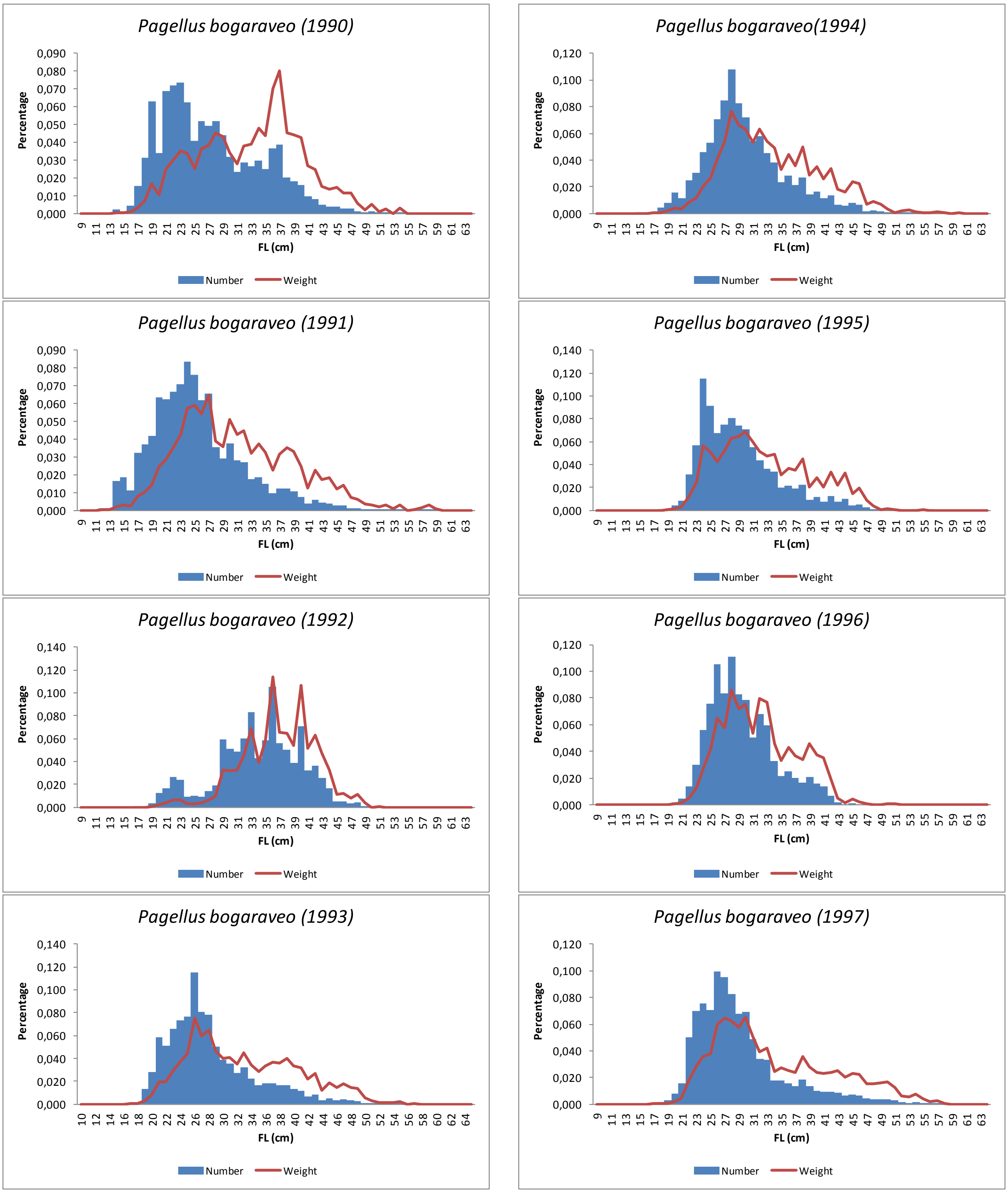

Figure 6. Length composition, in number and weight, of *Pagellus bogaraveo* from the Azores landings (1990-1997).

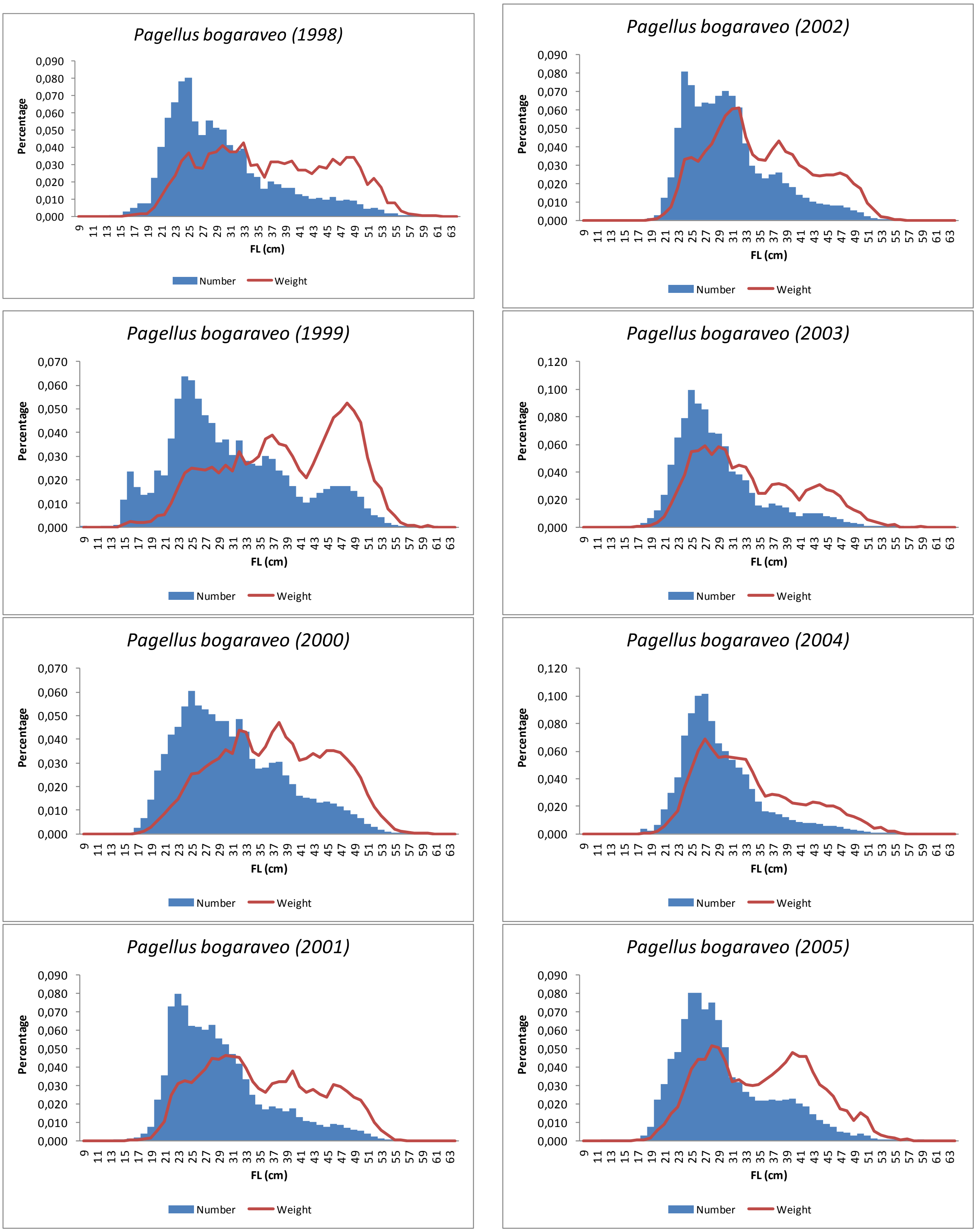

Figure 6 (Cont.). Length composition, in number and weight, of *Pagellus bogaraveo* from the Azores landings (1998-2005).

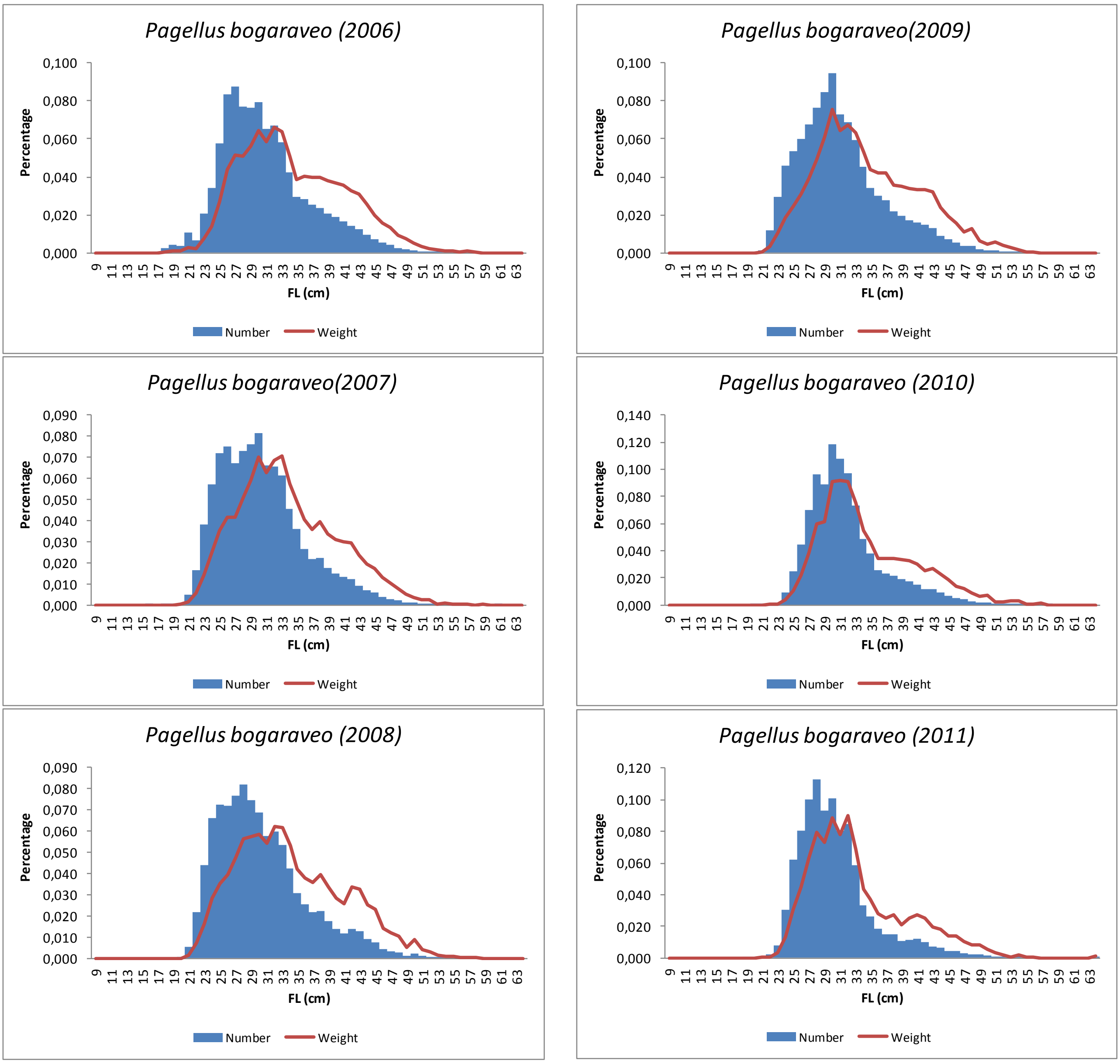

Figure 6 (Cont). Length composition, in number and weight, of *Pagellus bogaraveo* from the Azores landings (2006-2011).

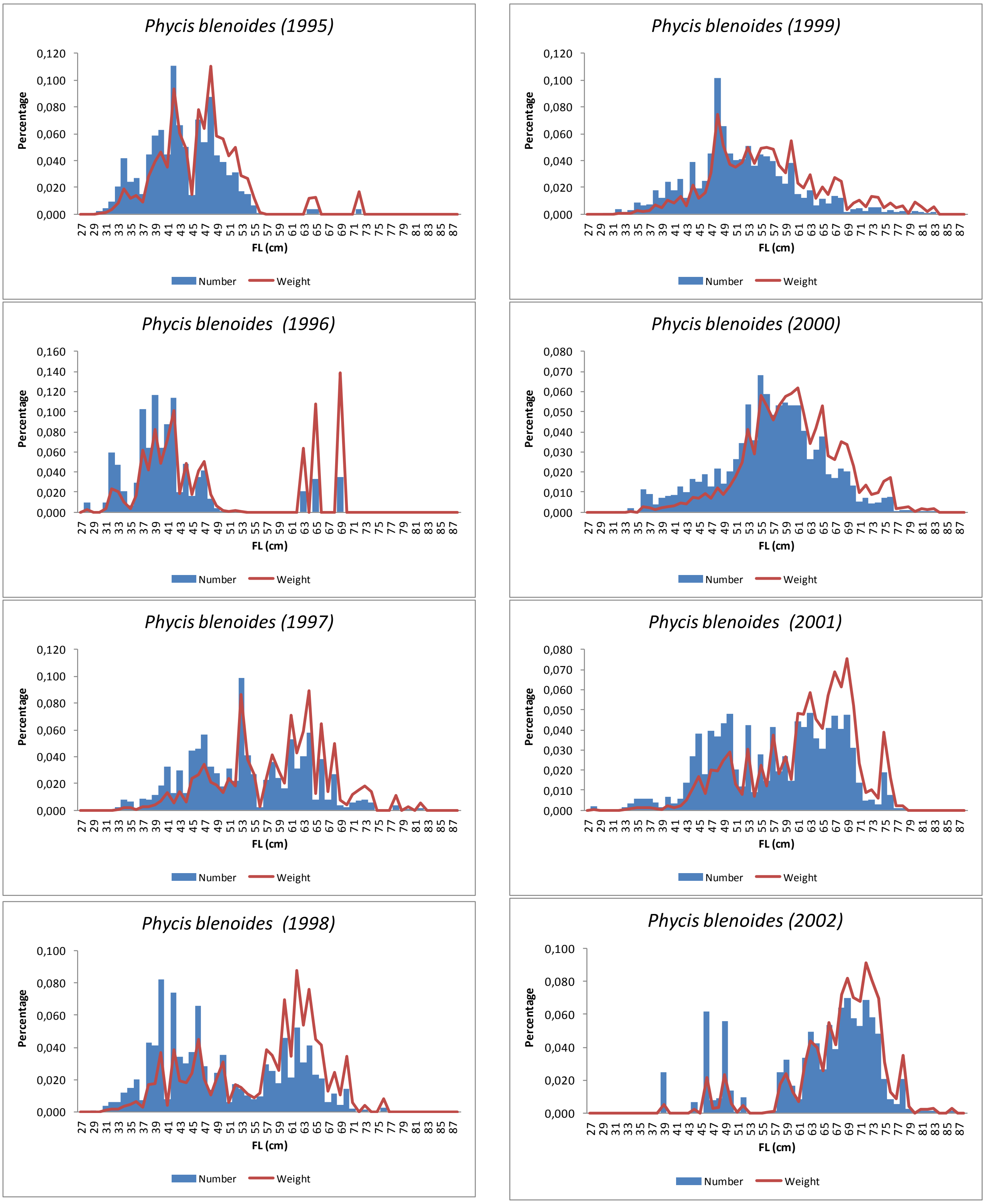

Figure 7. Length composition, in number and weight, of *Phycis blenoides* from the Azores landinga (1995-2002).

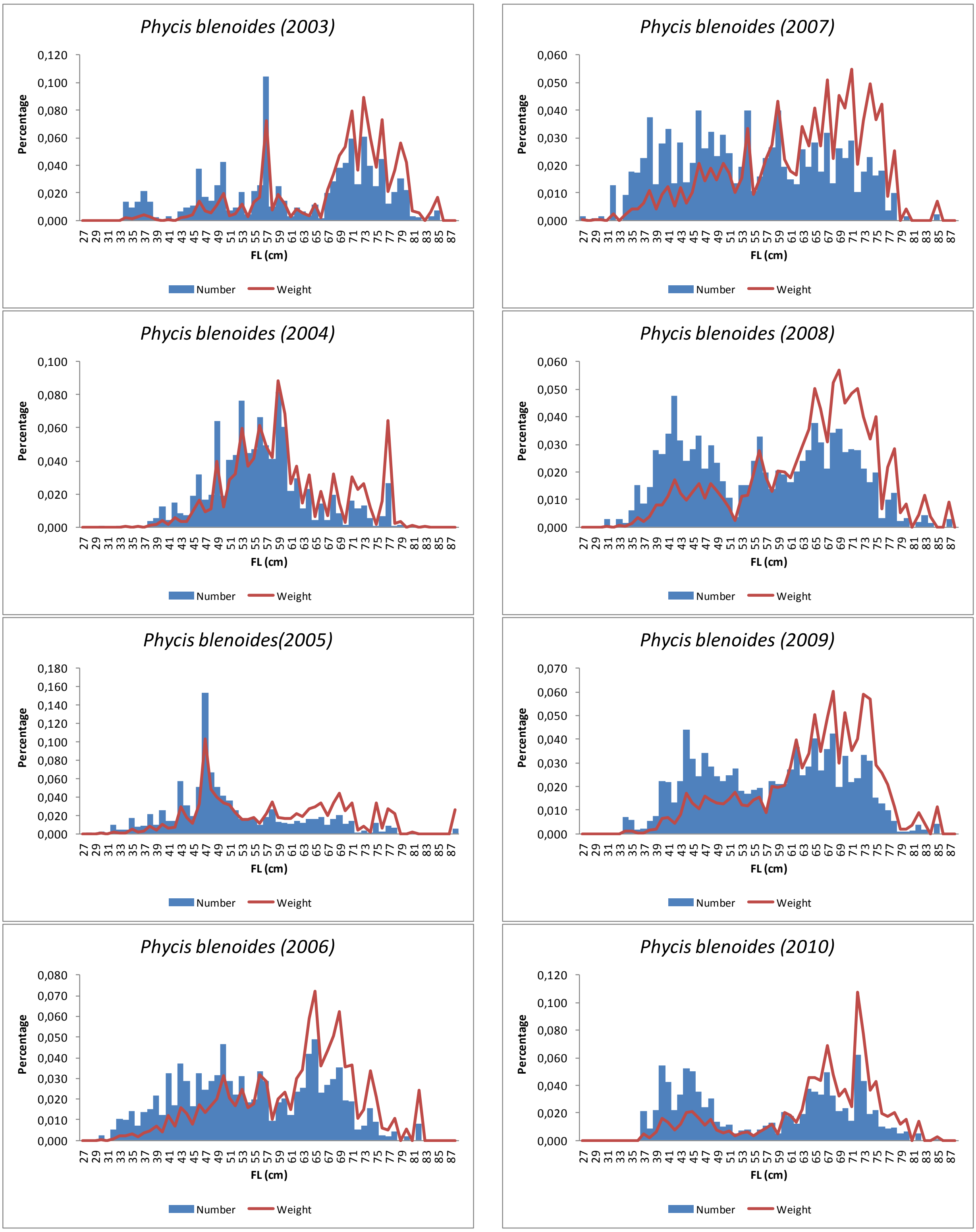

Figure 7 (cont.). Length composition, in number and weight, of *Phycis blenoides* from the Azores landings (2003-2010).

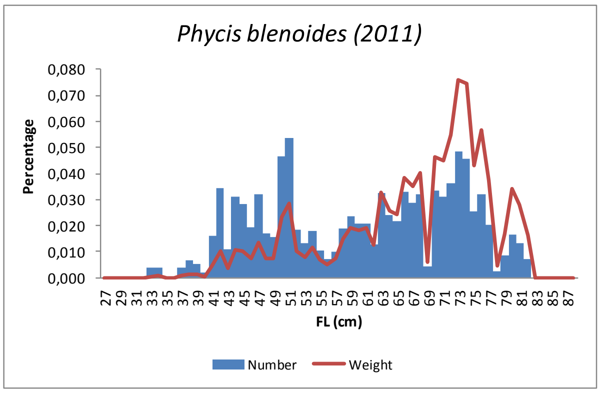

Figure 7 (cont.). Length composition, in number and weight, of *Phycis blenoides* from the Azores landings (2011).

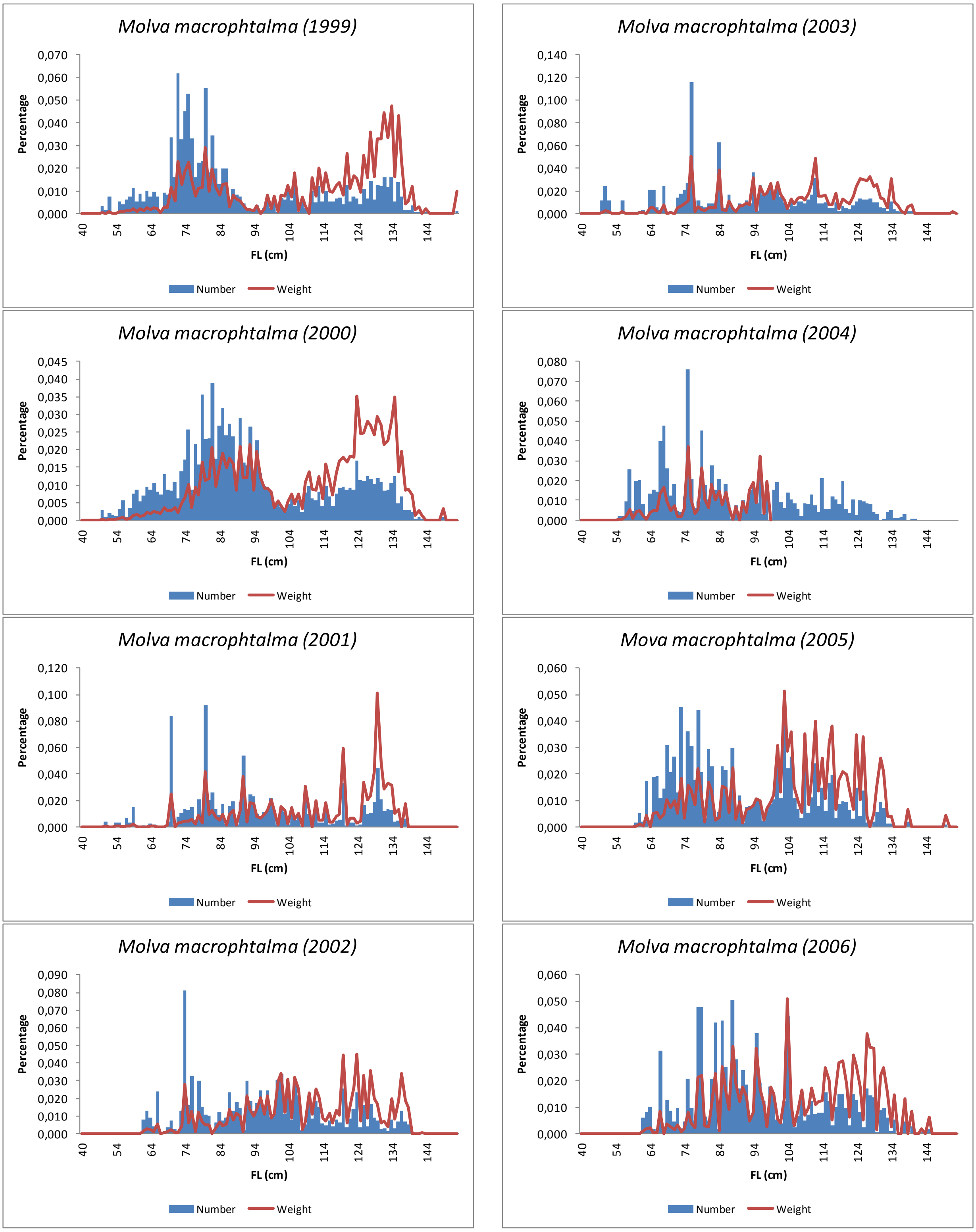

Figure 8. Length composition, in number and weight, of *Molva macrophtalma* from the Azores landings (1999-2006).

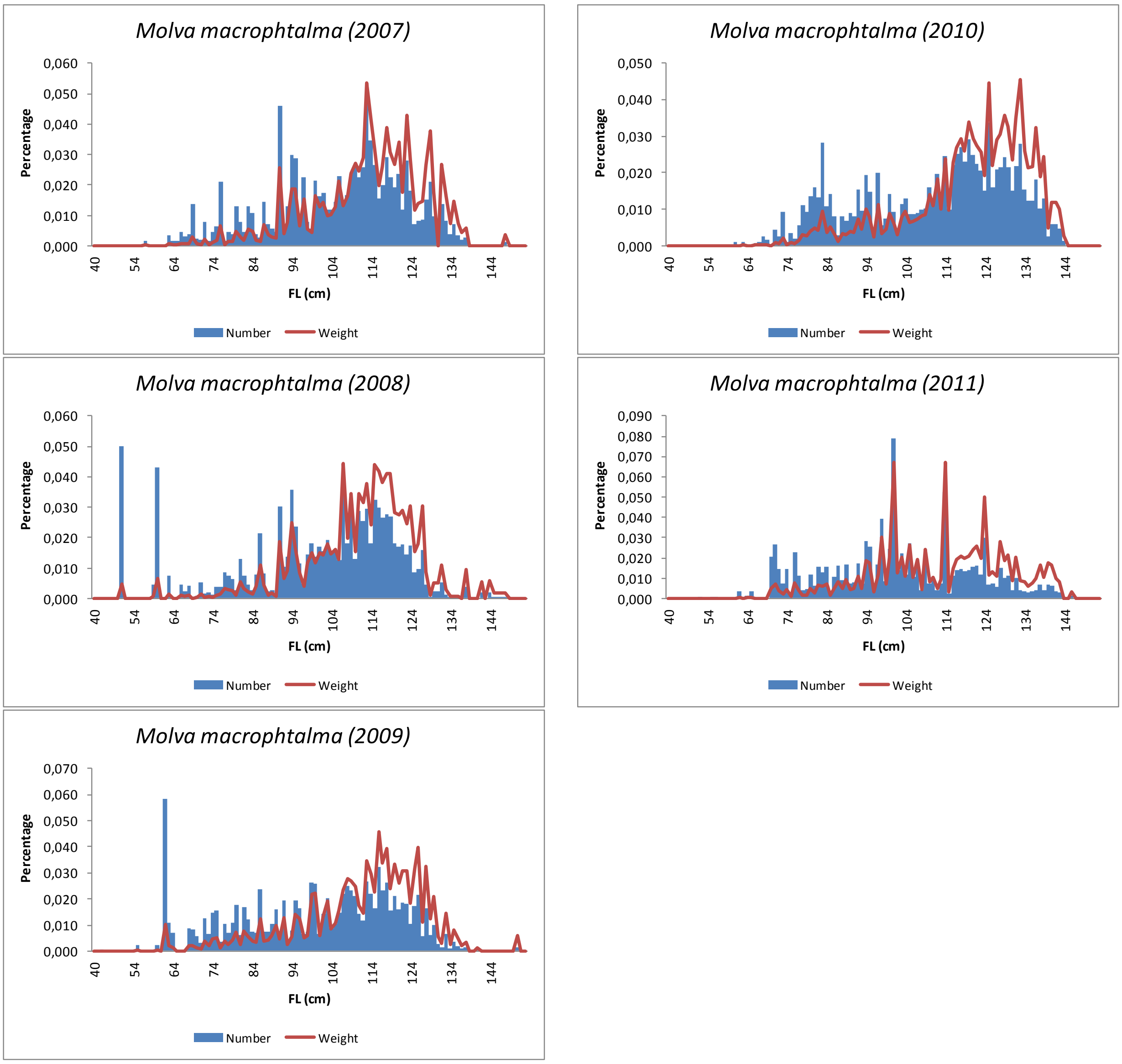

Figure 8 (Cont.) . Length composition, in number and weight, of *Molva macrophtalma* from the Azores landings (2007-2011).

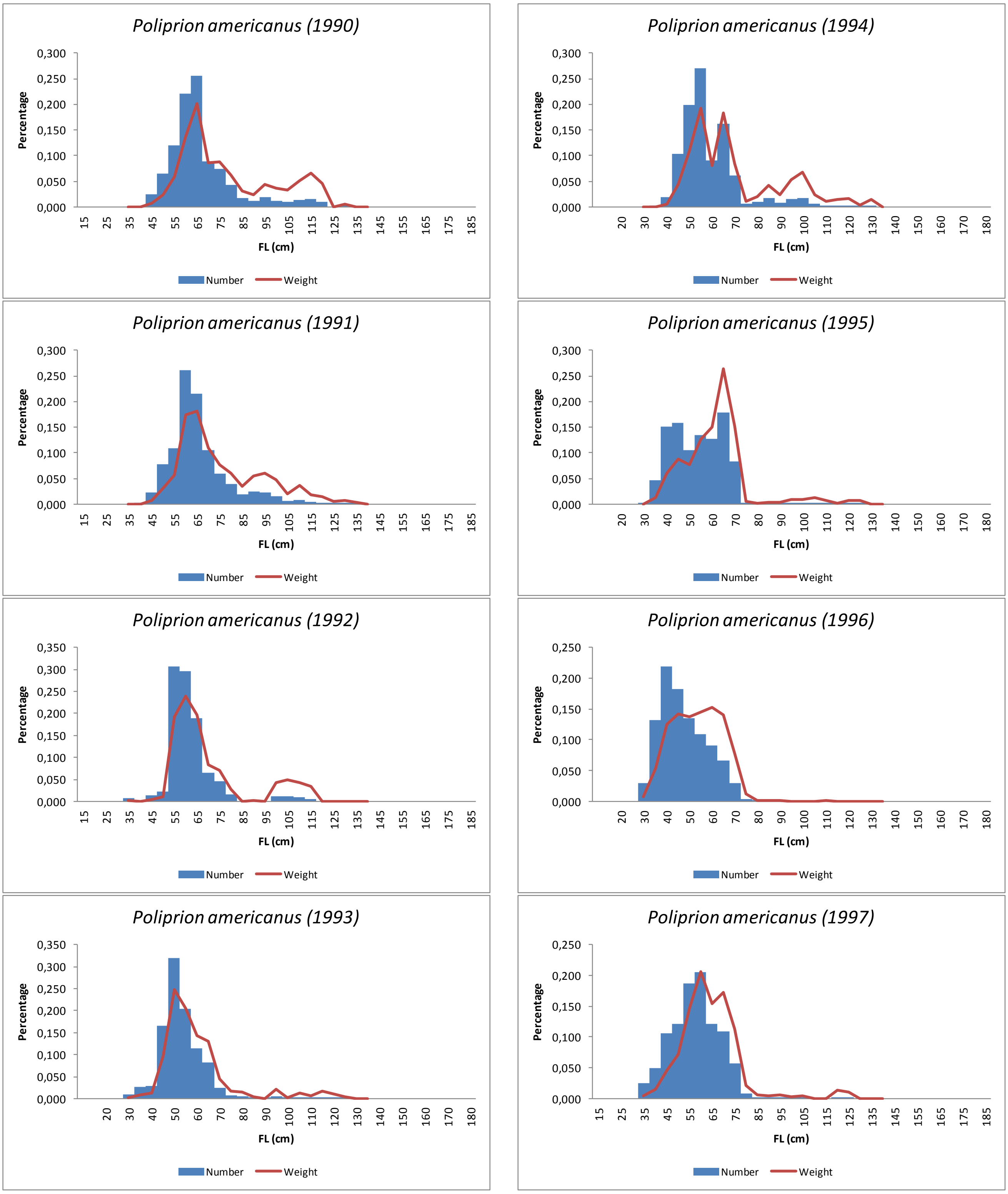

Figure 9. Length composition (class 5cm), in number and weight, of *Polyprion americanus* from the Azores landings (1990-1997).

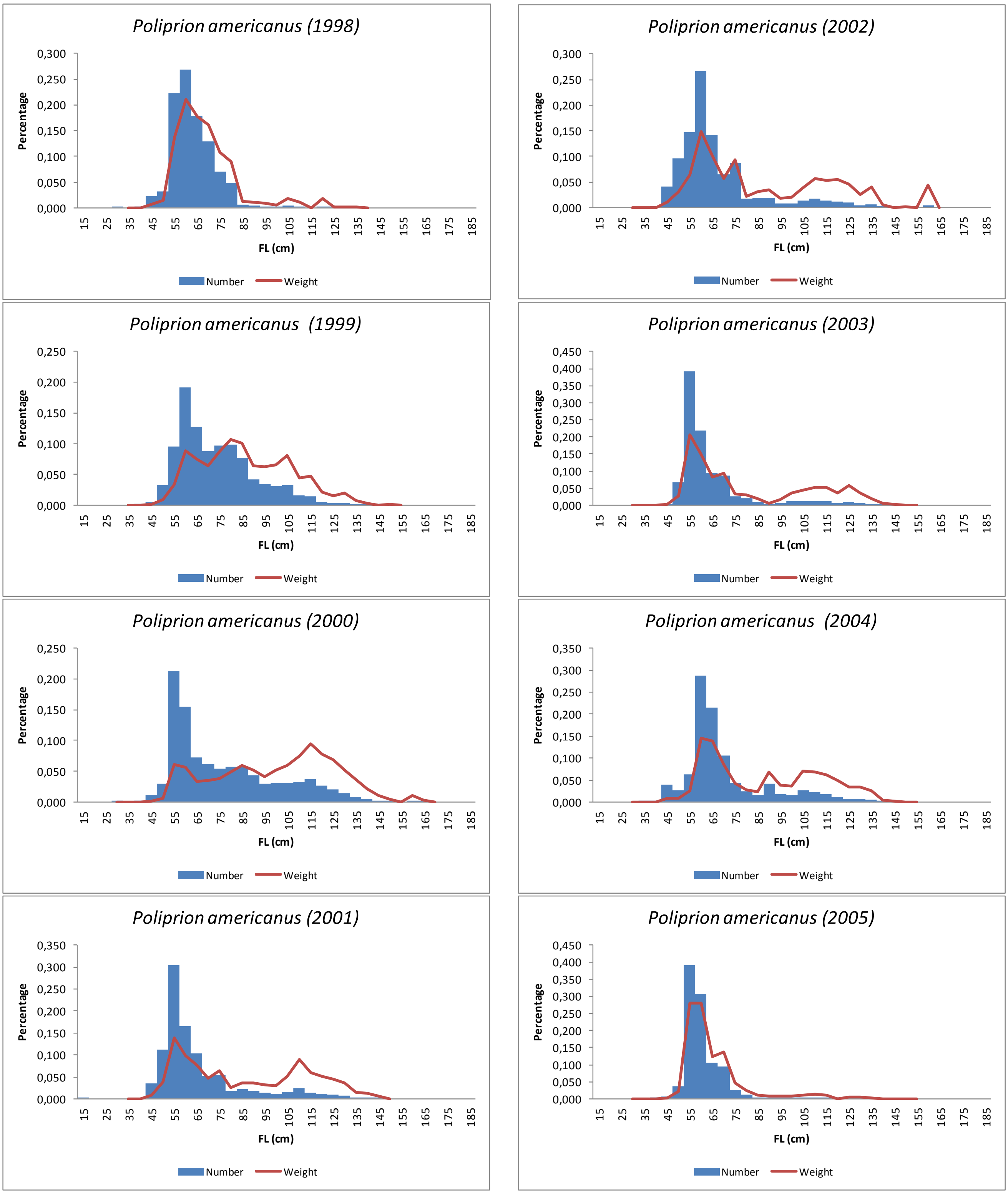

Figure 9 (cont.). Length composition (class 5cm), in number and weight, of *Polyprion americanus* from the Azores landings (1998-2005).

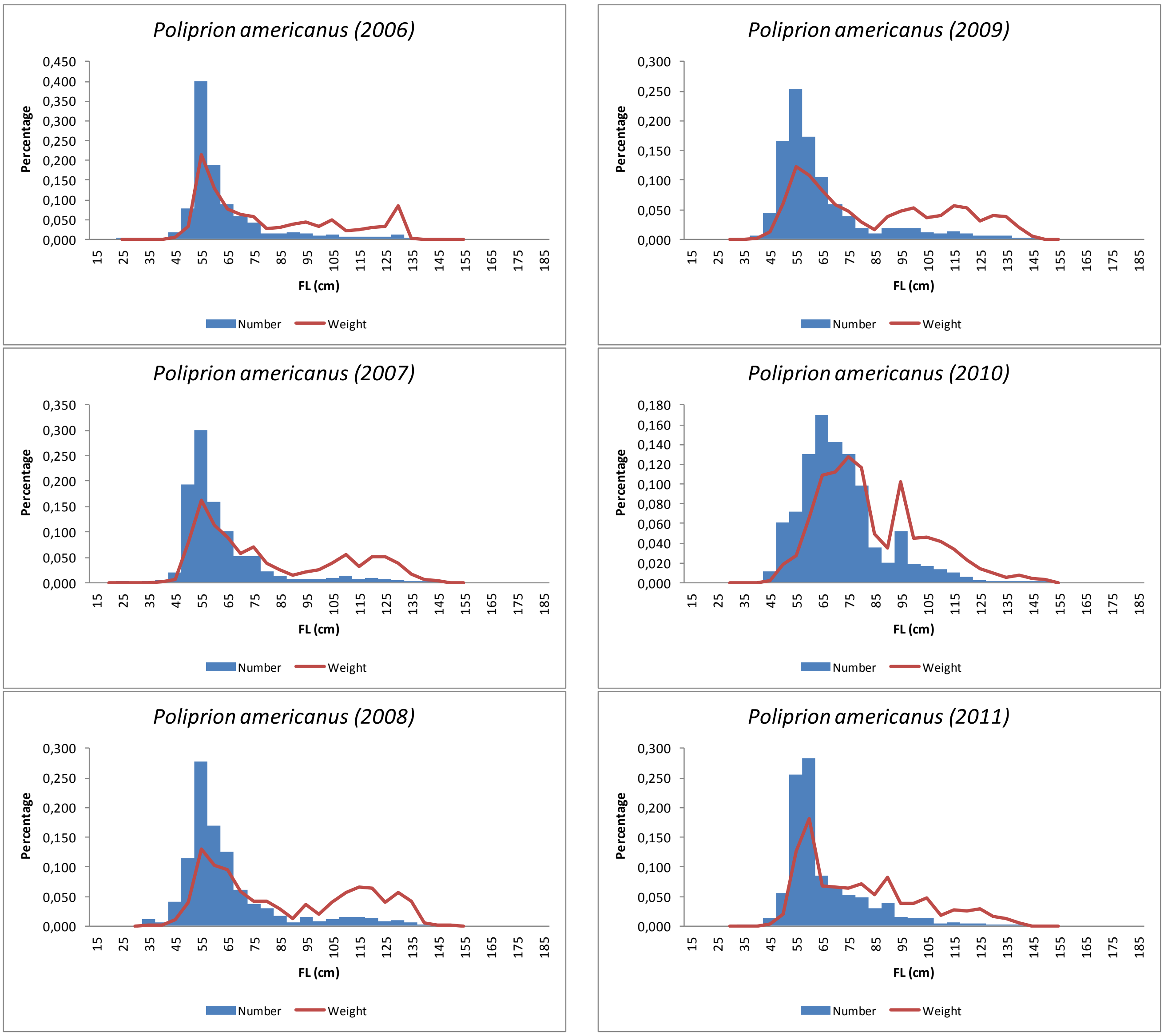

Figure 9 (cont.). Length composition (class 5cm), in number and weight, of *Polyprion americanus* from the Azores landings (2005-2011).

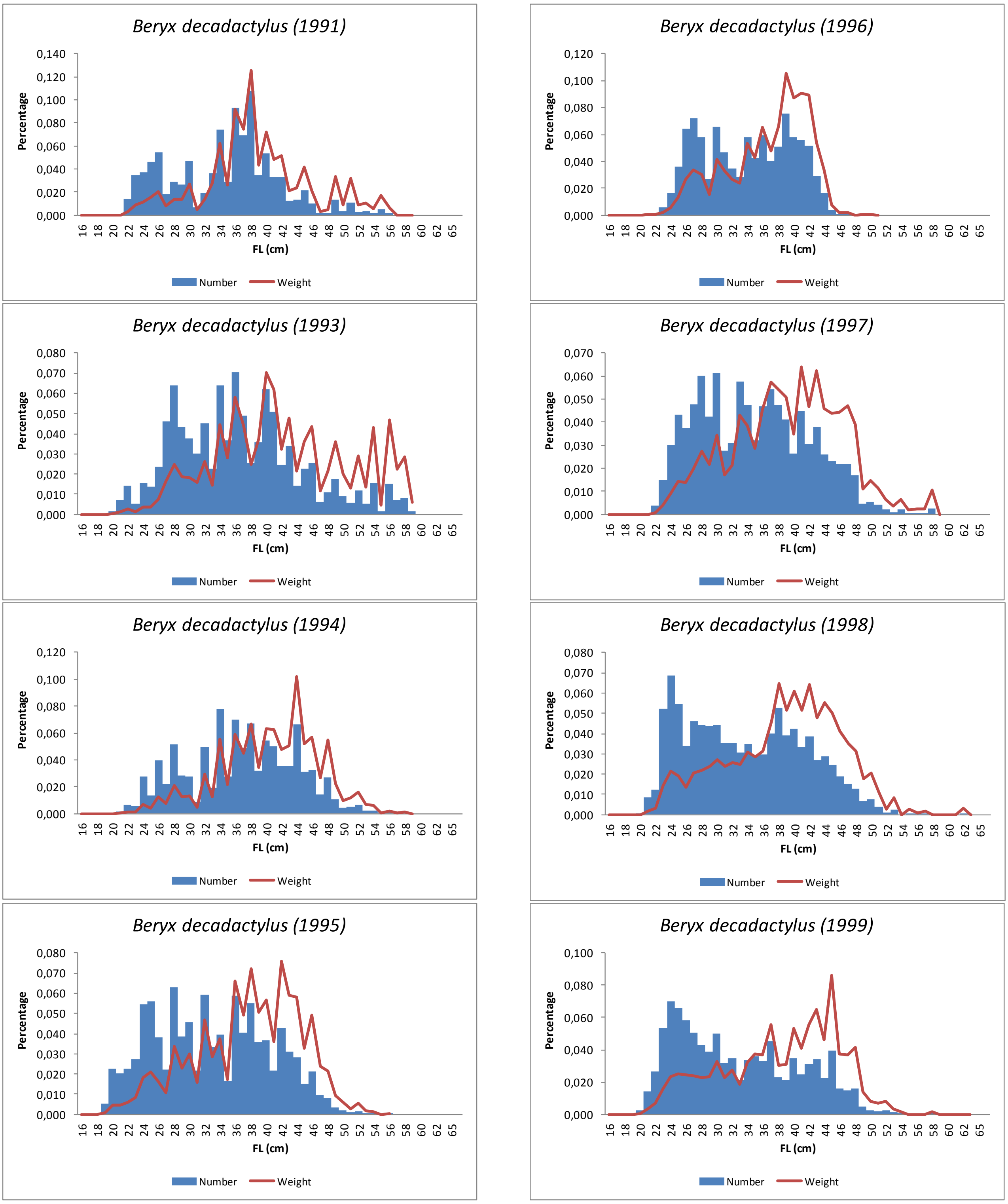

Figure 10. Length composition, in number and weight, of Golden eye perch (Beryx decadactylus) from the Azores landings for the period 1991-1999.

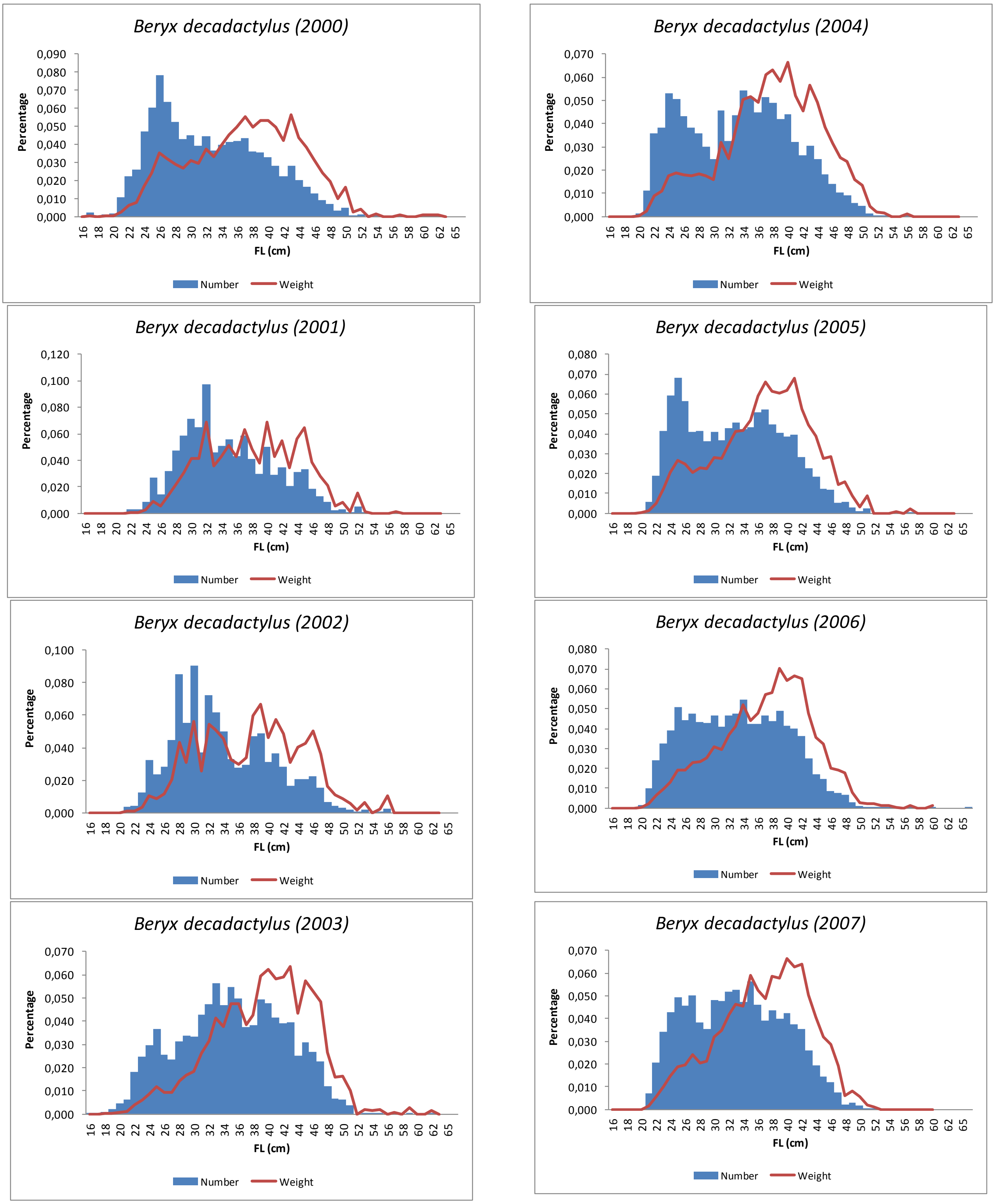

Figure 10 (cont.). Length composition, in number and weight, of Golden eye perch (*Beryx decadactylus*) from the Azores landings for the period 2000-2007.

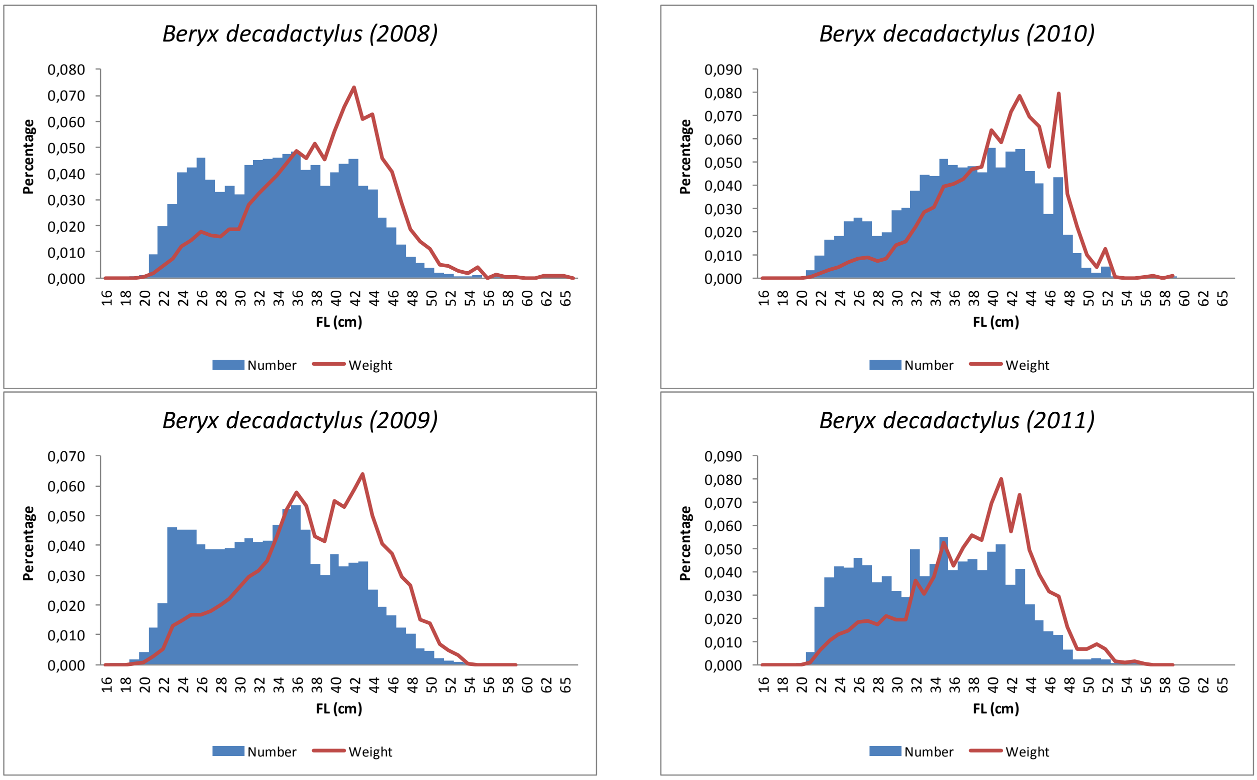

Figure 10 (cont.). Length composition, in number and weight, of Golden eye perch (*Beryx decadactylus*) s from the Azores landings for the period 2008-2011.

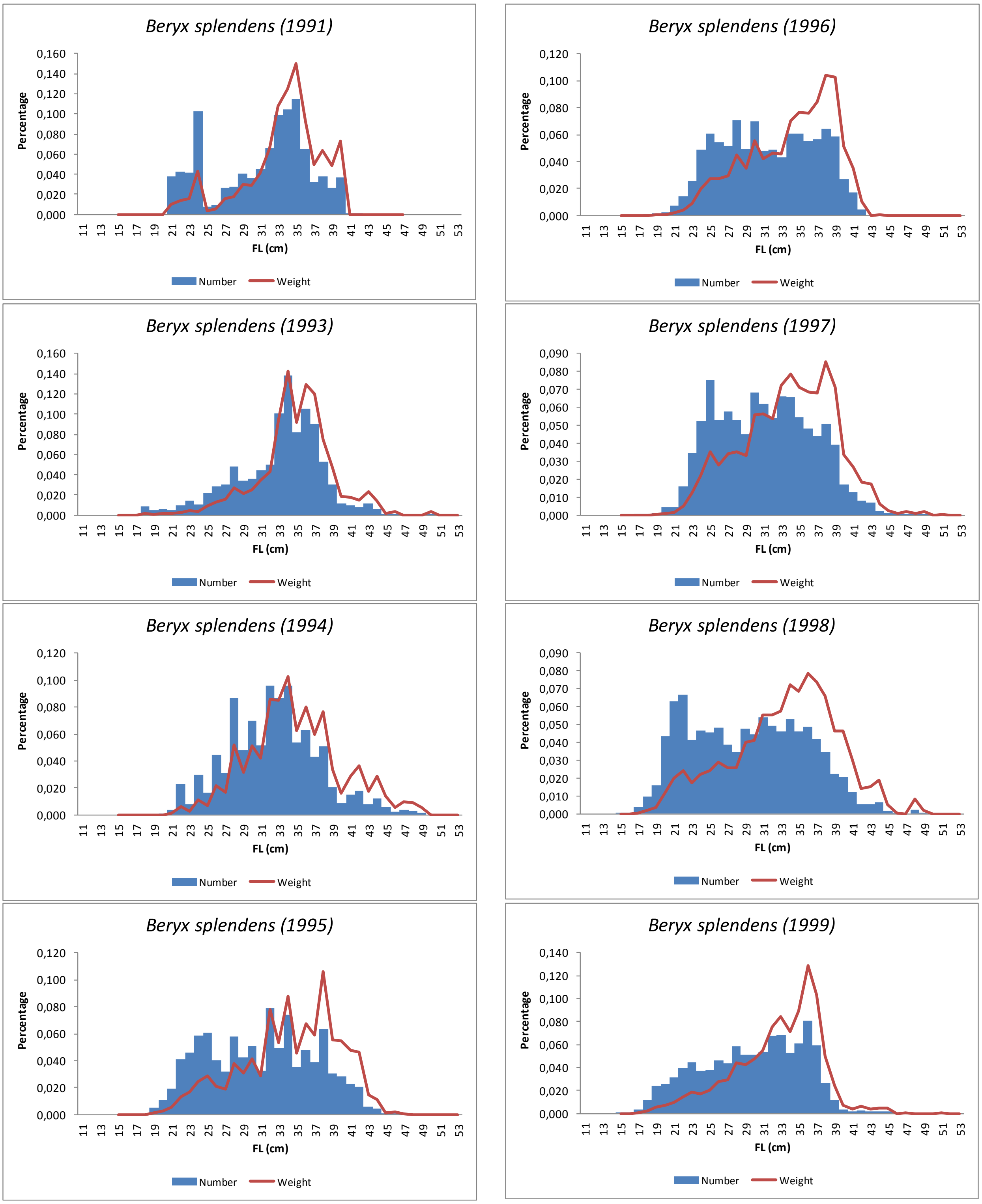

Figure 11. Length composition, in number and weight, of the alfonsino (*Beryx splendens*) from the Azores landings, for the period 1991-1999.

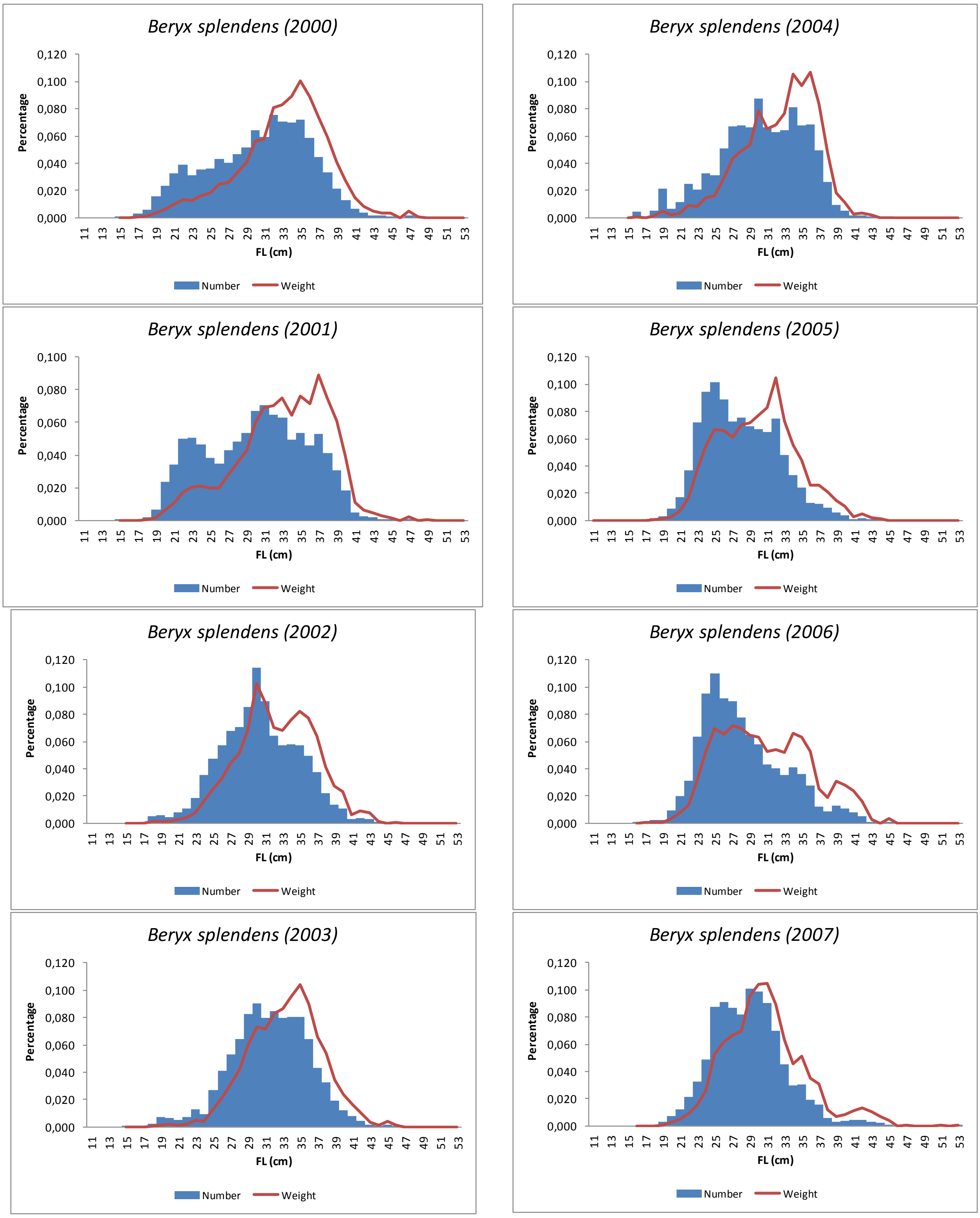

Figure 11 (cont). Length composition, in number and weight, of the alfonsino (*Beryx splendens*) from the Azores landings, for the period 2000-2007.

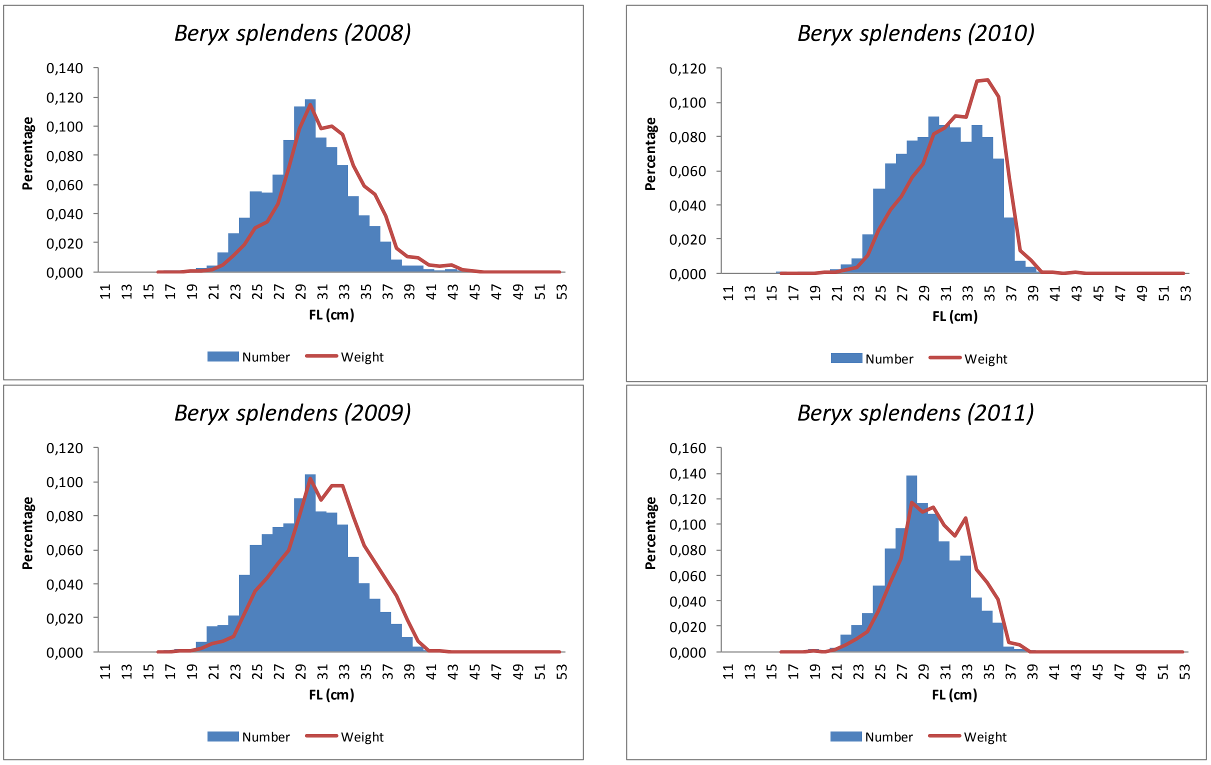

Figure 11 (Cont). Length composition, in number and weight, of the alfonsino (*Beryx splendens*) from the Azores landings, for the period 2008-2011.

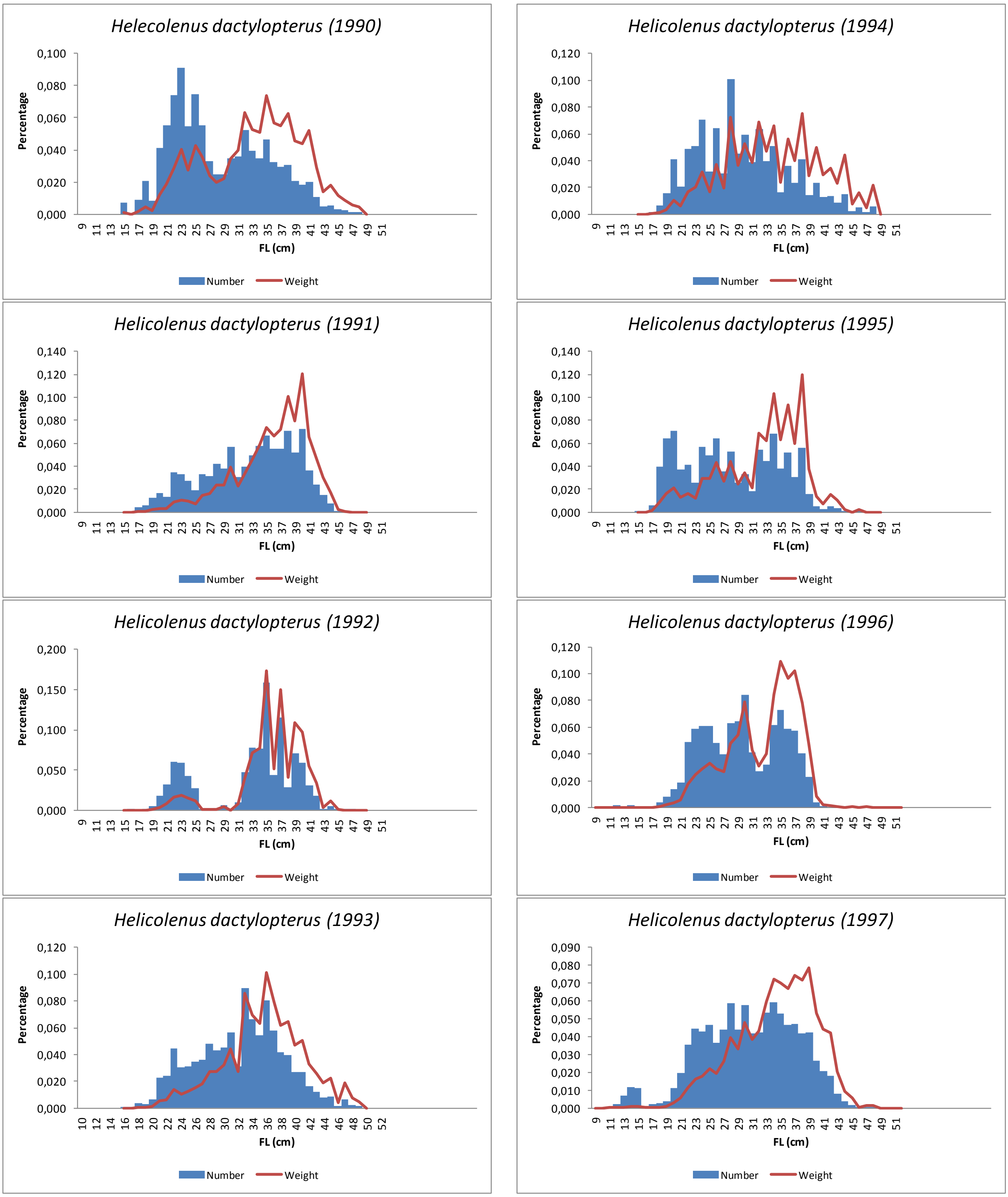

Figure 12. Length composition, in number and weight, of Bluemouth rockfish (*Helicolenus dactylopterus*) from the Azores landings for the period 1990-1997.

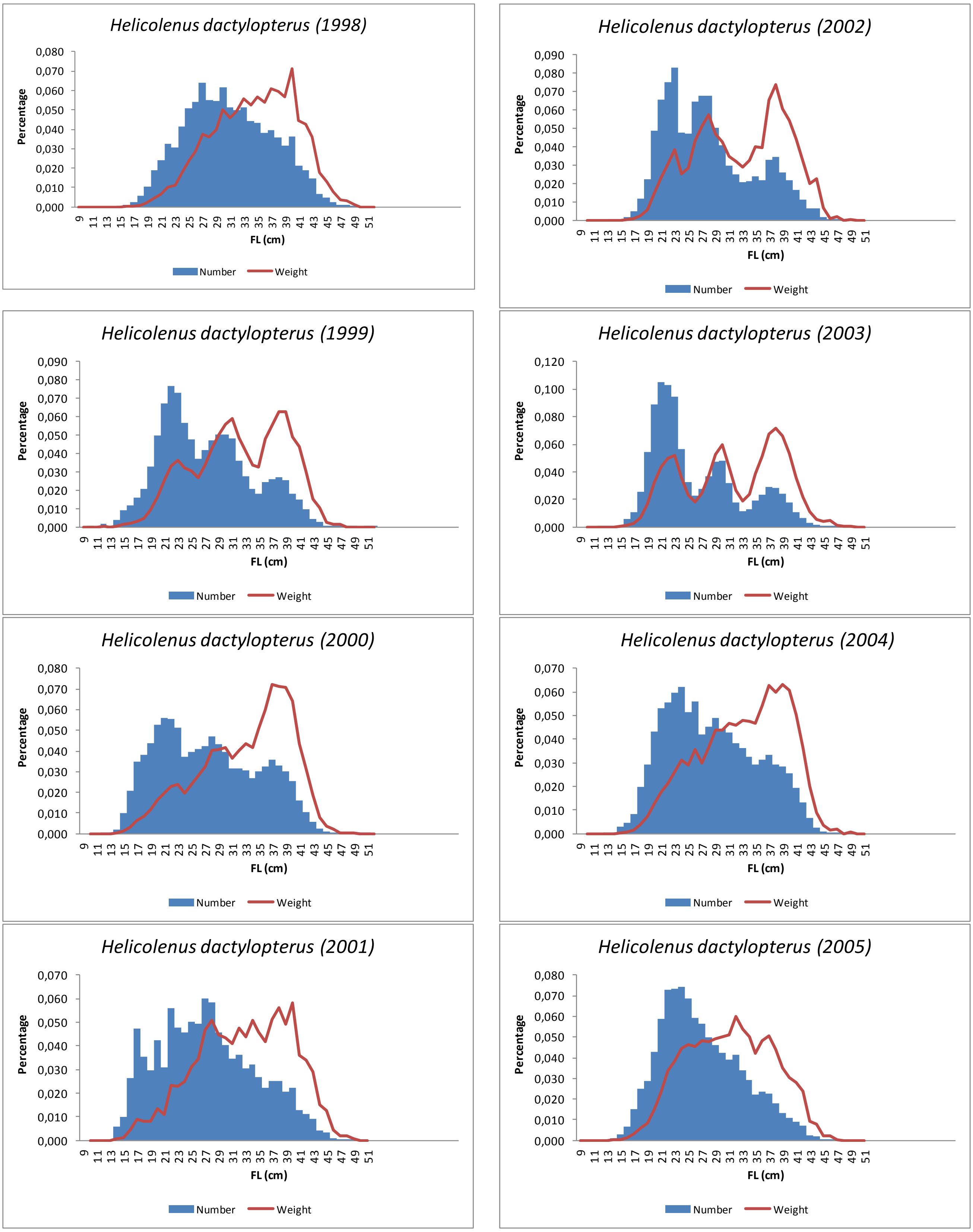

Figure 12 (Cont.). Length composition, in number and weight, of Bluemouth rockfish (*Helicolenus dactylopterus*) from the Azores landings for the period 1998-2005.

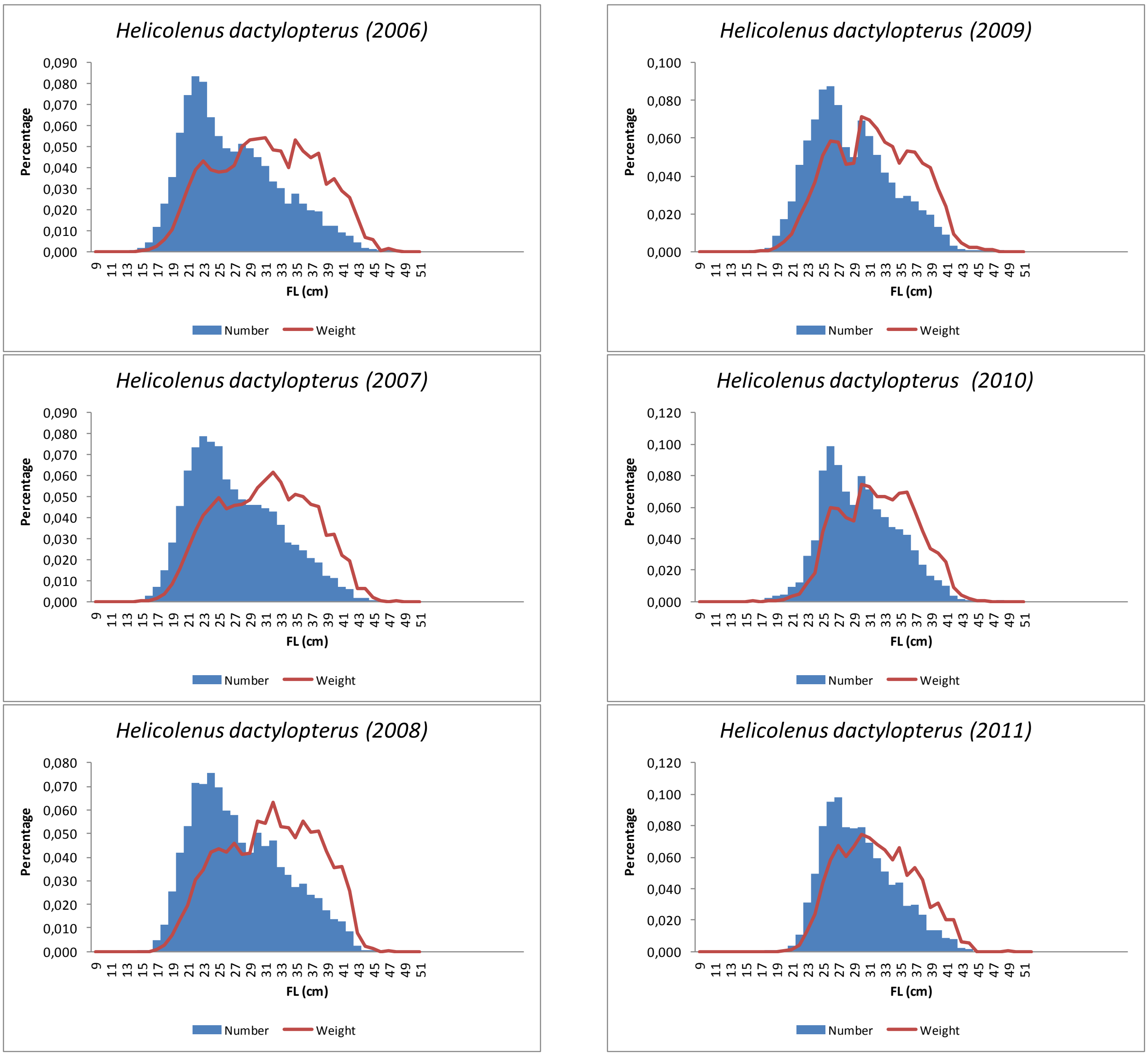

Figure 12. Length composition, in number and weight, of Bluemouth rockfish (*Helicolenus dactylopterus*) from the Azores landings for the period 2006-2011.

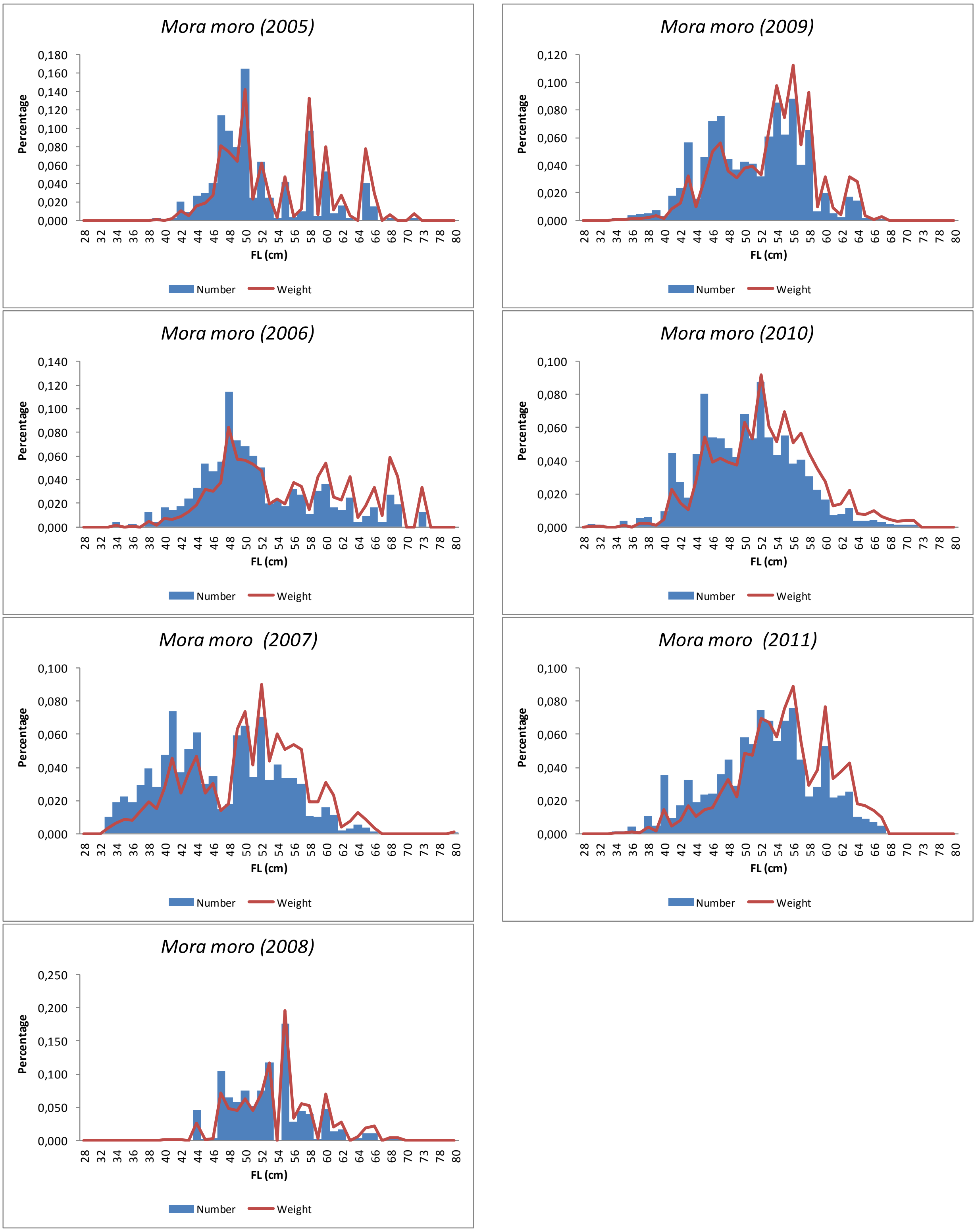

Figure 13. Length composition, in number and weight, of *Mora moro* from the Azores landings for the period 2005-2011.

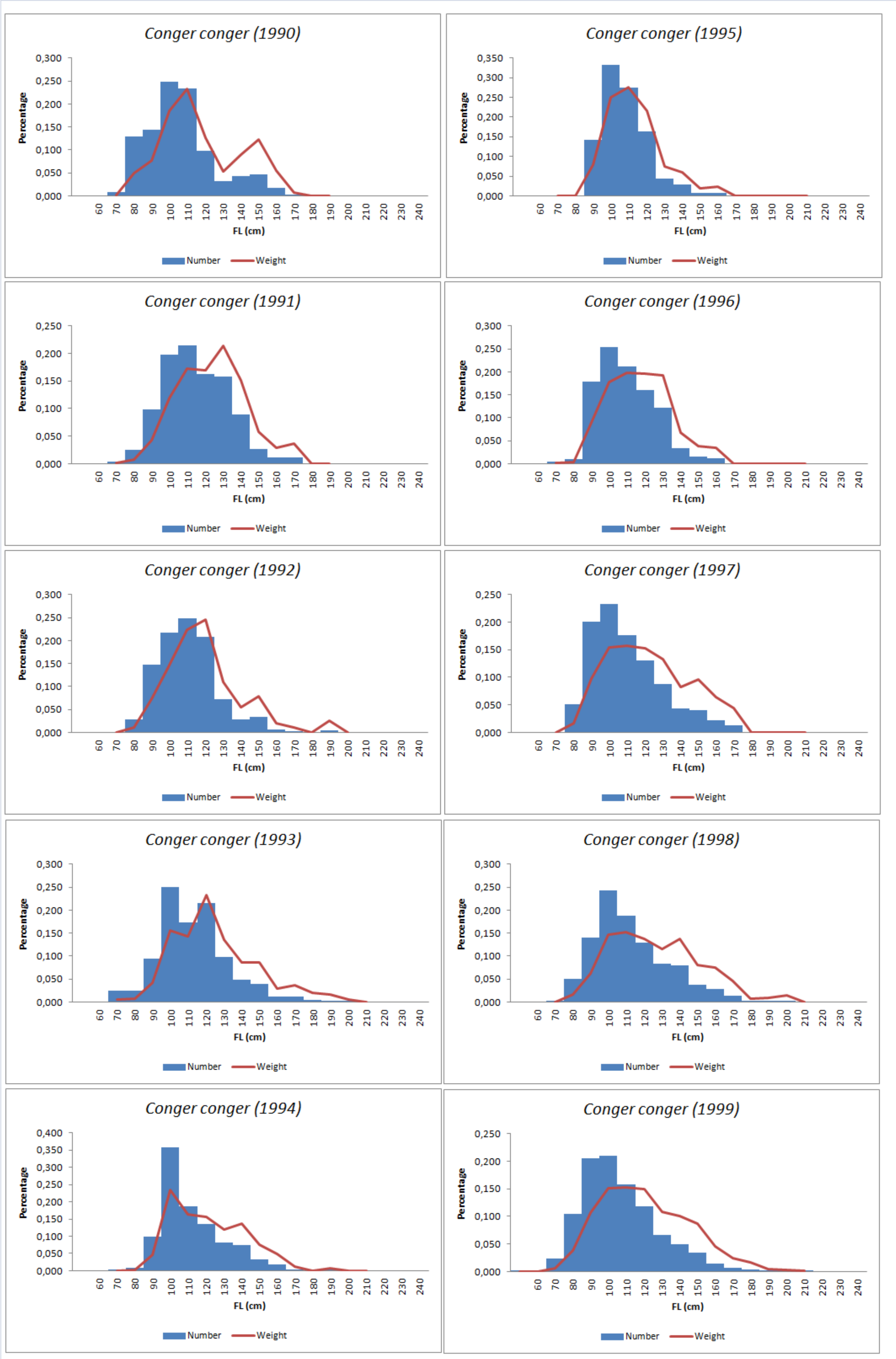

Figure 14. Length composition, in number and weight, of *Conger conger* from the Azores landings for the period 1990-1999.

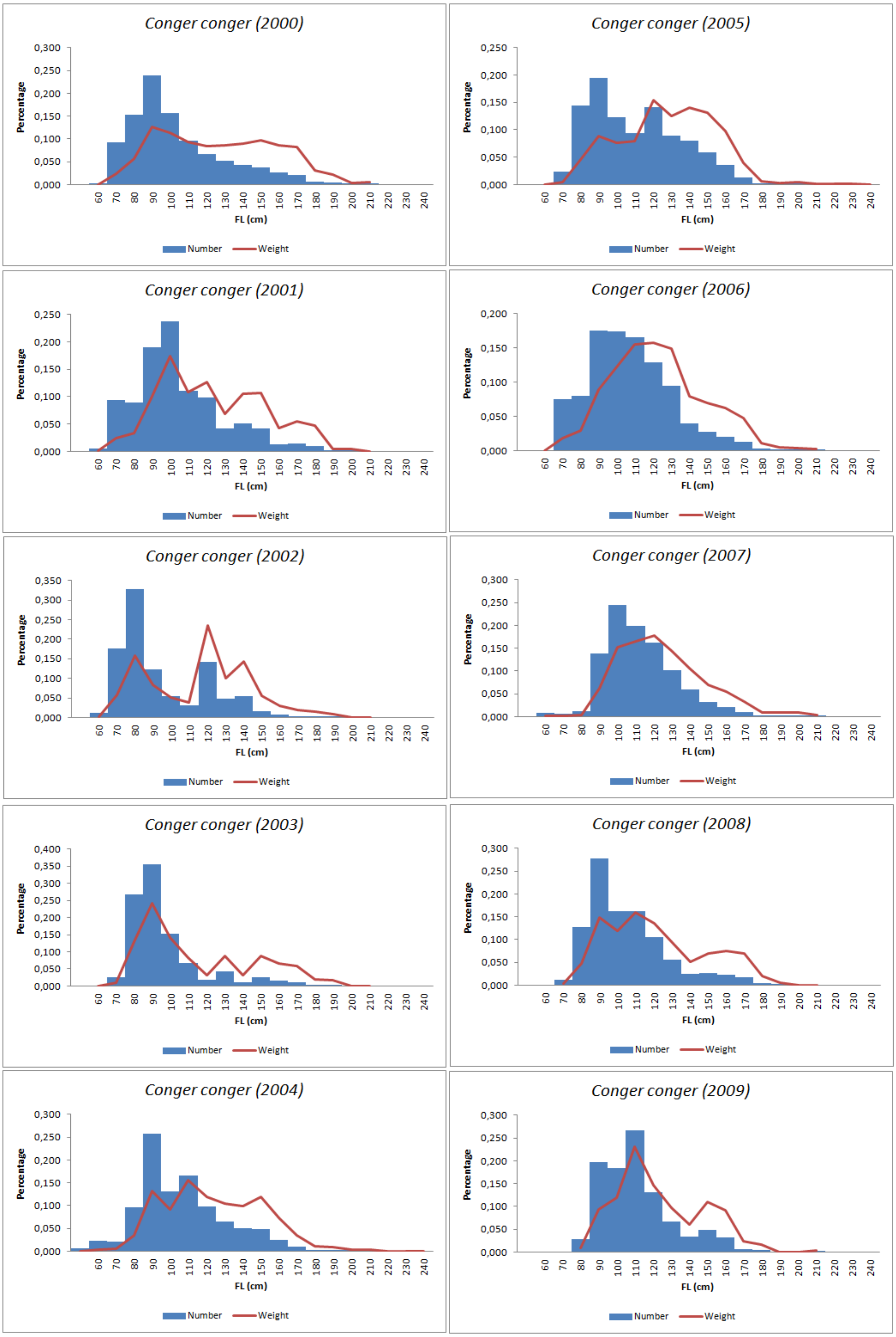

Figure 14 (Cont.). Length composition, in number and weight, of *Conger conger* from the Azores landings for the period 2000-2009.

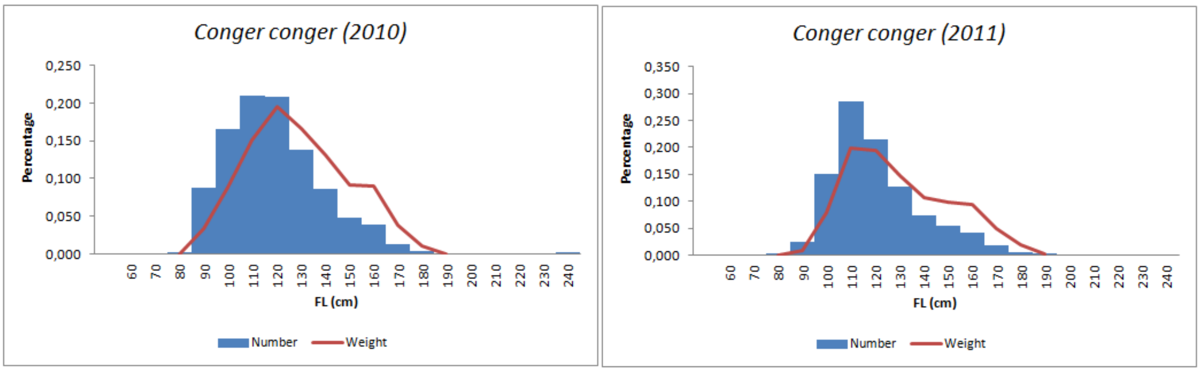

Figure 14 (cont). Length composition, in number and weight, of *Conger conger* from the Azores landings for the period 2010-2011.

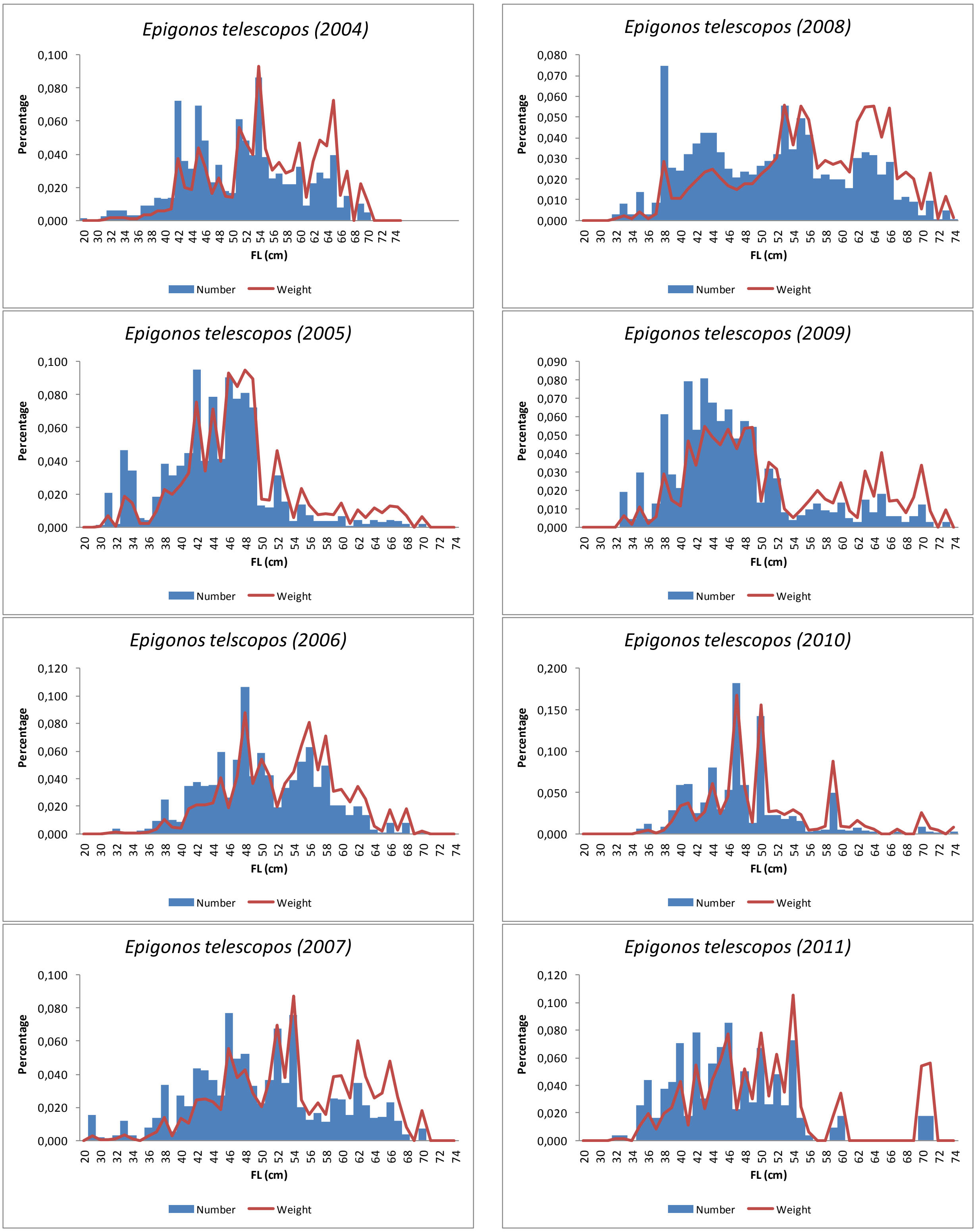

Figure 15. Length composition, in number and weight, of *Epigonus telescopus* from the Azores landings for the period 2004-2011.

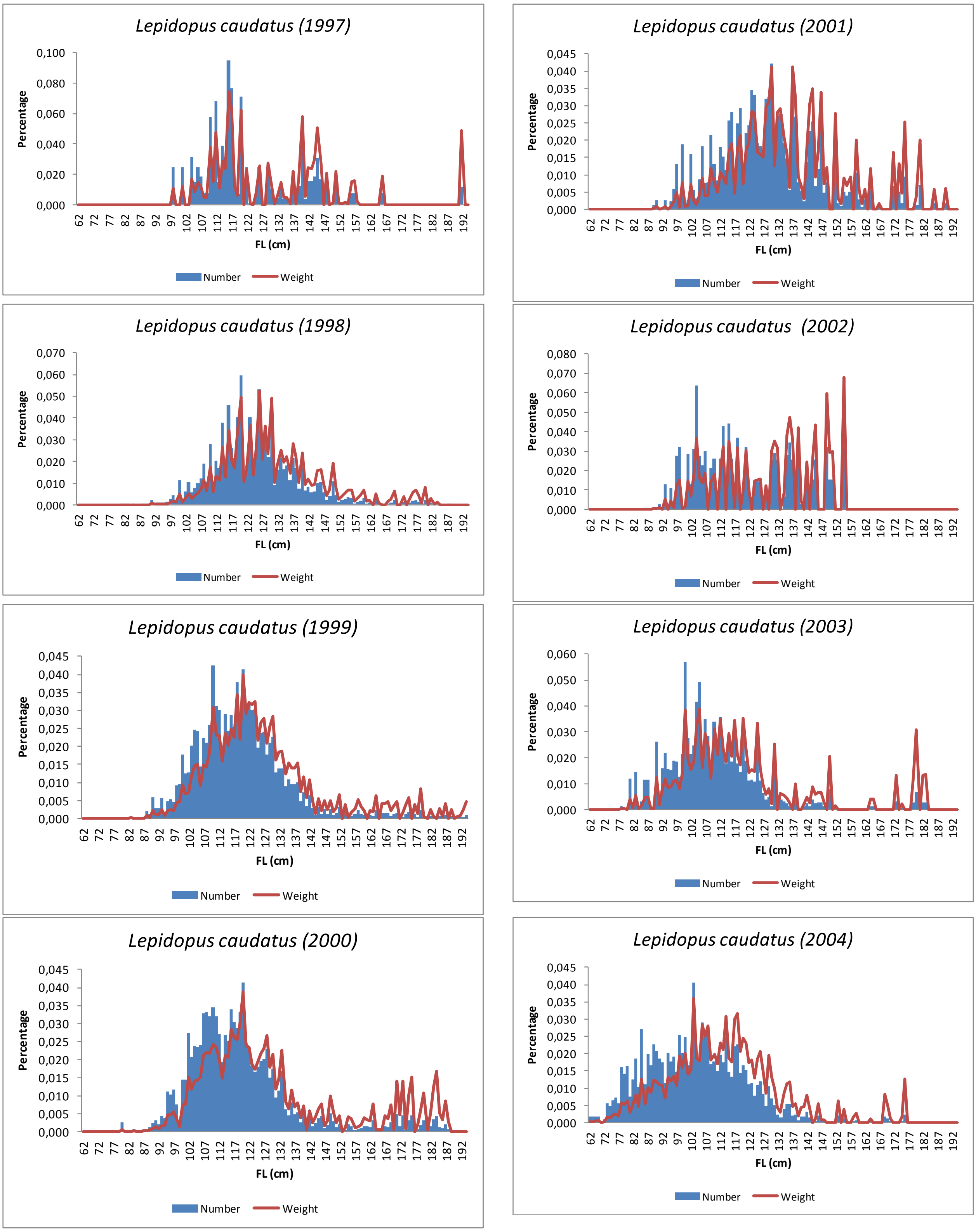

Figure 16. Length composition, in number and weight, of *Lepidops caudatus* from the Azores landings for the period 1997-2004.

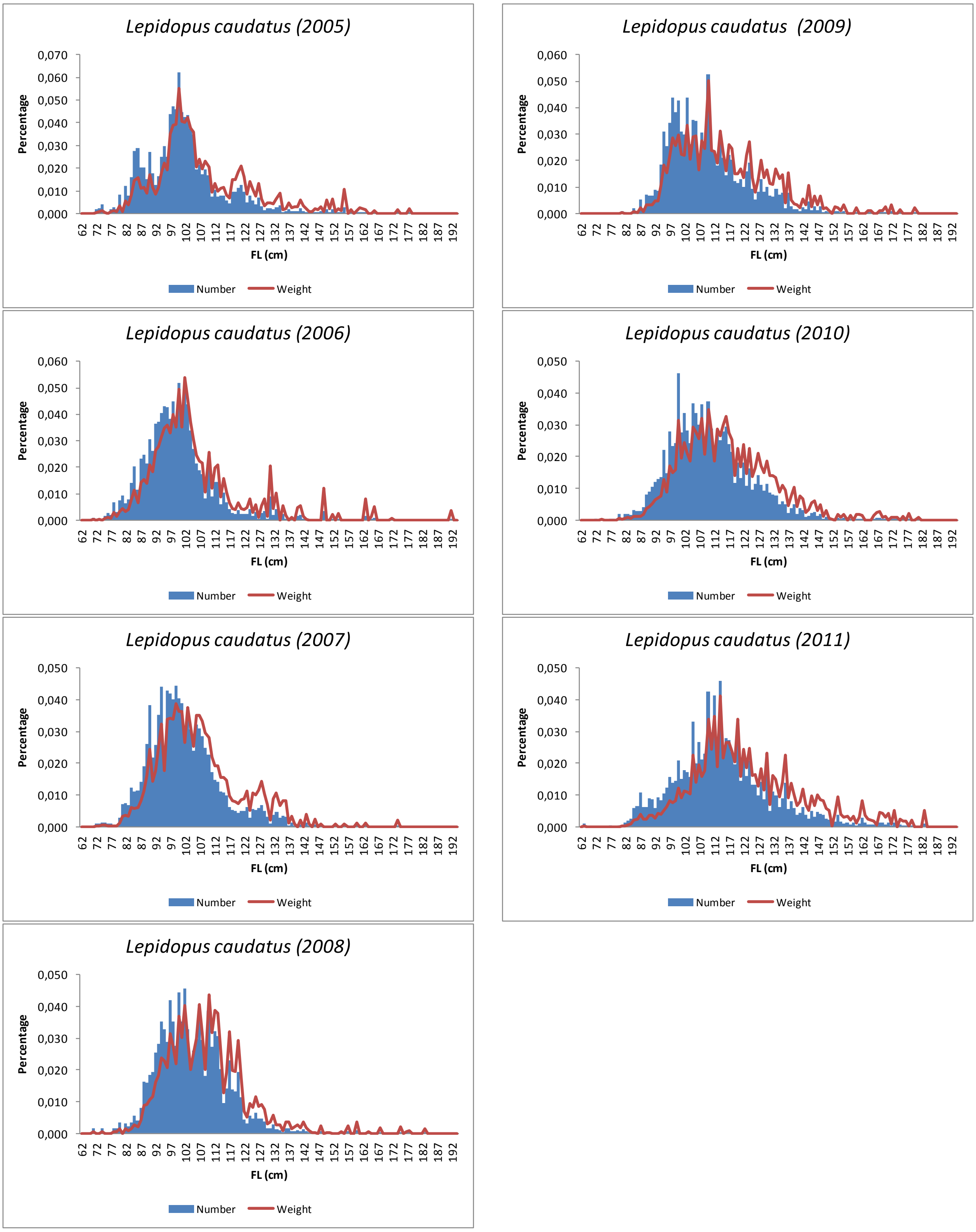

Figure 16 (Cont.). Length composition, in number and weight, of *Lepidops caudatus* from the Azores landings for the period 2005-2011.

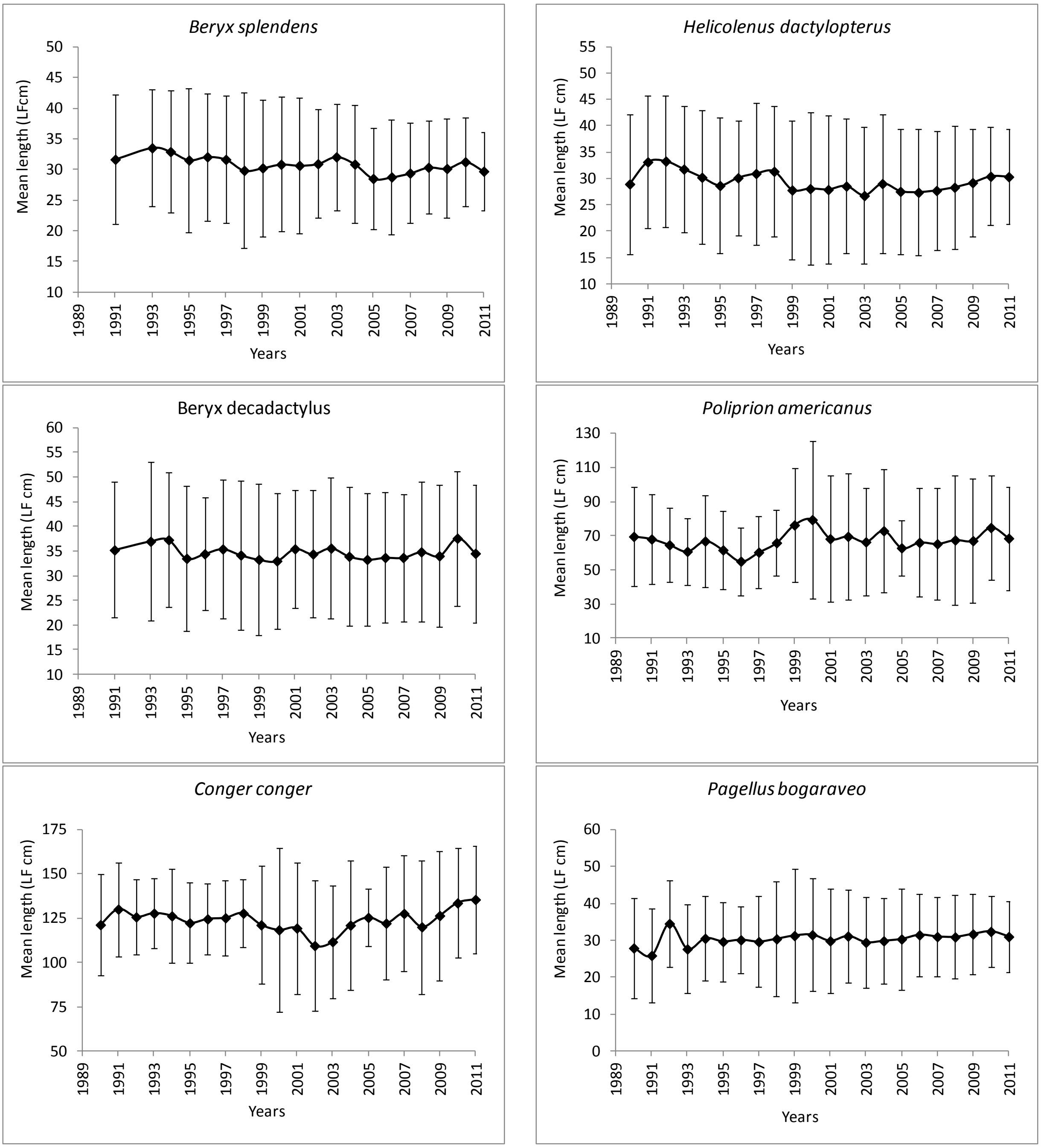

Figure 17. Annual mean length of some selected deep water species, landed at the Azores (ICES Xa2).

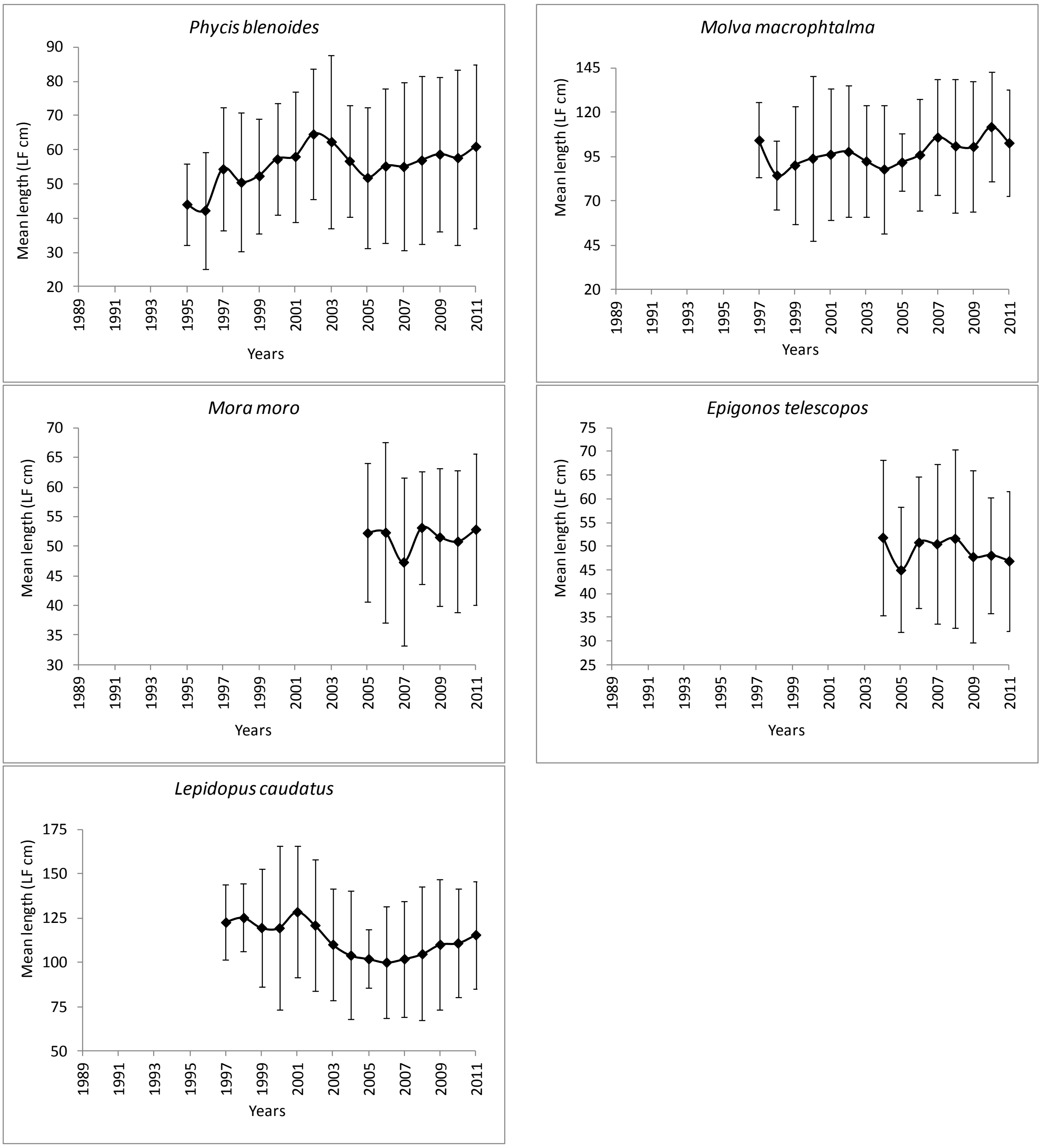

Figure 17 (Cont.). Annual mean length of some selected deep water species, landed at the Azores (ICES Xa2).

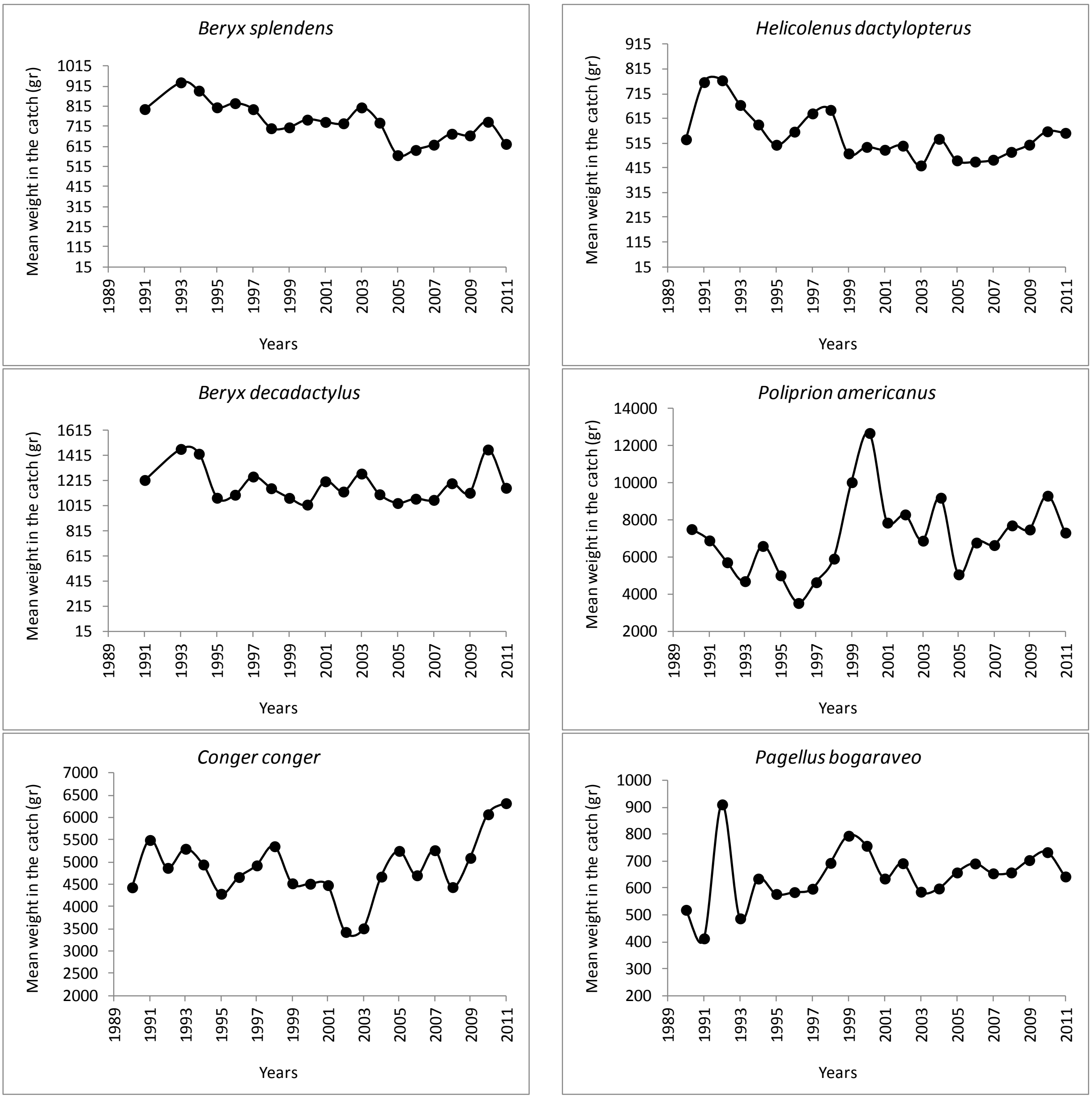

Figure 18. Annual mean weight in the catch of some selected deep water species, caught by the Azores fishery (ICES Xa2).

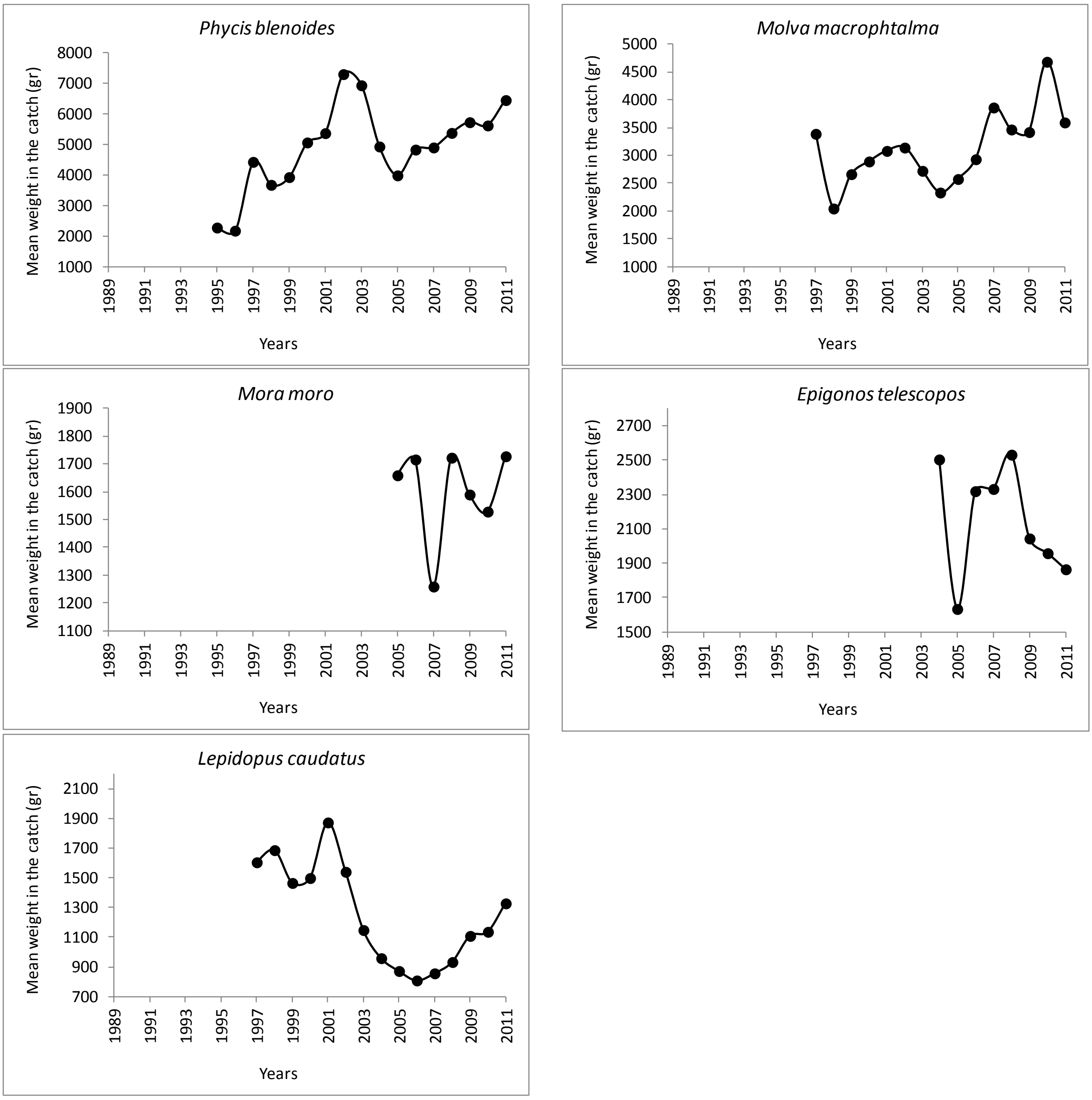

Figure 18 (Cont.). Annual mean weight in the catch of some selected deep water species, caught by the Azores fishery (ICES Xa2).

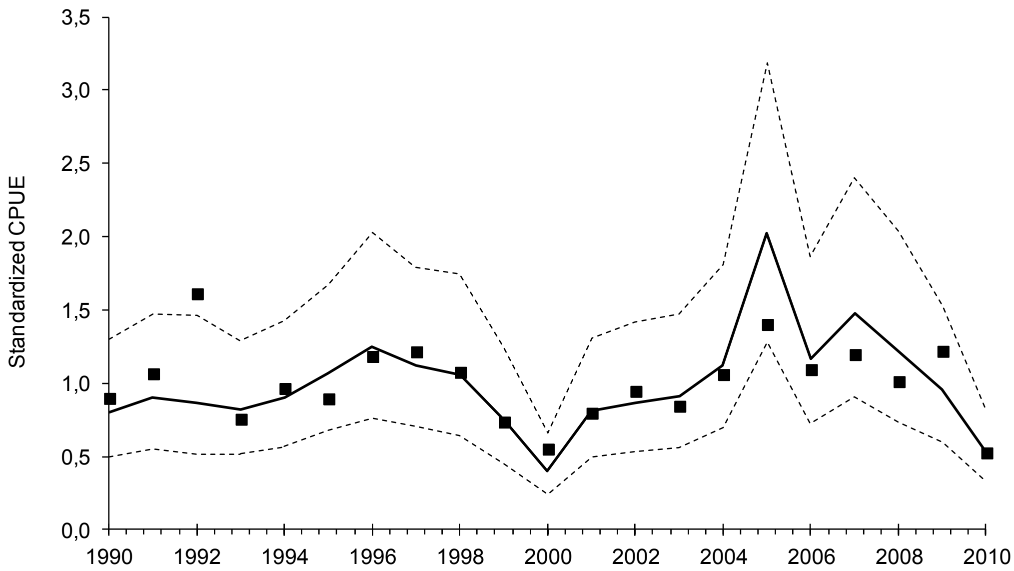

Figure 19. Standardized CPUE, in number, for *Pagellus bogaraveo* from the Azorean fishery (ICES area X) and for the period 1990-2010. Black squares are nominal cpue, black line standardized cpue and dashed lines the 95% confidence interval.

The ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP 2013).

Survey data from the Azores

by

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Abstract

This paper resumes the available information for the deep-water species (annex I and II from the EC regulations) from the Azorean Spring Demersal Longline survey for the 2013 ICES working group WGDEEP. Annual abundance indices, length composition and annual mean length by species are presented for the main commercial species of the Azores. Trends in the annual mean abundance indices are presented for other less abundant specie on the survey or non commercial species.

Introduction:

Since 1995, a longline survey has been conducted annually by the Department of Oceanography and Fisheries at the University of the Azores (DOP/UAç), during spring time, covering the main areas of distribution of demersal species (the coastal of the islands, and the main fishing seamounts), with the primary objective of estimating fish abundance for stock assessment. The survey is target for the abundance estimation of red (blackspot) seabream (*Pagellus bogaraveo*) from the Azores (ICES subdivision Xa2) but information for other commercial important species is also collected.

The survey follows a random stratified design, based on transepts covering the depth range from 50 to 1200m allocated proportionally to six statistical areas of the ICES sub-division Xa2 (ICES WGNEACS, 2010).

The objective of this paper is to resume the survey information of deep-water species to the WGDEEP 2012.

Material and methods

This paper uses information from the Azorean Spring Demersal Longline Survey from 1995 to 2012, to compute annual abundance index, mean annual abundance by depth stratum, length composition and annual mean length for the most important commercial species from the Azores. The survey follows a random stratified design covering the islands and main seamounts from 50 to 1200m. However, the survey is design for abundance estimates of benthopelagic species from 50 to 600m. This depth stratum was extended to 800m since 2004. The deepest strata, 600-1200m until 2004 and 800-1200m thereafter, were covered without replicates and the information collected for ecological proposes. In order to be comparable along all survey time series, annual abundance index was computed for the depth strata 50-600m, and the 95% confidence interval estimated by bootstrapping. For less abundant deep-water species on the survey, like *Phycis blenoids* and *P. americanus*, or species with broader depth distribution like deep-water sharks and *Mora moro* the annual abundance estimation follows the same computation procedure but covering the entire survey depth range (50-1200m). Trends in the abundance indices are presented in this last case and the confidence interval were not estimated, because for most depth stratum there were not replicates to estimate the variance.

Mean length composition for the period 1995-2012 and annual mean length are presented for the main species.

Results

Abundance indices

An index of annual abundance in number estimated for the more important survey species are presented in Figure 1. High interanual variability is observed on the abundance indices. Trends of the annual abundance for other species caught on the survey are presented on the annex.

Data on this paper covers the period 1995-2012. There is no information for 1998, 2006 and 2009 because there was no survey. Abundance index from the surveys seems to confirm the trend observed on the landings time series (see WD Pinho et al, 2013) for some species (e.g. *Beryx sp* and *Lepidopus caudatus*) (Fig. 1). For red (blackspot) seabream (*Pagellus bogaraveo*) is observed a stable trend on the abundance along time but with very high variability along time, with a marked cycle every three or four years until 2007. This result contradicts the landings trend where very significant decrease is observed during the last three years. A similar result is observed for *Conger conger*. For bluemouth (*Helicolenus dactylopterus*) a very significant decrease on the relative abundance is observed during the last three years.

Depth distribution along time does not present significant changes for these species. More annual variability by depth is observed for the more mobile species, like the *Beryx sp*. and *Lepidopus caudatus* (Fig.2). More annual variability is also observed for the deepest depth strata (700-1200m).

For the other species a general increased trend is observed on the abundance index. However, the Azorean Spring Longline Survey is design for abundance estimation on the strata 50-600m (800 after 2004) originally targeting the red (blackspot) seabream *Pagellus bogaraveo*. For some of this deep-water species, like *Poliprion americanus* and some deep water sharks, the survey may not be design because the gear has not the appropriate configuration or the depth range of the species distribution is broader than the survey coverage for abundance estimation purposes. Thus generalization about some stock status must be interpreted with care and information is presented here for illustration.

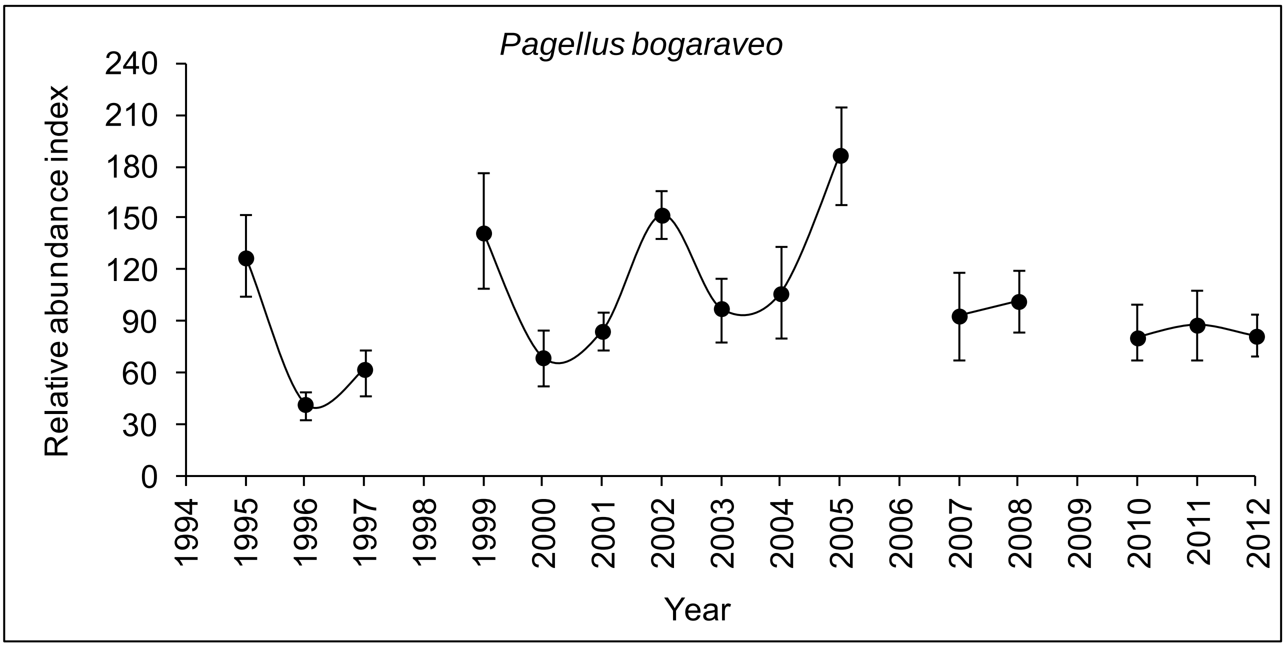
Length composition and mean length

Mean length composition for some deep-water species, for the period 1995-2012, is presented on Figure 3. The range of lengths sampled suggests that surveys cover the immature and mature fraction of the populations for most of the commercial important species. Annual mean length presents a decrease trend for almost all species with the exception of red black spot seabream (Fig.4). This result suggests that more small fish have been caught in the recent years.

References

ICES (WGNEACS report) 2010. Report of the Working Group for North-east Atlantic Continental Slope Survey. ICES CM 2010/SSGESST:16, REF. SCICOM, ACOM.

Abundance index



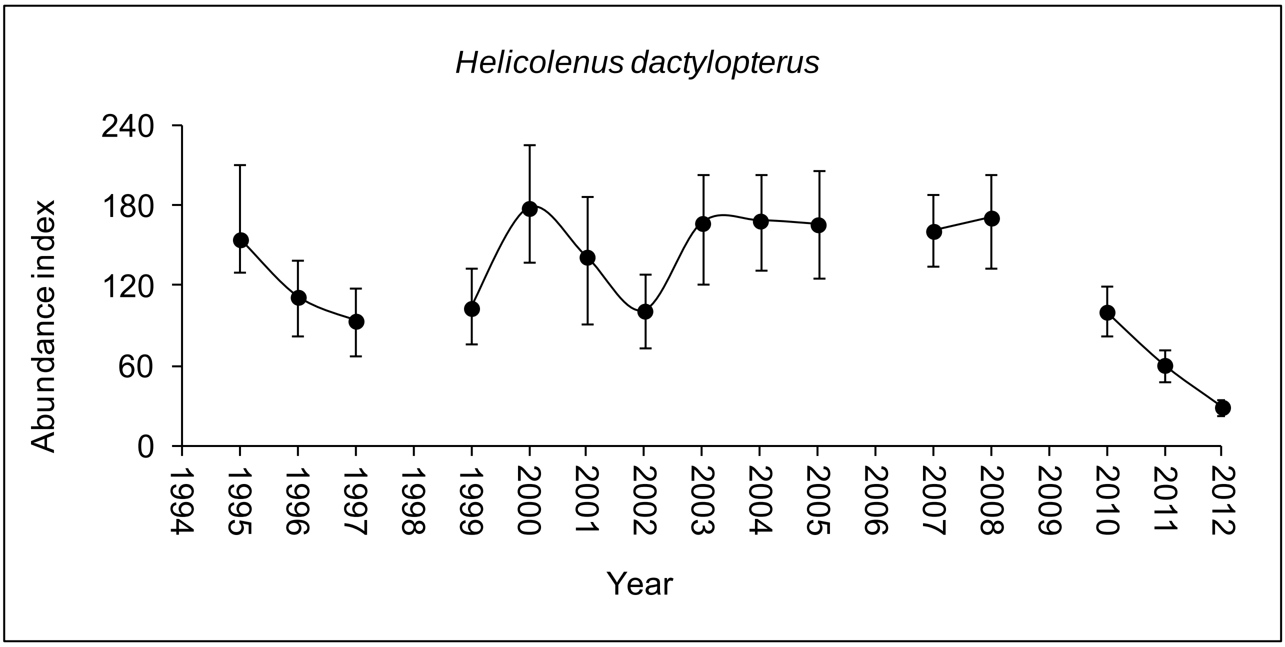
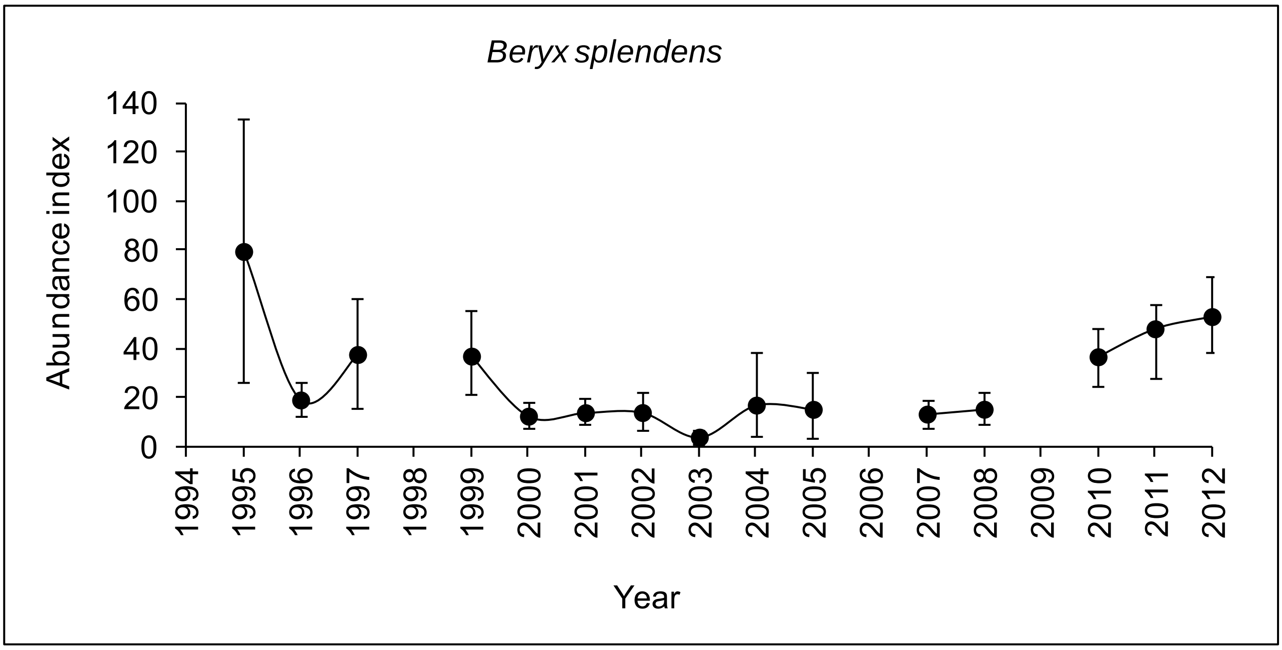


Figure 1. Annual bottom longline survey abundance index in number available for some of the Azorean deep-water species.



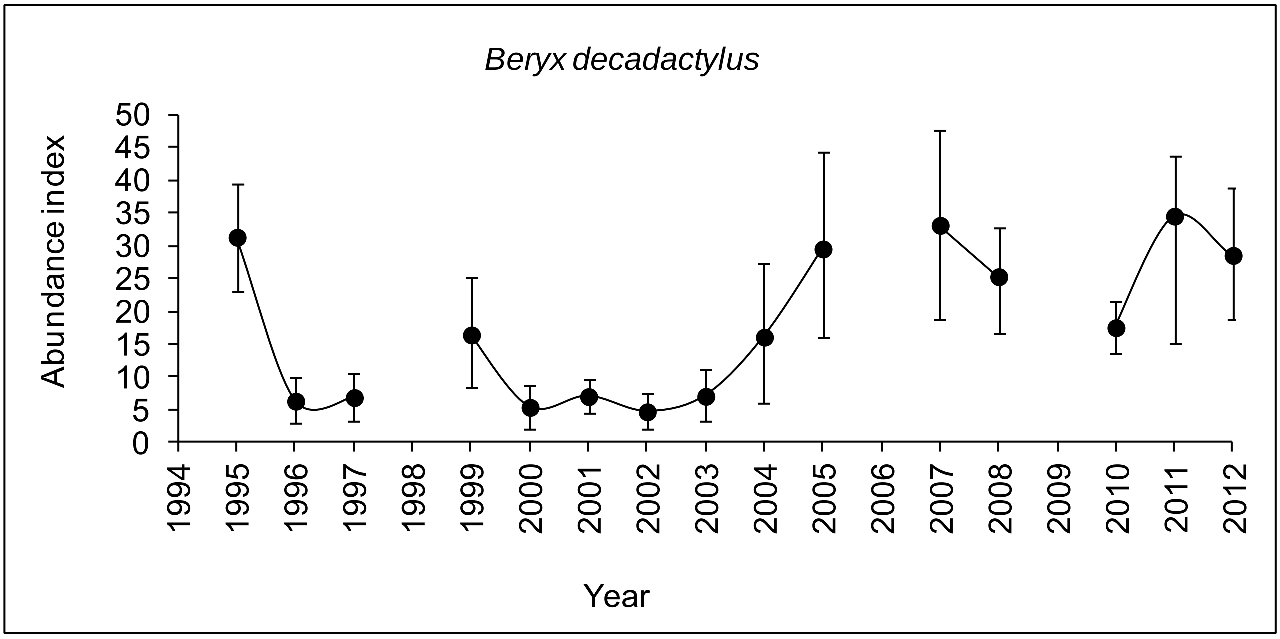
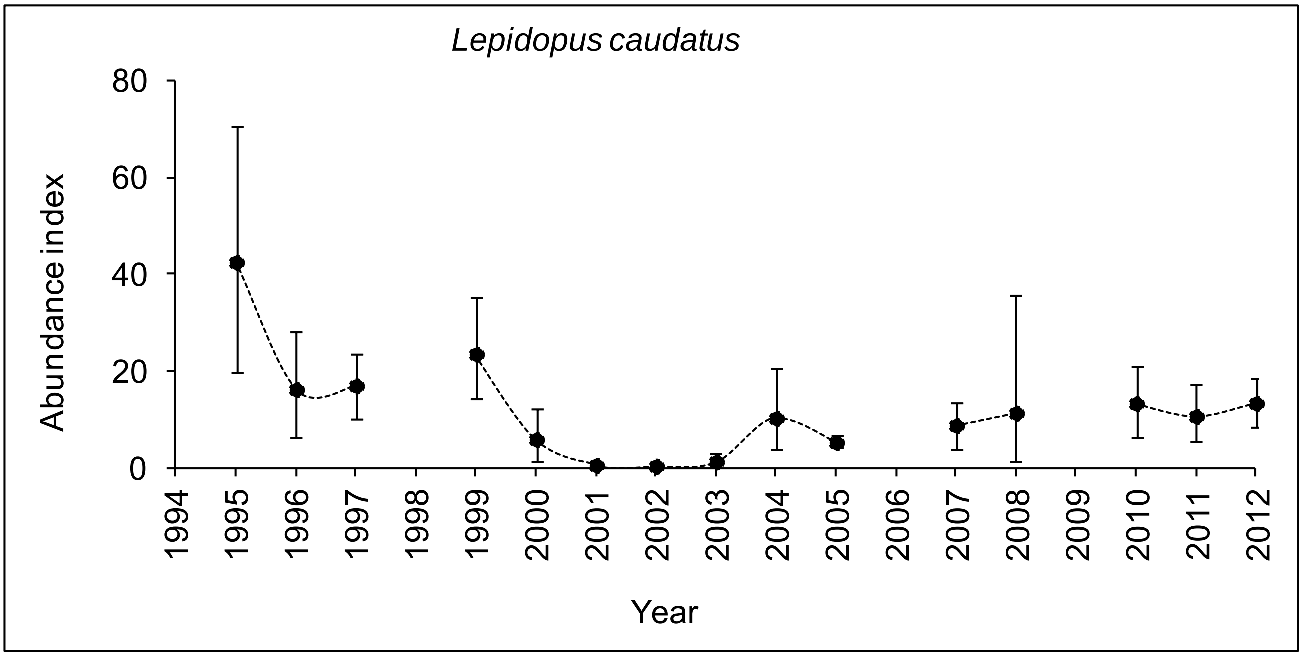


Figure 1 (Cont). Annual bottom longline survey abundance index in number available for some of the Azorean deep-water species.



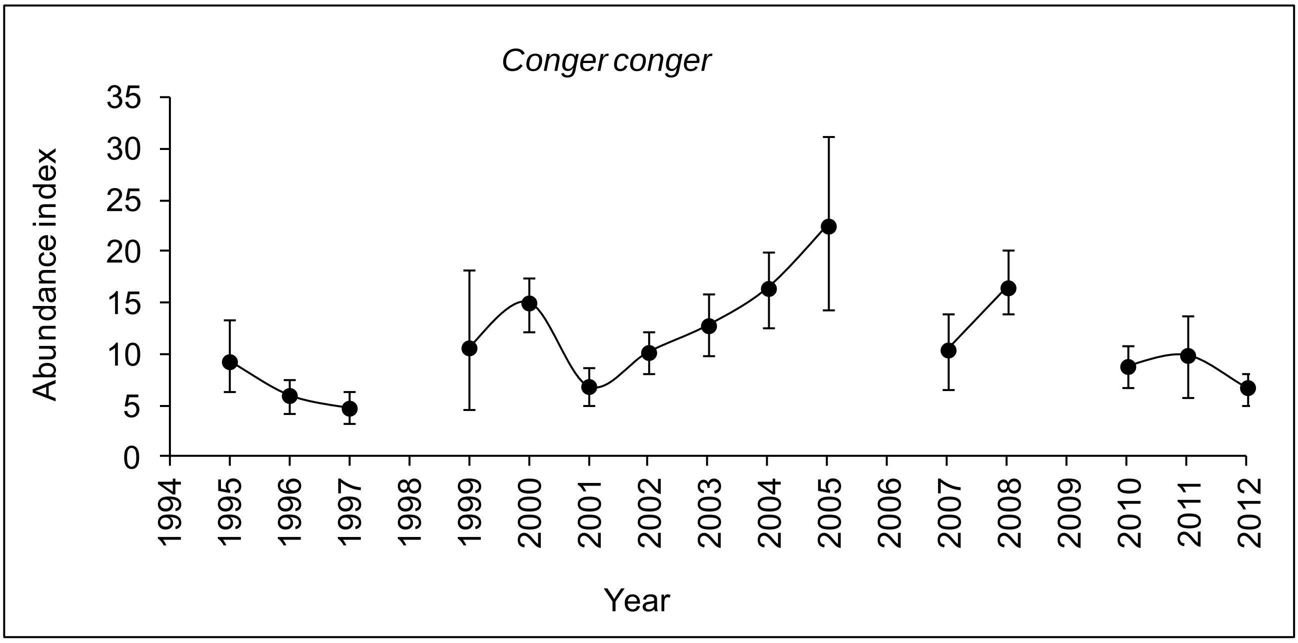
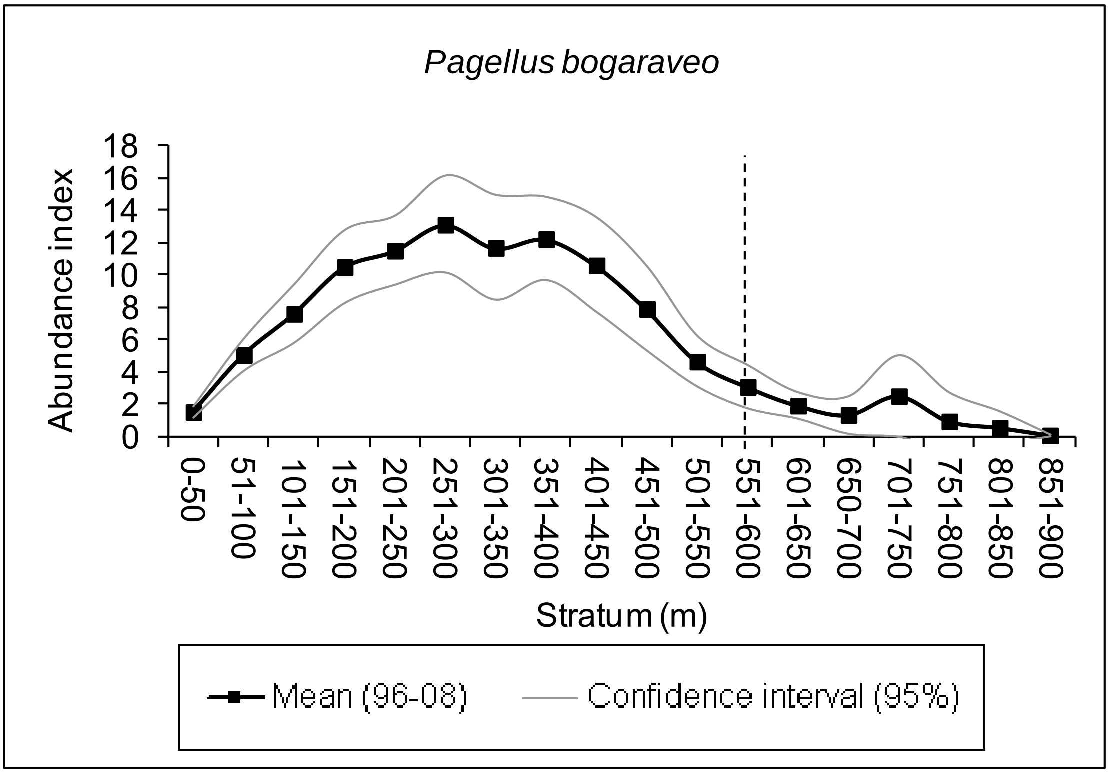


Figure 1(Cont.). Annual bottom longline survey abundance index in number available for some of the Azorean deep-water species.

Distribution by depth



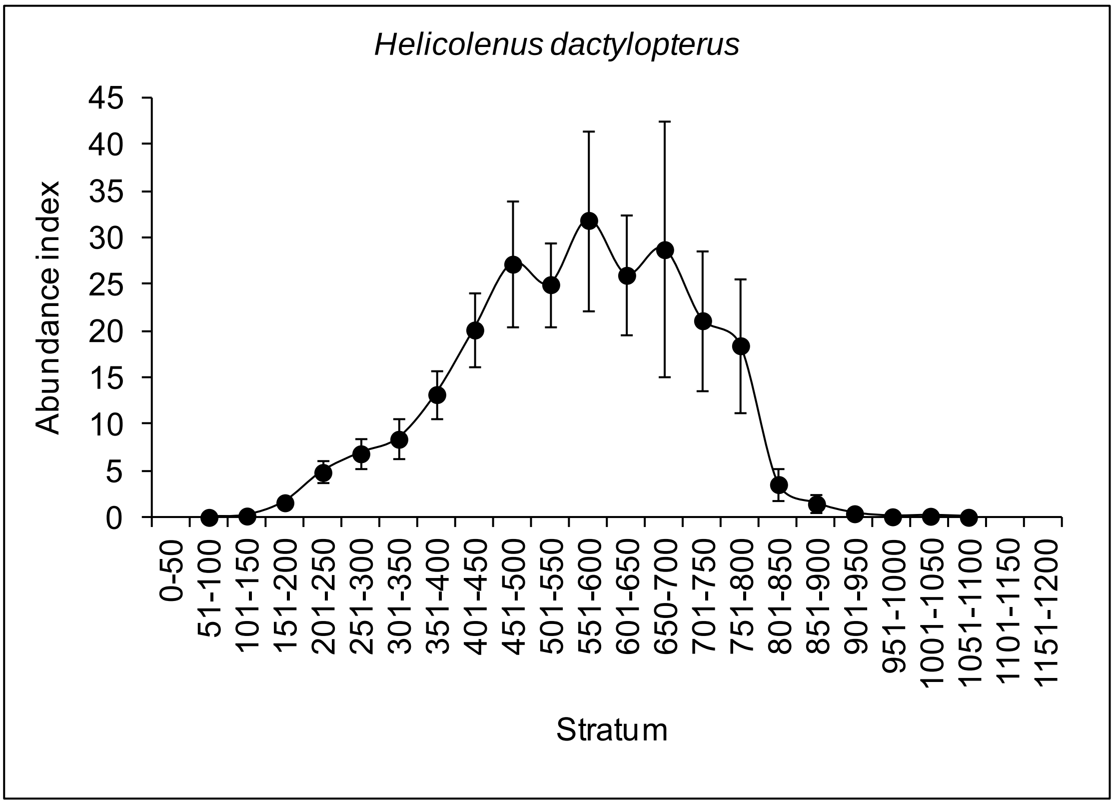
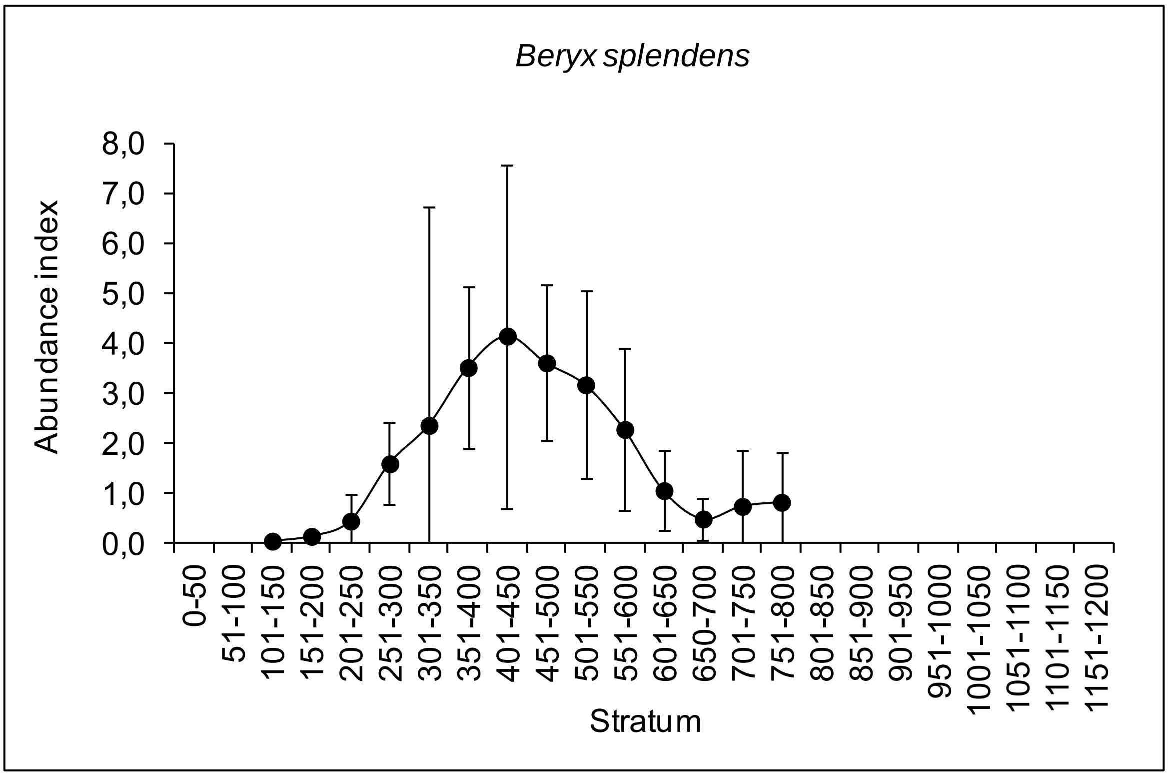


Figure 2.Mean abundance index by depth stratum for the period 1995-2012.



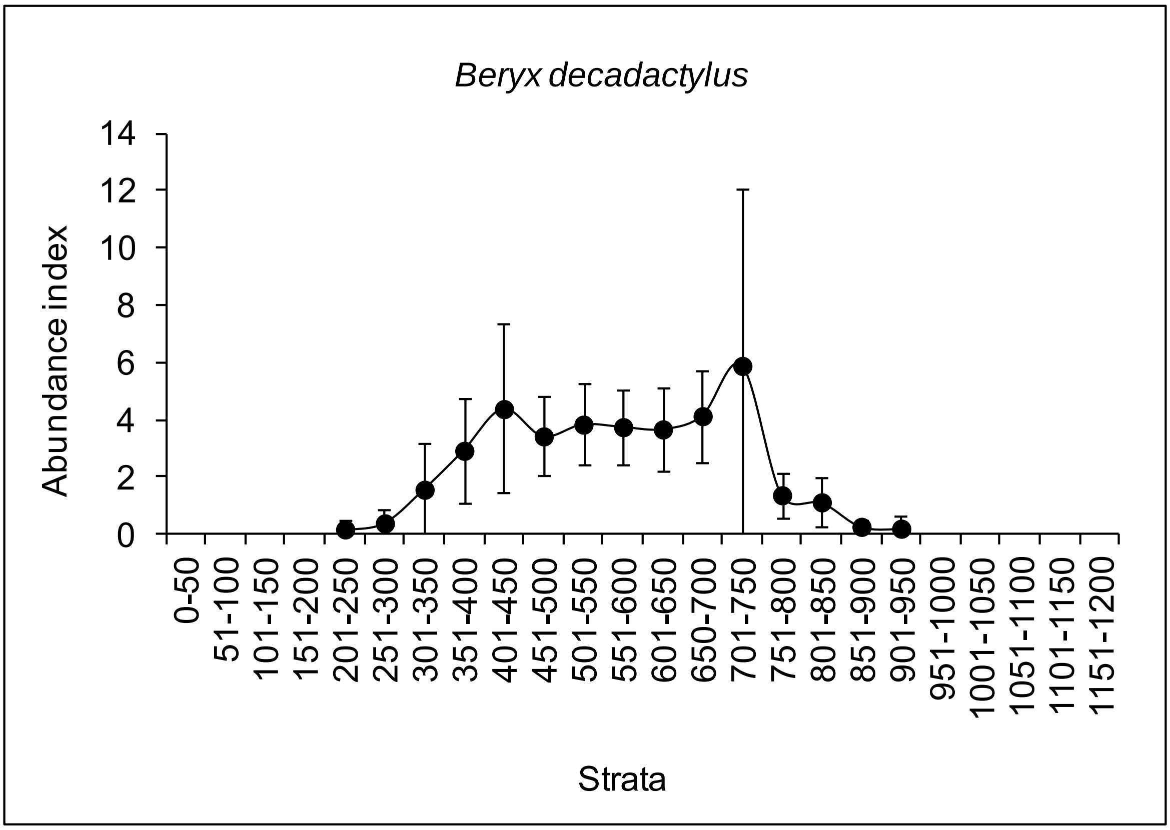
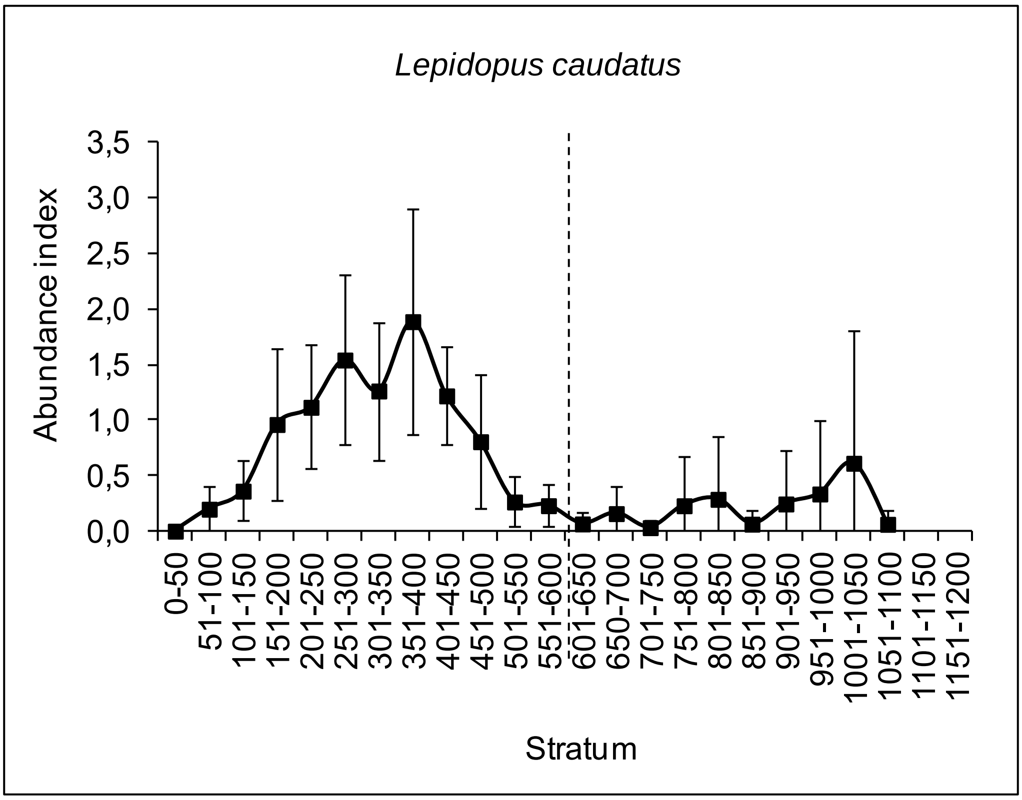


Figure 2 (Cont).Mean abundance index by depth stratum for the period 1995-2012.



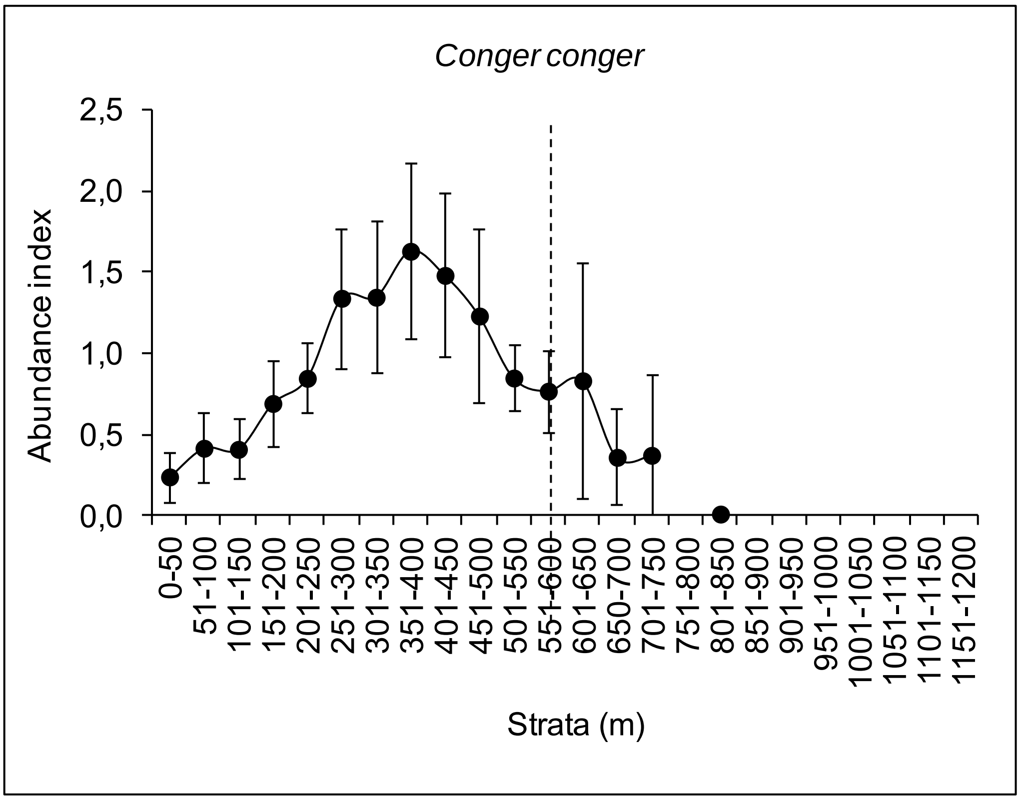
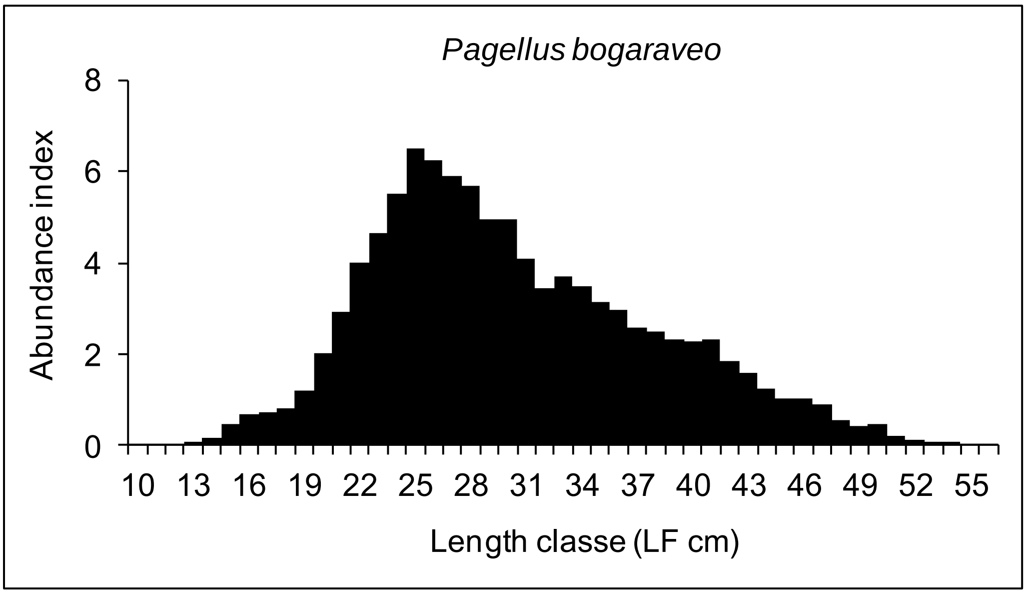


Figure 2 (Cont). ean abundance index by depth stratum for the period 1995-2012.

Length composition



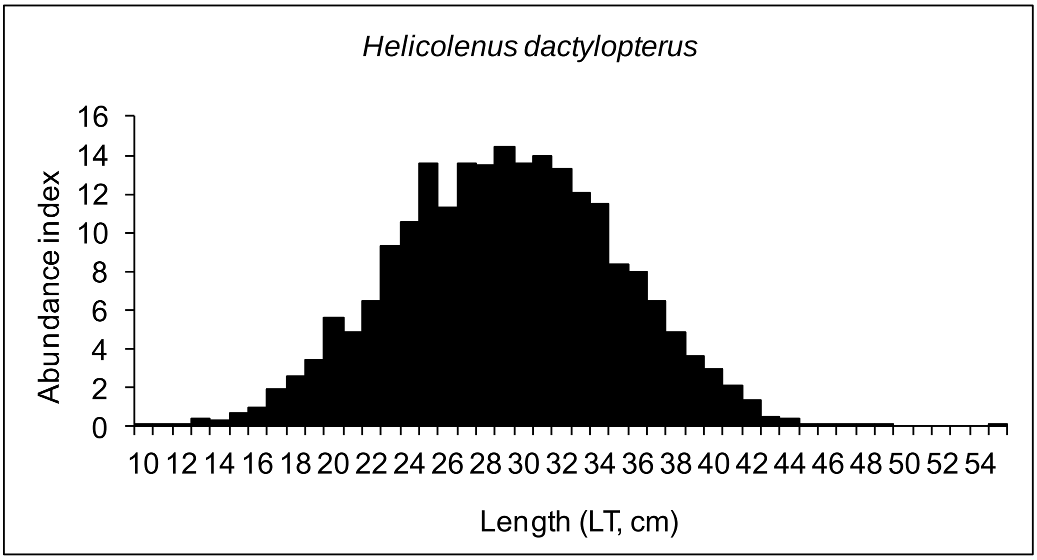
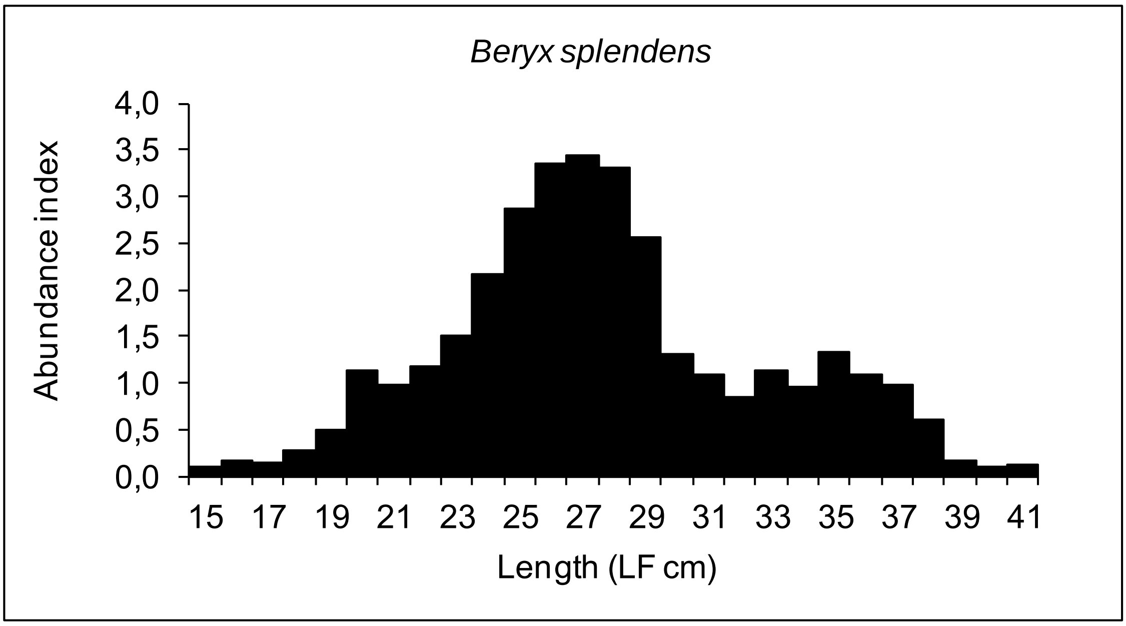


Figure 3. Mean length composition for the period 1995-2012 for some of the Azorean deep-water species.



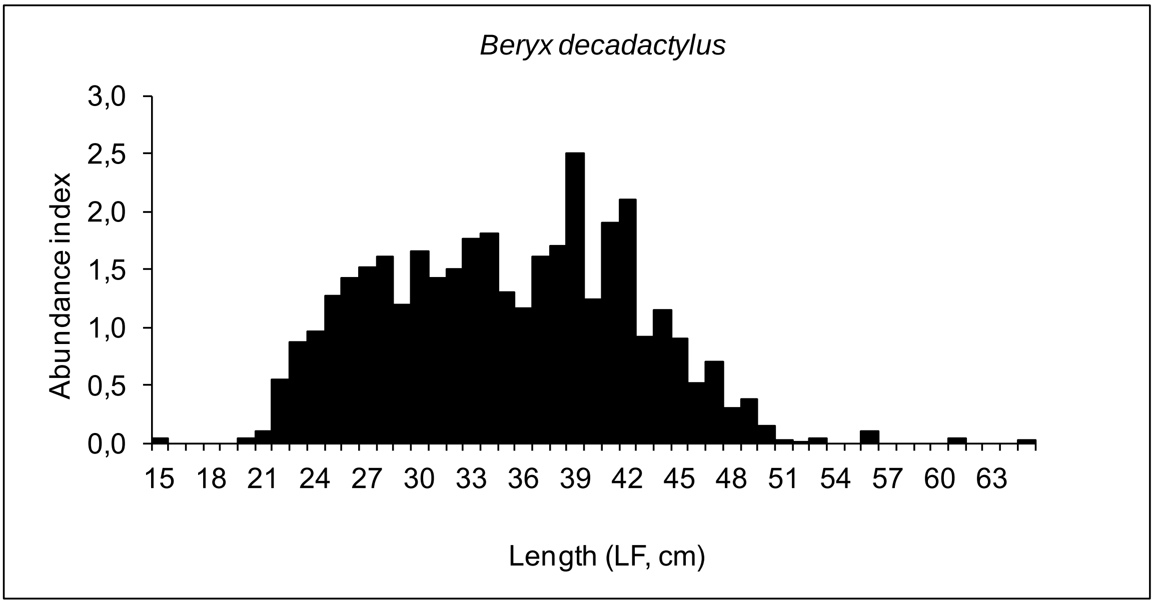
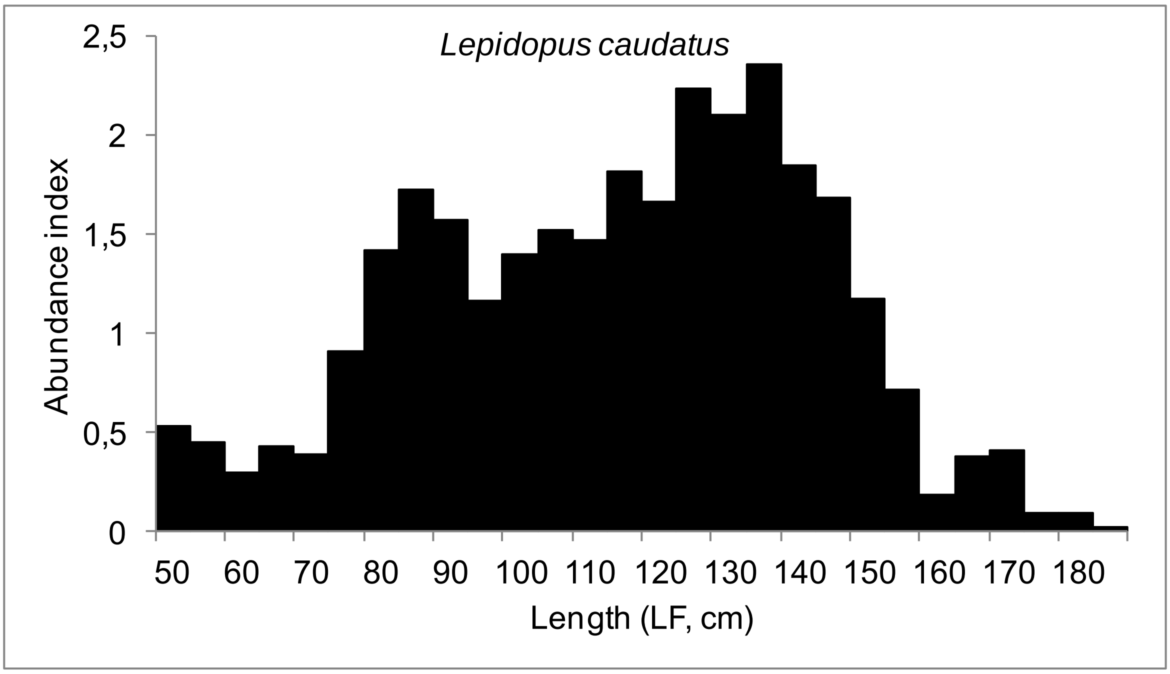


Figure 3 (Cont). Mean length composition for the period 1995-2012 for some of the Azorean deep-water.



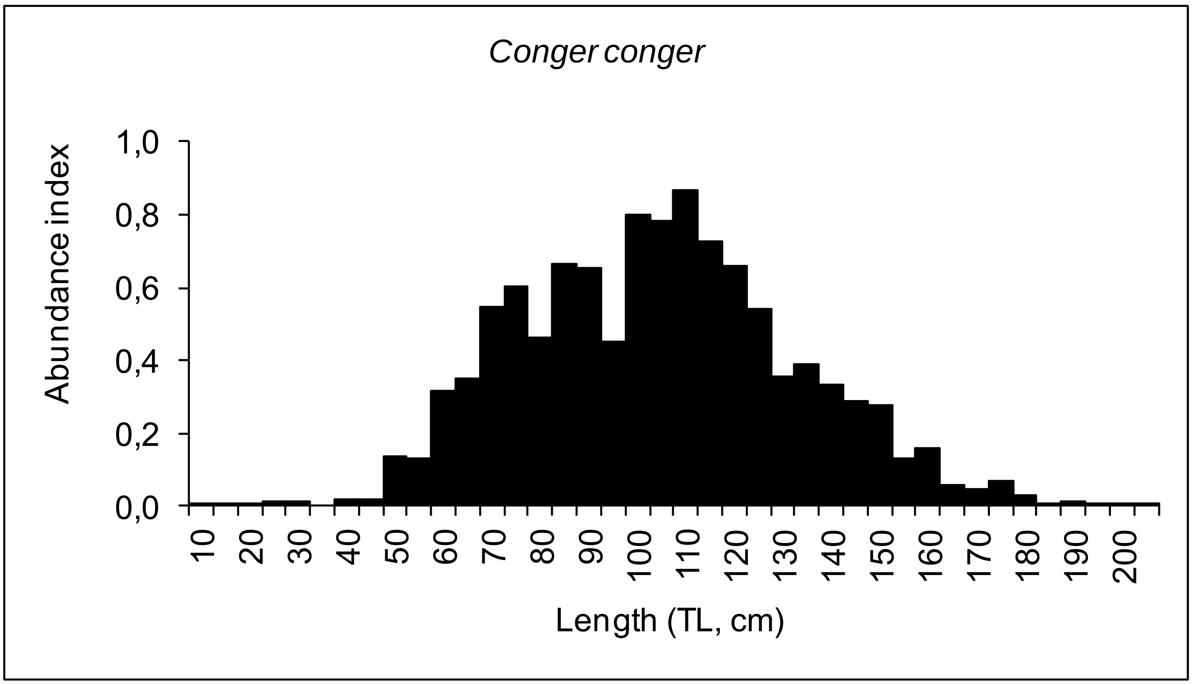
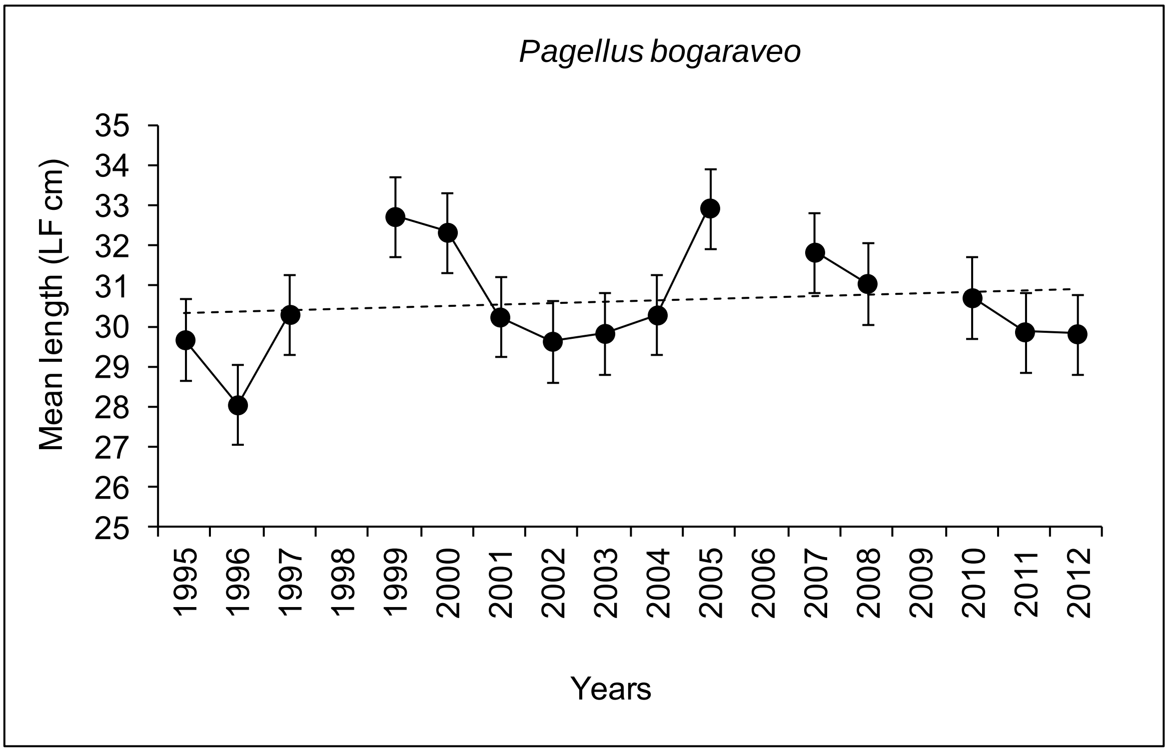


Figure 3 (Cont). Mean length composition for the period 1995-2012 for some of the Azorean deep-water species.

Mean length



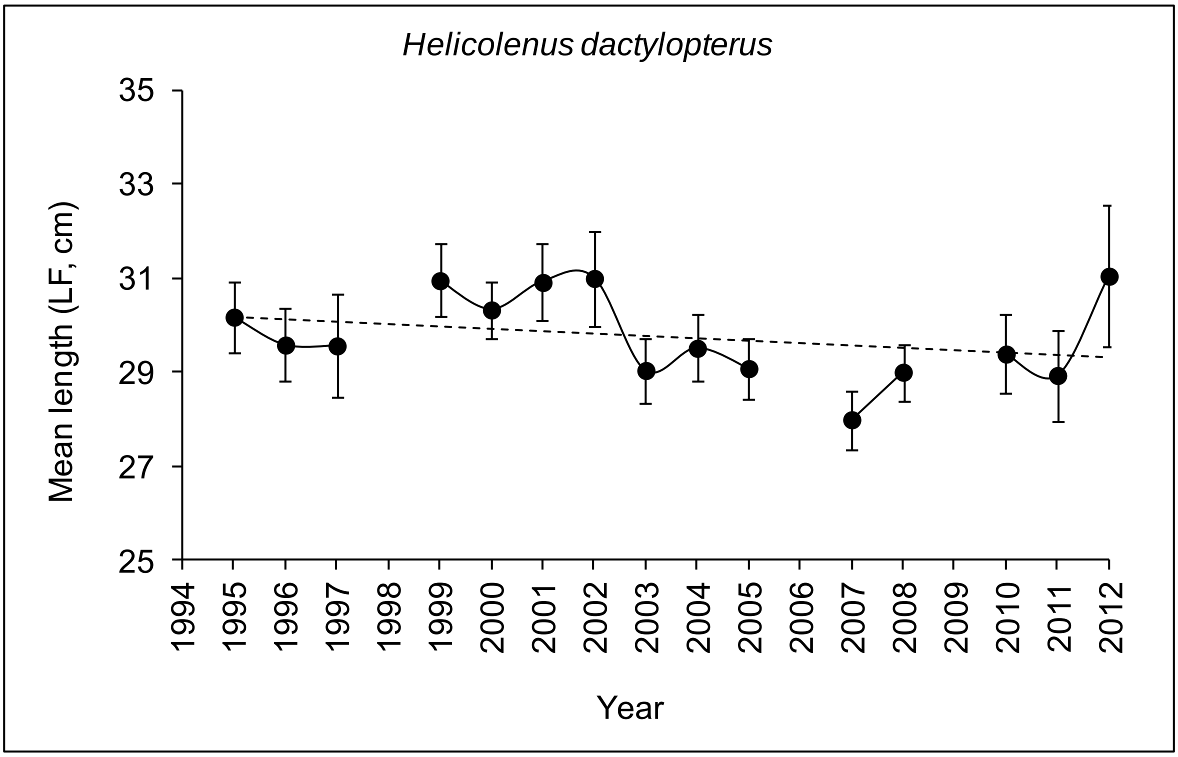
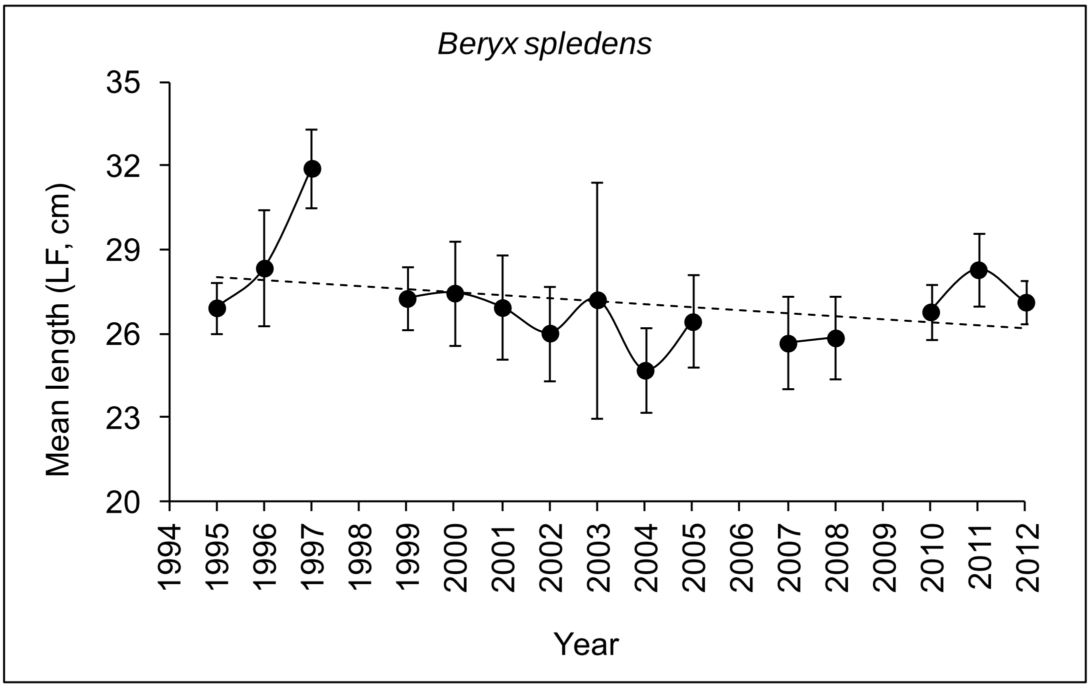


Figure 4. Annual mean length for some deep-water species.



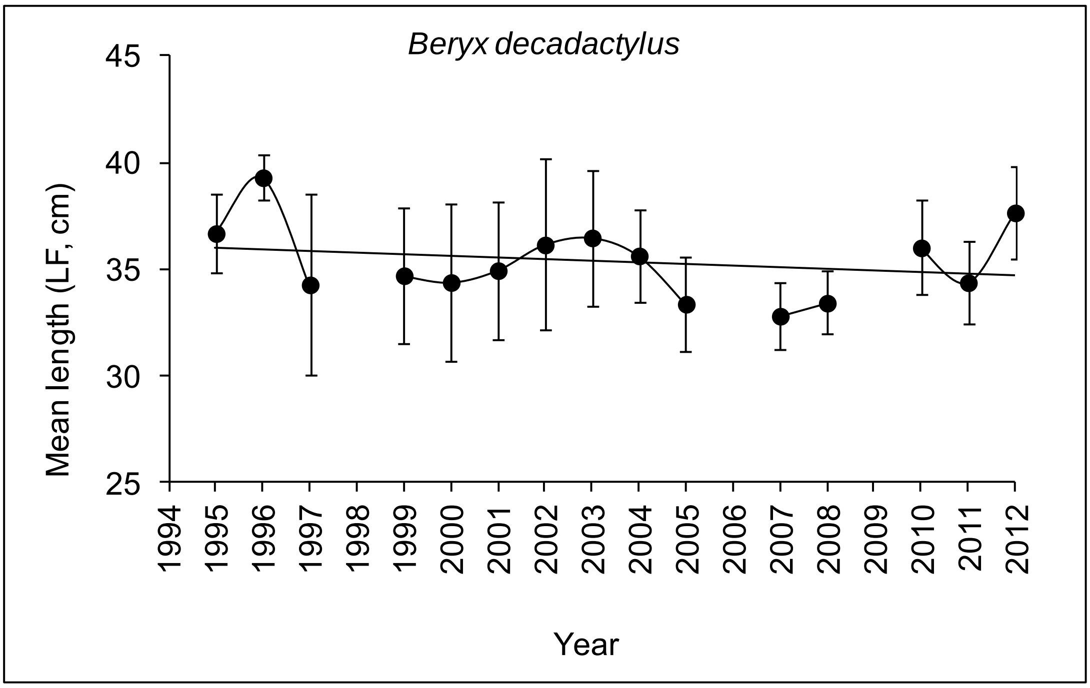
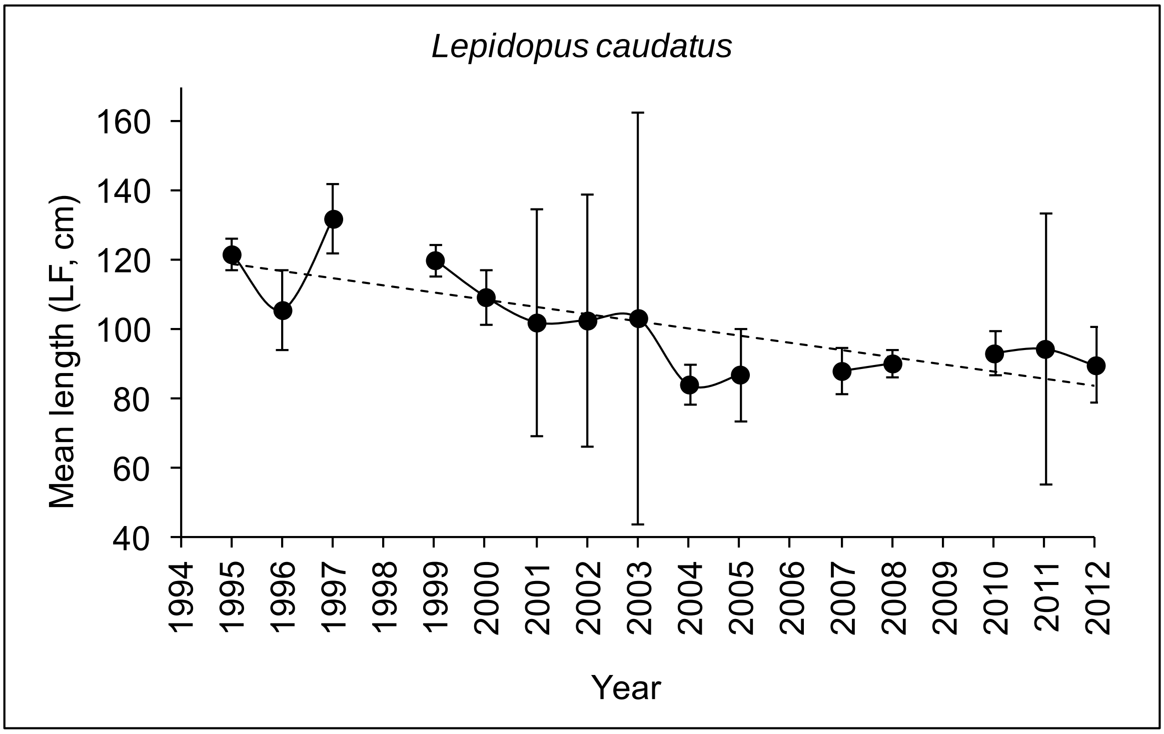


Figure 4 . (Cont) Annual mean length for some deep-water species.



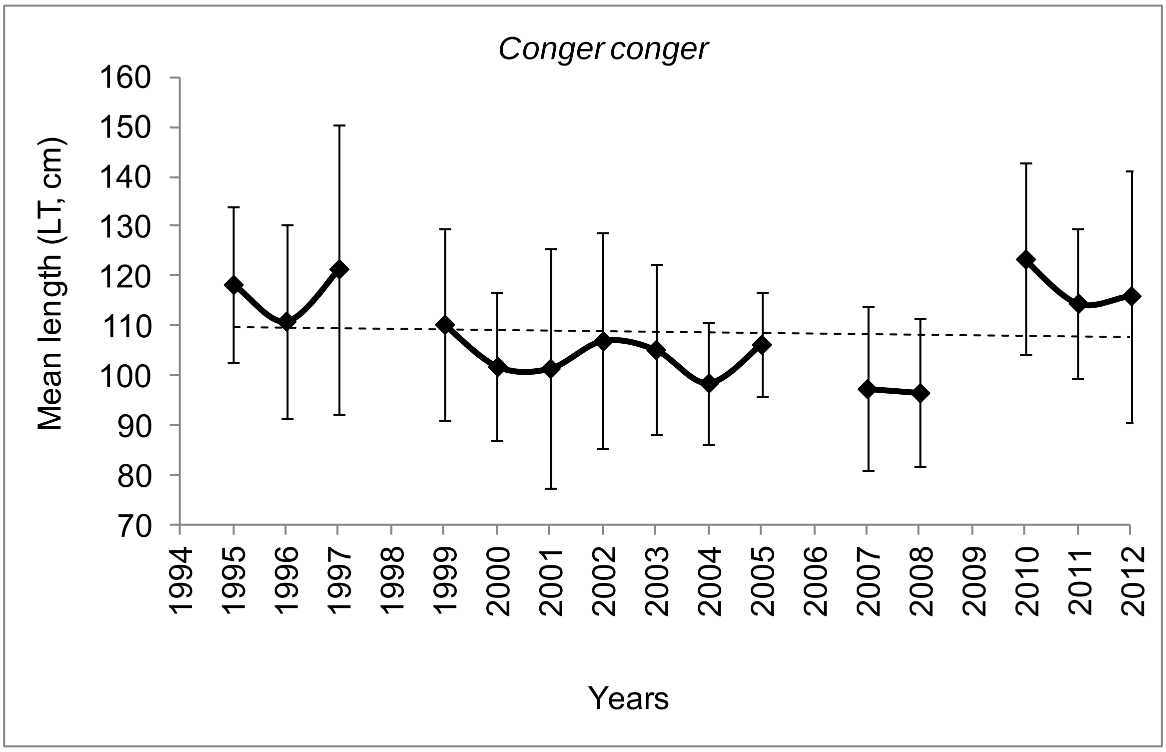
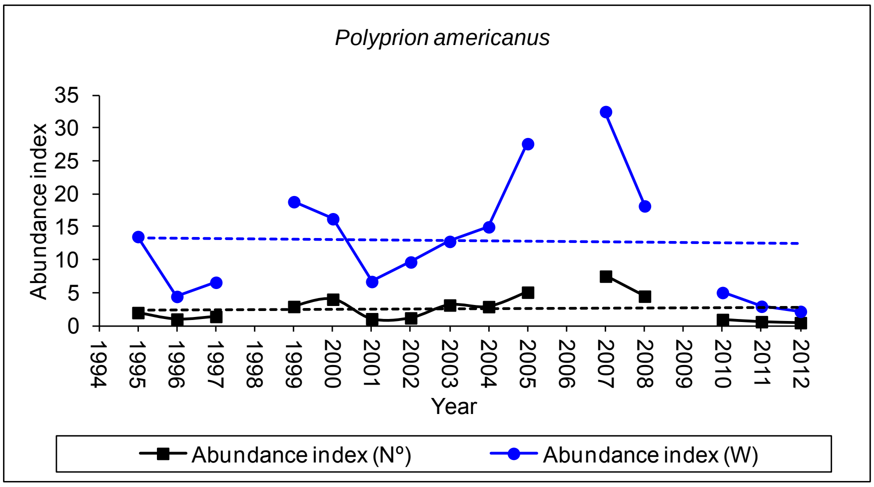
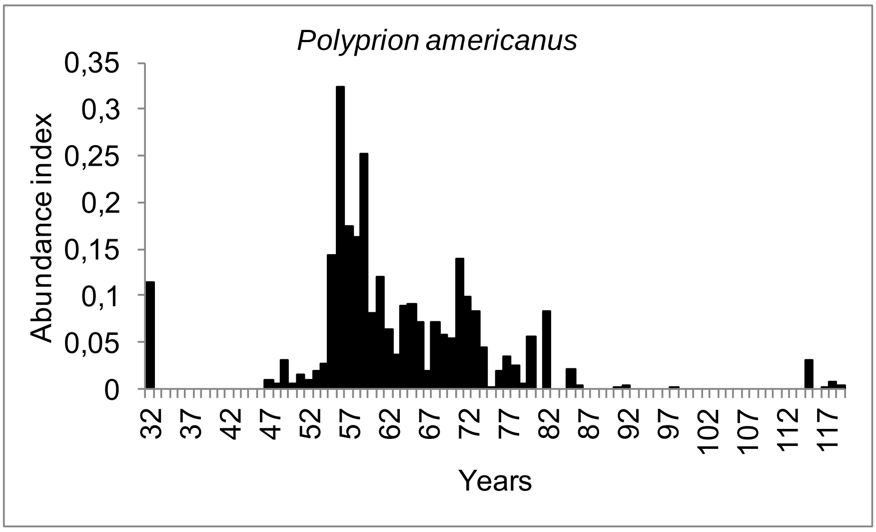


Figure 4 (Cont). Annual mean length for some deep-water species.

Other species





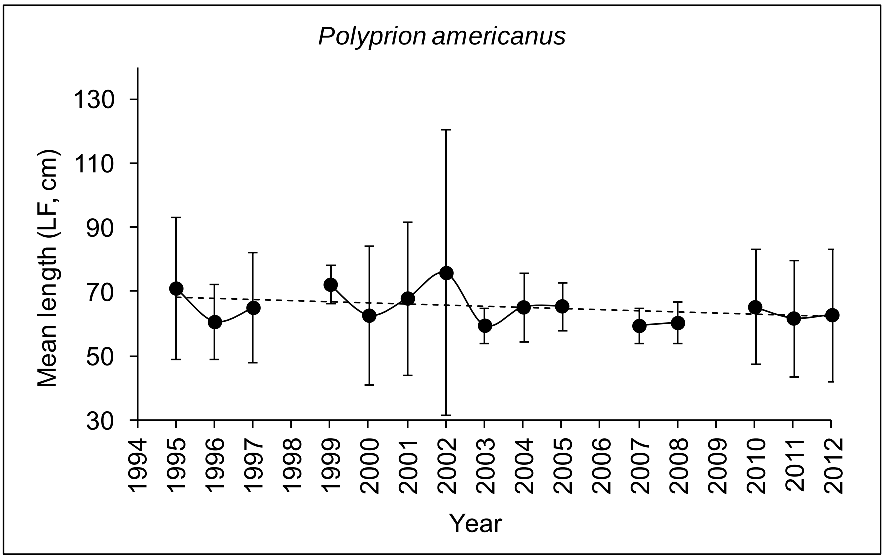
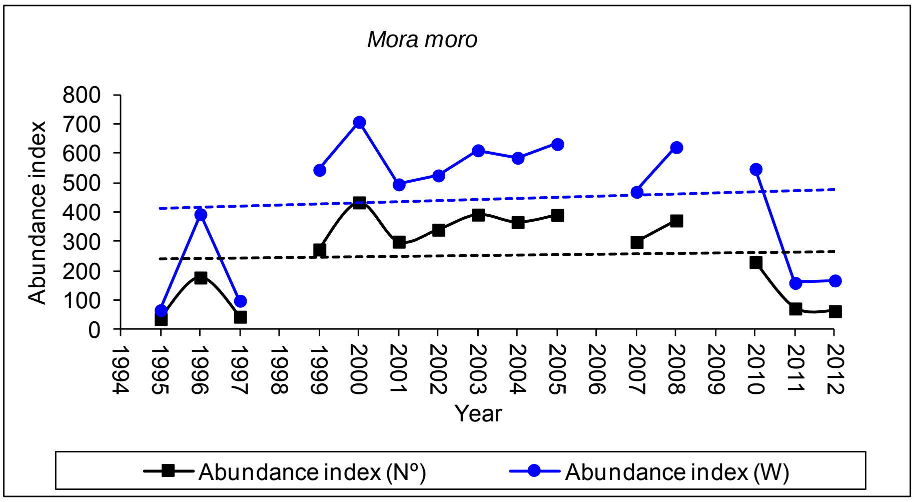
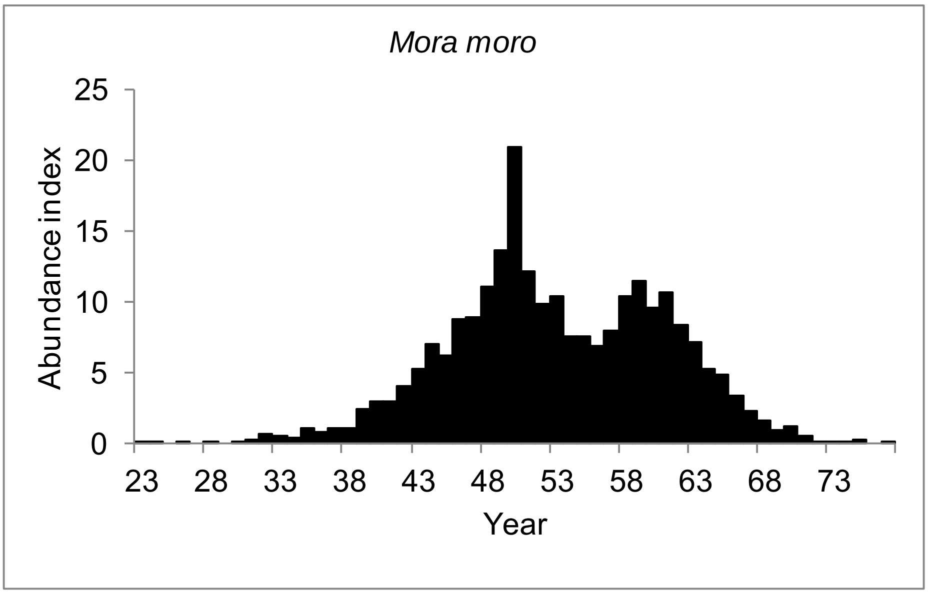


Figure 5 (Cont). Resumed survey information for *Polyprion americanus*.





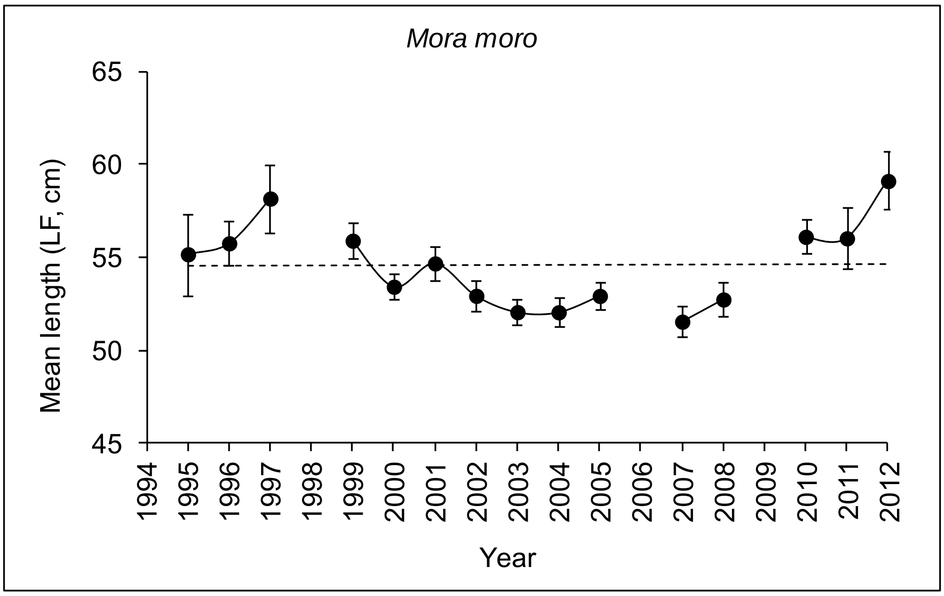
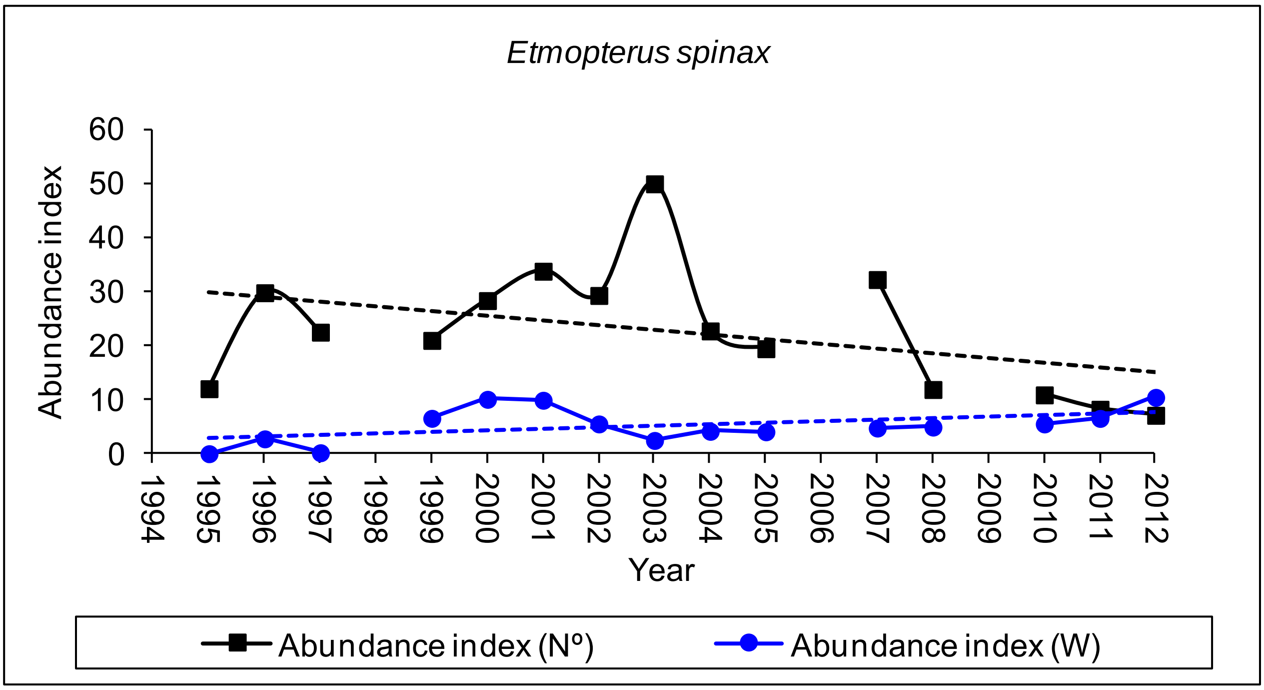


Figure 5 (Cont). Resumed survey information for *Mora moro*.



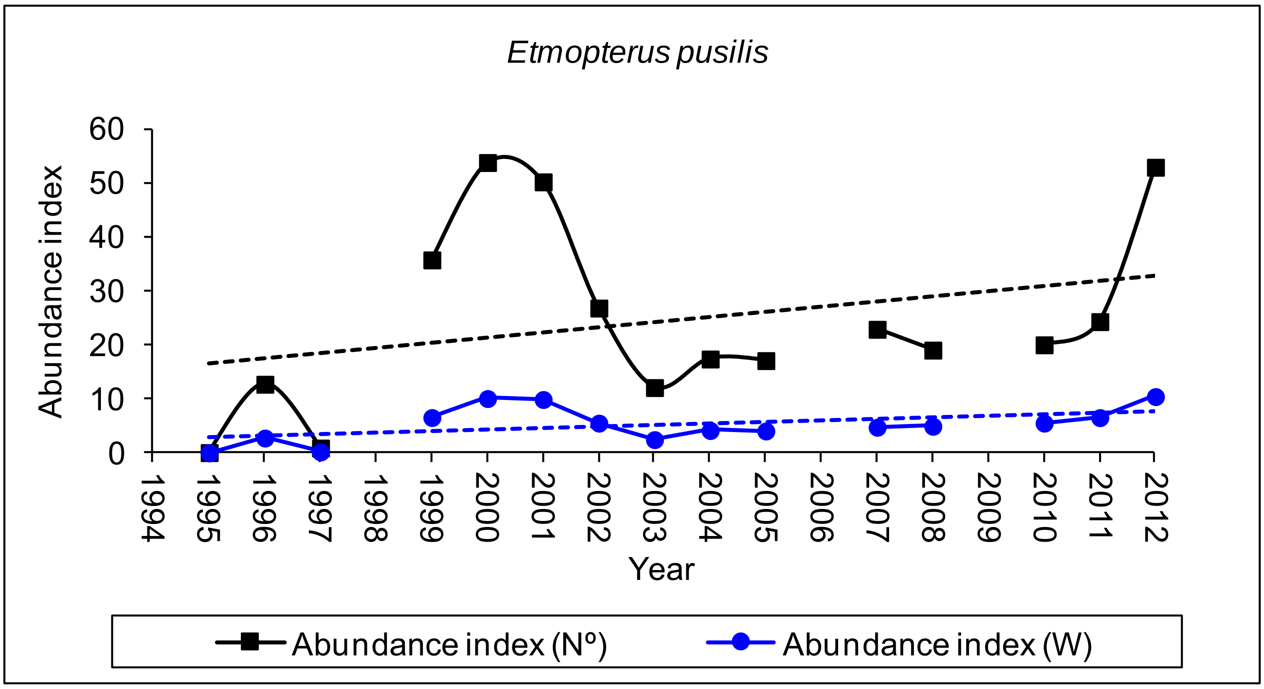
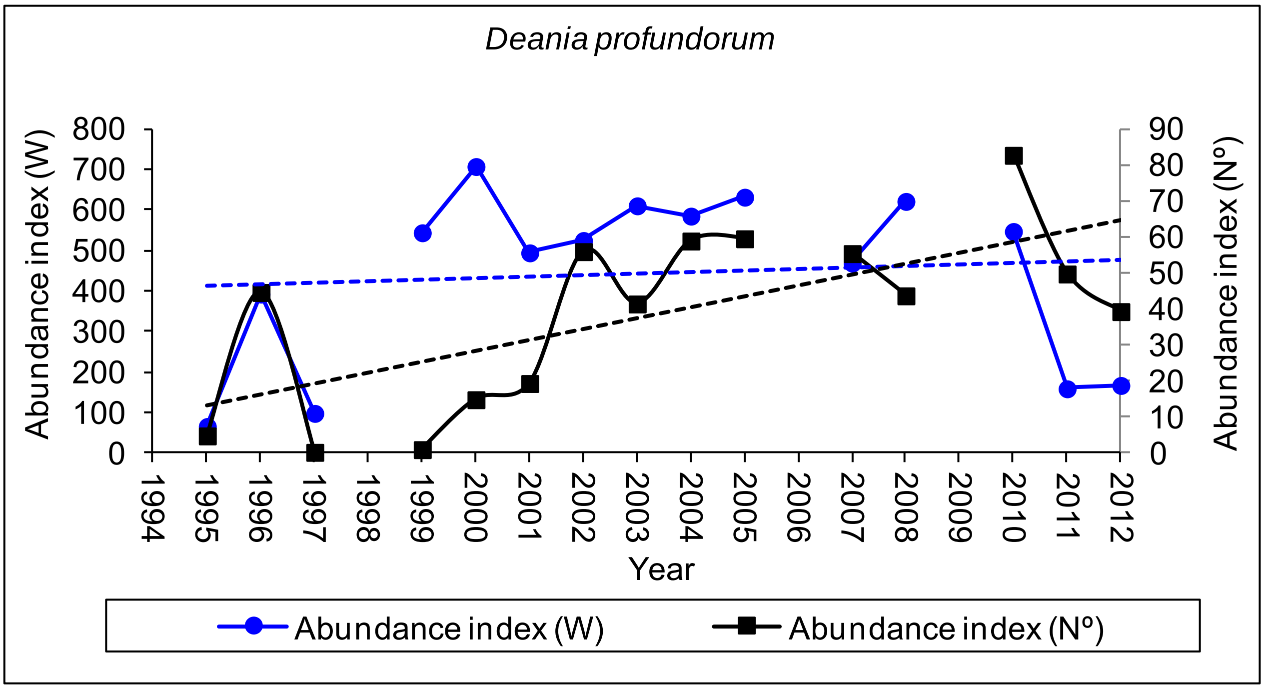


Figure 6. Abundance index, from the Azorean longline survey, for other deep-water species. Linear trends are represented on the graph.



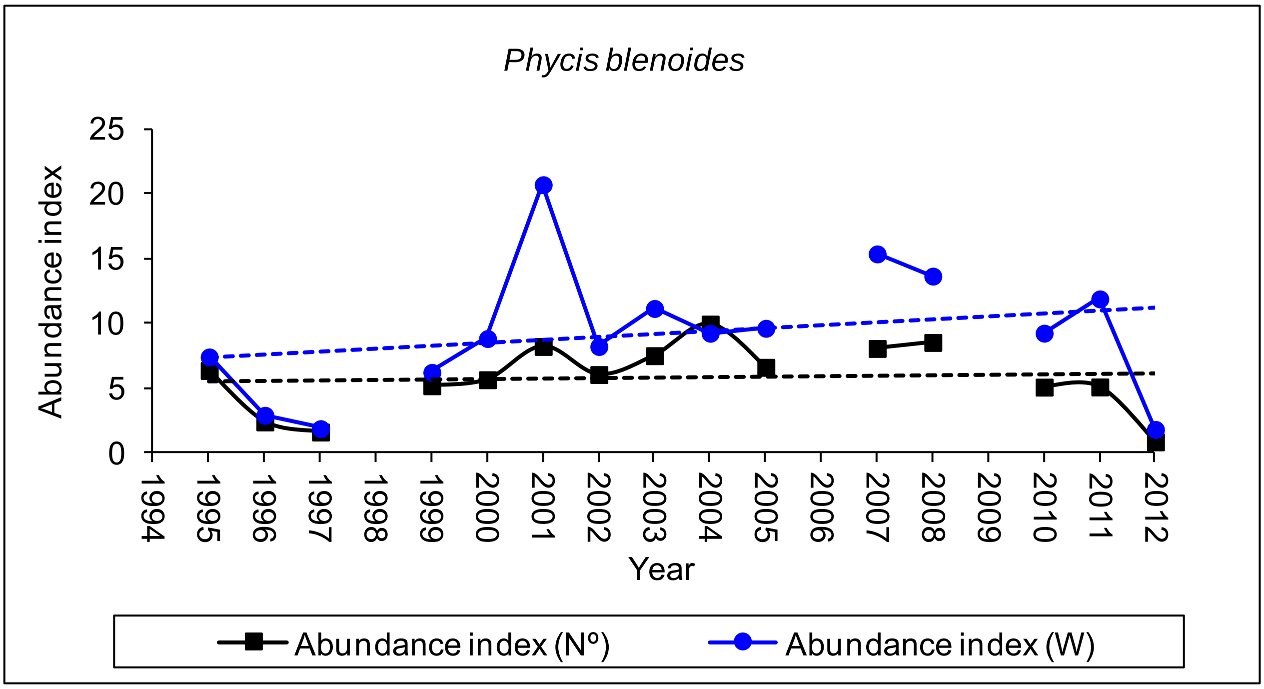


Figure 6. Abundance index, from the Azorean longline survey, for other deep-water species. Linear trends are represented on the graph.

Information about greater silver smelt in Faroese waters (Division Vb)

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(liseo@hav.fo)

Introduction
Greater silver smelt (GSS) in Faroese waters are currently considered to be a component of the GSS stock located in ICES areas I, II, IIIa, IV, Vb, VI, VII, VIII, IX, X, XII, XIV. An update of last year information used in the report is presented in this working document.

1 The fishery
In 2012 three pairs of pair trawlers fished 9744 tons of GSS in Vb and 2801 tons in VIa. The decrease in catch can be because the trawlers also attained in the mackerel fishery. The geographical range of the directed GSS fishery in Faroe Island is in depths below 350 m and the main fishing areas are west of the islands, around the banks and on the ridge south of the islands (Figure 1). The landing presented are the official landings from 1994-2008, thereafter the landings in Vb + VIa are used since the fishery in VIa is inside the Faroese 200 nm EEZ just south of Vb (Figure 2).

Temporal and spatial development of the fishery is described in the stock annex.

2 Landing trends
In the period from 2008 to 2011 the fishery has adopted their own harvest-control rule in the sense that they don't fish more than 20 thousand tons per year. In the WGDEEP 2009 report an exploratory assessment for GSS in Faroese waters is presented, with 20 thousand tons per year set as an upper limit for a sustainable fishery.

4 Management
The management in Vb is described in the stock annex.

An F0.1 corresponding to 24 thousand tons is derived from the assessment of GSS made in August 2011 (Report to the "Norske Veritas"), but FAMRI has recommended a TAC of 18 thousand tons for 2012, since the current assessment may not be stable enough to provide reliable estimates.

5 Data available
5.1 Landing data from Faroese vessels are provided by the Faroese Coastal Guard and the data for 2012 is preliminary.

5.2 The majority of the landed GSS in Faroese waters is still between 30 and 45 cm in length, with a mean length varying from 36 to 39 cm during the last 12 years. The length distribution from the catches is presented in Figure 3 and for the surveys in Figure 4 and Figure 5. The mean length in the groundfish surveys varied from 26 to 33 cm in the spring and 26 to 29 cm in the summer. 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 37.4 and 39.5 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 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 from the surveys into juvenile and mature individuals, and then calculate the mean length. This is done here, and there seems to be no decrease of the mean length in the period 1994-2011 (Figure 6).

5.3 The age of landed fish ranged between 4 and 14 years old fish. The age distribution, numbers of individuals available for calculation of ALK, as well as mean age of GSS from the landings in Vb is presented in Figure 7. The mean age in the landings decreased from 13 years in 1994 to 10 years in 2001 and has since then fluctuated between 9-12 years. The increase in mean age the last three years could be due to new and deeper fishing areas.

5.4 Weight at age
There are no clear changes observed in the mean weight at age from commercial catches over the period of time (Figure 8).

5.5 The proportion mature used in the assessment are based on the maturity ogive presented at the WKDEEP-2010. 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.

5.6 Catch and effort data of GSS in Faroese waters are available from the commercial fishery of 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 9). 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 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 less than 300 m (Figure 10).

6 Data analyses

CPUE

A GLM-treated version of the commercial CPUE series showed a decrease from about 3000 kg/hour in 2009 to about 2200 kg/hour in 2010 and has been that level in the last three years was observed. Mean CPUE from 1998 to 2011 is about 2100 kg/hour.

The CPUEs for the groundfish surveys were somewhat noisy with no obvious trend over time.

References

ICES WKDEEP report 2010 (page 133-198)

ICES WGDEEP report 2010

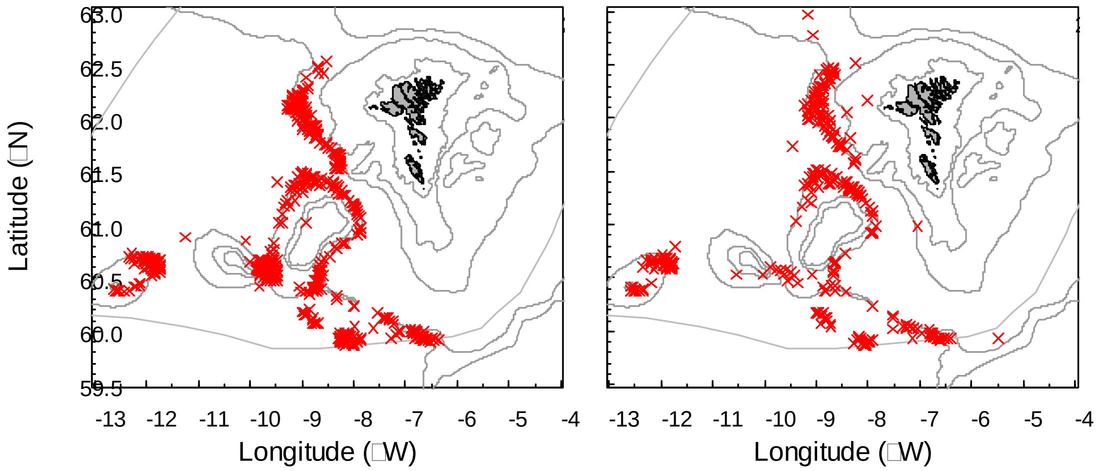

Figure 1. GSS Vb. Distribution of the GSS trawl hauls in 2010-2011 (catch more than 50% GSS of the total catch).

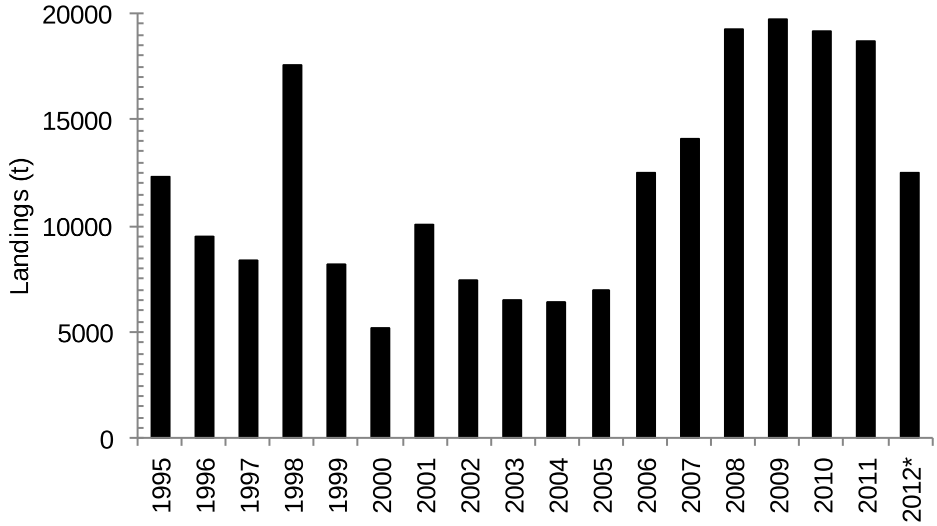

Figure 2. GSS Vb. Landings of GSS from Faroese trawlers. The catch is higher than the reported ICES catch in Vb for 2008-2011 because the catch caught in VIa is added to the total catch in Vb (fished just south of the Vb ICES boarder but inside the Faroese 200 EEZ boarder).

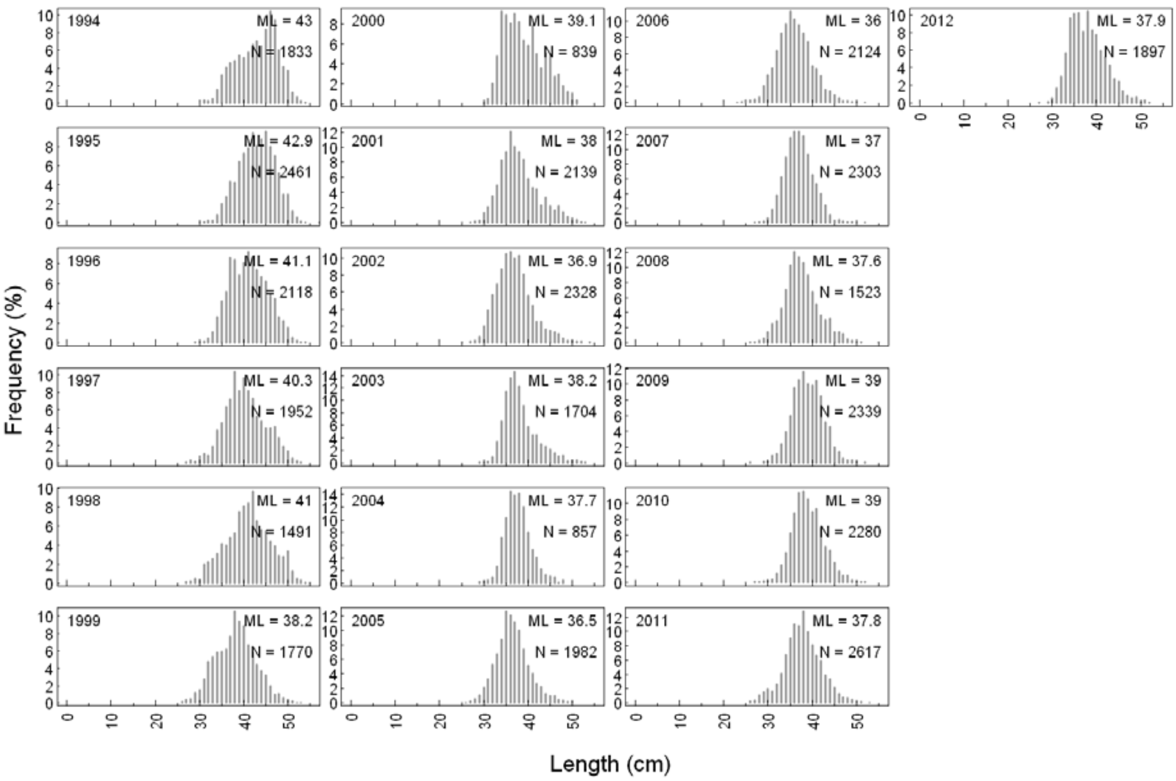

Figure 3. GSS Vb. Length distribution from the commercial trawl landings with mean length (ML) and number of measurements (N).

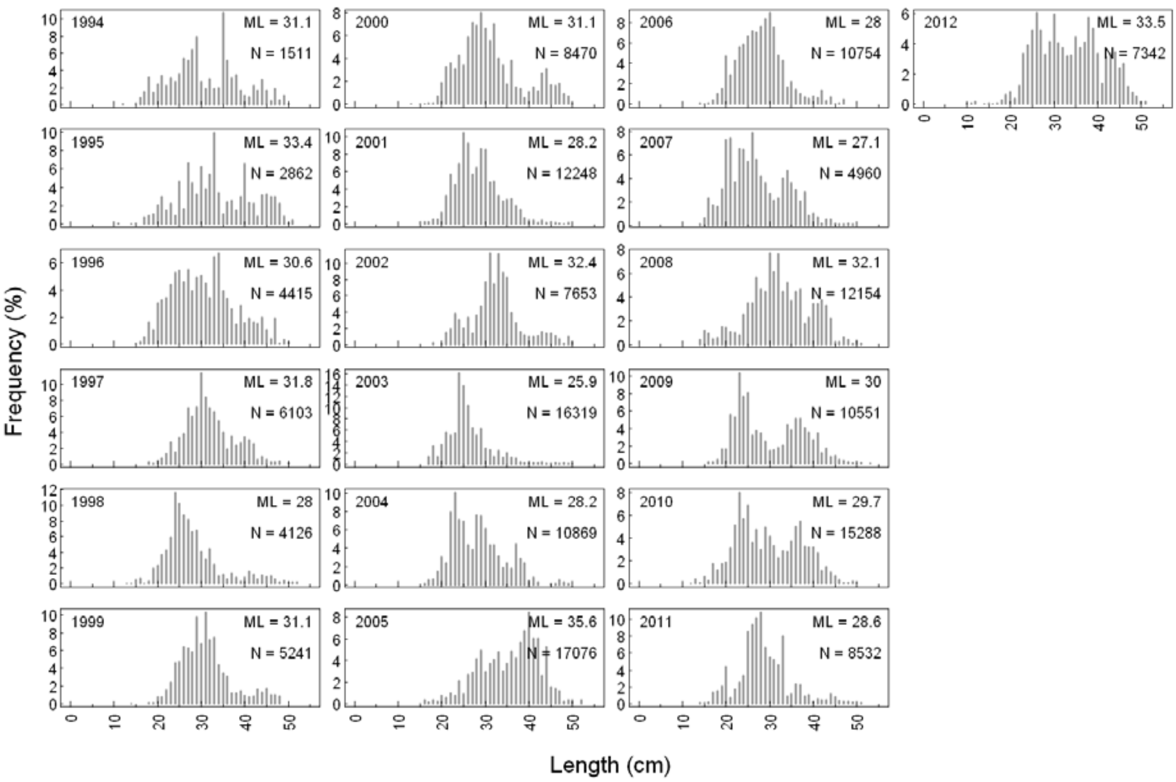

Figure 4. GSS Vb. Length distribution from the spring survey with mean length (ML) and number of calculated length measures (N). GSS is sampled from a subsample of the total catch, so the values are multiplied to total catch.

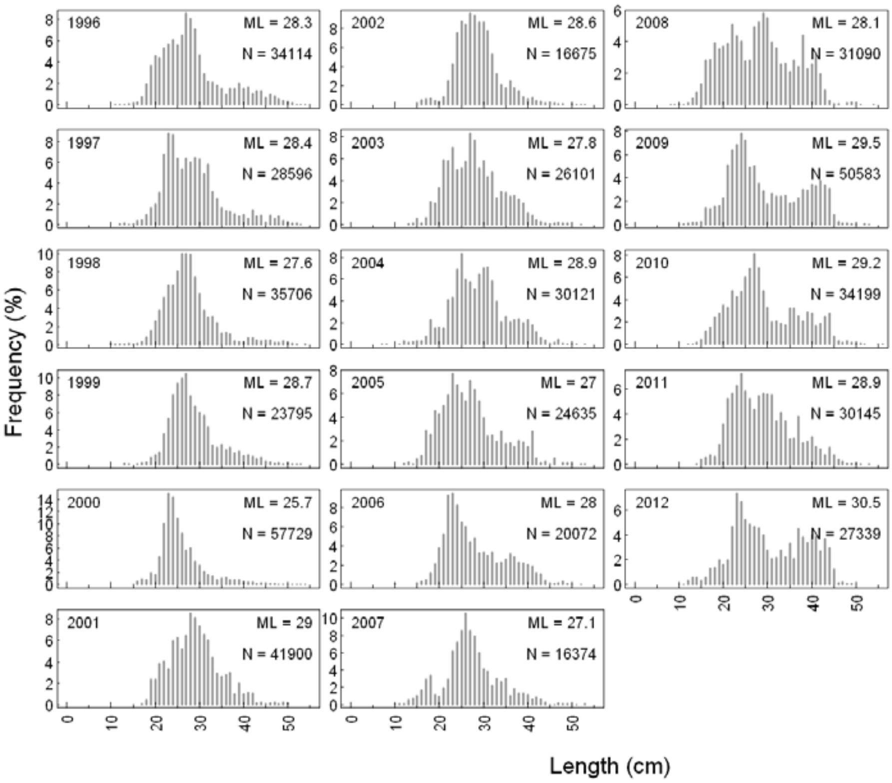

Figure 5. GSS Vb. Length distribution from summer survey with mean length (ML) and number of calculated length measures (N). GSS is sampled from a subsample of the total catch, so the values are multiplied to total catch.

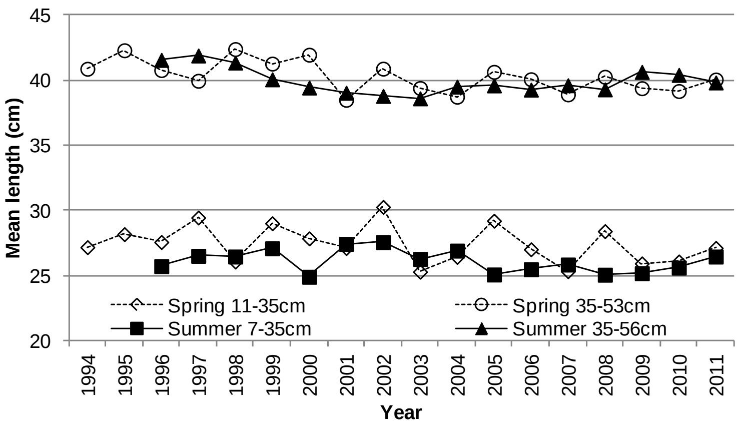

Figure 6. GSS Vb. Mean length for juvenile (<35cm) and mature (>34.9cm) GSS from the groundfish surveys.

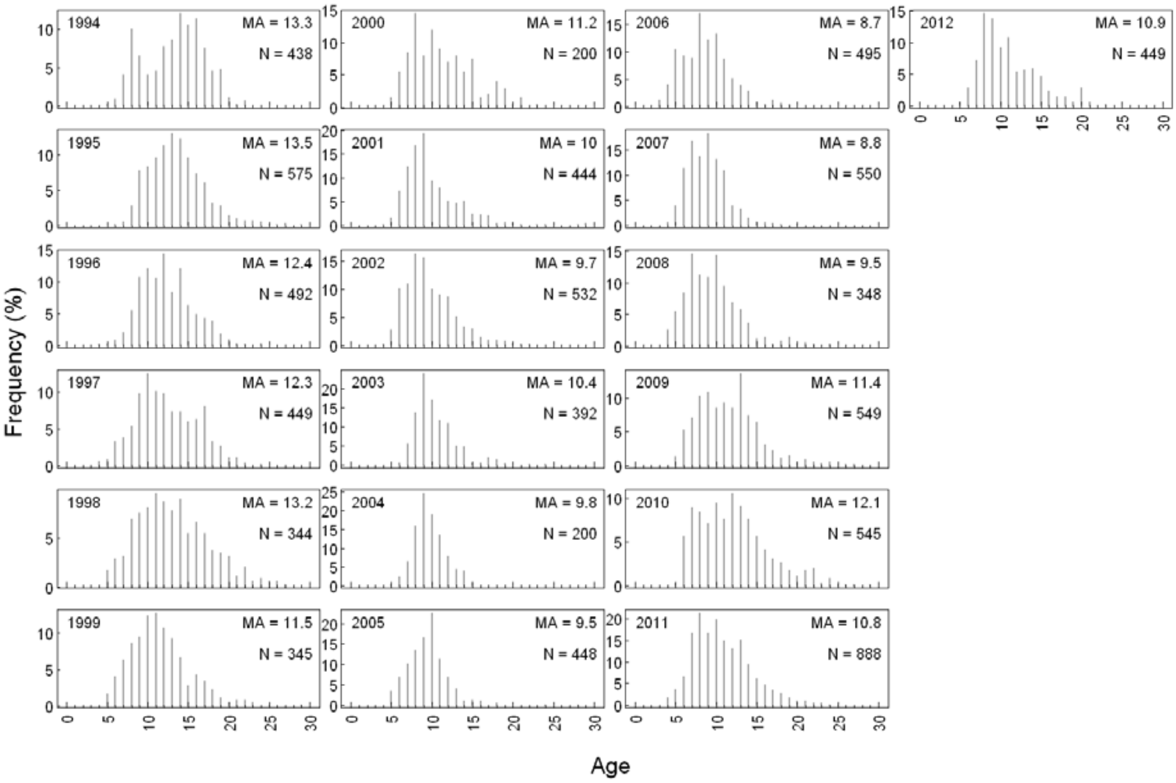

Figure 7. GSS Vb. Age distribution from commercial pair trawlers with mean age (MA) and number aged (N).

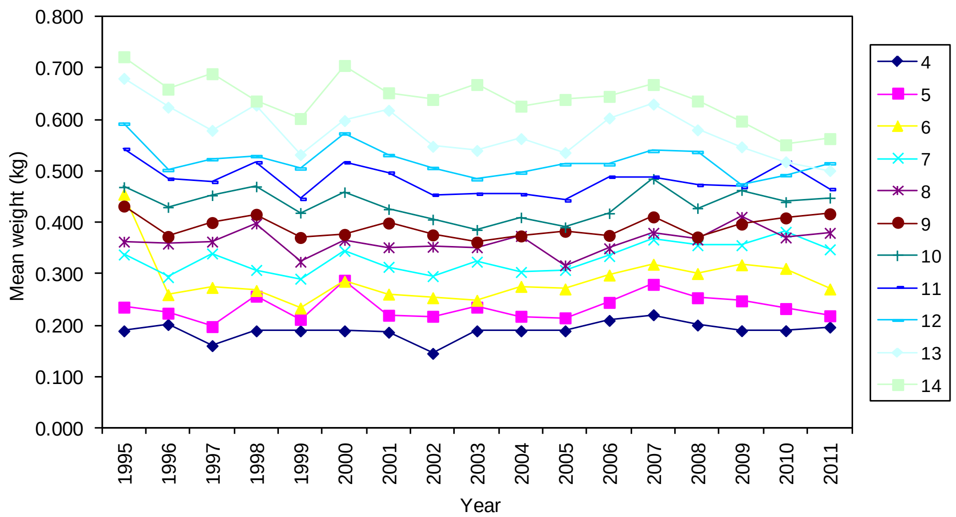

Figure 8. GSS Vb. Mean weight at age of GSS in the commercial catch.

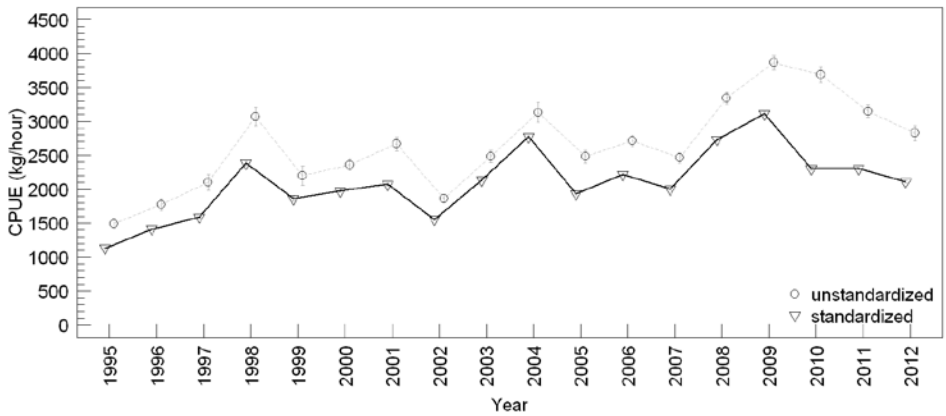

Figure 9. GSS Vb. Standardized CPUE from pair trawlers fishing greater silver smelt where catch of GSS is more than 50% of total catch in each haul. The vertical arrows present standard error.

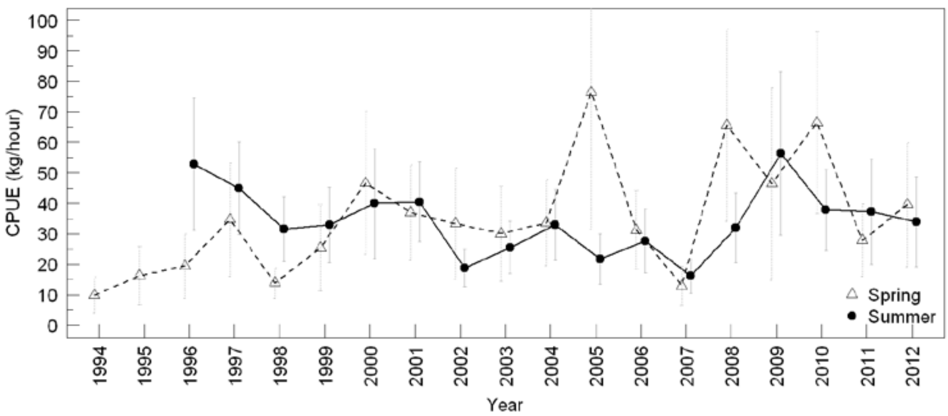

Figure 10. GSS Vb. Standardized CPUE from Faroese groundfish surveys. The vertical arrows present standard error.

WD ICES WGDEEP, Copenhagen 2013
(Work in progress)

Estimating a standardized CPUE series and its precision for ling based on a superpopulation model

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Introduction

A CPUE series for ling for the years 1971 to 1993 declined significantly over this period, which was assumed to reflect a steep decline in ling abundance. Based on this series, ling was classified as Near Threatened and placed on the Norwegian Red List in 2006, which caused difficulties for the marketing of ling. To determine whether ling was indeed threatened, the Institute of Marine Research (IMR), in cooperation with the Norwegian Directorate of Fisheries (NDF), implemented a project in 2003 to record in an electronic format the logbooks for 2000 and onwards of longliner vessels that were larger than 21 m. Vessels were selected that had a total landed catch of ling, tusk and blue ling that exceeded 8 tons in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day.

Based on these logbook data, we constructed a CPUE series for ling for the years 2000 through 2009. This logbook-based series indicated that the abundance of ling has been fairly stable and hence there was no compelling evidence that the abundance of ling was declining. Based on this analysis, ling was removed from the Norwegian Red List in 2010. The series before 2000 was based on a very low number of private logbooks and did not take into account major changes such as the change from hand baited lines to automatically baited lines, while the series after 2000 has also been criticized for not being sufficiently standardized,

A project whose goal is to develop a standardized CPUE series for ling and tusk was started in January, 2012. The project is a cooperation between the IMR, Møreforking marin in Ålesund and Runde Environmental Centre. The project was initiated because both fishermen and the ICES working group WGDEEP expressed a need to develop methods to more accurately track the abundance of these stocks. The CPUE series that has been used until now is based on logbooks from a large proportion of the longliner fleet larger than 21 m, but this series has not been adjusted for changes in the fishery, technological changes, etc.

In this note we assess several methods for calculating a CPUE series for ling, including a series based on fishers' intuition of when ling was the target catch and one based on the characteristics of the data. In particular, it is concluded that the precision was overestimated for the ling CPUE series developed for the years 2000 through 2009, and that t precision is most suitably measured based on a superpopulation model, which more accurately reflects vessel to vessel variability. Finally, all the CPUE series for ling constructed were fairly stable, which may be an indication that the abundance of ling has also been rather stable since 2000.

Materials and methods

Information about the fleet and its fishery

The Norwegian Directorate of Fisheries provided data on the landings, the number of fishing vessels engaged in the fishery, the vessel sizes, the gears employed the areas fished, and changes notified in vessel ownership for the period 2000 to 2012. The Directorate also provided the paper logbook records for approximately 60-70% of longliners in the fleet that were longer than 21 m and had a total landings of ling (*Molva molva*), tusk (*Brosme brosme*), and blue ling (*Molva dipterygia*) greater than 8 tonnes in a given year. Since 2011 all vessels had to send in electronic logbooks and in 2012 we now have logbooks for the entire longline fleet. These data include the total daily catch, where the vessel was fishing, and the number of hooks used each day.

Technological changes

The gear technology employed and the history of the ling longline fishery are described in a number of papers, books and project reports (Bjordal, 1983; 1987; 1988; Bjordal, and Løkkeborg, 1996; Magnusson et al., 1997; Poulsen et al.; 2007). A description of the technological changes from 1977 to 2012 is given in Hareide and Helle 2012(WD). Information on changes in days fished, areas fished, number of hooks set per day and other changes are given in Helle and Pennington (2013).

Detailed information on recent developments in gear technology; including changes in hook type and size; and other technological changes, such as the introduction of a new baiting machine were provided by Mustad and Fiskevegn, two of the main producers of fishing equipment for the Norwegian longline fleet.

Information on bait was provided by Kjell Oldeide (Bait Producer Domstein AS in Måløy). To obtain indepth and detailed information about the changes in the longline fishery; ship owners, skippers and fishermen were also interviewed.

An overview of the main changes from 1970 until 2012 is in Figure 1, which indicates that the main changes in the fishery occurred before 2000. The largest change from 2000 to 2012 is the increase in the number of hooks set per day, this due to larger vessels and new and improved baiting machines. From 2000 to 2012 the average number of hooks set per day has increased from 28 000 to 35 000.

The number of hooks set by each vessel when ling were caught varied considerably from vessel to vessel, but it does not appear that average catch of ling per 1000 hooks varied significantly with the number of hooks set. In particular the catch rate increased more or less linearly with increasing numbers of hooks: that is on average, doubling the number of hooks doubled the catch (Figure 2). The scatter is rather marked for individual catches (Figure 2, top pane), but the spread is greatly reduced when the average catch for vessels that set the same number of hooks 15 times or more is plotted against the number of hooks set (Figure 2 lower pane). Therefore, it was decided that no nonlinear adjustment is needed for the number of hooks set for estimating a CPUE series for ling. No other changes or variability in the longline fishery over the years appeared to affect noticeably the catchability of the fleet.

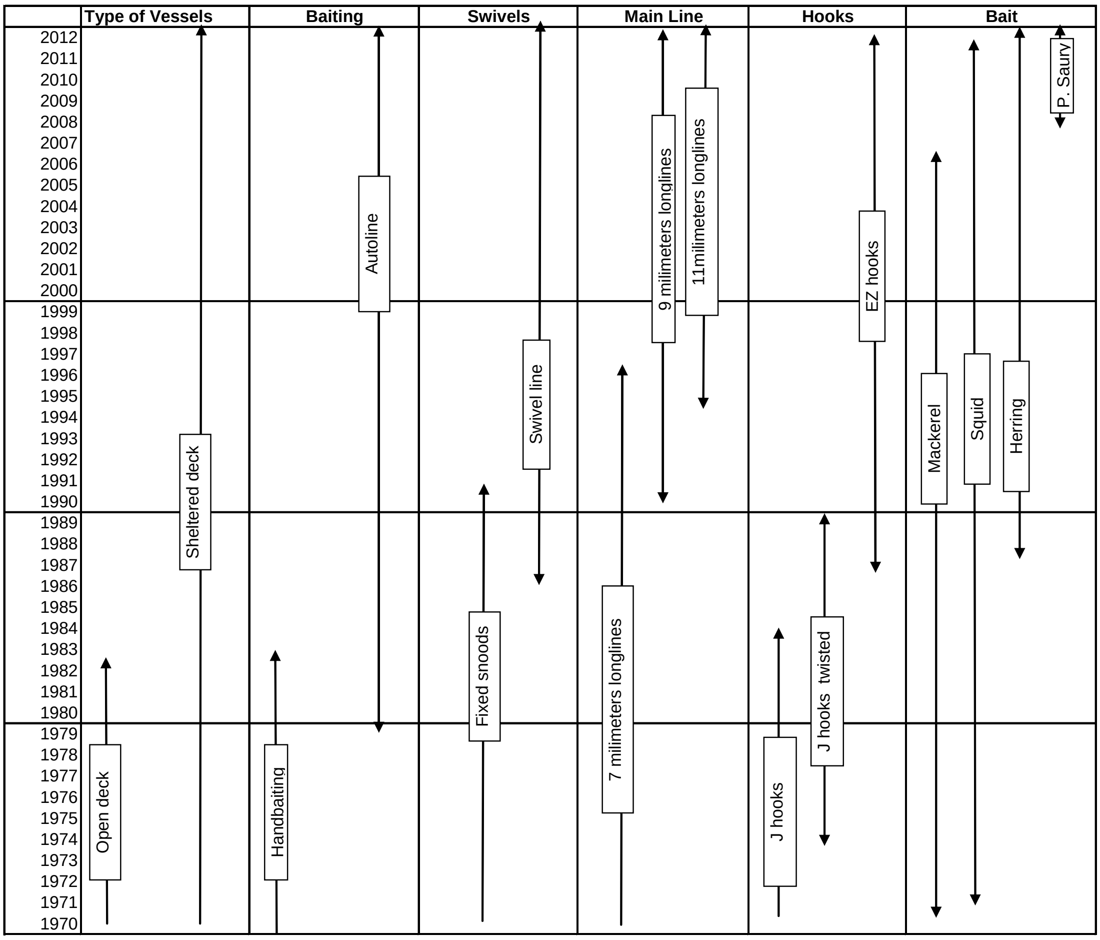

Figure 1. Timeline showing the main technological changes in the longline fleet.

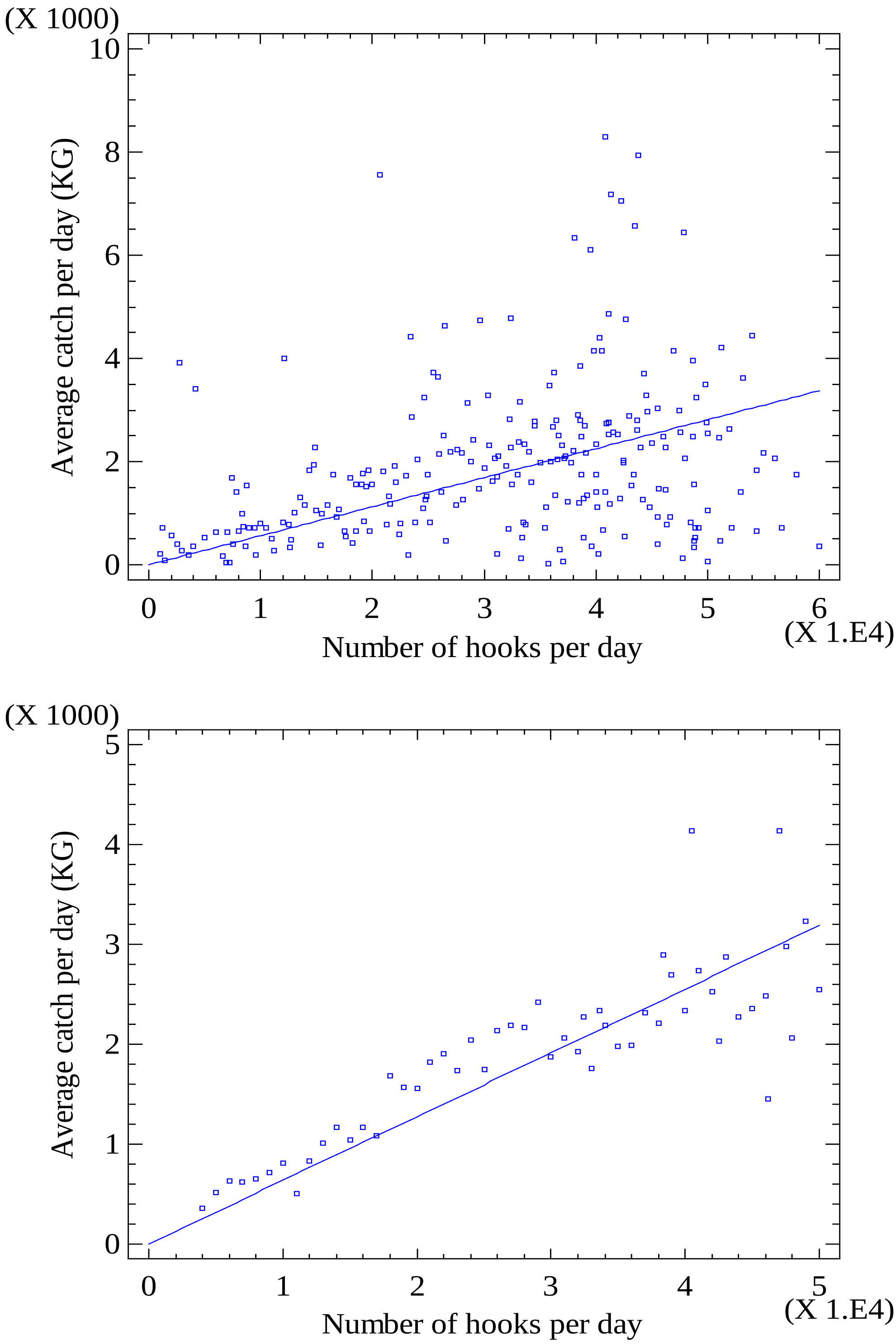

Figure 2. The average catch of ling per day by vessels setting the same number of hooks versus the number of hooks set. The plot in the top pane is based on all data combined for the period from 2000 through 2012: for all catches, and for the cases when there were more than 15 catches by vessels using the same number of hooks (bottom pane).

Calculating CPUE series based on assumed targeted catches

Some methods used to calculate CPUE series for ling were presented to representatives of the Norwegian longline fleet who were invited to comment on the methods. A criticism of one of the series, which was based on all catches containing ling, was that all catches were included whether or not ling were targeted. Unfortunately, until 2011 the logbooks did not record the target species. Different solutions were examined, and the fishers felt strongly that the CPUE series should be based only on those daily catches for which ling made up more than 30% (in weight) of the total catch.

Therefore two CPUE series were constructed, one based on all the catches that contained ling, and one based on the scenario suggested by the fishers; catch data used is restricted to catches containing 30% or more ling.

The CPUE series were calculated in two ways as follows. Let y_i and m_i denote the total catch and total number of hooks set, respectively, during the fishing season by boat *i*, then the first estimator;

$$\hat{\mu}_w = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} m_i} = \frac{\bar{y}}{\bar{m}}, \qquad (1)$$

where *n* is the number of boats that provided logbooks. For this estimator, the CPUE for each year and scenario is the average catch in kg per hook. The estimator $\hat{\mu}_w$ is a weighted average: that is the more hooks a boat sets, the more influence the boat has on the overall estimate of the average catch per hook.

The second method used to construct a CPUE index is an unweighted estimator;

$$\hat{\mu}_{uw} = \frac{\sum_{i=1}^{n} y_i / m_i}{n}, \qquad (2)$$

which gives each boat equal weight no matter how many hooks a vessel set. Since both *y* and *m* are random variables, the estimator $\hat{\mu}_w$ is a ratio-type estimator and its standard error can be estimated by;

$$s.e.(\hat{\mu}_w) = \frac{\sqrt{1-f}}{\sqrt{n}\bar{m}} \sqrt{\frac{\sum_{i=1}^{n} (y_i - \hat{\mu}_w m_i)^2}{n-1}}, \qquad (3)$$

where if *N* denotes the total number of boats in the fleet, then $f = n/N$, which is the finite population correction factor (Cochran 1977).

Since $\hat{\mu}_{uw}$ is simply the average catch per hook by each boat (the primary sampling unit), the estimate of its standard error is

$$s.e.(\hat{\mu}_{uw}) = \sqrt{\frac{(1-f)\sum_{i=1}^{n} (y_i / m_i - \hat{\mu}_{uw})^2}{n(n-1)}}. \qquad (4)$$

More details on both estimators; their properties and their relative variances are in Aanes and Pennington (2003).

There are two problems with calculating a CPUE series in this manner: first, it is rather arbitrary to include all catches or to select catches that are "targeted" based only on fishers' intuition; and second it is implicitly assumed that if data for all the vessels were available, then the variance of the estimated CPUE (equation 3) would be zero. In other words, if the true CPUE (i.e. based on a census) for a fleet were know, then it would be proportional to the actual population.

Calculating a CPUE series based on data characteristics

As noted, not all the longliners' have ling as their primary target species. Rather than select individual catches that are deemed to have targeted ling, we have selected longline vessels that appear to have often targeted ling in a particular year. In Figure 3 are graphs of the average catch of ling per day versus the number of days a vessel caught ling. For vessels that caught ling between 1 and a 100 days during a year, the average catch per vessel was significantly correlated (Pr = 0.00) with the number of days the vessel caught ling (Figure 3, upper pane), while there was no significant correlation (Pr =0.47) for vessels that caught ling on more than 100 days (Figure 3, lower pane).

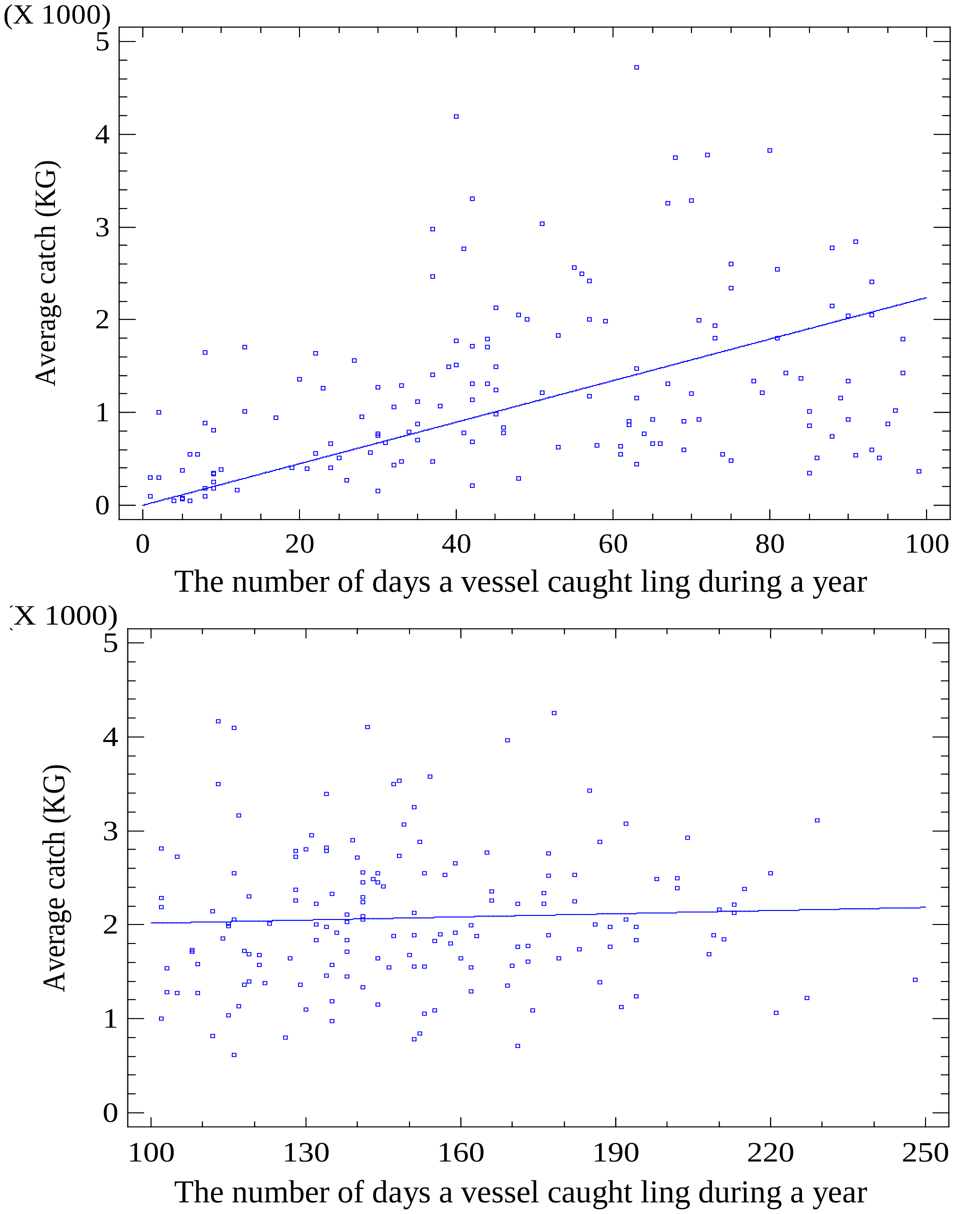

Figure 3. The average catch of ling per day by a vessel versus the number of days the vessel caught ling: for vessels that caught ling on less than 100 days (upper pane) and for those that caught ling on a hundred or more days. The data are all years combined.

Since if vessels were actually "surveying" the same segment of the ling population, then the average daily catch per vessel should not increase with "sample size" (i.e. days fished). Based on this analogy, it was decided to estimate a CPUE series for ling based only on vessels that caught ling on 100 or more days during a year (Table 1) and since the vessels generally did not "survey" the same regions, it was decided that the unweighted estimator (Equation 2) was most likely the appropriate estimator.

The average catch per hook varied considerably from vessel to vessel. For example, the variability among vessels in area IIa accounted for 11% of the total variance in 2012 (Fig. 4). Therefore, because of this relatively large vessel to vessel variability, it may be more realistic to regard the actual vessels providing data as a random sample from a conceptual "superpopulation" of longline vessels (for details on basing an analysis on a superpopulation see, e.g., Cochran, 1977; Dorfman and Valliant, 2005; Williams et al, 2011). The major difference in this model-based approach is that the finite population correction factor is no longer relevant, and therefore f *is* set to zero in Equations (3 and 4).

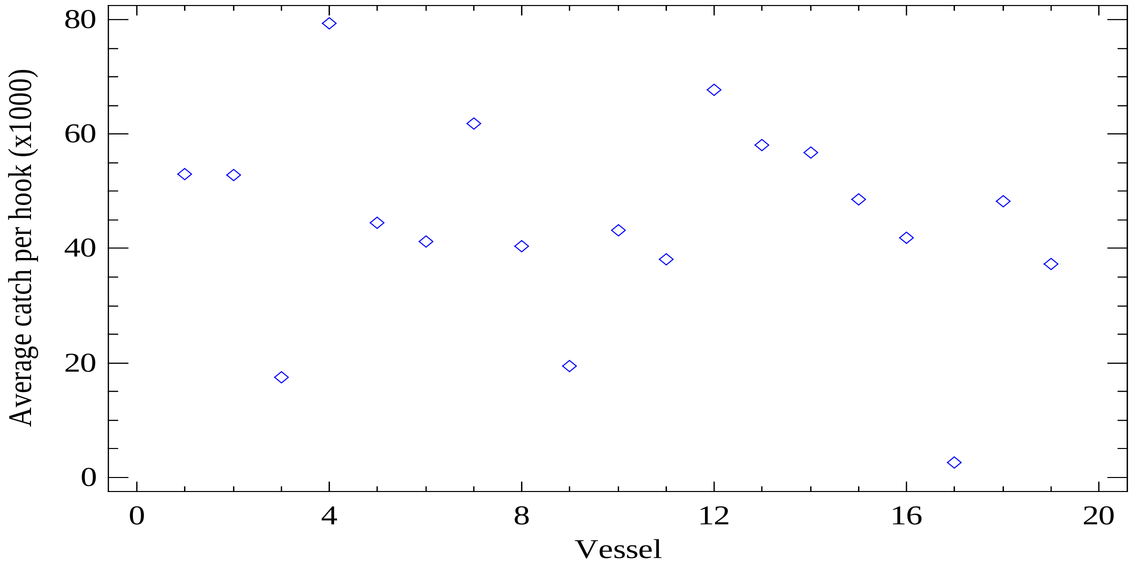

Figure 4. The average catch (per hook × 1000) of ling in 2012 by each vessel in ICES area IIa. The vessels are listed in no particular order.

Table 1. Summary statistics for the Norwegian longline fleet.

Year	Total number of longliners	Longliners that provided logbooks	Vessels that caught ling in a 100 or more fishing days.	Total number of catches	No. of catches by vessels with more than 100 fishing days per year	No. of catches when ling made up more than 30% of the catches
2000	72	35	11	2764	1682	1573
2001	65	35	13	3227	2118	1627
2002	58	29	12	2789	1864	1486
2003	52	27	11	2350	1639	1513
2004	43	22	12	2247	1768	1640
2005	39	17	11	2011	1744	1696
2006	35	17	12	2199	1889	1421
2007	38	21	15	2720	2327	1632
2008	36	18	13	2108	1969	1417
2009	34	10	10	1805	1357	924
2010	35	5	1	357	110	134
2011	37	35	20	3819	2993	1627
2012	36	36	19	3452	2677	1757

Results

The estimated CPUE series for ling based on vessels that caught ling on 100 or more days during a year were generated using Equation (2), which is an unweighted estimator, are shown in Figure 5. The estimates of the standard errors were calculated using Equation (3) with $f = 0$. The weighted CPUE estimates (Equation 1) were similar to the unweighted series and are therefore not shown.

In Figure 6 are the CPUE series for ling where all data are used vs. that were estimated (using Equation 3) based on only those catches where ling made up more than 30% (in weight) of the total catch. The estimated standard errors (Equation 3) included the finite population correction factor.

In Figure 7 are the new CPUE series vs. the old series where all data were used.
All series (Figures 5, 6 and 7) appear to show the same trend.

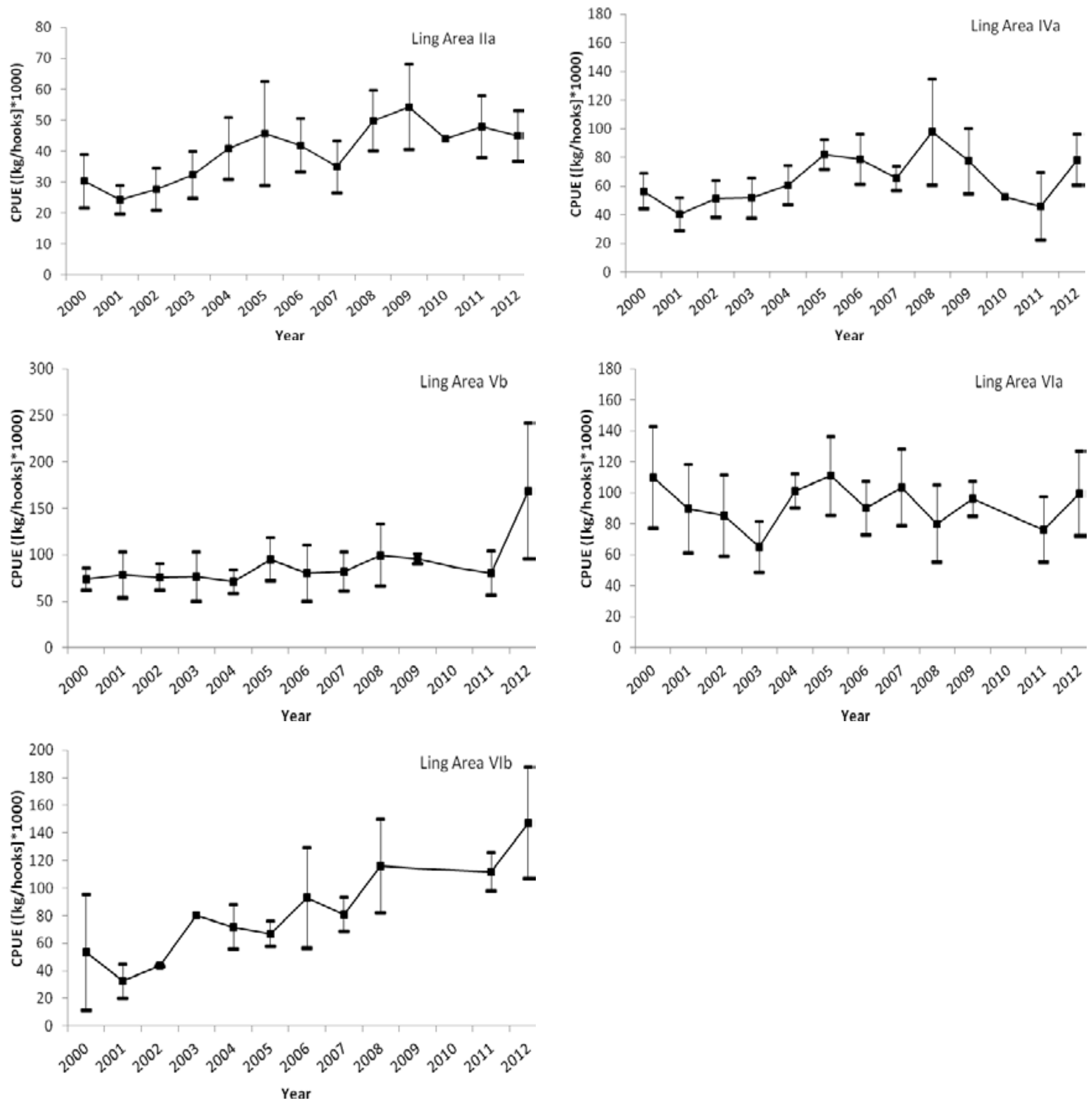

Figure 5. CPUE series for ling for the period 2000-2012 based only on vessels that caught ling on 100 or more days. The bars denote the estimated two standard errors.

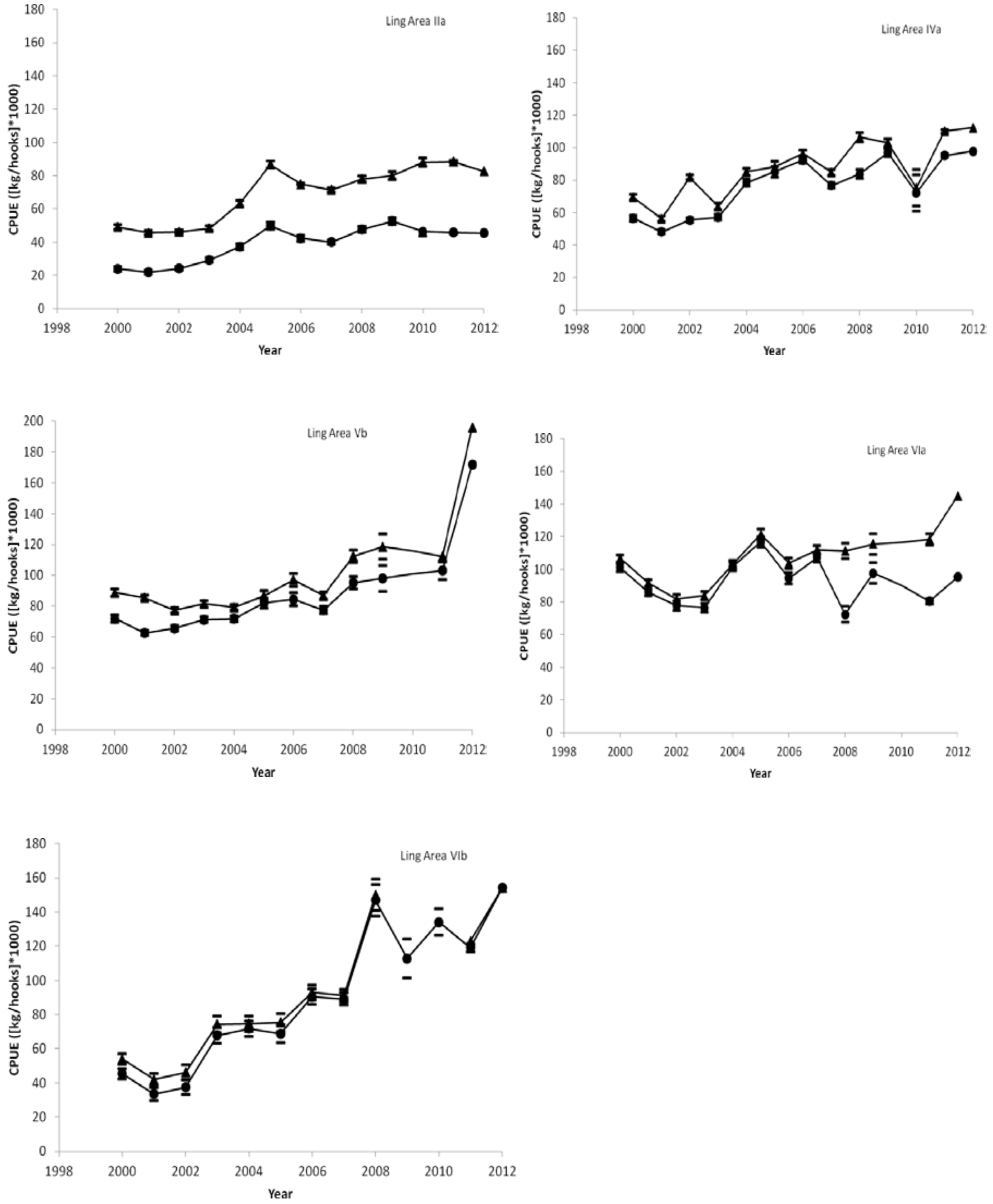

Figure 6. The logbook-based CPUE (kg per 1000 hooks) for the period 2000-2012 in both the total area and in the subareas fished by Norwegian lonliners. The two series were estimated based on all the catches containing ling (squares), those containing more than 30% ling by weight (triangles).

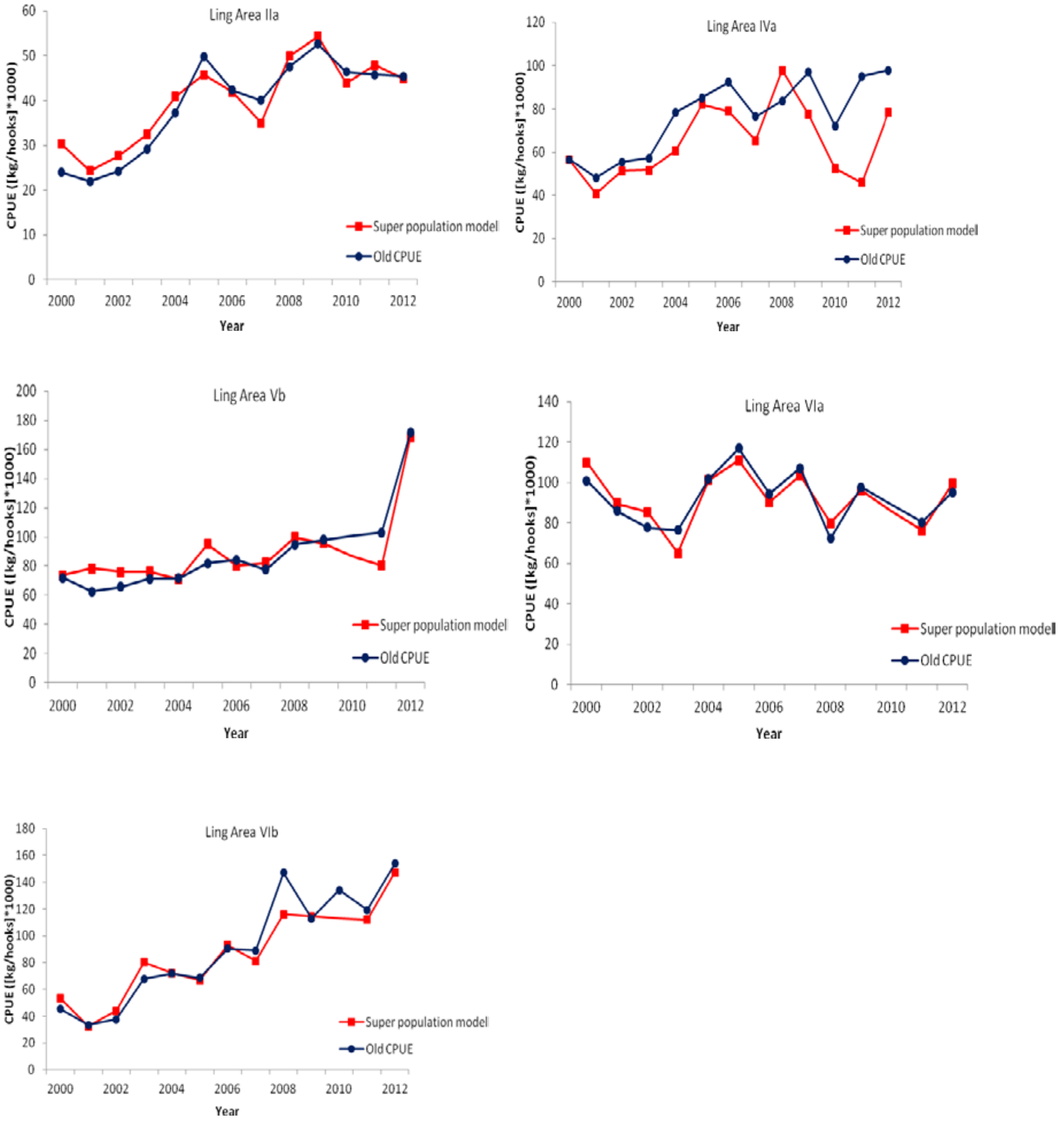

Figure 7. CPUE series for ling for the period 2000-2012 based only on vessels that caught ling on 100 or more days (red lines with squares) and the old CPUE series based on all available data (blue line with circles) .

Discussion and conclusions

The estimated CPUE series for ling, whether based on vessels that caught ling a 100 or more times during a year (Figure 4); or based either on all the catches, or only when ling comprised 30% or more (in weight) of the total catch (Figure 5) basically indicate that the ling population has been rather stable over the last 12 years. The main difference between the two ways of calculating the CPUE series is that the uncertainty associated with the superpopulation based estimates is larger, as would be expected, than if it is assumed that the "true" CPUE for the entire fleet is proportional to the actual population.

The use of a superpopulation model to estimate the precision of the ling CPUE series is straightforward and intuitive. In general, model-based inferences based on superpopulation models have many applications based on a wide range of models; for example, making valid inferences based on generalized linear models, GLM, (Särndal, et al., 1992).

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Working Document to be presented to the Working Group on the
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Results on Argentine (*Argentina* spp.), bluemouth (*Helicolenus dactylopterus*), Greater forkbeard (*Phycis blennoides*) and Spanish ling (*Molva macrophthalma*) from 2012 Porcupine Bank (NE Atlantic) survey

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Abstract

This paper presents the results on four of the most important deep fish species of the last Porcupine Spanish survey carried in 2012, and updates the documents presented in previous years with the information on the eleven years (2001-2011) of the Porcupine Spanish bottom trawl surveys on the Porcupine Bank. The document presents total abundances in weight, length frequencies and geographical distributions for Argentina spp. (mostly A. silus, results on proportions by Argentina species distribution in last surveys are provided), bluemouth, greater fork-beard and Spanish ling. All species considered present increases in their abundances, that are especially remarkable in the case of greater forkbeard and Spanish ling, confirming the good recruitments detected in 2011 survey. Besides both species have shown new recruitment peaks in 2012 survey.

1. Introduction

The Spanish bottom trawl survey on the areas surrounding the Porcupine Bank (ICES Divisions VIIc and VIIk) has been carried out annually since 2001 to study the distribution, relative abundance and biological parameters of commercial fish in the area (ICES, 2007). The main target species for this survey series are hake, monkfish, white anglerfish and megrim, which abundance indices are estimated by age (Velasco *et al*., 2005; Velasco *et al*., 2007). Nevertheless data are also collected for all the fish species captured, Norway lobster (*Nephrops norvegicus*) and other benthic invertebrates according to the IBTSWG (ICES, 2010a) protocols.

In 2008, a working document (Baldó et al. 2008) was presented to the WGDEEP summarizing the results on the most common deep water fish species caught in Porcupine Survey. Information is updated yearly since then (Velasco et al. 2011 and 2012 and other working documents presented to WGDEEP meetings). The aim of the present working document is to update those results with the information from 2012 survey (abundance indices, length frequency distributions and geographic and bathymetric distributions). In previous reports Argentine species had been treated as *Argentina* spp. an unidentified compound of both *A. silus* and *A. sphyraena* due to the problems to distinguish both species, especially given the huge catches of *Argentina* spp., that in 2001-2002 made up more than the 20% of the total fish biomass recorded, reaching hauls with more than 10 000 individuals. In recent years the abundance of this species has decreased steadily reaching around a 10% in weight, and although in 2012 an increase in the abundance of the species, reaching 2006 values in number and weight, the proportions of both species in last years' surveys is presented.

2. Material and methods

The area covered in Porcupine surveys (Figure 1) is the Porcupine bank from longitude 12° W to 15° W and from latitude 51° N to 54° N. The survey covers depths between 180 and 800 m, and in 2012 was carried out between the 1st and the 30th of September on board the R/V “Vizconde de Eza”, the stern trawler of 53 m and 1800 Kw that has been used along this series.

The sampling design used in this survey is random stratified (Velasco and Serrano, 2003), with two geographical sectors (North and South) and three depth strata defined by the 300, 450 and 800 m isobaths, resulting in 5 strata, given that there are no grounds shallower than 300 m in the Southern sector (Figure 1). As described in the IBTS manual for the Western and Southern areas (ICES, 2010b), sampling was random stratified and allocated proportionally to strata area using a buffered random sampling procedure (as proposed by Kingsley *et al*., 2004) to avoid the selection of adjacent 5×5 nm rectangles. The gear used was the Porcupine baca 40/52, described in ICES (2010b), with 250 sweeps, 850 kg doors, 90 mm net mesh all along the gear and a and 20 mm liner covering the cod-end inner part. Vertical opening was 2.50±0.04 m while door spread was 149.0±2.7 m, both within the ranges of the survey. Gear horizontal opening is not recorded regularly due to the unavailability of sensors, but varies around 25.0±1.4 m ICES (2010b).

Two different methods were used to estimate abundance variability: (i) the parametric standard error derived from the random stratified sampling (Grosslein and Laurec, 1982), and (ii) a non parametric bootstrap procedure implemented in R (R Core Team, 2012) re-sampling randomly with replacement stations within each stratum and maintaining the sampling intensity, and using 80% bootstrap confidence intervals from the 0.1 and 0.9 quantiles of the resultant distribution of bootstrap replicates (Efron and Tibshirani, 1993).

3. Results and discussion

A total of 198 species, 98 fish species, were captured in 2012, smaller than the number of species found last year (103 species) but still larger than the mean in the whole time series (94.9 fish species).

Argentina spp. presents an increase in its abundance in 2012, both in abundance and biomass, returning to levels similar to 2006 (Figure 2). In spite of this small increase the species presents abundances very low compared with the high abundances in the first years of the series, when mean stratified capture in biomass was more than 100 kg per 30’ haul.

The abundance in number increase is relatively larger than in biomass, this is explained regarding the length distribution (Figure 3) that presents a mode in 21-23 cm, with 217 individuals per haul, the third highest abundance in the series, and 261 between 20-25 cm that represents the fourth value in the time series after 2001-2003. Figure 4 presents the comparison of length distributions between *A. silus* and *A. sphyraena* from 2009 to 2012, and a remarkable part of these small argentines are *A. silus*, therefore it indicates strong recruitment of this species after years of poor recruitments and the marked decrease in its abundance. Also it has to be considered that in 2011 a small peak of *A. silus* recruits was remarked, this peak has been confirmed by the increase in abundance in number in 2012 survey that also seems to present again a good recruitment. Figure 5 presents the distribution of *Argentina* spp. in Porcupine bank along the time series, while Figure 6 presents the distribution of both species with a comparison of the proportion of each of them in each station in 2010-2012. The distribution pattern appears to be quite stable, with *A. silus* being the dominant species in the deeper hauls (>450 m since most of them are below the isobaths that define the deeper strata) in the southern and western part of the bank, while *A. sphyraena* is clearly less abundant in the survey area, but more abundant around the central part of the bank and also predominates in the hauls on the border of the Irish shelf, where the shoals are smaller. In terms of biomass *A. silus* made up more than 90% of the argentines caught in 2009 and 2010, while in the last two years it has been around 85%. In number it has ranged between 64% in 2011 and 79% in 2009, some of these differences may be due to the improvement of the identification skills of the team in charge.

Bluemouth in 2012 survey presents an increase in biomass and number terms (Figure 7) reaching abundances similar to 2007, the year that ended the peak in 2005-6. The length distribution (Figure 8) maintains the same patterns of previous years, with a decrease in the number of individuals smaller than ≤15 cm, 0.5 individuals per haul in 2012, while it was 0.9 last year, and 0.7 fish per haul in 2010. Nevertheless the abundances from these years are much smaller than those in the first years of the series (2001-04) when more than 5 small individuals per haul were captured. Figure 9 presents bluemouth geographical distribution that also is very similar to lasts years with most of the captures obtained on the western part of the bank, characterized by grounds rockier than the eastern part.

Greater forkbeard (Figure 10) presents a remarkable increase in both biomass (20 kg/haul: 136% increase) and numbers (58 ind/haul: 98% increase). These results represent values closer to those of 2005-6, that followed the pass of 2002 cohort (Figure 11). This recovery already was appointed in 2011, with an important increase in number (29.13 individuals per haul) that doubled the numbers found in the three previous years. Length distribution of greater forkbeard (Figure 11) also presents a shape similar to 2005-6, with three different modes 16-18 cm, 26-30 cm, and 37-40 cm. The number of recruits (individuals smaller than 21 cm) is 7.8 per haul, that is the highest number after 2002, (14.2 ind./haul), and therefore it can be considered an encouraging result for Greater forkbeard. Geographical distribution (Figure 12) shows that forkbeard has spread almost uniformly along the bank, except the north-western and southern parts of the central mound. Higher abundances seem to dwell in the southern and eastern part of the area.

Spanish ling presents an increase even more striking than greater forkbeard (Figure 13). In biomass (18.44 kg/haul) and number (43.64 ind/haul) the increases are more than 3.5 times the biomass, and almost four times the abundance found in 2011. This increase was anticipated (Velasco et al. 2012) by the noteworthy increase already found in 2011 that included a marked “recruitment” of individuals smaller than 30 cm. This result can also be observed in Figure 14, that shows the time series of length distributions, and in 2012 presents a smaller peak of recruits ≤30 cm) with 2 inds./haul and an outstanding mode between 46 and 51 cm, with 16.8 inds/haul. The sizes in this mode are smaller than those found last year, which was marked between 49 and 55 cm, and more similar to the one found in 2005 after the recruitment peak found in 2004. In any case apparently two consecutive good recruitments are identified by 2011 and 2012 surveys, being the later only slightly smaller than the one recorded in 2004. Figure 15 presents geographical distribution in weight terms of Spanish ling, Spanish ling has expanded its dwelling grounds out of the western slope of the bank, where it keeps being more abundant, but also is present on the north-western part of the bank, around the central mound and in the central part of the bank, reversing the shrinkage of the area inhabited found last year.

Finally, no blue ling was captured in 2012 survey.

4. Conclusions

The results of Porcupine bottom trawl survey in 2012, confirm the recruitment peaks detected and advanced last year (Velasco et al, 2012), the increases in abundances found for greater forkbeard and blue ling, offer valuable information for the assessment of these species, and remark the importance of this time series for deep species in the area. In the case of the other species usually reported from Porcupine Bank survey, Bluemouth and Argentine, both present increases in their abundances, though less remarkable than Spanish ling and greater forkbeard.

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5. Tables and figures

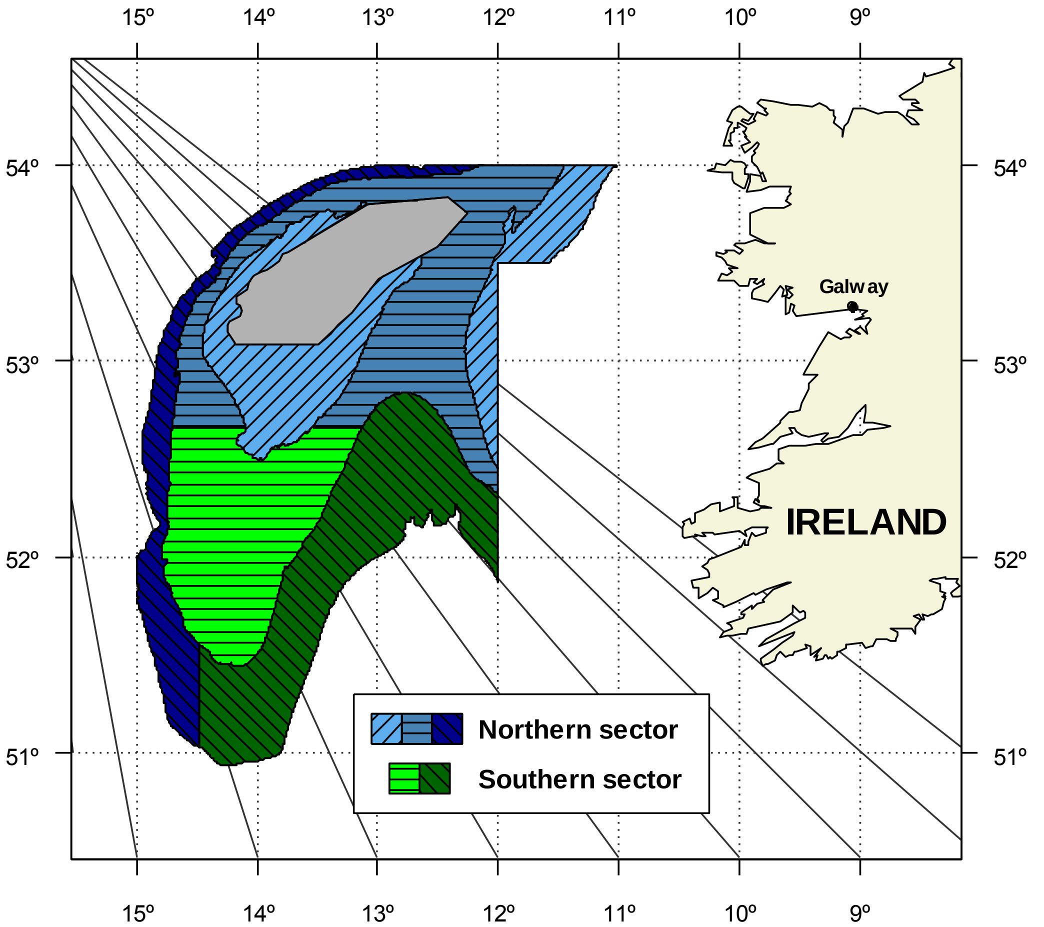

Figure 1. Stratification design used in Porcupine surveys from 2003. Depth strata are: A) shallower than 300 m, B) 301 – 450 m and C) 451 – 800 m. The grey area in the middle of Porcupine bank corresponds to a large non-trawlable area, not considered for area measurements and stratification.

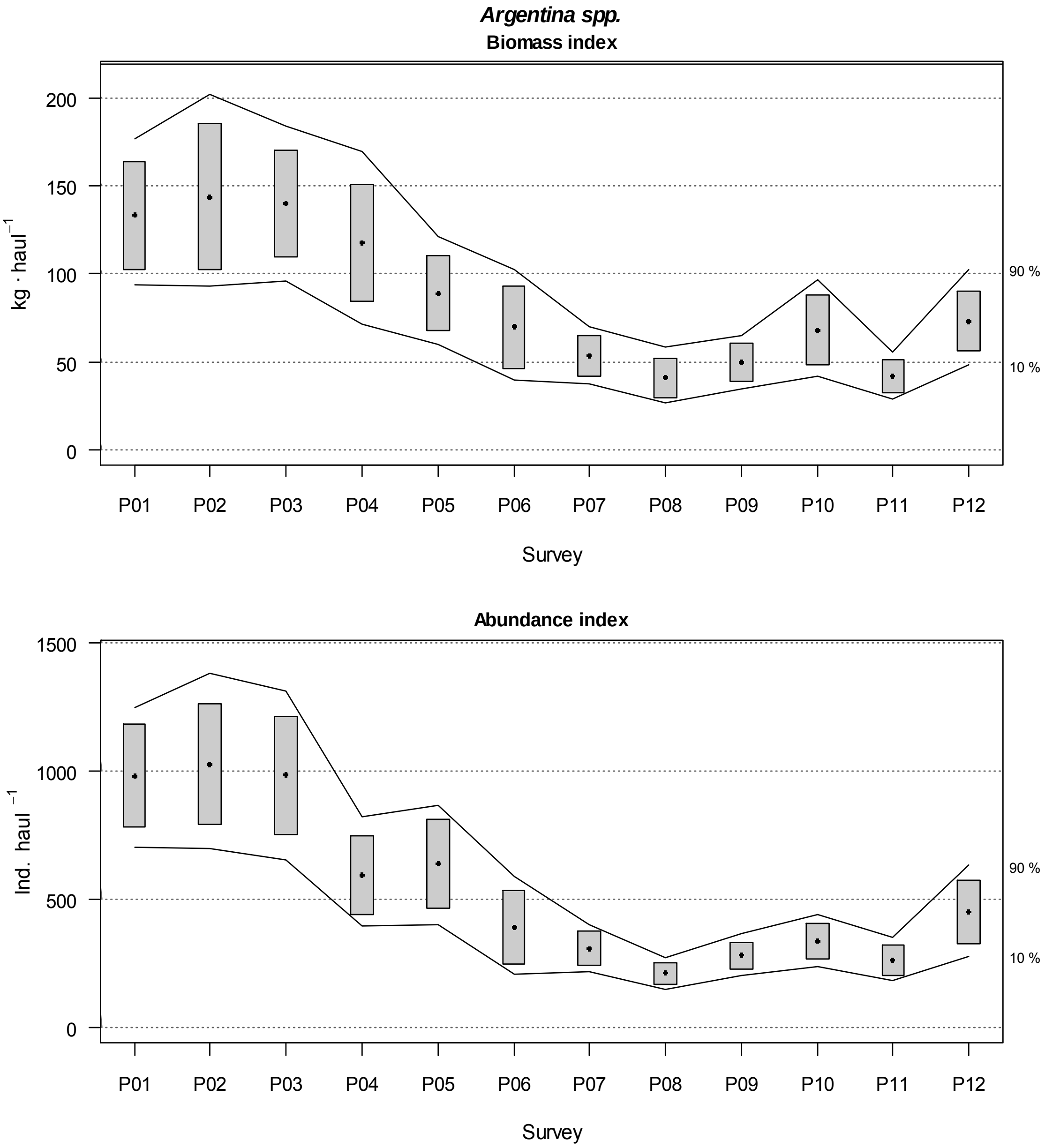

Figure 2. Changes in *Argentina* spp. (mainly *Argentina silus*) biomass and abundance indices during Porcupine Survey time series (2001-2012). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

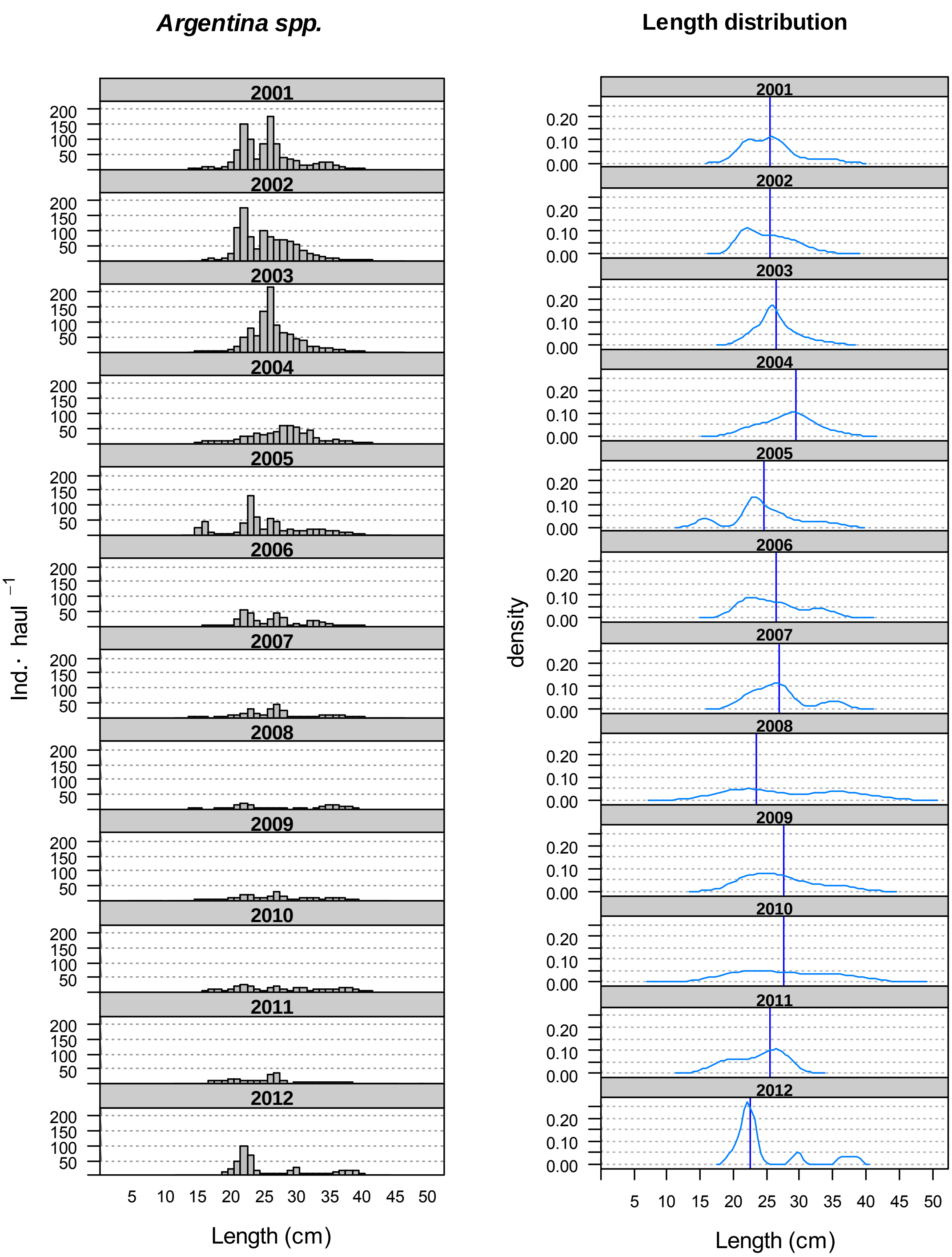

Figure 3. Mean stratified length distributions of *Argentina* spp. in Porcupine surveys (2001-2012)

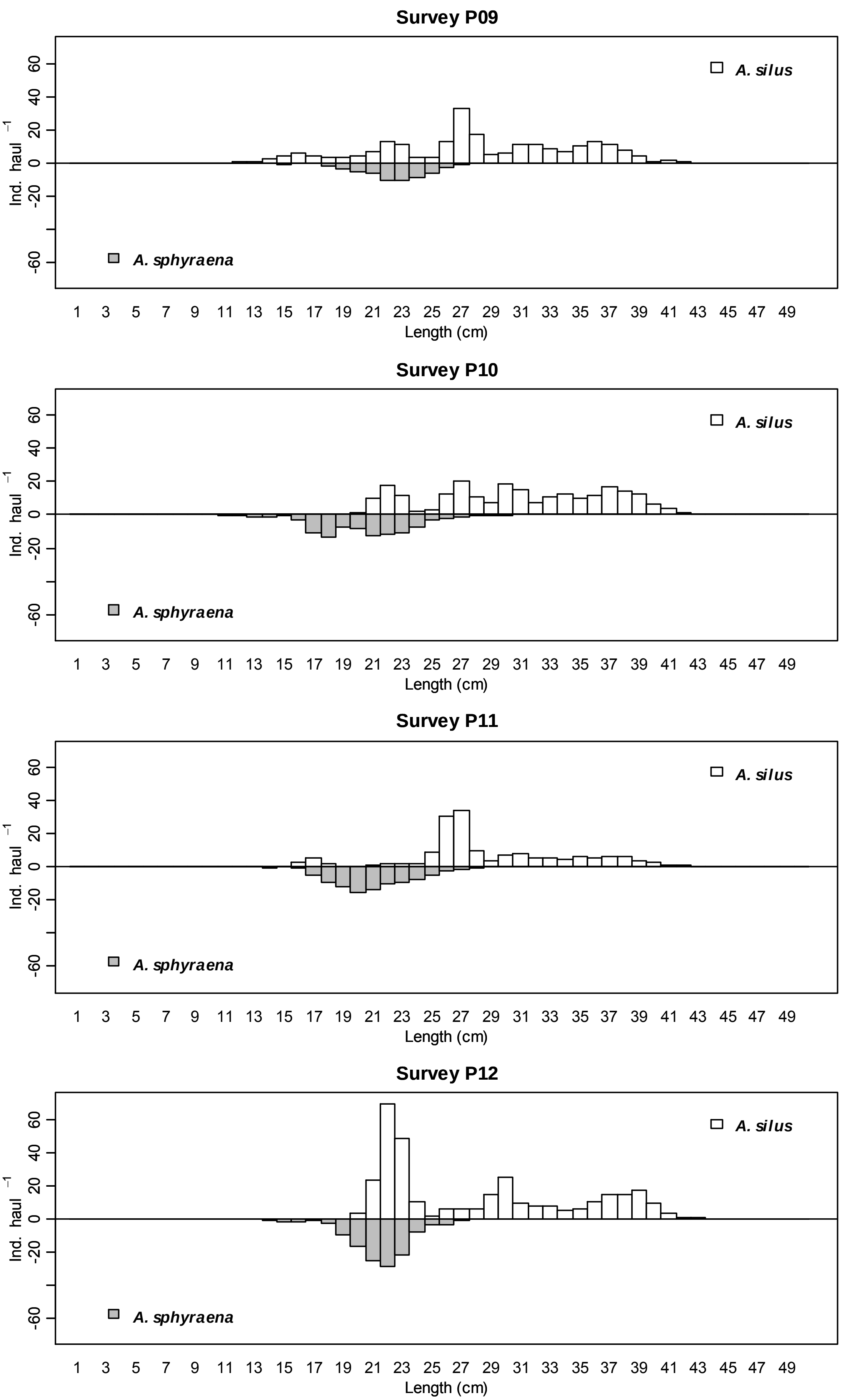

Figure 4. Mean stratified length distributions of *A. silus* and *A. sphyraena* in 2009-2012 surveys.

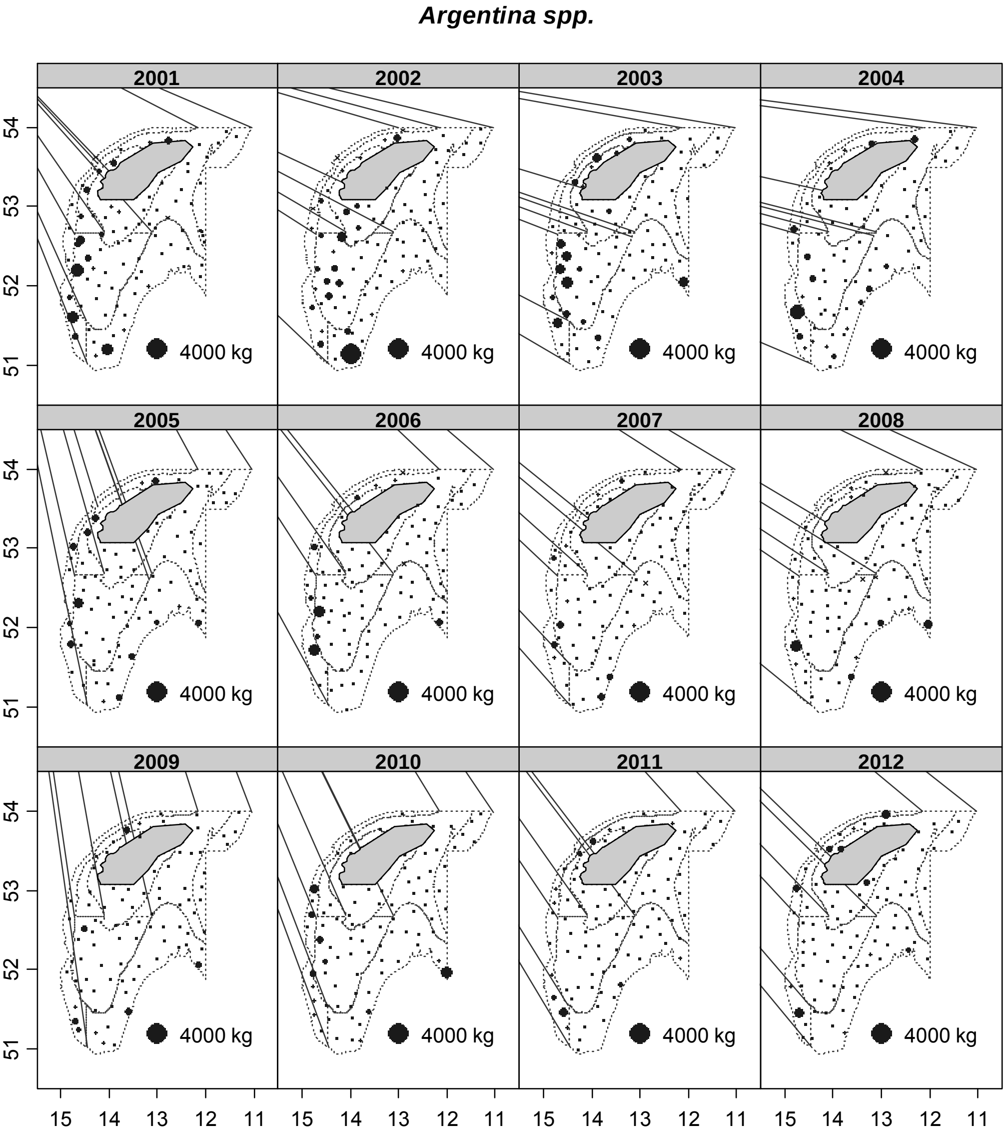

Figure 5. Geographic distribution of *Argentina* spp. catches (kg/30 min haul) in Porcupine surveys (2001-2011)

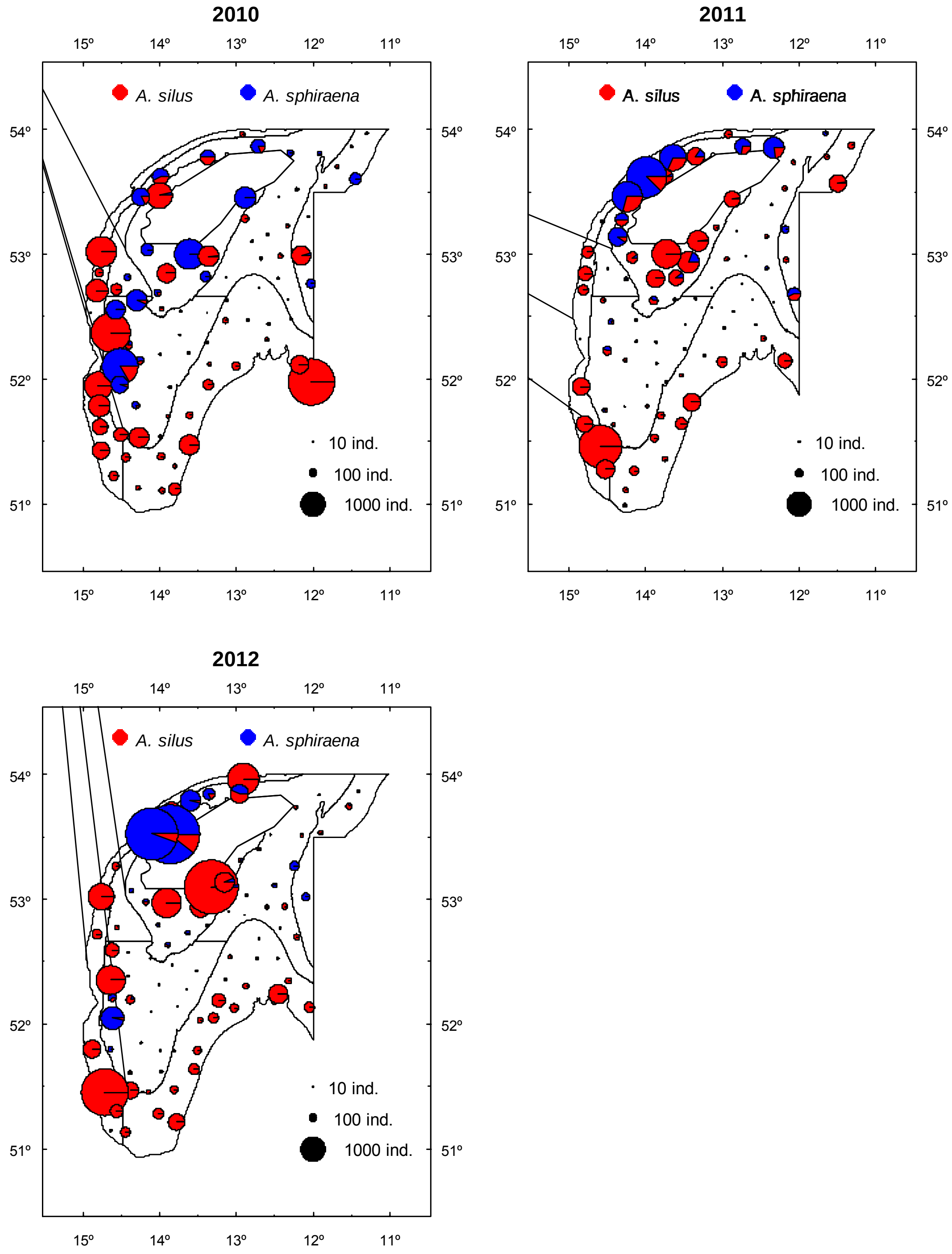

Figure 6. Distribution of *Argentina silus* and *A. sphyraena* during 2010 and 2011 Porcupine Bank surveys

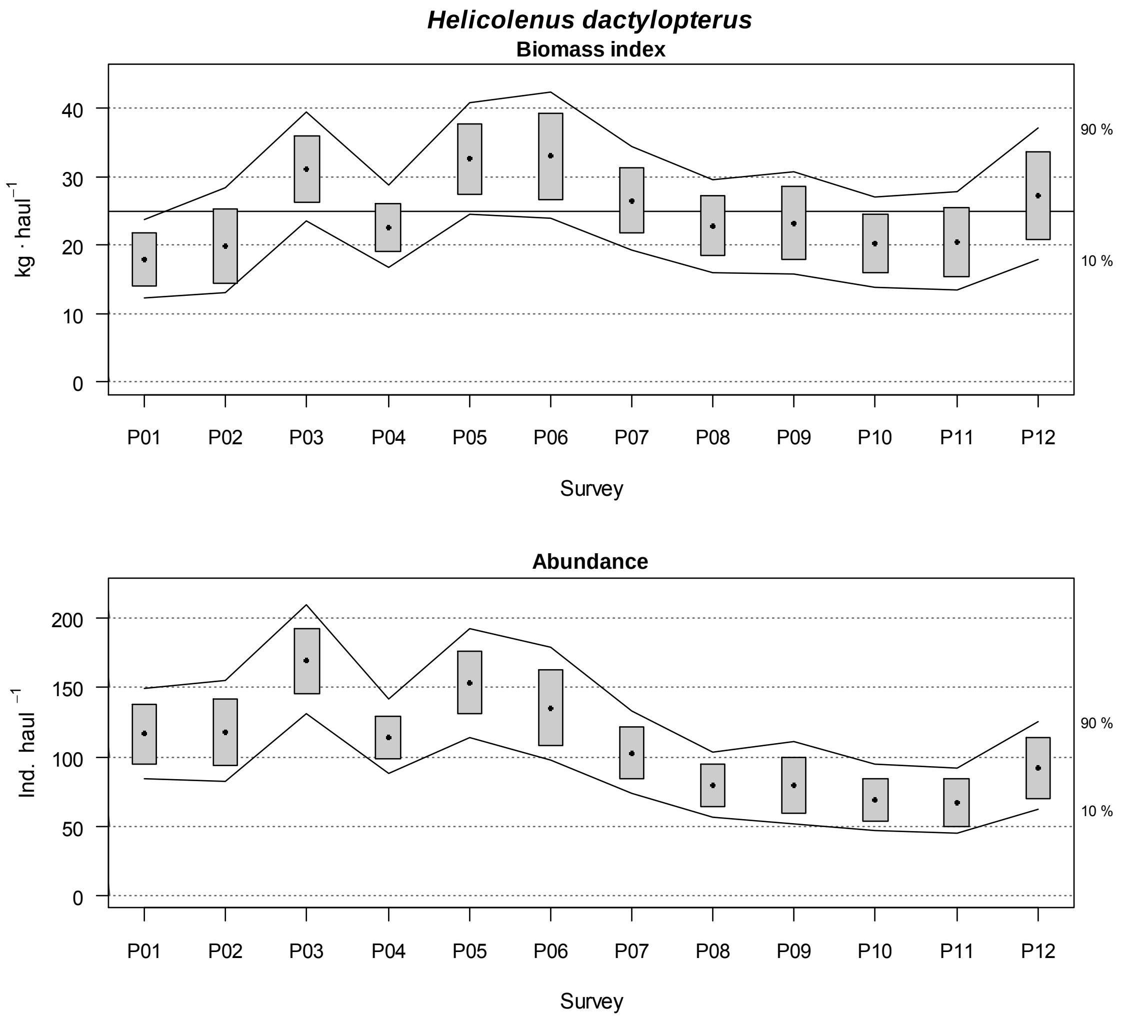

Figure 7. Changes in *Helicolenus dactylopterus* biomass and abundance indices during Porcupine Survey time series. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

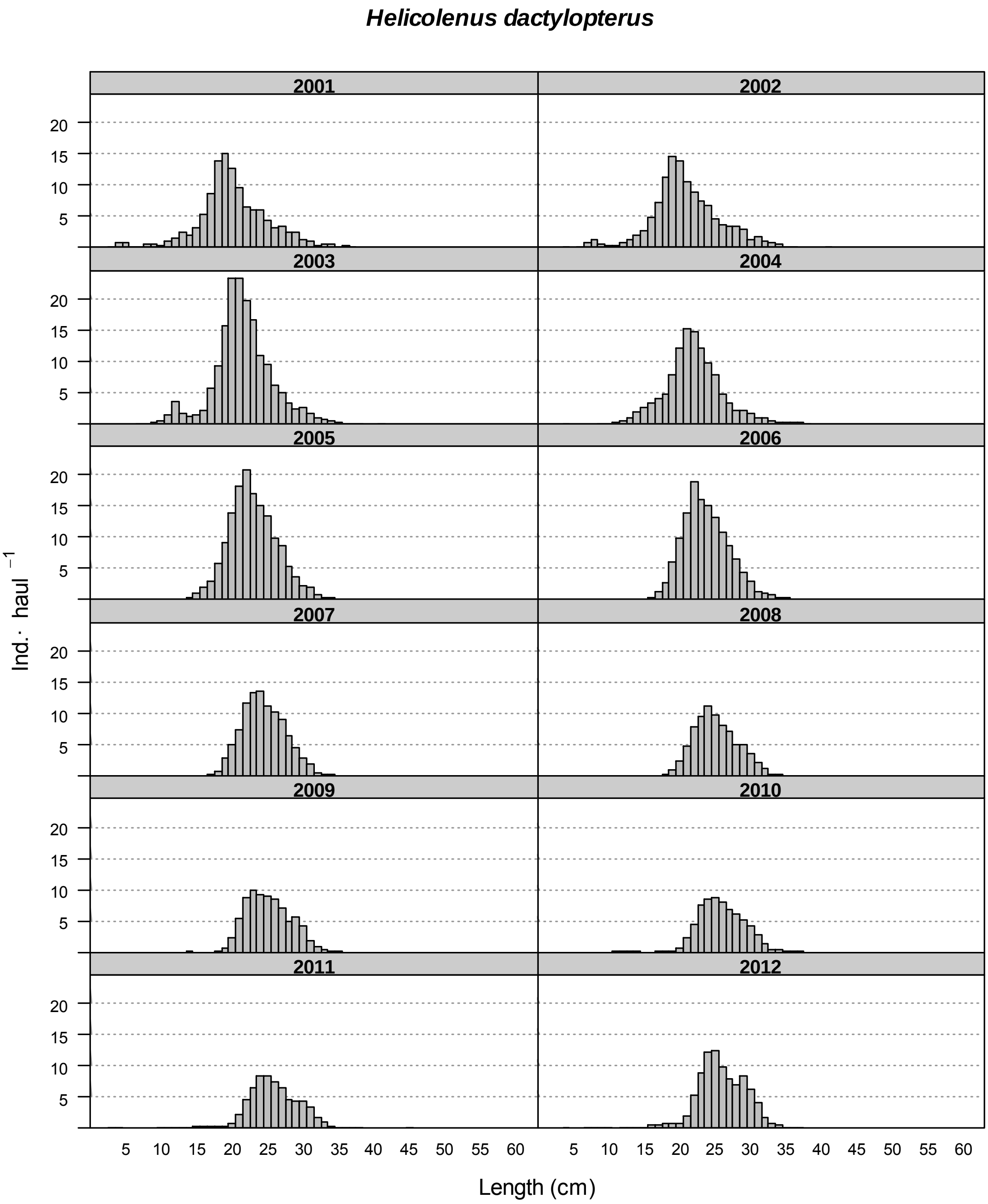

Figure 8. Mean stratified length distributions of *Helicolenus dactylopterus* in Porcupine surveys

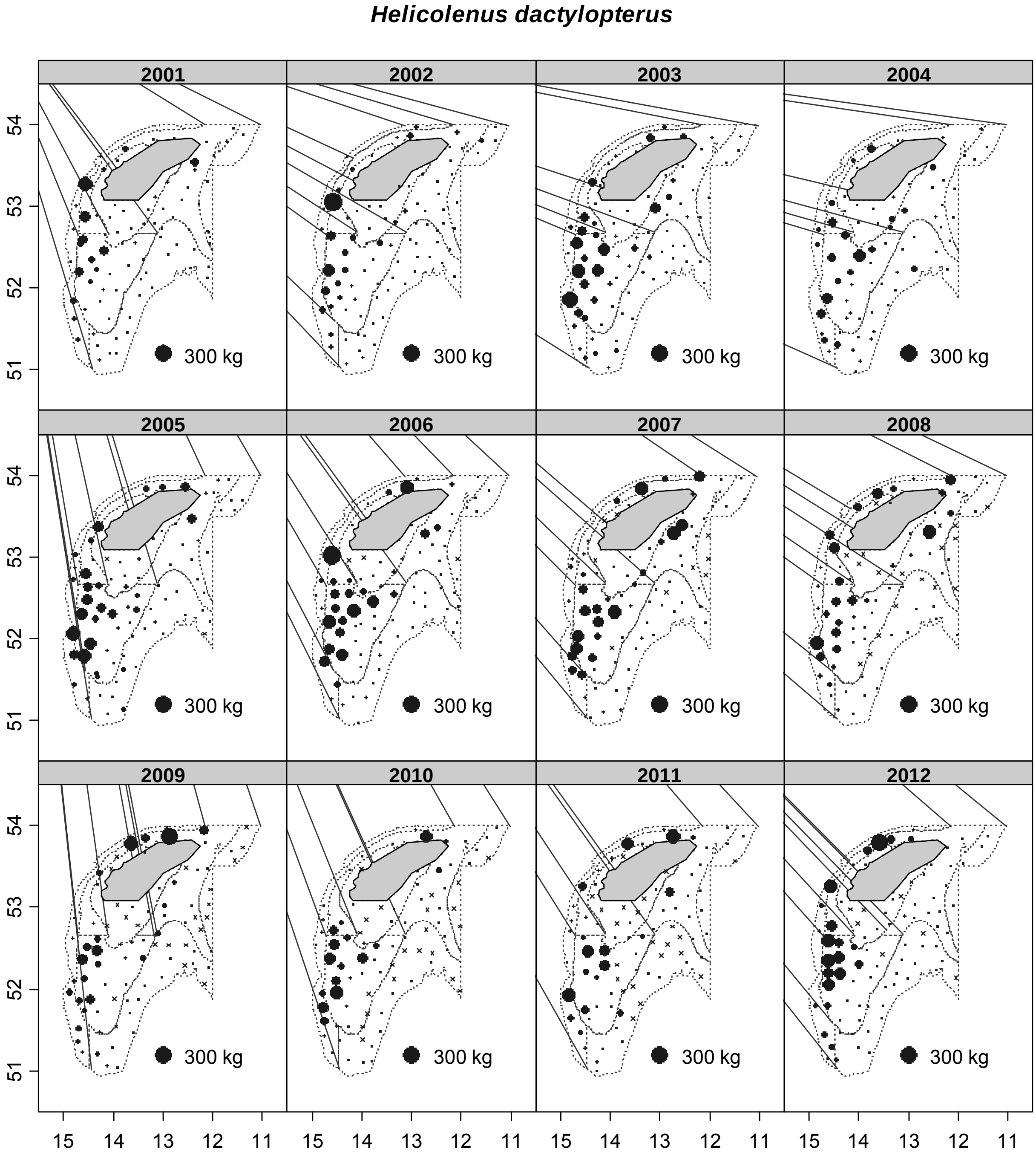

Figure 9. Geographic distribution of *Helicolenus dactylopterus* catches (kg/30 min haul) in Porcupine surveys

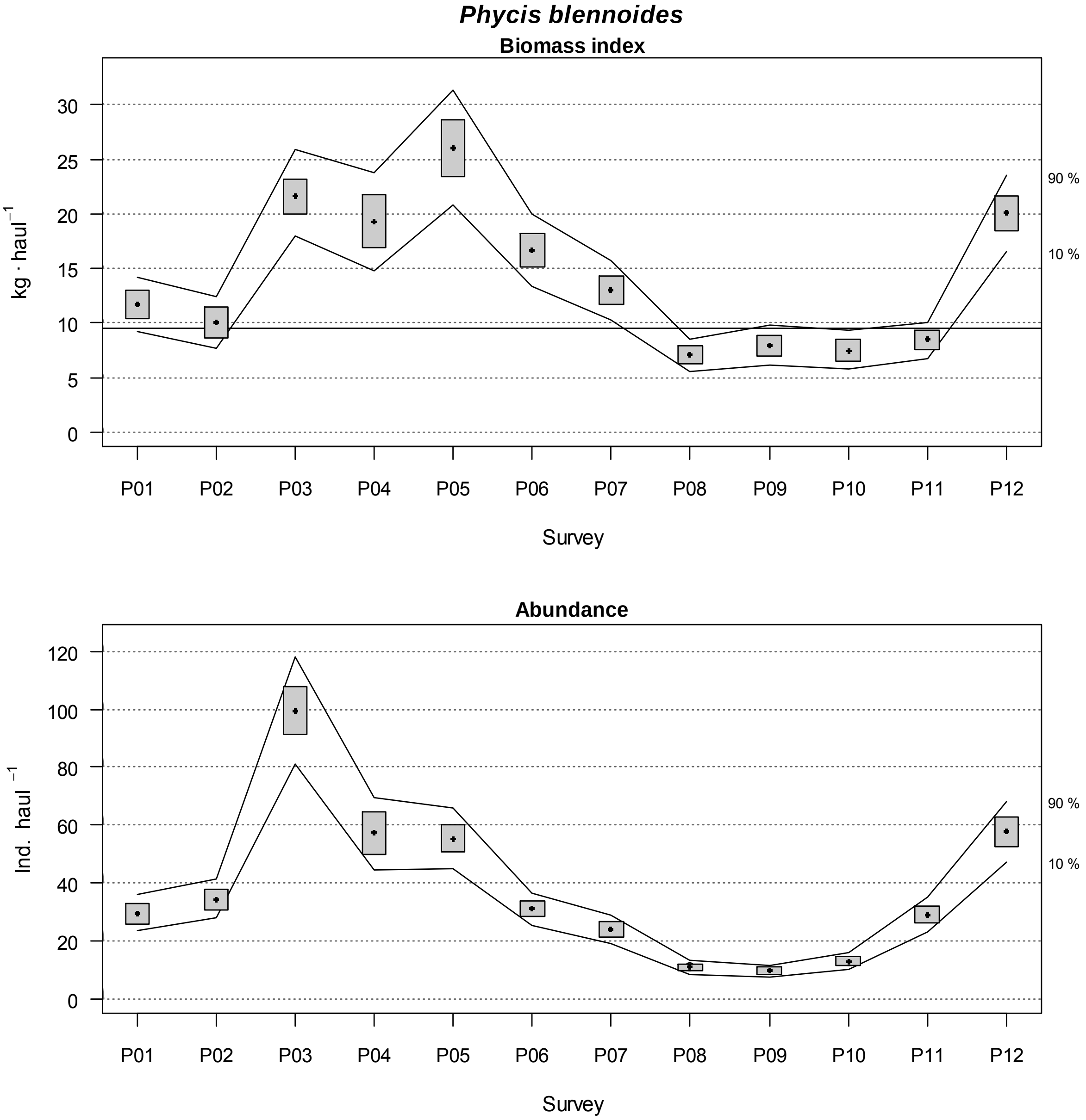

Figure 10. Changes in *Phycis blennoides* biomass and abundance indices during Porcupine Survey time series (2001-2012). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

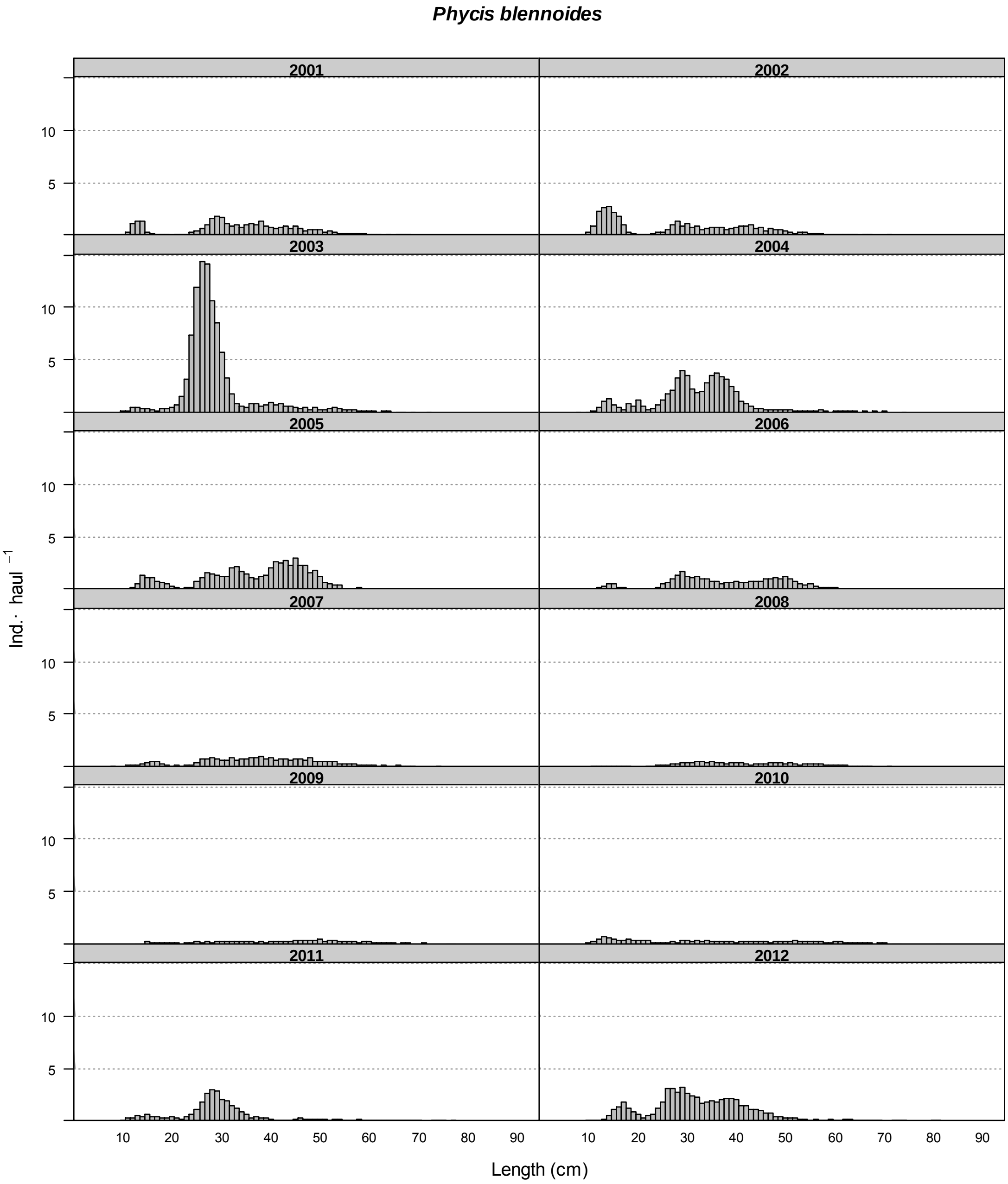

Figure 11. Mean stratified length distributions of *Phycis blennoides* in Porcupine surveys (2001-2012)

Phycis blennoides

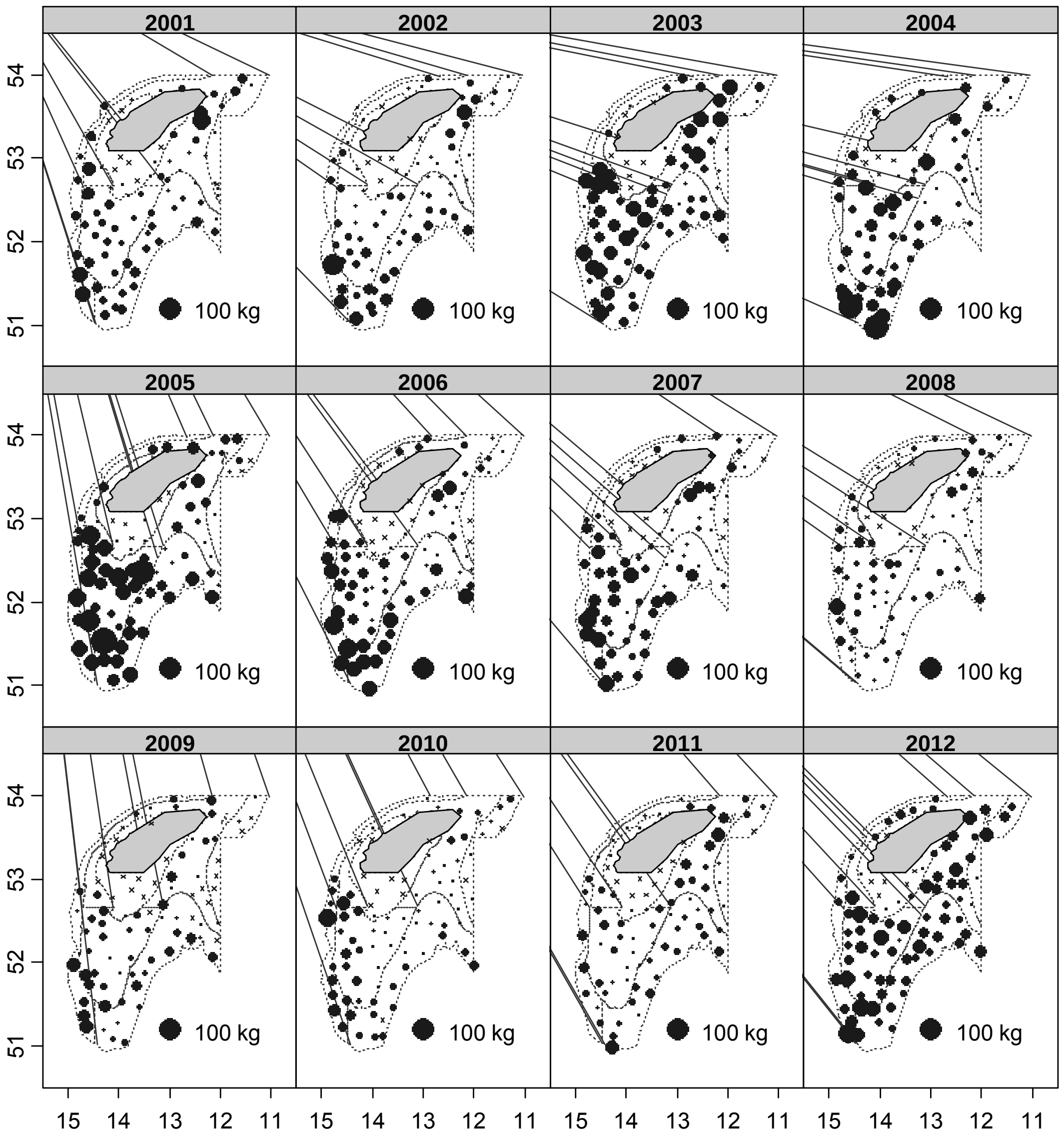

Figure 12. Geographic distribution of *Phycis blennoides* catches (kg/30 min haul) in Porcupine surveys

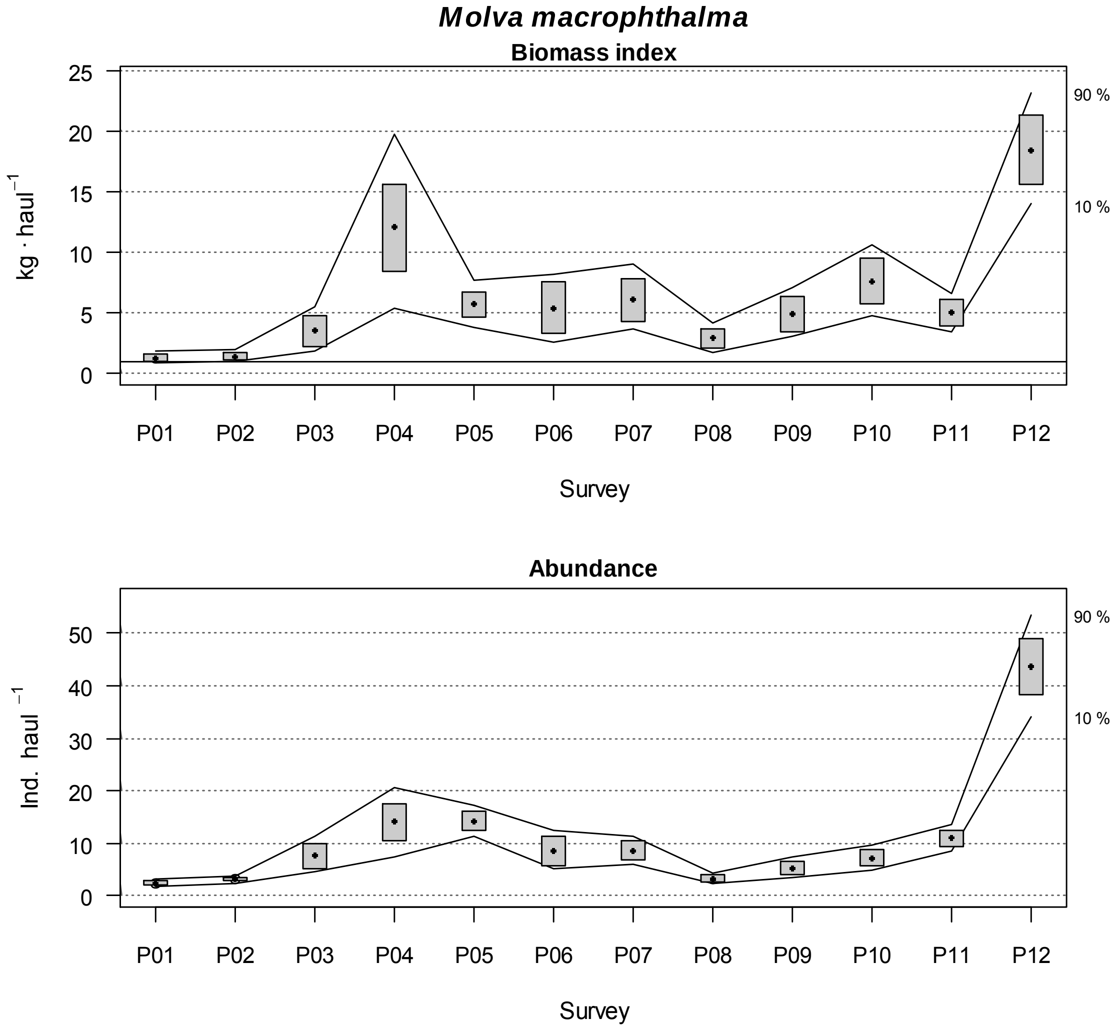

Figure 13. Changes in *Molva macrophthalma* biomass and abundance indices during Porcupine Survey time series. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

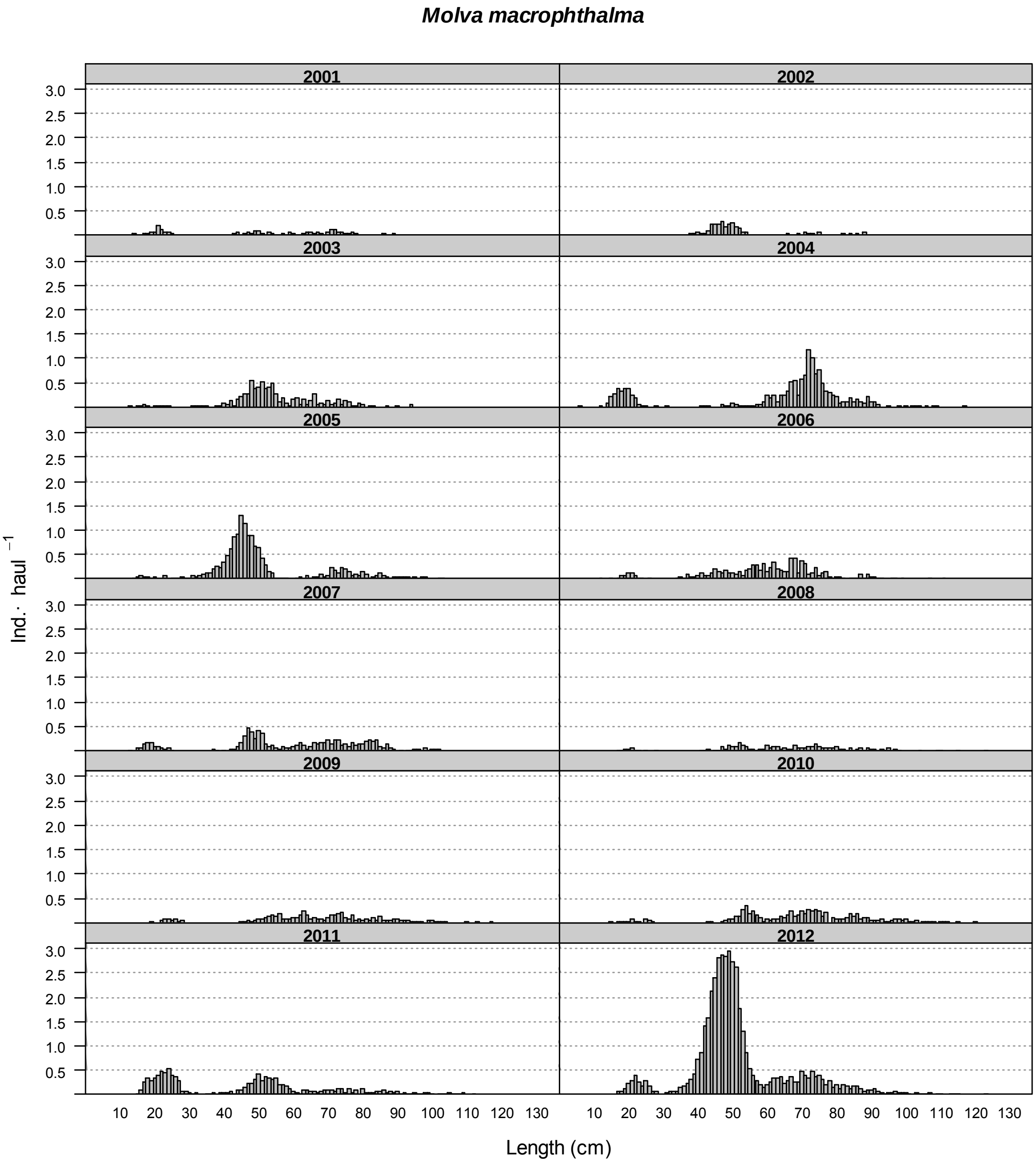

Figure 14. Mean stratified length distributions of *Molva macrophthalma* in Porcupine surveys

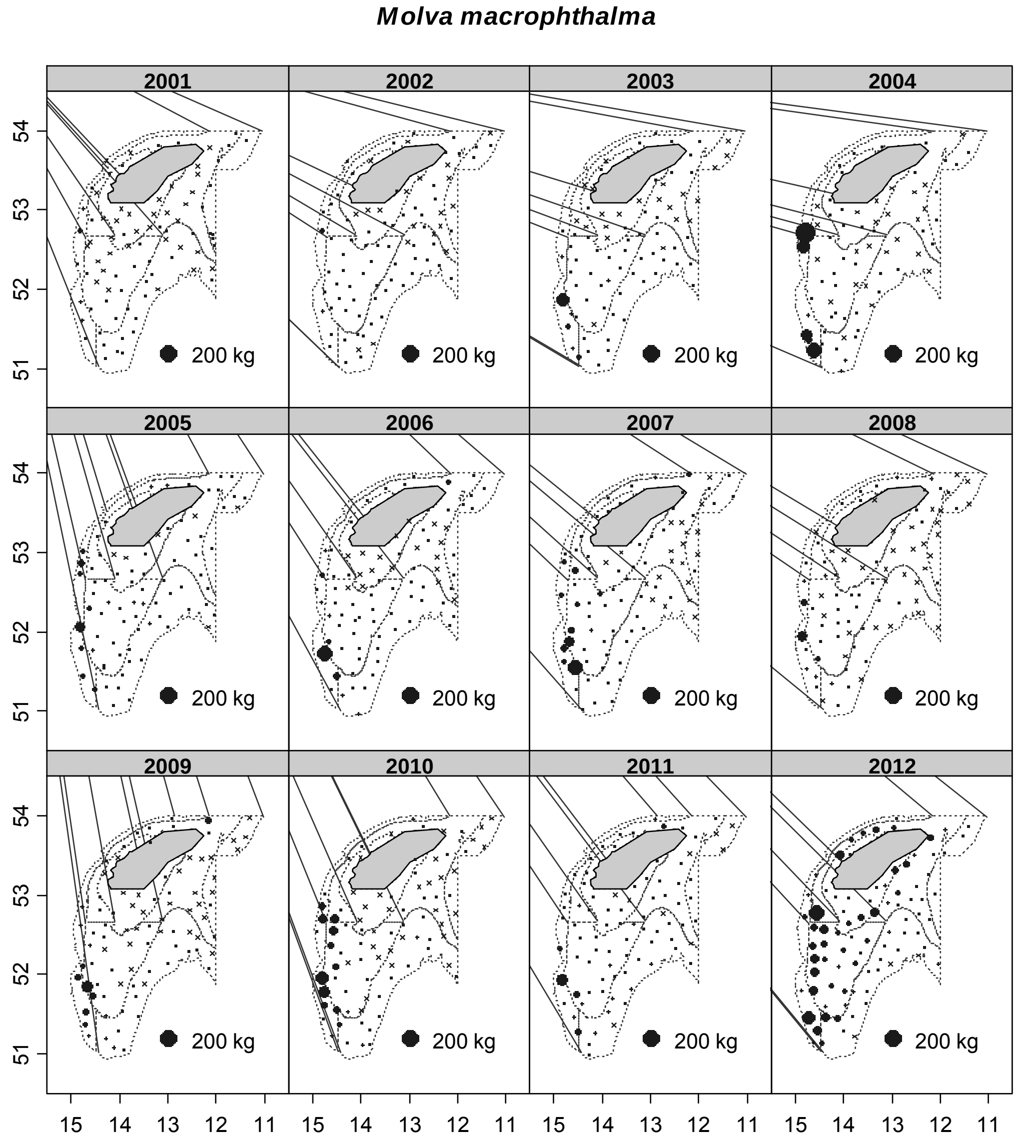

Figure 15. Geographic distribution of *Molva macrophthalma* catches (kg/30 min haul) in Porcupine surveys

ICES Working Group on the Biology and Assessment
of Deep-Sea Fisheries Resources (WGDEEP) 2012

Working Document

RUSSIAN FISHERIES AND INVESTIGATIONS OF DEEP-WATER FISH IN THE NORTHEAST ATLANTIC IN 2012

by

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Introduction

In 2012, Russian target fishery in the deep waters of the Northeast Atlantic was only carried out in the Faroese Fishing Zone (FFZ). The by-catch of deep-water fish was also taken during the target fishery in the other areas. In 2012, the total Russian catch of deep-water species amounted to 280.4 t (Table 1).

Materials and methods

Essential materials to be used to prepare this Working Document were as follows:

- daily vessel reports;
- materials collected during research surveys;
- information collected by observers on board fishing trawlers.

Catches of deep-water fish were taken by bottom and pelagic trawls with 16-135 mm mesh size.

Sampling of the biological material was performed in accordance with PINRO manual (Anon, 2004). In greater silver smelt two lengths, a fork length (FL) and a total length (TL), or a total length only were measured. Total length (TL) was used when measuring other fish species.

Maturity stages of gonads of greater silver smelt were assigned using the maturity scale for Norwegian herring: 2 – immature, 3 – first maturing, 4 – re-maturing, 5 – pre-spawning, 6 – spawning, 7 – post-spawning, 7-2 – post-spawning recovery. Maturity of rabbitfish was determined using the scale proposed by M.F.W. Stehmann (2002). Maturity stages of bluemouth were defined by the scale for redfish including for males: 2 – immature, 3 – maturing, 4 – pre-spawning, 5 – copulating, 6 – post-spawning, 6-2 – post-spawning recovery; for females: 2 – immature, 3 - maturing, 4 – copulating, 5 – fecundation, 6,7,8 – embryo development, 9 – extrusion, 9-2 – post-spawning recovery. Maturity of all remaining species was assigned by the scale as follows: 2 – immature, 3 – maturing, 4 – pre-spawning, 5 – spawning, 6 – post-spawning, 6-2 – post-spawning recovery.

Intensity of feeding was estimated using the following scale: 0 – no food, 1 – very little food, 2 – little food; 3 – stomach is full of food and has folds on its walls; 4 – very much food, stomach is stretched. Intensity of feeding was expressed using mean index of stomach fullness (MISF).

Fat content on the internal organs was estimated by the scale: 0 – no fat; 1 – little fat; 2 – mean fatness, a wide fat band almost covers viscera; 3 – much fat, fat completely covers viscera.

All data are presented for individual fish species and different ICES Divisions according to the structure of the WGDEEP report. The data were aggregated in accordance with ICES statistical areas.

Fisheries

The Faroese Fishing Zone (Divisions Vb and VIa)

In April-May, a middle-tonnage vessel fished in the southeastern part**,** on the Bill-Bailleys and Lousy Banks, at 505-670 m depths. Mean fishing efficiency was 9.7 t per a fishing day or 0.7 per a trawling hour. In total, caught were greater silver smelt *Argentina silus* – 106.0 t, rabbitfish *Chimaera monstrosa* – 11.1 t, blue ling *Molva dypterygia* – 4.8 t, bluemouth *Helicolenus dactylopterus* **-** 2.0 t, beacked redfish *Sebastes mentella* – 1.8 t. In the catches insignificant amounts of greater forkbeard *Phycis blennoides*, ling *Molva molva*, common mora *Mora moro*, anglerfish *Lophius piscatorius*, deep-water cardinal fish *Epigonus telescopus*, black-spot grenadier *Coelorhinchus caelorhinchus*, black scabbardfish *Aphanopus carbo*, silver roughy *Hoplostethus mediterraneus*, deepwater sharks *Etmopterus spinax*, *Deania calcea*, *Galeus melastomus* were found.

In April, in the fishery of blue whiting *Micromesistius poutassou*, in the south, when trawling at 300-600 m depths, small amounts of great silver smelt, the total catch of which was 5.1 t, were registered.

Eastern Greenland (Sub-Division XIVb2)

In May-October, in the trawl fishery of Greenland halibut (*Reinhardtius hippoglossoides*), at the depths of 665-1350 m, roughhead grenadier (*Macrourus berglax*) occasionally occurred in the catches. The total catch of roughhead grenadier comprised 17.8 tons.

Norwegian Sea (Divisions IIa2 and IIb2)

Deep-water fish were mainly caught as by-catch taken by bottom trawls and longlines. Tusk *Brosme brosme*, 88.2 tons, including 74.0 t taken by longline and ling *Molva molva*, 19.0 tons, all the catch of which was obtained by bottom trawls occurred in the catches.

Barents Sea (Subarea I)

Small catches of tusk *Brosme brosme*, 0.2 tons, were taken as a by-catch in trawl and longline fishery for demersal fish.

Investigations

Greater silver smelt (Argentina silus)

The Faroese Fishing Zone (Subdivisions Vb and VIa)

In April-May, the species was caught on the northern and northwestern slopes of the Lousy Bank (505-560 m depths) and on the northern slope of the Bill Baileys Bank (610-670 m depths). Catches per a trawling hour were 0.2-1.5 t and, on the average, 0.7 t.

The catches were, mainly, consisted of males with the fork length of 28-43 cm (mainly, 35-37 cm) and females with that one of 26-46 cm (primarily, 36-39 cm) (Figure 1). The mean weight of males and females was 408 and 514 g, respectively.

All the fish studied were mature. In the end of April, on the Lousy Bank, most of fish were post-spawning (Figure 2). In early May, on the Bill Baileys Bank, 88% of males and 84% of females had running gonads. Males prevailed in abundance: on the Lousy Bank – in 2.1 times, on the Bill Baileys Bank, - in 2.7 times. The fish fed poorly (the mean index of stomach fullness – 0.2). The diet included crustaceans, squids, small fish and digested food (Figure 3). The index of fatness condition, on the average, was equaled to 0.5.

That species with length of 18-46 cm was caught by pelagic trawls in the area of the Wyville-Thomson Ridge in the end of April. The average length of males was 28.6 cm, of females – 27.1 cm. Males were predominating in abundance in two times.

Norwegian Sea (Divisions IIa and IIb)

During the year, single fishes were occasionally recorded in the catches by bottom and pelagic trawls at 182-650 m depths. As the analysis of 13 specimens showed, the total length varied from 31 to 43 cm.

Barents Sea (Subarea I)

In August, in the central part of sea, 2 males with the total length of 10 cm were taken from 182-233 m depths.

Ling (Molva molva)

The Faroese Fishing Zone (Subdivisions Vb and VIa)

In April-May, on the Lousy and Bill Baileys Banks, 4 prespawning females 126-159 cm in length were caught by bottom trawl from 510-520 m depths. The stomachs of all the fish were everted.

Norwegian Sea (Divisions IIa and IIb)

This species was caught by bottom trawls in February-April and December at 250-500 m depth. The length of caught males (2 specimens) equaled to 74 and 98 cm. The length of caught females (11 specimens) varied from 74 to 116 cm, the mean length was 97.1 cm.

Barents Sea (Subarea I)

In December, in the west, at 131 m depth, one male of 70 cm length was captured by bottom trawl.

Tusk (Brosme brosme)

Barents Sea (Subarea I)

This species was caught with bottom trawls at a depth of 50-267 m. 22 individuals with 30-86 cm length (the average length – 48.5 cm) were caught.

Norwegian Sea (Divisions IIa and IIb)

The species was caught with bottom trawls at 187-600 m depth. The length of specimens varied from 20 to 75 cm, predominantly from 51 to 60 cm. The mean length was equal to 53.7 cm.

The Faroese Fishing Zone (Subdivision Vb)

In April, one fish 56 cm in length was taken at 520 m depth.

Greater forkbeard (Phycis blennoides)

The Faroese Fishing Zone (Subdivision Vb)

The species occurred at 505-670 m depths, on the Lousy and Bill Baileys Banks, in April-May. The fish length varied from 21 to 78 cm (Figure 4). Among the studied individuals the majority (78 %) were females. Most of females (74%) and males (46%) were immature. A small portion of females (26%) and males (18%) were post-spawning. The rest of males (36%) had maturing gonads (Figure 5). The stomachs were mainly everted. In the others blue whiting and also euphausiids and gammarids were found.

Common mora (Mora moro)

The Faroese Fishing Zone (Subdivision Vb)

Occasionally the species was found on the Lousy Bank (505-525 m depths) in April-May. In the catches fish were 15-51 cm in length, on the average, 29.3 cm. Among 9 studied fish, there were 5 immature males and 3 immature females. Besides, one female had gonads at the stage of post-spawning recovery. The two thirds of examined stomachs were everted, the rest of them were empty.

Rabbitfish (Chimaera monstrosa)

The Faroese Fishing Zone (Subdivision Vb)

The species was an important bottom fishing object (up to 40% in single catches) when hauling at 505-670 m depths, on the Lousy and Bill Baileys Banks, in April-May. The greatest catches of that species were registered on the Lousy Bank, where they amounted to 150 kg/h, on the average. On the Bill Baileys Bank, the species occurred in smaller quantities. On the Bill Baileys Bank, the mean catch per an hour of trawling equaled to 95 kg.

In the catches the length of males varied from 60 to 101 cm and from 93 to 95 cm, on the average. Females had the length of 53-107 cm, 93-95 cm predominantly (Figure 6).

About 70% of studied males were mature, 23% - maturing and 7% - immature (Figure 9). There were no found active males in the period of study. The gonads of females were mainly in the ovarian stages of development. 7% of females had developing eggs in the tubes. There were no found females with extruded and attached capsules, however the alive eggs of the fish occurred in the catches.

Rabbitfish almost did not feed. Among 60 studied individuals, there were only 4 having some heavily digested food in the stomachs.

Norwegian Sea (Divisions IIa and IIb)

In December, on the continental slope, at 420-650 m depths, 9 fish were caught by bottom trawls. Of them, there were 2 males as long as 73 and 88 cm and 7 females 36-105 cm in length (85.1 cm, on the average).

Roundnose grenadier (Coryphaenoides rupestris)

The Rockall Bank (Sub-Division VIb1)

In September, in the fishery of gray gurnard, when hauling by bottom trawl at 235 m depth, four immature females with 5-6 cm pre-anal length were caught. The grenadier moderately fed on shrimps and jellyfishes (MISF was 2.3).

Roughhead grenadier (Macrourus berglax)

Subarea I

In September, in the site with the positions of 82°03'N and 40°23'E, two females as long as 34 and 36 cm were caught from 691 m depth.

Norwegian Sea (Divisions IIa and IIb)

That species was caught by bottom trawls at a depth of 540-720 m. The length of specimens varied from 16 to 78 cm (Figure 8), predominantly from 46 to 55 cm. Sex ratio was close to 1:2.

Blackspot grenadier (Coelorhinchus caelorhinchus)

The Faroese Fishing Zone (Subdivision Vb)

The species was caught in small amounts on the Lousy and Bill Baileys Banks, at 505-670 m depths. Males had the length of 25-35 cm and 31.8 cm, on the average, females – 24-39 cm and 34.4 cm, respectively (Figure 9). The number of mails was 1.4 times more than of females (Figure 10). All the studied individuals were mature (Figure 10). The grenadier poorly fed (MISF – 0.9) on gammarids, euphausiids, polychaetes and gastropods (Figure 11).

Silver scabbard fish (Lepidopus caudatus)

Josephine Bank (Subarea IXb)

In June-September, the fish occurred in small amounts in the catches by the pelagic trawl in the fishery of horse mackerel *Trachurus picturatus* and chub mackerel *Scomber japonica*, mainly when trawling in bottom layers (130-233 m).

Individuals as long as 56-117 cm (mainly, 65-85 cm) were caught (Figure 12).

In June-July, the fish with maturing gonads predominated. In the late August-September, the most of fish had the post-spawning gonads (Figure 13).

Feeding intensity was low. Mean index of stomach fullness equaled to 1.1. In the diet fish objects such as mictophides, curled picarel *Centracanthus cirrus*, boarfish *Capros aper*, horse mackerel juveniles predominated (Figure 14).

Big eye (Epigonus telescopus)

The Faroese Fishing Zone (Subdivision Vb)

Small amount of the fish occurred within the depth range of 505-520 m on the Lousy Bank. Individuals as long as 15-39 cm were registered. Most of them (74 %) were males with a mean length of 33.2 cm. Females and juveniles accounted for 13% for each group with a mean length of 30.7 and 17.0 cm, respectively.

Blue mouth (Helicolenus dactylopterus)

The Faroese Fishing Zone (Subdivision Vb)

The species was caught on the Lousy and Bill Baileys Banks, when bottom trawling at 505-670 m depths, in April-May. Males with the length of 18-34 cm and females as long as 19-36 cm were found in the catches (Figure 15). The mean weight amounted to 331 g.

Sex ratio was 1:0.9. Males, mainly, had maturing gonads or they were post-spawning. Majority of females (60%) were fertilized, the rest of them – maturing (Figure16).

Food (shrimps and amphipods) was found in the stomachs of single individuals (MISF was 0.1).

The Rockall Bank (Sub-Division VIb1)

In August, single specimens with 14-20 cm length were registered in the catches by bottom trawl at 200-235 m depths. The mean length of males was 16.3 cm, of females – 16.7 cm. In all, 11 males and 6 females were examined.

Other species

The Faroese Fishing Zone (Subdivision Vb)

In April-May, in the deep-water fishery, silver roughy *Hoplostethus mediterraneus* with 19 cm length and black scabbardfish *Aphanopus carbo* female 101 cm length were found in the catches as single specimens.

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Stehmann, M.F.W. 2002. Proposal of a maturity stages scale for oviparous and viviparous cartilaginous fishes (Pisces, Chondrichthyes). Arch. Fish. Mar. Res. 50(1):23-48.

Table 1. Russian catches (t) of deep-sea fish in 2012 (preliminary data)

Species	ICES areas								
	I	IIa	IIb	Vb	VIa	VIb1	X	XIVb2	Total
Greater silver smelt				110	1				111
Tusk	+	48	40						88
Ling		45	+						45
Blue ling				5					
Roughhead grenadier								18	18
Blue mouth (as “other red-fish” in the reports)				2					
Rabbitfish				11					
Total	+	93	40	128	1	-	-	18	280

+ — catches under 0.5 t

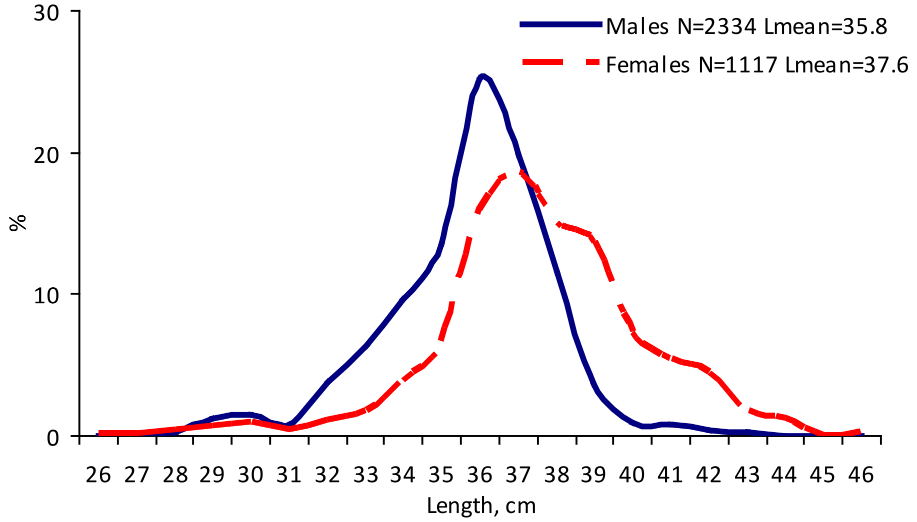

Figure 1. Length composition of Greater silver smelt from commercial bottom trawl catches in the Faroese FZ in April-May 2012

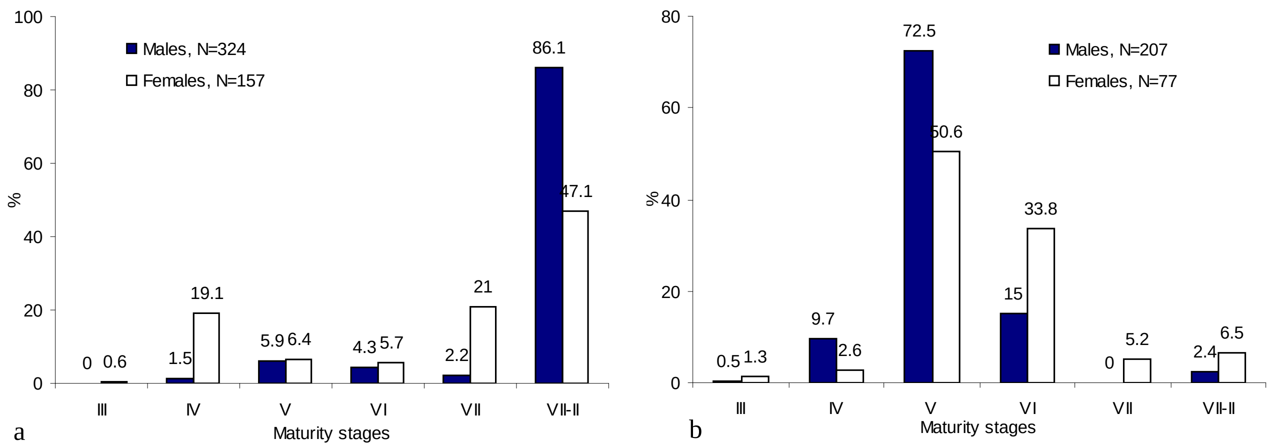

Figure 2. Maturity of Greater silver smelt from commercial bottom trawl catches in the Faroese FZ in April-May 2012 (a- Lousy Bank, b- Bill Bailey Bank)

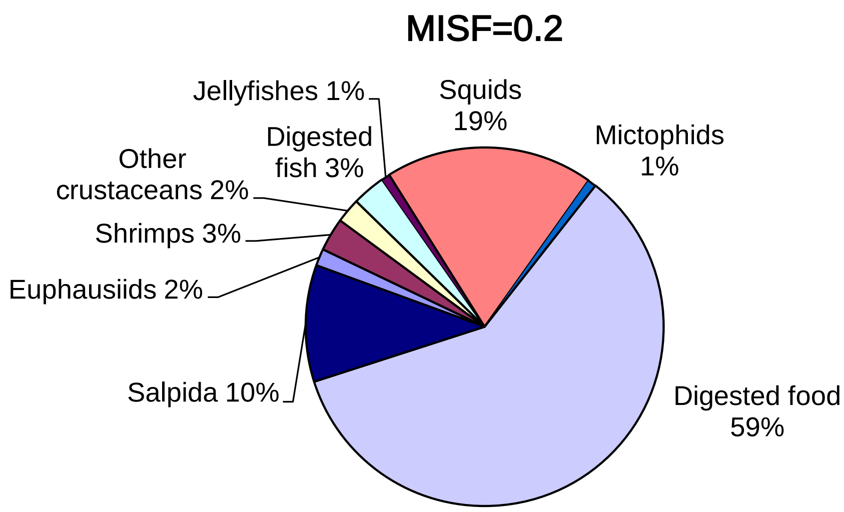

Figure 3. Food composition (% by occurence in stomach with food) Greater silver smelt from commercial bottom trawl catches in the Faroese FZ in April-May 2012

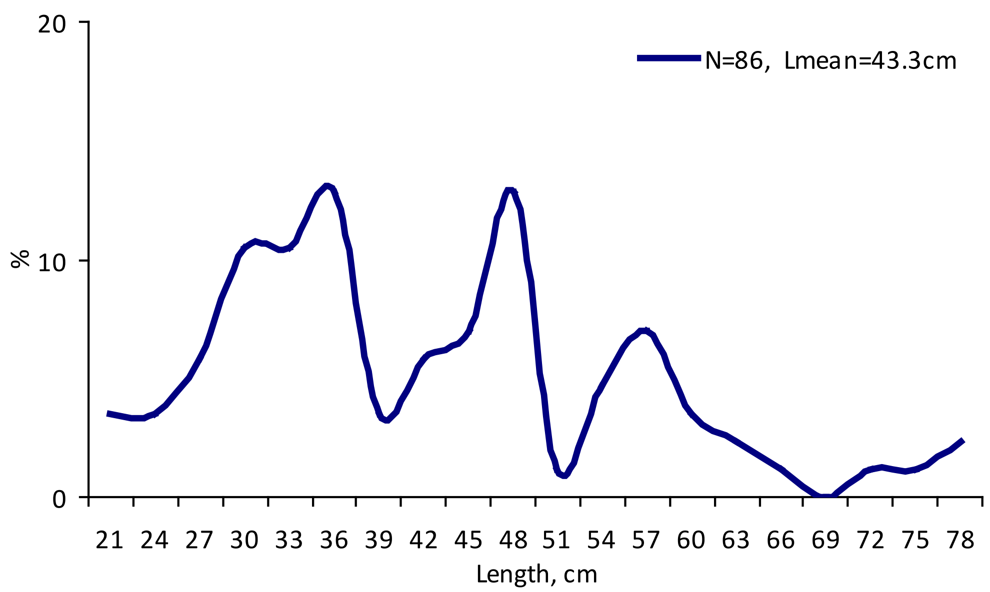

Figure 4. Length composition of Greater forkbeard from bottom trawl catches in the Faroese FZ in April-May 2012

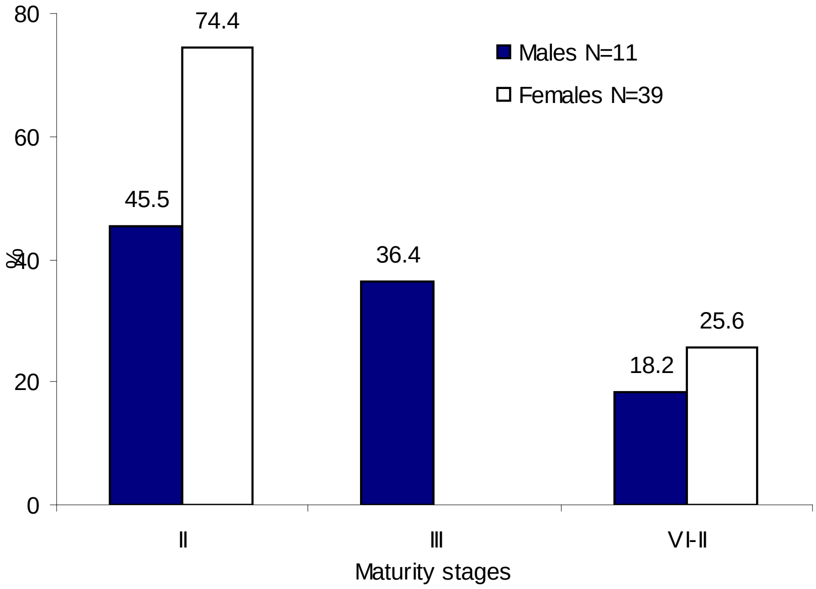

Figure 5. Maturity of Greater forkbeard from bottom trawl catches in the Faroese FZ in April-May 2012

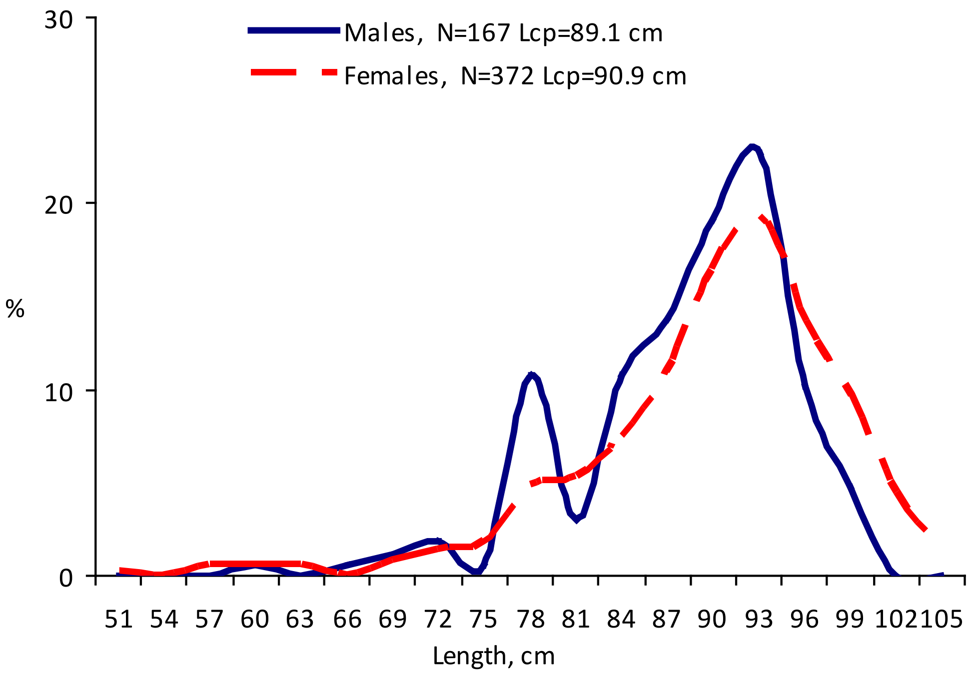

Figure 6. Length composition of Rabbitfish from bottom trawl catches in the Faroese FZ in April-May 2012

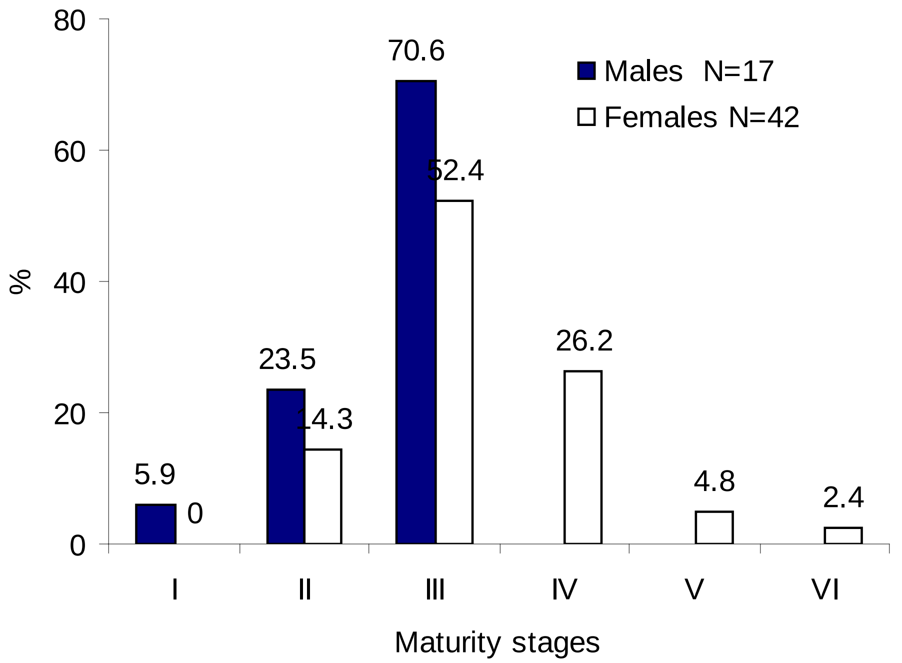

Figure 7. Maturity of Rabbitfish from bottom trawl catches in the Faroese FZ in April-May 2012

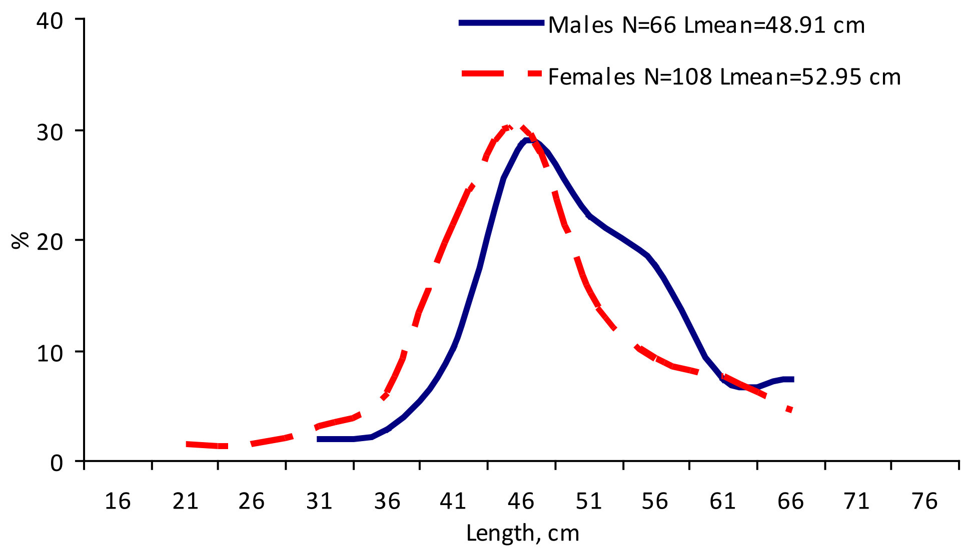

Figure 8. Length composition of Roughhead grenadier from bottom trawl catches in ICES IIa & IIb in February-December 2012.

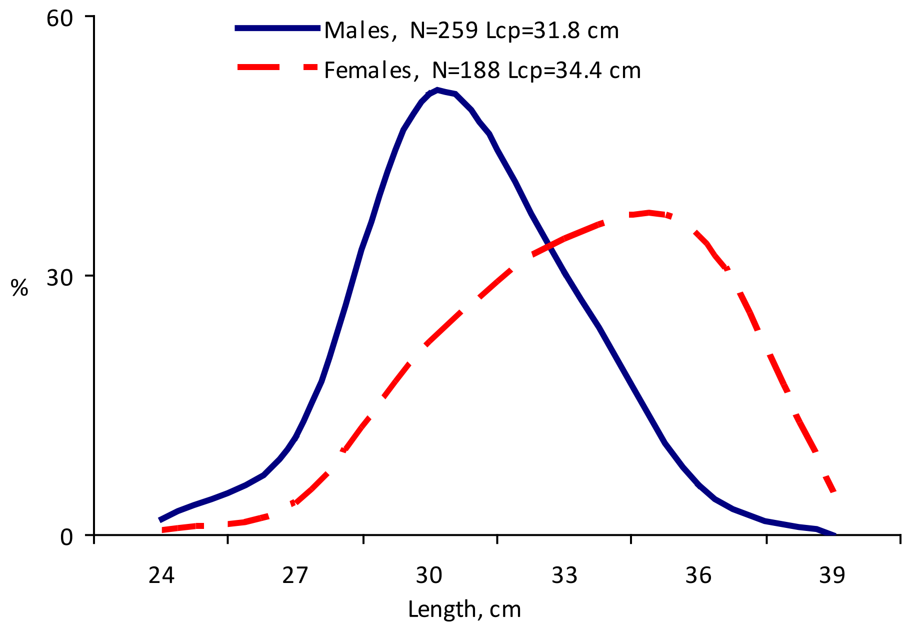

Figure 9. Length composition of Blackspot grenadier from bottom trawl catches in the Faroese FZ in April-May 2012

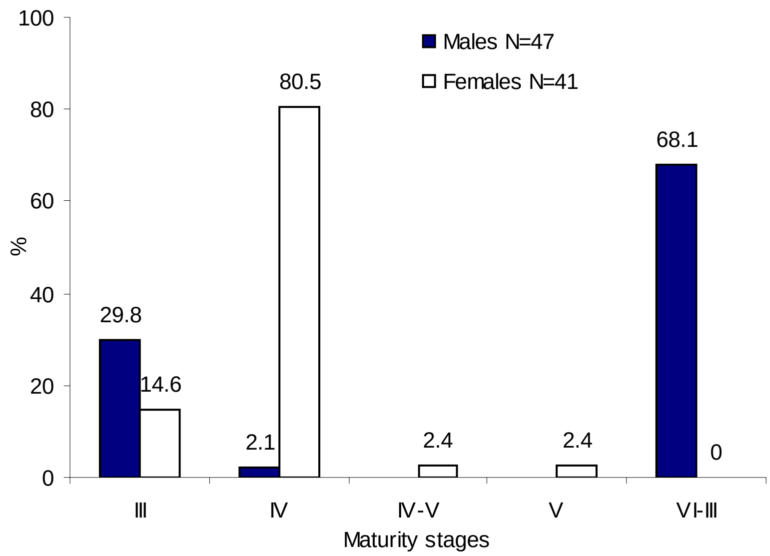

Figure 10. Maturity of Blackspot grenadier from bottom trawl catches in the Faroese FZ in April-May 2012

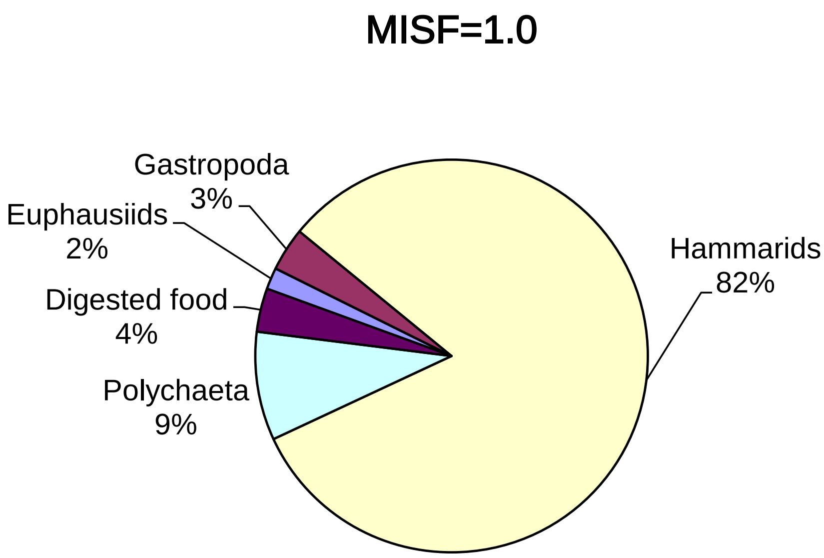

Figure 11. Food composition of Blackspot grenadier from bottom trawl catches in the Faroese FZ in April-May 2012, % by occurency

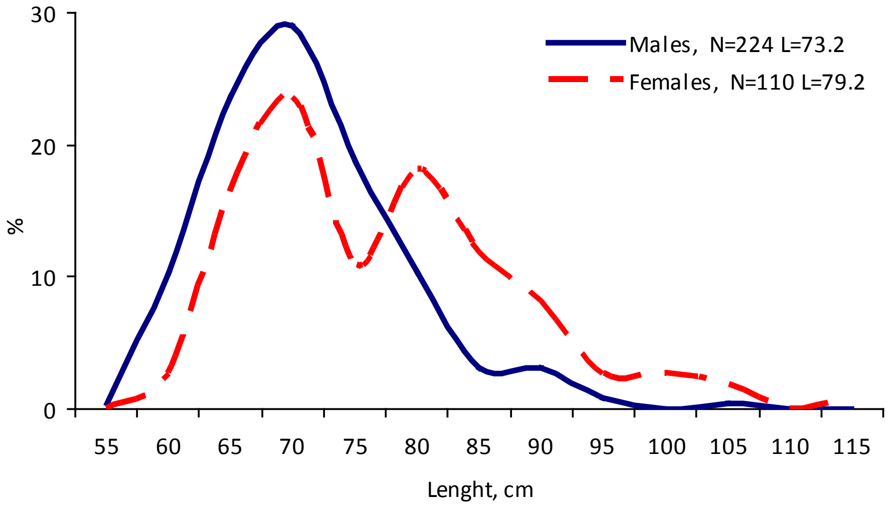

Figure 12. Length composition of Silver scabbard fish on the Josephine Bank in June-September 2012

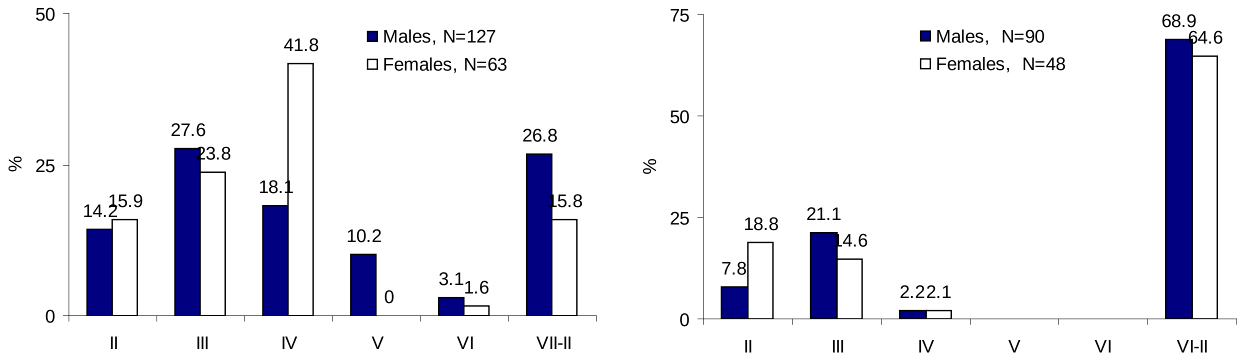

Figure 13. Maturity of Silver scabbard fish on the Josephine Bank in June-July(a) and August-September (b) 2012

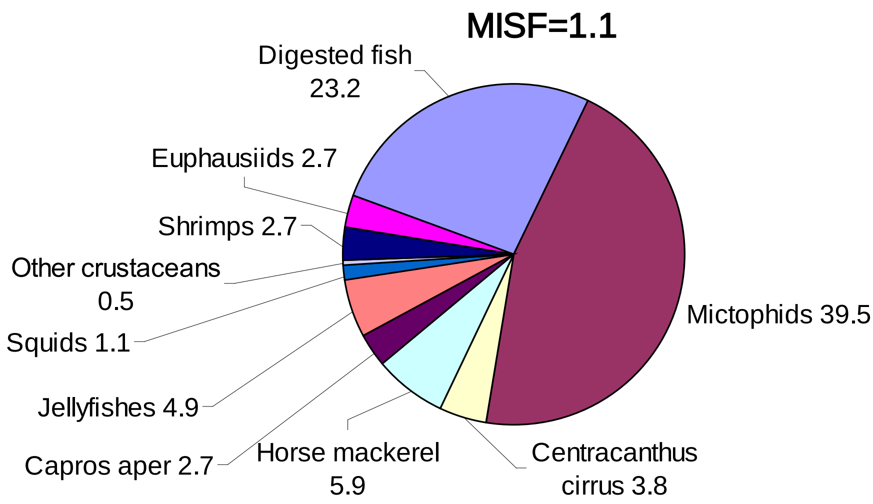

Figure 14. Food composition of Silver scabbard fish on the Josephine Bank in June- September 2012, % by occurency

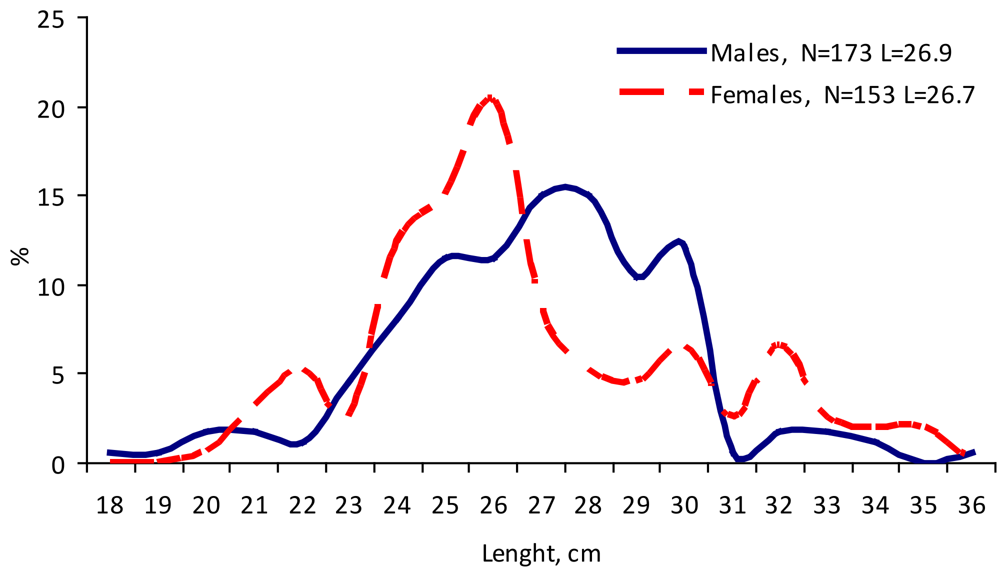

Figure 15. Length composition of Bluemouth from bottom trawl catches in the Faroese FZ in April-May 2012

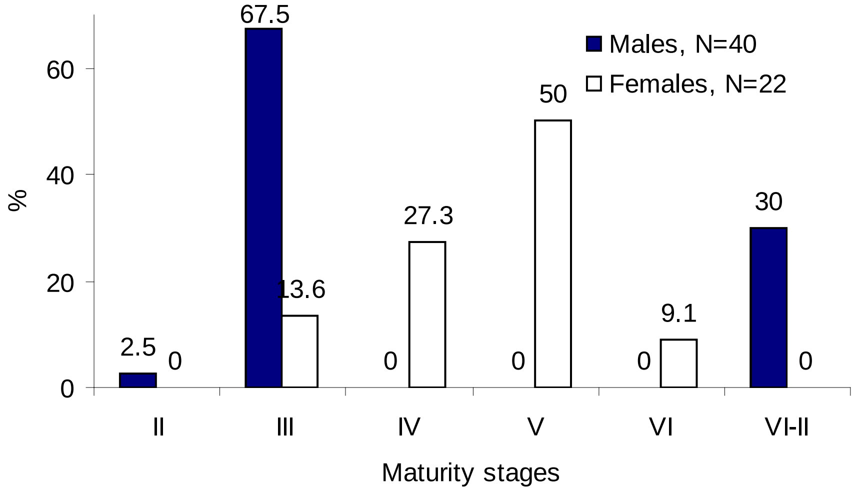

Figure 16. Maturity of Bluemouth from bottom trawl catches in the Faroese FZ in April-May 2012

Info about length distributions and CPUE from groundfish surveys and commercial catches for tusk, blue ling, grenadier and black scabbard fish in Faroese waters (Vb).

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Introduction

The objective for this document is to provide information on the length distributions and CPUE indices of 1) tusk, 2) blue ling in Faroese waters from the annual groundfish surveys and commercial fishery logbooks and CPUE indices for 3) grenadier and 4) black scabbard fish from commercial fishery logbooks.

Groundfish 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 1). 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 are standardized according to number of stations in each stratum and weighted with strata area for all the different strata.

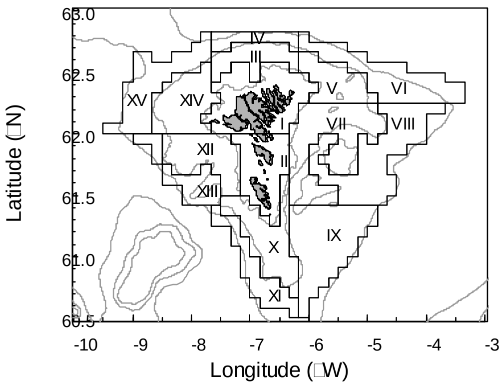

Figure 1. Stratification of the Faroe Plateau in the groundfish surveys.

Commercial fishery logbooks

The 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 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.

1 Tusk

Mean length in the spring and summer groundfish surveys varied between 43 to 53 cm (Figure 1.1 and 1.2). 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 total catch and thereafter multiplied up to the total catch weight. There was few fish caught less than 30 cm, so no abundance indices (recruitment) on juvenile tusk from the spring survey. Abundance indices need further investigations.

The mean lengths from the landings by the longliners varied from 46 to 51 cm, and there was no downward trend in mean lengths with year (Figure 1.3). The main catches are within the lengths between 40 and 60 cm.

The abundance indices (CPUE) from the groundfish surveys do not show the same trend as the longline CPUE (Figure 1.4 and 1.5). The CPUE in 2012 is decreasing compared to the years before for both the spring and summer surveys.

The commercial CPUE is based on 5 longliners, and data was selected where tusk was in the catch and 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 2012 has been quite stable around 50 kg/1000 hooks for these 8 years (Figure 1.5).

In 2010-2012, tusk was mainly fished by longliners (about 90%). The remaining was fished 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. As the Norwegian longliners are not allowed to fish inside the Faroese EEZ in 2011 and 2012, the Faroese longliners fish in area where the Norwegian longliners used to fish.

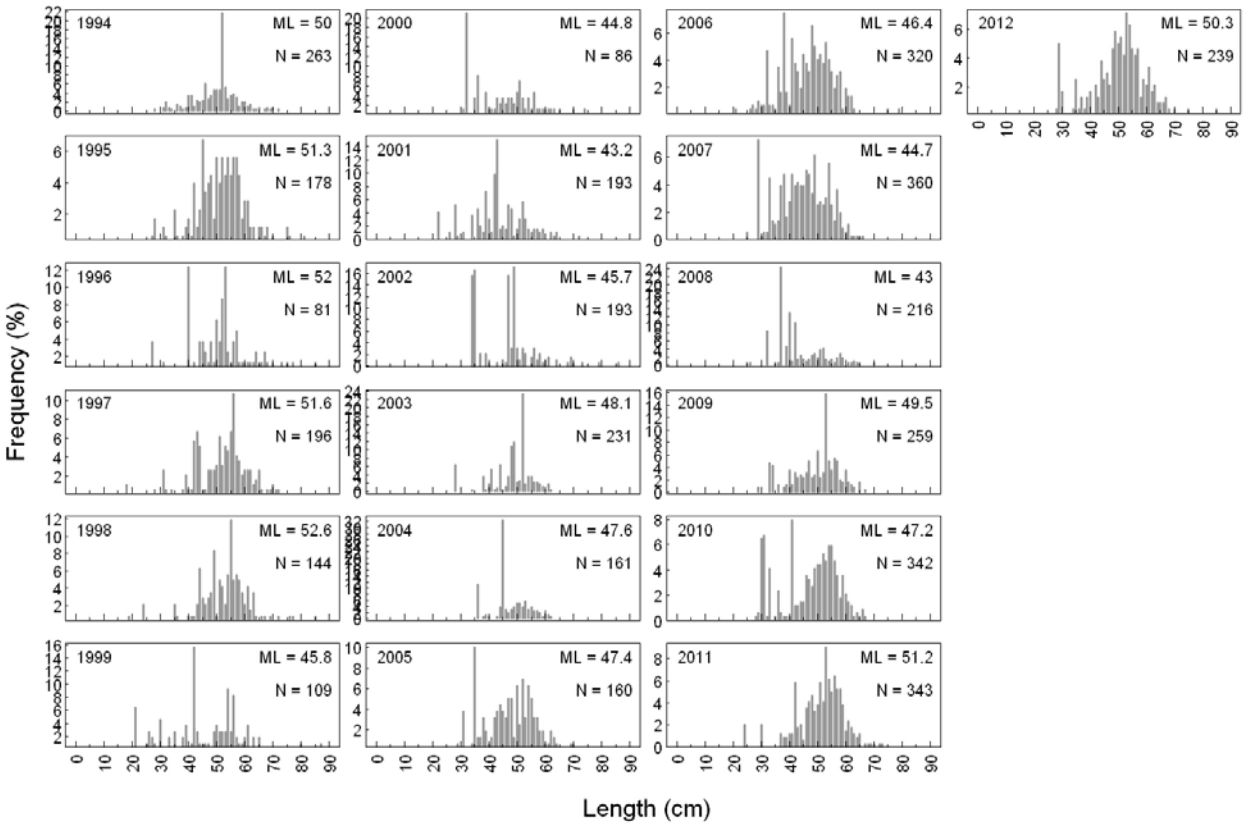

Figure 1.1. Tusk Vb. Length distribution in the spring groundfish surveys.

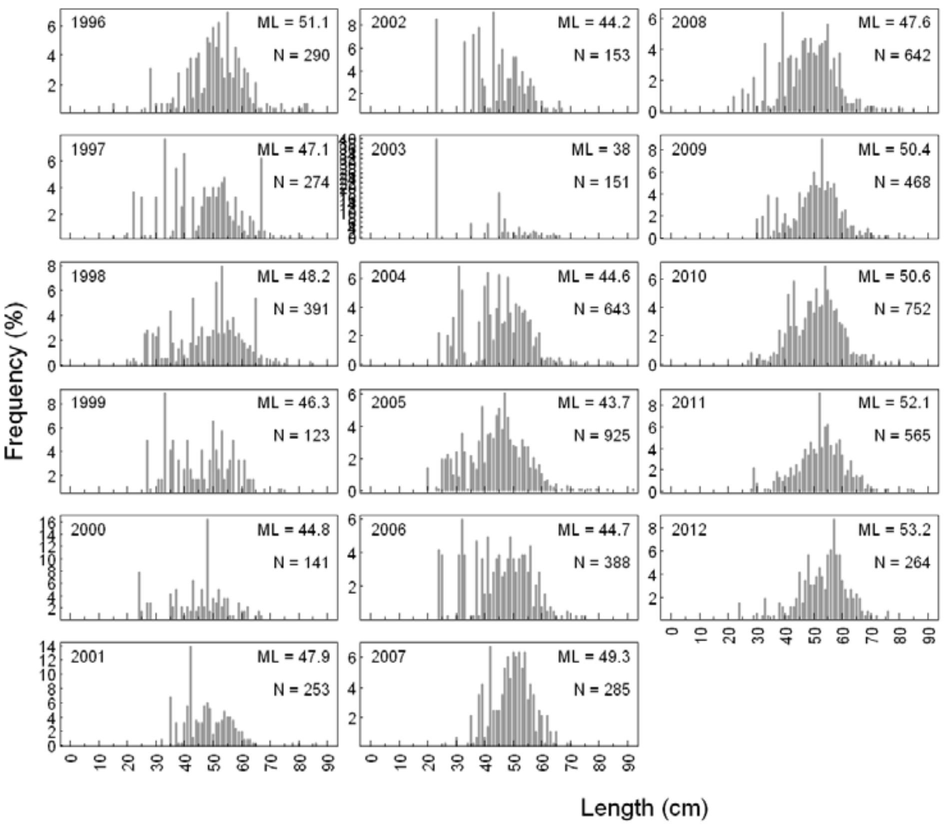

Figure 1.2. Tusk Vb. Length distribution in the summer groundfish surveys.

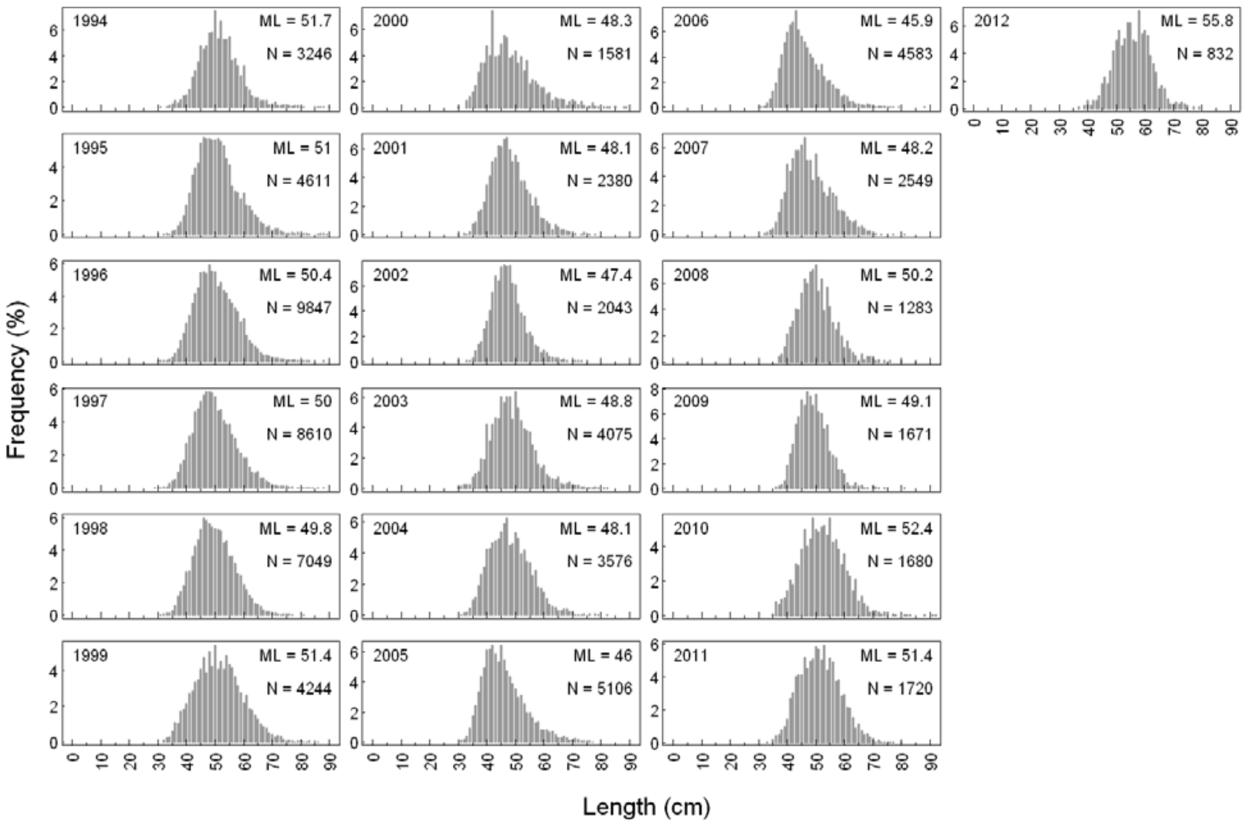

Figure 1.3. Tusk Vb. Length distribution from the fishery by longliners (>100 BRT).

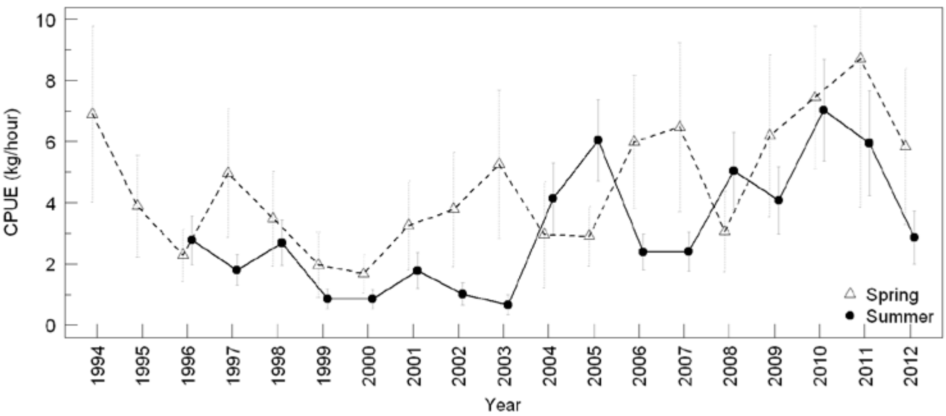

Figure 1.4. Tusk Vb. CPUE from the groundfish surveys

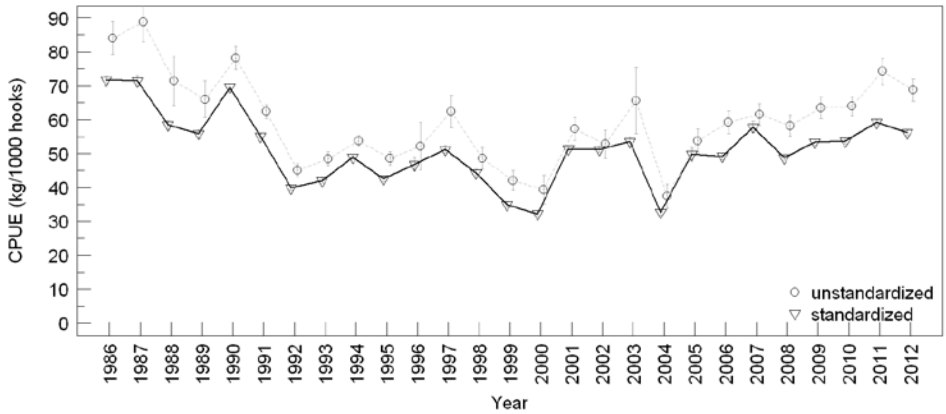

Figure 1.5. Tusk Vb. Standardized CPUE for 4-5 longliners (<110 GRT) fishing in Faroese waters. Criteria: tusk was in the catch, ling+tusk>60% of total catch and the depth was >200 m.

2 Blue ling

The mean length of blue ling from the spring and summer survey was between 53 to 80 cm (Figure 2.1 and 2.2). 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. There could maybe be a sign of a good yearclass in the length distribution as 40-50 cm in spring 2012 and 50-60 cm in summer survey 2012 (Figure 2.1 and 2.2). The number of juveniles (<80 cm) increased in the catch in 2008 to 2012 in the spring survey and partly also in the summer survey (Figure 2.3).

The mean lengths in the landings of the trawlers varied from 88 to 103 cm in the period 1989-2011. There was no length measurements in 2012. There was no decreasing trend in mean lengths with year (Figure 2.4). The main length group in the catches from 2001- present is from 80 to 110 cm. There were also a few length samples available from gillnet and longline fisheries.

The abundance indices (CPUE) from the groundfish surveys do not show the same trend over years as the commercial fleet (Figure 2.5). The CPUE in 2012 is above mean CPUE for the whole period for both spring and summer surveys.

The commercial CPUE is from deepwater trawlers. Only data where blue ling was more than 30% of the total catch was used. The CPUE for 2009-2010 are at the same level as average CPUE for the whole period, while 2011 are above average and 2012 at average (Figure 2.6).

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. Blue ling is mainly fished on the slope around the Faroes Plateau and around the Faroe Bank.

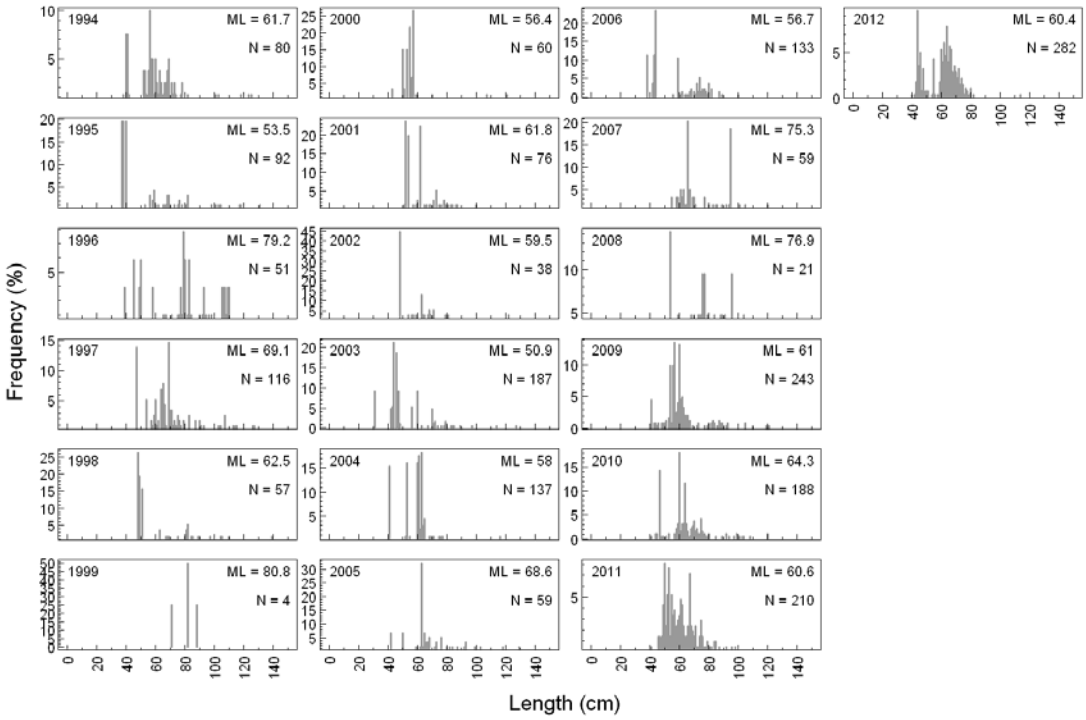

Figure 2.1. Blueling Vb. Length distribution from the spring groundfish surveys.

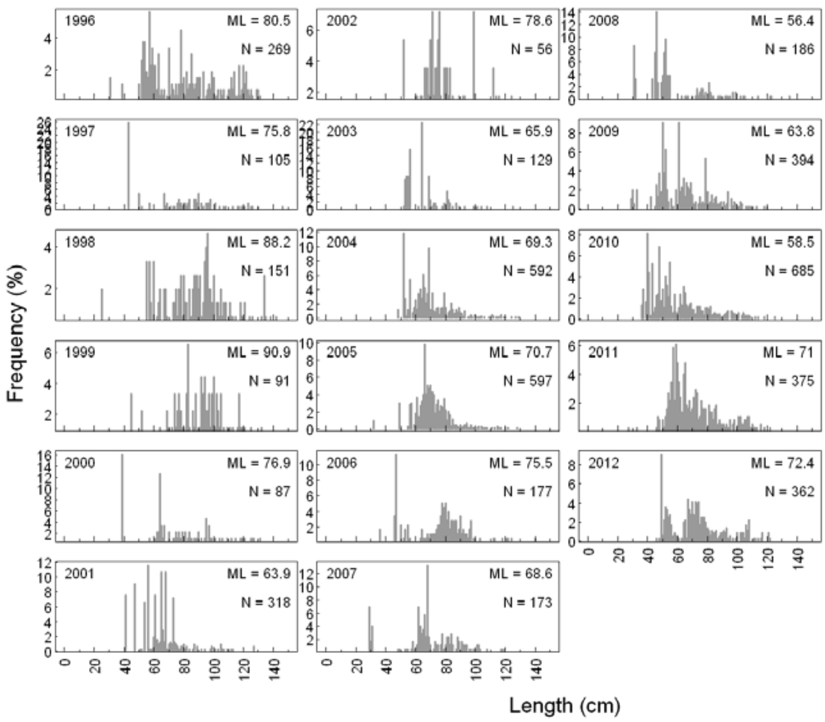

Figure 2.2. Blueling Vb. Length distribution from the summer groundfish surveys.

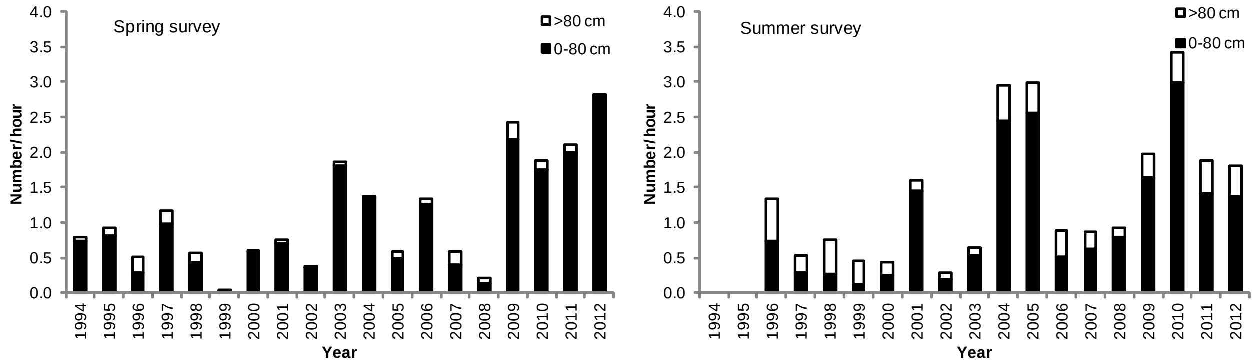

Figure 2.3. Blueling Vb. Number of juvenile (<80 cm) and adult (>80 cm) fish caught in the Faroese groundfish survey on the Plateau from a) spring and b) summer.

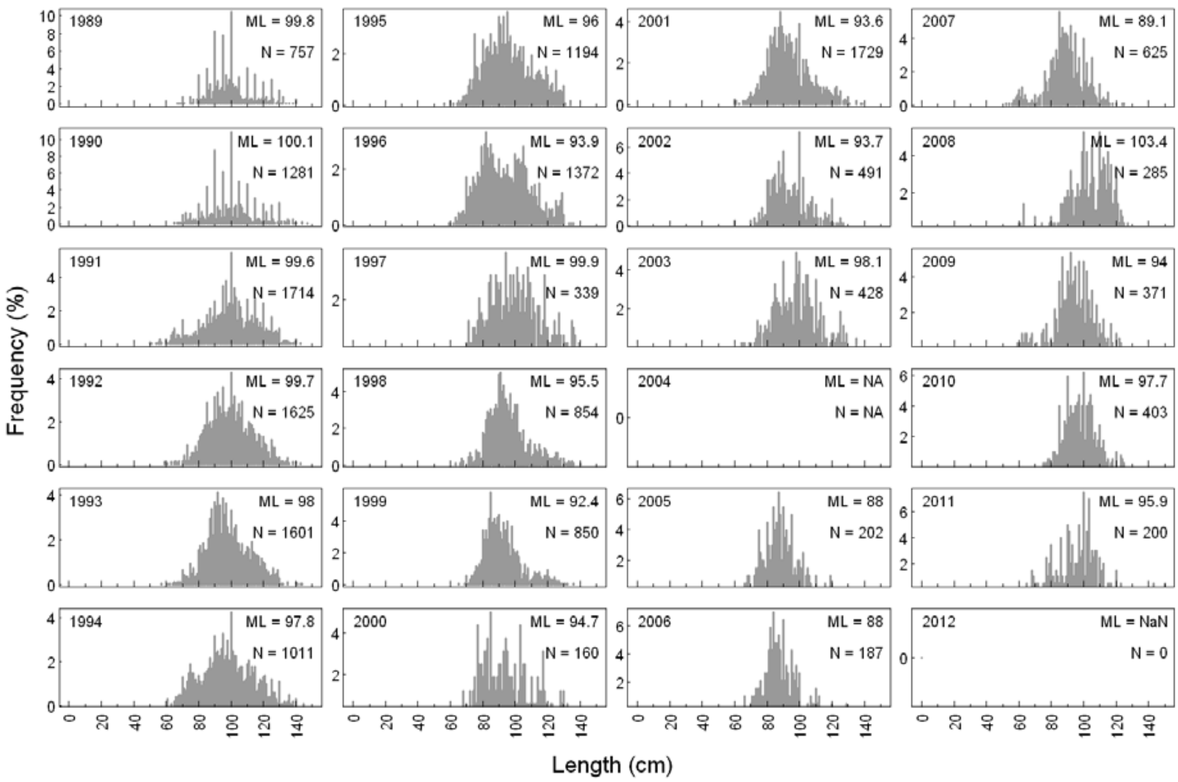

Figure 2.4. Blueling Vb. Length distribution from commercial trawlers

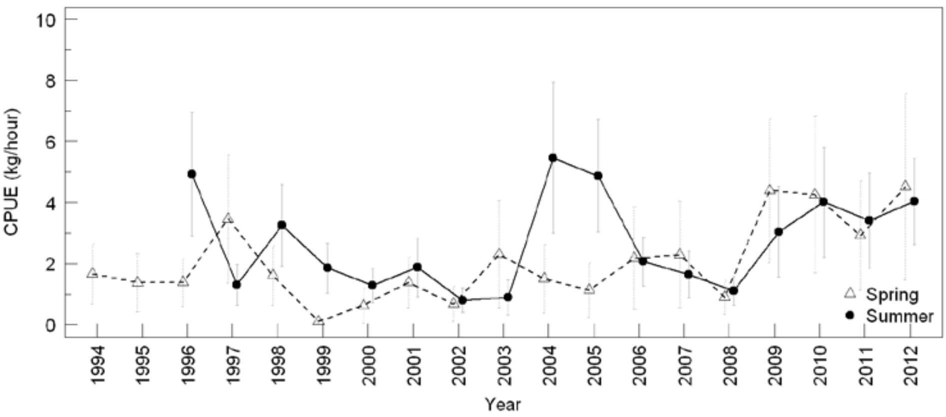

Figure 2.5. Blueling Vb. CPUE from the groundfish surveys.

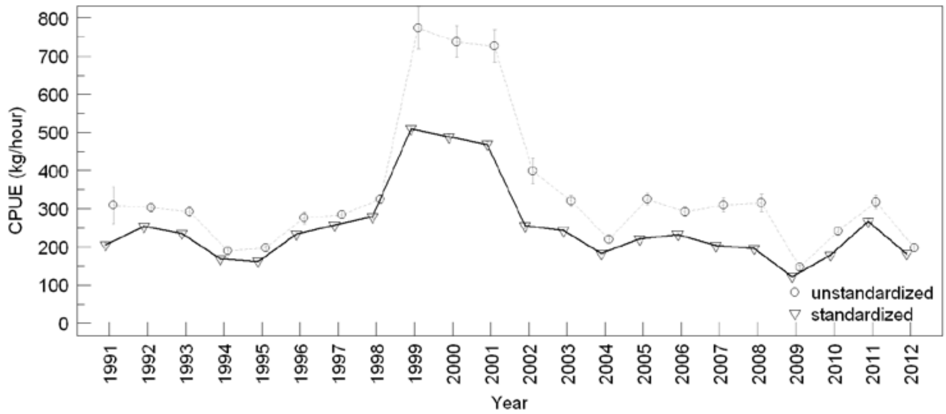

Figure 2.6. Blueling Vb. Standardized CPUE for trawlers (>1000 HK) fishing in Faroese waters. Criteria: >30% blueling in the catch.

3 Roundnose grenadier

The commercial CPUE series is from trawlers, where the criteria were that grenadier contributed more than 30% of the total catch. The CPUE for the period 2009-2010 are the same as average CPUE for the whole period; while CPUE in 2011 is above average (Figure 3.1).

Roundnose grenadier is only fished by large trawlers and the main fishing area is on the slope around the Faroe Bank.

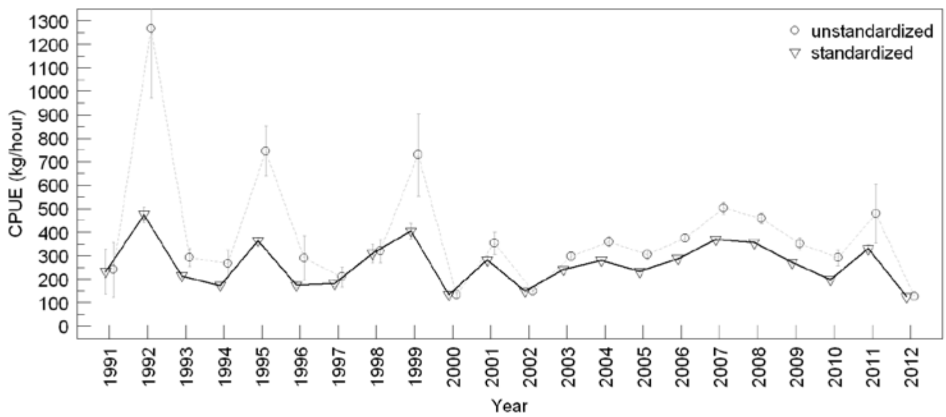

Figure 3.1. Roundnose Grenadier Vb. CPUE from otterboard trawlers. Criteria: >30% of roundnose grenadier in the catch.

4 Black scabbardfish

The commercial CPUE is 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 about the same level as average CPUE for the whole period, while the CPUE for 2011 and 2012 is above average (Figure 4.1).

Black scabbardfish is only fished by large trawlers and the main fishing area is on the slope around the Faroe Bank.

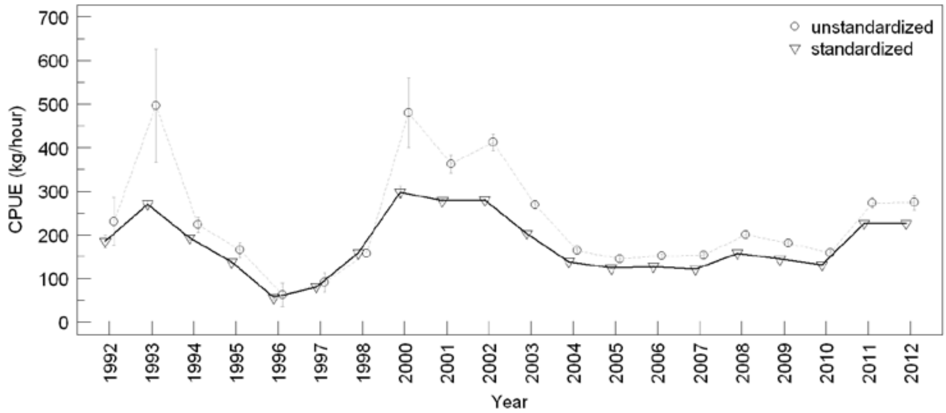

Figure 4.1. Black scabbardfish Vb. CPUE from otterboard trawlers (> 1000 HK). Criteria: black scabbardfish >30% of total catch per haul.

ICES WGDEEP, Copenhagen 2013

The development of the Norwegian longline fleet 2000-2012

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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 three 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).

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 the abundance of these stocks, 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 whether the selected series actually is trackings the abundance of the entire stock.

Development of the Norwegian fleet of longliners, 1977- 2012

In addition to data on total landings*, the NDF also provides data on how many fishing vessels satisfying the above criteria participated in the fishery, the gear employed, areas fished and changes in vessel ownership. In Table 1 are the numbers of long liners during the period 1977 to 2012, 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 there after the number decreased to 35 in 2006. Since 2006 the number of vessels seemed have stabilized.

The number of vessels declined mainly because of changes in the law concerning quotas for catching cod. The decrease in vessels was followed by a reduction in total catches until 2004; afterwards there was an increase in total catch, 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, after that the catches have remained relatively stable (Figure 3b).

* The data provided by the NDF are; the total landed catch, the logbook data, and the catch along with its location.

In 2012 new regulations were initiated and the number of cod quotas each vessel can own was raised from 3 to 5. This is believed to have led to a further reduction of the longline fleet from 36 to fewer than 30.

Logbooks

All available logbooks for the years 2000-2012 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 in the longline fleet. The Norwegian Directorate of Fisheries has received these 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 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 a declining trend since 2007, most likely because of the record large stock size of Arcto Norwegian cod.

Division IIa has been the main fishing area since 2000, followed by IVa and Vb. For both ling and tusk the number of fishing days has increased in the areas closest to Norway i.e. areas IIa and IVa.

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 2000-2012. For all areas combined there was a steady increase in the number of hooks used from 2000 through 2009. There was also similar trends in 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 2012 (Figure 6).

Total number of hooks per year

Based on the number of vessels, the number of hooks per day, and 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 gives the estimated number of hooks (in thousands) set in each of the ICES subareas and in the total for all areas for the years 2000-2012. During the period 1974 to 2012 the total number of hooks per year has varied considerably, but with no clear trend (Figure 6).

The size of the vessels

There has been a steady increase in the average size of the fishing vessels from 34 m in 1977 to almost 43 m in 2012. Figure 7 show the average size of the vessels and the smallest and the largest vessel in the fleet for the period 1977 to 2012.

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. Because of the reductions in; the number of vessels (52 % 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. In 2011 the number of vessels increased to 37; however, the number of days in the fishery and the number of hooks set per day declined, and it is therefore likely that the total effort stayed at the same level as in 2009. 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 has declined to the 1998-level.

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 1995-2012 (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

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
I	**3**	**1**	**5**	**5**	**6**	**5**	**1**	**5**	**4**	**6**	**4**	**12**	**9**
IIa	**34**	**57**	**66**	**58**	**60**	**69**	**67**	**89**	**92**	**87**	**93**	**103**	**78**
IIb	1		2		1	2	1	3	4	2	2	4	4
IVa	18	22	28	19	21	25	37	26	30	56	2	21	25
IVb	1			2						2			
Va		1		3	2	2	3	2	4	2	3	2	2
Vb	11	18	20	25	34	21	11	15	14	4		1	2
VIa	12	14	12	12	14	23	13	10	15	7		9	5
VIb	4	6	8	5	5	8	7	6	5	2	4	4	4
VIIc	2	1			1	0		0					1
XII	1	3											
XIVb	2	1	2	1	3	3				1	2		2
All areas	88	124	141	130	148	158	140	157	169	159	112	155	132

Ling	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
IIa	23	40	50	40	37	51	54	65	52	65	70	73	59
IIIa	+			1					1	1			
IVa	19	22	29	20	22	25	38	27	25	49	3	21	26
IVb	1	+		1				3				3	1
Va		1		3	2	2	3	2	4	2	3	4	2
Vb	12	17	18	24	34	21	11	15	11	4		2	2
VIa	13	13	11	12	14	23	13	10	9	7		8	5
VIb	4	5	7	4	5	8	7	6	2	2	7	4	5
VIIc	3	1			1	+		1					1
All areas	76	100	114	104	115	126	126	128	104	130	83	113	98

Blue ling	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
IIa	1	1	1	1	+	+	1	1	2	1	2	2	1
IVa	1	+	1		1	1	2	2	4	4	1	2	2
Va		1		1	2	1	2	1	3	2	2		
Vb	4	3	4	5	5	1	4	5	4	3		1	2
VIa	9	6	4	8	6	10	8	6	10	6		7	5
VIb	1	1	2	2	+		+	1					
XII	2	5		2									
XIVb	+		+	+	+	+			1	1	2		1
All areas	18	15	11	14	14	14	18	16	25	17	7	12	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 2000-2012 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

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 2000-2012.

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

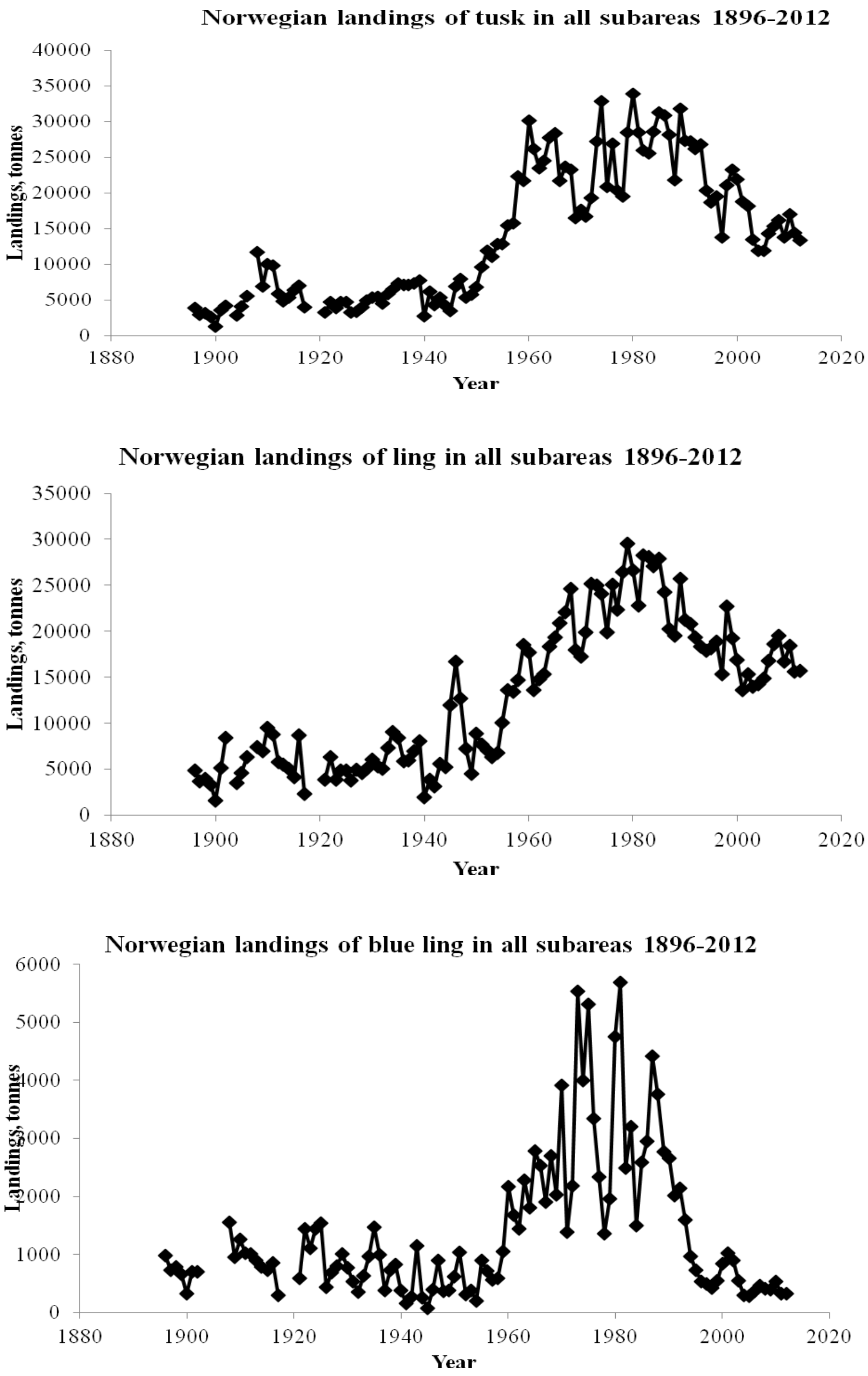


Figure 1. Reported Norwegian landings of tusk, ling and blue ling for the period 1896 -2012.

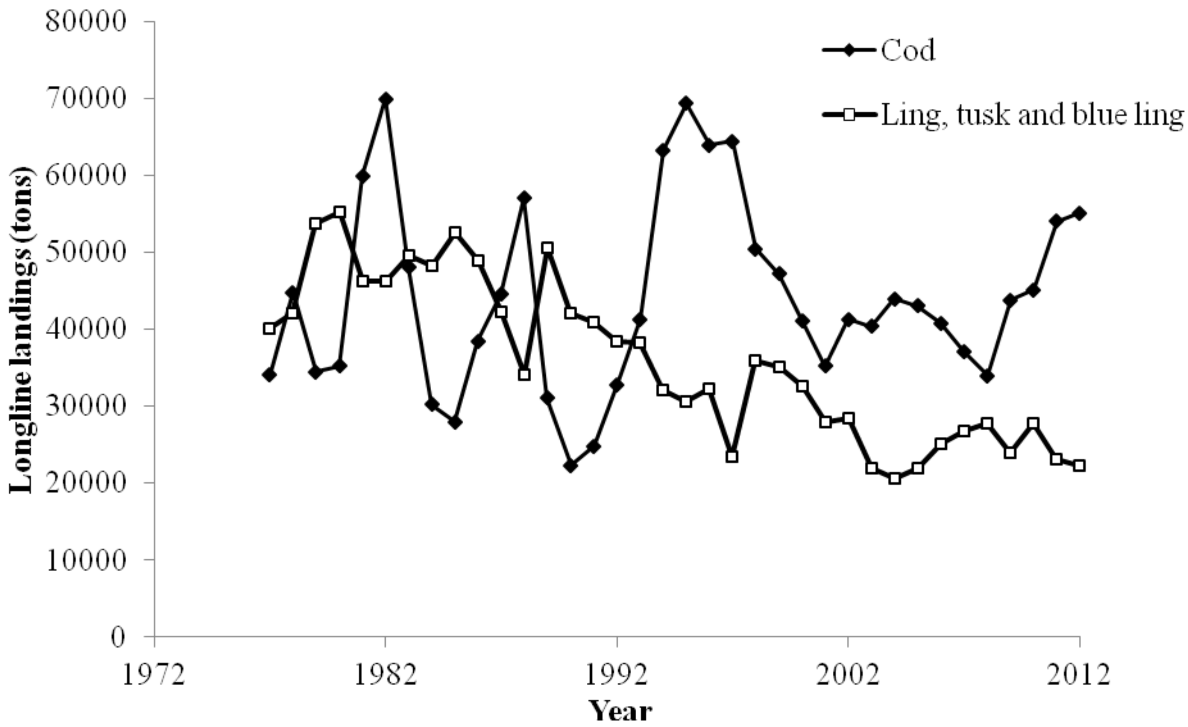
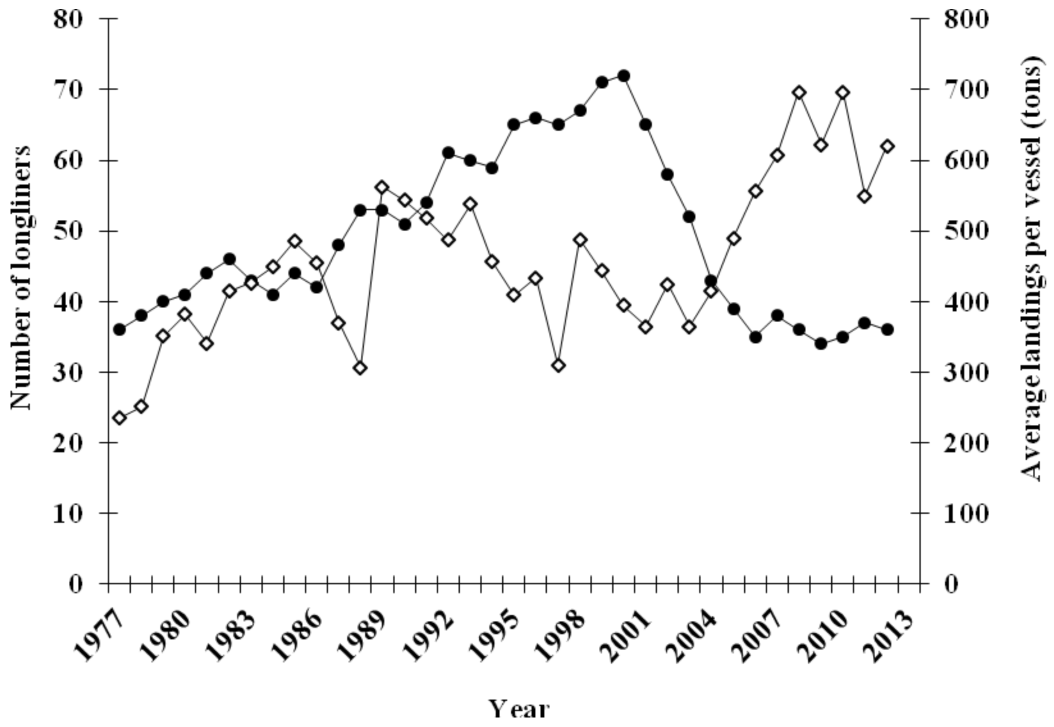


Figure 2. Total landings by longliners of cod (diamonds) and the combined total landings of ling, tusk and blue ling (open squares) for the period 1977- 2012.



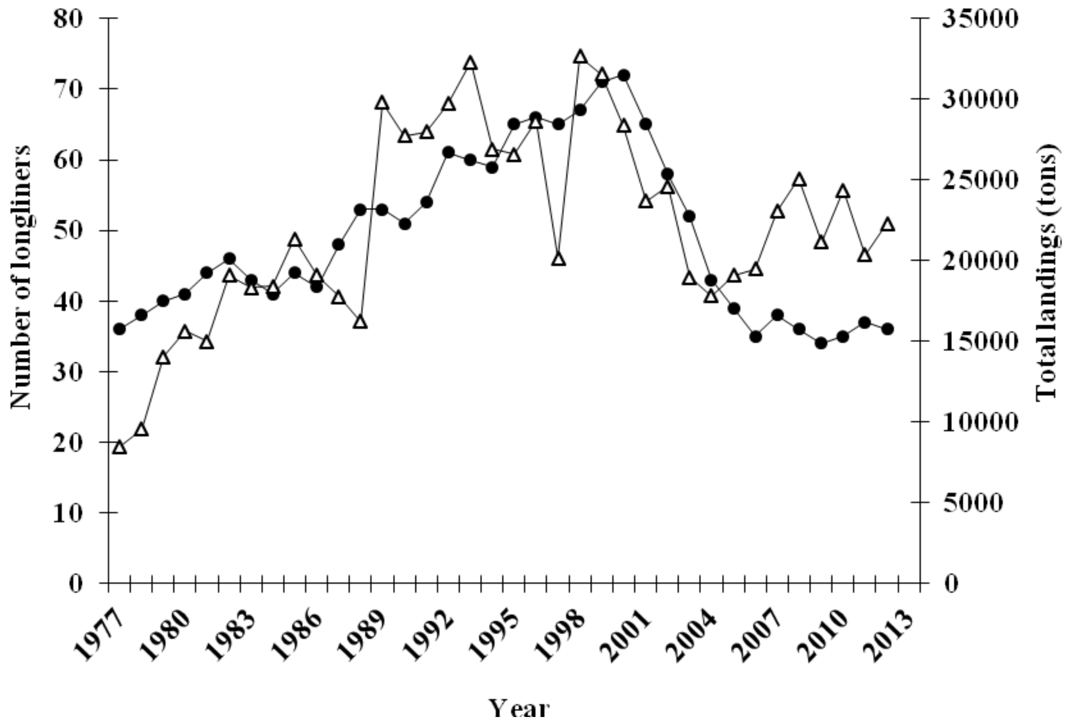


Figure 3. a) The number of long liners (filled circles) and average landings per vessel of ling and tusk (open diamonds) in the period 1977-2012 and, b) the number of longliners and the total landings of ling and tusk (open triangles).

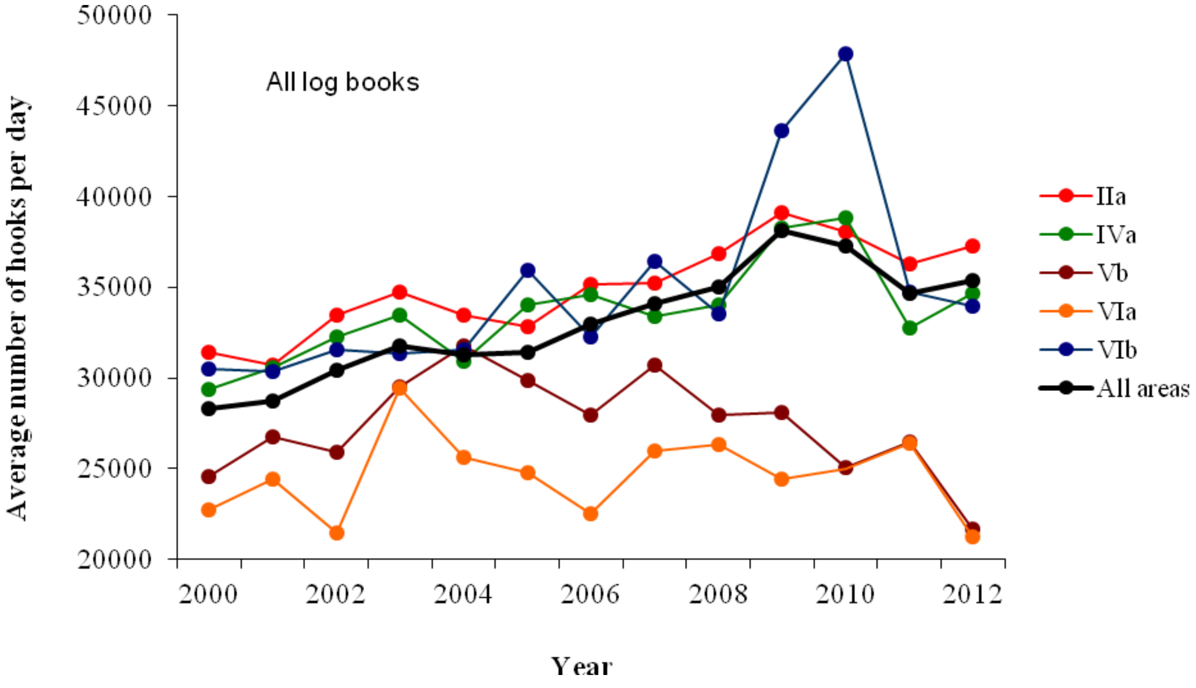


Figure 4. Average number of hooks the Norwegian longliner fleet used per day in each of the ICES subareas and in the total fishery for the years 2000-2012 for the fishery for tusk, ling and blue ling.

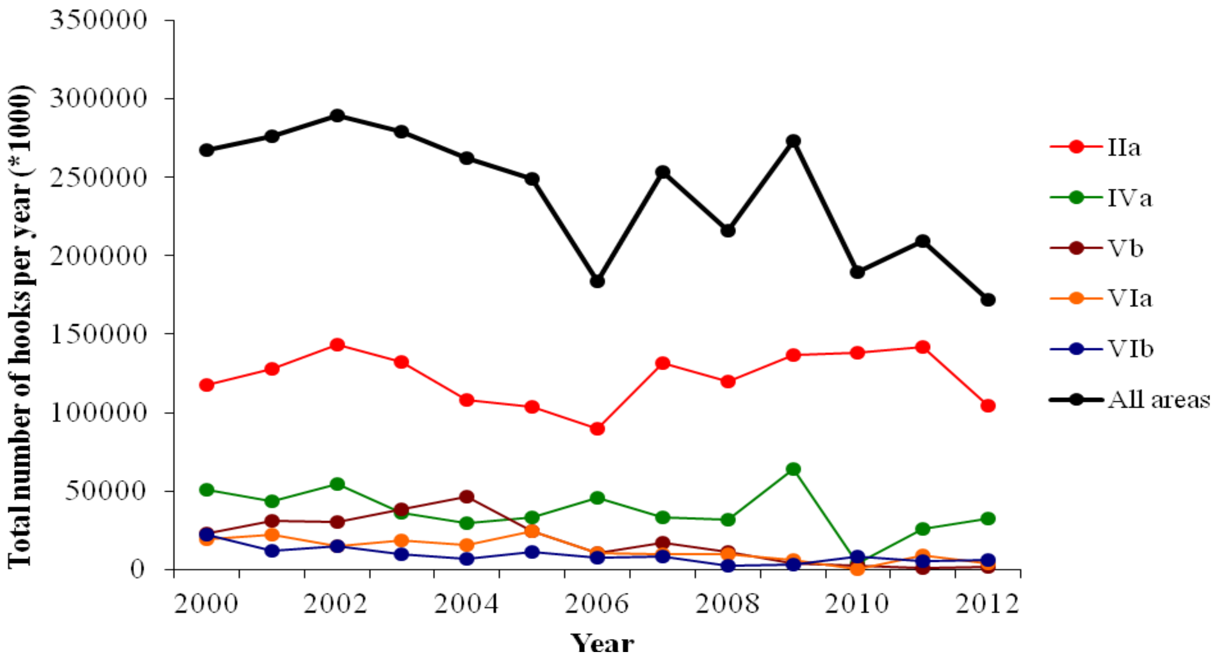
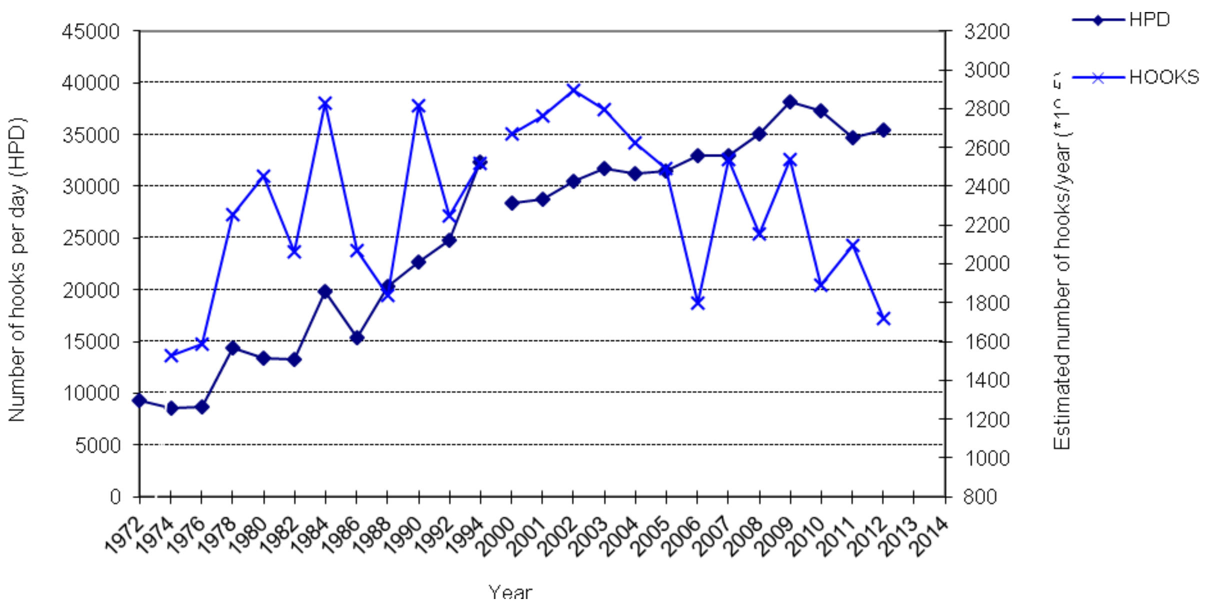


Figure 5. Estimated total number of hooks (in thousands) the Norwegian longliner fleet used in the ICES subareas with highest catches and in the total fishery for the years 2000-2012 for the fishery for tusk, ling and blue ling.

a.



b.

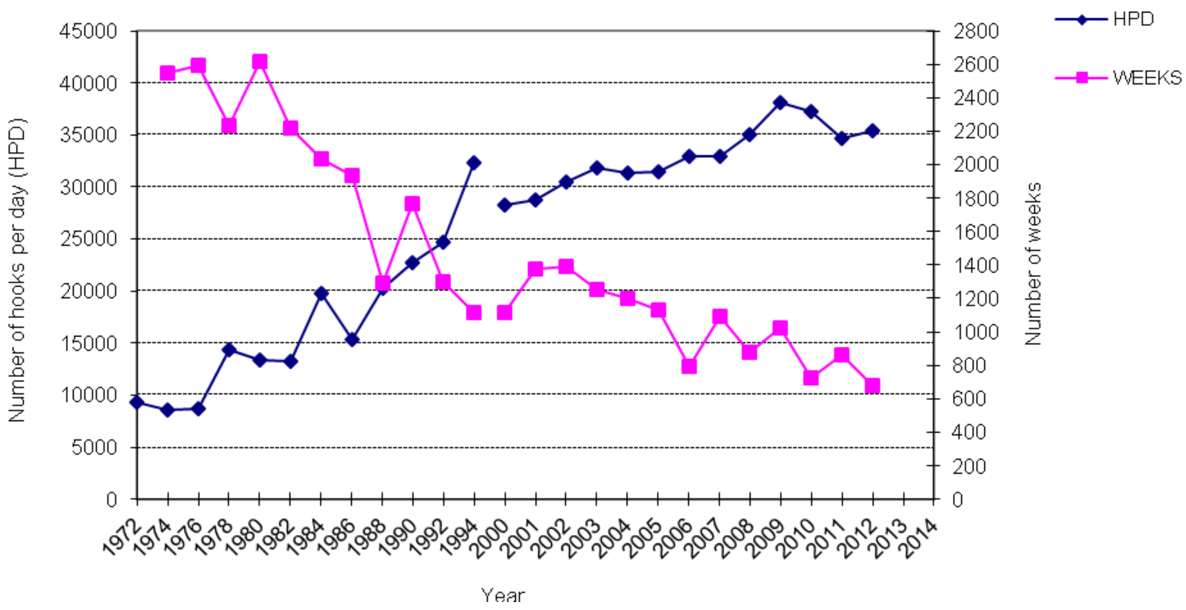


Figure 6. The combined time series for 1972-1994 (Bergstad and Hareide, 1996) and the series based on data from 2000-2012. a) The numbers of hooks used per day and the total number of hooks used per year. b) The numbers of hooks used per day and the total number of weeks the long liners participated in the fishery for ling and tusk.

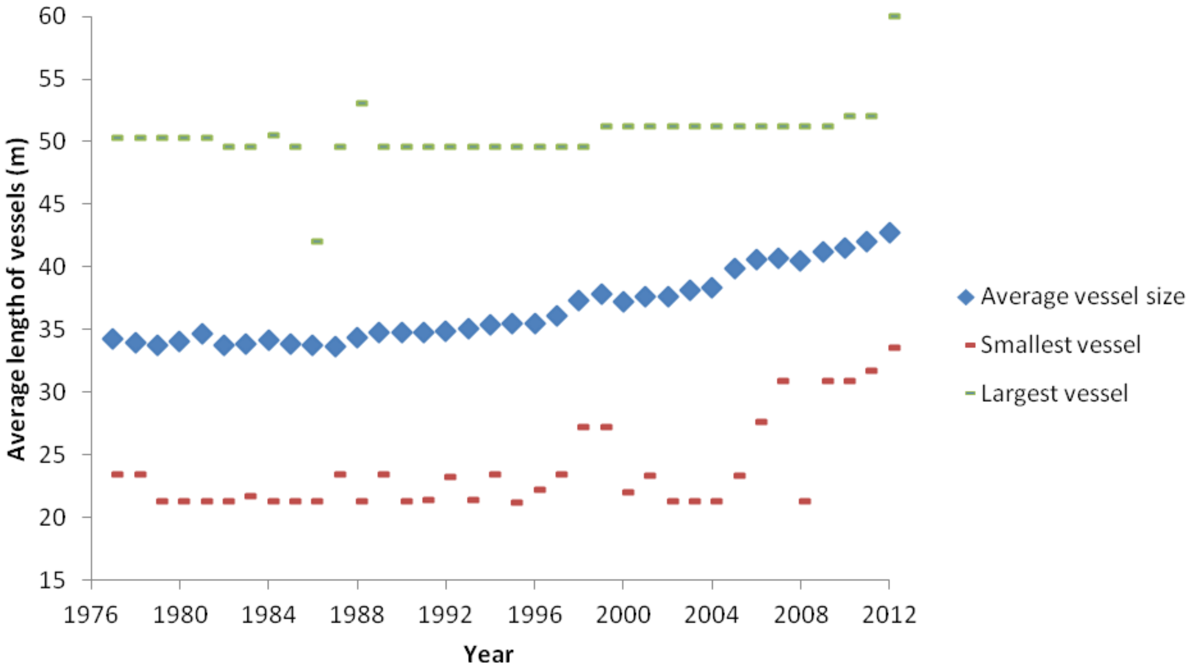


Figure 7. Average size of longliners >21 m for the period 1977-2012.

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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). 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 30 years (1984-2013). 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.

Material and Methods

Data was collected from the annual *Pandalus borealis* shrimp survey performed by the Institute of Marine Research in the years 1984-2013 (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.* 2009).

Catch rates in terms of biomass and abundance were calculated for stations 300m 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.

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 Munch-Petersen *et al.* 2011). 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 strongly through the time series (Fig. 1 and 2), but elevated levels were observed from 1998 to 2005. The recent decline appears to have continued and in 2013 both biomass and abundance was the lowest on record.

Size distributions

The time series of annual length distributions also show a major shift in the early 1990s (Fig. 4). From 1992 the proportion of large fish with AFL>15cm declined to less than 10% which contrasts with the pre-1990 distributions dominated by large fish. A pronounced mode of small fish can be followed in subsequent years, with modal length increasing until 2005. Sampling was inadequate in 2006-2007 but the more reliable distributions in 2008-2010 suggest a similar size distribution to that observed in 2005.

The very recent distributions contrast 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 2009-2013 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 3.), nor in the time series of mean abundance of small fish (Fig. 4).

Geographical distribution
The area sampled in a given year and the corresponding geographical distribution of grenadier catches is presented in Figure 5. The overall distribution area does not seem to have changed considerably during the time series 1984-2012. 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. 6). 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. 7) 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 1984-2013. 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 2013 abundance and biomass was the lowest observed in the 30-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 1984-2013. 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. 1). The fishery may have utilized a period of elevated abundance resulting from what appears to be the single large pulse in recruitment in the 30 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. 1) 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, the potential for recovery of the roundnose grenadier in Skagerrak may be good. But 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 almost 3 decades.

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Munch-Petersen, S., Eigaard, O., Søvik, G. and Ulmestrand, M. 2011. The Northern shrimp (*Pandalus borealis*) stock in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa East). NAFO SCR Doc. 11/069.

Table 1. Summary of data on the bottom trawl survey series, 1984-2013. 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 2013 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

* Path width of the tow constrained by a 10 m rope connecting the warps, 200 m in front of otter boards..

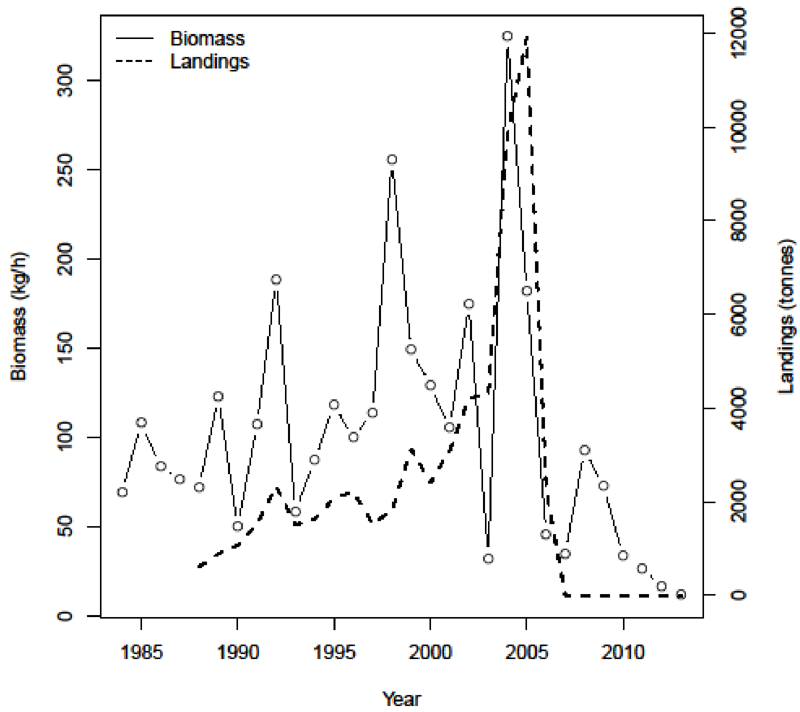


Figure 1. Survey catches rates (kg/h) of grenadier 1984-2013 (circles) and landings. Note: in 1984, 2003, -06, and -07 only a single or no trawls were made deeper than 400m. Thus the primary grenadier habitat was not sampled.

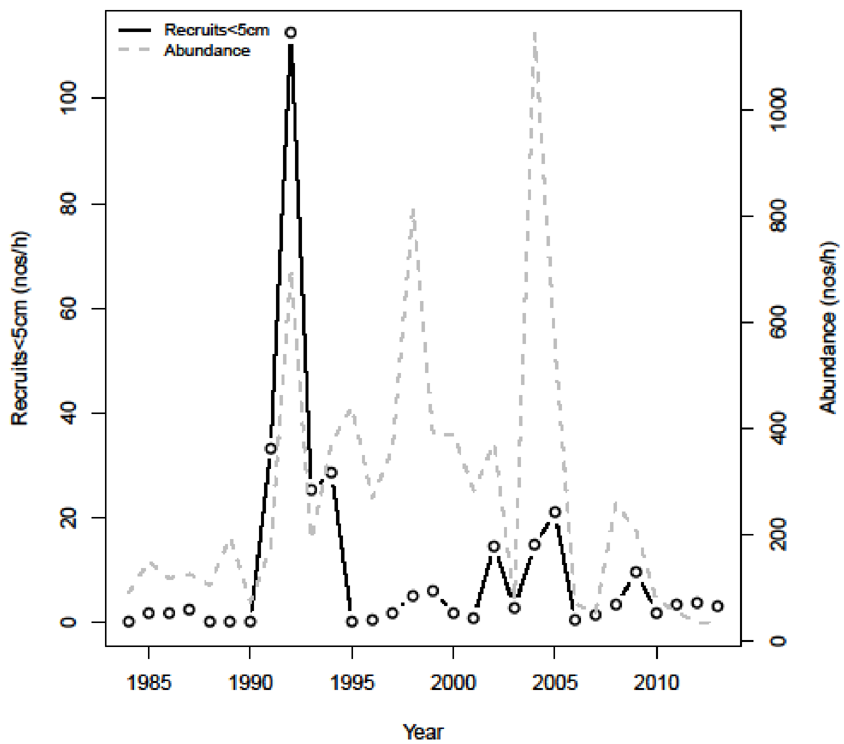


Figure 2. Survey catch rates (nos/h) of grenadier 1984-2013 and recruits (nos/h) less than 5 cm.

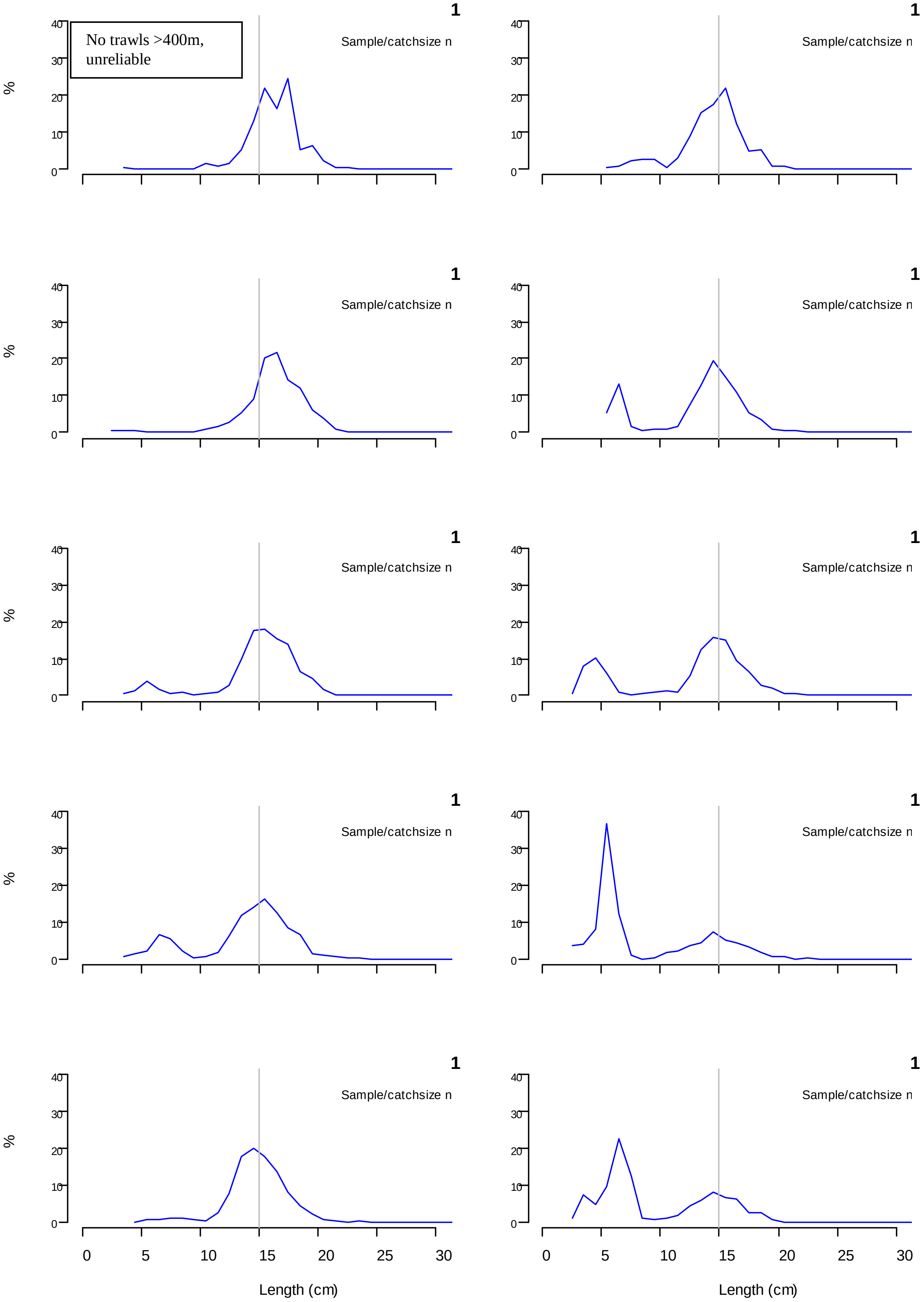


Figure 3. Length distributions of roundnose grenadier. Length is measured as pre-anal fin length in cm. The distributions are calculated as percent number of fish in each cm length interval standardized to total catch number and trawling distance for each station each year.

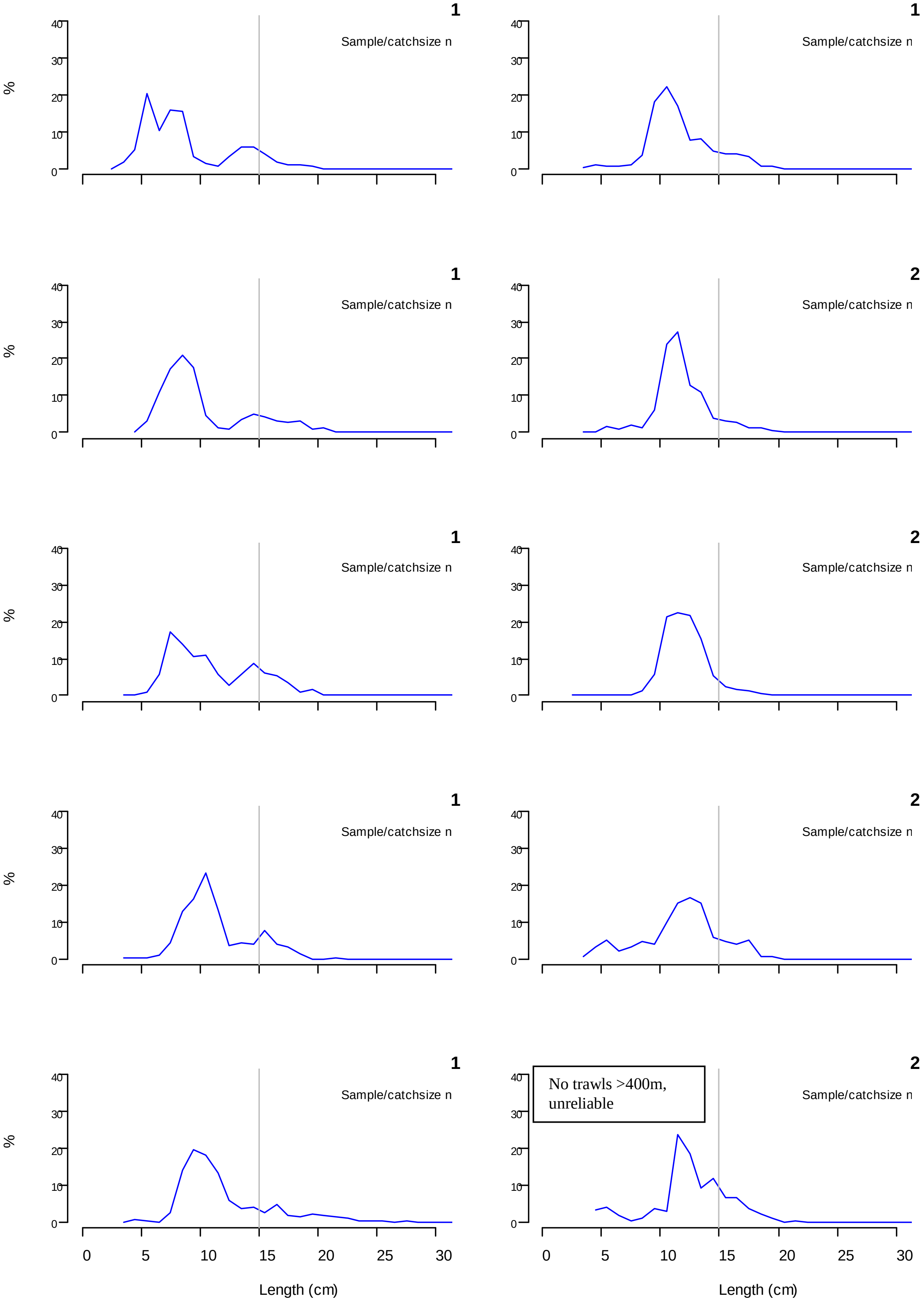


Figure 3 continued

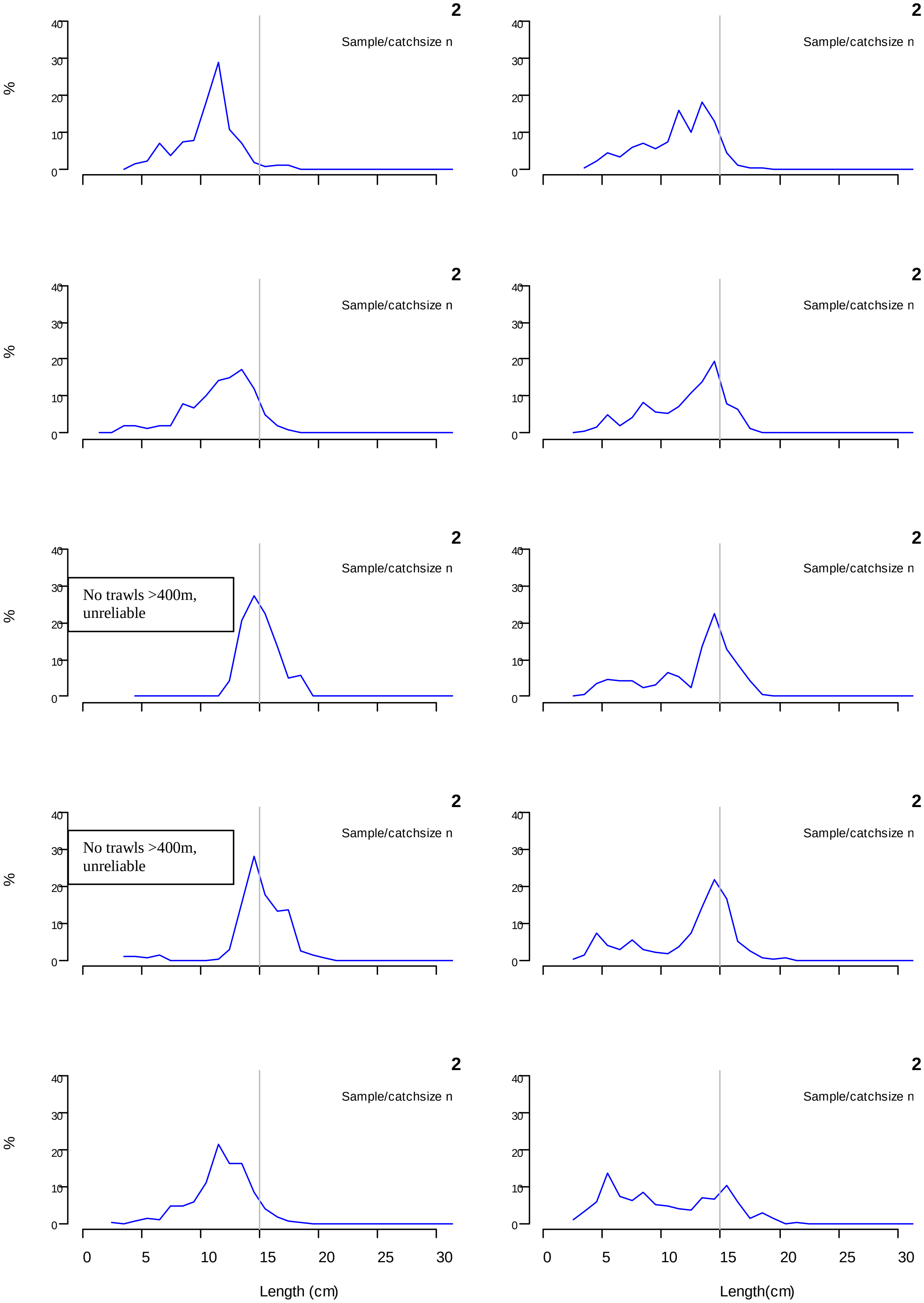


Figure 3 continued

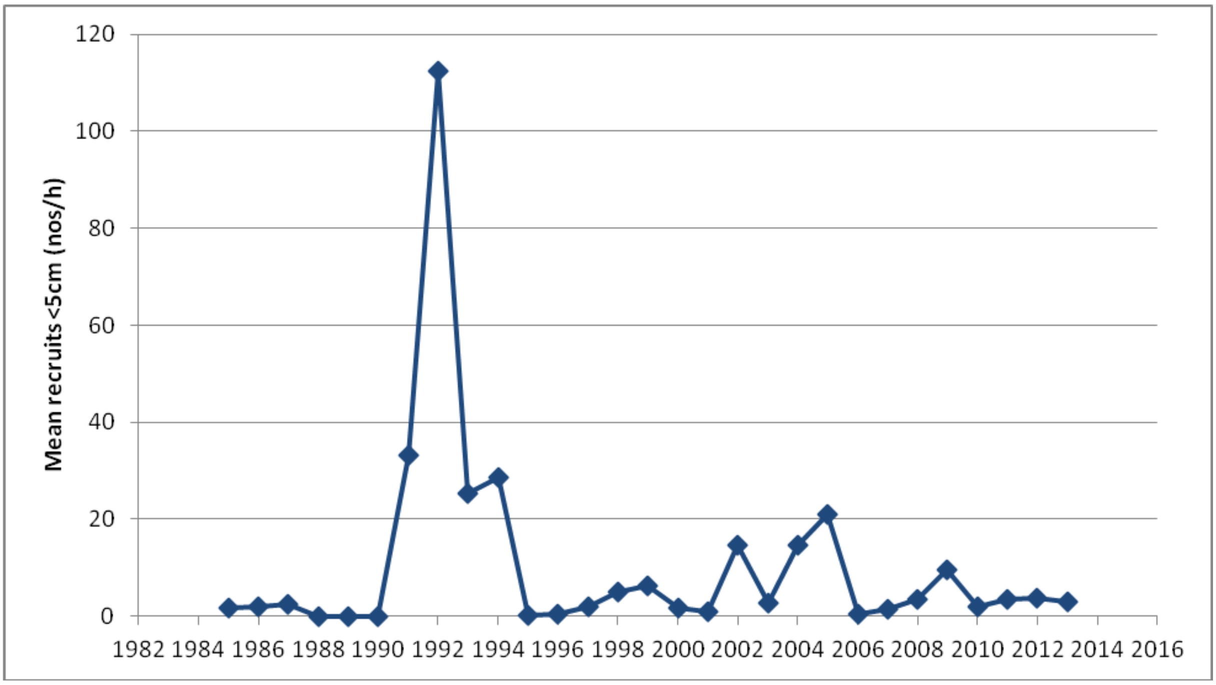


Figure 4. Time series of mean survey catches of roundnose grenadier of PAFL<5cm. ICES Div IVa and IIIa, depths greater than 300m. Note: in 1984, 2003, -06, and -07 only a single or no trawls were made deeper than 400m, hence a significant subarea of the grenadier range was not sampled.

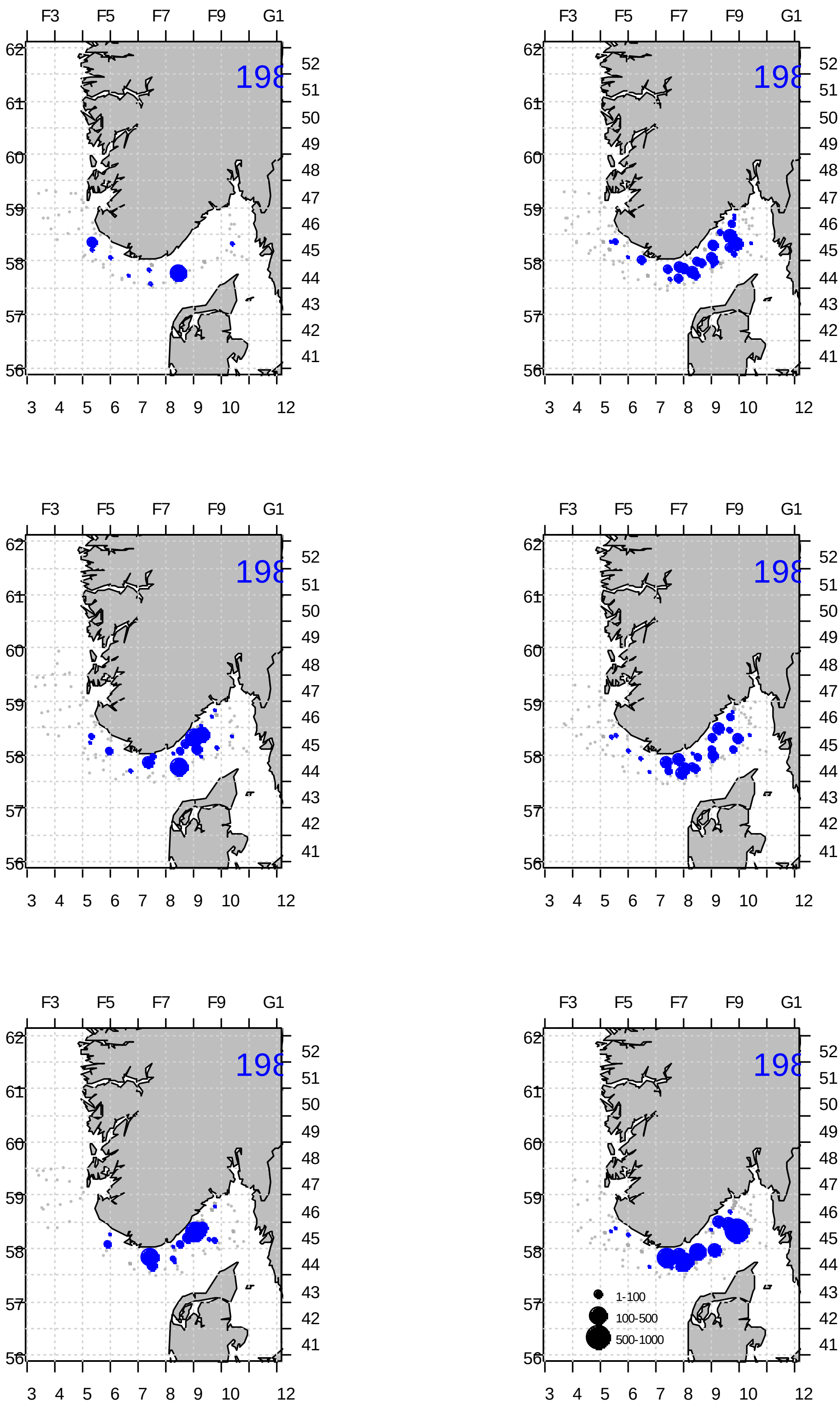


Figure 5. Geographical distributed biomass (kg/h) on roundnose grenadier from the survey (blue dots). Grey scaled dots are stations with zero catches; open dots are all stations taken the actual year, filled dots are stations>300m. Note: in 1984, 2003, -06, and -07 only a single or no trawls were made deeper than 400m, hence a significant subarea of the grenadier range was not sampled.

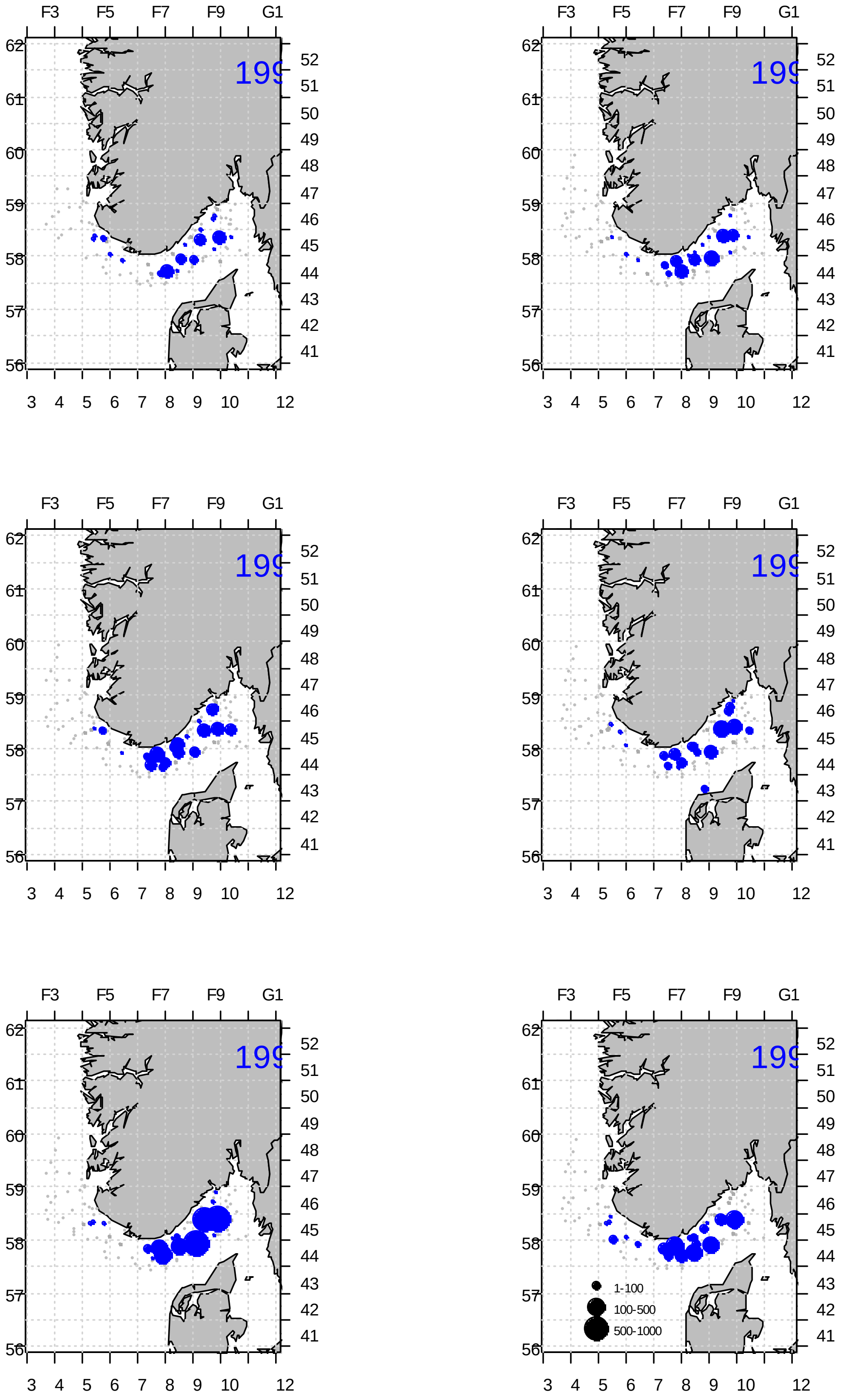


Figure 5 continued.

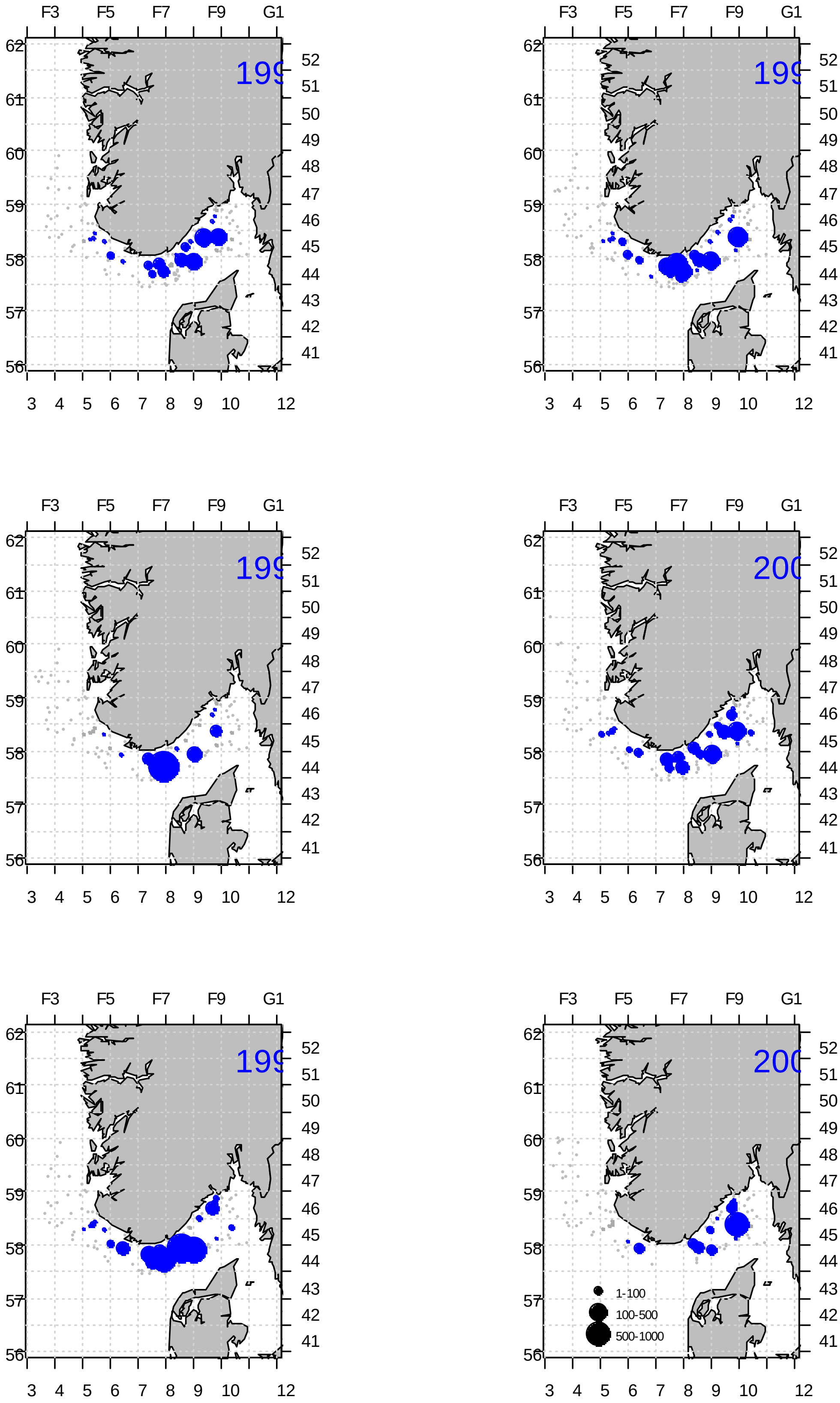


Figure 5 continued.

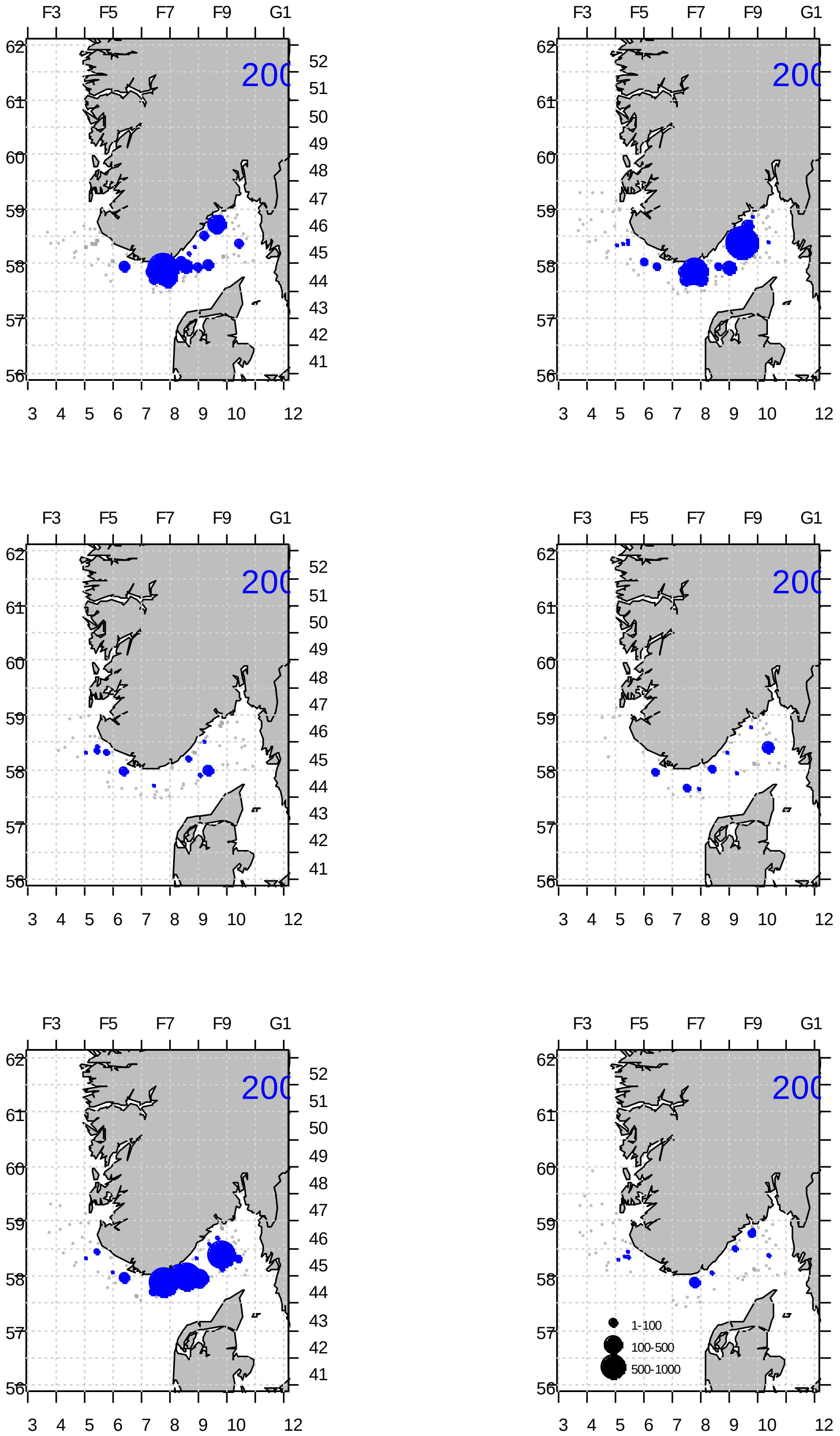


Figure 5 continued.

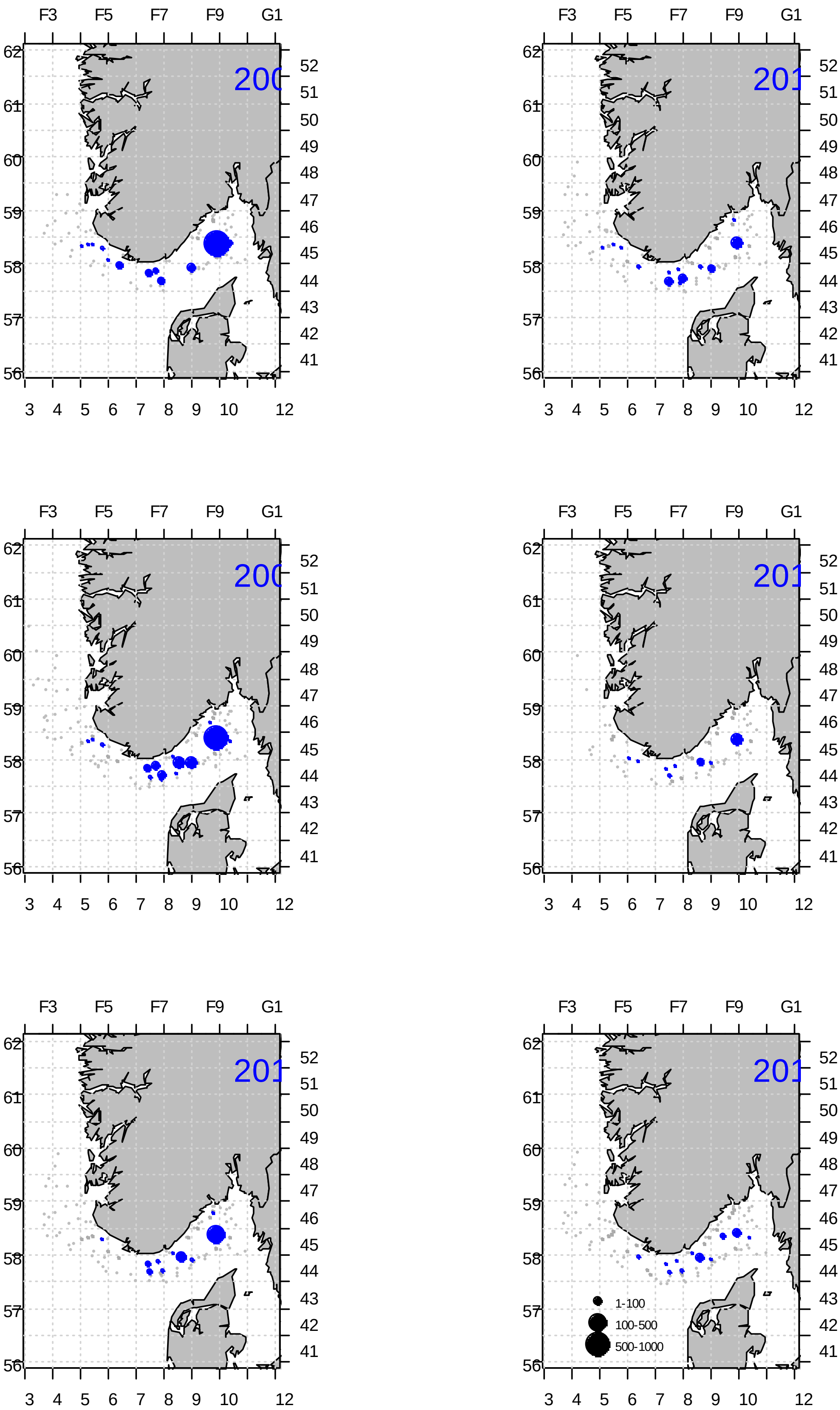


Figure 5 continued.

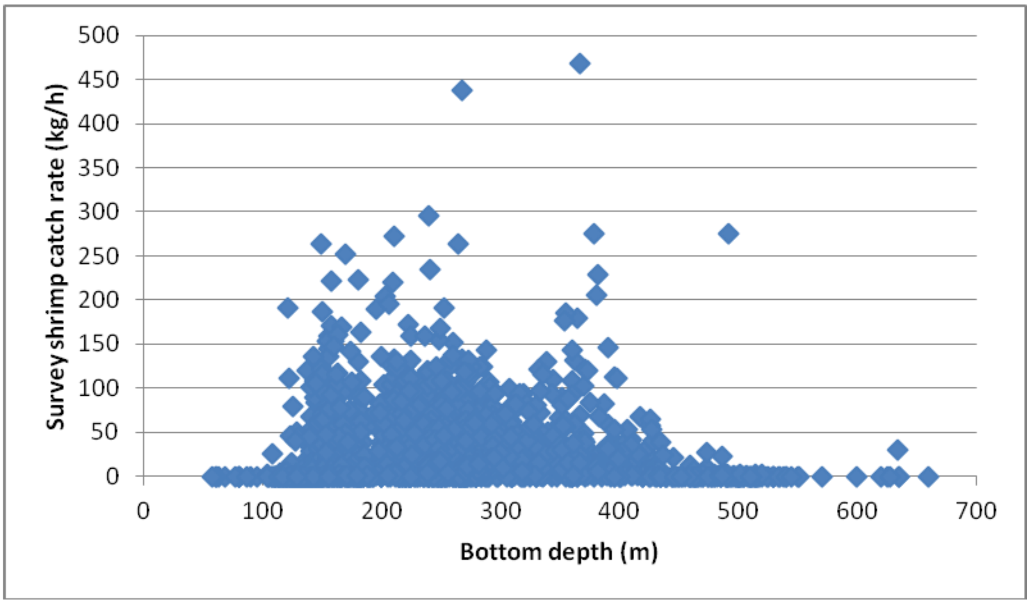


Figure 6. Depth distribution of deepwater shrimp (*Pandalus borealis*) as illustrated by catch rates in the Norwegian shrimp trawl survey, 1984-2013.

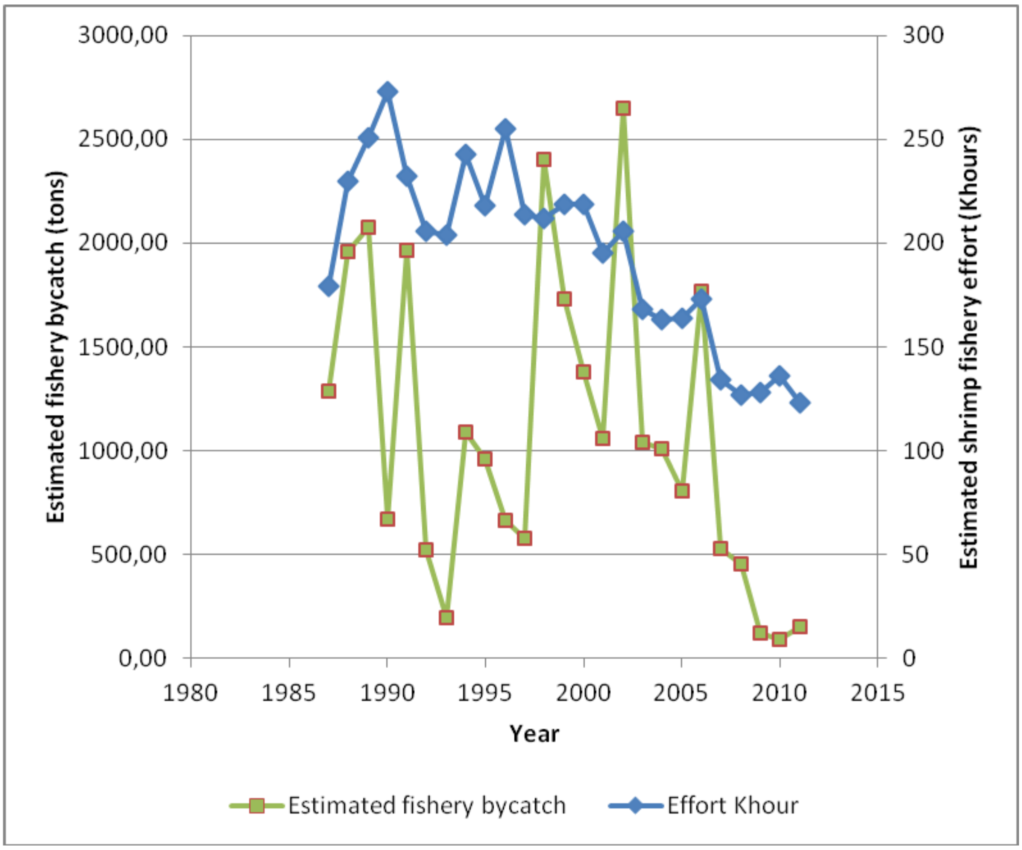


Figure 7. Estimated by-catch of roundnose grenadier in the Norwegian shrimp fishery in ICES Div. IVa and IIIa, and the estimated commercial shrimp fishery effort in the same area. See text for explanation.

Not to be cited without reference to the authors

Working Document, ICES WGDEEP 2013

Recent Norwegian fisheries for deep-sea species in the NEAFC Regulatory Area.

By

Odd Aksel Bergstad, Åge S Høines, Institute of Marine Research, Norway

Introduction

The TOR a) of the ICES WGDEEP 2013 calls for updates of the descriptions of deep-water fisheries in the NEAFC Regulatory Area, and reads as follows:

a) *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.*

In this paper we provide information on landings from the NEAFC RA in recent years, as well as maps of VMS records of the relevant Norwegian vessels operating in that area.

Table 1. Landings (tonnes) of deepwater species by Norwegian vessels in the NEAFC RA and the entire ICES area. Source: Norwegian directorate of Fisheries.

	2010		2011			2012			
	VIb1	Entire ICES area	Vb1a	VIb1	Entire ICES area	Ia	VIb1	XIVb1	Entire ICES area
Argentines		12871.1			12061.4				12362.4
Blue ling	12.4	525.5	0.3		323.6			5.0	325.3
Greater forkbeard	23.5	572.7			579.5		0.3		526.7
Ling	559.7	18413.0		117.8	15878.1	1.0	11.9		15740.4
Mora		1.1			0.2				1.9
Rabbit fish	2.0	247.6		0.4	169.2		0.3		149.6
Roughhead grenadier		40.6			32.7			3.7	68.9
Roundnose grenadier		28.8		0.1	19.9				7.7
Tusk	148.2	17004.0	1.1	5.7	14838.8		2.7	16.9	13411.1
Total landings, NEAFC RA		**745.8**			**125.4**				**41.9**

Landings

The 2010-2012 Norwegian landings of deep-water species from the entire ICES area, and the subdivisions of the NEAFC RA (i.e. areas beyond national jurisdiction) are presented in Table 1. The bulk of those landings from the NEAFC RA comes from fisheries in Rockall, i.e. Subdivision VIb1, and was taken by longliners. The fisheries in international waters have recently declined to low levels compared with earlier years.

VMS-data (see below) from 2010 showed that a single longliner operated on the Reykjanes Ridge, but no landings were reported from that subdivision (XIVb1).

Distribution of fishing in the NEAFC RA

VMS records for Norwegian vessels fishing in the NEAFC RA in 2008-2011 are shown in Figure 1. Data for 2012 were not available at the time this report was compiled. Records where vessel speed between consecutive single reports was less than 5 knots were included in the graph. This is a relatively conservative filtering, and some vessels may have been steaming rather than fishing. However, reducing the speed filter to 3 knots did not produce significantly different results.

The number of vessels varied between years from 2 to 7, and all were large ocean-going longliners. In years except 2010 the activity was confined to the Celtic Seas. In 2010 a single vessel operated for a few days on the Reykjanes Ridge and weekly catch reports indicated that the vessel fished 33.5 tonnes, of which 19.5 tonnes were species on the NEAFC deep-sea species list (primarily tusk and blue ling).

In 2011 all vessels fished in the Rockall area. Also shown in the figure are NEAFC bottom fishing closures in force by 2011. To illustrate possible effect of the introduction of closures on the distribution of activity, these same 2011 closures are also shown on the maps for 2008-2010.

The longliners apparently operate both along closure borders and beyond. Contrasting the patterns pre-2011 with the 2011 distribution suggests that the closures to some extent restricted the spatial distribution of the fishing activity on SW Rockall in 2011.

In 2011 a single vessel entered closures temporarily, but the VMS data alone cannot be used to draw firm conclusions on the nature of the operation within the closure.

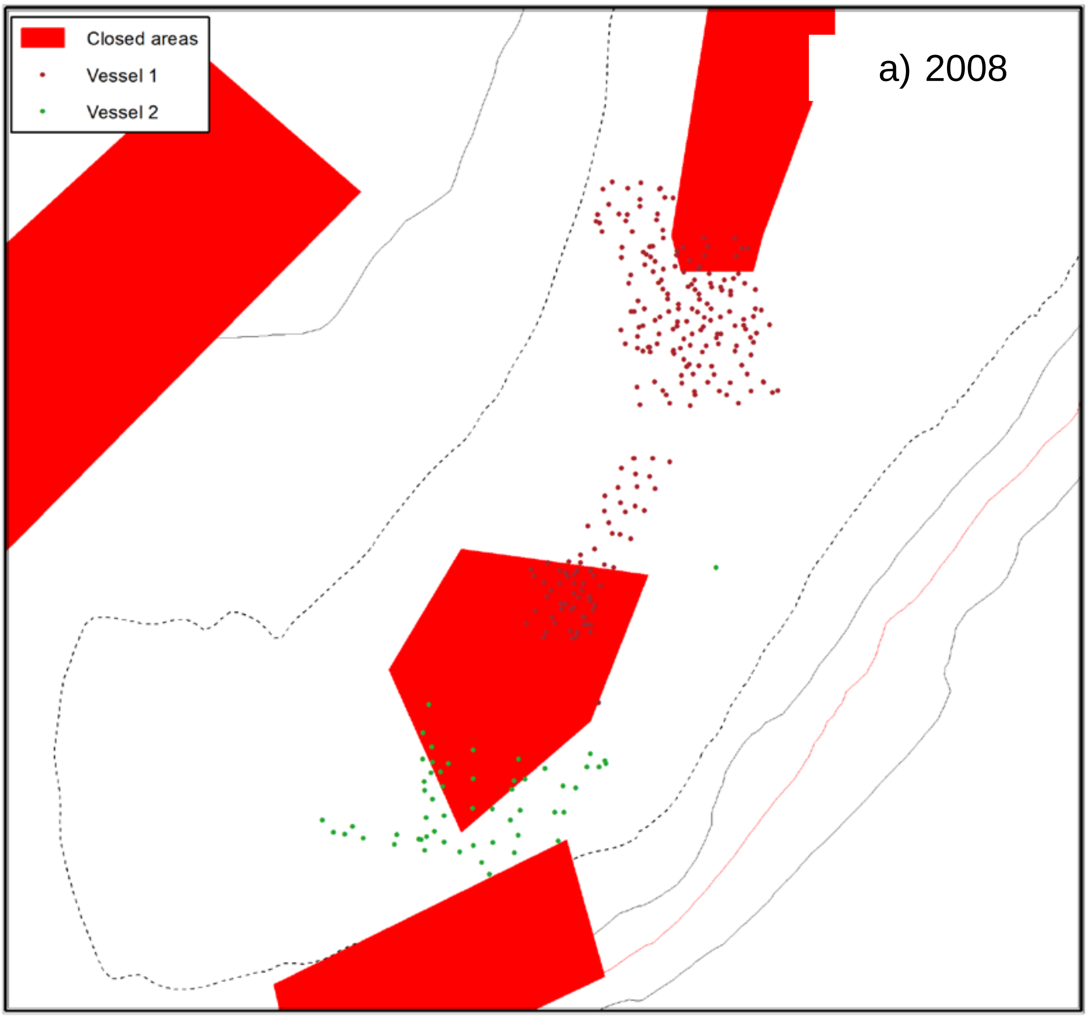
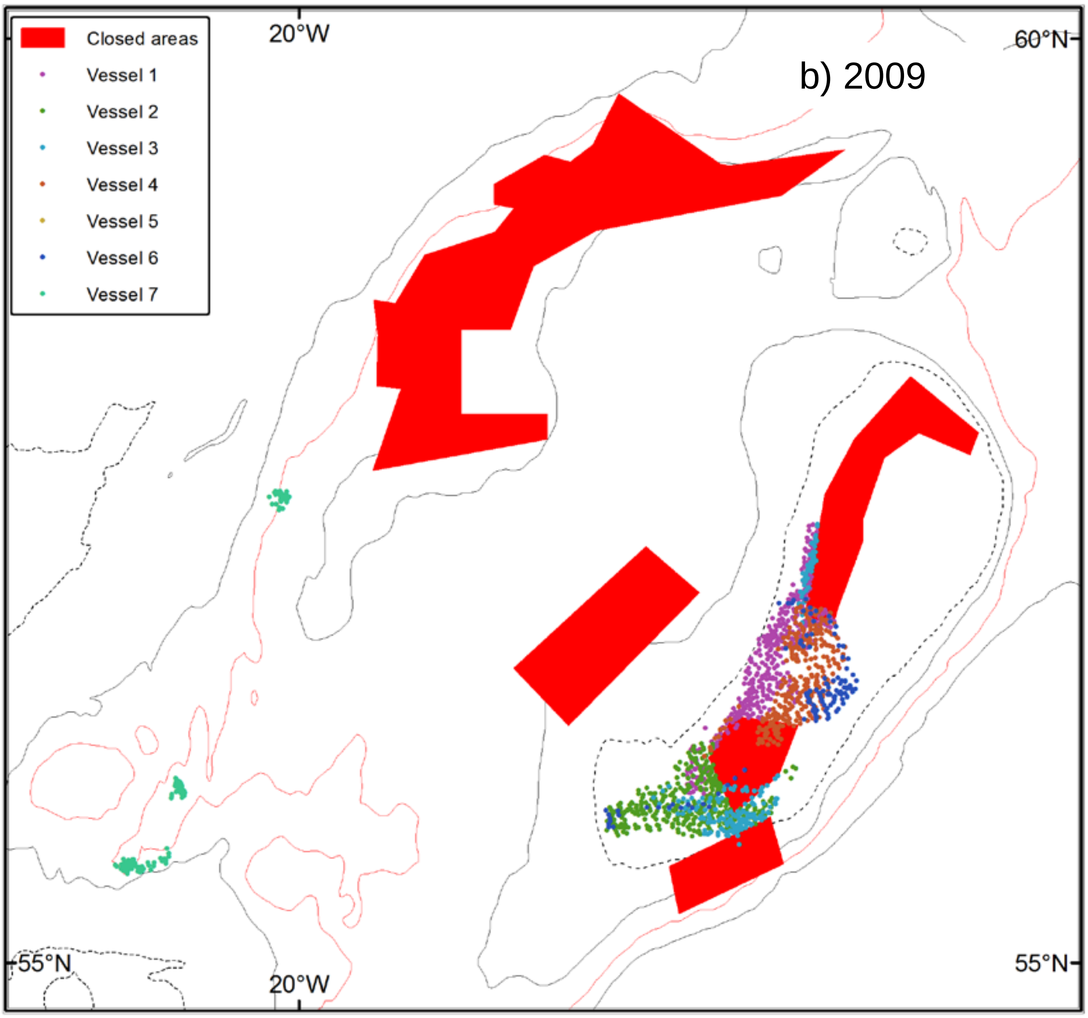
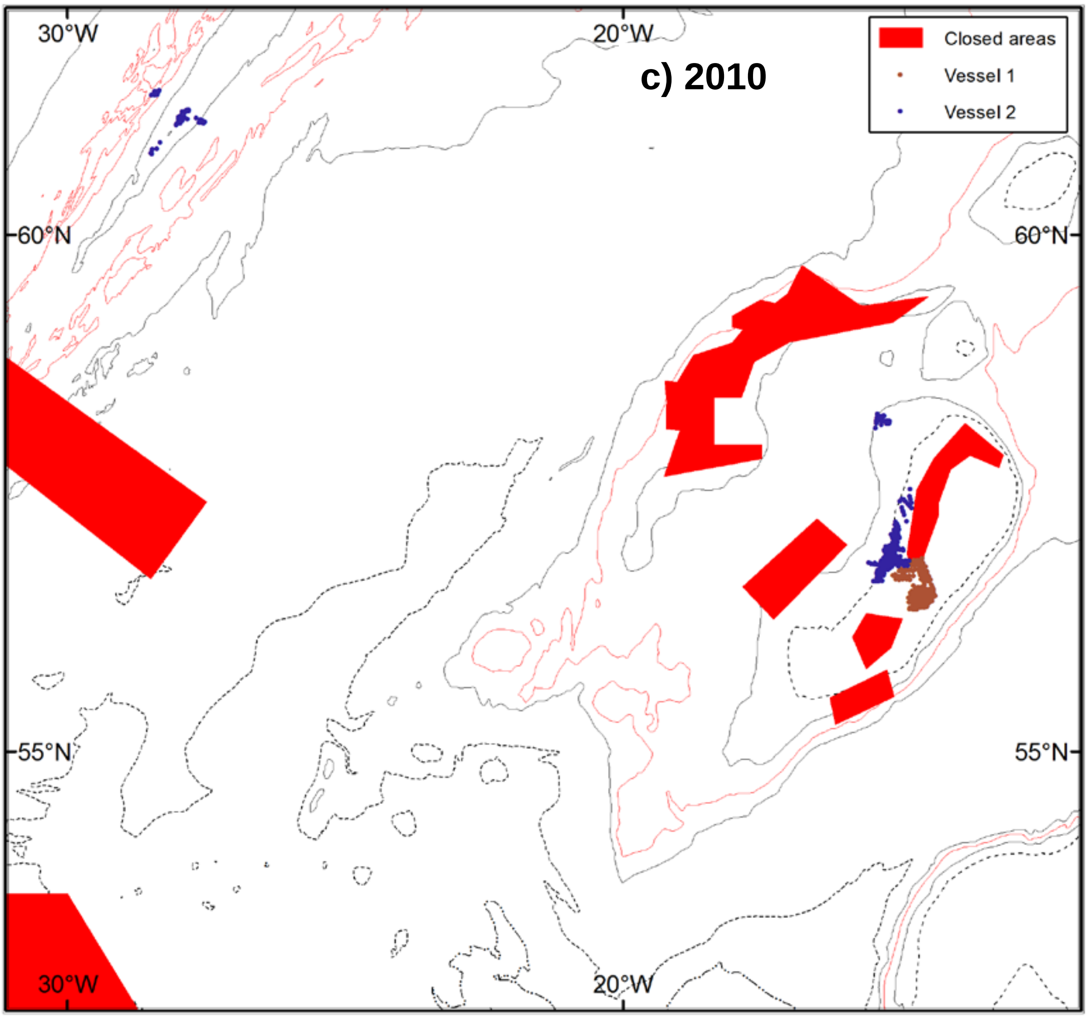
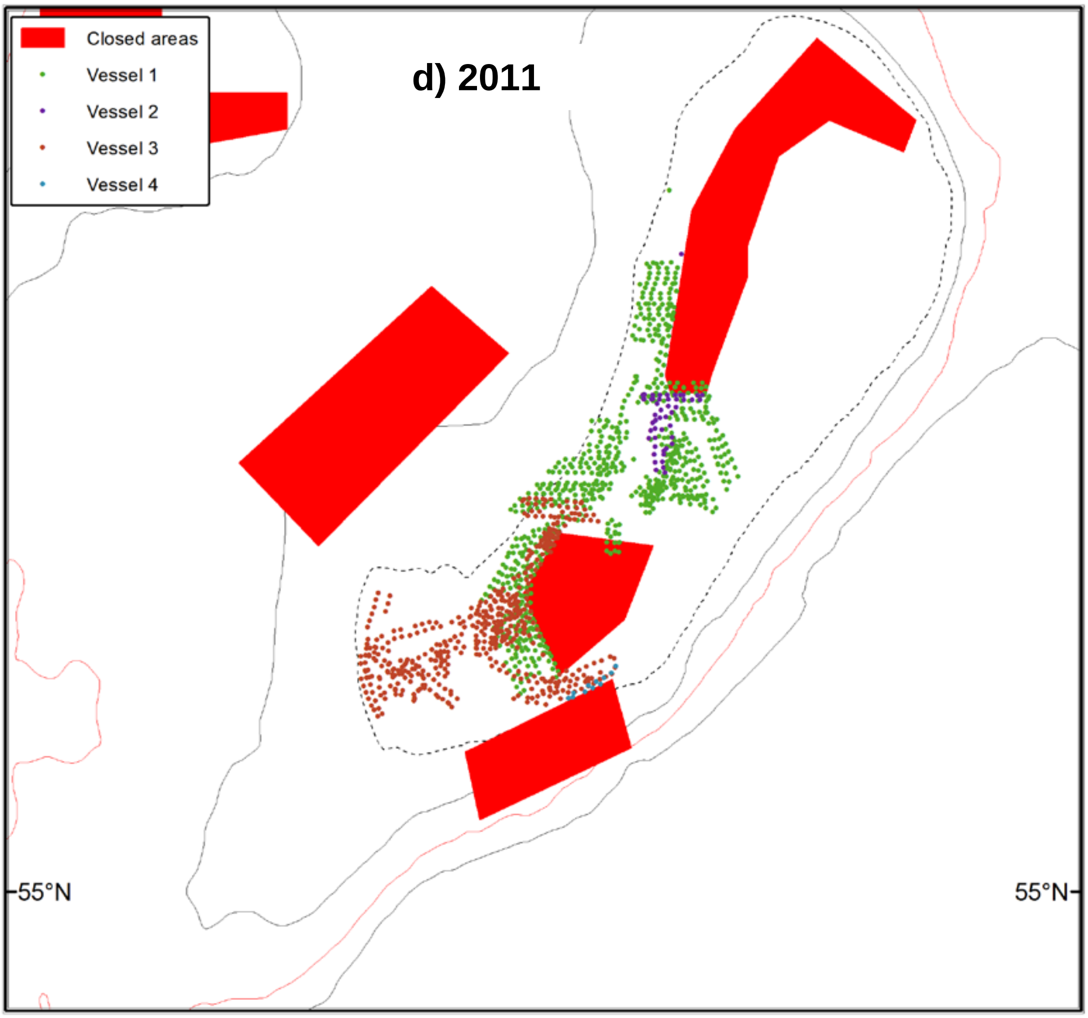


Figure 1 a)-d). VMS records of Norwegian fishing vessels in the NEAFC RA 2008-2011. For vessels, all longliners, operated in the area. Symbols represent records where vessel speed between consecutive records was less than 5 knots. Closed areas are NEAFC bottom fishing closures <u>in force in 2011</u>. Source: Norwegian VMS data submitted to NEAFC.



Closed areas
Vessel 1
Vessel 2
Vessel 3
Vessel 4
Vessel 5
Vessel 6
Vessel 7
20°W
60°N
b) 2009
55°N
20°W
55°N


c) 2010
Closed areas
Vessel 1
Vessel 2
30°W
20°W
60°N
55°N
60°N
55°N
30°W
20°W



Closed areas
Vessel 1
Vessel 2
Vessel 3
Vessel 4
d) 2011
55°N
55°N

Monthly length frequency distribution of black scabbardfish commercial data from ICES division IXa

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The present WD presents the results of length data collected under DCF program conducted at Sesimbra landing port regarding the Portuguese deep-water longline métier.

Material and Methods

Under the DCF monthly trips to Sesimbra landings port and length data are collected from the fishing boats randomly selected. A stratified sampling program is adopted in which the strata correspond to commercial size categories. Two boxes are randomly selected and total length of all the specimens is measured.
The landings on black scabbardfish landings are made by three different commercial categories: large fish (L), small fish (S), and a category that includes fish that have been partially eaten by sharks and cetaceans (P). The weight for the whole body of specimens included in the latter category is estimated using a conversion factor of the partial to the total body weight and by that the total weight of each category is summed to get the total landed weight of black scabbardfish by vessel.
For each sampled vessel, the length frequency distribution of the species is determined by extrapolating the sample to the total landed weight. Finally the length frequency distribution for all the sampled vessels corresponds to a weighted total estimate, determined as a function of the landed weight of each vessel relatively to the total weight.

Results

The length frequency distribution for the sampled landings of black scabbardfish landed in Sesimbra during 2012 is presented in Figure 1.
Please note that the extrapolation for the overall black scabbardfish landings by the Portuguese longline fishery in the year 2012 could not be performed due to problems detected with the official data.

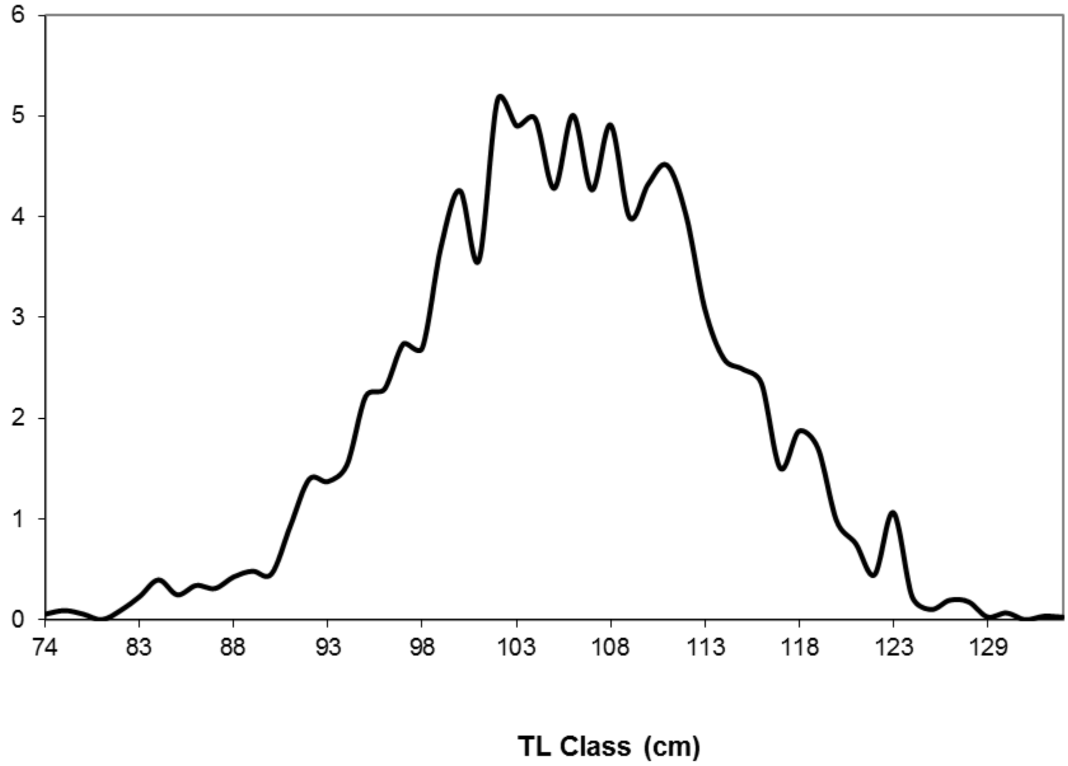

Figure 1. Length relative frequency (in percentage) distribution of black scabbardfish extrapolated for 2012 landings.

This distribution is very similar from the one estimated for 2011 landings: the median (106 cm) is very close to the 2011 median value (105 cm) and the minimum and maximum are wider.

Reference

ICES, 2012. Report of the working group on the biology and assessment of deep-sea fisheries resources (WGDEEP). ICES CM 2012/ACOM:17. 28 March–5 April 2012, ICES Headquarters, Copenhagen.

Information on deep-water species from mainland Portugal

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The information on deep-water species' landings from 2011 (updated) and 2012 (preliminary) are presented according with the established terms of reference for mainland Portugal, Sub-area IX (Table 1 and Table 2).

Table 1. Deep-water species landings (Tonnes) by fishery segment for mainland Portugal (Sub-area IX) in 2011 (updated). + marks landings inferior to 0.050 ton.

SPECIES	TRAWL	PURSE-SEINE	ARTISANAL	TOTAL
Aphanopus carbo	1.1		3474.4	3475.5
Argentina spp.	0.8		0.1	1.0
Beryx decadactylus	+		12.3	12.3
Beryx splendens	+		8.0	8.0
Beryx spp.	+		0.8	0.8
Brosme brosme			+	+
Conger conger	30.5	0.1	1396.8	1427.4
Epigonus telescopus	0.2		0.4	0.5
Helicolenus dactylopterus	22.9		102.5	125.4
Hoplostethus atlanticus	3.0		0.8	3.8
Hoplostethus mediterarneus	3.4		+	3.4
Lepidopus caudatus	1.7		99.3	101.0
Macrourus spp.			+	+
Molva macrophthalmus			+	+
Molva molva	+		+	+
Mora moro	0.2		1.2	1.3
Osteichthyes			5.0	5.0
Pagellus acarne	473.5	41.2	340.7	855.4
Pagellus bogaraveo	22.7	+	73.6	96.3
Phycis blennoides	+		13.4	13.5
Phycis phycis	7.1	+	450.7	457.8
Phycis spp.			5.9	5.9
Polyprion americanus	0.2		140.9	141.1
Scorpaena scrofa	0.8		2.1	2.9
Scorpaena spp.	0.2	+	16.6	16.8
Scorpaenidae	3.7		7.5	11.3
Sebastes marinus			0.7	0.7
Sebastes spp.	1.6		0.7	2.2
Trichiurus lepturus	0.1	0.1	0.7	0.8
Total	573.6	41.3	6155.0	6770.0

Table 2. Deep-water species landings (Tonnes) by fishery segment for mainland Portugal, Sub-area IX in 2012 (preliminary). + marks landings inferior to 0.050 ton.

SPECIES	TRAWL	PURSE-SEINE	ARTISANAL	TOTAL
Aphanopus carbo	0.2		2667.9	2668.0
Argentina spp.	+		0.1	0.1
Beryx decadactylus			7.1	7.1
Beryx splendens	+		3.6	3.6
Beryx spp.			0.3	0.3
Brosme brosme			+	+
Conger conger	30.2	+	1102.0	1132.3
Epigonus telescopus			0.3	0.3
Helicolenus dactylopterus	41.2		145.8	187.0
Hoplostethus atlanticus	22.8		5.6	28.4
Hoplostethus mediterarneus	5.3		0.1	5.3
Lepidopus caudatus	4.2		23.5	27.7
Molva molva	+		+	+
Mora moro	+		0.2	0.3
Osteichthyes			+	+
Pagellus acarne	314.8	138.6	321.0	774.4
Pagellus bogaraveo	46.0		96.8	142.8
Phycis blennoides	0.1		5.6	5.7
Phycis phycis	4.2	+	456.1	460.4
Phycis spp.			5.2	5.2
Polyprion americanus	0.3		156.2	156.5
Scorpaena scrofa	0.4		2.6	3.0
Scorpaena spp.	0.6	+	17.6	18.2
Scorpaenidae	2.9		11.4	14.3
Sebastes marinus	0.6		0.8	1.4
Sebastes spp.	1.1		1.2	2.3
Trichiurus lepturus	0.3		0.5	0.7
Total	475.2	138.7	5031.5	5645.4

The artisanal segment of the mainland Portugal commercial fishing fleet continues to be responsible for the largest quantities of deep-water species' landings, 91% in 2011 and 89% in 2012 of the total landed weight.

The majority of these landings are due to fisheries operating in the Portuguese continental slope along the central west coast of mainland Portugal, namely in Sesimbra and Peniche, but also in Matosinhos, in the north, and Portimão and Sagres, in the southern coast. Together they represented 84% in 2011 and 81% in 2012 of the total landed weight (Table 3 and Table 4).

Table 3. Landings (Tonnes) of important deep-water species on Portuguese landing ports in 2011 (updated). Species with grand total inferior to 50 kg are not shown. Ports where total landings were inferior to 25 ton are not shown but their landings are included in the grand total. + marks landings inferior to 0.050 ton.

SPECIES	Aveiro	Castelo do Neiva	Costa da Caparica	Figueira da Foz	Lagos	Matosinhos	Nazaré	Olhão	Peniche	Portimão	Póvoa de Varzim	Quarteira	Sagres	Sesimbra	Setúbal	Sines	V. Nova de Milfontes	Viana do Castelo	Vila Real Sto António	Total
Aphanopus carbo	+					10.2	+		4.9	+	+			3457.8		+			2.5	3475.5
Argentina spp.							1.0													1.0
Aristeus antennatus		0.4				0.3		+			3.1			0.1				0.2	21.6	28.8
Beryx decadactylus								0.1	8.2		1.4	0.1	1.3	1.2		+				12.3
Beryx splendens	0.1					+	1.2		3.1	0.3	0.1		1.8	1.3	+			+		8.0
Beryx spp.			+			0.8				+				+						0.8
Conger conger	35.0	41.1	22.6	33.9	28.3	204.6	60.6	33.6	492.1	38.6	27.8	27.1	81.8	61.4	25.5	70.7	15.0	68.2	3.2	1427.4
Epigonus telescopus							+	+						0.4					0.1	0.5
Helicolenus dactylopterus	4.4	+		2.5	+	5.0	6.2	8.0	54.4	3.7		0.7	19.2	14.0	0.1	4.7	0.2	2.4		125.4
Hoplostethus mediterarneus									3.4											3.4
Hoplostethus atlanticus													+	3.8						3.8
Lepidopus caudatus	+					0.9	+		56.6	0.8			0.9	41.0	0.7	+			0.1	101.0
Mora moro														1.3						1.3
Osteichthyes																				5.0
Pagellus acarne	35.8	0.1	2.0	32.3	65.8	53.2	50.7	20.6	178.9	172.0	4.0	61.6	24.9	64.3	36.1	25.0	2.1	5.7	4.7	855.4
Pagellus bogaraveo	3.9	+	0.2	1.1	+	6.2	7.9	0.1	55.3	1.1	0.5	+	14.9	1.7	0.1	0.6	+	2.5	0.1	96.3
Pandalus spp.																			0.5	0.5
Phycis blennoides		+		+					13.2					+		+		0.2		13.5
Phycis phycis	1.1			2.4	7.6	3.1	9.3	5.6	293.0	8.5	1.2	4.3	58.2	17.1	0.8	32.1	8.1		0.4	457.8
Phycis spp.			3.1																	5.9
Plesiopenaeus edwardsianus																			59.4	59.4
Polyprion americanus	0.1		+	0.1		1.1	2.6	1.3	106.5	0.8	0.4	0.1	19.9	6.7	+	0.8		+	0.6	141.1
Scorpaena scrofa						0.2		0.2	2.2			0.3							+	2.9
Scorpaena spp.			0.1	0.1	1.2		+		+	0.6			6.9	0.7	0.1	3.8	1.2			16.8
Scorpaenidae	4.6		1.6			5.0														11.3
Sebastes marinus								+			0.7									0.7
Sebastes spp.							0.1						0.4						1.6	2.2
Trichiurus lepturus			+		+		0.5						0.3	+						0.8
Total	85.1	41.7	29.6	72.5	103.0	290.6	140.3	69.7	1271.7	226.5	39.1	94.0	230.5	3672.7	63.5	137.9	26.7	79.3	94.8	6858.7

Table 4. Landings (Tonnes) of important deep-water species on Portuguese landing ports in 2012 (preliminary). Species with grand total inferior to 50 kg are not shown. Ports where total landings were inferior to 25 ton are not shown but their landings are included in the grand total. + marks landings inferior to 0.050 ton.

SPECIES	Aveiro	Castelo do Neiva	Figueira da Foz	Lagos	Matosinhos	Nazaré	Olhão	Peniche	Portimão	Póvoa de Varzim	Quarteira	Sagres	Sesimbra	Setúbal	Sines	Viana do Castelo	Vila Real Sto António	Total
Aphanopus carbo					10.1	+		1.5		+			2656.3		+	0.1	0.1	2668.0
Argentina spp.						0.1												0.1
Aristeus antennatus	0.1	0.1			0.1		+	+	+	1.8			+			0.1	35.1	38.7
Beryx decadactylus							0.1	4.5		0.1		1.8	0.5		+			7.1
Beryx splendens					+	0.6		1.9	+	+		1.1	0.1		+			3.6
Beryx spp.					0.3		+											0.3
Conger conger	39.2	25.0	23.6	16.7	195.3	61.2	23.0	372.1	25.7	28.4	15.4	53.7	41.8	21.0	55.1	52.1	3.4	1132.3
Epigonus telescopus							+						0.1				+	0.3
Helicolenus dactylopterus	4.4		5.6	0.1	16.3	7.5	11.8	82.3	12.6		1.2	22.3	14.4	0.3	6.0	1.9		187.0
Hoplostethus mediterarneus						+		0.1					5.3					5.3
Hoplostethus atlanticus													28.4					28.4
Lepidopus caudatus	+				1.4	+		23.0	0.7	+		0.3	2.2		+			27.7
Mora moro													0.3					0.3
Pagellus acarne	31.0	+	27.4	48.4	36.9	47.0	15.7	167.9	93.6	4.9	49.1	33.6	114.6	33.0	46.5	5.2	1.8	774.4
Pagellus bogaraveo	4.5	+	2.2	+	7.3	11.2	0.5	85.1	6.5	0.4	+	19.4	3.1	0.2	0.6	0.7	+	142.8
Pandalus spp.					+				+								0.5	0.5
Phycis blennoides		+						5.0							0.5	0.1		5.7
Phycis phycis	1.7		1.5	9.3	3.1	10.0	5.7	301.0	11.1	1.4	6.4	58.5	8.2	1.1	29.3		0.8	460.4
Phycis spp.																		5.2
Plesiopenaeus edwardsianus																	29.5	29.5
Polyprion americanus	0.3		0.8	+	1.1	8.6	2.1	111.3	1.4	1.8	0.1	18.0	7.5	0.2	1.0	0.1	1.3	156.5
Scorpaena scrofa					+		+	2.1			0.8						+	3.0
Scorpaena spp.	0.2		0.2	1.3	+	0.1	+	0.8	0.7			5.1	1.2	0.1	4.2			18.2
Scorpaenidae	10.3				1.8	+												14.3
Sebastes marinus							0.9			0.5	+							1.4
Sebastes spp.						+					+	1.2					1.1	2.3
Trichiurus lepturus				+		0.4	+	+	0.1			0.2	+					0.7
Total	91.6	25.2	61.3	75.8	273.7	146.8	59.9	1158.7	152.5	39.2	73.2	215.1	2884.0	55.9	143.2	60.3	73.6	5714.1

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Assessing the risk of vulnerable species exposure to deepwater trawl fisheries- The case of orange roughy *Hoplostethus* atlanticus (Collett, 1889) to the west of Ireland and Britain

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Abstract

With slow growth rates, late maturity and a high maximum age (> 130 years) orange roughy can be classified as a vulnerable deepwater fish species that can only sustain low rates of exploitation. Historic patterns of fisheries associated with this species suggest that it is currently not possible to manage its fisheries sustainably and the total allowable catch for orange roughy has been gradually reducede to zero for European fisheries since 2010. Orange roughy to the west of Ireland and Britain occurs on distinct bathymetric features (seamounts and canyons) as well as on flat grounds along the continental deepwater slope. Productivity susceptibility analysis (PSA) was performed to evaluate the biological vulnerability of orange roughy and the risk that recent and current fisheries pose to its populations in the study area. Using a variety of data sources including survey data, personal logbooks and VMS data, high resolution spatial mapping was preformed to define the distribution of orange roughy populations in detail and characterise their habitat in terms of depth and area. Biological information was used to describe distribution pattern according to life stages. These results were combined with information on recent and existing deepwater fisheries in order to carry out a detailed evaluation of the potential risk of fisheries to the conservation of this species.

Introduction

With slow growth rates, late maturity and a high maximum age (> 130 years) orange roughy can be classified as a vulnerable deepwater fish species that can only sustain low rates of exploitation (Clark 2001). In the Northeast Atlantic, the species has been subjected to direct fisheries targeting spawning aggregations on seamounts and mixed trawl fisheries fishing for deepwater species along the continental slope. The landing statistics show that the continental slopes and seamounts to the west of The British Isles have produced the highest accumulated catch of this species in the North Atlantic (34,000 tons) between 1988 and 2008. The directed fishery for orange roughy to the west of The British Isles started in the early 90´s in ICES Division VIa where it was rapidly depleted and the fishery ceased (ICES, 2011). The deep water mixed fishery however continued on target species such as roundnose grenadier and blackscabbard fish. Fisheries moved towards ICES Subarea VII in early 2000 and peaked in 2002 with landings over 5 thousand tons taken in Subarea VII for that year. Although the true state of stocks was never fully known, data indicated that high catches were not sustained by individual fleets and dropped to low levels, suggesting sequential depletion of local aggregations. It is therefore assumed that several local aggregations to the west of Britain and Ireland were depleted (ICES 2011). A total allowable catch (TAC) was introduced for orange roughy in ICES Subareas VI and VII from 2003 onwards. Spatial management measures were also implemented around the Porcupine Bank. EU TACs were drastically reduced between 2006 and 2009 and are set to zero since 2010.

As the catch limits for orange roughy in ICES Subareas VII and VI are zero, the species cannot be landed by the EU fleet. While regulations are not permitting a directed fishery for orange roughy in the area, a mixed deepwater fishery is still occurring to the west of the British Isles and is being regulated for. A zero TAC without allowing a bycatch can lead to discarding and/or misreporting if fisheries for other species overlap with the distribution area of the stock. The closed fishery has resulted in a scarcity of data to assess whether the stock is recovering. In addition there are currently no adequate fisheries independent monitoring programmes covering the main distribution area of the stock.

Productivity susceptibility analysis (PSA) is a semi quantitative approach that can be used in data poor situations, to evaluate the risk that fisheries pose to fish populations (Hobday et al., 2007; (Patrick et al. 2009). PSA examines the attributes of a population to evaluate its vulnerability to a particular fishery. Productivity is the average of attributes which relate to life history characteristics and include age and size at maturity, maximum age and size, fecundity and reproductive strategy as well as trophic level. Susceptibility is the product of attributes relating to a particular fishery and includes the availability of a stock to the fishery, i.e. its distribution and behavioural characteristics. Susceptibility attributes consider the overlap of fishing effort with the population distribution and the encounterability, which is the likelihood of the population to encounter fishing gear that is deployed within its geographic distribution. This characteristic is based on two attributes, the adult habitat and bathymetry. The third and fourth susceptibility attributes comprise selectivity, which considers the potential of the gear to capture or retain a species, and post capture mortality. In this study, PSA is applied to evaluate to what extent local orange roughy aggregations to the west of Britain and Ireland are vulnerable to recent and current deepwater fisheries. The assumption is that the productivity of the population is not changing within the timeframe of this analysis, but the susceptibility to recent and existing fisheries can be examined and evaluated. This approach is presented as a proposed management tool to monitor the susceptibility of vulnerable species to particular fisheries in data deficient situations.

Materials and methods

Data used

Spatial catch information of orange roughy was compiled from scientific observer programmes and scientific surveys. Data from deepwater surveys included the orange roughy acoustic survey programme carried out on the Porcupine Bank in 2005 (O'Donnell et al. 2007), the Irish deepwater trawl survey which sampled the European shelf slope between 53.5-57°N and the northern Porcupine Bank between 2006 and 2009 and data from the Scottish Deepwater survey which sampled the Scottish slope between 55°N and 60°N for the years 2000 to 2011. Spatial extent, survey strategies and sampling details are described in Jonston et al. (2010) and Francis et al. (2010) for the Irish and Scottish surveys respectively. Overall, 404 positive catch records of orange roughy with positional and depth information were compiled. The catch position data was gridded at a spatial resolution of 0.03° longitude and 0.02° latitude.

VMS analysis

In EU waters, all fishing vessels >15m are required to transmit their position and speed via Vessel Monitoring by Satellite (VMS) (EC 2003). Spatial and temporal distribution of the French and Irish Deepwater fisheries in the part of ICES Subareas VI and VII that is under the jurisdiction of Ireland were derived from VMS data between 2006 and 2011. Irish Deepwater fisheries were identified by linking VMS data with logbook data and selecting catches with >50% of deepwater species. Species were classified as deepwater if listed on annex 1 of the European deepwater access scheme (EC 2002). French deepwater fisheries were identified by only selecting vessels with deepwater fishing licenses defined by the same regulation. In addition, positions of both data sets were only selected, if they fell between the 800-2000m contour lines. Fishing positions were identified by speed filters according to Gerritsen and Lordan (2011). Deepwater effort from France and Ireland was mapped on a grid of 0.03° longitude and 0.02° latitude (approx 1 x 1 nautical mile) using the R-package mapplots in R 2.15.1. Fishing effort (in hours) and mean depth was estimated for each grid cell by country and year. The area impacted was calculated by adding up the surface area (in nm^2) of all the cells with >0 hours effort and also of the cells of >3h and >5h effort.

Productivity Susceptibility Analysis

Productivity susceptibility analysis was carried out according to Hobday et al. (2007) using a modified version of the MSC assessment worksheets (MarineStewardshipCouncil 2012). Productivity scores were calculated for seven attributes and were based on biological data derived from published literature on orange roughy using Northeast Atlantic estimates where available (see table 1). Susceptibility scores were based on four attributes, which were availability, encounterability, selectivity and death after capture. Availability is the spatial overlap of fishing effort distribution with the distribution of a population. It was calculated by summing up the grid cells of the orange roughy distributional area which intersected with the grid cells of VMS deepwater effort for every year and expressing them as a percentage of the total orange roughy distribution area by the following formula:

$$\frac{\sum_{i=1}^{n}(C_i \cap E_i)}{\sum_{i=1}^{n} C_i} * 100 \qquad (1)$$

Whereby C are the grid cells that contain orange roughy catches and E are the grid cells that contain deepwater effort.

Instead of scoring this attribute according to categories as proposed by (Hobday et al. 2007), availability was converted into a continuous score between 0 and 3 as a direct linear function of availability to highlight any progressive changes with time. Encounterability is the likelihood that a species will encounter fishing gear that is deployed within its geographical range. The encounterability was estimated by 1.) comparing the depth in orange roughy distribution and the depth distribution of annual deepwater fishing effort and 2.) considering the fishing practices of existing deepwater fleets. Other susceptibility scores were fixed in time and scored according to the categories as proposed by Hobday et al. (2007).

Overall PSA vulnerability scores were calculated as follows:

1) The individual productivity attributes were scored and averaged to obtain an overall productivity score;

2) The individual susceptibility attributes were scored and the scaled-product was used for the overall susceptibility score;

3) The risk scores were calculated as the euclidian distance.

Time-dependant susceptibility analysis was performed by evaluating the exposure of orange roughy to the main deepwater fisheries in the area for the years 2006 to 2011.

<u>Results</u>

Distribution of orange roughy

Positive catches of orange roughy were recorded between the south of the Porcupine Bank (50°N) and the west of Scotland (60°N) (figure 1). While catches were in general low and dispersed, high values were noted in concentrated patches at ca. 54.5°N at the Slyne ridge, the northern and the western Porcupine Bank close to the Porcupine Bank Canyon mounds and to the southwest of the Porcupine Bank at the “Explorer” and “Aglantha” sea mounds. The depth distribution ranged from 474m to 1800m but was mainly concentrated around 1100m. The catch depths of the different data sources (observer and survey data) were significantly different (ANOVA on log depth, p=0.001) but not of the different bathymetric features (ANOVA on log depth, p=0.1), see table 2 for mean depths.

Distribution of deepwater effort

French and Irish deepwater effort (in the Irish EEZ) as recorded with VMS was distributed along the continental slope with more intense effort southwest of Ireland and the southern Porcupine Bank, as well as the northern side of the Porcupine Bank and the west of Scotland (figure 2). Over the observed time period (2006 to 2011) there was a strong reduction in deepwater effort by both countries. While Irish effort decreased 94% from almost 6000h in 2006 to 344h in 2011, French effort decreased 42% from 8600h to just above 5000h in the same time frame (figure 3). Spatially, this reduction in effort was stronger south of 54°N and in particular on the Porcupine Bank. While in 2006 the northern, western and southern slopes of the bank were still intensely fished, only limited fishing continued on the northern slope in 2008 and one year later, almost no deepwater fishing could be observed on the slopes of the Porcupine Bank (figure 2). In 2009, some remaining deepwater fisheries could be observed in the southwest of Ireland, but by 2010/2011, this had decreased. In 2010 and 2011 some effort had returned to a small section on the northern slope of the Porcupine Bank, but effort was most concentrated to the northwest of Ireland. Over the observed time period, the area impacted by deepwater trawling decreased from ca. 3800nm^2 to less than 1700nm^2 (figure 4). The area exposed to more than 2.5 hours and 5 hours fishing decreased by ca 60% between 2006 and 2011 (figure 4). Median depth was similar between years all ranging between 1030 and 1120m, while orange roughy distribution was around 1100m for peaks and 1140 for flat areas (figure 5). There was a small but significant decrease in VMS depth distributions from 2006 to 2011 (ANOVA on log depth, p=0.001).

PSA analysis

Table 1 shows the biological characteristics of NEA orange roughy and the associated productivity scores according to Hobday et al (2007). Average age at maturity and average maximum age indicated low productivity and resulted in high risk scores. So did the high trophic level of orange roughy. Due to its short body size, orange roughy scored low on maximum body size and size at maturity suggesting high productivity. Its fecundity (> 20000 eggs a year) and reproductive strategy (broadcast spawner) also resulted in low scores, suggesting high productivity. Overall, orange roughy scored 2 in productivity, which is the midpoint and indicates a medium biological risk to fishing. In this study, the biological attributes were considered not to change over time. The susceptibility scores were composed as follows: post-capture mortality resulted in high susceptibility scores as orange roughy are either retained or dead when released. This does not change over time. Selectivity of gear type also received a high susceptibility score as the individual sizes are at least 2 times the mesh size. This is also a fixed attribute in time. Availability scores were given according to the spatial overlap between the distribution of orange roughy and the distribution of deepwater fishing effort as monitored by VMS. In 2006, almost 60% of the cells intersected, this figures decreased to 17% by 2009 and remained at 25% for the last two years (figure 6). The main reduction in overlap over time could be observed on the on the western and southwestern slopes of the Porcupine Bank. Highest consistent overlap through time was evident on the northern slope of the Porcupine Bank and the continental slope northwest of Ireland. Encounterability was measured as the depth overlap between Orange Roughy distribution and the distribution of fishing effort as well as the overlap between the adult habitat and exisitng fishing practices. As the boxplots on figure 5 indicates, the depth of fishing effort decreased over time, but the 25% and 75% quantiles of Orange Roughy distribution remain within the 25% and 75% quantiles of deepwater effort throughout the time series (with the exception of 2010), this results in a high encounterabilbity risk, 3. Direct target fisheries with vessels fishing on spawning aggregations of Orange Roughy over seamounts decreased from 2007 onwards, reducing the overall encounterability risk from high to medium from 2007 onwards. Aggregated PSA scores range between 2.33 and 2.95 and there was a reduction in risk scores over time (figure 7). Scores fell within the medium risk category for 2006 and decreased into the low risk category from 2007 onwards.

Discussion

Traditionally, productivity susceptibility analyses (PSA) have been performed to evaluate the risk of a fishery to different stocks or species, whereby populations were scored according to their intrinsic vulnerability and their exposure to the particular fishery in question (Hobday et al. 2007, Patrick et al. 2009, Hobday et al. 2011). This method has been successfully applied in situations where the majority of stocks are data deficient such as in fisheries certifications by the Marine Stewardship Council (MarineStewardshipCouncil 2012), for fisheries management under the Magnuson Stevens Fishery Conservation and Management Act in the US (Cope et al. 2011, Ormseth and Spencer 2011) and for management of bycatch species in Australia (Zhou and Griffiths 2008, Zhou et al. 2009). Here we present a new application of the PSA, whereby we use the approach on a single species to evaluate whether and how the risk of recent and current fisheries changes over time. This stems from the necessity to develop a form of risk assessment for a population which is considered depleted and is data deficient with regards to fisheries dependant and independent data due to closed fisheries and a lack of scientific monitoring programmes. Using the PSA approach on one species means that the productivity attributes are fixed in time and the focus of the analysis is on the susceptibility of the species to fisheries and their changes over time.

In the original approach developed by Hobday (2007), there were seven attributes used to describe a stock's productivity. When the productivity of orange roughy in the Northeast Atlantic was scored accordingly, the species fell into the medium productivity category. The attributes are heavily based on size and age, and although orange roughy reaches a centenarian life span (Andrews et al. 2009), its maximum size of less than 100cm falls into the high productivity and low risk category. The original scoring suggests an underestimation of the biological vulnerability of orange roughy, which has been classified as one of the most vulnerable deepwater species in the northeast Atlantic (STECF 2010, Norse et al. 2012, ICES 2001). Patrick et al. (2010) added further attributes to the productivity scores which included natural mortality M, the growth parameters r, ie the intrinsic population growth rate that would occur in the absence of fishing at the lowest population size, and the von Bertalanffy growth coefficient k, which measures how fast a fish reaches its maximum size. All three parameters are extremely low for orange roughy and result in scores in the high risk category. The emergent productivity assessment of 2.22 would, however, still classify the species as with medium productivity. In contrast, deepwater sharks such as C. *squamosus*, would fall into the low productivity category due to their low reproductive potential, highlighting the emphasis of this assessment method on size and reproductive output. A careful consideration of the productivity attributes to be included in a PSA needs to be given if orange roughy was to be comparatively scored to other deepwater species to evaluate sustainability, in particular if long bodied teleosts such as black scabbard and blue ling and elasmobranch species are included in the analysis.

The susceptibility of orange roughy to current and historic fisheries was evaluated by carrying out a high resolution analysis of the spatial overlap between the distribution of the stock and the spatial foot print of recent and current deepwater fisheries. For this purpose we aggregated every suitable data source for the biological distribution over a time period of ca. 10 years, including data from fisheries dependent and independent monitoring programmes. This approach would not be suitable for a highly mobile or short lived species, as it could not be ascertained that the species distribution is stable over time. Orange roughy in the NEA, on the other hand, has several life history traits which allow the assumptions that their spatial distribution has not significantly changed over the study period. Orange Roughy can reach max ages of over 150 years (Thomsen 1998, Nolan 2004, Shephard and Rogan 2004) and a decade represents less than 10% of its life expectancy. They form close habitat associations with bathymetric features such as seamounts and canyons, which in themselves are stable structures and allow the formation of small scaled endemic populations (Carlsson et al. 2011). Active adult dispersal and longevity allows for panmixia and a certain degree if genetic connectivity among populations (Varela et al. 2012).

It has to be emphasised that the distribution of orange roughy in the study area should not be regarded as a definite distribution, but as an inference as it only contains non-null data. The aim of this study was to use the most extensive data available to establish where orange roughy occur, but not to draw conclusions on extent. In order to confirm the absence of orange roughy, sampling needs to have a much more extensive spatial and temporal coverage.

The calculation of spatial overlap is highly dependent on the choice of grid size (Piet and Quirijns 2009, Lambert et al. 2012). Studies have shown that at grid cells of ca. 10km and lower, there is a marked reduction in the error in calculated extent, suggesting that cells of that size are appropriate for describing the footprint of trawling (Mills et al. 2007) but increased resolution improves the accuracy of the footprint as it makes it more comparable with the actual widths of trawls (Piet and Hintzen 2012). In this study a grid size of ca. 1 nautical mile was applied (0.03ºN*0.02ºW), which is higher than the recommended grid size of 3km*3km for the calculation DCF indicators on fishing footprints (EC 2008).

The results show that there was large overlap at the beginning of the study when 60% of the biological distribution intersected with the extent of deepwater fisheries. At the onset of this study (2006) the orange roughy TAC for VII was 1149t and catches were 488t which were primarily caught in a directed fishery (ICES 2011). TACs reduced to 0 within a timeframe of four years and catches decreased accordingly as deepwater fleets discontinued direct fisheries for orange roughy. In addition, several spatial management measures were introduced, including, in 2007, orange roughy protection areas from which no orange roughy could be landed (EC 2006) and offshore areas of special conservation for the protection of VMEs which banned fishing with bottom impacting gear from 2008 onwards (EC 2007). The cessation of a directed fishery and the adherence to management measures is reflected in the change of fishing positions which moved away from historic areas where directed fisheries were executed on bathymetric features such as mounds, ridges and canyons. This is particularly apparent on the western and southwestern Porcupine bank with its high concentrations of canyons and mounds which has been identified as areas of high orange roughy abundance (O'Donnell et al, 2007). The change in fishing pattern resulted in a decrease of PSA scores from the medium risk category to the low risk category. The fishery subsequently developed into a mixed fishery on flat fishing grounds targeting roundnose grenadier and black scabbard. The areas where these fisheries are still executed, are the continental slope to the north west of Ireland extending to the west of Scotland. Distribution maps of orange roughy and the deepwater fishing effort indicates that there is limited spatial overlap in this area. One geographical region worth highlighting is, however, the northern slope of the Porcupine Bank. Fishing effort had ceased in this location in 2009 but returned in 2010 and 2011. In the same area, positive catch rates from scientific trawl surveys have confirmed the presence of orange roughy. These areas are flat fishing grounds and include juveniles and adults (O'Donnell et al. 2007, ICES 2011) which are believed to migrate to bathymetric features to spawn (Shephard et al. 2007). Thus although the risk has decreased over the study period, as indicated by the PSA, some risk stills remains in certain locations. In order to evaluate whether certain life stages are more at risk than others, the PSA analysis could be increased in complexity, by splitting the susceptibility attributes into different life stage categories ie juveniles and spawners and assess their vulnerability separately.

Conclusion

The new application of the productivity susceptibility analysis provides a useful tool to evaluate the change of ecological risk, a fishery is posing on a species. It allows visualising the response of fisheries to management measures and evaluating whether and how these result in a reduction in risk. In the case of orange roughy in the NEA, the study has shown that the risk of deepwater fisheries to the species has been drastically reduced in recent years as a combination of different management measures, but that some fishing mortality to adults and juveniles on the flat deepwater fishing grounds cannot be ruled out.

Table 1)

Productivity			**Scores**					
Attribute	Value	Ref	Ory 2006	Ory 2007	Ory 2008	Ory 2009	Ory 2010	Ory 2011
Age at maturity	Approx 30 years 20-40 years 27.5 years (37cm)	(Shephard and Rogan 2004) (Nolan 2004) (Minto and Nolan 2006)	3					
Max age	>130years in NEA; 169 years in NEA; 187 years in NEA 93 years NZ*	(Thomsen 1998) (Shephard and Rogan 2004) (Nolan 2004) (Andrews et al. 2009)	3					
Fecundity	22000 eggs per kg body weight 48,530 eggs per kg body weight 33376 eggs	(Pankhurst and Conroy 1987) (Gordon 1999) (Minto and Nolan 2006)	1					
Max size	70.6 cm SL 60 cm SL	(Nolan 2004) (Shephard and Rogan 2004)	1					
Average size at Maturity	34 -37 cm SL	(Shephard and Rogan 2004)	2					
Reproductive strategy	Broad cast spawner	(Pankhurst et al. 1987)	1					
Trophic level	4.3±0.6 SE	(FishBase 2012)	3					
Total Productivity (average)			**2.00**					
Susceptibility			**Scores**					
Availability	See figure 4	This study	1.77	1.49	0.98	0.50	0.75	0.76
Encounterability	strong vertical overlap	This study	3	2	2	2	2	2
Selectivity	Adult size >2* mesh size		3	3	3	3	3	3
Post-capture mortality	Retained species, or all dead when released		3	3	3	3	3	3
Total Susceptibility (multiplicative)			**2.17**	**1.64**	**1.41**	**1.20**	**1.31**	**1.32**
PSA								
Total Scores			**2.95**	**2.59**	**2.45**	**2.33**	**2.39**	**2.4**
Risk category			**Medium**	**Low**	**Low**	**Low**	**Low**	**Low**

*Validated through lead radium dating

Table 1) Life history characteristics, references and PSA scores for NEA orange roughy between 2006 and 2011 (scoring according to (Hobday et al. 2007, MarineStewardshipCouncil 2012).

	Canyon	Flat	Peak
Observer Data	1015	1107	1101
Survey Data	NA	1213	1128

Table 2) Mean of orange roughy depth distribution broken down by data source and geographical feature.

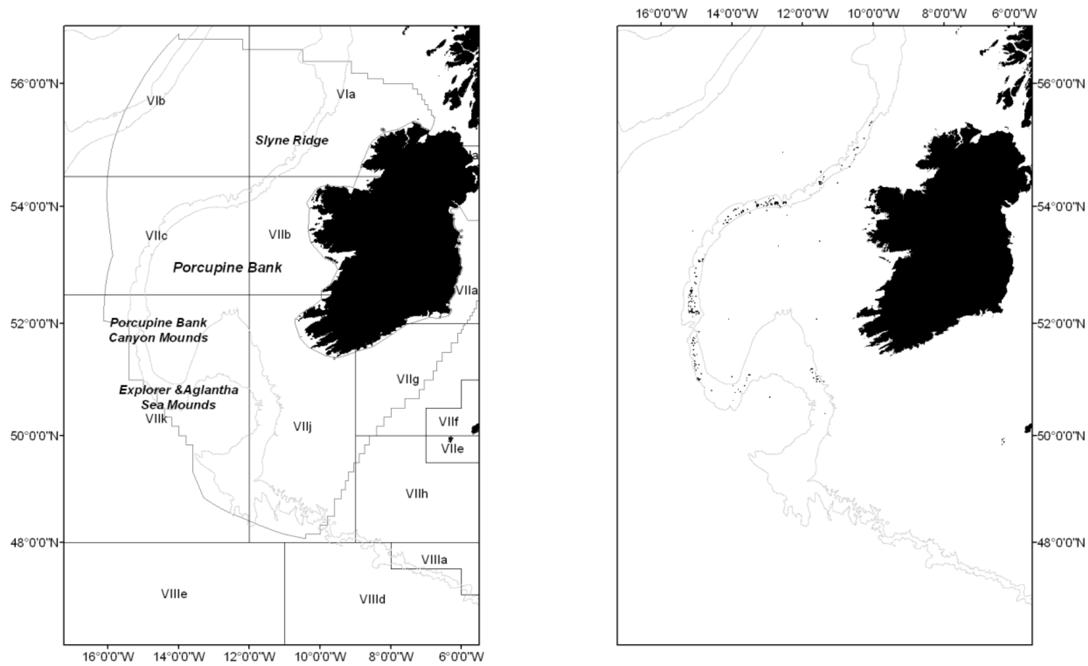

Figure 1) Study area with Irish EEZ, depth countours and geographical areas mentioned in the text (left panel) and spatial positions of orange roughy catches between 2001 and 2011 derived from scientific trawl surveys and fisheries observer programmes as gridded means at a resolution of 0.03°longitude *0.02°latitude (right panel). Contour lines in light gray present the 800m and 2000m depth band

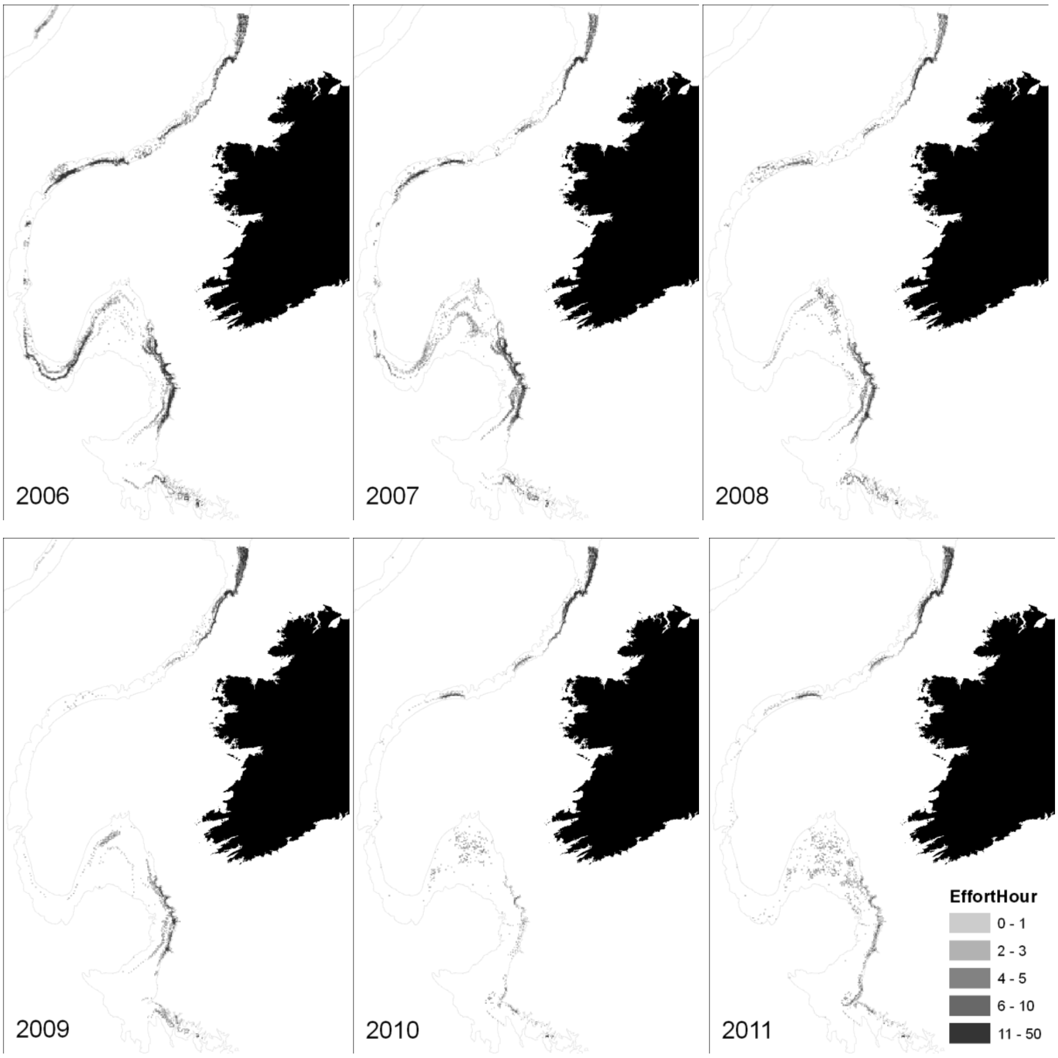

Figure 2) Spatial positions of French and Irish deepwater fishing effort between 800m and 2000m by VMS for the years 2006 to 2011. Contour lines in light gray present the 800m and 2000m depth band. For definition of “deepwater effort” see text in materials and methods.

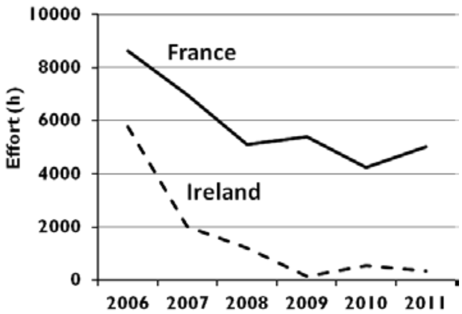

Figure 3) Hours of Irish and French deepwater effort over time in the Irish EEZ, based on VMS data analysis.

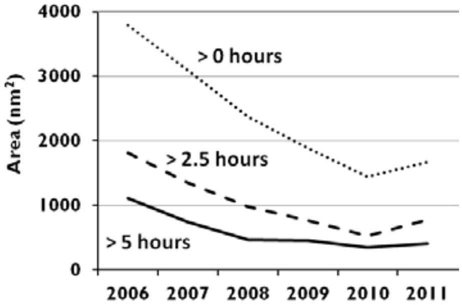

Figure 4) Spatial Footprint (the area impacted by adding up the surface area (in nm^2) of all the cells with >0 hours effort, >2.5h effort and >5h effort.

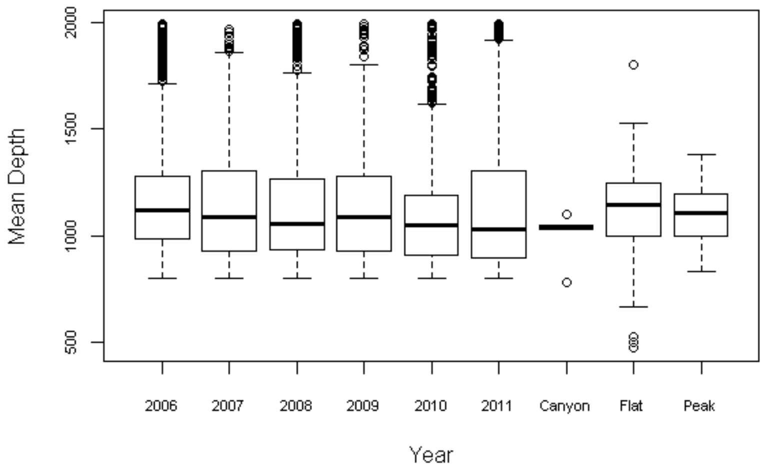

Figure 5) Depth distribution boxplot of orange roughy and deepwater fishing effort (French and Irish) in the Irish EEZ between 2006 and 2011.

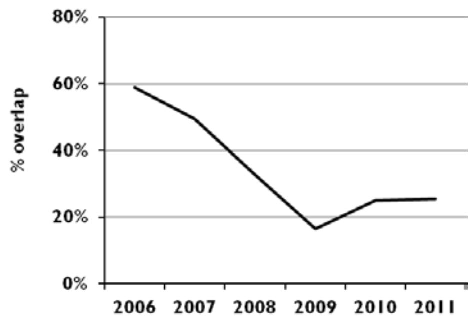

Figure 6) Change in spatial overlap of orange roughy and deepwater fisheries (proportion of orange roughy distribution area which intersected with VMS deepwater effort area at a resolution of 0.03°longitude *0.02°latitude).

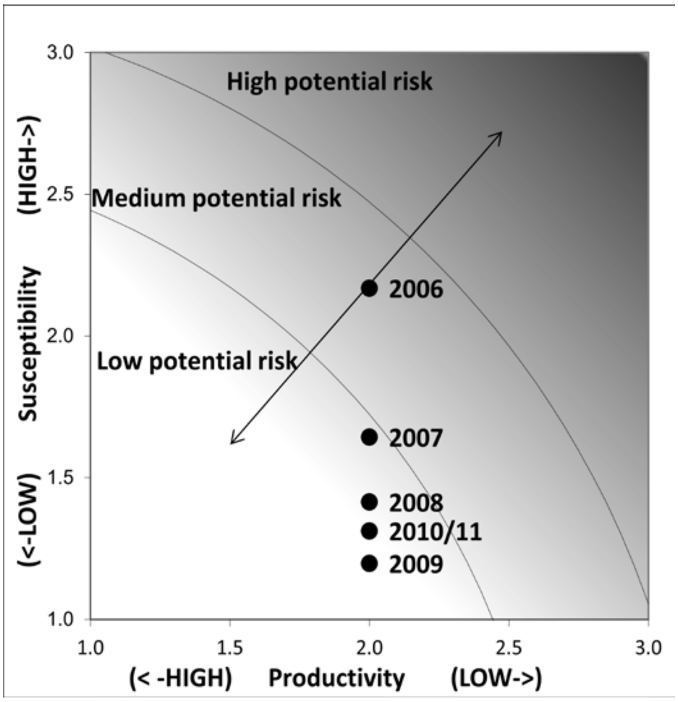

Figure 7) The PSA plot: The x-axis gives average scores of the attributes that influence the productivity of orange roughy; the y-axis gives the scaled scores of attributes that influence the susceptibility of orange roughy to the impacts from deepwater fishing in the study area between 2006 and 2011. Productivity and susceptibility scores are used to calculated the euclidian distance and indicate the relative risk of the fishery to the species. The contour lines divide regions of equal risk levels according to Hobday *et al*. (2007).

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The Red seabream fishery in the Strait of Gibraltar: update of the available information from the fishery statistics and some considerations about the current knowledge on the target species growth.

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Abstract

This paper presents the available information of the Red seabream (Pagellus bogaraveo) fishery in the Strait of Gibraltar and updates the documents presented in previous years with the information from the last analyzed year, 2012. The document presents data about landings, LPUE, length frequencies and also some biological information about the species growth which should be useful to fishery management considerations.

1. Introduction and fishery description

Since the earlies 1980´s an artisanal fishery targeted to the red seabream (*Pagellus bogaraveo*, namely "*voraz*") have been developing along the Strait of Gibraltar area (ICES IXa south). This fishery has already been broadly described in previous Working Documents presented to the ICES WGDEEP (Gil *et al*., 2000; Gil & Sobrino, 2001, 2002 and 2004; Gil *et al*., 2003, 2005, 2006, 2007, 2008, 2009, 2010, 2011 and 2012). Spanish red seabream fishery in the Strait of Gibraltar is almost a monospecific fishery with one clear target species which represents the 74% from the total landed species which constitutes a fleet component by itself (Silva *et al*., 2002).

The Instituto Español de Oceanografía (IEO) began the study and the fishery monitoring following the request from the Fishermen Corporations. In 2006, 2008, 2010 and 2012 different assessment trials were attempted within the ICES WGDEEP (ICES, 2006, 2008, 2010 and 2012).

The main objective of this paper is to provide an updated summary of the available fishery information and some considerations about the growth of this deep-water species in ICES area IX to the 2013 ICES WGDEEP meeting.

2. Material and methods

Fishery information was gathered for the period 1983-2012 from the sale sheets: monthly landings, monthly number of sales and the number of days in which those sales were carried out. Moreover, from the beginning of the IEO monitoring, June 1997, an *ad hoc* monthly length samplings from the different commercial sizes are carrying out to estimate the landings length distribution (Gil *et al*., 2000).

R software was quite helpful to draw growth curves and integrated recaptures information in it. So observed growth from tag-recapture experiences were compared with the expected ones from three different VBGF estimated by means of otoliths readings results: ALK 1997-1999 (FISHPARM software) and ALK 2003-2009 (FISHPARM software and Bayesian von Bertalanffy growth model with Schnute parameterization).

3. Results and discussion

- Landings data: Figure 1 shows a continuous increase of the landings to a maximum in 1994. Since 1994 landings have gone decreasing till 2002, except in 1996 and 1997. Then, from 2003 onwards it shows an increasing trend till reached the highest value of the last years in 2009, followed by a new decrease till last year, with the lowest value of the recent years. However Morocco landings from the same fishing grounds are not included.

- LPUEs and CPUEs: Fishing effort increases too till 2009 (Figure 2). It is important to emphasize that the effort unit chosen (number of sales) cannot be too appropriate as do not consider the missing effort. Thus, in the years when the resource is not so abundant the missing effort increases substantially (fishing vessels with no catches, so no sale sheet were recorded). So, the LPUE trend from the decline of the fishery, 1997, should be interpreted with caution because it cannot be a real image of the resource abundance but even so the decreasing trend since 2010 is quite clear.

- Length frequencies:

The fishery resource suffers a decrease of the landed mean length (Figure 3) mainly from 1995 to 1998. It is necessary to point out that species probably does not have a homogeneous geographic and bathymetric distribution related to their length. This fact could explain the different landed mean length between the main landing ports, Tarifa and Algeciras. The mean length of the landings gets progressively increasing from 1999 onwards, but along the last years the trend varies increasing again from 2006 on in both ports. However the median value from these years remains under the mean in every case. The mean length from both landing ports became lower since 2010. Nowadays there is not minimum landing size adopted for the area.

- Biological information: No new biological information is available. Figure 4 draws the size increment between tag and recapture dates from the twelve longest lived samples. In every case observed values are below than the expected in the VBGF functions from otoliths readings. So, it seems that readings may be overestimated and some hyaline rings are uncounted and/or missing. Thus, age and growth based on otolith readings should be revised and further work is needed.

4. Main conclusions

Figure 1 is clear enough. There is no evidence of the fishery sustainability at the current levels. Landings and mean length decreasing since 2010 remember a similar history in the middle 1990s. Besides, because of its particular biology the Red seabream may be especially sensitive to overfishing. Fish ageing has an important role in fisheries assessment and management. Typically, fisheries based on slow growing species could be subject to growth overfishing. The use of biased age estimation criterion may have important consequences. Besides, underestimating growth is likely to result also in underestimate of stock´s productivity; a stock with a fast growth rate might recover faster than be expected from low biomass levels, and vice versa. Improving the precision in the absence of accuracy cannot, under any account, guarantee data quality (de Pontual *et al*., 2006). Therefore, considerable effort should be made to improve the precision of age data through workshops on ageing (i.e. ICES WKAMDEEP next October).

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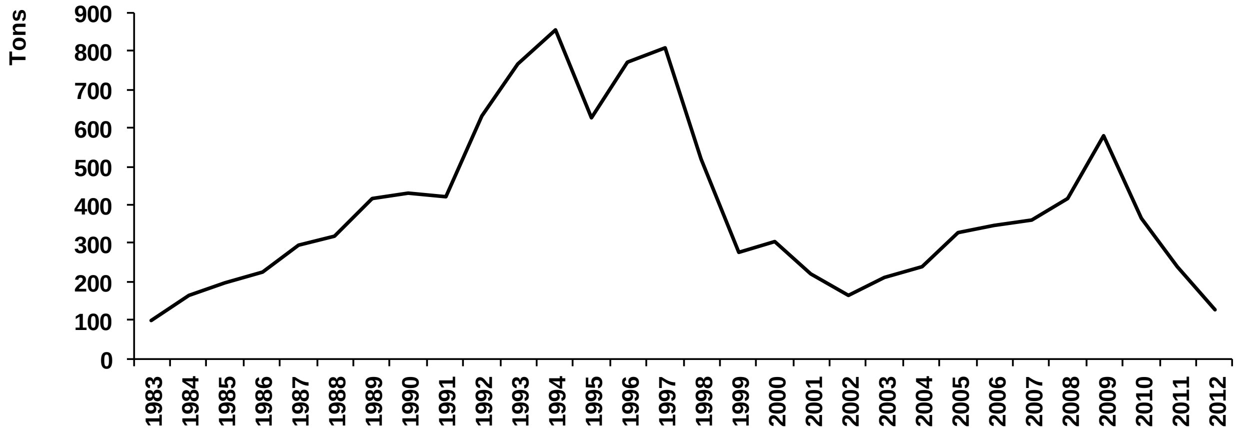

Figure 1. Red seabream Spanish fishery of the Strait of Gibraltar: Landings (1983-2012).

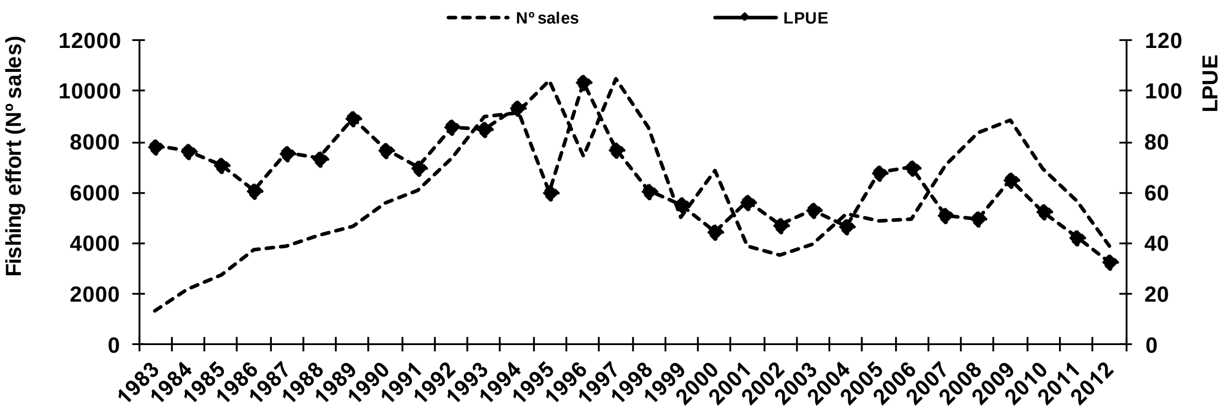

Figure 2. Red seabream Spanish fishery of the Strait of Gibraltar: Evolution of the chosen effort unit (number of sales) and its estimated LPUE (1983-2012).

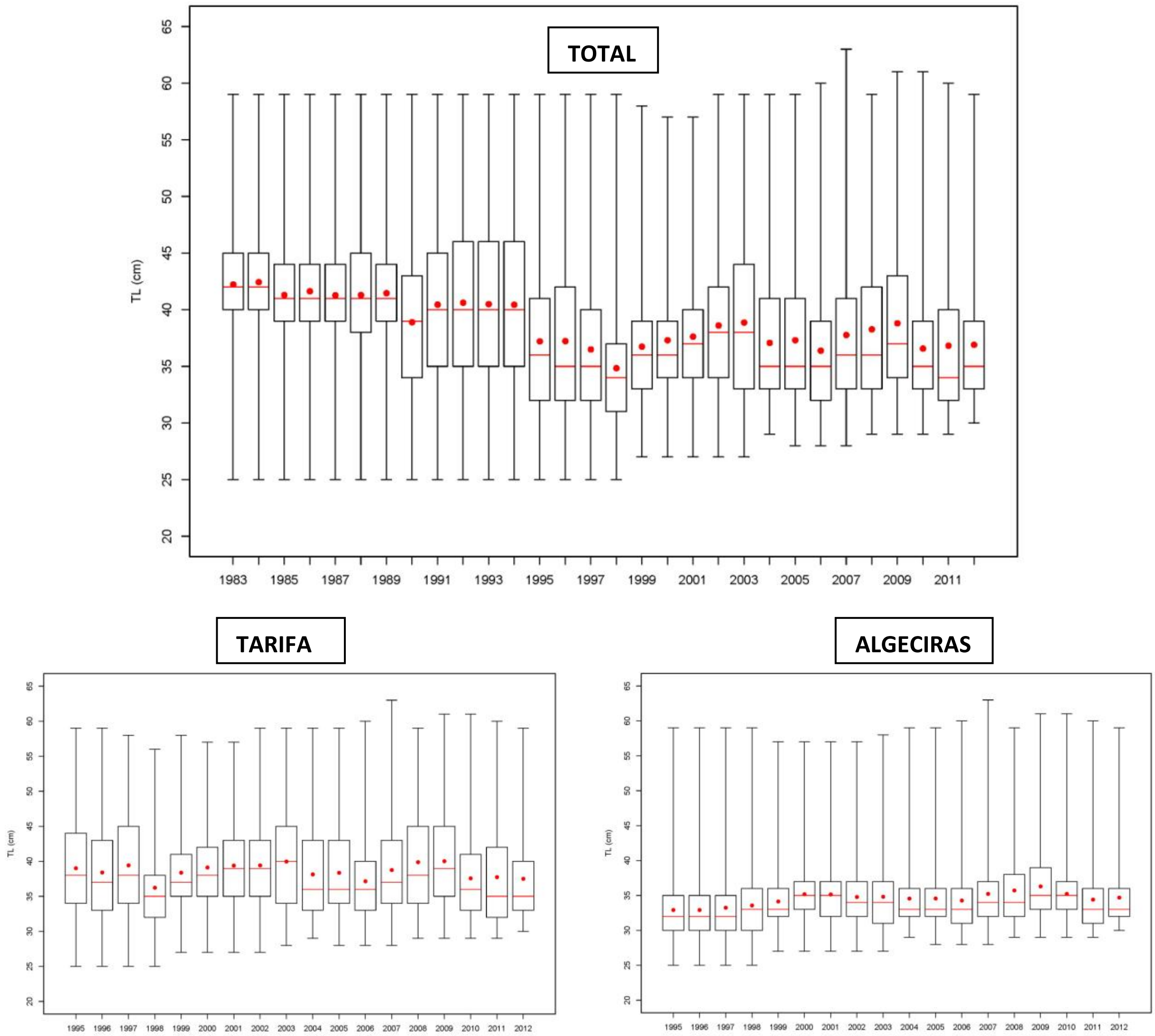

Figure 3. Red seabream Spanish fishery of the Strait of Gibraltar: Evolution of the landings length distribution descriptive statistics.

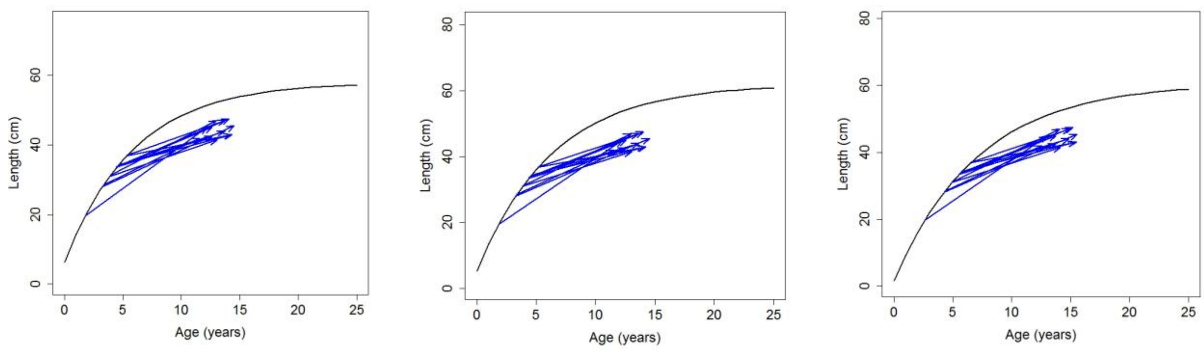

Figure 4. Red seabream of the Strait of Gibraltar: von Bertalanfy growth curves estimated from otolith readings. Straight lines correspond to the 12 long time at sea recaptures (Left: ALK 1997-1999; Center: ALK 2003-2009 FISHPARM soft. and Rigth: ALK 2003-2009 Bayesian fit).

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Analysis of the Vessel Monitoring System information to estimate the missing effort of the Spanish "voracera" fishery in the Strait of Gibraltar area.

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1. Introduction and fishery description

Since the earlies 1980´s an artisanal fishery targeting the Red seabream (*Pagellus bogaraveo*, namely "*voraz*") have been developing along the Strait of Gibraltar area. The "*voracera*", a local mechanized hook line baited with sardine, is the gear used by the fleet from Tarifa and Algeciras ports. Fishing is carried out taking advantage of the turnover of the tides in bottoms from 200 to 400 fathoms. Primarily, around 25 boats carried out the fishery in 1983 and the fleet has been increasing up to more than a hundred from the 1990´s. Nowadays 2011 authorized list includes 94 fishing boats.

One common variable used in fisheries assessment is the fishing effort estimates. Effort measures can consider several units, as in case of a hook fishery: number of fishing days, number of fishing sets, number of hooks deployed, etc. In our case, till now the effort unit available chosen was the number of sales as a fishing day's proxy. It is important to emphasize that it may be inappropriate as it fails to consider the missing effort when vessels had not caught enough fish to sell at public auction. Thus, in those years where missing effort increases substantially (fishing vessels with no catches and no sale sheet to be recorded) effort was under-estimated so CPUE values should be over-estimated.

The "*voracera*" fleet is eminent artisanal and the boats involved are smaller so no EU VMS by satellite is available. However, since 2004 the Andalucía Regional Government starts the installation of its own Vessel Monitoring System in smaller boats. This system called SLSEPA

("*Sistema de Localización y Seguimiento de Embarcaciones Pesqueras Andaluzas*") performs the on-line monitoring to preserve the safety at sea, control fishing activity and improve the monitoring and assessment of fisheries resources. Boats carry on a device, namely "green boxes" (to differentiate from the EU ones), that transmits to the control center information about their position, heading, speed, etc every three minutes. Data transmission uses the GPRS/GSM technology of cellular networks instead of satellite system.

This information analysis allows the determination of preferred fishing areas, steaming routes and fishing operations of the "*voracera*" fleet. So, as a first step real figures of fishing days are provided as well as the estimated number of hauls (fishing operations) per boat. Landings geographical situations could be draw linking the VMS data with its respective sales at landing port.

2. Material and methods

Information source

Data analysis comprises information from the "*voracera*" fleet of the Strait of Gibraltar along the years 2009 – 2011. First, the received information was preprocessed in the control center of the Department of Agriculture and Fisheries at the Andalucía Regional Government. Later, at the Oceanographic Center of Cadiz these data were integrated into an Ms Access database for its management and integration into a Geographic Information System (GIS).

Filtering process

Only records with switch off port signal and speed less than 4 knots were chosen, based on the assumption that this is the maximum speed of fishing operations and higher speeds should corresponds to boat displacements. Previous experiences from observers on board scheme backed up this assumption. Additionally, GIS tools let other data erasure, such as: entries and exits from main port zones (Algeciras, Tarifa, Barbate and Ceuta) and shallow locations (<30 m depth).

Then, data were labeled with the target species from the landings statistics database. So, fishing trips with Atlantic bluefin tuna (*Thunnus thynnus*) or Silver scabbardfish (*Lepidopus caudatus*) identify those trips done by the "*voracera*" fleet but with another fishing gear and in different fishing zones. Any record in the areas comprised by this two other fisheries without landings is discarded and ascribed to the Tuna or Silver scabbardfish fishing days.

At last, the remainder records are those which belong to fishing operations targeting Red seabream. This is the first step to the effort estimation in the Strait of Gibraltar.

Fishing days

Red seabream fishery fishing days (trips) is a straightaway result from the previous cleaning process. The total "*voracera*" fishing trips by year could be estimated comparing the "green boxes" CPUE and the total landings information.

Fishing operations estimates

Fishing operations (hauls) were disaggregated through an algorithm which incorporates fishery knowledge. Consecutive records (without speed breaks of more than 6 minutes interval) were grouped from a minimum of 15 minutes to a maximum of 60 minutes to consider it as a same haul. Estimated Number of hauls obtained were checked through a cross validation with the reported information from the observers on board of the "*voracera*" fleet program in 2009.

Spatial distribution

The fishing effort (number of hauls) spatial distribution was obtained splitting the study area into 1 square nautical miles cell grid and summarizing the number of fishing operations within each cell. A total daily landing per boat was proportionally distributed among its estimated fishing operations. Then, landings spatial distribution could be charted along the designed cell grid.

3. Results and discussion

Fishing activity has been determinate for the "voracera" boats. The activity is confined to a relatively small and so located area, the Strait of Gibraltar. 2009 – 2011 green boxes data provided by Andalucía Regional Government only includes records with speed lower than 5 knots (Figure 1). Gaps between situations are the consequence of high speed absences from intermediate steaming tracks. If this was not avoided, all the Strait of Gibraltar area was a "green dot".

Every year, boats speed was characterized by a mode at 1 knot (fishing state), because 0 - 0.3 knots values belongs to port scales (Figure 2). These distributions corroborate the boat behavior during a fishing haul, with low speed (but never stopped) to steer it against the strong currents of the Strait of Gibraltar.

Along the data filtering process those areas with different target species (Atlantic bluefin tuna or Silver scabbardfish) were excluded. So, Red seabream fishing grounds defined were quite contiguous and characterized by smaller patches (Figure 3). These positions coincide with traditional red seabream fishing zones previously described by Gil and Sobrino in 2006.

Fishing activity has been determined for “voracera” fleet targeting Red seabream. Figure 4 represents the final fishing grounds obtained from 2009 to 2011. In 2011, certain boats moved to a far fishing area. This so western area is also frequented by other fleet component from Conil which fish with different gear (longlines).

The Red seabream fishing effort in terms of number of fishing days per boat (fishing trips) could be obtained from the filtered records. Table I shows summary information from the VMS analysis, including several fishing effort estimates for the 2009 – 2011 period. Also information from sale sheets (landings and sale days) is provided, as well as other CPUEs for the whole landings.

Finally, Figures 5 and 6 shows the output of the analysis aimed to evaluate the effect of the application of the proposed disaggregation method to estimate the number of hauls. Each map and each year contains cells with the assigned numbers of hauls, presenting the spatial distribution of fishing effort in terms of the number of estimated hauls grouped into 1 square nautical miles cell. While, Figure 6 shows the spatial distribution of its corresponding assigned landings. Relationships between the total fishing area and the cumulative activity in certain areas demonstrated that most fishing activity took place in a small proportion of the total fished area along the study period. The spatial distribution of the CPUE (kilos/haul) by quarter in the intermediate year (2010) appears in Figure 7. Patches distribution is common along the year but the westerns fishing grounds were visited after the first quarter, when weather conditions are milder. Daily fishing grounds choice depends on weather conditions (East or Western winds), tidal coefficient, yesterday or previous landings and, obviously, skipper opinion.

4. Main conclusions

Even it could be good enough for the estimation of fishing effort: “A picture is worth than a thousand words” is a very relevant saying in the case of link geo referenced boats fishing activities and its landings. The main problem found using blue boxes data is the large time interval between datasets (2 hours). Far from it, green boxes send data every three minutes that is a proper interval even for artisanal fleets like the “*voracera*”. Results obtained seem to be more suitable with the fishery reality. As guessed, the missing effort increases when the resource levels decrease.

Acknowledgments

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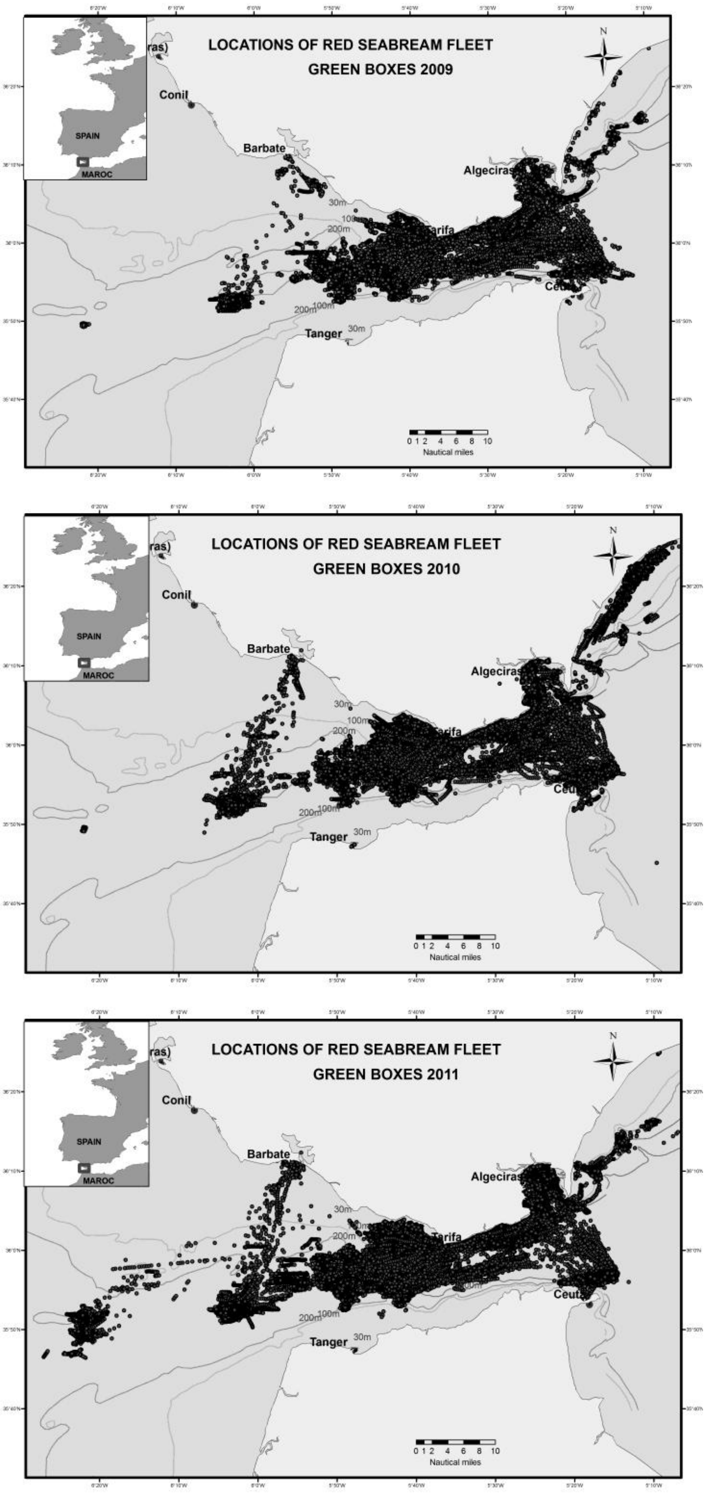

Figure 1. Yearly non filtered situations from "*voracera*" fleet in the Strait of Gibraltar area.

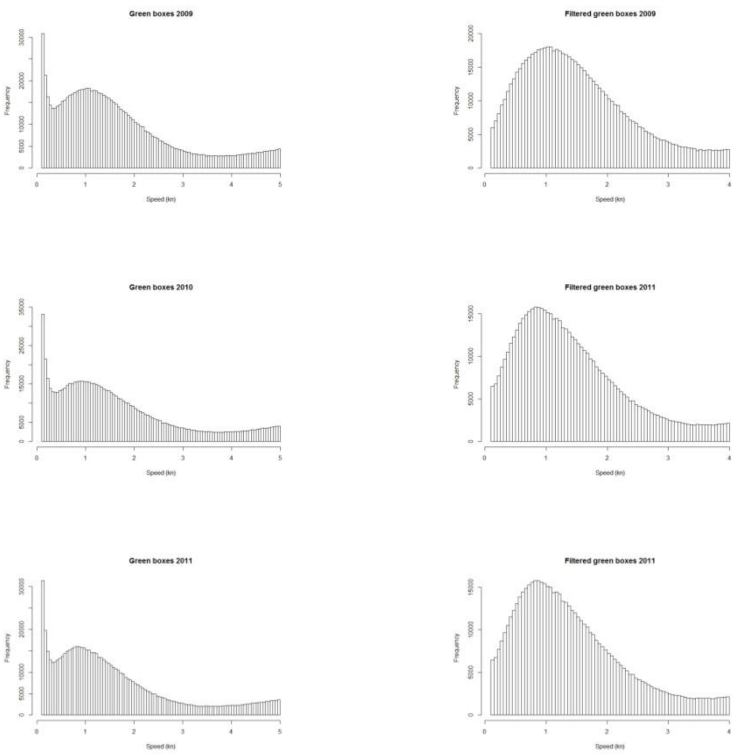

Figure 2. Distribution of speeds (in knots) by year, before and after VMS filtering process.

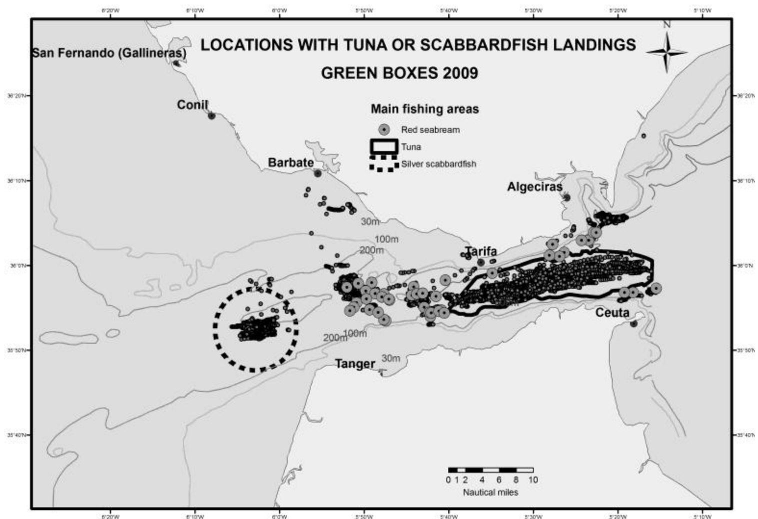

Figure 3. Location of traditional Red seabream fishing areas (Gil and Sobrino, 2006) and main fishing areas identified from VMS data for Atlantic bluefin tuna and Silver scabbardfish.

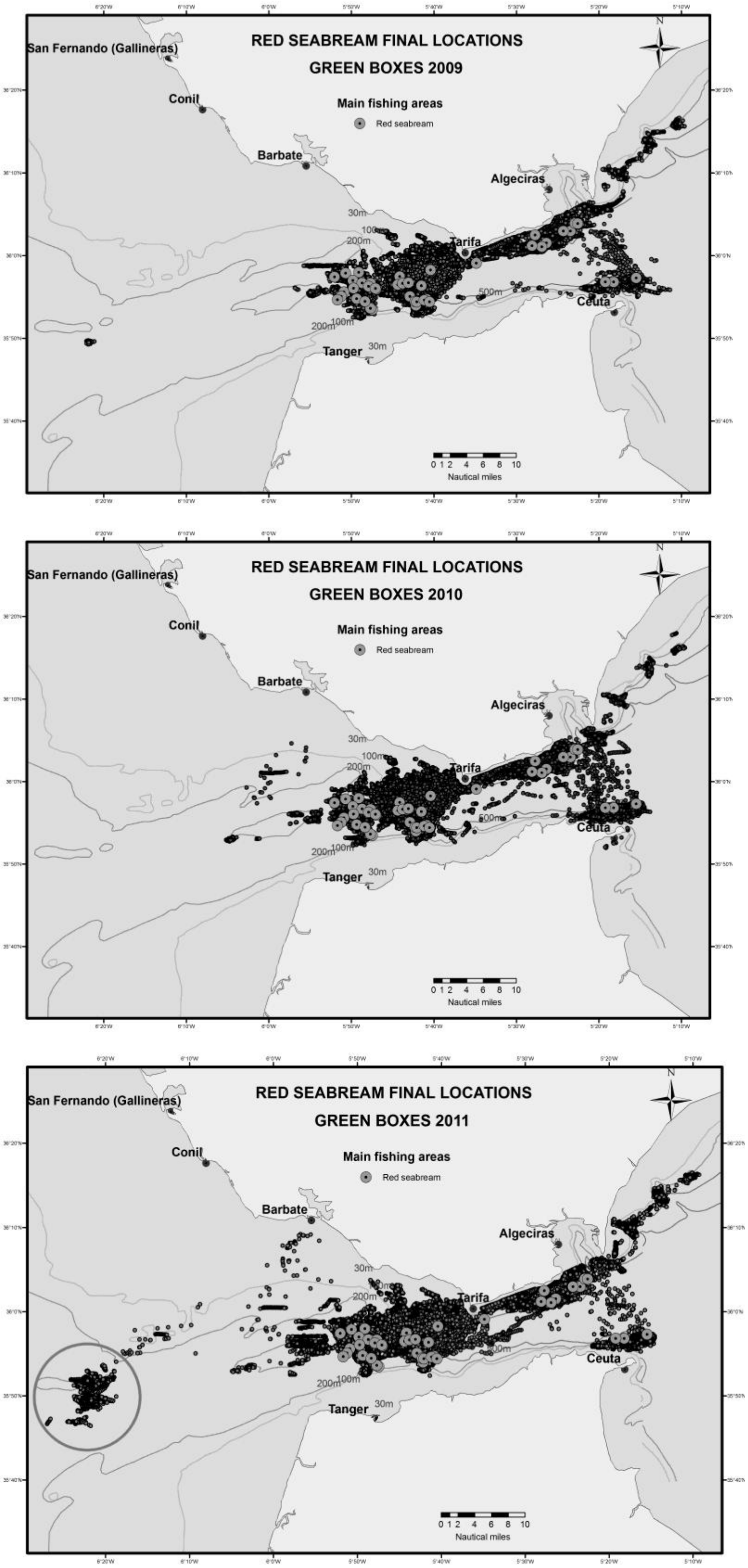

Figure 4. Final Red seabream fishing grounds located from 2009 – 2011 VMS data.

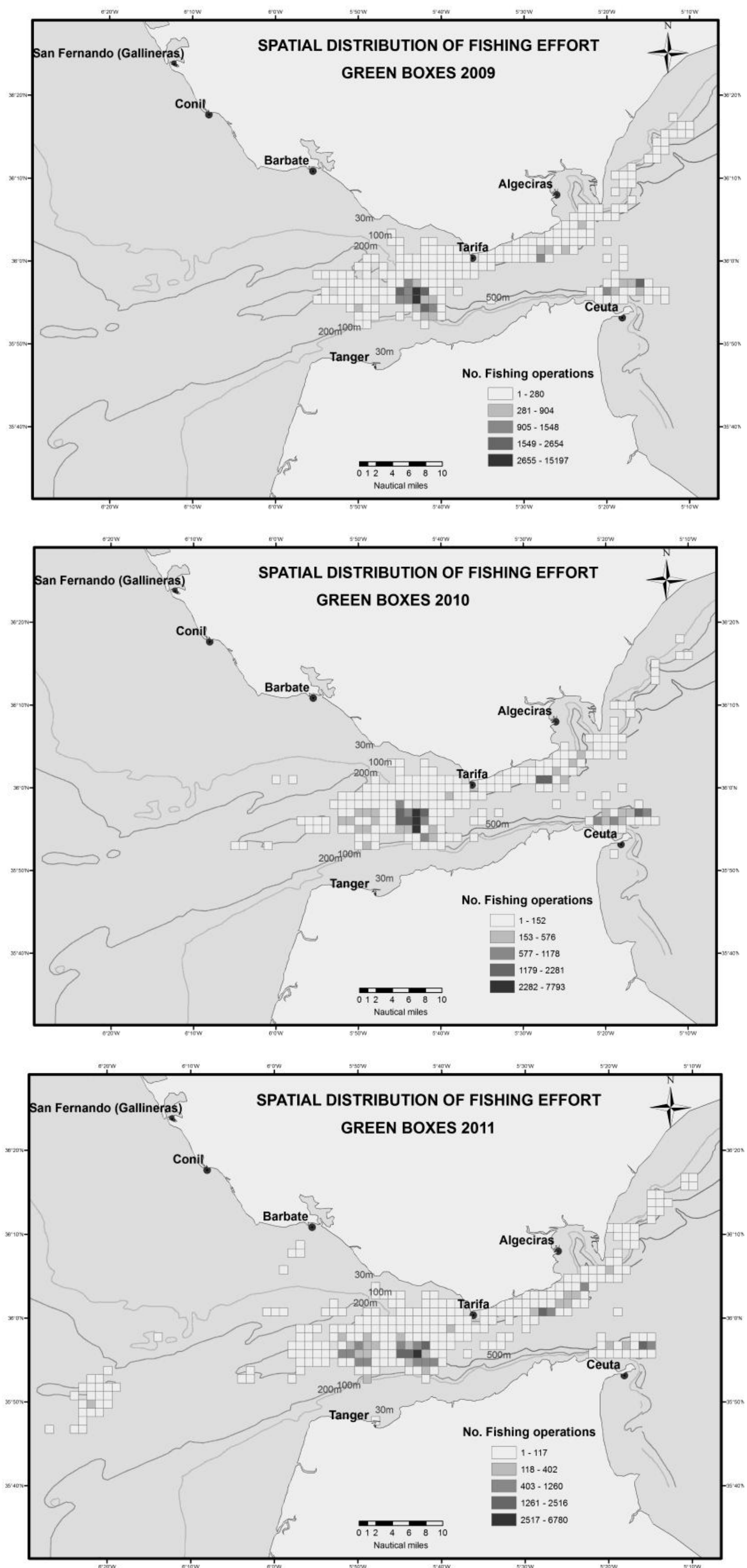

Figure 5. Red seabream spatial distribution of fishing effort, estimated as number of fishing operations (hauls).

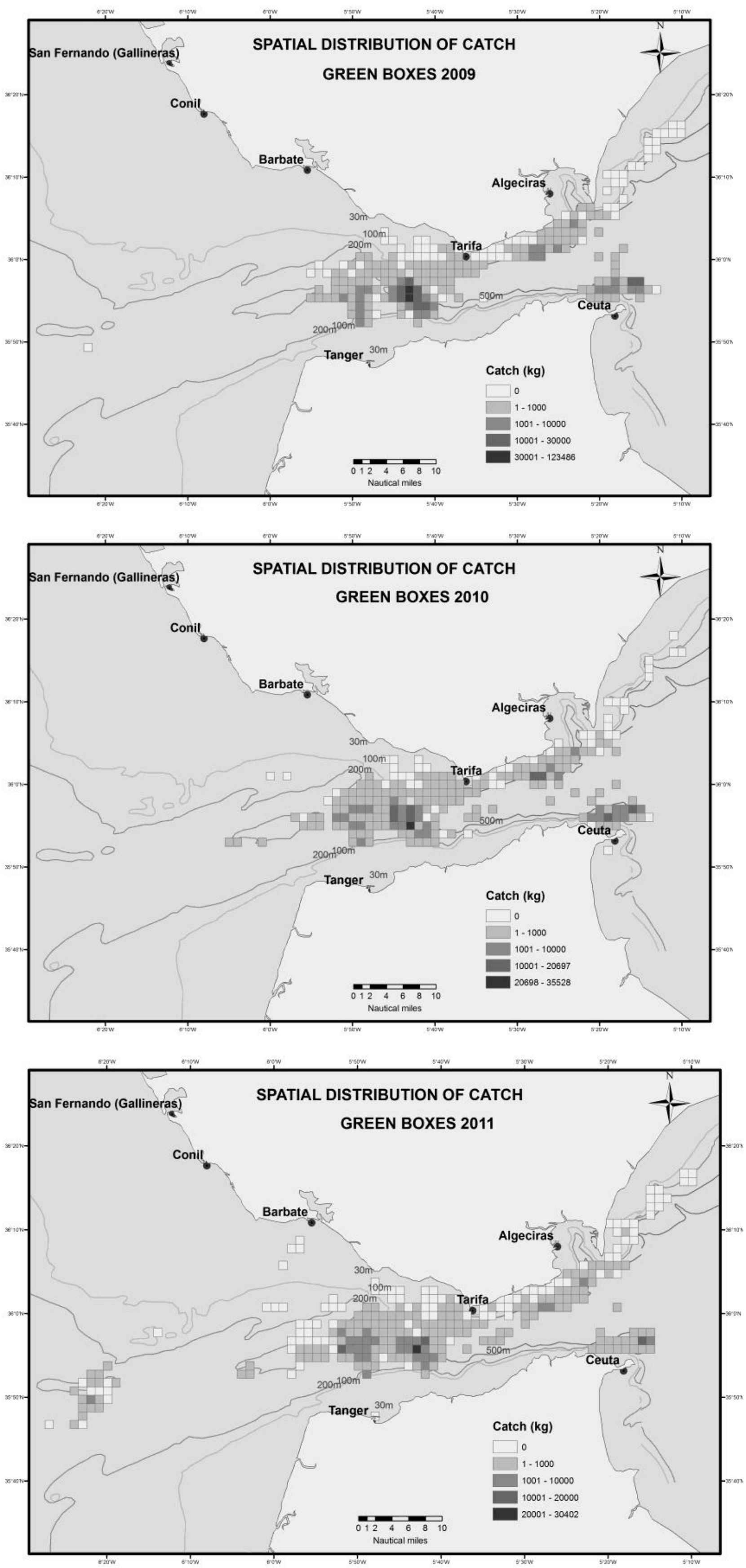

Figure 6. Red seabream spatial distribution of landings.

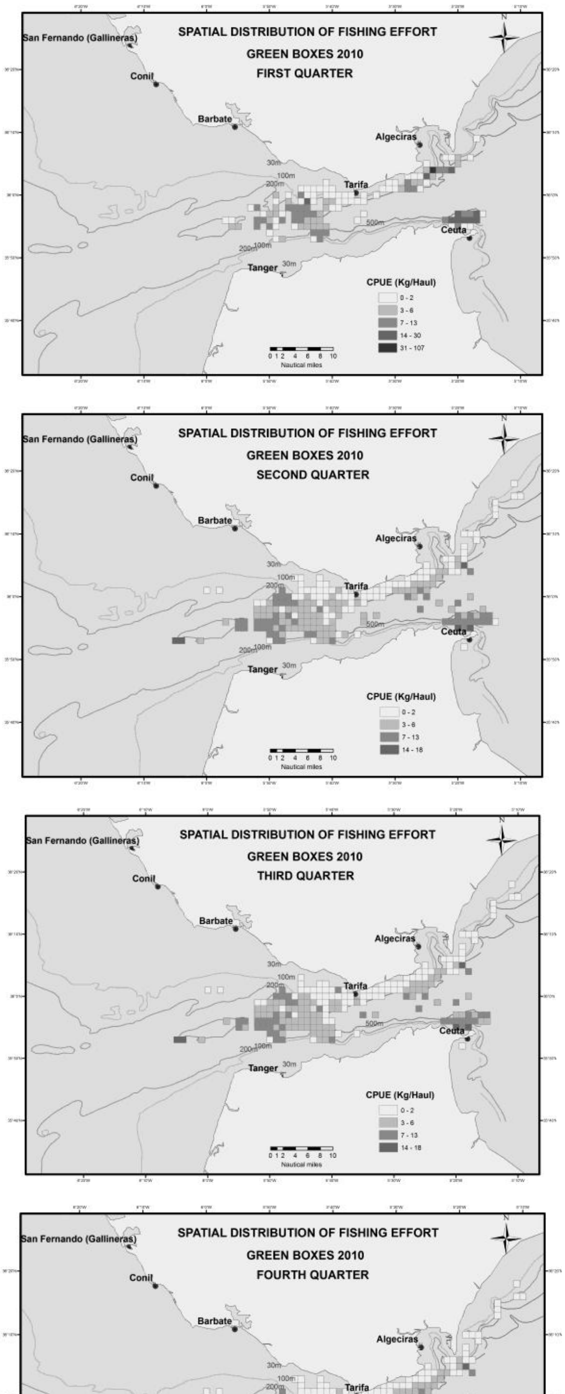

Figure 7. Spatial distribution of the Red seabream CPUE (kilos/haul) by quarter in the intermediate year (2010).

Table I. "*Voracera*" fleet VMS analysis: Summary results and its different estimates.

"*Voracera*" fleet / Year	**2009**	**2010**	**2011**
Boats	85	82	82
Sale sheets	7,200	5,863	4,711
Fishing days (trips)	8,373	7,238	6,160
Fishing operations (hauls)	60,593	46,579	38,345
Landings (in kilos)	459,010	274,882	190,786
CPUE 1 (Landings/Sale sheets)	64	47	40
CPUE 2 (Landings/trips)	55	38	31
Total boats	97	92	86
Total sale sheets	8,892	6,945	5,662
Total fishing days (trips)	10,564	9,629	7,743
Total Landings (in kilos)	579,139	365,672	239,286
CPUE 1´(Total landings/Total sale sheets)	65	53	42
CPUE 2´(Total landings/trips)	55	38	31

Discards of deepwater species by the Portuguese bottom otter trawl and deepwater set longline fisheries operating in ICES Division XIa (2004-2012)

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Abstract

We compile the information available on the discards of WGDEEP stocks (Black scabbardfish, *Aphanopus carbo*; Greater silver smelt, *Argentina silus*; Alfonsinos, *Beryx* spp.; Blue ling, *Molva dypterygia*; Ling, *Molva molva*; Orange roughy, *Hoplostethus atlanticus*; Roundnose grenadier, *Coryphaenoides rupestris*; Blackspot(=red) seabream, *Pagellus bogaraveo*; and Tusk, *Brosme brosme*) produced by Portuguese vessels operating with bottom otter trawl (OTB) and deepwater set longlines that target black scabbardfish (LLS_DWS) in Portuguese ICES Division IXa. The data was collected by the Portuguese on-board sampling programme (EU DCR/NP) between 2004 and 2012. We describe the on-board sampling programme, estimation algorithms and data quality assurance procedures and provide results for three fisheries: the crustacean bottom otter trawl fishery (OTB_CRU), the demersal bottom otter trawl fish fishery (OTB_DEF) and the deepwater set longline fishery that targets black scabbardfish (LLS_DWS). The low frequency of occurrence (and number of specimens) of most species in the trawl hauls and longline sets sampled on board indicates that discards can be assume negligible for assessment purposes of most WGDEEP 2013 stocks.

1 Introduction

This working document compiles the information available on the discards of black scabbardfish (*Aphanopus carbo*), greater silver smelt (*Argentina silus*), alfonsinos (*Beryx* spp.), lings (*Molva dypterygia* and *Molva molva*), orange roughy (*Hoplostethus atlanticus*), roundnose grenadier (*Coryphaenoides rupestris*), blackspot(=red) seabream (*Pagellus bogaraveo*) and tusk (*Brosme brosme*) produced by the Portuguese bottom otter trawl fleet (OTB) and deepwater longline fleet that operates in Portuguese ICES Division IXa. The data was collected by the Portuguese on-board sampling programme (EU DCR/NP) between 2004 and 2012. The document starts with a description of the on-board sampling programme and details of the estimation algorithms and data quality assurance procedures (Section 2). Then, results on species's annual frequency of occurrence in discards, total discard estimates and length composition of discards are presented (Section 3). Finally, conclusions are drawn on the importance of discards of these species for WGDEEP stock assessments (Section 4).

2 Onboard sampling and data analysis

The Portuguese on-board sampling program, included in the EU DCR/NP, is based on a quasi-random sampling of cooperative commercial vessels between 12 and 40 meters long. The programme started in late 2003 and involves on-board sampling of several fishing métiers. These include, amongst other, bottom otter trawl and deepwater set longlines that target black scabbardfish in ICES Division IXa. From these, the bottom otter trawl fleet (OTB) constitutes the most comprehensively sampled fleet. For sampling purposes the OTB fleet is split into two components: a crustacean fishery (OTB_CRU) that operates cod-end mesh sizes 55-59mm and >70mm targeting deep-water rose shrimp, Norway lobster and blue whiting and a demersal fish fishery (OTB_DEF) that operates cod-end mesh size 65-69mm and >70mm and targets horse-mackerel, cephalopods and other finfish. A detailed account of the characteristics in these fisheries is found in Castro et al. (2007). The deepwater set longline fleet that targets black scabbardfish (LLS_DWS) has been sampled from 2005 onwards. However, sampling intensity in this fishery has been low and fleet coverage is not optimal (Fernandes and Ferreira, 2006; Fernandes et al., 2008; Fernandes et al., 2009). An account of the vessel characteristics of the Portuguese deepwater longline fishery targeting black scabbardfish is provided in Bordalo-Machado et al. (2009).

2.1 Trip selection

The EU DCR/NP (CR (EC) 199/2008; CD 2010/93/EU) establishes fishing trip as the sampling unit to be used by at-sea discard sampling programmes. The Portuguese onboard sampling programme targeting the bottom otter trawl fleet (OTB_CRU and OTB_DEF) and the deepwater set longline fleet that targets black scabbardfish (LLS_DWS) is based on a quasi-random sampling of trips from a set of cooperative vessels known to operate in each fishery. Annual sampling targets are fixed for each fishery, namely 12 trips in the OTB_CRU fishery, 27 trips in the OTB_DEF fishery and 12 trips in the LLS_DWS fishery. The sampling levels attained in the 2004-2012 period are presented in Table 1 and Table 2. The OTB fisheries have been extensively sampled throughout the period with annual sampling levels attaining or surpassing the annual sampling targets (Table 1). Sampling levels achieved in the LLS_DWS fishery were lower and remained below 50% of the annual targets in the first 4 years of the sampling programme (2005-2008), improving from 2009 to the present with the entry of a set of vessels of larger size (n=4) into the list of cooperative vessels. Reasons for lower coverage in LLS_DWS fishery are mostly related to vessels not having space onboard to accommodate observers and/or being unable to guarantee their safety under bad weather conditions (Fernandes et al., 2008), logistic constrains in accessing ports of departure, and after 2009 an increasing need to allocate observers to other fisheries, namely set gill/trammel nets that target demersal stocks (GNS_DEF, GTR_DEF).

Table 1: Sampling levels of the Portuguese onboard sampling programme in the two OTB fisheries (2004-2012).

	Trips sampled		Hauls sampled		Hours fished	
Year	OTB_CRU	OTB_DEF	OTB_CRU	OTB_DEF	OTB_CRU	OTB_DEF
2004	17	24	111	125	479	315
2005	15	39	74	159	372	349
2006	7	42	30	194	133	380
2007	12	38	73	162	263	296
2008	12	34	66	128	267	254
2009	16	38	84	135	314	264
2010	16	31	103	116	375	208
2011	13	30	56	83	217	161
2012	13	31	68	60	302	130

Table 2: Sampling levels of the Portuguese onboard sampling programme in the LLS_DWS fishery (2005-2012).

Year	Trips	Sets	Hours fished
2005	3	3	115
2006	6	5	197
2007	3	3	110
2008	4	4	157
2009	6	6	247
2010	9	9	373
2011	6	6	169
2012	9	9	380

2.2 Catch sampling

The sampling protocols used in Portuguese onboard sampling of the OTB and LLS_DWS fisheries are detailed in Prista et al. (2011). A brief account follows. In both fisheries two observers are deployed per fishing trip. In the OTB fisheries several hauls are made on each fishing trip and observers take a sample from the haul's catch, sort the specimens into retained and discarded fraction and register the weight and length composition of each species fraction. In the LLS_DWS fishing trips a single longline is hauled per trip and the mainline is generally divided into 6-10 short segments (Bordalo-Machado et al., 2009). Observers identify and count every specimen caught in a sample of segments and allocate it to one of two categories: retained or discarded. Afterwards, a sample of fish from each species and category is used to determine length composition. In both fleets, observers collect concurrent fishing effort information (hours fished, number of hooks, etc.) and register environmental information (GPS coordinates, depth, bottom type, etc.). The on-board sampling protocols of the OTB_CRU, OTB_DEF and LLS_DWS fisheries have suffered only minor changes and adaptations between 2004 and 2010. In 2011 the size of catch samples taken from the OTB fishery was doubled (from 1 to 2 boxes of catch) and the within-trip selection of hauls and sets was standardized to "at least, every other haul/segment".

2.3 Estimates of discards (haul and set level)

In the OTB fisheries, the total volume discarded (in kg) in each haul is estimated by multiplying the ratio of discard and retained sample weights (all species combined) by the total retained weight in the haul (all species combined). The volume of discards of individual species in each haul is calculated *a posteriori* by multiplying the proportion (in weight) of species discards in the catch sample by the total catch volume estimated for each haul (total volume discarded + total volume landed). In the LLS_DWS fisheries, The number of fish discarded in each species and set is estimated by multiplying the species counts by the inverse of sampling fraction (i.e., total by the ratio of "no. segments in gear" to "no. segments counted").

2.4 Estimates of discards (fleet level)

The procedure generally used to raise discards from haul to fleet level in the Portuguese trawl fisheries is adapted from Fernandes et al. (2010) (Jardim and Fernandes*, in prep.*). Using this procedure, species with low frequency of occurrence or abundance in discards (i.e., a large number of zeros in the data set) cannot be reliably estimated at fleet level (Jardim et al., 2011). The frequency of occurrence and abundance of WGDEEP 2013 species in the discards of the Portuguese bottom trawl fleet was below 30% (see Section 3.2.). Consequently, annual discard volumes at fleet level were not estimated. Fleet level estimates were also not obtained for the deepwater set longline fisheries targeting black scabbardfish due to low sampling levels and the current lack of a procedure that appropriately corrects for a shifts in vessel size and fishing ground coverage throughout the period (see Section 3.2).

2.5 Quality assurance procedures

The Portuguese onboard database is programmed in Oracle and contains internal routines for the detection of basic errors (e.g., errors in dates). In what concerns the OTB fisheries, the database contains general trip information (vessel information, date, location, haul number, retained weight by species), along with sample information by fraction (retained, discarded) and species, namely weight, number of specimens and length composition. Quality checks involving the manual checking of (at least) 10% of annual trawl records have been routinely carried out since the beginning of the on-board sampling programme. In 2010-2011 a semi-automated R quality assurance procedure was designed and the 2000-2011 trawl database was checked for so far undetected errors. Since then, routine quality assurance procedures include: quarterly checks using the semi-automated R routine and an annual check of 10% of the trawl records that detects observer-related biases, with only minor updates and data reviews being performed in the previous data. In what concerns the LLS_DWS fishery, the current design of the Portuguese onboard database does not fully encompass the structure of the data. Consequently, LLS_DWS data has not yet been subjected to a full quality check. The data used in the current estimates were extracted from the database in 15/03/2013.

2.6 Note on species identification

The Portuguese on-board observers are trained in using the FAO 3-alpha code list (ASFIS List of Species for Fishery Statistics Purposes: available at http://www.fao.org/fishery/collection/asfis/en, date: February 2011) to identify species and species groups during field observations. General training in species identification is provided to observers during demersal surveys and/or market sampling. When onboard a commercial fishing trip observers are requested to record fish data at the most appropriate taxonomic level based on the specimen's conservation status, on field logistics, and their own identification expertise. Practice shows that Portuguese on-board observers are quite accurate in the identification of most commercial and non-commercial species but that substantial differences between observers and/or inaccuracies in species identification still exist during the identification of less common species and species that are very similar to others. In this working document we present data on roundnose grenadier (*Coryphaenoides rupestris*) which is relatively rare in the Portuguese continental slope. These data should be used with caution until these identifications are independently verified. The FAO 3-alpha codes, and scientific and common names of species covered by this working document are shown in Table 3.

Table 3: Species codes and common names

3-alpha code	Species	English name	Portuguese name
BSF	*Aphanopus carbo*	Black scabbardfish	Peixe-espada-preto
ARU	*Argentina silus*	Greater argentine	Argentina-dourada
ALF	*Beryx* spp.	Alfonsino nei	Imperadores
BLI	*Molva dypterygia*	Blue ling	Maruca-azul
LIN	*Molva molva*	Ling	Maruca
ORY	*Hoplostethus atlanticus*	Orange roughy	Olho-de-vidro-laranja
RNG	*Coryphaenoides rupestris*	Roundnose grenadier	Lagartixa-da-rocha
SBR	*Pagellus bogaraveo*	Blackspot(=red) seabream	Goraz
USK	*Brosme brosme*	Tusk	Bolota

3 Species discards

3.1 Frequency of occurrence

3.1.1 Bottom otter trawl fisheries

No discards of greater silver smelt, lings (*Molva* spp.) and tusk were ever observed in the two otter trawl fisheries. The frequency of occurrence of the remaining species in the discards was also very low (ranging 0% to 13% in OTB_CRU and 0% to 2% in OTB_DEF). When, all species presented low numbers. In fact, in the 665 hauls sampled in the OTB_CRU fishery only n = 8 alfonsinos (1 *Beryx splendens* and 7 *Beryx decadactylus*), n = 26 black scabbardfish, n = 8 orange roughy, n = 15 groundnose grenadier and n = 3 blackspot(=red) seabream were sampled; and in 1102 hauls sampled in the OTB_DEF fishery only n = 10 black scabbardfish and n = 10 blackspot(=red) seabream were sampled. Complete data on the frequency of occurrence of the WGDEEP 2013 species in the discards of the OTB_CRU and OTB_DEF fisheries are displayed in Table 4 and Table 5, respectively.

Table 4: Frequency of occurrence (%) of WGDEEP 2013 species in the discards of hauls sampled in the OTB_CRU fishery (2004-2012). See Table 3 for species codes; "—" indicates no occurrence

Year	ALF	ARU	BLI	BSF	LIN	ORY	RNG	SBR	USK
2004	1	—	—	6	—	1	1	—	—
2005	—	—	—	1	—	—	1	—	—
2006	13	—	—	—	—	—	3	—	—
2007	—	—	—	—	—	1	4	3	—
2008	—	—	—	—	—	2	—	—	—
2009	—	—	—	—	—	—	—	—	—
2010	—	—	—	—	—	—	—	1	—
2011	2	—	—	—	—	—	2	—	—
2012	—	—	—	—	—	—	—	1	—

Table 5: Frequency of occurrence (%) of WGDEEP 2012 species in the discards of hauls sampled in the OTB_DEF fishery (2004-2012). See Table 3 for species codes; "—" indicates no occurrence

Year	ALF	ARU	BLI	BSF	LIN	ORY	RNG	SBR	USK
2004	—	—	—	2	—	—	—	—	—
2005	—	—	—	1	—	—	—	—	—
2006	—	—	—	2	—	—	—	1	—
2007	—	—	—	—	—	—	—	1	—
2008	—	—	—	—	—	—	—	—	—
2009	—	—	—	—	—	—	—	—	—
2010	—	—	—	—	—	—	—	—	—
2011	—	—	—	—	—	—	—	—	—
2012	—	—	—	—	—	—	—	—	—

3.1.2 Deepwater set longline fisheries

No discards of greater silver smelt, alfonsinos (*Beryx* spp.), lings (*Molva* spp.), orange roughy, blackspot(=red) seabream or tusk were observed in the deepwater set longline fishery. The frequency of occurrence of black scabbardfish (the target fish for this fishery) was high (range: 83-100%) but that of roundnose grenadier was low (33%). We note however, that the latter percentage corresponds to a single individual. In what concerns black scabbard fish, in the 25 sets sampled in 2008-2011, 1017 individuals were discarded (98% of them due to damage caused by shark and cetacean predation marks), corresponding to an almost negligible discard rate (3.5%). Complete data on the frequency of occurrence of the WGDEEP 2013 species discards of the LLS_DWS fishery are displayed in Table 6.

Table 6: Frequency of occurrence (%) of WGDEEP 2013 species in the discards of sets sampled in the LLS_DWS fishery (2005-2012). See Table 3 for species codes; "—" indicates no occurrence. "BSF-D" = black scabbardfish damaged by predation; "BSF-W" = black scabbardfish not damaged by predation (i.e., whole). (a) BSF-D data includes fish which good parts (i.e., parts not affected by predation marks) may have been marketed

Year	ALF	ARU	BLI	BSF-D	BSF-W	LIN	ORY	RNG	SBR	USK
2005 (a)	—	—	—	100	—	—	—	33	—	—
2006 (a)	—	—	—	100	20	—	—	—	—	—
2007 (a)	—	—	—	100	33	—	—	—	—	—
2008	—	—	—	100	25	—	—	—	—	—
2009	—	—	—	100	—	—	—	—	—	—
2010	—	—	—	100	—	—	—	—	—	—
2011	—	—	—	83	—	—	—	—	—	—
2012	—	—	—	89	—	—	—	—	—	—

3.2 Total discards

3.2.1 Bottom otter trawl fisheries

To accurately estimate the discard volume of rare species (i.e., species with low abundance and low frequency of occurrence in the sampled hauls) a large number of observations are generally required. The WGDEEP 2013 species were rare in the discard samples and when present were found in low number and weight. The algorithm currently used to estimate trawl discards at fleet level is considered sensitive to large numbers of zeros in the data set (Jardim et al., 2011). Consequently, discard estimates were not calculated at fleet level and only haul level estimates are provided (Table 7 and Table 8).

Table 8: Discards (in number per haul) of WGDEEP 2013 species in the OTB_DEF fishery (2004-2012). See Table 3 for species codes; "—" indicates no occurrence

	BSF			SBR		
Year	Mean	SD	Range	Mean	SD	Range
2004	0.4	3.6	0-37	—	—	—
2005	1.0	10.1	0-121	—	—	—
2006	0.9	8.3	0-109	0.5	5.3	0-72
2007	—	—	—	0.3	2.5	0-24
2008	—	—	—	—	—	—
2009	—	—	—	—	—	—
2010	—	—	—	—	—	—
2011	—	—	—	—	—	—
2012	—	—	—	—	—	—

3.2.2 Deepwater set longline fisheries

To accurately estimate the discard volume of longline fisheries at fleet level, a total effort estimate is required along with discard data from an unbiased sample of fishing trips. At the time of this report, the full 2005-2012 data set of effort data on the LLS_DWS fishery was not available to the authors. Furthermore, we have reasons to suspect that the trips observed in recent years may be biased towards larger vessels that operate in the northerly grounds

Table 7: Discards (in number per haul) of WGDEEP 2013 species in the OTB_CRU fishery (2004-2012). See Table 3 for species codes; "—" indicates no occurrence

	ALF			BSF			ORY		
Year	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
2004	0.4	4.6	0-48	3.5	19.7	0-174	0.1	1.0	0-11
2005	—	—	—	0.3	2.5	0-21	—	—	—
2006	47.3	237.2	0-1300	—	—	—	—	—	—
2007	—	—	—	—	—	—	1.9	16.3	0-139
2008	—	—	—	—	—	—	0.3	2.3	0-23
2009	—	—	—	—	—	—	—	—	—
2010	—	—	—	—	—	—	—	—	—
2011	20.8	2.8	0-21	—	—	—	—	—	—
2012	—	—	—	—	—	—	—	—	—

	RNG			SBR		
Year	Mean	SD	Range	Mean	SD	Range
2004	0.7	7.1	0-75	—	—	—
2005	0.2	2.0	0-17	—	—	—
2006	1.2	6.7	0-37	—	—	—
2007	7.0	53.3	0-454	0.3	2.5	0-21
2008	—	—	—	—	—	—
2009	—	—	—	—	—	—
2010	—	—	—	0.5	4.8	0-49
2011	0.4	3.0	0-22	—	—	—
2012	—	—	—	0.4	3.5	0-29

of the country. A preliminary comparison of effort data obtained onboard vessels of different sizes throughout the 2005-2012 period indicates that larger vessels deploy more hooks per set and may fish different fishing grounds from the remainder of the fleet. Consequently, simple raising procedures involving average discards and total number of trips risk producing biased estimates of volumes discarded at fleet level. Hence, only set level estimates are provided (Table 9).

Table 9: Discards (in number per set) of WGDEEP 2013 species in the LLS_DWS fishery (2005-2012). See Table 3 for species codes; "—" indicates no occurrence. (a) BSF data includes fish which good parts (i.e., parts not affected by predation marks) may have been marketed

	BSF			RNG		
Year	Mean	SD	Range	Mean	SD	Range
2005 (a)	98.0	10.0	88-108	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	—	—	—
2009	29.3	12.5	13-48	—	—	—
2010	49.7	26.9	13-96	—	—	—
2011	30.5	28.6	0-78	—	—	—
2012	34.7	31.4	0-96	—	—	—

3.3 Length frequency of discards

3.3.1 Bottom otter trawl fisheries

A summary of the length frequencies of WGDEEP 2013 discards in the trawl fisheries is presented in Table 10.

Table 10: Length frequency of discards (in cm) of WGDEEP 2013 species sampled in the OTB fishery (2004-2012). See Table 3 for species codes

Fishery	Species	n	Mean	SD	Range
OTB_CRU	ALF	8	26.0	3.0	23-32
	ARG	63	16.3	3.3	9-22
	BSF	16	60.2	9.9	50-87
	ORY	8	8.0	2.1	6-12
	RNG	15	7.0	4.6	5-23
	SBR	4	21.5	2.4	20-25
OTB_DEF	BSF	10	56.1	13.0	40-79
	SBR	6	17.5	2.6	15-21

3.3.2 Deepwater set longline fisheries

Length frequency of discards sampled in the deepwater set longline fisheries are presented in Table 11. Note that black scabbardfish length data displayed in the table refers to discards when these were not damaged by predation and could be measured (BSF-W). Figures from the retained catch are supplied for comparative purposes (BSF-W*). Discards of whole black scabbardfish in the LLS_DWS fishery are rare (see section 3.1) and take place mainly for commercial reasons (small sized fish).

Table 11: Length frequency of discards (in cm) of WGDEEP 2013 species sampled in the LLS_DWS fishery (2005-2012). See Table 3 for species codes; "BSF-W" = black scabbardfish not damaged by predation (i.e., whole); "BSF-W*" = black scabbardfish retained on board

Species	n	Mean	SD	Range
BSF-W	7	72.3	6.4	63-80
BSF-W*	6851	108.7	7.5	74-133
RNG	1	14.0	—	1-1

4 Conclusions

Discards of most WGDEEP 2013 species carried out by Portuguese vessels operating bottom otter trawl and deepwater set longlines (targeting black scabbardfish) within the Portuguese ICES Division IXa were not been quantified at fleet level. However, the low frequency of occurrence (and number of specimens) registered in the sampled hauls and sets indicates discards can be assumed null or negligible for most assessment purposes. Exception to this could be the black scabbardfish discards in the set longline fishery targeting this very species. These discards are mainly caused by shark and cetacean predation on hooked black scabbardfish. Even so, black scabbardfish discard mortality is relatively low when compared to landings and should not be of major significance for species assessment.

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Research on greater silver smelt in Norway 2012.

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Introduction

This working document summarises results from Norwegian research on greater silver smelt (*Argentina silus*) in 2012.

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 A. silus. In 2007-2012 the Norwegian catches have declined to around 12000 t per year in accordance to regulations.

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 (Bergestad et al 2008). 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 2007-2012. 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 2012

On request from IMR inspectors from the Norwegian Directorate of Fisheries conducted sampling of greater silver smelt at fishing ports in the 2012 fishing season. This is the fourth year that data from the fisheries are collected this way. Additionally data came from direct fisheries from three vessels in the commercial reference fleet (Cetus, Fiskebank 1 and Straumberg), caught north of 62°N. In addition to field measurements, frozen samples were sent to IMR for biological sampling. Length measured samples from the fisheries were nine and biological samples were taken from eight samples (Table 1).

The samplings from the fisheries were in the time period 26th of February until 24th of March 2012 and came from the traditional fishing grounds in the direct fisheries (Figure 1). Here the 2012 samples are analysed separately for four known fishing fields: “Haltenbanken Sør”, “Garsholbanken”, “Sklinnadjupet” and “Trænadjupet/Gamlebanken”. The samples taken from catches of the reference fleet boat Cetus were from “Trænadjupet/Gamlebanken” and “Garsholbanken”. The samples from reference fleet boat Fiskebank 1 were taken from “Haltenbanken Sør” and “Garsholbanken”, while reference fleet boat Straumberg provided samples from “Sklinnadjupet” (table 1).

Length distributions from catches in the direct fisheries in 2012 did not show obvious differences between fishing areas and the mean length per sample varied from 27.1 cm to 34.8 cm (figure 2) with 31.6 cm as mean for the summed up distribution. No considerable increase in occurrence of large greater silver smelt (> 40 cm) was found, as were noticeably represented in studies from the 1980ties and 1990ties (Bergstad 1993, Monstad and Johannessen 2003, Johannessen and Monstad 2003) (figure 3). However, the 2012 results on length distributions are not substantially different from results in surveys and from fisheries in 2008 to 2011 (Hallfredsson and Svellingen 2009, Halfredsson et al. 2009, Hallfredsson 2010, Hallfredsson 2011). The length distribution summed up for all samples in 2012 is similar to the results for 2009 to 2011 (figure 2). It should be noted that the summed up length distributions in figure 2 are simply sum of the length distributions in the samples and are not weighted in any way.

Age distributions in the biological samples in 2012 show that greater silver smelt in general were less than 15 years old (figure 4). In total, 239 individuals were age determinate and only 27 of these individuals were older than 15 years. This age distributions are similar to that found in acoustic method development survey in 2008 where supporting trawling was approximately similar to commercial fishing praxis (Hallfredsson and Svellingen 2009). 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 (figur3). 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.

Survey 2012

An acoustical survey was conducted 17 March to 10 April in 2012 along the continental slope in Norwegian EEZ from 62-74° N. This survey is planned to run biennially and 2012 is the second time the survey is carried out. Highest densities of greater silver smelt in 2012 were found in similar areas as in 2009 on the continental slope off central Norway (figure 5). Spatial horizontal distribution in 2012 was somewhat more northerly with higher densities north from 70°N and less south from 64°N compared to 2009. However, the proportion of estimated acoustical biomass further north than 70°N was not substantial, or 3% and 7% in 2009 and 2012 respectively (table 2). Length distribution in 2012 showed that females were larger than males and that length increases with bottom depth, a trend commonly found for greater silver smelt (figure 6). Greater silver smelt had highest median length in the area between 68°N and 70°N (figure 6). Compared to 2009 the length distribution in the 2012 survey was narrower and had higher mean value (figure 7). It is apparent that large fish are more abundant in the survey results than in samples from the catches (figure 2, 6 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. Also age distribution in the 2012 survey is closer to what found in surveys in the 1980ties, with considerable proportion of fish older than 20 years (figure 2 and 8). Age of greater silver smelt in the bottom-trawl catches increases with increasing depth (figure 9).

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 2012 compared to surveys in the 1980ties, but there are small changes compared to the most recent years. Length and age in survey in 2012 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 four 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. Preliminary figures for catches in Norway in 2012 are 12330 tones, around 10% of the estimated biomass in the acoustic survey the same year. This could imply that fishing pressure is on an acceptable level, but it should be carefully noted that absolute biomass estimates from acoustical surveys can be very inaccurate. At present acoustical biomass indices should rather be used to analyse trends. Compared to the 2009 survey acoustic biomass estimates are 13% lower in the 2012. This is not necessarily alarming at this stage considering expected precision and that this is the second time the survey is conducted. It is not correct to interpret this as a downward trend jet. 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 lack of time series other than amounts of catch and lack of knowledge about stock structure imply caution in management of greater silver smelt fisheries in Norwegian waters.

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Table 1: Overview over greater silver smelt sampling from Norwegian catches in 2012. Sampling type 1 is length measurements in field while sampling type 2 is full 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	Aged	LDAM	Fiskebank 1	435-540	64,09	8,37	Haltenbanken Sør
48202	Length	Bio.sample	Aged	LDAM	Fiskebank 1	340-410	65,15	5,15	Garsholbanken
48203	Length	Bio.sample	Aged	LIOD	Straumberg	440-470	65,58	9,45	Sklinnadjupet
86485	Length	Bio.sample	Aged	LLYM	Cetus	357-408	67,00	8,02	Trænadjupet/Gamlebanken
86486		Bio.sample	Aged	LLYM	Cetus	355-397	67,01	8,04	Trænadjupet/Gamlebanken
86487	Length	Bio.sample	Aged	LLYM	Cetus	358-390	67,00	8,02	Trænadjupet/Gamlebanken
86490	Length	Bio.sample	Aged	LLYM	Cetus	391-415	65,03	5,05	Garsholbanken
86491	Length	Bio.sample	Aged	LLYM	Cetus	385-424	65,02	5,05	Garsholbanken
86492	Length			LLYM	Cetus	367-418	67,00	8,02	Trænadjupet/Gamlebanken
86494	Length			LLYM	Cetus	374-411	67,00	8,03	Trænadjupet/Gamlebanken

Table 2. Abundance estimates (tons) for Greater silver smelt in Norwegian slope surveys Mars 2009 and 2012. For methods se Harbitz (2010).

	2009	**2012**
Lat < 70 deg, depth > 500m	77272	33468
Lat < 70 deg, depth < 500m	57897	79624
Lat > 70 deg, depth > 500m	1642	5310
Lat > 70 deg, depth < 500m	2447	2961
Total	139258	121363

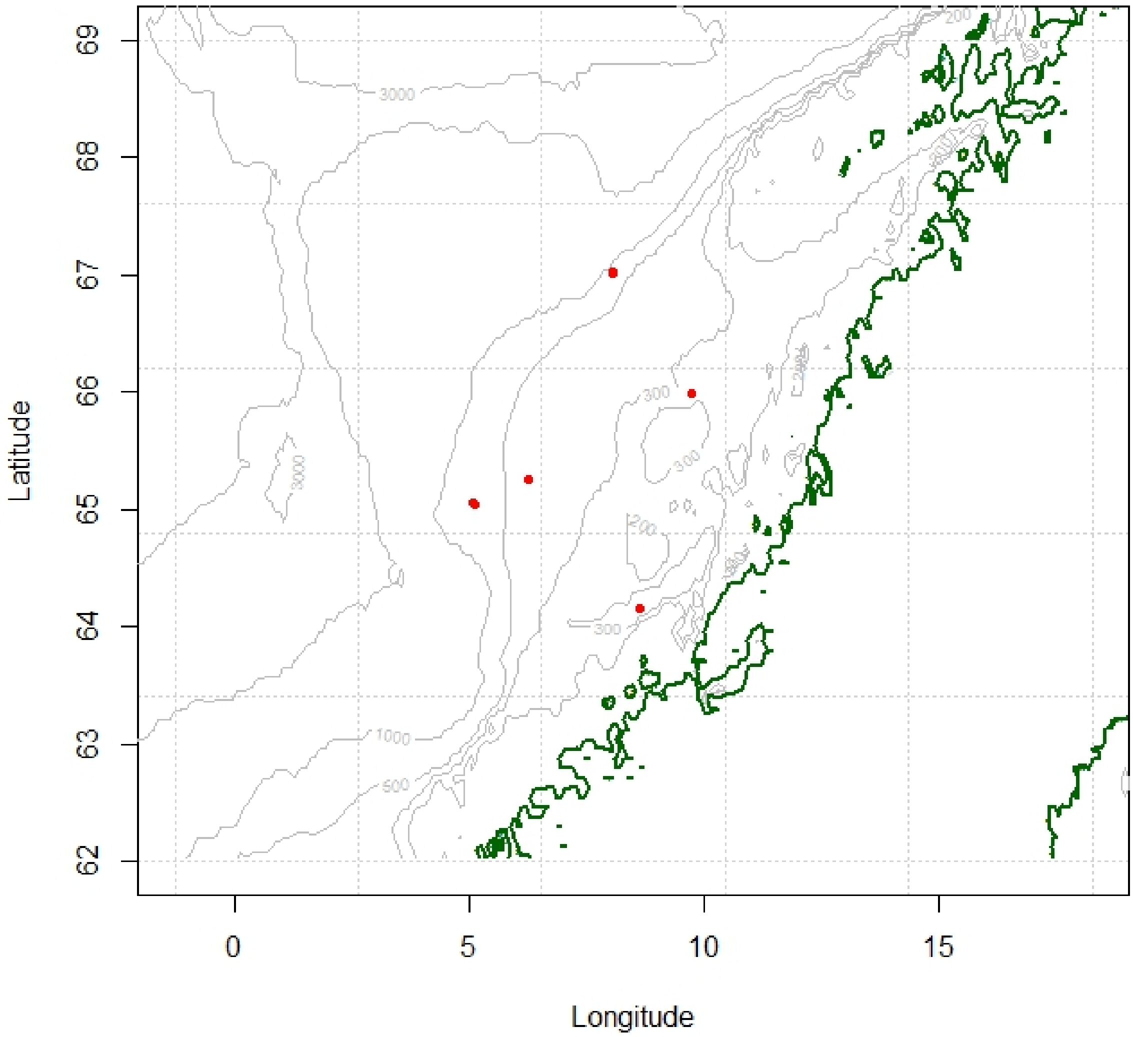

Figure 1: Positions for greater silver smelt catches that samples were taking from in 2012.

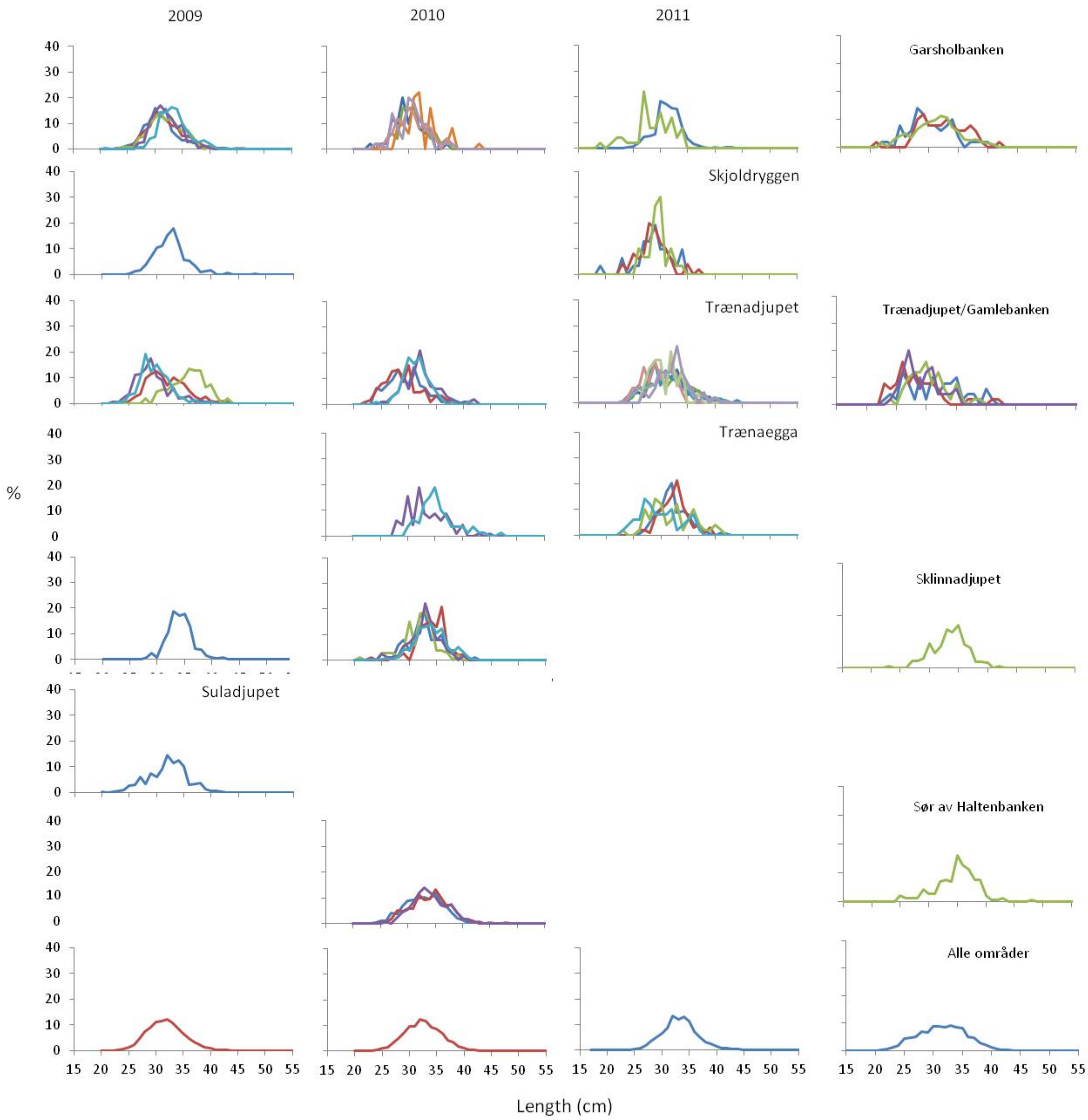

Figure 2: Length distributions per sample taken from the fisheries in 2009-2012, divided on fishing fields (Norwegian names). NB the lowermost panels show percentage distribution for the sum of all samples per year, and are not weighted for spatial or temporal variations in catches. Thus they cannot be interpreted as fully representative distributions for the total fisheries in a given year.

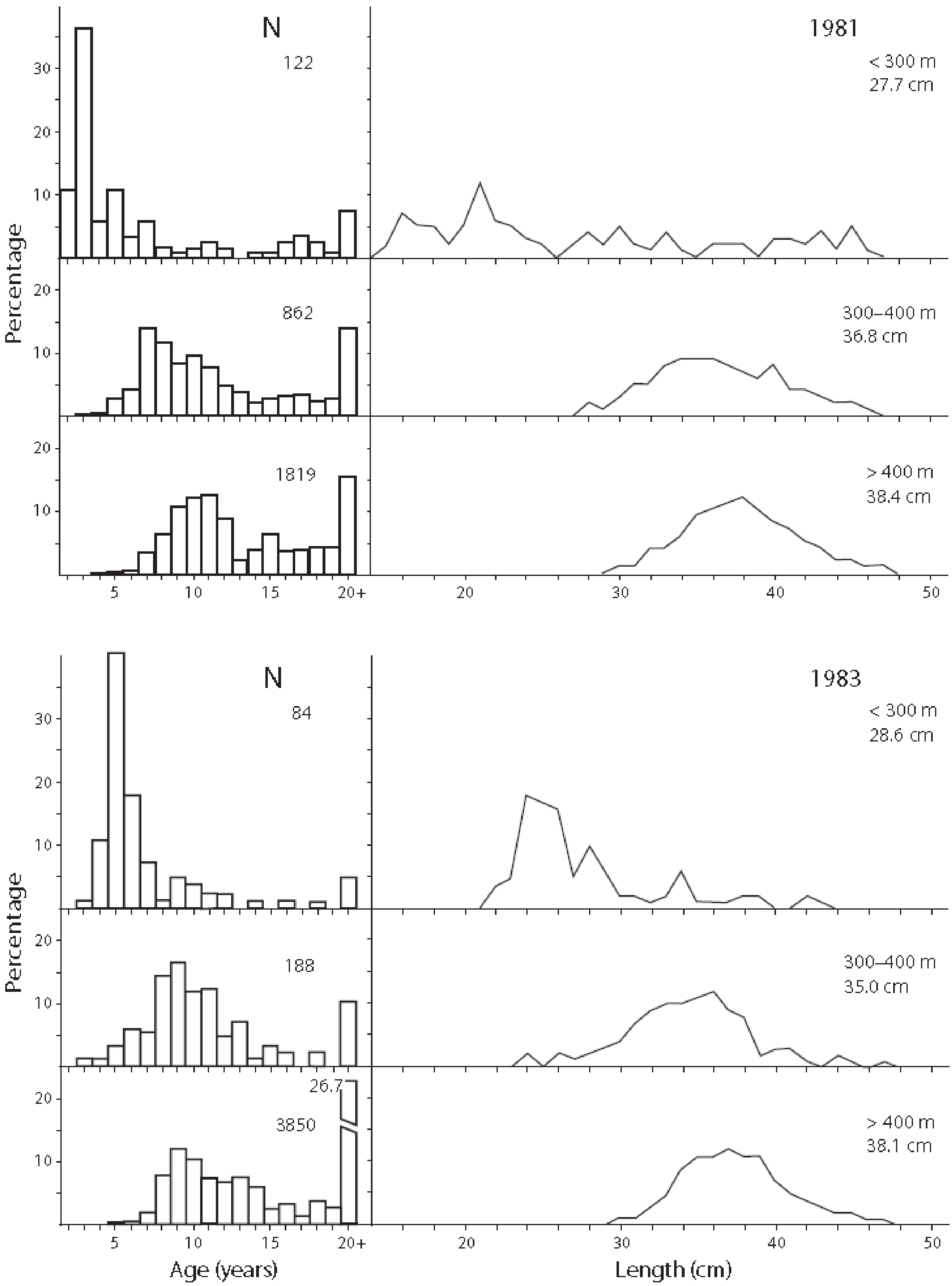

Figure 3: Age and length distributions for greater silver smelt in 1981 and 1983. Bottom trawl samples from three different depth intervals in geographic area limited to 64°-66°N (Monstad and Johannesen 2003).

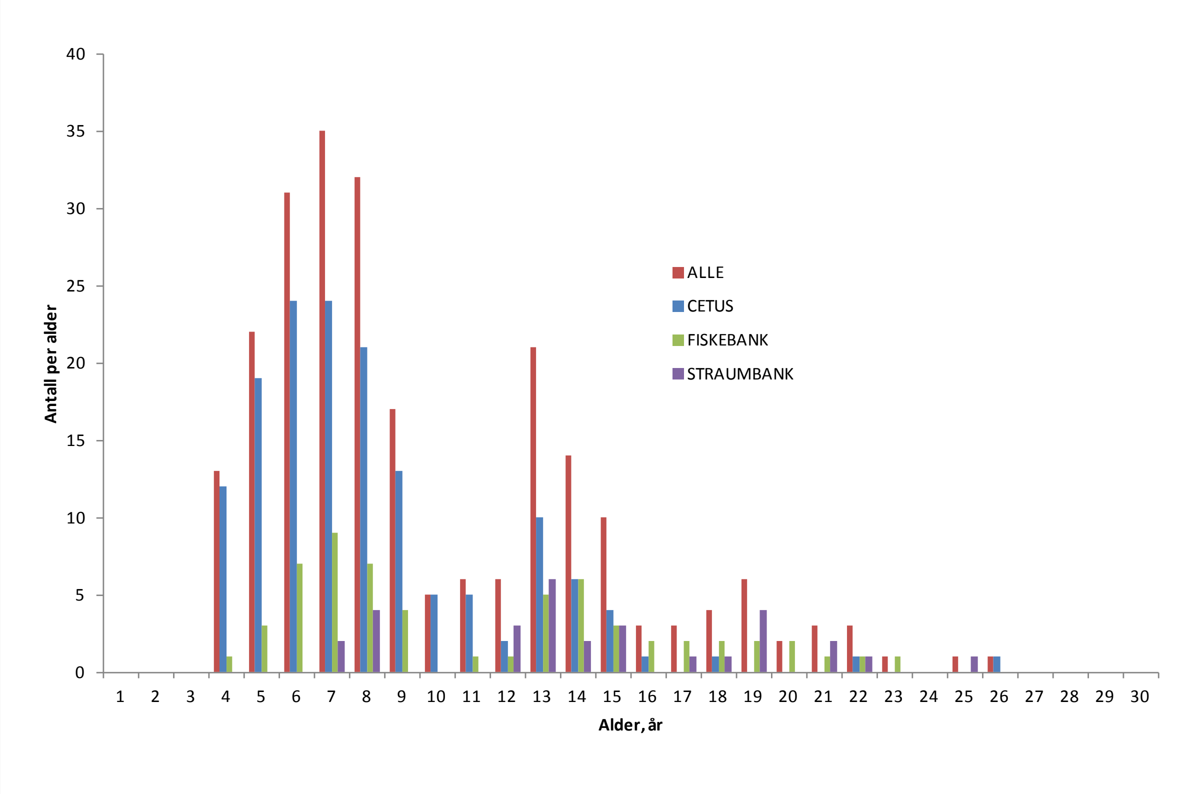

Figure 4: Age distributions from the fisheries in 2012, red columns show age distributions combined from the three vessels, while blue, green and purple columns show ages from samples taken by Cetus, Fiskebank and Straumbank, respectively.

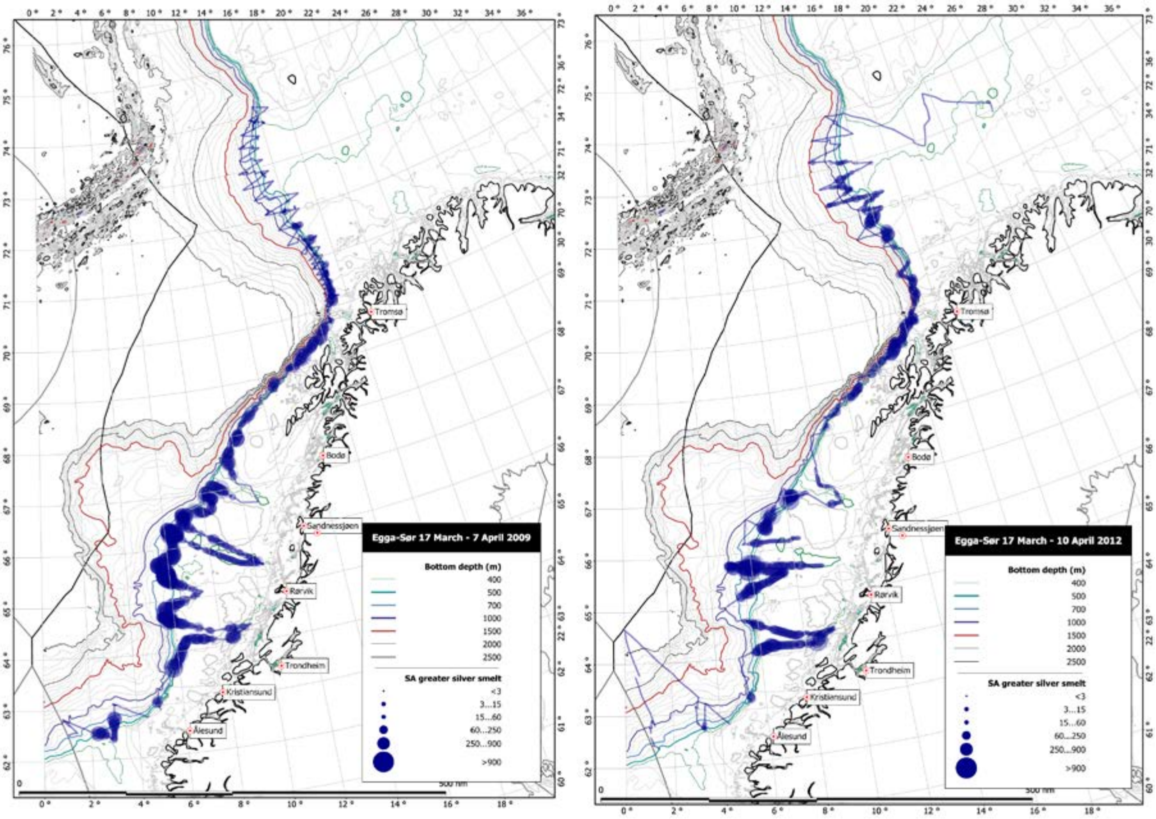

Figure 5. Acoustic estimates (SA-values) for distribution of Greater silver smelt in 2009 and 2012.

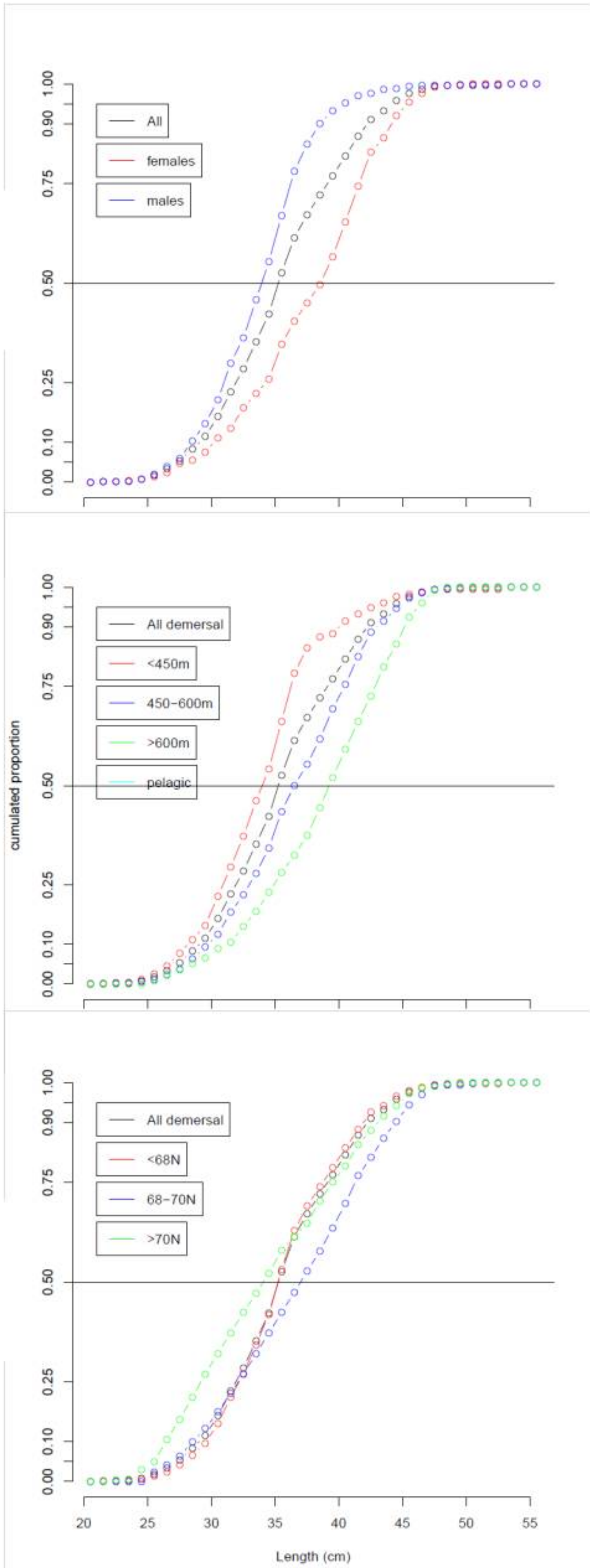

Figure 6. Cumulative length distribution for Greater silver smelt in Norwegian slope survey Mars 2012 by sex, bottom depth and south-north latitude.

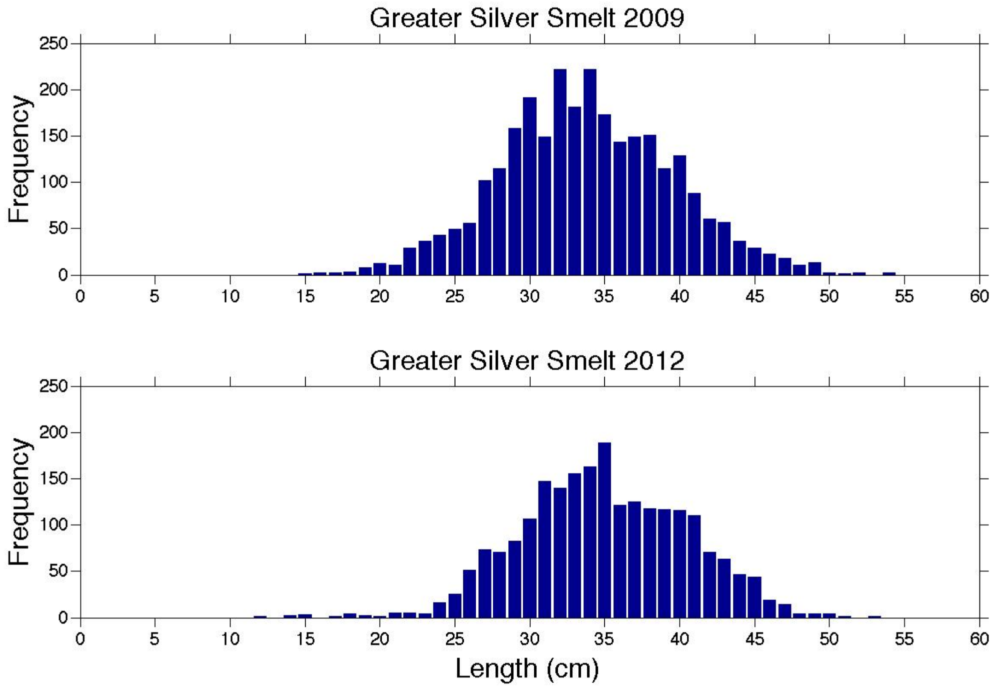

Figure 7. Length distributions for Greater silver smelt in the Norwegian slope surveys Mars 2009 and 2012.

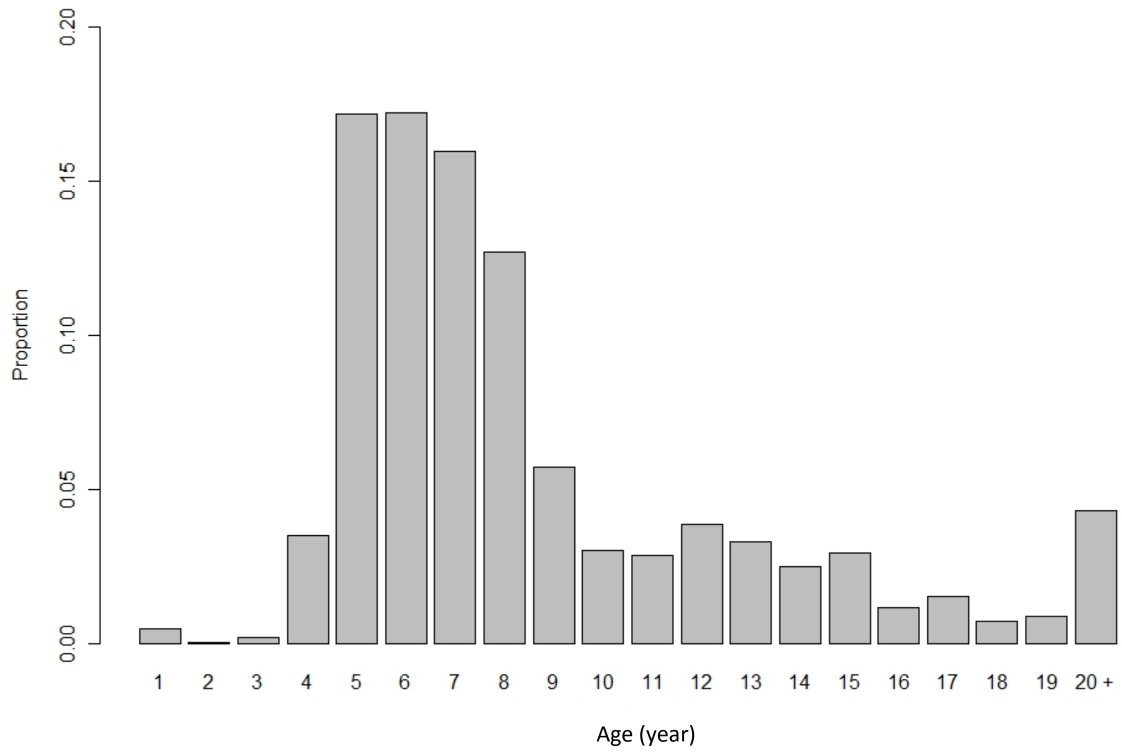

Figure 8. Age distribution for greater silver smelt in the survey 2012.

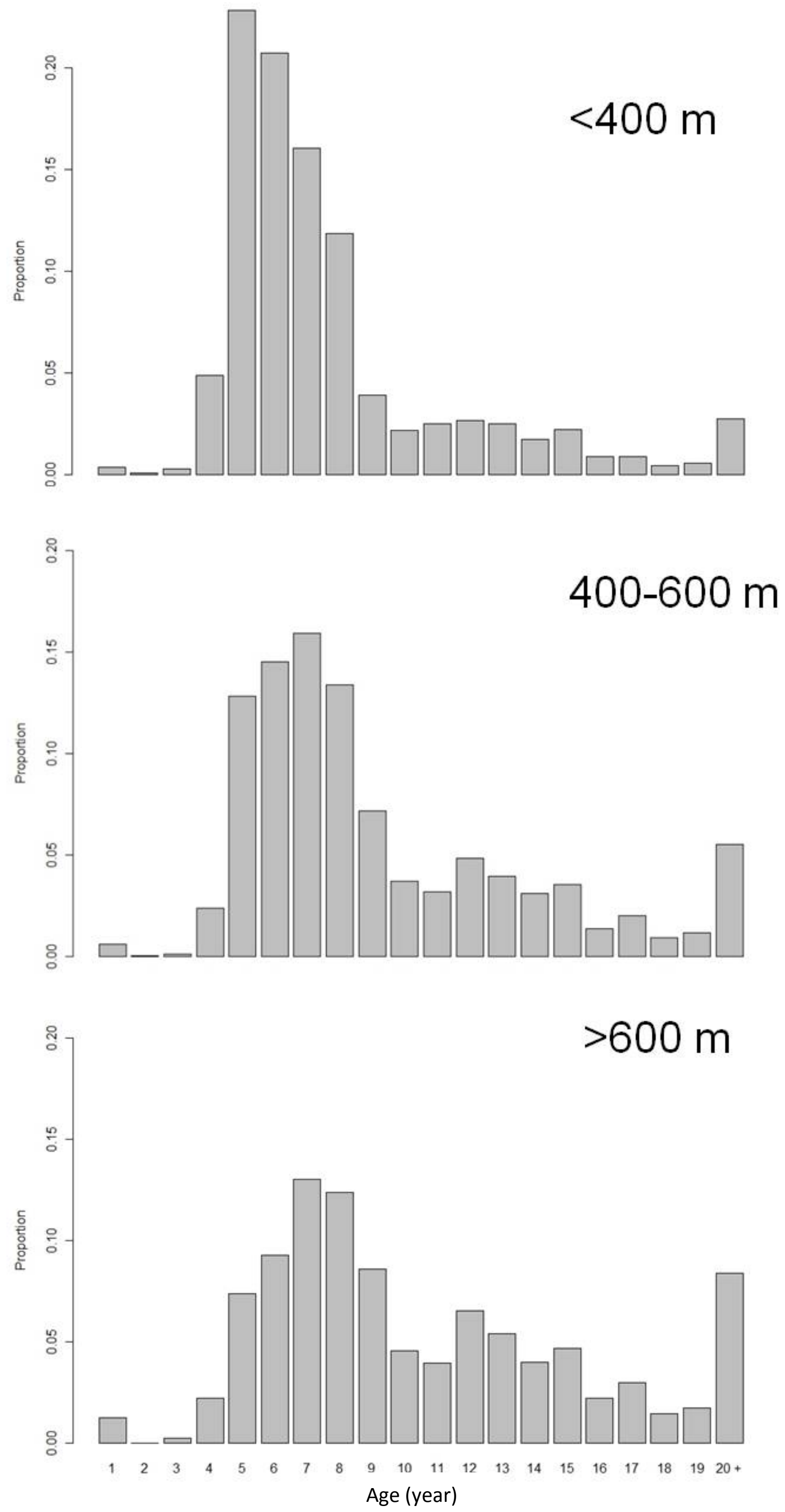

Figure 9. Age distribution by depth for greater silver smelt in survey 2012.

Annex 3: Recommendations

ID	Recommendation	Comments	Recipient
1	In light of the 2013 advice for greater silver smelt where ACOM states that 'greater silver smelt may be sufficiently isolated at separate fishing grounds to be considered as individual assessment units'. As this may also apply to other stocks assessed by WGDEEP the group would ask ACOM to give clear guidance on what criteria has to be met for this to apply.	The ICES approach to DLS recognizes that it is possible to give advice in data-limited situations. A similar approach could be extended to cover the definition of advice units where data is limited and it is unlikely that conclusive evidence on stock identity will be available in the near future. WGDEEP to provide supporting information for SIMWG in a working document. Communicated to WGDEEP.	SIMWG; WGDEEP
2	During WGDEEP's review of the HCR for data-limited stocks, it became apparent that the HCR was not always correctly applied by ADGDEEP 2012. In particular, inappropriate selection of reference period for "status quo catches" of roundnose grenadier on the Mid-Atlantic Ridge led to advice that was not supported by WGDEEP 2013. ACOM should reconsider this advice and, if appropriate, issue new advice in 2013.		ACOM; WKLIFE
3	The current stock unit for blue ling southern stock excludes Division XIIc. Given the continuous distribution of fish and fisheries between this division and VIb1, the assessment unit for blue ling in Vb, VI and VII should be changed to include XIIc.	XIIc to be added to the southern stock	WGDEEP; ICES DataCentre

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Annex 5: Stock annexes

4.2 Ling in Vb

Stock	Ling in Vb
Working Group	WGDEEP
Date	March 2013
Revised by	WGDEEP-2013/Lise H. Ofstad

A. General

A.1. Stock definition

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

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

A.2. Fishery

During the first half of the 19th century ling (and tusk) were only caught as bycatch in the British trawl fishery. In the 1950s the longline fishery for ling (and tusk) expanded considerably and was conducted by British, Norwegian and Faroese vessels. The British fishery declined steadily from the beginning of the 1960s and in the late 1970s the Faroese deep-water fisheries started following the expansion of the national EEZs to 200 nm and a wish to reallocate fishing effort from traditional shelf fisheries. The fishery for ling in Vb has not changed substantially in recent years. The demersal fisheries in Vb are detailed described in Chapter 2, Demersal Stocks in the Faroe Area in ICES NWWG Report, 2011.

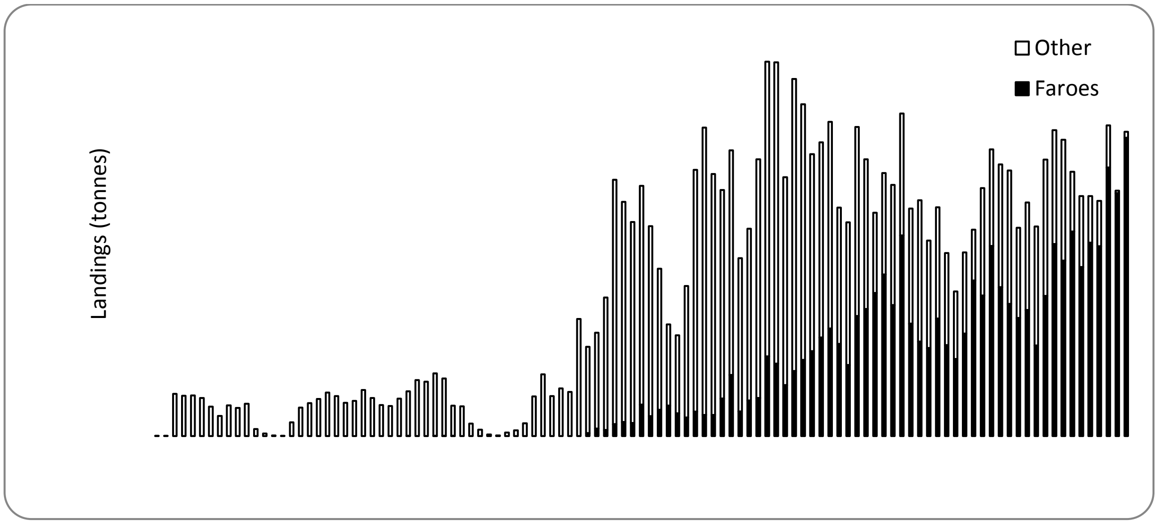

Figure 1. Nominal landings of ling Vb from 1903 to 2012.

The traditional longline fleet fishing ling, tusk and blue ling consist of 24 longliners larger than 110 GRT; they are mainly targeting cod and haddock and in years where the availability of these species is high and market conditions satisfactory, they spend very little effort in deep water. The main deep-water fleet consist of about 13 otterboard trawlers with engines larger than 1000 HP. However, due to poor economic conditions especially the very high fuel prices, the number of vessels has declined in the most recent years and the effort towards deep-water species has declined further due to a switch to pair-trawling targeting mainly saithe. The pairtrawler fleet consist of xx pairtrawlers larger than 1000 HP are mainly targeting saithe, but there are some bycatch of ling in this fishery.

Most of ling in Vb is caught by longlines and the proportion caught by that gear has increased since 2000 to around 65% in 2010. In the resent years about 70–75% of ling in Vb are caught by longliners and the rest mainly by trawlers. Most of the ling caught in Vb by Faroese longliners and trawlers is caught at depths less than 500 meters. The main fishing grounds for ling in Vb as observed from logbooks are on the slope of the Faroe Plateau and Faroe Bank.

A.3. Ecosystem aspects

It seems like the primary production on the Faroe shelf (<130 m) and the Subpolar Gyre index (for deeper areas) has importance for species like cod, haddock and saithe in Faroese waters (Section 2.1.3 in ICES NWWG report, 2011); and this could also have affect the ling.

A.4. Management

The Ministry of Fisheries is responsible for management of the Faroese fisheries and implementation of the legislation. The Ministry issues regulations for commercial fishing for each fishing year. The fishing year started on 1st September and ended 31st August the following year.

During the 1980s and 1990s the Faroe authorities have regulated the fishery and the investment in fishing vessels. In 1987 a system of fishing licenses was introduced. The demersal fishery at the Faroes has been regulated by technical measures (minimum mesh sizes and closed areas). A reduction of effort has been attempted through banning of new licences and buy-back of old licences.

A quota system, based on individual quotas, was introduced in 1994 for cod, haddock, saithe and redfish. A new system entered into force on 1st June 1996 that is based on individual transferable quotas in days within fleet categories. Nearer description of the day quota system is in Section 2.1.2 in the ICES NWWG report, 2011.

A system of instant area closure is in place for many species. The aim of the system is to minimize fishing on juveniles. An area is closed temporarily (for two weeks) for fishing if on-board inspections (not 100% coverage) reveal that more than a certain percentage of the catch is composed of fish less than the defined minimum length. To prevent fishing of small fish various measures such as mesh size regulation and closure of fishing areas are in place. Discard is banned in the Faroese demersal fishery.

All fishing boats operating in Faroese waters have to maintain a logbook record of catches in each haul/set. The records are available to the stock assessors at the Faroe Marine Research Institute.

B. Data

B.1. Commercial catch

The text table below shows which data from landings is supplied from ICES Division Vb.

ICES Division Vb	Kind of data				
Country	Caton (Catch in weight)	Canum (catch-at-age in numbers)	Weca (weight-at-age in the catch)	Matprop (proportion mature-by-age)	Length composition in catch
Denmark (Greenland)	x				
Faroes	x	x	x		x
France	x				
Norway	x				
Scotland	x				

Faroese ling catch in tonnes by month, area and gear are obtained from Statistical Faroe Islands (www.hagstovan.fo) and Faroese Coast Guard (www.fvg.fo). The distribution of catches is obtained from logbook statistic where location of each haul, effort, depth of trawling and total catch of ling is given. Good logbook information is available since 1995. Landings from foreign nations fishing in Vb are given by the Faroese Coast Guard and reported to the Directorate of Fisheries.

B.2. Biological

Biological data from the commercial longline and trawl fleet catches are collected from landings by technicians of the Faroe Marine Research Institute (FAMRI). The biological data collected are length (cm), gutted weight, and otoliths for age reading. Most of the fish that otoliths were collected from were also weighted (to the nearest gramme). Each sample consists of 200 length measurements and from 1995 were also 60 weights and otoliths taken in some of the samples. From 2007 very few otoliths have been taken of ling, but there are good samplings of lengths and gutted weights.

The biological data from the fishery is stored in a database at FAMRI. The data are used for description of the fishery and abundance indices.

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

No information is available on natural mortality of ling in Vb, but a natural mortality of 0.15 is assumed for all ages in previous assessments.

Population biology of ling in Vb from Magnússon *et al*., 1997: Ling eggs were observed scattered over wide areas of the Northeast Atlantic and no spawning aggregations of ling have been observed so far. In Faroes waters spawning occur in April to June, in depths of 60 to about 500 m. Ling eggs are planktonic, without oil globule and of 1 mm diameter in size. In Faroese waters pelagic stages of ling have been observed mainly on 0-group surveys which were carried out since 1972 in June/July. 35–40 cm ling are taken on hooks near land. Young ling (<40 cm) are about 2–4 years old. Length–weight relationship from the annual Faroese spring survey in March (1983–1994) was $W=0.0027\ L^{3.1574}$, $R^2=0.97$. For most areas, 50% of the ling seems to become mature at ages 5–7, corresponding to lengths 60–75 cm. Ling is mainly feeding on species as Norway pout, blue whiting, Argentines, herring and cod depending on their availability. Other foods are squids, crustaceans and echinoderms.

B.3. Surveys

The spring groundfish surveys in Faroese waters were initiated in 1983 with the research vessel Magnus Heinason. Up to 1991 three cruises per year were conducted between February and the end of March, with 50 stations per cruise selected each year based on random stratified sampling (by depth) and on general knowledge of the distribution of fish in the area. In 1992 the first cruise was not conducted and one third of the stations used up to 1991 were fixed. Since 1993 all the 100 stations on the Faroe Plateau are fixed.

The summer (August–September) groundfish survey was initiated in 1996 and covers the Faroe Plateau with 200 fixed stations distributed within the 65 to 520 m contour. Half of the stations were the same as in the spring survey. Effort for both surveys is recorded in terms of minutes towed (~60 min).

Survey data for Faroe ling are available to the WG from both spring (since 1994) and summer (since 1996) surveys. There are lengths (cm) and round weights of ling from these two groundfish surveys and a recruitment index was calculated as the stratified number and biomass of ling less than 60 cm. The abundance indices from the groundfish surveys are standardized according to number of stations in each stratum and weighted with strata area for all the different strata.

The summer survey is considered descriptive of biomass trends.

B.4. Commercial cpue

Data used to estimate cpue for ling in Division Vb are obtained from logbooks of the Faroese longline and trawl fleet. The effort obtained from the logbooks is estimated as number of fishing (trawling) hours from the trawlers, as 1000 hooks from the longliners and the catch as kg stated in the logbooks.

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

A general linear model (GLM) was used to standardize all the cpue series (kg/h or kg/1000 hooks) for the commercial fleet where the independent variables were the following: vessel (actually the pair ID for the pairtrawlers, 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 or kg/1000 hooks measure for each trawl haul or longline setting, which was back-transformed prior to use. The reason for this selection of hauls/settings was to try to get a series that represents changes in stock abundance.

B.5. Other relevant data

None.

C. Historical stock development

Assessment: data and method

Ling in Vb is assessed based on trends in survey indices from the Faroese spring and summer survey. Supplementary information includes relevant information from the fishery such as length distributions, maturity data, effort and cpue.

Exploratory analysis

The 2008 WGDEEP Report showed an analytical assessment exercise on ling in Vb (ICES WGDEEP Report, 2008). This year, several attempts were made by running a traditional XSA but they are not presented here due to the noise because of very few samples of otoliths from the last five years. It was necessary to combine otolith samples for different fleets/seasons and also across years in order to increase the number of age–length relationships. But the resulting catch-at-age matrix was so noisy that it is very difficult to follow cohorts.

D. Short-term projection

No short-term predictions are performed.

E. Medium-term projections

No medium-term predictions are performed.

F. Long-term projections

No long-term predictions are performed.

G. Biological reference points

No biological reference points are defined for ling in Vb. At the 2012 WGDEEP meeting was F_{MAX} and $F_{0.1}$ calculated from a yield-per-recruit model (Figure 4.2.17). This analysis indicated F_{MAX} to be around 0.33, when the age of first catch, AFC = 5 years and F_{MAX} = 0.27 with AFC = 4 years. Other input values was L_∞ = 227 cm, K = 0.052, t_0 = -0.93, M = 0.15, L_{50} = 7 years. The results are shown in the table below.

AFC=	4	5	AFC=	4	5
F_{MAX} =	0.27	0.33	F=	0.1	0.1
Y/R =	1.38	1.55	Y/R =	1.07	1.09
SPR =	3.42	3.51	SPR =	8.67	9.58

At the 2012 WGDEEP was also WKLIFE Gislason spreadsheet applied using an L_{MAX} of 180 cm and AFC = 5. The parameters estimated by the model (k = 0.11,) were unrealistic based on what is known about this stock and the F_{MAX} value (F_{MAX} = 0.22) was substantially lower than that estimated by YPR.

H. Other Issues

None.

I. References

ICES. 2013. NWWG Report, Section 2. ICES CM 2013/ACOM:07. 1538 pp.

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4.3 Ling in Subareas I and II

Stock	Ling in Subareas I and II
Working Group	WGDEEP
Date	(March 2011)
Revised by	(WGDEEP /Kristin Helle)

A. General

A.1. Stock definition

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

A.2. Fishery

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

During the period 2000–2005 the landings varied between 6000 and 7000 tonnes, which are about the same catches as in the preceding decade. In 2007 and 2008 the landings increased to over 10 000 tonnes.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

Full landings data are available from 1988 to present but it is thought that fisheries in some of these areas pre-date the time-series. Incomplete landings data are available from Norwegian longline fisheries from 1889 onwards. Additional landings data from other areas may be available from 1950 onwards.

B.2. Biological

Length data for the Norwegian reference fleet in Subarea IIa have been routinely collected since 2002.

Considerable general information is available on the life-history characteristics of this species.

B.3. Surveys

No data available.

B.4. Commercial cpue

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2009. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 tonnes in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day. Cpue were calculated as the average total catch of ling per vessel (*C*), and the average number of hooks per set and per vessel (*N*) associated with these catches. Then, for each year and catch category, the estimated cpue for the entire fleet was determined as *C*/*N*. Thus the estimated cpue for each year and subarea was the mean catch in kg per hook for the entire fleet.

The boats that provided logbooks are the primary sampling units, and *C* and *N* are both random variables. It follows that this is a ratio-type estimator, therefore the standard errors of the cpue estimates could be calculated as described in Cochran (1977, page 32). This cpue estimator is a weighted average, that is the more hooks a boat sets, the more influence it has on the estimate (Cochran, 1977). For comparison, an unweighted cpue series was also constructed (i.e. the average cpue per boat).

A standardized series will be developed in preparation for WGDEEP 2012.

B.5. Other relevant data

C. Assessment: data and method

Model used: The stock is assessed using trends in catch and cpue.

Software used:

Model Options chosen:

Input data types and characteristics: (table below is just an example; adapt the description of input accordingly)

Type	Name	Year range	Split on areas and countries	Variable from year to year Yes/No
Caton	Catch in tonnes	1988-2000	Yes	
Canum	Catch-at-age in			

	numbers	
Weca	Weight at age in the commercial catch	
West	Weight at age of the spawning stock at spawning time.	
Mprop	Proportion of natural mortality before spawning	
Fprop	Proportion of fishing mortality before spawning	
Matprop	Proportion mature at age	
Natmor	Natural mortality	

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological Reference Points

	Type	Value	Technical basis
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

No biological reference points have been defined.

H. Other issues

H.1. Historical overview of previous assessment methods

I. References

4.4 Ling in Va

Stock	Ling in Va
Working Group	WGDEEP
Date	(March 2011)
Revised by	(WGDEEP-2011/Gudmundur Thordarson)

A. General

A.1. Stock definition

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

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

A.2. Fishery

The fishery for ling in Va has not changed substantially in recent years. Around 150 longliners annually report catches of ling, around 70 gillnetters and a similar number of trawlers. Most of ling in Va is caught on longlines and the proportion caught by that gear has increased since 2000 to around 65% in 2010. At the same time the proportion caught by gillnets has decreased from 20–30% in 2000–2001 to 4–8% in 2008–2010. Catches in trawls have varied less and have been at around 20%.

Most of the ling caught in Va by Icelandic longliners is caught at depths less than 300 meters and less than 500 meters by trawlers. The main fishing grounds for ling in Va as observed from logbooks are on the south, southwestern and western part of the Icelandic shelf.

In the 1950s until 1970 the total landings of Ling in Va amounted to 10 000 to 16 000 tonnes annually of which more than half was usually caught by foreign fleets. This changed with the extension of the Icelandic EEZ in the early 1970s when total landings fell to 4000–8000 tonnes of which the Icelandic fleet caught the main share. Between 1980 and 2000 catches varied between 3200 to 5800 tonnes.

A.3. Ecosystem aspects

Ling in Icelandic waters is mainly found on the continental shelf and slopes of southeast, south, and west of Iceland at depths of 0–1000 m, but mainly but is mainly caught in the fisheries at depths around than 200–500 meters. Warming of sea temperature, have been documented in Va and an expansion of distributional area of warm-water species such as anglerfish. The significance and reliability of such metrics is considered at the moment insufficient for their consideration in the provision of management advice of ling in Va.

A.4. Management

The Ministry of Fisheries is responsible for management of the Icelandic fisheries and implementation of the legislation. The Ministry issues regulations for commercial fishing for each fishing year, including an allocation of the TAC for each of the stocks subject to such limitations. Below is a short account of the main feature of the management system and where applicable emphasis will be put on ling.

A system of transferable boat quotas was introduced in 1984. The agreed quotas were based on the Marine Research Institute's TAC recommendations, taking some socio-economic effects into account, as a rule to increase the quotas. Until 1990, the quota year corresponded to the calendar year but since then the quota, or fishing year, starts on September 1 and ends on August 31 the following year. This was done to meet the needs of the fishing industry. In 1990, an individual transferable quota (ITQ) system was established for the fisheries and they were subject to vessel catch quotas. The ITQ system allows free transferability of quota between boats. This transferability can either be on a temporary (one year leasing) or a permanent (permanent selling) basis. This system has resulted in boats having quite diverse species portfolios, with companies often concentrating/specializing on particular group of species. The system allows for some but limited flexibility with regards converting a quota share of one species into another within a boat, allowance of landings of fish under a certain size without it counting fully in weight to the quota, and allowance of transfer of unfished quota between management years. The objective of these measures is to minimize discarding, which is effectively banned. Since 2006/2007 fishing season, all boats operate under the TAC system.

At the beginning, only few commercial exploited fish species were included in the ITQ system, but many other species have gradually been included. Ling in Va was included in the ITQ-system in the 2001/2002 quota year.

Landings in Iceland are restricted to particular licensed landing sites, with information being collected on a daily basis time by the Directorate of Fisheries in Iceland (the enforcement body). All fish landed has to be weighted, either at harbour or inside the fish processing factory. The information on each landing is stored in a centralized database maintained by the Directorate and is available in real time on the Internet (www.fiskistofa.is). The accuracy of the landings statistics are considered reasonable.

All boats operating in Icelandic waters have to maintain a logbook record of catches in each haul/set. The records are available to the staff of the Directorate for inspection purposes as well as to the stock assessors at the Marine Research Institute.

With some minor exceptions it is required by law to land all catches. Consequently, no minimum landing size is in force. To prevent fishing of small fish various measures such as mesh size regulation and closure of fishing areas are in place.

A system of instant area closure is in place for many species. The aim of the system is to minimize fishing on juveniles. An area is closed temporarily (for two weeks) for fishing if on-board inspections (not 100% coverage) reveal that more than a certain percentage of the catch is composed of fish less than the defined minimum length.

B. Data

B.1. Commercial catch

The text table below shows which data from landings is supplied from ICES Division Va.

ICES Division Va	Kind of data				
Country	Caton (Catch in weight)	Canum (catch-at-age in numbers)	Weca (weight-at-age in the catch)	Matprop (proportion mature-by-age)	Length composition in catch
Iceland	x				x
The Faroe Islands	x				
Norway	x				

Icelandic bling catch in tonnes by month, area and gear are obtained from Statistical Iceland and Directorate of Fisheries. Catches are only landed in authorized ports where all catches are weighed and recorded. The distribution of catches is obtained from logbook statistic where location of each haul, effort, depth of trawling and total catch of ling is given. Logbook statistics are available since 1991. Landings of Norwegian and Faroese vessels are given by the Icelandic Coast Guard and reported to the Directorate of Fisheries.

Discard is banned in the Icelandic demersal fishery. 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 discards in mixed fisheries.

B.2. Biological

Biological data from the commercial longline and trawl fleet catches are collected from landings by scientists and technicians of the Marine Research Institute (MRI) in Iceland. The biological data collected are length (to the nearest cm), sex and maturity stage (if possible since most ling is landed gutted), and otoliths for age reading. Most of the fish that otoliths were collected from were also weighted (to the nearest gramme). Biological sampling is also collected directly on board on the commercial vessels during trips by personnel of the Directorate of Fisheries in Iceland or from landings (at harbour). These are only length samples.

The general process of the sampling strategy is to take one sample of ling for every 180 tonnes landed. Each sample consists of 150 fish. Otoliths are extracted from 50 fish which are also length measured and weighed gutted. In most cases ling is landed gutted so it not possible to determine sex and maturity. If ling is landed ungutted, the ungutted weight is measured and the fish is sexed and maturity determined. The remaining 100 in the sample are only length measured. Age reading of ling from commercial catches ended in 1998. The reason was uncertainty in ageing and cost saving.

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

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

The biological data from the fishery is stored in a database at the Marine Research Institute. The data are used for description of the fishery.

B.3. Surveys

For detailed description of the surveys relevant to ling in Va, please refer to the stock annex (SA 6.2) for tusk in Va and XIV.

The Icelandic Spring survey (March) commenced in 1985 and covers the Icelandic shelf down to 500 meters. The survey is considered descriptive of biomass trends. The Icelandic Autumn survey (October) commences in 1996 and was expanded in 2000 the survey is considered to cover the distributional range of ling in Va and therefore to be representative of stock biomass, it is however a shorter time-series and has fewer stations that the spring survey.

B.4. Commercial cpue

Data used to estimate cpue for ling in Division Va since 1991 are obtained from logbooks of the Icelandic trawl and longline fleet. Non-standardized cpue and effort is calculated for each year which is simply the sum of all catch divided by the sum of number of hooks.

B.5. Other relevant data

None.

C. Assessment: data and method

Ling in Va and XIV is assessed based on trends in survey indices from the Icelandic spring and autumn survey. Supplementary information includes relevant information from the fishery such as length distributions, maturity data, effort, cpue and analysis of changes in spatial and temporal distribution.

D. Short-term projection

No short-term predictions are performed.

E. Medium-term projections

No medium-term predictions are performed.

F. Long-term projections

No long-term predictions are performed.

G. Biological reference points

No biological reference points are defined for ling in Va.

H. Other issues

I. References

4.5 Ling in all other areas

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

Working Group WGDEEP

Date (March 2011)

Revised by (WGDEEP/Kristin Helle)

A. General

A.1. Stock definition

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

A.2. 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 2010 landings, 83% were taken by longlines, 8% by gillnets, and the remainder by trawls. The bulk of the landings from other countries were taken by trawls as bycatches in other fisheries, and the landings from the UK (Scotland) are the most substantial. The comparatively low landings from the central and southern North Sea (IVb,c), are only 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 1988–2010, 40% of the landings were in Area IV, 29% in Area VI, and 26% in Area VI.

In Subarea VII the Divisions b, c, and g–k provide most of the landings of ling. Norwegian landings, and some of Irish and Spanish 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 bycatches in various fisheries.

There was a decline in landings from 1988 to 2003, afterwards the landings have been stable (Figure 5.5.1). When Areas III–IV are pooled, the total landings averaged 32 thousand tons in 1988–1998 and then declined to an average of 15 thousand tons in 2003–2010. The decline has been simultaneous in the main Areas IV, VI and VII, but Area VII has had a greater reduction in landings than in Areas IV and VI (Figure 4.5.2).

In Division IVa the total landings have varied between 10 000 and 13 000 t until 1998, then declined until 2003 to about half previous level, and have since remained stable.

In Division VIa the statistics are incomplete for the period 1989–1993. In the period 1994–2008, when the data are complete, they demonstrate a declining trend towards a level less than half that in the 1990s. The Norwegian landings declined substantially since the mid-1990s compared with earlier years. In Division VIb landings decreased in the late 1990s and reached a minimum in 2002, after which a gradual increase has occurred. In 2010 the landings were above the mean annual landings for the period 1988–1995.

In Subarea VII landings were around 10 000 t in the period 1995–1998. After this there was a gradual decrease, and the preliminary estimate of catch for 2010 is only 1233 t.

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

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

Full landings data are available from 1988 to present but it is thought that fisheries in some of these areas pre-date the time-series. Incomplete landings data are available from Norwegian longline fisheries from 1889 onwards. Additional landings data from other areas may be available from 1950 onwards.

B.2. Biological

Length data for the Norwegian reference fleet in other areas have been routinely collected since 2002.

Considerable general information is available on the life-history characteristics of this species.

B.3. Surveys

B.4. Commercial cpue

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2009. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 tonnes in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day. Cpue were calculated as the average total catch of ling per vessel (C), and the average number of hooks per set and per vessel (N) associated with these catches. Then, for each year and catch category, the estimated cpue for the entire fleet was determined as *C/N*. Thus the estimated cpue for each year and subarea was the mean catch in kg per hook for the entire fleet.

The boats that provided logbooks are the primary sampling units, and *C* and *N* are both random variables. It follows that this is a ratio-type estimator, therefore the standard errors of the cpue estimates could be calculated as described in Cochran (1977, page 32). This cpue estimator is a weighted average, that is the more hooks a boat sets, the more influence it has on the estimate (Cochran, 1977). For comparison, an unweighted cpue series was also constructed (i.e. the average cpue per boat).

A standardized series will be developed in preparation for WGDEEP 2012.

B.5. Other relevant data

C. Assessment: data and method

Model used: The stock is assessed using trends in catch and cpue.

Software used:

Model Options chosen:

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes	1988–2010		
Canum	Catch-at-age in numbers			
Weca	Weight-at-age in the commercial catch			
West	Weight-at-age of the spawning stock at spawning time.			
Mprop	Proportion of natural mortality before spawning			
Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:

3) Maturity:

4) F and M before spawning:

5) Weight-at-age in the stock:

6) Weight-at-age in the catch:

7) Exploitation pattern:

8) Intermediate year assumptions:

9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

Evaluation of reference points

At the 2012 WGDEEP meeting several methods were trialled to estimate reference points for ling in all other areas. These methods included the Gislason method, the Extended Beverton–Holt yield simple model (BHAC) and FLAdvice as recommended in WKLIFE.

The input parameters were as follows:

For Gislason: L_{MAX} of 180 cm

AFC = 5.

For BHAC: natural mortality M = 0.15

k VB growth K = 0.09

Length 1st maturity L_{mat} <- 70

L infinity L_inf <- 160

For FLadvice: Age range is 1–16

L infinity L_inf <- 160

k VB growth K = 0.09

LW relationship a = 0.0043

LW relationship b = -3.051

Several estimates from the different approaches were available. The table below summarizes the outputs of the different methods:

Method/Estimate	FMAX	F0.1	F30%SPR	F40%SPR	Fmsy
Gislason spreadsheet (WKLIFE) with AFC=5	0.22	0.1	0.13	0.09	
BHAC (WKLIFE)	0.21	0.11			
FLAdvice (WKLIFE) based on Linf and K	0.16	0.08	0.10		
FLAdvice (WKLIFE) based on Linf, K and LW parameters	0.14	0.06	0.08		0.09

This analysis indicated that F_{MAX} (around 0.22) for the Gislason spreadsheet and (0.21) for the BHAC methods were similar, in both methods the estimation of $F_{0.1}$ is similar at ca. 0.1. FLAdvice was tested with the input of LW parameters and without, The F_{max} values were lower for FLAdvice based on Linf and K and lower still when LW parameters were included in the calculations.

There is no obvious basis for selecting an F_{MSY} proxy from the range of values described above however values between 0.1 and 0.2 would seem appropriate.

	Type	Value	Technical basis
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

H. Other issues

H.1. Historical overview of previous assessment methods

I. References

5.2 Blue ling in Va and XIV

Stock	Blue ling in Va and XIV
Working Group	WGDEEP
Date	(March 2011)
Revised by	(WGDEEP-2011/Gudmundur Thordarson)

A. General

A.1. Stock definition

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

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

A.2. Fishery

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

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

Before 2008 the majority of the catches of blue ling in Va were caught by trawlers, as by-catch where the main target species are cod, haddock and other demersal species. 50% of the bottom-trawl catches in 2007 were taken within the depth range of 300–700 and 50% of the longline catches was taken at depths greater than 400 m. After 2008 there has been a substantial change in the fishery for blue ling in Va as longliners started targeting blue ling.

The gross fluctuation in catches in the late seventies, early eighties and again in the early nineties is most likely a reflection transient fisheries on spawning grounds. As a result of depletion of fish on spawning grounds, total international landings in Va declined from around 8500 t in 1980 to a level of between 2000 and 3000 t in the late 1980s. Landings were at a historical low in the late 1990s, but have increased in recent years.

Historically the fisheries in Subarea XIV have been relatively small.

A.3. Ecosystem aspects

Blue ling in Icelandic waters is mainly found on the continental shelf and slopes of south-east, south, and west of Iceland at depths of 0–1000 m, but mainly but is mainly caught in the fisheries at depths greater than 500 meters. Warming of sea temperature, have been documented in Va and an expansion of distributional area of warm-water species such as anglerfish. The significance and reliability of such metrics is considered at the moment insufficient for their consideration in the provision of management advice of blue ling in Va.

A.4. Management

The Ministry of Fisheries is responsible for management of the Icelandic fisheries and implementation of the legislation. The Ministry issues regulations for commercial fishing for each fishing year, including an allocation of the TAC for each of the stocks subject to such limitations. Below is a short account of the main feature of the management system and where applicable emphasis will be put on blue ling.

A system of transferable boat quotas was introduced in 1984. The agreed quotas were based on the Marine Research Institute's TAC recommendations, taking some socio-economic effects into account, as a rule to increase the quotas. Until 1990, the quota year corresponded to the calendar year but since then the quota, or fishing year, starts on September 1 and ends on August 31 the following year. This was done to meet the needs of the fishing industry. In 1990, an individual transferable quota (ITQ) system was established for the fisheries and they were subject to vessel catch quotas. The ITQ system allows free transferability of quota between boats. This transferability can either be on a temporary (one year leasing) or a permanent (permanent selling) basis. This system has resulted in boats having quite diverse species portfolios, with companies often concentrating/specializing on particular group of species. The system allows for some but limited flexibility with regards converting a quota share of one species into another within a boat, allowance of landings of fish under a certain size without it counting fully in weight to the quota, and allowance of transfer of unfished quota between management years. The objective of these measures is to minimize discarding, which is effectively banned. Since 2006/2007 fishing season, all boats operate under the TAC system.

At the beginning, only few commercial exploited fish species were included in the ITQ system, but many other species have gradually been included. Blue ling in Va is one of the few species in the Icelandic fisheries that is not included in the ITQ-system and as such not subjected to annual TAC.

Landings in Iceland are restricted to particular licensed landing sites, with information being collected on a daily basis time by the Directorate of Fisheries in Iceland (the enforcement body). All fish landed has to be weighted, either at harbour or inside the fish processing factory. The information on each landing is stored in a centralized database maintained by the Directorate and is available in real time on the Internet (www.fiskistofa.is). The accuracy of the landings statistics are considered reasonable.

All boats operating in Icelandic waters have to maintain a logbook record of catches in each haul/set. The records are available to the staff of the Directorate for inspection purposes as well as to the stock assessors at the Marine Research Institute.

With some minor exceptions it is required by law to land all catches. Consequently, no minimum landing size is in force. To prevent fishing of small fish various measures such as mesh size regulation and closure of fishing areas are in place.

A system of instant area closure is in place for many species. The aim of the system is to minimize fishing on juveniles. An area is closed temporarily (for two weeks) for fishing if on-board inspections (not 100% coverage) reveal that more than a certain percentage of the catch is composed of fish less than the defined minimum length. The only restrictions on the Icelandic fleet regarding the blue ling fishery was the introduction of closed areas in 2003 to protect known spawning locations of blue ling, which are in effect during the spawning period of blue ling in Va 15th of February until 30th of April.

B. Data

B.1. Commercial catch

The text table below shows which data from landings is supplied from ICES Division Va.

ICES Division Va	Kind of data				
Country	Caton (Catch in weight)	Canum (catch-at-age in numbers)	Weca (weight-at-age in the catch)	Matprop (proportion mature-by-age)	Length composition in catch
Iceland	x				x
The Faroe Islands	x				
Norway	x				

Icelandic blue ling catch in tonnes by month, area and gear are obtained from Statistical Iceland and Directorate of Fisheries. Catches are only landed in authorized ports where all catches are weighed and recorded. The distribution of catches is obtained from logbook statistic where location of each haul, effort, depth of trawling and total catch of blue ling is given. Logbook statistics are available since 1991. Landings of Norwegian and Faroese vessels are given by the Icelandic Coast Guard and reported to the Directorate of Fisheries.

Discard is banned in the Icelandic demersal fishery and there is no information available on possible discard of blue ling. Being a relatively valuable species and not subjected to TAC constraints or minimum landing size there should be little incentive to discard blue ling in Va.

B.2. Biological

Biological data from the commercial longline and trawl fleet catches are collected from landings by scientists and technicians of the Marine Research Institute (MRI) in Iceland.

The biological data collected are length (to the nearest cm), sex and maturity stage (if possible since most blue ling is landed gutted), and otoliths for age reading. Most of the fish that otoliths were collected from were also weighted (to the nearest gramme). Biological sampling is also collected directly on board on the commercial vessels during trips by personnel of the Directorate of Fisheries in Iceland or from landings (at harbour). These are only length samples.

The general process of the sampling strategy is to take one sample of blue ling for every 180 tonnes landed. Each sample consists of 150 fish. Otoliths are extracted from 50 fish which are also length measured and weighed gutted. In most cases blue ling is landed gutted so it not possible to determine sex and maturity. If blue ling is landed ungutted, the ungutted weight is measured and the fish is sex and maturity determined. The remaining 100 in the sample are only length measured. Age reading of blue ling from commercial catches ended in 1998. The reason was great uncertainty in ageing and cost saving.

Earlier observations indicates that blue ling becomes mature at-age of about 8–13 years or at around the length of 90 cm. The mean length-at-maturity is close to the mean length of blue ling in the commercial catches. This means that a large proportion of the blue ling is caught as immature.

No estimates of natural mortality are available for blue ling in Va and XIV.

The biological data from the fishery are stored in a database at the Marine Research Institute. The data are used for description of the fishery.

B.3. Surveys

For detailed description of the surveys relevant to blue ling in Va, please refer to the stock annex (6.2) for tusk in Va and XIV.

The Icelandic spring survey (March) commenced in 1985 and covers the Icelandic shelf down to 500 meters. As such the survey is not considered descriptive of biomass trends. However smaller blue ling is found at shallower depths and therefore the spring survey may contain valuable information on smaller and younger blue ling. This has at present not been explored.

The Icelandic autumn survey (October) commences in 1996 and after its expansion in 2000 the survey is considered to cover the distributional range of blue ling in Va and therefore to be representative of stock biomass.

B.4. Commercial cpue

Data used to estimate cpue for blue ling in Division Va since 1991 are obtained from logbooks of the Icelandic trawl and longline fleet. Non-standardized cpue and effort is calculated for each year which is simply the sum of all catch divided by the sum of number of hooks.

B.5. Other relevant data

None.

C. Assessment: data and method

Blue ling in Va and XIV is assessed based on trends in survey indices from the Icelandic autumn survey. Supplementary information includes relevant information from the fishery such as length distributions, maturity data, effort, cpue and analysis of changes in spatial and temporal distribution. Indices from the Icelandic spring survey may also be indicative of biomass of smaller blue ling. No data, other than landings, is available from XIV.

D. Short-term projection

No short-term predictions are performed.

E. Medium-term projections

No medium-term predictions are performed.

F. Long-term projections

No long-term predictions are performed.

G. Biological reference points

No biological reference points are defined for blue ling in Va and XIV.

H. Other issues

H.1. Historical overview of previous assessment methods

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

I. References

5.3 Blue ling in Vb and Subareas VI and VII

Stock	Blue ling (*Molva dypterygia*) in ICES Division Vb and Subareas VI and VI
Working Group	WGDEEP
Date	March 2011
Revised by	WGDEEP 2011/P. Lorance.

A. General

A.1. Stock definition

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

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

The assessment unit was defined as ICES Division Vb and Subareas VI and VII. In Subareas VI and VII, only adults fish occur, juveniles are not caught to any significant level in. The situation is slightly different in Division Vb where some small fish occur and could be used for age and growth estimation purposes (Magnussen, 2007) but the numbers previously reported from Faroese trawl surveys do not seem significant to the size of the exploited adult stock.

Similarly, in the neighbouring ICES Divisions IVa and XIIb, from where landings are currently a few hundred tonnes per year but have been higher in the past, only adult fish are known to be caught and these should probably be considered as the same stock as blue ling in Vb, VI and VII.

Spawning areas

Based largely on this information, in Subarea VI blue ling spawning occurs (i) in Vb, on the southern and southwestern margins of Lousy Bank;(ii) in VIa along the continental slope northwest of Scotland and close to of Rosemary Bank; (iii) in VIb on the margins of Hatton Bank (Figure 1) and is considered to take place at depths of 730–1100 m between March and May inclusive in Vb and VIa, and during March and April in VIb. From 1970 to 1990, the bulk of the fishery for blue ling was seasonal fisheries targeting these aggregations, which are subject to sequential depletion. To prevent depletion of adult populations, temporal closures were introduced by the EC in 2009 within ICES Division VIa.

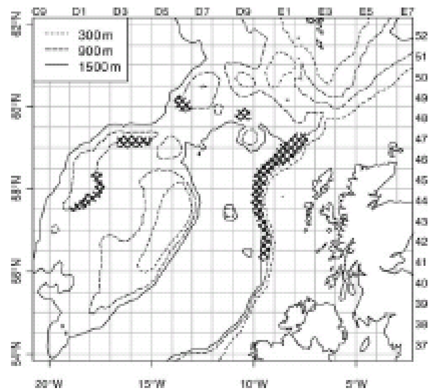

Figure 1. Known spawning areas of blue ling to the West of Scotland (from Large *et al.*, 2010).

A.2. 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 bycatch in other fisheries. In Subarea Vb and Division VI, other fisheries landings blue ling are the Norwegian longline fishery for ling and tusk where blue ling is a bycatch and Scottish trawlers. Landings from these fleets have been small since the 2000s but where high in the 1960s and 1970s for some fleet. Landings from Subareas VIII and IX previously reported as blue ling are now ascribed to the closely related Spanish ling (*Molva macrophthalma*) and blue ling is not known to occur to any significant level in these Subareas. The area of distribution of the stock is limited to somewhere between 50 and 55°N along the Porcupine Bank slope (Bridger, 1978; Ehrich, 1983; Lorance *et al*., 2009).

Landings by Faroese trawlers are mostly taken in the spawning season. Historically, this was also the case for French trawlers fishing in Vb and VI. However, in recent years blue ling has been taken mainly in a mixed French trawl fishery for roundnose grenadier, black scabbardfish and blue ling. This fishery is further mixed with fishing for shelf species such as saithe, hake, monkfish and megrim.

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

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

B. 1.1. Landings and discards

In 2008, the landings time-series from the southern blue ling stock was extended back to 1966 based upon North Western Working Group reports from 1989–1991 and data in Moguedet, (1988). Landings data in the 1980s for French freezer trawlers may be underestimated in some years but were included in 2011 for years 1988–2000.

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

Landings data by ICES statistical rectangles have been provided by France, (UK) Scotland, UK (England and Wales), Spain (Basque country fleet fishing along the continental slope to the West of the British Isles) and Ireland and have been aggregated by quarter and plotted to display the geographical distribution of the fishery by year starting from 2005.

Blue ling is not discarded to any significant level because no small blue ling are caught in the fishery.

B.2. Biological

Available growth parameter in length and weight for blue ling are summarized in Tables 1 and 2, and maturity parameters in Table 3.

Table 1. Growth parameters of blue ling.

L∞ (cm)	K (year-1)	t0	Number of fish	Age range	Sex	Maximum observed size	Area	Reference
160	0.11	N/A	79	3–17	Combined		Faroe Bank	Magnussen, 2007
165.8	0.084	-0.138	N/A	? –20	Female	147 (1)	ICES VIa	Moguedet, (1985, 1988)
112.2	0.158	0.318	N/A	? –19	Male	110	ICES VIa	(1)
125	0.152	1.559	2619	5–25 (2,3)	Combined	136 (3)	Vb VIa,b	
145.2	0.155	1.281	1412		Female		Vb VIa,b	Ehrich and Reinsch, 1985
109.7	0.199	1.833	1391		Males		Vb VIa,b	(4)
116.25	0.17	0.57	590	5–20+	Female	130	Faroe Islands (5)	
104.2	0.197	0.57	331	5–20+	Male	107	Faroe Islands (5)	
137.37	0.13	0.46	117	6–18+	Female	139	Shetland Islands (5)	Thomas, 1987
108.31	0.185	0.57	227	5–20+	Male	109	Shetland Islands (5)	
			563	20 +	Female	138.5 (7)	Icelandic slope	
			431	17	Male	115 (7)	Icelandic slope	
			1492	20+ (6)	Combined	137.86 (7)	Icelandic slope	
			?	?	Combined	145-150 (8)	Iceland and RR (9)	Magnússon and Magnússon, 1995
			?	?	Female	140	Spawning aggreg. RR (9)	
			?	?	Male	124	Spawning aggreg. RR (9)	
			1399		Combined	130–135 (10)	West of the British Isles	Bridger, 1978
					Female	ca 145 (11)	West of the British Isles	Ehrich, 1983
					Males	ca 112 (11)	West of the British Isles	
			240 (♂+♀)		Female	150–155 (12)	West of the British Isles	Gordon and Hunter, 1994
			240 (♂+♀)		Male	110–115 (12)	West of the British Isles	Gordon and Hunter, 1994
			197		Combined	140	Norwegian Deep	Bergstad, 1991

(1) from sampling in 1984–1985; Female>= 130 cm were 3% of total female numbers; (2) the bulk in age groups 7–20;(3) from length distribution of German landings 1980 and 1982; (4) estimates based upon length and age data from sampling of German blue ling landings (Ehrich and Reinsch, 1985).

(5) based upon sampling in 1977 and 1979 (Shetland Islands) and 1977 and 1978 (Faroe Islands); areas are defined according to Figure 1 (Thomas, 1987).

(6) Magnússon and Magnússon (1995) reported mean length by age for the years 1978–1982. In their sample (n=1492), there were seven7 fish of the age group 20+

(7) from age estimation sample; mean length of the oldest age group: six individuals for females, one for males, seven combined; (8) visually from length distribution plots; few fish above 130 cm; (9) RR: Reykjanes Ridge; (10) from a plot of length distribution by 5 cm length classes. Largest length class was 130–135 cm. It included 1–2% of total number of fish measured, they modal size class was 95–99 cm; (11) from plot, modal size by 120 cm for females and 95 cm for males.

(12) from SAMS surveys (unpublished data), from histogram by 5 cm size classes. Modal sizes of 95–100 cm for males and 105–110 for females, n=240 (sex combined).

Table 2. Growth parameters in weight.

W_∞ (g)	K	t_0	Number of fish aged	Length range (TL, cm)	Age range (y)	Sex	Reference	Area
19 688	0.094		79	NA	3–17	Combined	Magnussen, 2007	Faroe Islands
5191						Male	Ehrich and Reinsch, 1985	
13 166						Female	Ehrich and Reinsch, 1985	

Table 2. Maturity parameters, A50: age at 50% maturity; m: rate at which the population attains maturity (Magnussen, 2007); L50 length at 50% maturity; M50 weight at 50% maturity.

Sex	Area	A50	m	L50 (cm)	M50 (g)	Reference
Combined	Faroe Bank	6.2	1.66	79	1696	Magnussen, 2007
Female	Iceland	11	N/A	88	N/A	Magnússon and Magnússon, 1995
Male	Iceland	9	N/A	75	N/A	Magnússon and Magnússon, 1995
Female	Faroe Islands	8.1	N/A	N/A	N/A	Thomas, 1987 (1)
Male	Faroe Islands	6.4	N/A	N/A	N/A	Thomas, 1987 (1)
Female	South and West of the Faroe Islands	7	N/A	85		Magnússon *et al.*, 1997
Male	South and West of the Faroe Islands	6	N/A	80		Magnússon *et al.*, 1997
Combined	ICES IIa	N/A	M/A	75		Joenes, 1961

(1) The author specified that not too much significance should be given do the result because very few immature fish were caught and stated "it might be sufficient to know that the fish mature at an age between 6 and 8 years".

Table 3. Coefficient a and b of weight–length relationship $W=a*L^b$ for blue ling.

Area	Sex	a	b	Number of fish	size range (cm)	Weight range (g)	Reference
ICES VI	Combined	0.00191	3.14882	280	62–142		Dorel, 1986
ICES VI	Males	0.002	3.02	NA	69–109	715–2900	Moguedet 1988
	Females	0.0023	3.00	NA	74–142	1150–8600	

B. 1.2. Length composition

Length composition of the landings has been available from Faroese trawlers in Division Vb since 1996 and French trawlers in Division VIa since 1984. Mean length of blue ling from the Norwegian reference fleet in Divisions Vb, VIa, VIb are also provided. Age estimation of blue ling was carried out in the past and was disrupted because consistency between readers was considered poor. Nevertheless, there is a general agreement that blue ling recruits to this stock at a size of 70–80 cm have an age of 6–8 years. Age estimation of blue ling sampled from French landings was resumed in 2009 in application of DCF. Reading scheme for estimating the age of blue ling does not significantly differ for that of most gadoid species although the number of growth increments to count is higher (Figure 2). Nevertheless, age estimation for this species is unvalidated.

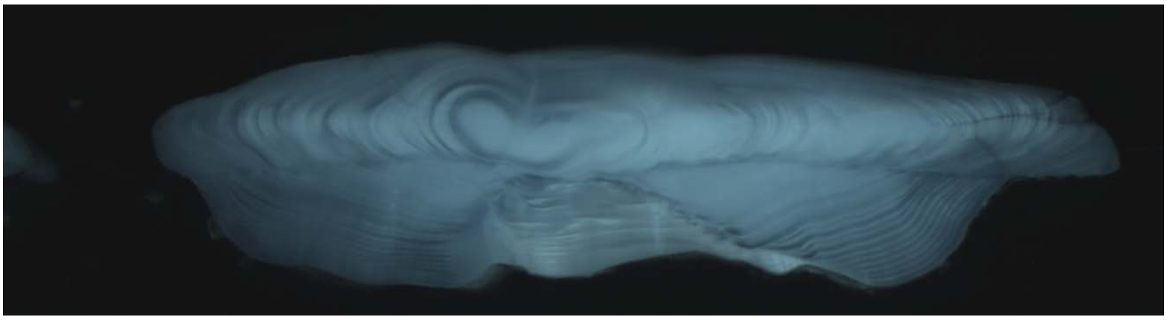

Figure 2. Thin sections of blue ling otolith.

B.1.4 Weight-at-age

No time-series but overall weight-at-age are derived from age–length keys and length–weight relationships.

B 1.5. Maturity and natural mortality

Natural mortality (M). was estimated using the relationship (Annala, J. H., Sullivan, K. J. (1996)):

M = ln(100)/maximum age

In this relationship, the maximum age should be set at the age where 1% of a year class is still alive. Based on Faroese and French age readings and considering a maximum age for blue ling at 30 years M has been presumed in the order of 0.15. In a compilation of published age data as part of the EU DEEPFIHSMAN project more than 4000 individual age data were found, none exceeded 25 years. Based on this the maximum age was refine as 25. As a consequence, *M* estimated from the relationship from Hoenig (Hoenig, 1983; Hewitt and Hoenig, 2005) and from was maximum age relationship above has been refined to 0.18. The empirical relationship from Pauly (1980) applied by WKLIFE with growth parameters *K*=0.152 and L_∞.= 125 for both sex combined (Ehrich and Reinsch, 1985) returns a similar *M* of 0.19.

Juvenile blue ling are not known to occur on the fishing nor in Subareas Vb, VI and VII to any significant level. Fish recruit to this area and to the spawning stock at an age of six to eight years. All blue ling occurring in Vb, VI and VI can be considered as mature fish.

B.3. Surveys

Weight and number per hour trawling in the Faroese spring survey since 1994 have been provided. Number have been provided for small (<80 cm) and large (>80 cm) fish. However, it was stressed that these surveys are limited to depth shallower than 500 m. These data may provide useful information on recruitment.

An index of abundance in number per hour was available from a Scottish deep-water survey to the west of Scotland for years 1998–2011. The fish community of the continental shelf slope to the northwest of Scotland has been surveyed by Marine Scotland Science since 1996, with strictly comparable data available between 1998 and 2008. This has focused on a core area between 55–59°N, with trawling undertaken at depths ranging from 300 to 1900 m with most of the hauls being conducted at fixed stations, at depths of around 500 m, 1000 m, 1500 m and 1800 m. Further hauls have been made on seamounts in the area, and on the slope around Rockall Bank, but these are exploratory, irregular and are not taken into account in the index of abundance. This survey was conducted biennially, in September, until 2004, and annually in 2004–2009. Locations of trawl sites between depths of 500–1500 m are shown in Figure 1. From 1998 to 2008 the bottom trawl was rigged with 21” rock-hopper groundgear, however in 2009, a switch was made to lighter groundgear, with 16” bobbins.

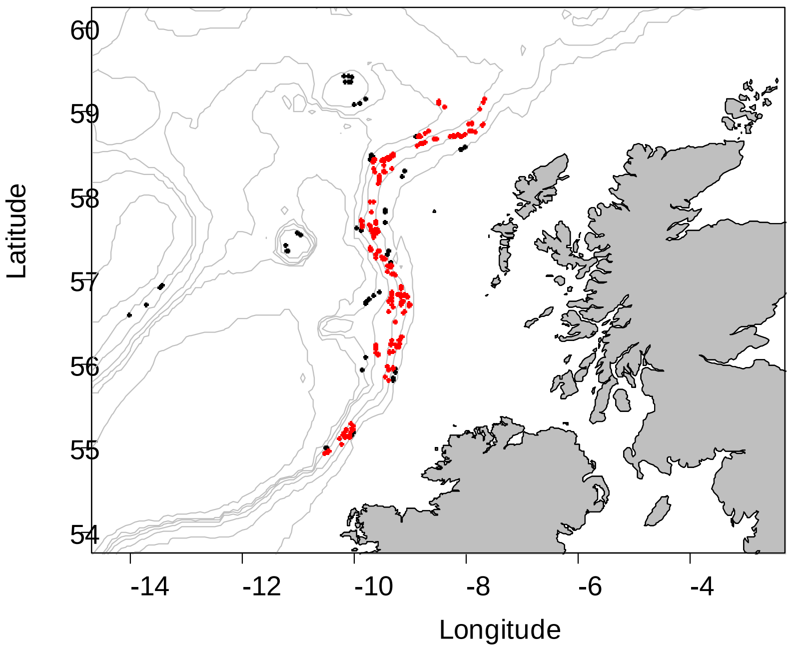

Figure 1. Sites of valid hauls in the 500–1500 m depth band in the Scottish Deep-water Survey dataset, 1998–2009 (in red). Valid hauls at other depths are shown in black.

An index of abundance was available from an Irish deep-water trawl survey of the fish community of the continental shelf slope to west and northwest of Ireland carried out from 2006 to 2009. The sampling protocol of this survey was standardized in accordance with the Scottish deep-water survey with trawling at fixed stations around 500 m, 1000 m, 1500 m and 1800 m. The gear used throughout the surveys series was the same as that used by Scotland in 2009. To be consistent across the years the haul data used for the index calculation only includes the areas that are covered in all four years and the depth bands (500–1500 m) that are covered in all four years. In total, the dataset comprised 42 valid hauls.

B.4. Commercial cpue

A French deep-water tallybook database (based on fishers' own records) developed by the French industry is used to compute Landings per Unit of Effort (lpue) indices starting from year 2000 (Lorance *et al.*, 2010). The database includes more years back to 1992 with landings of blue ling back to 1993. However, there is not enough data on blue ling before 2000 because of different components of deep-water vessels being included and small catch of blue ling from vessel contributing to the data in 1993–1999. The abundance index is standardized using a GAM model.

To represent the spatial aspect in the model, five small areas where the fleet has caught blue ling were defined as cluster of ICES rectangles (Figure 3). Fishing area definition was based on a working paper presented at WGDEEP 2006 on an analysis of logbook data. In this working document fishing grounds, exploited since the 1990s were denoted ref5 (for reference 5), edge6 (for edge of continental slope) and other6 (for other fishing grounds in VI. New fishing grounds, i.e. not fished by French trawlers for fresh fish before 2000 in ICES Division Vb and Subareas VI were denoted new5 and new6 respectively (Figure 3).

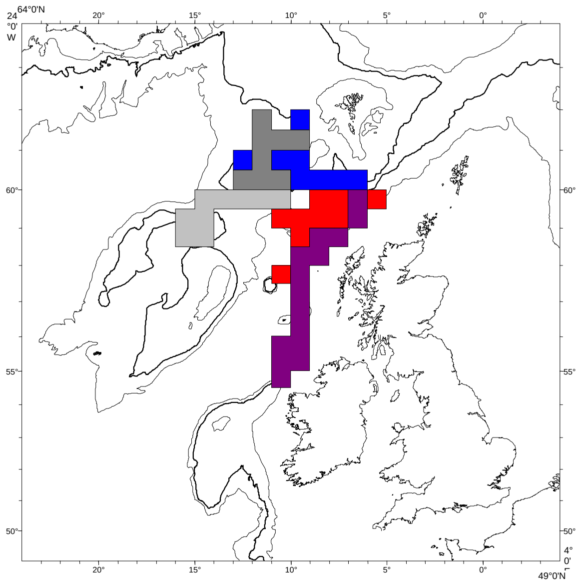

Figure 3. Areas (clusters of statistical rectangles) used to calculate French lpue for blue ling. Dark grey, new grounds in ICES Division Vb (new5); light grey, new grounds in Subarea VI (new6); red, others in Subarea VI (other6); purple, edge in VI (edge6); blue, reference in Division Vb (ref5).

The GAM models used to standardize the haul-by-haul catch data has the form:

log(E[landings]) = s(haul duration) + s(depth) + month + vessel.id+ rectangle + year:Area

where E[] denotes expected value, s() indicates a smooth nonlinear function (cubic regression spline), vessel.id the vessel identity and year:area an interaction term. The dependent variable is landings and not lpue, which allows including haul duration as explanatory variable and have a non-proportional relationship between landings and fishing time. The fit was done assuming a Tweedie distribution of the dependent variable with a log-link function using the mgcv package in R (Wood, 2006).

The Tweedie distribution has mean μ and variance $\phi\mu^p$, where ϕ is a dispersion parameter and p is called the index. As a Poisson-Gamma compound distribution was used, $1<p<2$, the index p could not be estimated simultaneously with the model parameters. In 2010, a detailed study was carried out and p=1.3 provided the best fit (Lorance *et al*., 2010).

In 2009, the model fit was restricted to haul durations from 60 to 300 minutes and depth 200–1100 m covering the species depth range and excluding too short and long hauls for which there is a few data. This lpue standardization method allowed estimating lpue time-trends for the five small areas. The model provided lpue time-trends for the five areas. To derive standardized estimates for the whole study zone, lpue values are predicted for January, for all rectangles in each area (using the average haul depth in each rectangle), a five hour haul duration, and a vessel that operated during the whole period as prediction variables. Predictions for the entire study zone were then derived as the weighted average of the five area (rectangle average) estimates, with the weights being the number of rectangles in each area (Lorance *et al*., 2010). Some changes occurred in the fishery: protection areas for bleu ling spawning were introduced in 2009. As these limited the possibility for fishing for blue ling in these areas, hauls carried out throughout the time-series were excluded. The small areas new5 and new6 were not fished in 2011 by vessels contributing to the tallybooks. As a result, the index for based upon the catch in three areas only. The depth and haul duration range was adjusted to reduce the confidence limits of the estimated. Depth range of 500–1200 m and duration of 120–480 minutes were used. The change in these selections impacts little the estimates but reduce the confidence limits.

B.5. Other relevant data

No other relevant data.

C. Assessment: data and method

There is no benchmark assessment method for this stock. All assessments described below are exploratory.

Multiyear catch curve

The multiyear catch curve model was carried out to estimate total annual mortality Zt taking account of interannual variations in recruitment. The data used are proportions-at-age in numbers by year and total catch (landings) in numbers by year.

The population dynamics in numbers are modelled as:

$$N_{a,t} = N_{a-1,t-1}e^{-Z_{t-1}} \qquad a_r \le a \le A_+ \qquad t = 1.........T \qquad (1)$$

$$N_{A_+,t} = (N_{A_+-1,t-1} + N_{A_+,t-1})e^{-Z_{t-1}} \qquad (2)$$

where $N_{a,t}$ are population numbers-at-age a in year t, A_+ is an age plus group and Z_t are annual total ~mortality rates. Recruitment-at-age a_r is assumed to vary randomly over time following a lognormal distribution

$$N_{1,t} = R_t \qquad R_t \sim \text{logN}(\mu_R, \sigma_R) \qquad t = 1\ldots T \qquad (3)$$

where μ_R is the mean recruitment and σ_R the standard deviation. For ease of interpretation the coefficient of variation (CV_R) instead of σ_R was calculated making use of the fact that ***var(ln(x)) ≈ ln(CV(x)²+1)***. Recruitment is treated as a random effect in model fitting.

Annual total mortality Zt is modelled by a random effect using a random walk over time:

$$Z_t = Z_{t-1} + \varepsilon_t \qquad \varepsilon_t \sim \mathrm{N}(0, \sigma_Z) \qquad t = 1\ldots\ldots T \tag{4}$$

The initial state vector at the beginning of year t=1 is calculated assuming constant historic total mortality $Z_0 = M + F_0$

$$N_{a,1} = e^{(a_r - a)Z_0} R_{a_r+1-a} \qquad a_r < a \le A_+ \tag{5}$$

where F_0 is constant historic fishing mortality.

The initial numbers in the plus group $N_{A+,1}$ are estimated by an infinite sum over previous years.

The observation model has two parts, the first one for population numbers-at-age $Y_{a,t}$ and the second for total catch in numbers. Numbers-at-age, assumed to follow a multinomial distribution

$$Y_{a,t} \sim \mathrm{Multinom}(\mathrm{p}_{a,t}, m_t) \qquad a_r \le a \le A_+ \qquad t = 1\ldots\ldots T \tag{6}$$

where $p_{a,t}$ are proportions-at-age and m_t is the effective sample size in year t. Due to the clustered nature of individuals, the sample size in trawl surveys or harbour sampling programmes does not correspond to the number of individuals measured but is rather much smaller (Pennington and Vølstad, 1994). As a result the observed variability is much larger than would be expected given the number of measurements. Therefore the effective sample size was estimated from the sampling data using a Dirichlet-multinomial distribution and the dirmult package in R by Twedebrin272 k Twedebrink (2009).

The second observation model for the total catch (in numbers) which is assumed to follow a Gamma distribution with parameters α and β

$$Ct \sim \mathrm{Gamma}(\alpha,\beta) \tag{7}$$

$$E[C_t] = \left(\frac{Z_t - M}{Z_t}\right)(1 - e^{-Z_t})\sum N_{a,t} \tag{8}$$

The coefficient of variation (CV_c) of the Gamma distribution is related to the α parameter as CVc=1/sqrt(α) and $\beta = \alpha / E[Ct]$. The model is parameterized in terms of CVc.

Not all model parameters $\boldsymbol{\theta}$={Z_0,..., Z_t, M, F_0, μ_R, σ_R, $NA_{+,1}$, CV_R, CVc} can be estimated and some need to be fixed. The fixed parameters where set as follows:

- natural mortality M=0.18;
- coefficient of variation of landings or catch (CVc=0.05) to allow for some misreporting.

Estimation of free model parameters $\boldsymbol{\theta}$ **i**s carried out by maximum likelihood based on the observation vector $\boldsymbol{y} = (C_1, \ldots, C_T, Y_{ar,T}, \ldots, Y_{A+,T})$ which has conditional density f_θ (**y** | **u**,**v**) where $\boldsymbol{u}$ = ($R1$,..., Rn) is the vector of the latent random recruitment variable with marginal density $h(\boldsymbol{u}\ )$ $\boldsymbol{v}$=(Z_1,………,Z_{T-1}) is the total mortality random effect variable with marginal density $g(v)$. The marginal likelihood function is obtained by integrating out ***u* and *v*** from the joint density $\mathcal{L}$.

$$\mathcal{L}(\theta) = \iint f_\theta(y|u,v)h_\theta(u)g_\theta(v)y(u)y(v) \quad (9)$$

The double integral in (9) is evaluated using the Laplace approximation as implemented in the random effects module of AD Model builder and described in Skaug and Fournier (2006). AD Model builder automatically calculates standard deviations of estimates based on the observed Fisher Information matrix.

For the analysis the data are restricted to the fully recruited age classes, 9 and over, a plus group is set at age 19, called 19+.

Model used: SRA

Stock reduction analysis (SRA) is a developed form of delay-difference model (Quinn and Deriso, 1999). The method uses biological parameters and information for time delays due to growth and recruitment to predict the basic biomass dynamics of age structured populations without requiring information on age structure. Thus, it can be considered to be a conceptual hybrid between dynamic surplus production and full age based models (Hilborn and Walters, 1992). A full description of the general approach can be found in Kimura and Tagart (1982), Kimura *et al*. (1984) and Kimura (1985 and 1988); (Large, unpublished 2002).

Software used: *FLaspm*

FLaspm is a package for the statistical computing environment R (R Development Core Team, 2010). The package is open source and is currently hosted at GoogleCode (the source code is freely available at http://code.google.com/p/deepfishman/. *FLaspm* is part of the FLR project (Kell *et al*., 2007) and requires that the package *FLCore* is also installed (v >2.3). The stock reduction model used in this analysis implements the model described in Francis (1992) and is capable of fitting multiple indices simultaneously. The method requires time-series data of annual catches, one or more abundance index and a range of biological parameters. The effect of these biological parameters on results is investigated using sensitivity analysis. A Beverton and Holt stock and recruitment relationship with a steepness of 0.75 is used throughout.

Input data:

Total international landings from 1966 should be used for this assessment. Three tuning indices were available: French abundance index derived from skipper tallybook data, Marine Scotland's FRV SCOTIA deep-water survey and Irish (2006 to 2009).

Other stock indicators

Change in mean length in the landings, catch curve to estimate total mortality Z are used to track trends in the stock.

Model Options chosen:

Input data types and characteristics:

Parameter	Symbol	Value
Maximum age	A_{max}	30
Natural mortality	M	0.15
Steepness of Beverton–Holt stock–recruitment relationship	h	0.75
Age of first selectivity	A_{sel}	7
Age of maturity	A_{mat}	7
von Bertalanffy growth parameters	L_∞	125 cm
	k	0.152
	t_0	1.552
Length–weight parameters	a	2e-6
	b	3.15

D. Short-term projection

Not short-term predictions are carried out for this stock.

E. Medium-term projections

None.

F. Long-term projections

None.

G. Biological reference points

	Type	Value	Technical basis
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

No biological reference points defined.

H. Other issues

The stock identity is an issue for blue ling. The only area were juvenile are known to occur in high number in the Icelandic shelf. No juvenile are known to occur in Subareas VI and VII and number observed in the Faroese survey (about one fish smaller than 80 cm per hour) do not seem sufficient to supply the abundance for adult blue ling.

H.1. Historical overview of previous assessment methods

Exploratory assessment carried out far are summarized below (synthesis carried out as part of the DEEPFISHMAN project).

Year	Assessment type[3]	Method	Assessment package/ program used	Used for advice?	If not, what was latest scientific advice based on?
1998	Exploratory	Schaefer and DeLury depletion model	CEDA (1)	No	French OTB and Faroese longline lpue
2000	Exploratory	Schaefer and DeLury depletion model	CEDA (1)	No	French OTB unstandardized lpue
2004	Exploratory	Schaefer, Pella-Tomlinson and Fox production models and DeLury depletion model	CEDA (1)	No	Trend in French commercial otter trawl lpue
	Exploratory	Stock reduction	PMOD	No	Trend in French commercial otter trawl lpue
2006	Exploratory	Catch Survey analysis	CSA (Mesnil, 2003)	No	Trend in French commercial otter trawl lpue

(1) MRAG (UK) software.

Summary of data ranges used in recent assessments:

Data	2007 assessment	2008 assessment	2009 assessment	2010 assessment
Landings	Years: 1988–2006	Years: 1988-2007	Years: 1966-2008	Years: 1966–2009
Quarterly length dist. of French landings	Years: 1989–2006	Years: 1984–2007	Years: 1984–2008	Years: 1984–2010
Quarterly length dist. of Faroese landings	Years: 1995–2006	Years: 1995–2007	Years: 1995–2008	Years: 1995–2009
Quartely age dist.				Year: 2009
Survey: Scottish deep water			Years: 1998-2008 N° per hour	Years: 1998–2009 N° per hour
Survey: Irish				Years: 2006–2009 N° per hour

[3] Exploratory, Benchmark (to identify best practise), Update (repeat of previous years' assessment using same method and settings but with the addition of data for another year).

Data	2007 assessment	2008 assessment	2009 assessment	2010 assessment
Survey: spring and autumn Faroese				Years: 1994–2009 N° per hour Size
Haul-by-haul lpues from French trawlers	Not used	Not used	Years: 2000–2008	Years: 2000–2009
Aggregated unstandardized French lpue	Years: 1989–2006	Years: 1989–2007	Years: 1989–2008	Not used

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5.4 Blue ling in other areas

Stock	Blue ling in Subareas I, II, III, IV, VIII, IX, X and XII.
Working Group	WGDEEP
Date	March 2011
Revised by	WGDEEP/Pascal Lorance

A. General

A.1. Stock definition

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

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

A.2. Fishery

Blue ling has been an important bycatch in trawl fisheries for mixed deep-water species on Hatton Bank (Division XIIb) although historically there have been directed fisheries on spawning aggregations in that area. Historically there was a directed fishery on spawning aggregations in Subarea II but now this species is now only taken as bycatch in Norwegian longline fisheries in this area. In other areas blue ling is taken in small quantities. Small reported landings in Subareas VIII, IX and X probably refer to *Molva macropthalma*.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

Full landings data are available from 1988 to present but it is thought that fisheries in some of these areas pre-date the time-series. Incomplete landings data are available from Norwegian longline fisheries from 1889 onwards. Additional landings data from other areas may be available from 1950 onwards.

There is limited data on discarding from Spanish observers in Subarea XII. Discard data for other areas is unavailable but it is thought that discarding of this species is insignificant.

B.2. Biological

No data available.

Considerable general information is available on the life-history characteristics of this species.

B.3. Surveys

No data available.

B.4. Commercial cpue

No data available.

B.5. Other relevant data

C. Assessment: data and method

Model used: Landing trends (total landings split on area and countries).

Software used:

Model Options chosen:

Input data types and characteristics:

Type	Name	Year range	Split on areas and countries Yes/No	Variable from year to year Yes/No
Caton	Catch in tonnes	1988–2010	Yes	No
Canum	Catch-at-age in numbers			
Weca	Weight-at-age in the commercial catch			
West	Weight-at-age of the spawning stock at spawning time.			
Mprop	Proportion of natural mortality before spawning			
Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:

4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

	Type	*Value*	*Technical basis*
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

No biological reference points have been defined.

H. Other issues

H.1. Historical overview of previous assessment methods

I. References

6.2 Tusk in ICES Division Va and XIV

Stock	Tusk (Division Va)
Working Group	WKDEEP
Date	February 2010
Revised by	Kristjan Kristinsson, Gudmundur Thordarson

Likelihood weighting text added by WGDEEP 2011

A. General

A.1. Stock definition

Tusk in Icelandic and Greenland waters (ICES Divisions Va and XIV respectively) is considered as one stock unit and is separated from the tusk found on the mid-Atlantic Ridge, on Rockall (VIb), and in Divisions I and II. This stock discrimination is based on genetic investigation (Knutsen *et al.*, 2009) and was reviewed at the WGDEEP meeting in 2007.

A.2. Fishery

The tusk in ICES Division Va is mainly caught by Iceland (75—85% of the total annual catches in recent years), but the Faroe Islands and Norway also important fishing nations. Foreign catches of tusk in Va, mainly conducted by the Faroese fleet, has always been considerable but have decreased since 1990, whereas the Icelandic catches have increased.

Over 95% of the Icelandic tusk catch in Va comes from longliners and mainly caught as either bycatch in other fisheries or in mixed fishery. The Icelandic longline fleet mainly targets cod and haddock where tusk is often caught as bycatch. The directed fishery for tusk has traditionally been little but has increased in recent years. Tusk is then often caught with ling and blue ling along the south and southwest coast of Iceland.

In recent years between 150–250 longliners have annually reported tusk catches, whereof 80–85% have been caught by about 20–25 vessels (annual catch of each vessel from about 50 tonnes up to 800 tonnes).

Since 1991, 60–80% of the catches have been taken within the depth range of 100–300 m, with 80–95% of the catches taken at depth less than 400 m. In some years, about 20% of the annual tusk catch has been taken at depths between 600–700 m.

The longline fleet in Icelandic waters is composed of both small boats (<10 GRT) operating in shallow waters as well as much larger vessels operating in deeper waters. Cod and haddock are the main target species of this fleet but tusk, ling and blue ling are also caught, sometimes in directed fisheries. The ten longline vessels that fish about 65% of the total tusk catch in Va are vessels between 300–600 GRT.

Tusk fishery in ICES Division XIV has traditionally been very little, with less than 100 t caught annually. The tusk is caught as bycatch in other fisheries.

A.3. Ecosystem aspects

Tusk in Icelandic waters is mainly found on the continental shelf and slopes of south-east, south, and west of Iceland at depths of 0–1000 m, but mainly at depths between 100–500 m.

A.4. Management

The Ministry of Fisheries is responsible for management of the Icelandic fisheries and implementation of the legislation. The Ministry issues regulations for commercial fishing for each fishing year, including an allocation of the TAC for each of the stocks subject to such limitations. Below is a short account of the main feature of the management system and where applicable emphasis will be put on tusk.

A system of transferable boat quotas was introduced in 1984. The agreed quotas were based on the Marine Research Institute's TAC recommendations, taking some socio-economic effects into account, as a rule to increase the quotas. Until 1990, the quota year corresponded to the calendar year but since then the quota, or fishing year, starts on September 1 and ends on August 31 the following year. This was done to meet the needs of the fishing industry. In 1990, an individual transferable quota (ITQ) system was established for the fisheries and they were subject to vessel catch quotas. The ITQ system allows free transferability of quota between boats. This transferability can either be on a temporary (one year leasing) or a permanent (permanent selling) basis. This system has resulted in boats having quite diverse species portfolios, with companies often concentrating/specializing on particular group of species. The system allows for some but limited flexibility with regards converting a quota share of one species into another within a boat, allowance of landings of fish under a certain size without it counting fully in weight to the quota, and allowance of transfer of unfished quota between management years. The objective of these measures is to minimize discarding, which is effectively banned. Since 2006/2007 fishing season, all boats operate under the TAC system.

At the beginning, only few commercial exploited fish species were included in the ITQ system, but many other species have gradually been included. Tusk was included into the ITQ system in the 2001/2002 quota year.

Landings in Iceland are restricted to particular licensed landing sites, with information being collected on a daily basis time by the Directorate of Fisheries in Iceland (the enforcement body). All fish landed has to be weighted, either at harbour or inside the fish processing factory. The information on each landing is stored in a centralized database maintained by the Directorate and is available in real time on the Internet (www.fiskistofa.is). The accuracy of the landings statistics are considered reasonable.

All boats operating in Icelandic waters have to maintain a logbook record of catches in each haul/set. The records are available to the staff of the Directorate for inspection purposes as well as to the stock assessors at the Marine Research Institute.

With some minor exceptions it is required by law to land all catches. Consequently, no minimum landing size is in force. To prevent fishing of small fish various measures such as mesh size regulation and closure of fishing areas are in place.

A system of instant area closure is in place for many species, including tusk. The aim of the system is to minimize fishing on juveniles. For tusk, an area is closed temporarily (for two weeks) for fishing if on-board inspections (not 100% coverage) reveal that more than 25% of the catch is composed of fish less than 55 cm in length. Since tusk is often bycatch in other fisheries, this rule does only apply when the tusk catch is more than 30% of the total catch in a set/haul. Because of repeated instant area closures off the south and southeast coast of Iceland in 2003, four areas were closed permanently for longline fishery in order to protect juvenile tusk (Figure 1).

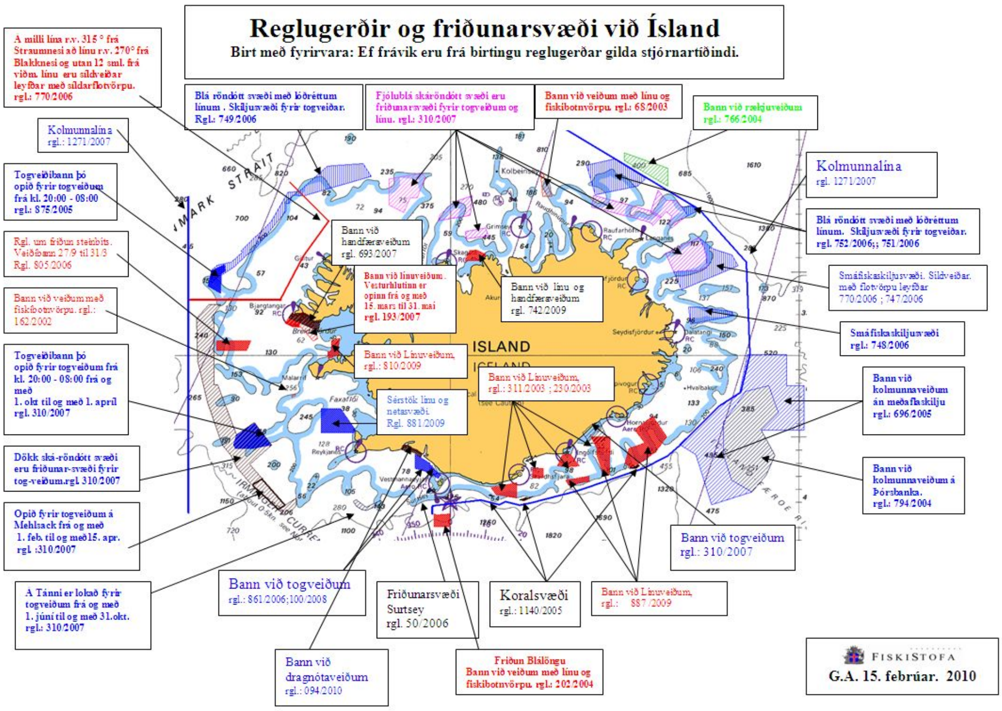

Figure 1. Marine protected areas in Icelandic waters. These areas are closed for various types of fisheries and may be closed permanently (all year around) or temporarily (closed part of the years. Four areas marked red south and southeast of Iceland (reference to the box *Bann við Línuveiðum, rgl.: 311/2003; 230/2003*) are areas permanently closed for longline fisheries in order to protect juvenile tusk. Trawling does not occur within these areas. Figure provided by Directorate of Fisheries in Iceland.

B. Data

B.1. Commercial catch

Landings and discards

The text table below shows which data from landings is supplied from ICES Division Va.

ICES Division Va	Kind of data				
Country	Caton (Catch in weight)	Canum (catch-at-age in numbers)	Weca (weight-at-age in the catch)	Matprop (proportion mature by age)	Length composition in catch
Iceland	x	Two years	Two years		x
The Faroe Islands	x				x
Norway	x				

Icelandic tusk catch in tonnes by month, area and gear are obtained from Statistical Iceland and Directorate of Fisheries. Catches are only landed in authorized ports where all catches are weighed and recorded. The distribution of catches is obtained from logbook statistic where location of each haul, effort, depth of trawling and total catch of tusk is given. Logbook statistics are available since 1991. Landings of Norwegian and Faroese vessels are given by the Icelandic Coast Guard and reported to the Directorate of Fisheries.

Discard is banned in the Icelandic demersal fishery and there is no information available on possible discard of tusk.

B.2. Biological

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

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

Biological data from the commercial longline catch are collected from landings by scientists and technicians of the Marine Research Institute (MRI) in Iceland. The biological data collected are length (to the nearest cm), sex and maturity stage (if possible since most tusk is landed gutted), and otoliths for age reading. Most of the fish that otoliths were collected from were also weighted (to the nearest gramme). Biological sampling is also collected directly on board on the commercial vessels during trips by personnel of the Directorate of Fisheries in Iceland or from landings (at harbour). These are only length samples.

The general process of the sampling strategy is to take one sample of tusk for every 180 tonnes landed. This means that between 30–40 samples are taken from the commercial longline catch each year. Each sample consists of 150 fish. Otoliths are extracted from 50 fish which are also length measured and weighed gutted. In most cases the tusk is landed gutted so it not possible to determine sex and maturity. If tusk is landed un-gutted, the un-gutted weight is measured and the fish is sex and maturity determined. The remaining 100 in the sample are only length measured.

Age reading of tusk from the commercial catch is not done on regular basis and otoliths from only two years have been age read.

Earlier observations indicates that tusk becomes mature-at-age of about 8–10 years or at around the length of 56 cm. However, new ageing of tusk otoliths from 1995 and 2009 suggest that tusk grows considerably faster than previously assumed. The new age readings are considered more plausible than the older estimates as they results in more similar estimates of growth of tusk in Va as has been reported in other management units.

The mean length-at-maturity is close to the mean length of tusk in the commercial catches. This means that a large proportion of the tusk is caught as immature.

No estimates of natural mortality are available for tusk in Va and XIV. In the Gadget model (see below) natural mortality is assumed to be 0.2 year^{-1}.

The biological data from the fishery is stored in a database at the Marine Research Institute. The data are used for description of the fishery and as input data for the GADGET model.

B.3. Surveys

Iceland

Two bottom-trawl surveys, conducted by the Marine Research Institute in Va, are considered representative for tusk are the Icelandic Groundfish Survey (IGS or the spring survey) and the Autumn Groundfish Survey (AGS or the autumn survey) The spring survey has been conducted annually in March since 1985 on the continental shelf at depths shallower than 500 m and has a relatively dense station-net (approximately 550 stations). The autumn survey has been conducted in October since 1996 and covers larger area than the spring survey. It is conducted on the continental shelf and slopes and extends to depths down to 1500 m. The number of stations is about 380 so the distance between stations is often greater. The main target species in the autumn survey are Greenland halibut (*Reinhardtius hippoglossoides*) and deep-water redfish (*Sebastes mentella*).

The text in the following description of the surveys is mostly a translation from Björnsson *et al*. (2007). Where applicable the emphasis has been put on tusk.

B.3.1. Spring survey in Va

From the commencing of the spring survey the stated aim has been to estimate abundance of demersal fish stocks, particularly the cod stock with increased accuracy and thereby strengthening the scientific basis of fisheries management. That is, to get fisheries-independent estimates of abundance that would result in increased accuracy in stock assessment relative to the period before the spring survey. Another aim was to start and maintain dialogue with fishermen and other stakeholders.

To help in the planning, experienced captains were asked to map out and describe the various fishing grounds around Iceland and then they were asked to choose half of the tow-stations taken in the survey. The other half was chosen randomly.

B.3.1.1. Timing, area covered and tow location

It was decided that the optimal time of the year to conduct the survey would be in March, or during the spawning of cod in Icelandic waters. During this time of the year, cod is most easily available to the survey gear as diurnal vertical migrations are at minimum in March (Pálsson, 1984). Previous survey attempts had taken place in March and for possible comparison with that data it made sense to conduct the survey in March.

The total number of stations was decided to be 600 (Figure 2). The reason of having so many stations was to decrease variance in indices but was inside the constraints of what was feasible in terms of survey vessels and workforce available. With 500–600 tow-stations the expected CV of the survey would be around 13%.

The survey covers the Icelandic continental shelf down to 500 m and to the EEZ-line between Iceland and Faroe Islands. Allocation of stations and data collection is based on a division between northern and southern areas. The northern area is the colder part of Icelandic waters where the main nursery grounds of cod are located, whereas the main spawning grounds are found in the warmer southern area. It was assumed that 25–30% of the cod stock (in abundance) would be in the southern area at the survey time but 70–75% in the north. Because of this, 425 stations were allocated in the colder northern area and 175 stations were allocated in the southern area. The two areas were then divided into ten strata, four in the south and six in the north.

Stratification in the survey and the allocation of stations was based on pre-estimated cod density patterns in different "statistical squares" (Palsson *et al.*, 1989). The statistical squares were grouped into ten strata depending on cod density. The number of stations allocated to each stratum was in proportion to the product of the area of the stratum and cod density. Finally the number of stations within each stratum was allocated to each statistical square in proportion to the size of the square. Within statistical squares, stations were divided equally between fishermen and fishery scientist at the MRI for decisions of location. The scientist selected random position for their stations, whereas the fishermen selected their stations from their fishing experience. Up to 16 stations are in each statistical square in the northern area and up to seven in the southern are. The captains were asked to decide the towing direction for all the stations.

B.3.1.2. Vessels, fishing gear and fishing method

In the early stages of the planning it was apparent that consistency in conducting the survey on both spatial and temporal scale was of paramount importance. It was decided to rent commercial stern trawlers built in Japan in 1972–1973 to conduct the survey. Each year, up to five trawlers have participated in the survey each in a dedicated area (NW, N, E, S, SW). The ten Japan-built trawlers were all build on the same plan and were considered identical for all practical purposes. The trawlers were thought to be in service at least until the year 2000. This has been the case and most of these trawlers still fish in Icelandic waters but have had some modifications since the start of the survey, most of them in 1986–1988.

The survey gear is based on the trawl that was the most commonly used by the commercial trawling fleet in 1984–1985. It has relatively small vertical opening of 2–3 m. The headline is 105 feet, fishing line is 63 feet, footrope 180 feet and the trawl weight 4200 kg (1900 kg submerged).

Length of each tow was set 4 nautical miles and towing speed at approximately 3.8 nautical miles per hour. Minimum towing distance so that the tow is considered valid for index calculation is 2 nautical miles. Towing is stopped if wind is more than 17–21 m/sec, (8 on Beaufort scale).

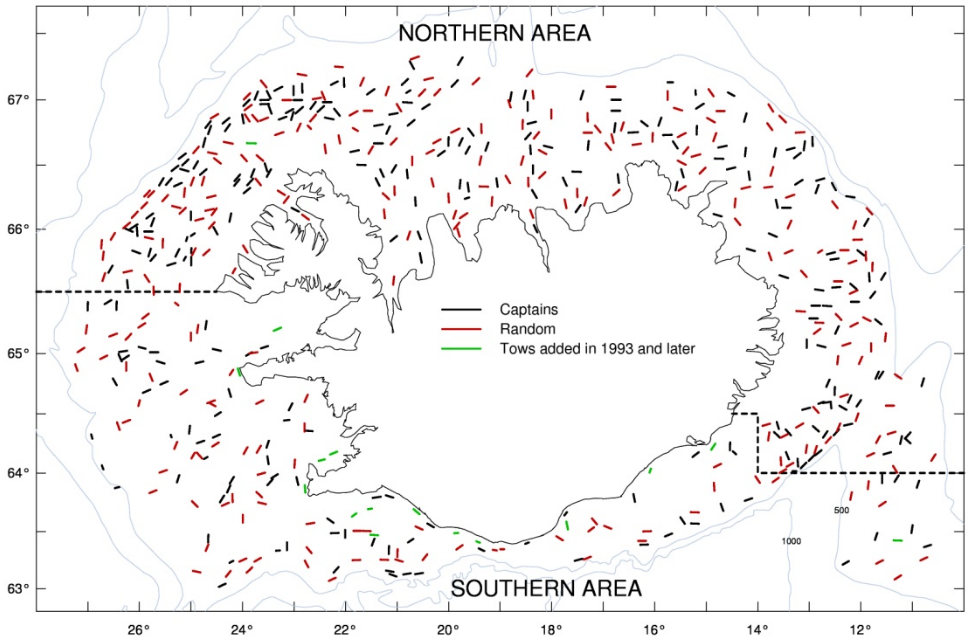

Figure 2. Stations in the spring survey in March. Black lines indicate the tow-stations selected by captains of commercial trawlers, red lines are the tow-stations selected randomly, and green lines are the tow-stations that were added in 1993 or later. The broken black lines indicate the original division of the study area into Northern and Southern area. The 500 and 1000 m depth contours are shown.

B.3.1.3. Later changes in vessels and fishing gear

The trawlers used in the survey have been changed somewhat since the beginning of the survey. The changes include alteration of hull shape (bulbous bow), the hull extended by several meters, larger engines, and some other minor alterations. These alterations have most likely changed the qualities of the ships but it is very difficult to quantify these changes.

The trawlers are now considered old and it is likely that they will soon disappear from the Icelandic fleet. Some search for replacements is ongoing. In recent years, the MRI research vessels have taken part in the spring survey after elaborate comparison studies. The RV Bjarni Sæmundsson has surveyed the NW-region since 2007 and RV Árni Friðriksson has surveyed the Faroe–Iceland Ridge in recent years and will in 2010 survey the SW area.

The trawl has not changed since the start of the survey. The weight of the otter-boards has increased from 1720–1830 kg to 1880–1970 kg. The increase in the weight of the otter-boards may have increased the horizontal opening of the trawl and hence decreased the vertical opening. However, these changes should be relatively small as the size (area) and shape of the otter-boards is unchanged.

B.3.1.4. Later changes in trawl-stations

Initially, the numbers of trawl stations surveyed was expected to be 600 (Figure 2). However, this number was not covered until 1995. The first year 593 stations were surveyed but in 1988 the stations had been decreased down to 545 mainly due to bottom topography (rough bottom that was impossible to tow), but also due to drift ice that year. In 1989–1992, between 567 and 574 stations were surveyed annually. In

1993, 30 stations were added in shallower waters as an answer to fishermen's critique.

In short, until 1995 between 596 and 600 stations were surveyed annually. In 1996 14 stations that were added in 1993 were omitted. Since 1991 additional tows have been taken at the edge of the survey area if the amount of cod has been high at the outermost stations.

In 1996, the whole survey design was evaluated with the aim of reduce cost. The number of stations was decreased to 532 stations. The main change was to omit all of the 24 stations from the Iceland–Faroe Ridge. This was the state of affairs until 2004 when in response to increased abundance of cod on the Faroe–Iceland Ridge nine stations were added. Since 2005 all of the 24 stations omitted in 1996 have been surveyed each year.

In the early 1990s there was a change from Loran C positioning system to GPS. This may have slightly changed the positioning of the stations as the Loran C system was not as accurate as the GPS.

B.3.2. Autumn survey in Va

The Icelandic autumn survey has been conducted annually since 1996 by the MRI. The objective is to gather fishery-independent information on biology, distribution and biomass of demersal fish species in Icelandic waters, with particular emphasis on Greenland halibut (*Reinhardtius hippoglossoides*) and deep-water redfish (*Sebastes mentella*). This is because the spring survey does not cover the distribution of these deep-water species. Secondary aim of the survey is to have another fishery-independent estimate on abundance, biomass and biology of demersal species, such as cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and golden redfish (*Sebastes marinus*), in order to improve the precision of stock assessment.

B.3.2.1. Timing, area covered and tow location

The autumn survey is conducted in October as it is considered the most a suitable month in relation to diurnal vertical migration, distribution and availability of Greenland halibut and deep-sea redfish. The research area is the Icelandic continental shelf and slopes within the Icelandic Exclusive Economic Zone to depths down to 1500 m. The research area is divided into a shallow-water area (0–400 m) and a deep-water area (400–1500 m). The shallow-water area is the same area covered in the spring survey. The deep-water area is directed at the distribution of Greenland halibut, mainly found at depths from 800–1400 m west, north and east of Iceland, and deep-water redfish, mainly found at 500–1200 m depths southeast, south and southwest of Iceland and on the Reykjanes Ridge.

B.3.2.2. Preparation and later alterations to the survey

Initially, a total of 430 stations were divided between the two areas. Of them, 150 stations were allocated to the shallow-water area and randomly selected from the spring survey station list. In the deep-water area, half of the 280 stations were randomly positioned in the area. The other half were randomly chosen from logbooks of the commercial bottom-trawl fleet fishing for Greenland halibut and deep-water redfish in 1991–1995. The locations of those stations were, therefore, based on distribution and pre-estimated density of the species.

Because MRI was not able to finance a project in order of this magnitude, it was decided to focus the deep-water part of the survey on the Greenland halibut main distributional area. For this reason, important deep-water redfish areas south and west of Iceland were omitted. The number and location of stations in the shallow-water area were unchanged.

The number of stations in the deep-water area was therefore reduced to 150. A total of 100 stations were randomly positioned in the area. The remaining stations were located on important Greenland halibut fishing grounds west, north and east of Iceland and randomly selected from a logbook database of the bottom-trawl fleet fishing for Greenland halibut 1991–1995. The number of stations in each area was partly based on total commercial catch.

In 2000, with the arrival of a new research vessel, MRI was able finance the project according to the original plan. Stations were added to cover the distribution of deep-water redfish and the location of the stations selected in a similar manner as for Greenland halibut. A total of 30 stations were randomly assigned to the distribution area of deep-water redfish and 30 stations were randomly assigned to the main deep-water redfish fishing grounds based on logbooks of the bottom-trawl fleet 1996–1999.

In addition, 14 stations were randomly added in the deep-water area in areas where great variation had been observed in 1996–1999. However, because of rough bottom which made it impossible to tow, five stations have been omitted. Finally, twelve stations were added in 1999 in the shallow-water area, making total stations in the shallow-water area 162. Total number of stations taken since 2000 has been around 381 (Figure 3).

The RV "Bjarni Sæmundsson" has been used in the shallow-water area from the beginning of the survey. For the deep-water area MRI rented one commercial trawler 1996–1999, but in 2000 the commercial trawler was replaced by the RV "Árni Friðriksson".

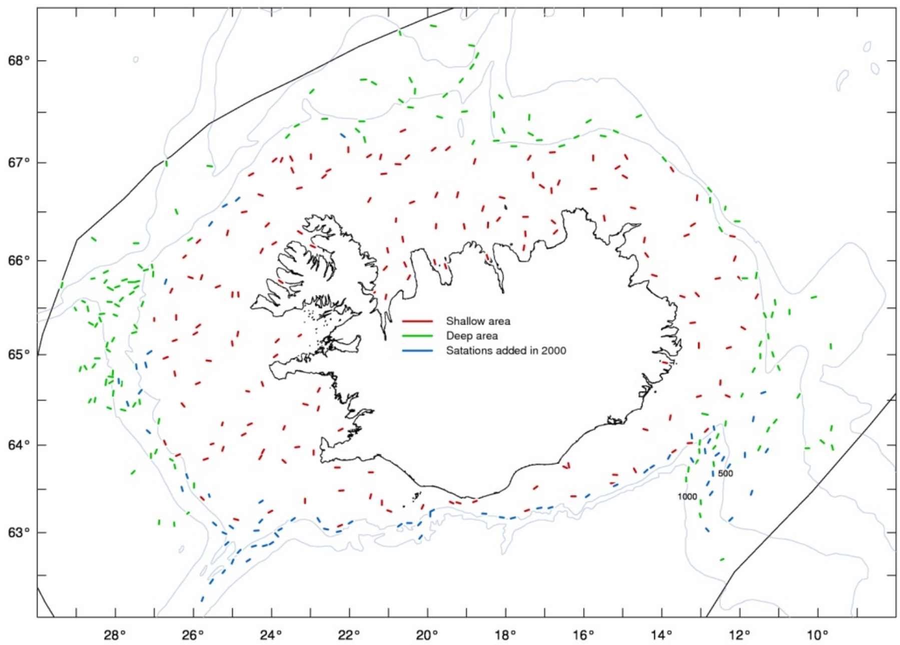

Figure 3. Stations in the Autumn Groundfish Survey (AGS). RV "Bjarni Sæmundsson" takes stations in the shallow-water area (red lines) and RV "Árni Friðriksson" takes stations in the deep-water areas (green lines), the blue lines are stations added in 2000.

B.3.2.3. Fishing gear

Two types of the bottom survey trawl "Gulltoppur" are used for sampling: "Gulltoppur" is used in the shallow water and "Gulltoppur 66.6 m" is used in deep waters. The trawls were common among the Icelandic bottom-trawl fleet in the mid-1990s and are well suited for fisheries on cod, Greenland halibut and redfish.

"Gulltoppur", the bottom trawl used in the shallow water, has a headline of 31.0 m, and the fishing line is 19.6 m. The deep-water trawl, "Gulltoppur 66.6 m" has a headline of 35.6 m and the fishing line is 22.6 m.

The towing speed is 3.8 knots over the bottom. The trawling distance is 3.0 nautical miles calculated with GPS when the trawl touches the bottom until the hauling begins (i.e. excluding setting and hauling of the trawl).

B.3.3. Data sampling

The data sampling in the spring and autumn surveys is quite similar. In short there is more emphasis on stomach content analysis in the autumn survey than the spring survey. For tusk, the sampling procedure is the same in both surveys except tusk is weighed ungutted and stomach content analysed in the autumn survey.

B.3.3.1. Length measurements and counting

All fish species are measured for length. For the majority of species including tusk, total length is measured to the nearest cm from the tip of the snout to the tip of the longer lobe of the caudal fin. At each station, the general rule, which also applies to tusk, is to measure at least four times the length interval of a given species. Example: If the continuous length distribution of tusk at a given station is between 15 and 45 cm, the length interval is 30 cm and the number of measurements needed is 120. If the catch of tusk at this station exceeds 120 individuals, the rest is counted.

Care is taken to ensure that the length measurement sampling is random so that the fish measured reflect the length distribution of the haul in question.

B.3.3.2. Recording of weight, sex and maturity stages

Sex and maturity data has been sampled for tusk from the start of both surveys. Tusk is weighted as ungutted in the autumn survey.

B.3.3.3. Otolith sampling

For tusk a minimum of one otolith in the spring and autumn surveys is collected and a maximum of 25. Otoliths are sampled at a four fish interval so that if in total 40 tusks are caught in a single haul, ten otoliths are sampled.

B.3.3.4. Stomach sampling and analysis

Stomach samples of tusk are routinely sampled in the autumn survey.

B.3.3.5. Information on tow, gear and environmental factors

At each station/haul relevant information on the haul and environmental factors, are filled out by the captain and the first officer in cooperation with the cruise leader.

Tow information

- **General:** Year, Station, Vessel registry no., Cruise ID, Day/month, Statist. Square, Subsquare, Tow number, Gear type no., Mesh size, Briddles length (m).
- **Start of haul:** Pos. N, Pos. W, Time (hour:min), Tow direction in degrees, Bottom depth (m), Towing depth (m), Vert. opening (m), Horizontal opening (m).
- **End of haul:** Pos. N, Pos. W, Time (hour:min), Warp length (fm), Bottom depth (m), Tow length (naut. miles), Tow time (min), Tow speed (knots).
- **Environmental factors:** Wind direction, Air temperature °C, Windspeed, Bottom temperature °C, Sea surface, Surface temperature °C, Towing depth temperature °C, Cloud cover, Air pressure, Drift ice.

Greenland

Two research vessel series from Greenland waters are conducted annually, but very little tusk is caught.

B.3.2.4. Data processing

B.3.2.4.1. Abundance and biomass estimates at a given station

As described above the normal procedure is to measure at least four times the length interval of a given species. The number of fish caught of the length interval L_1 to L_2 is given by:

$$P = \frac{n_{measured}}{n_{counted} + n_{measured}}$$

$$n_{L_1-L_2} = \sum_{i=L_1}^{i=L_2} \frac{n_i}{P}$$

Where $n_{measured}$ is the number of fished measured and $n_{counted}$ is the number of fish counted.

Biomass of a given species at a given station is calculated as:

$$B_{L_1-L_2} = \sum_{i=L_1}^{i=L_2} \frac{n_i \alpha L_i^{\beta}}{P}$$

Where Li is length and alpha and beta are coefficients of the length–weight relationship.

B.3.2.4.2. Index calculation

For calculation of indices the Cochran method is used (Cochran, 1977). The survey area is split into subareas or strata and an index for each subarea is calculated as the mean number in a standardized tow, divided by the area covered multiplied with the size of the subarea. The total index is then a summed up estimates from the subareas.

A 'tow-mile' is assumed to be 0.00918 square nautical mile. That is the width of the area covered is assumed to be 17 m (17/1852=0.00918). The following equations are a mathematical representation of the procedure used to calculate the indices:

$$I_{strata} = \frac{\sum_{strata} Z_i}{N_{strata}}$$

$$\sigma^2_{strata} = \frac{\sum_{strata} (Z_i - I_{strata})^2}{N_{strata} - 1}$$

$$I_{region} = \sum_{region} I_{strata}$$

$$\sigma^2_{strata} = \sum_{region} \sigma^2_{strata}$$

$$CV_{region} = \frac{\sigma_{region}}{I_{region}}$$

Where *strata* refers to the subareas used for calculation of indices which are the smallest components used in the estimation, *I* refers to the stations in each subarea and region is an area composed of two or more subareas. *Zi* is the quantity of the index (abundance or biomass) in a given subarea. *I* is the index and sigma is the standard deviation of the index. CV refers to the coefficient of variation.

The subareas or strata used in the Icelandic groundfish surveys (same strata division in both surveys) are shown in Figure 3. The division into strata is based on the so-called BORMICON areas and the 100, 200, 400, 500, 600, 800 and 1000 m depth contours.

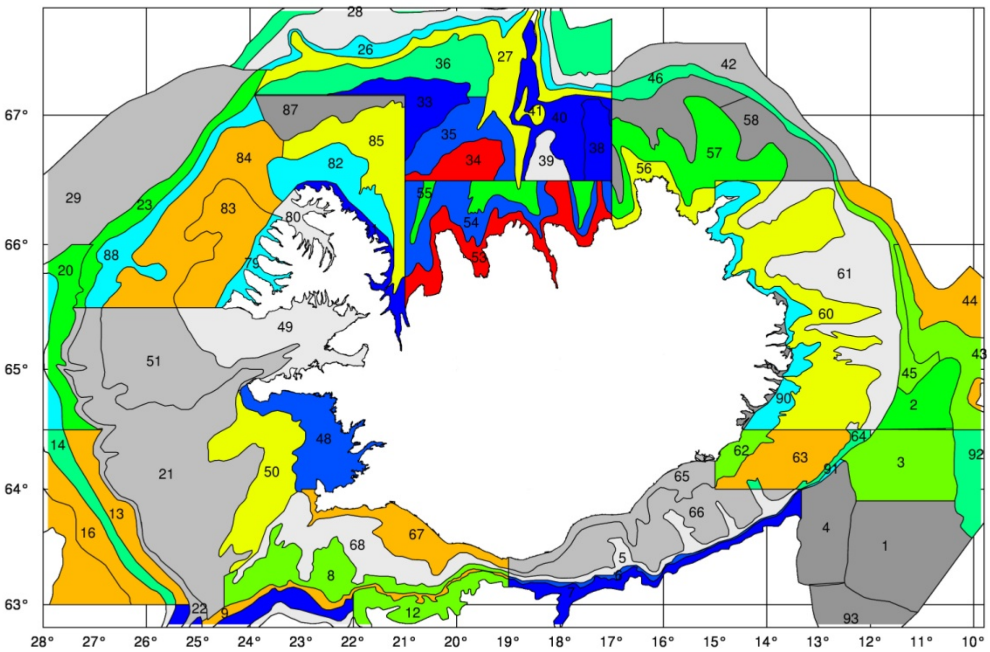

Figure 3. Subareas or strata used for calculation of survey indices in Icelandic waters.

B.4. Commercial cpue

Data used to estimate cpue for tusk in Division Va since 1991 were obtained from logbooks of the Icelandic longline fleet. Only sets were used where catches of tusk was registered, but also for sets where tusk constituted tom more than 10% and 30% of the catch.

Non-standardized cpue and effort is calculated for each year which is simply the sum of all catch divided by the sum of number of hooks.

B.5. Other relevant data

No other relevant data available.

C. Historical stock development

C.1. Description of gadget

Gadget is shorthand for the "Globally applicable Area Disaggregated General Ecosystem Toolbox", which is a statistical model of marine ecosystems. Gadget (previously known as BORMICON and Fleksibest). Gadget is an age–length structured forward-simulation model, coupled with an extensive set of data comparison and optimization routines. Processes are generally modelled as dependent on length, but age is tracked in the models, and data can be compared on either a length and/or age scale. The model is designed as a multiarea, multifleet model, capable of including predation and mixed fisheries issues; however it can also be used on a single species basis. Gadget models can be both very data and computationally intensive, with optimization in particular taking a large amount of time. Worked examples, a detailed manual and further information on Gadget can be found on www.hafro.is/gadget. In addition the structure of the model is described in Björnsson and Sigurdsson (2004), Begley and Howell (2004), and a formal mathematical description is given in Frøysa *et al*. (2002).

Gadget is distinguished from many stock assessment models used within ICES (such as XSA) in that Gadget is a forward simulation model, and is structured be both age and length. It therefore requires direct modelling of growth within the model. An important consequence of using a forward simulation model is that the plus groups (in both age and length) should be chosen to be large enough that they contain few fish, and the exact choice of plus group does not have a significant impact on the model.

Setup of a Gadget run

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

Catches

All catches within the model are calculated on length, with the fleets having size-based catchability. This imposes a size-based mortality, which can affect mean weight and length-at-age in the population (Kvamme, 2005). A fleet (or other predator) is modelled so that either the total catch in each area and time interval is specified, or that the catch per time-step is estimated. In the hake assessment described here the commercial catch and the discards are set (in kg per quarter), and the surveys are modelled as fleets with small total landings. The total catch for each fleet for each quarter is then allocated among the different length categories of the stock according to their abundance and the catchability of that size class in that fleet.

Likelihood data

A significant advantage of using an age–length structured model is that the modelled output can be compared directly against a wide variety of different data sources. It is not necessary to convert length into age data before comparisons. Gadget can use various types of data that can be included in the objective function. Length distributions, age–length keys, survey indices by length or age, cpue data, mean length and/or weight-at-age, tagging data and stomach content data can all be used. Importantly this ability to handle length date directly means that the model can be used for stocks such as hake where age data are sparse or considered unreliable. Length data can be used directly for model comparison. The model is able to combine a wide selection of the available data by using a maximum likelihood approach to find the best fit to a weighted sum of the datasets.

Optimization

The model has two alternative optimizing algorithms linked to it; a wide area search simulated annealing Corona *et al*. (1987) and a local search Hooke and Jeeves algorithm Hooke and Jeeves, 1961. Simulated annealing is more robust than Hooke and Jeeves and can find a global optima where there are multiple optima but needs about 2–3 times the order of magnitude number of iterations than the Hooke and Jeeves algorithm. The model is able to use both in a single run optimization, attempting to utilize the strengths of both. Simulated annealing is used first to attempt to reach the general area of a solution, followed by Hooke and Jeeves to rapidly home in on the local solution. This procedure is repeated several times to attempt to avoid converging to a local optimum. The algorithms are not gradient based, and there is therefore no requirement on the likelihood surface being smooth. Consequently neither of the two algorithms returns estimates of the Hessian.

Likelihood weighting

The total objective function to be minimized is a weighted sum of the different components. Selection of the weights estimated following the procedure laid out by Taylor *et al*. (2007) where an objective reweighting scheme for likelihood components is described for Gadget models using cod as a case study. The iterative reweighting heuristic tackles this problem by optimizing each component separately in order to determine the lowest possible value for each component. This is then used to determine the final weights. The iterative re-weighting procedure has now been implemented in the R statistical language as a part of the **rgadget** package which is written and maintained by B. Th. Elvarsson.

Conceptually the likelihood components can roughly be thought of as residual sums of squares (SS), and as such their variance can be estimated by dividing the SS by the degrees of freedom. Then the optimal weighting strategy is the inverse of the variance. The variances and hence the final weights are calculated according the following algorithm:

1) Calculate the initial SS given the initial parameterization. Assign the inverse SS as the initial weight for all likelihood components. With these initial weights the objective function will start off with value equal to the number of likelihood components.

2) For each likelihood component, do an optimization run with the initial score for that component set to 10 000. Then estimate the residual variance using the resulting SS of that component divided by the effective number of datapoints that is all non-zero datapoints.

3) After the optimization set the final weight for that all components as the inverse of the estimated variance from step 3 (weight =(1/SS) * df*).

The effective number of datapoints (df*) in 3) is used as a proxy for the degrees of freedom determined from the number of non-zero datapoints. This is viewed as satisfactory proxy when the dataset is large, but for smaller datasets this could be a gross overestimate. In particular, if the survey indices are weighed on their own while the yearly recruitment is estimated they could be over-fitted. If there are two surveys within the year Taylor *et al*. (2007) suggest that the corresponding indices from each survey are weighed simultaneously in order to make sure that there are at least two measurements for each yearly recruit. In general problem such as those mentioned here could be solved with component grouping that is in step 2) above likelihood components that should behave similarly, such as survey indices, should be heavily weighted and optimized together.

Another approach for estimating the weights of each index component, in the case of a single survey fleet, would be to estimate the residual variances from a model of the form:

$$\log(I_{lt} = \mu + Y_t + \lambda_t + \varepsilon_{lt}$$

where *t* is denotes year, *l* length-group and the residual term, ε_{lt}, is independent normal with variance σ_s^2 where *s* denotes the likelihood component. The inverse of the estimated residual variance are then set as weights for the survey indices. In the RGadget routines this approach is termed **sIw** as opposed to **sIgroup** for the former approach.

C.2. Settings for the tusk assessment

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

Weight–length relationship is obtained from spring survey data.

Natural mortality was assumed to be 0.2 year^{-1}. However different values of M are tested (0.1 and 0.3).

The commercial landings are modelled as one fleet, starting in 1980 with a selection pattern described by a logistic function and the total catch in tonnes specified for each quarter. The survey (1985 onwards), on the other hand is modelled as one fleet with constant effort and a nonparametric selection pattern that is estimated for each length group (one 10 cm length group).

Data used for the assessment are described below:

- Length disaggregated survey indices (10 cm increments) from the Icelandic groundfish survey in March 1985–2009.
- Length distribution from the Icelandic commercial catch since 1979. The sampling effort was though relatively limited until the 1990s.
- Landings data divided into four month periods per year (quarters).
- Age–length keys and mean length-at-age from the Icelandic commercial fishery.

Description	period	by quarter	area	Likelihood component
Length distribution of landings	1981–1989, 1991+	YES	Iceland	ldist.catch
Length distribution of Icelandic GFS	1985+	-	Iceland	ldist.survey
Abundace index of Icelandic GFS of 20–39 cm individuals	1985+	-	Iceland	si2039

Description	period	by quarter	area	Likelihood component
Abundace index of Icelandic GFS of 40–59 cm individuals	1985+	-	Iceland	si4059
Abundace index of Icelandic GFS of 60–110 cm individuals	1985+	-	Iceland	si60110
Age–length key of the landings	See stock section	YES	Iceland	alkeys.catch
Age–length key of the Icelandic GFS	See stock section	1st quarter	Iceland	alkeys.survey
Mean length by age of landings	1995, 2009	YES	Iceland	meanl.catch

Description of the likelihood components weighting procedure

Component	Description	Quarters	Type
Bounds	Keeps estimates inside bounds	All	8
Understocking	Makes sure there is enough biomass	All	2
Si2039	Survey Index 20–39 cm	1	1
Si4049	Survey Index 40–59 cm	1	1
Si60110	Survey Index 60–100 cm	1	1
Si2080-2	Survey Index (To get a smoothed estimate of the survey selection curve	1	1
Ldist.catch	Length distribution commercial catches (Longlines)	All	3
Ldist.survey	Length distribution from the spring survey	1	3
Alkeys.catch	Age–length data from commercial catches	All	3
Meanl.catch	Mean length-at-age from commercial catches	All	4
Alkeys.survey	Age–length data from the spring survey	1	3

The parameters estimated are:

- The number of fish by age when simulation starts (ages 3 to 5) - 3 parameters. Older ages are assumed to be a fraction of age 5;
- Recruitment each year (1980 and onwards);
- Parameters in the growth equation; Linf is constant at 120 cm and K is estimated;
- Parameter β that models the transition from one length class to the next;
- Length-at-recruitment (mean length and SD);
- The selection pattern of:
    - The commercial catches (1980 and onwards) - 2 parameters.
    - Icelandic Spring survey - 1 parameter as the slope is kept constant.

The estimation can be difficult because of some or groups of parameters are correlated and therefore the possibility of multiple optima cannot be excluded. The optimization is started with simulated analysing to make the results less sensitive to the initial (starting) values and then the optimization was changed to Hooke and Jeeves when the 'optimum' was approached. The model runs presented at WGDEEP-2010 was started using the initial values and bounds below:

Initial parameter values used and the bounds assigned.

Switch	Value	Lower	Upper	Optimize
Linf	120	50	200	0
K	90	0.1	1000	1
Bbeta	0.1	0.001	15	1
Ic03	4	0.001	15	1
Ic04	3	0.001	15	1
Ic05	2	0.001	15	1
Recl	15	5	40	1
Recsdev	4	0.01	15	1
Rec1980	2	0.01	15	1
Rec1981	2	0.01	15	1
Rec1982	2	0.01	15	1
Rec1983	2	0.01	15	1
Rec1984	2	0.01	15	1
Rec1985	2	0.01	15	1
Rec1986	2	0.01	15	1
Rec1987	2	0.01	15	1
Rec1988	2	0.01	15	1
Rec1989	2	0.01	15	1
Rec1990	2	0.01	15	1
Rec1991	2	0.01	15	1
Rec1992	2	0.01	15	1
Rec1993	2	0.01	15	1
Rec1994	2	0.01	15	1
Rec1995	2	0.01	15	1
Rec1996	2	0.01	15	1
Rec1997	2	0.01	15	1
Rec1998	2	0.01	15	1
Rec1999	2	0.01	15	1
Rec2000	2	0.01	15	1
Rec2001	2	0.01	15	1
Rec2002	2	0.01	15	1
Rec2003	2	0.01	15	1
Rec2004	2	0.01	15	1
Rec2005	2	0.01	15	1
Rec2006	2	0.01	15	1
Rec2007	2	0.01	15	1
Rec2008	2	0.01	15	1
Alphacomm	0.9	0.03	10	1
L50comm	40	20	50	1
L50sur	15	5	100	1

However multiple optimization cycles were conducted to ensure that the model had converged to an optimum, and to provide opportunities to escape convergence to a local optimum.

The **diagnostics** run to analyse the model are:

- Likelihood profiles plot. To analyse convergence and problematic parameters.
- Plot comparing observed and modelled proportions in fleets (catches). To analyse how estimated population abundance and exploitation pattern fits observed proportions.

- Plot for residuals in catchability models. To analyse precision and bias in abundance trends.
- Retrospective analysis. To analyse how additional data affects historical predictions of the model.

D. Short-term projection

Short and medium-term forecasts for tusk in Va and XIV can be done in gadget using the settings described below. However the model setup was not finalized at the Benchmark meeting (WKDEEP-2010). The Benchmark meeting concluded that the setup presented at the meeting as indicative of trends and suggested further improvements. If assessment improvements were addressed properly, WKDEEP agreed with the following parameters as input for short-term forecast. The ADGDEEP and subsequently ACOM decided to base the ICES advice for 2010 for tusk in Va and XIV based on projections from Gadget.

Model used: Age–length forward projection

Software used: GADGET (script: run.sh)

Initial stock size: abundance-at-age and mean length for ages 0 to 20+

Maturity: Fixed maturity ogive

F and M before spawning: NA

Weight-at-age in the stock: modelled in GADGET with VB parameters and length–weight relationship

Weight-at-age in the catch: modelled in GADGET with VB parameters and length–weight relationship

Exploitation pattern:

Landings: logistic selection parameters estimated by GADGET.

Intermediate year assumptions: F = last assessment year F

Stock–recruitment model used: geometric mean of years 1989–2007

Procedures used for splitting projected catches: driven by selection functions and provide by GADGET.

E. Medium-term projections (NA)

F. Long-term projections

Model used: Age–length forward projection

Software used: GADGET

Initial stock size: 1 year class of 1 million individuals

Maturity: Fixed maturity ogive

F and M before spawning: NA

Weight-at-age in the stock: modelled in GADGET with VB parameters and length–weight relationship

Weight-at-age in the catch: modelled in GADGET with VB parameters and length–weight relationship

Exploitation pattern:

Landings: logistic selection parameters estimated by GADGET.

Procedures used for splitting projected catches:

Driven by selection functions and provided by GADGET.

Yield-per-recruit is calculated by following one year class of million fish for 29 years through the fisheries calculating total yield from the year class as function of fishing mortality of fully recruited fish. In the model, the selection of the fisheries is length based so only the largest individuals of recruiting year classes are caught reducing mean weight of the survivors, more as fishing mortality is increased. This is to be contrasted with age based yield-per-recruit where the same weights-at-age are assumed in the landings independent of the fishing mortality even when the catch weights are much higher as the mean weight in the stock.

G. Biological reference points

There are no reference points defined for this stock.

H. Other issues

I. References

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6.3 Tusk on the Mid-Atlantic Ridge

Stock	Tusk (*Brosme Brosme*) on the Mid-Atlantic Ridge (Subdivi sions XIIa1 and XIVb1)
Working Group	WGDEEP
Date	March 2011
Revised by	WGDEEP/Kristin Helle

A. General

A.1. Stock definition

In 2007, WGDEEP examined the available evidence of stock discrimination in this species. Based on the genetic investigation, the group suggested that Tusk on the Mid-Atlantic Ridge should be treated as one unit.

A.2. Fishery

Tusk is a bycatch species in the gillnet and longline fisheries in Subdivisions XIIa1 and XIVb1. Russia reported catches of tusk in 2005–2007 and 2009. No catches were reported for 2010. During the period 1996–1997 Norway also had a fishery in this area.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

B.2. Biological

B.3. Surveys

B.4. Commercial cpue

B.5. Other relevant data

C. Assessment: data and method

Model used:

Software used:

Model Options chosen:

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes			
Canum	Catch-at-age in numbers			

Weca	Weight-at-age in the commercial catch
West	Weight-at-age of the spawning stock at spawning time.
Mprop	Proportion of natural mortality before spawning
Fprop	Proportion of fishing mortality before spawning
Matprop	Proportion mature at age
Natmor	Natural mortality

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

	Type	Value	Technical basis
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

H. Other Issues

H.1. Historical overview of previous assessment methods

I. References

6.4 Tusk in VIb

Stock	Tusk (*Brosme Brosme*) in VIb
Working Group	WGDEEP
Date	March 2011
Revised by	WGDEEP/Kristin Helle

A. General

A.1. Stock definition

In 2007, WGDEEP examined the available evidence of stock discrimination in this species. Based on the genetic investigation, the Group suggested that Tusk in VIb should be treated as one unit.

A.2. Fishery

Tusk is a bycatch species in the trawl, gillnet and longline fisheries in Subarea VIb. Norway has traditionally landed the largest percentage of the total catch. Longliners catch about 90% of the Norwegian landings. Since the 12th of January 2007 parts of the Rockall bank has been closed to fishing with bottom trawls, gillnets and longlines. The areas closed are traditional areas fished by the Norwegian longline fleet.

In 2004 Russia started longline fishery of ling with bycatch of tusk in international waters of the Rockall Bank. Maximum catch (137 t) was taken in 2005. In recent years intensity of Russian longline fishery decreased. Small bycatches of tusk were also taken in the area by trawlers on haddock fishery.

A.3. Ecosystem aspects

B. Data

Full landings data are available from 1988 to present but it is thought that fisheries in some of these areas pre-date the time-series. Incomplete landings data are available from Norwegian longline fisheries from 1889 onwards. Additional landings data from other areas may be available from 1950 onwards.

B.2. Biological

Length data for the Norwegian reference fleet in Subarea IIa have been routinely collected since 2002.

Considerable general information is available on the life-history characteristics of this species.

B.3. Surveys

No data available.

B.4. Commercial cpue

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2009. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 tonnes in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day. Cpue were calculated as the average total catch of ling per vessel (*C*), and the average number of hooks per set and per vessel (*N*) associated with these catches. Then, for each year and catch category, the estimated cpue for the entire fleet was determined as *C*/*N*. Thus the estimated cpue for each year and subarea was the mean catch in kg per hook for the entire fleet.

The boats that provided logbooks are the primary sampling units, and *C* and *N* are both random variables. It follows that this is a ratio-type estimator, therefore the standard errors of the cpue estimates could be calculated as described in Cochran (1977, page 32). This cpue estimator is a weighted average, that is the more hooks a boat sets, the more influence it has on the estimate (Cochran, 1977). For comparison, an unweighted cpue series was also constructed (i.e. the average cpue per boat).

A standardized series will be developed in preparation for WGDEEP 2012.

B.5. Other relevant data

C. Assessment: data and method

Model used:

Software used:

Model Options chosen:

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes			
Canum	Catch-at-age in numbers			
Weca	Weight-at-age in the commercial catch			
West	Weight-at-age of the spawning stock at spawning time.			
Mprop	Proportion of natural mortality before spawning			
Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:

5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

	Type	*Value*	*Technical basis*
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

No biological reference points have been defined.

H. Other issues

H.1. Historical overview of previous assessment methods

I. References

6.5 Tusk in Subareas I and II

Stock	Tusk (*Brosme Brosme*) in Subareas I and II
Working Group	WGDEEP
Date	March 2011
Revised by	WGDEEP/Kristin Helle

A. General

A.1. Stock definition

In 2007, WGDEEP examined the available evidence of stock discrimination in this species. Based on the genetic investigation, the Group suggested that Tusk in I and II should be treated as one unit.

A.2. Fishery

Tusk has been caught, primarily as a bycatch in the ling and cod fisheries, in these subareas for centuries, and the historical development is described by e.g. Bergstad and Hareide, 1996, including the post-World War II increase caused by a series of technical advances. Currently the major fisheries in Subareas I and II are the Norwegian longline and gillnet fisheries, but there are also bycatches by other gears, i.e. trawls and handlines. Of the Norwegian landings, usually around 85% is taken by longlines, 10% by gillnets and the remainder by a variety of other gears. Other nations catch tusk as a bycatch in trawl and longline fisheries.

Russian landings (107 tonnes) from Subdivisions IIa and IIb in 2010 were mainly taken as bycatch in longline fisheries. In Subarea I one t was caught (Vinnichenko *et al*., WD 2011).

A.3. Ecosystem aspects

B. Data

Full landings data are available from 1988 to present but it is thought that fisheries in some of these areas pre-date the time-series. Incomplete landings data are available from Norwegian longline fisheries from 1889 onwards. Additional landings data from other areas may be available from 1950 onwards.

B.2. Biological

Length data for the Norwegian reference fleet in Subarea IIa have been routinely collected since 2002.

Considerable general information is available on the life-history characteristics of this species.

B.3. Surveys

No data available.

B.4. Commercial cpue

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2009. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 tonnes in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day. Cpue were calculated as the average total catch of ling per vessel (*C*), and the average number of hooks per set and per vessel (*N*) associated with these catches. Then, for each year and catch category, the estimated cpue for the entire fleet was determined as *C*/*N*. Thus the estimated cpue for each year and Subarea was the mean catch in kg per hook for the entire fleet.

The boats that provided logbooks are the primary sampling units, and *C* and *N* are both random variables. It follows that this is a ratio-type estimator, therefore the standard errors of the cpue estimates could be calculated as described in Cochran (1977, page 32). This cpue estimator is a weighted average, that is the more hooks a boat sets, the more influence it has on the estimate (Cochran, 1977). For comparison, an unweighted cpue series was also constructed (i.e. the average cpue per boat).

A standardized series will be developed in preparation for WGDEEP 2012.

B.5. Other relevant data

C. Assessment: data and method

Model used:

Software used:

Model Options chosen:

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes			
Canum	Catch-at-age in numbers			
Weca	Weight-at-age in the commercial catch			
West	Weight-at-age of the spawning stock at spawning time.			
Mprop	Proportion of natural mortality before spawning			
Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:

5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

	Type	Value	Technical basis
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

No biological reference points have been defined.

H. Other issues

H.1. Historical overview of previous assessment methods

I. References

6.6 Tusk in other areas

Stock	Tusk (*Brosme Brosme*) in other Areas (IIIa, IVa, Vb, VIa, VII, VIII, IX and other Areas of XII)
Working Group	WGDEEP
Date	March 2011
Revised by	WGDEEP/Kristin Helle

A. General

A.1. Stock definition

In 2007, WGDEEP examined the available evidence of stock discrimination in this species. Based on the genetic investigation, the group suggested that tusk in other areas (IIIa, IVa, Vb, VIa, VII, VIII, IX and other areas of XII) should be treated as one unit.

A.2. Fishery

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

When Areas III–IV and Via–XIV are pooled over the period 1988–2010, 36% of the landings have been in Area IV, 46% in Area Vb, and 15% in Area VIa.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

Full landings data are available from 1988 to present but it is thought that fisheries in some of these areas pre-date the time-series. Incomplete landings data are available from Norwegian longline fisheries from 1889 onwards. Additional landings data from other areas may be available from 1950 onwards.

B.2. Biological

Length data for the Norwegian reference fleet in other areas have been routinely collected since 2002.

Considerable general information is available on the life-history characteristics of this species.

B.3. Surveys

Data from Faroese summer and autumn surveys are available for the period 1994 onwards.

B.4. Commercial cpue

Catch and effort data for Norwegian and Faroese longliners and Danish trawlers are available. Abundance indices and length–frequency data from the Faroese groundfish surveys were presented.

A cpue series for Danish trawlers fishing in IVa was available for the period 1992–2010.

Data from Faroese summer and autumn surveys were available for the period 1994 onwards.

A cpue series for the Faroese longliners (>100 GRT) for the period 1987–2009 was also available.

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2009. 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. Cpue were calculated as the average total catch of ling per vessel (*C*), and the average number of hooks per set and per vessel (*N*) associated with these catches. Then, for each year and catch category, the estimated cpue for the entire fleet was determined as *C*/*N*. Thus the estimated cpue for each year and Subarea was the mean catch in kg per hook for the entire fleet.

The boats that provided logbooks are the primary sampling units, and *C* and *N* are both random variables. It follows that this is a ratio-type estimator, therefore the standard errors of the cpue estimates could be calculated as described in Cochran (1977, page 32). This cpue estimator is a weighted average, that is the more hooks a boat sets, the more influence it has on the estimate (Cochran, 1977). For comparison, an unweighted cpue series was also constructed (i.e. the average cpue per boat).

A standardized series will be developed in preparation for WGDEEP 2012.

B.5. Other relevant data

C. Assessment: data and method

Model used: The stock is assessed using trends in catch and cpue.

Software used:

Model Options chosen:

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes	1988–2010		
Canum	Catch-at-age in numbers			
Weca	Weight-at-age in the commercial catch			
West	Weight-at-age of the spawning stock at spawning time.			

Type	Name	Year range	Age range	Variable from year to year Yes/No
Mprop	Proportion of natural mortality before spawning			
Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

No biological reference points have been defined.

	TYPE	VALUE	TECHNICAL BASIS
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

H. Other Issues

H.1. Historical overview of previous assessment methods

I. References

Cochran, W.G. 1977. Sampling Techniques, 3rd. edn. John Wiley, New York. 428 pp.

7.2 Greater silver smelt in Division Va

Stock	Greater silver smelt in Division Va
Working Group	WKDEEP
Date	February 2010
Revised by	WGDEEP/Gudmundur Thordarson

A. General

A.1. Stock definition

Greater silver smelt (*Argentina silus*) stock in Division Va (Icelandic waters) is treated as a separate assessment unit is from greater silver smelt in Subareas I, II, IV, VI, VII, VIII, IX, XII, XIV and Divisions IIIa and Vb.

A.2. Fishery

Greater silver smelt is mostly fished along the south, southwest, and west coast of Iceland, at depths between 500 and 800 m.

Greater silver smelt was caught in bottom trawls for years as bycatch in the redfish fishery. Only small amounts were reported prior to 1996 as most of the greater silver smelt was discarded. Since 1997, direct fishery for greater silver smelt has been ongoing and the landings have increased significantly. At the beginning, the fishery was mainly located along the slopes of the south and southwest coast, but in recent years the fishery has expanded and significant catches are taken along the slopes west of Iceland.

The greater silver smelt fishery is at present not managed by quotas but rather as an exploratory fishery subject to licensing (see A.2.1) since 1997. Greater silver smelt is now mainly taken both in a directed fishery with, but also as a bycatch in the redfish fishery.

A.2.1. Fleet

Greater silver smelt in Va is caught only in bottom trawls, often as a bycatch or in conjunction with redfish and Greenland halibut fishing. Between 20 and 30 trawlers have participated in the fishery since 1996. In recent years, the majority of the greater silver smelt landings have been taken in hauls were the species was 50% or more of the catch in the haul. The trawlers that target greater are mainly freezer trawlers that are between 1000 and 2000 GRT. The fleet uses a bottom trawl with small mesh size belly (80 mm) and codend (40 mm).

A.2.2. Regulations

The greater silver smelt fishery is subject to regulation nr 717, 6th of October 2000 with amendments 1138/2005 from the Ministry of Fisheries. In short the regulation states among others that:

1) All fishing of greater silver smelt is subject to licensing by the Directorate of Fisheries that has to be renewed each year.
2) Fishing for Greater silver smelt is only allowed south and west of Iceland. That is west of W19°30 and south of N66°00 at depths greater than 220

fathoms (approximately 430 m). Between W19°30 and W14°30 taking of greater silver smelt is allowed south of given line (Figure 1 and Table 1).

3) It is mandatory to keep logbooks were the date, exact position of haul, catch and depth are recorded.

4) Samples shall be collected, at least one from each fishing trip. The sample shall consist of randomly selected 100–200 specimens of greater silver smelt. The sample is frozen on board and sent to the Marine Research Institute in Reykjavik for further investigation.

5) Minimum mesh size in the trawl is 80 mm but 40 mm in the codend.

A revised regulation will soon come into effect that expands the fishing area north to 67°N and east to 12°W.

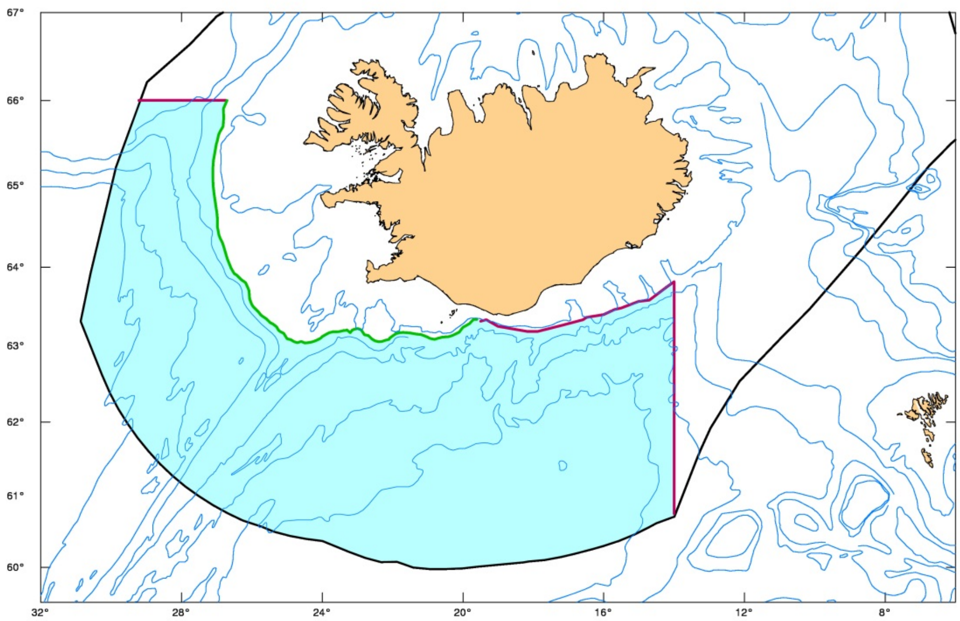


Figure 1. Area open to commercial fishing of greater silver smelt in Va according to regulation nr 717, 6th of October 2000 with amendments 1138/2005 from the Ministry of Fisheries (the shaded blue area). The red line off the south coast drawn according to Table 1 and the green line is an approximation of the 400 m depth contour.

A.3. Ecosystem aspects

Warming of sea temperature, have been documented in Va and an expansion of distributional area of warm-water species such as anglerfish. The significance and reliability of such metrics is considered at the moment insufficient for their consideration in the provision of management advice of greater silver smelt in Va.

B. Data

B.1. Commercial catches

Icelandic commercial catches in tonnes by month and gear are provided by Statistical Iceland and the Directorate of Fisheries. Data on catch in tonnes from other countries are taken from ICES official statistics (STATLAN) and/or from the Icelandic Coast

Guard. Annual landings are available from 1985 or from the commencing of the targeted fishery. The fishing statistics are considered accurate. Discards are not considered to be of relevance and therefore not included in the assessment. There are limited measurements of discard from 2002 to 2009. The distribution of catches is obtained from logbook statistics where location of each haul, effort, depth of trawling and total catch of greater silver smelt is given. From the logbook catch per unit of effort and effort is estimated.

B.2. Biological

Biological data from the greater silver smelt catch is collected on board of the fishing vessel, as it is mandatory to send at least one sample from each fishing trip. The sample is sent to the Marine Research Institute and analysed by scientists and technicians. Each sample consists of randomly selected 100–200 specimens of greater silver smelt. In each sample, otoliths are extracted from 50 specimens. The biological data collected are length (to the nearest cm), sex and maturity stage, and ungutted weight (to the nearest gramme). The rest of the sample is only length measured.

From 1987–1996, biological sampling from the catches were sporadic. Biological sampling of the catches has been generally considered sufficient since 1997. Age reading is considered accurate.

Greater silver smelt in Va reaches 50% maturity at around 36 cm or at around 6–8 years of age. The species enters the fishery at around 30 cm or 3–4 years of age. Only very few greater silver smelt have been measured 60 cm or larger.

B.3. Surveys

The annual Icelandic groundfish surveys give trends on fishable biomass of many exploited stocks on Icelandic fishing grounds. The main objective in the design of the surveys was to monitor the most important commercial stocks such as cod, haddock, saithe, and redfish. However the surveys are considered representative for many other exploited stocks of lesser economic importance.

B.3.1. The Icelandic groundfish survey in March

In the Icelandic groundfish survey which has been conducted annually in March since 1985 gives trends on fishable biomass of many exploited stocks on Icelandic fishing grounds. Total of more than 500 stations are taken annually in the survey at depths down to 500 meters. Therefore the survey area does not cover the most important distribution area of greater silver smelt and is not considered fully representative for greater silver smelt in Va.

B.3.2. The Icelandic groundfish survey in October (autumn survey)

The Icelandic Autumn Groundfish Survey (AGS) has been conducted annually since 1996 by the Marine Research Institute (MRI). The objective is to gather fishery-independent information on biology, distribution and biomass of demersal fish species in Icelandic waters, with particular emphasis on Greenland halibut (*Reinhardtius hippoglossoides*) and deep-water redfish (*Sebastes mentella*). This is because the Icelandic Groundfish Survey (IGS) conducted annually in March does not cover the distribution of these deep-water species. Secondary aim of the survey is to have another fisheries-independent estimate on abundance, biomass and biology of demersal species, such as cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and golden redfish (*Sebastes marinus*), in order to improve the precision of stock assessment.

AGS is conducted in October as it is considered the most a suitable month in relation to diurnal vertical migration, distribution and availability of Greenland halibut and deep-sea redfish. The research area is the Icelandic continental shelf and slopes within the Icelandic Exclusive Economic Zone to depths down to 1500 m. The research area is divided into a shallow-water area (0–400 m) and a deep-water area (400–1500 m). The shallow-water area is the same area as covered by IGS. The deep-water area is directed at the distribution of Greenland halibut, mainly found at depths from 800–1400 m west, north and east of Iceland, and deep-water redfish, mainly found at 500–1200 m depths southeast, south and southwest of Iceland and on the Reykjanes Ridge.

Initially, a total of 430 stations were divided between the two areas. Of them, 150 stations were allocated to the shallow-water area and randomly selected from the IGS station list. In the deep-water area, half of the 280 stations were randomly positioned in the area. The other half were randomly chosen from logbooks of the commercial bottom-trawl fleet fishing for Greenland halibut and deep-water redfish in 1991–1995. The locations of those stations were, therefore, based on distribution and pre-estimated density of the species.

Because MRI was not able to finance a project in order of this magnitude, it was decided to focus the deep-water part of the survey on the Greenland halibut main distributional area. For this reason, important deep-water redfish areas south and west of Iceland were omitted. The number and location of stations in the shallow-water area were unchanged.

The number of stations in the deep-water area was therefore reduced to 150. A total of 100 stations were randomly positioned in the area. The remaining stations were located on important Greenland halibut fishing grounds west, north and east of Iceland and randomly selected from a logbook database of the bottom-trawl fleet fishing for Greenland halibut 1991–1995. The number of stations in each area was partly based on total commercial catch.

In 2000, with the arrival of a new research vessel, MRI was able finance the project according to the original plan. Stations were added to cover the distribution of deep-water redfish and the location of the stations selected in a similar manner as for Greenland halibut. A total of 30 stations were randomly assigned to the distribution area of deep-water redfish and 30 stations were randomly assigned to the main deep-water redfish fishing grounds based on logbooks of the bottom-trawl fleet 1996–1999. The years 1996–1999 cannot be used for abundance and biomass estimates of greater silver smelt since the AGS in those years did not cover adequately the distribution of the species.

In addition, 14 stations were randomly added in the deep-water area in areas where great variation had been observed in 1996–1999. However, because of rough bottom which made it impossible to tow, five stations have been omitted. Finally, twelve stations were added in 1999 in the shallow-water area, making total stations in the shallow-water area 162. Total number of stations taken since 2000 has been around 381 (Figure 2).

The RV "Bjarni Sæmundsson" has been used in the shallow-water area from the beginning of the survey. For the deep-water area MRI rented one commercial trawler 1996–1999, but in 2000 the commercial trawler was replaced by the RV "Árni Friðriksson".

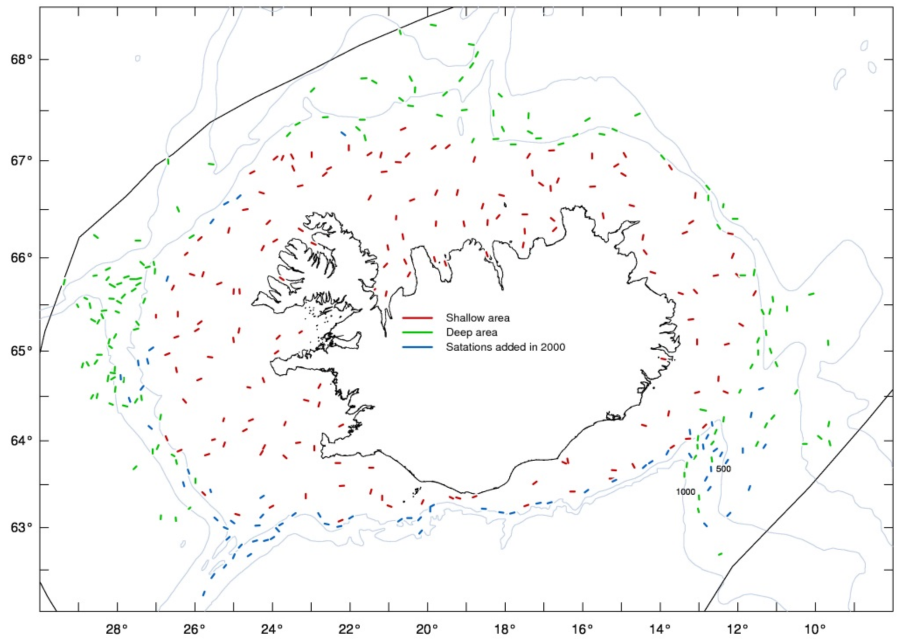


Figure 2. Stations in the Autumn Groundfish Survey (AGS). RV "Bjarni Sæmundsson" takes stations in the shallow-water area (red lines) and RV "Árni Friðriksson" takes stations in the deep-water areas (green lines), the blue lines are stations added in 2000.

B.3.2.1. Data collection (biological sampling)

B.3.2.1.1. Length measurement, counting (subsampling)

All fish species are measured for length. For the majority of species including greater silver smelt, total length is measured to the nearest cm from the tip of the snout to the tip of the longer lobe of the caudal fin. At each station, the general rule, which also applies to greater silver smelt is to measure at least four times the length interval of a given species. Example: If the continuous length distribution of greater silver smelt at a given station is between 15 and 45 cm, the length interval is 30 cm and the number of measurements needed is 120. If the catch of greater silver smelt at this station exceeds 320 individuals, the rest is counted.

Care is taken to ensure that the length measurement sampling is random so that the fish measured reflect the length distribution of the haul in question.

B.3.2.1.2. Recording of weight, sex and maturity stages

Sex and maturity data has not been collected from greater silver smelt sampled in the autumn survey, nor has silver smelt been weighted. Collection of these data is supposed to commence in 2010.

B.3.2.1.3. Otolith sampling and weighing

For greater silver smelt a minimum of one and a maximum of 25 otoliths are collected from each haul. Otoliths are sampled at a 30 fish interval so that if in total 300 greater silver smelt are caught in a single haul, ten otoliths are sampled.

B.3.2.2. Station information

At each station relevant information on the haul and environmental factors, are filled out by the captain and the first officer in cooperation with the cruise leader.

Tow information

- **General:** Year, Station, Vessel registry no., Cruise ID, Day/month, Statist. Square, Subsquare, Tow number, Gear type no., Mesh size, Briddles length (m).
- **Start of haul:** Pos. N, Pos. W, Time (hour:min), Tow direction in degrees, Bottom depth (m), Towing depth (m), Vert. opening (m), Horizontal opening (m).
- **End of haul:** Pos. N, Pos. W, Time (hour:min), Warp length (fm), Bottom depth (m), Tow length (naut. miles), Tow time (min) , Tow speed (knots).
- **Environmental factors:** Wind direction, Air temperature °C, Windspeed, Bottom temperature °C, Sea surface, Surface temperature °C, Towing depth temperature °C, Cloud cover, Air pressure, Drift ice.

B.3.2.3. Fishing gear

Two types of the bottom survey trawl "Gulltoppur" are used for sampling: "Gulltoppur" is used in the shallow water and "Gulltoppur 66.6 m" is used in deep waters. The trawls were common among the Icelandic bottom-trawl fleet in the mid-1990s and are well suited for fisheries on cod, Greenland halibut and redfish.

The bottom trawl used in the shallow water is called "Gulltoppur". The headline is 31.0 m, and the fishing line is 19.6 m. The trawl used in the deep-water area is "Gulltoppur 66.6 m" (Figures 6–9). The headline is 35.6 m and the fishing line is 22.6 m.

Towing speed and distance: The towing speed is 3.8 knots over the bottom. The trawling distance is 3.0 nautical miles calculated with GPS when the trawl touches the bottom until the hauling begins (i.e. excluding setting and hauling of the trawl).

B.3.2.4. Data processing

B.3.2.4.1. Abundance and biomass estimates at a given station

As described above the normal procedure is to measure at least four times the length interval of a given species. The number of fish caught of the length interval L_1 to L_2 is given by:

$$P = \frac{n_{measured}}{n_{counted} + n_{measured}}$$

$$n_{L_1-L_2} = \sum_{i=L_1}^{i=L_2} \frac{n_i}{P}$$

Where $n_{measured}$ is the number of fished measured and $n_{counted}$ is the number of fish counted.

Biomass of a given species at a given station is calculated as:

$$B_{L_1-L_2} = \sum_{i=L_1}^{i=L_2} \frac{n_i \alpha L_i^{\beta}}{P}$$

Where Li is length and alpha and beta are coefficients of the length–weight relationship.

B.3.2.4.2. Index calculation

For calculation of indices the Cochran method is used (Cochran, 1977). The survey area is split into subareas or strata and an index for each subarea is calculated as the mean number in a standardized tow, divided by the area covered multiplied with the size of the subarea. The total index is then a summed up estimates from the subareas.

A 'tow-mile' is assumed to be 0.00918 square nautical mile. That is the width of the area covered is assumed to be 17 m (17/1852=0.00918). The following equations are a mathematical representation of the procedure used to calculate the indices:

$$I_{strata} = \frac{\sum_{strata} Z_i}{N_{strata}}$$

$$\sigma^2_{strata} = \frac{\sum_{strata} (Z_i - I_{strata})^2}{N_{strata} - 1}$$

$$I_{region} = \sum_{region} I_{strata}$$

$$\sigma^2_{strata} = \sum_{region} \sigma^2_{strata}$$

$$CV_{region} = \frac{\sigma_{region}}{I_{region}}$$

Where *strata* refers to the subareas used for calculation of indices which are the smallest components used in the estimation, *I* refers to the stations in each subarea and region is an area composed of two or more subareas. *Zi* is the quantity of the index (abundance or biomass) in a given subarea. *I* is the index and sigma is the standard deviation of the index. CV refers to the coefficient of variation.

The subareas or strata used in the Icelandic groundfish surveys (same strata division in both surveys) are shown in Figure 3. The division into strata is based on the so-called BORMICON areas and the 100, 200, 400, 500, 600, 800 and 1000 m depth contours.

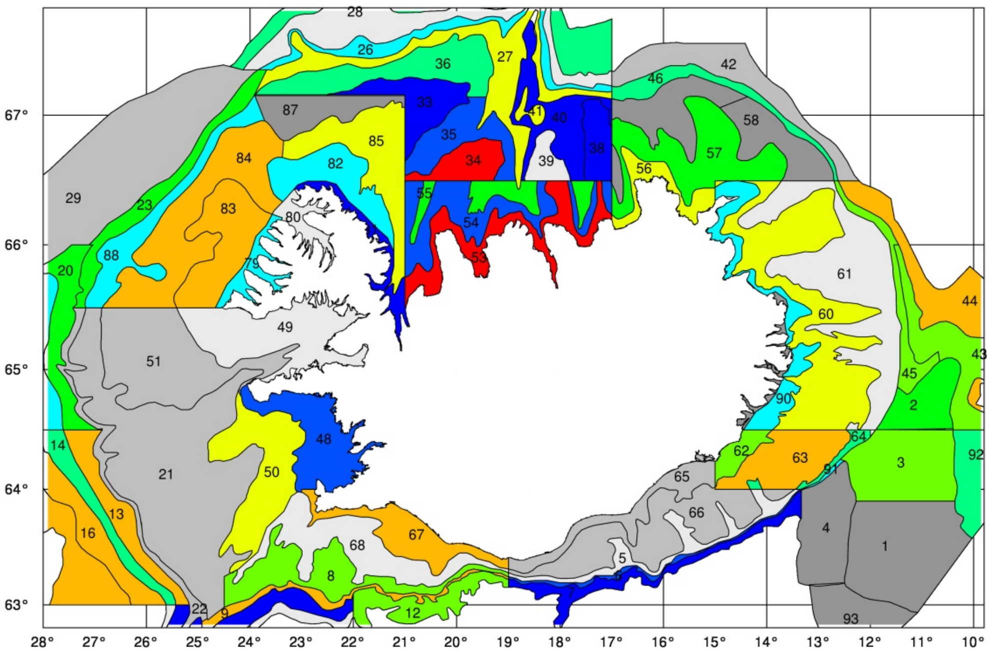


Figure 3. Subareas or strata used for calculation of survey indices in Icelandic waters.

B.3.2.4.3. Stratification for greater silver smelt

The standard calculations of regional survey indices are not particularly applicable to greater silver smelt (originally designed for cod). Therefore, the processing of the autumn survey data is done at a slightly different regional scale. In short, the main distributional area of greater silver smelt off the southeast, south and west coast of Iceland, and in recent years also off the northwest coast. Also, fishing of greater silver smelt is banned at depths less than 220 fathoms (~400 m). To get a proxy for 'fishable' survey indices a few regions are defined for depths greater than 400 m (Table 1 and Figure 4).

Table 1. Survey regions used for calculation of various Autumn Groundfish Survey indices for greater silver smelt in Va.

Region	No. strata	Area (km2)	No. stations
Total	74	339 691	378
GSS fishing grounds	13	46 993	80
Depth >400 m	32	152 626	186
Depth <400 m	41	186 870	192
NW >400 m	2	20 081	16
W >400 m	9	31 613	60
S >400 m	6	26 715	24
SE >400 m	7	30 358	36

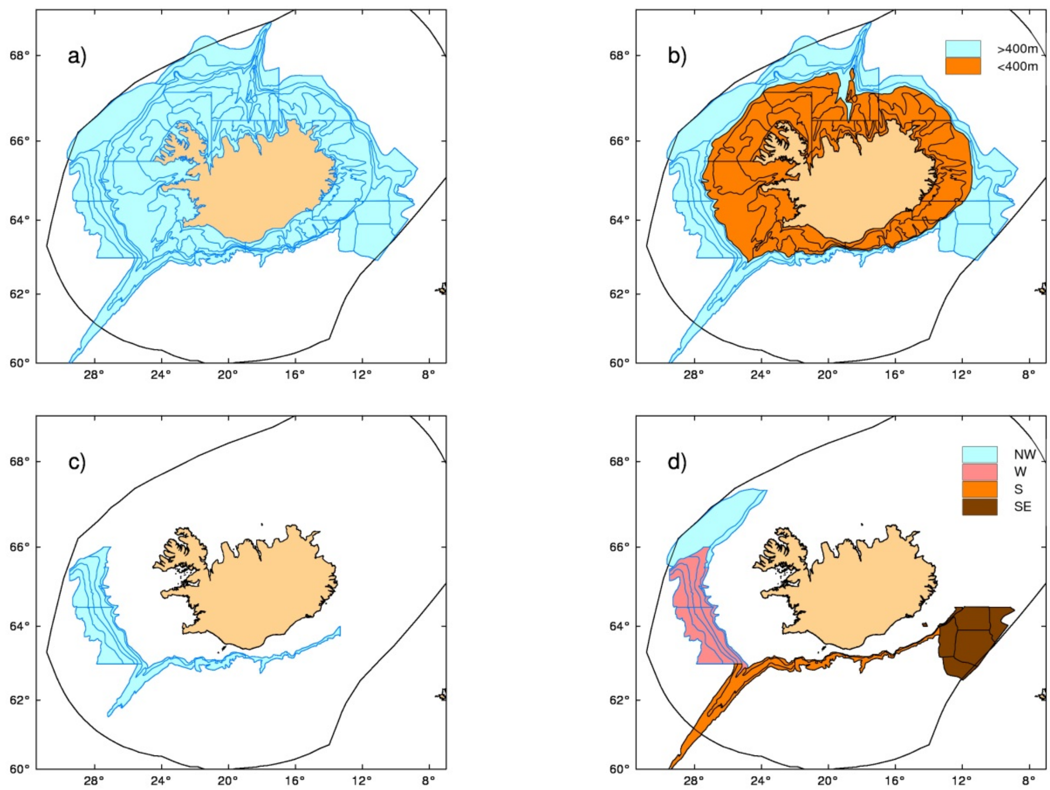


Figure 4. Divisions used in calculation of indices for greater silver smelt in Va. a) Total area. b) Division at 400 m depth contour. c) Greater silver smelt fishing area. d) Subdivisions of the main distributional area of greater silver smelt.

B.3.2.4.4. Winsorization of survey data

One of the main problems when calculating indices from tow surveys is how to treat few large hauls. In some cases, one or two hauls, that happens to be inside a large stratum, can result in very marked increase in survey estimates. This is a problem for greater silver smelt as for many other species. Not only can exceptionally large hauls increase survey estimates but also greatly affect estimated *CV* of the index in question.

Winsorization is one way to deal with outliers (Sokal and Rolf, 1995). A typical way to go when applying Winsorization is to set all outliers to a specified percentile of the data; for example, a 90% Winsorisation would set all data below the 5th percentile to the 5th percentile, and data above the 95th percentile set to the 95th percentile. Winsorised estimators are usually more robust to outliers than their un-winsorised counterparts.

This strategy is applied to the greater silver smelt data from Autumn Groundfish Survey. The number of greater silver smelt in a tow that are greater than the 95th percentile are set at the quantile. The same is done for the 5th percentile quantile, that is, numbers of greater silver smelt in a tow that are lower than 5th percentile quantile are set at the quantile. It should be noted that tow-stations that have no greater silver smelt are excluded from the Winsorization.

B.4. Commercial cpue

Catch per unit of effort (cpue) has been calculated using all data where catches of the greater silver smelt were more than 30%, 50% and 70% of the total reiterated catch in each haul. Estimates of raw-cpue is simply the sum of all catch divided by the sum of the hours trawled. As the trawlers do not set out the trawl except when the captain is certain there is an aggregation of greater silver smelt and as the fishery is largely driven by markets and quota shares in other species (deep-water redfish and Greenland halibut) it is not certain how representative the cpue series is of stock trends.

C. Historical stock development

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

At present analytical assessments cannot be conducted because of contrasting signals in the available data and the relative shortness of the time-series available.

D. Short-term predictions

No short-term predictions are performed.

E. Medium-term predictions

No medium-term predictions are performed.

F. Long-term predictions

No long-term predictions are performed.

G. Biological reference points

No biological reference points are defined for greater silver smelt in Division Va.

H. Other issues

Stock identity of greater silver smelt in the Northeast Atlantic is unclear and further research is needed. Strong recommendations are given in the 2010 WKDEEP Report on this issue (Section 7.1, WKDEEP 2010 Report).

I. References

Cochran,W.G. 1977. Sampling techniques, 3rd edition. New York: Wiley & Sons.

Sokal, R. R. and Rohlf, F. J. 1995. Biometry. W. H. Freeman and Company, 3rd edition.

8 Orange roughy in all areas

Stock	Orange roughy (*Hoplostethus atlanticus*) in I, II, IIIa, IV, V, VI, VII, VIII, IX, X, XII, XIV
Working Group	WGDEEP
Date	March 2011
Revised by	WGDEEP

A. General

A.1. Stock definition

The current practice is to assume three assessment units;

- Subarea VI;
- Subarea VII;
- Orange roughy in all other areas.

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.

A.2. Fishery

The main fishery for Orange roughy was conducted in areas VI and VII on the peak fisheries. Small fisheries have existed in Subareas Va, Vb, VIII, X and XII.

In VI, there was a French target fishery, centred on spawning aggregations around the Hebrides Terrace Seamount. Irish vessels fished there for two years starting in 2001, but they have now abandoned it. The fishery began in 1989 with landings peaking at 3500 t in 1991, and 5300 t were removed from the stock by the end of 1993 (Figure 1). It is not clear if over-reporting was a feature of the fishery in this area in the years preceding the introduction of TACs. Reported landings since 2003 have been decreasing to very low levels.

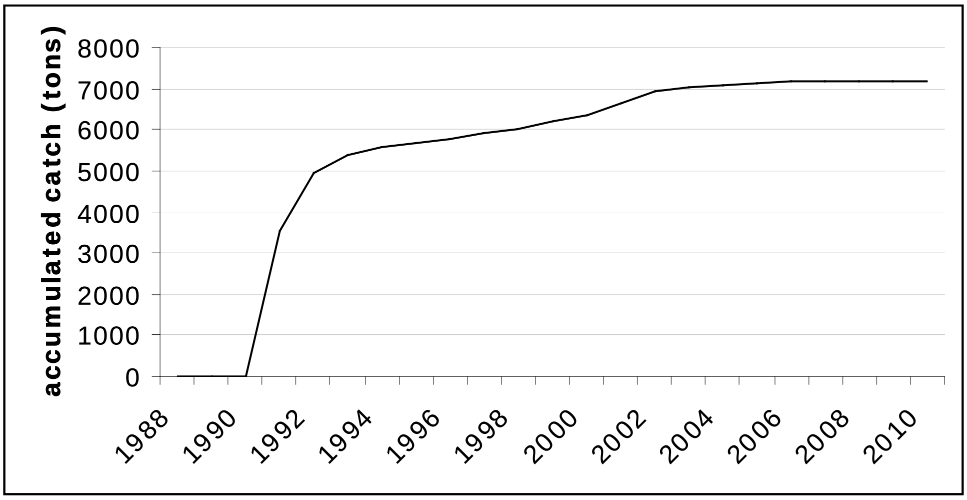


Figure 1. Accumulated catches of orange roughy in ICES Area VI.

After the collapse of the VI fishery, the main fishery for orange roughy in the northern hemisphere moved to Subarea VII. French vessels used to prosecute this fishery alone, but in 2001, new Irish vessels became heavily involved in this fishery for a short number of years. Orange roughy aggregations are mainly associated with seamounts, but they are also found close to other features and on the flat grounds of the continental slope. Initially, trawlers targeted orange roughy at the base of seamounts, but from 2000 onwards, there was a shift to fishing down the slopes of seamounts. Before the fishery closure, new features were found to replace them, as catch rates declined. Large (~50 m) high-sea French trawlers targeted orange roughy in Subarea VII up to 2001. These large trawlers have reduced their activity in VII. There were two fisheries for orange roughy in the area. A single targeted peak fishery that has been occurring on distinct topographical features and a mixed-trawl flat fishery that occurs along the continental slope and has orange roughy as a bycatch. In recent years some targeted fishing from a few or even one single 20–24 m trawlers was carried out until 2008. Since 2010, the TAC has been set at zero.

When the French fishery in VII developed in 1991, landings peaked at over 3000 t in 1992. By the end of 2000 the French fleet had removed over 13 500 t of orange roughy from Subarea VII (Figure 4). An Irish fishery commenced in 2001, and since then the combined Irish and French accumulated landings have amounted to a further 10 800 t (Figure 4). Historical landings data suggest several pulses in landings (Figures 9.3.1 and 9.3.2). The first occurred in 1992 when over 3000 t were landed. Landings declined until 1995, but then increased again to the highest in the series in 2002. The total accumulated catch in Area VII is close to 25 thousand tons. A restrictive quota was introduced in 2003 and resulted in a decrease in declared landings since then. Since 2010, the TAC has been set at zero.

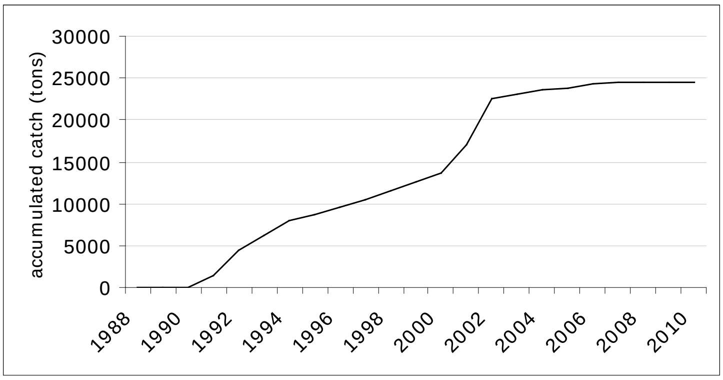


Figure 2. Accumulated catches of orange roughy in ICES Area VII.

In Division Va, the fishery peaked with landings of over 700 t in 1993, and landings have declined to very low levels by 2002. In Division Vb, landings were highest in 1995, at 420 t, but since 1997 they have been trivial except for 2000.

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

In Subarea X, there are fluctuating Faroese landings, and in 2000, there was an experimental fishery by the Azores (Portugal).

In Subarea XII, the Faroes dominated the fishery throughout the 1990s, with small landings by France. New Zealand and Ireland have targeted orange roughy in this area for single years. There are many areas of the Mid-Atlantic Ridge where aggregations of this species occur, but the terrain is very difficult for trawlers.

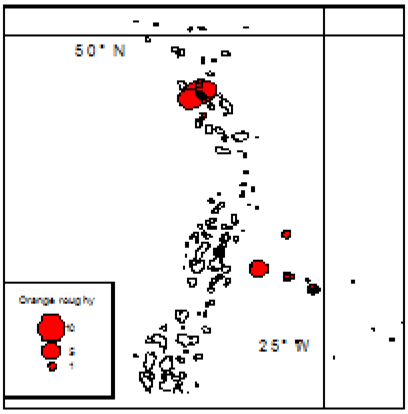


Figure 3. Total catches of orange roughy (tonnes) during the Faroese exploratory orange roughy fishery on the Mid-Atlantic Ridge (X and XII) in 2008.

A.2.1. Fleet

A.2.2. Regulations

In 2003 an EU TAC was introduced for orange roughy in VI and VII. For the other areas, an EU TAC was introduced in 2005. EU TACs have been decreasing in the last years and are now set to zero for all three management areas.

Table 1. Development of EU TAC for orange roughy in VI, VII and other areas since 2003.

YEAR	EU TAC (T) VI	EU TAC (T) VII	EU TAC (T) OTHER
2003	88	1349	
2004	88	1349	
2005	88	1149	102
2006	88	1149	102
2007	51	193	44
2008	34	130	30
2009	17	65	15
2010	0	0	0
2011	0	0	0
2012	0	0	0

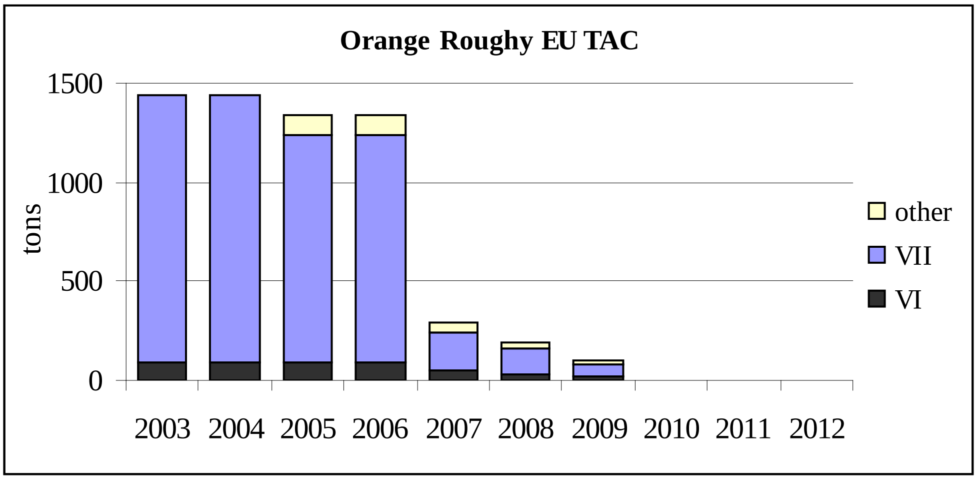


Figure 4. Total allowable catch for orange roughy in VI, VII and all other areas for EU vessels since 2003.

A.3. Ecosystem aspects

Directed trawl fisheries for orange roughy have been associated with seamounts and other bathymetric features. In ICES Divisions VI and VI there has been a spatial overlap of historic orange roughy fisheries with vulnerable habitats such as cold-water corals. The direct impact of this fishery on vulnerable habitats has not been evaluated. However, in other areas of the world, such fisheries have been demonstrated to have considerable impact. There are currently no directed fisheries targeting orange roughy in Subareas VI and VII. The spatial resolution of catch data for orange roughy in other areas currently available to the working group is not sufficient to assess the spatial overlap with vulnerable habitats. There are currently orange roughy fisheries occurring in ICES Subarea X and XII. There potential impact on vulnerable habitats should be evaluated. However, NEAFC have introduced precautionary closed areas to protect VMEs on the Mid-Atlantic Ridge.

B. Data

B.1. Commercial catch

Landings data are available for all fleets. Onboard observations of the French deep-water fishery in Areas Va, VI and VII are available and suggest that the bycatch of orange roughy might be minor on most fishing grounds. Irish discard information is available from three observer discard trips carried out in 2003 and 2004, covering targeted fishery on peaks and in canyons for orange roughy and fishing on flat grounds for a mixture of roundnose grenadier, black scabbard, blue ling, siki sharks and orange roughy. Discarding of orange roughy was zero in the peak fishery and <1% of landed orange roughy on the flat fishery.

B.2. Biological

Summary of life characteristics

Table 2. Summary of biological parameters for orange roughy in VI, VII.

LHC	Best estimate	Derived from?
Maximum observed length	70.6 cm SL	Nolan(ed) 2004
	60 cm SL	Shepard and Rogan 2004
Maximum observed age	>130	Thompson 1998
	169 years	Shepard and Rogan 2004
	187 years	Nolan(ed) 2004
Length at 50% maturity	34 -37 cm SL	Shepard and Rogan 2004
Age at 50% maturity	Approx 30 years	Shepard and Rogan 2004
	20-40 years	Nolan(ed) 2004
	27.5 years (37cm)	Minto and Nolan 2006
Length at recruitment	30-34 cm SL	Shepard and Rogan 2004
	Approx 35 cm	Nolan(ed) 2004
Age at recruitment	30-40 years	Shepard and Rogan 2004
	30-35 years	Nolan(ed) 2004
Growth parameters: (von Bertalanffy parameters: B_0,T_0, L infinity, for example)	$L\infty$=476 mm,	Shepard and Rogan 2004
	k=0.039 yr^{-1} and	
	t_0=2.61 years.	
Fecundity, egg size etc	22000 eggs per kg body weight. Diameter 2mm	Panchurts & Conroy 1987
	48,530 eggs per kg body mass	Gordon 1999
	33376 eggs	Minto and Nolan 2006
Natural mortality	M= 0.04	Annala (1993)
	M=0.025	WGDEEP, 2002
	M= 0.045	Large (2002) WD from WGDEEP 2002

Length compositions

There are a number of historic length frequencies available for Areas VI, VII and X and XII from observer programmes (Figures 5 to 7). Length frequencies from most of the commercial catches show a distribution between 45 and 65 cm. Survey data show that the length–frequency distribution on bathymetric features is mainly between 38 and 55 cm (Figure 8). Survey length–frequency information is available from the Irish and Scottish deep-water trawl surveys (Figure 9) which sample the flat grounds along the continental slope in VI and VII. Survey data show that the length frequency on gentle slopes has several peaks between 7 and 23 cm with a further peak between 45 and 65 cm suggesting the presence of several juvenile cohorts.

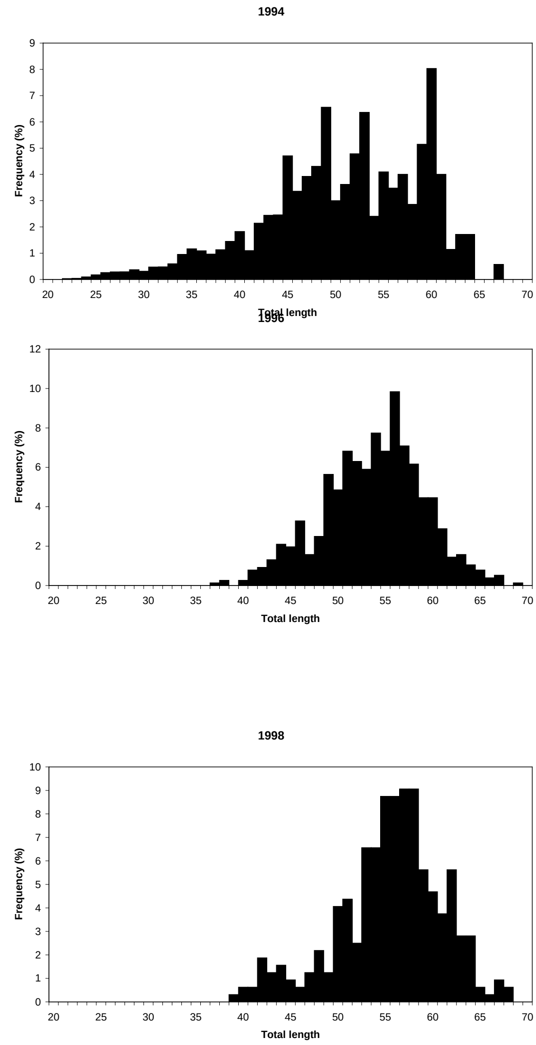


Figure 5. Length distribution of French landings of orange roughy from 1994 to 1998.

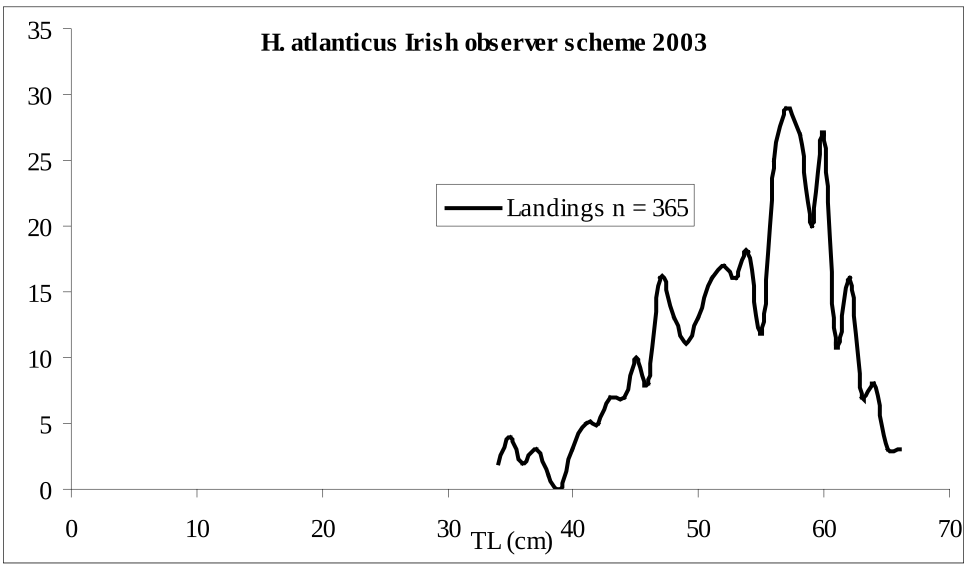


Figure 6. Length frequencies from Irish fishery in 2003 (VI and VII) from Irish Marine Institute observer scheme.

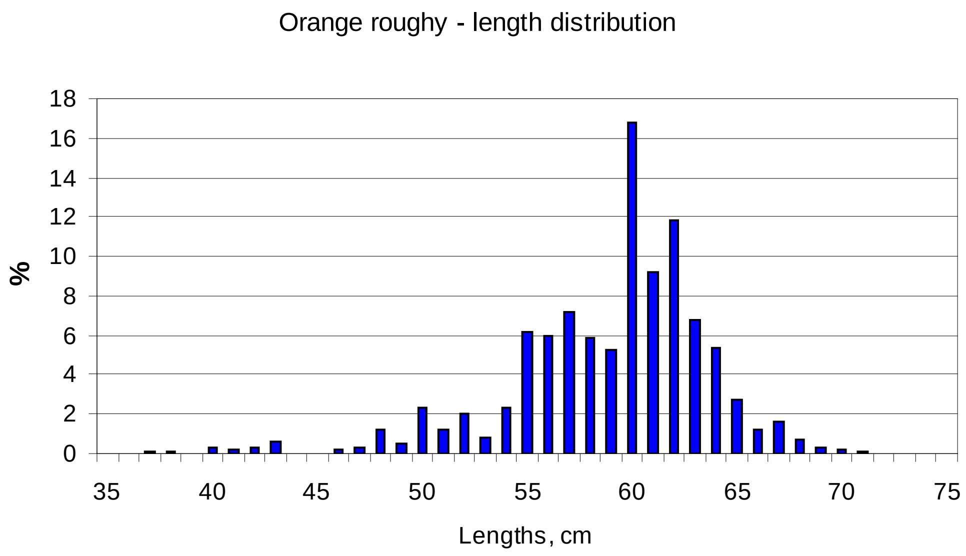


Figure 7. Orange roughy length frequencies from Faroese exploratory fishery in 2008 in the Mid-Atlantic Ridge (MAR_X and XII).

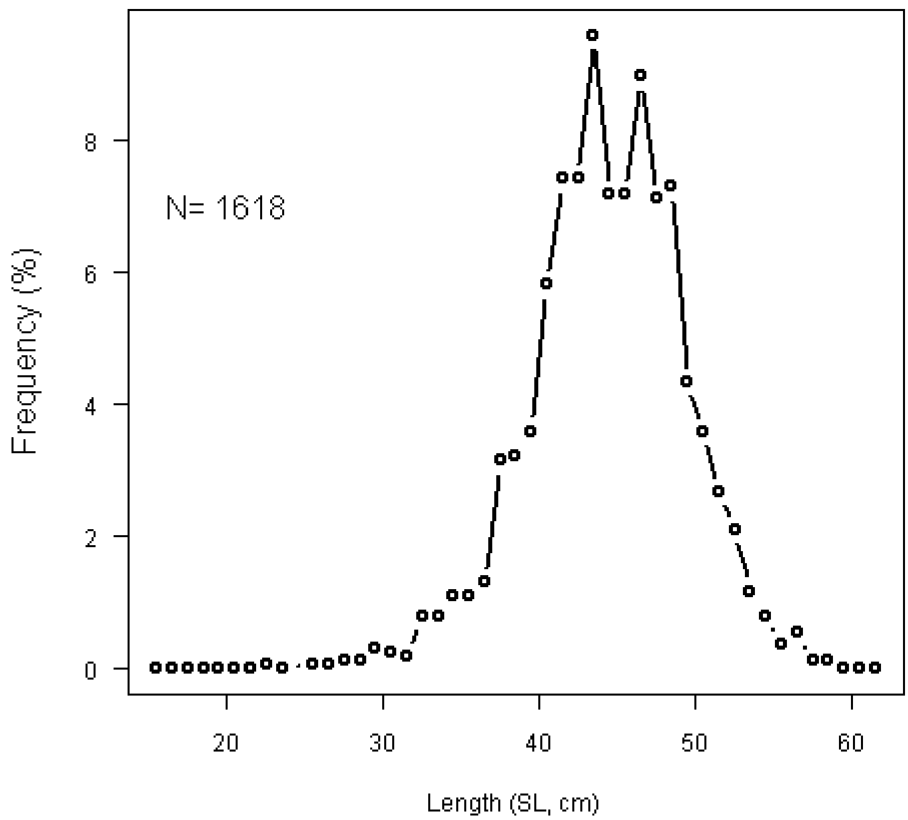
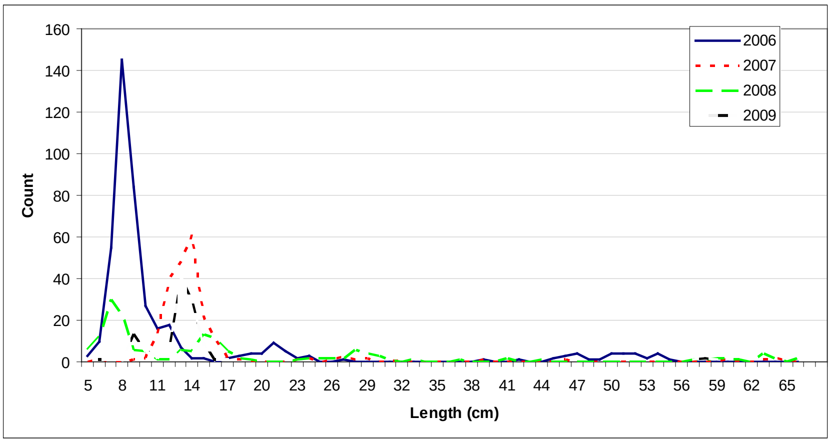


Figure 8. Length frequency from bathymetric feature trawl data sampled on the 2005 acoustic survey, VII.



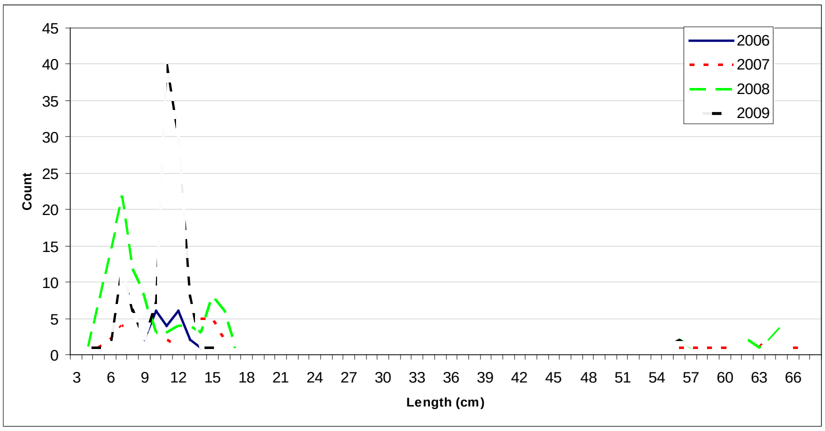


Figure 9. Length frequency of orange roughy caught at the Irish (upper panel) and Scottish (lower panel) deep-water survey 2006–2009.

Age compositions

Age data were available from sampling at-sea on commercial trawlers operating on the Porcupine Bank during September 2003–April 2004 and February 2005 (Sheppard and Rogan, 2006). Most otolith samples were of juvenile fish (<30 cm SL). Otoliths were prepared and sectioned according to Tracey and Horn (1999). Age estimates (6–169 years) were obtained from a total of 151 otoliths. The von Bertalanffy growth model was fitted to the data (R^2=0.92) (Figure 9.3.6). Estimated growth parameters were: L_∞=47.6 cm, k=0.039 yr^{-1} and t_0=2.61 years.

Age estimates were presented by Talman *et al*. (2002) based on samples taken from the Irish developmental fishery in 2001, in VI and VII (BIM, WD 2002). Age estimates from sectioned otoliths ranged from 20 to 187 years (Standard Lengths 30 to 68 cm). Empirical growth curves presented by Talman *et a*l. (2002) suggest that growth slows and reaches an asymptote at about 55 cm SL and 37 years. This asymptote is far greater than estimate above and the cause of this is unknown (it possibly could be TL rather than SL). The orange roughy in the area west of Ireland appear to reach the greatest age of any populations so far examined.

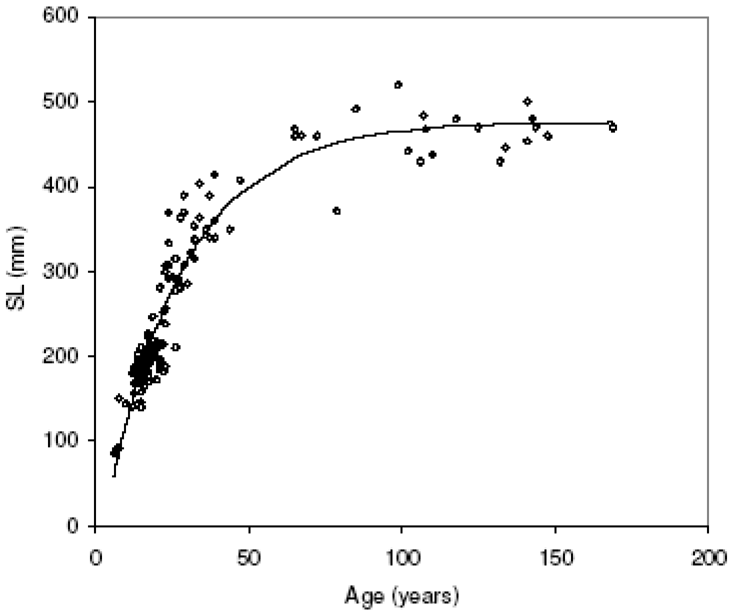


Figure 10. Age estimates and the estimated von Bertalanffy growth curve (Sheppard and Rogan, 2006 check). Note that the y axis refers to standard length rather than total length as used elsewhere.

Weight-at-age

No data.

Maturity and natural mortality

Recently estimated maturity L50 was 34 cm SL for orange roughy collected from the flats fishery and 37 cm SL from hill aggregations on the Porcupine Bank (Sheppard and Rogan, 2006). This is similar to the estimate from the west of Ireland of 36 cm SL (Minto and Nolan, 2003). These are higher than that estimated for orange roughy in New Zealand and Australia.

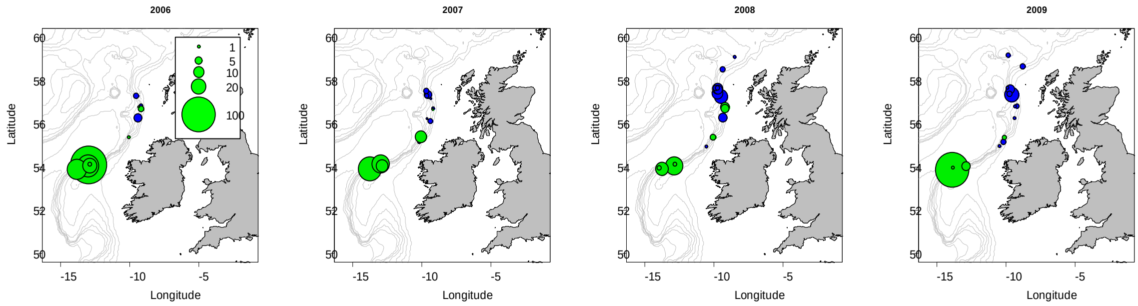
B.3. Surveys

In 2005 an acoustic survey was carried out on the slopes to the west and north of the Porcupine Bank. Estimates of biomass were considered to be unreliable due to concerns over target strength.

Biological samples and multibeam echosounder and a ROV were used on selected seamounds to map the orange roughy habitats (O'Donnell *et al*., 2007).

Distribution of juvenile and adult cpues of orange roughy in VI and VII within the survey areas of the Scottish and Irish deep-water survey are shown in Figure 11. Mean catch rates (number/hours) for orange roughy from the Irish deep-water trawl survey are shown in Figure 12 for individuals >23 cm (a.) and <23 cm (b.) caught in the 1000 m to 1500 m depth band between 2006–2009. Data are very variable, but do indicate the entry of juveniles into the population.

a.)



b.)

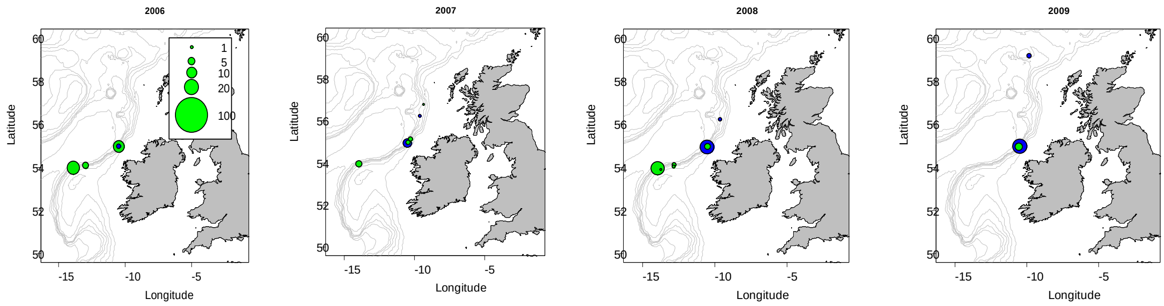
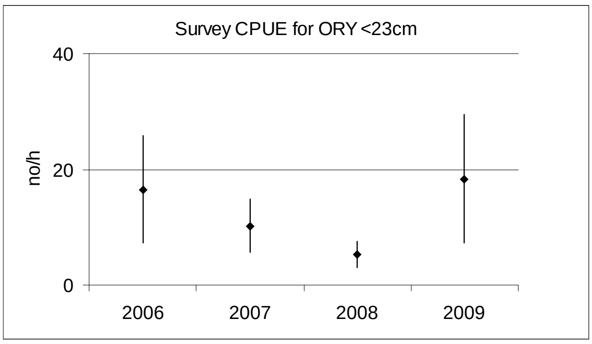


Figure 11. Cpue of a.) orange roughy (≤23 cm) and cpue of b.) orange roughy (>23 cm), 2006–2009. Combined Irish (green) and Scottish (blue) Deep-water survey data.



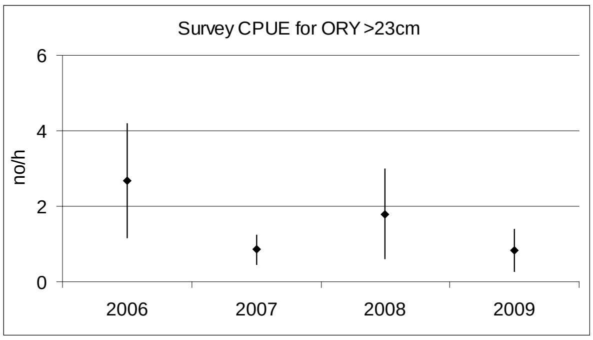


Figure 12. Mean catch rates (number/hours) for orange roughy >23 cm (a.) and <23 cm (b.) caught at the Irish deep-water survey 2006–2009 in the 1000 m to 1500 m depth band (±1SE).

B.4. Commercial cpue

Historical French cpue series is shown in Figure 13 and 14 for Subarea VI and VII. No new data are available for this cpue from 2006 onwards, as the fishery has virtually ceased.

Standardized cpues for Irish deep-water trawlers targeting orange roughy are shown in Figure xx. These are based on personal logbooks and are calculated using the mean catch weight per haul per month for the period of January 2001 to December 2003, i.e. the main period when the Irish trawlers were participating in the fishery. In the peak fishery for orange roughy, the trawl is often fast on the bottom or sometimes lifted over coral and rocks. Effective fishing time can be as short as 20 minutes. Trawling time therefore does not give any good indication of effort and consequently, only catch per haul is used for the analysis. The cpue from fishery on flat ground was also worked up but the data were scarcer as it only developed as a regular fishery since the second half of 2002.

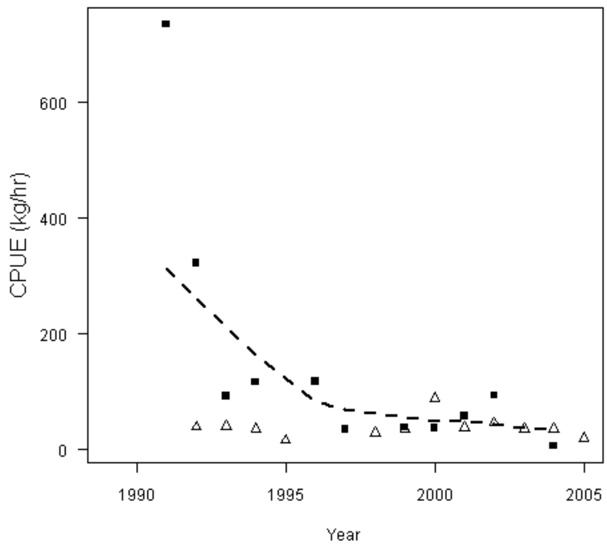


Figure 13. French 2006 cpue series (VIa) for 400–600 kw power vessels (open triangles) and for 1400–1600 kw vessels (solid squares). The line is a smooth curve through the latter series. Reviewer comments: why no trend for low powered vessels?

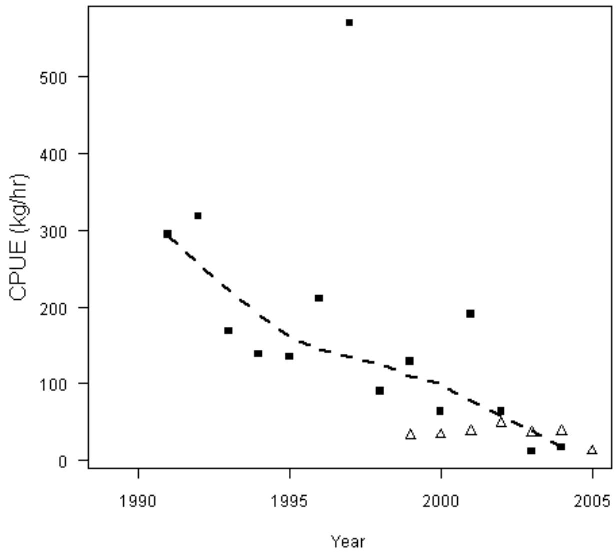


Figure 14. 2006 cpue series for 400–600 kw power vessels (open triangles) and for 1400–1600 kw vessels (solid squares). The line is a smooth curve through the latter series excluding the high 1997 point.

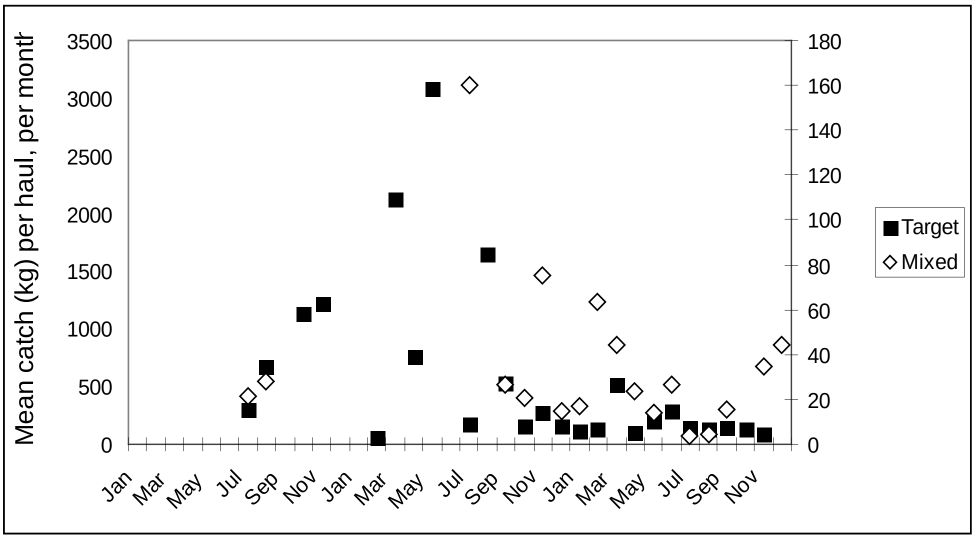


Figure 15. Cpue series for Irish deep-water trawlers targeting orange roughy with mean catch weight by haul per month between January 2001 and December 2003 for targeted (closed squares) and mixed fisheries hauls (open diamonds). Secondary axis corresponds to mixed fishery.

B.5. Other relevant data

C. Assessment: data and method

No assessment. Advice is based on historic landings and cpue trends.

Model used:

Software used:

Model Options chosen:

Input data types and characteristics:

D. Short-term projection

Na.

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

Estimation of reference points for orange roughy in VI and VII.

At the 2012 WGDEEP meeting several methods were trialled to estimate reference points for orange roughy in all other areas. As there are no fisheries-dependant or independent data available for orange roughy, the estimation of reference points was based on life-history traits. The methods explored included the DCAC method, the Gislason method, the Extended Beverton and Holt yield simple model (BHAC) and FLAdvice as recommended in WKLIFE and WKFRAME.

The DCAC method was explored for ICES Subareas VI and VII, but not for the Mid-Atlantic Ridge (X and XII) as the ratio for catch to virgin biomass is highly uncertain. For the exploration of reference points for orange roughy based on the three latter methods, biological input parameters from Area VII were used and were based on data and references summarized in the stock annex.

Input parameters

For the DCAC method:

Data type	VI	VII
accumulated Catch	7200 t	24 600 t
Natural mortality	0.05	0.035
Period of depletion	15 years	12 years
Ratio between virgin biomass and catch	0.9	0.5
Fmsy to M	0.8	0.8
Bmsy to B	0.4	0.4

For the Gislason, BHAC and FLadvice.

Data type	VI	Method in which it is used
Lmax	48 cm	Gislason
AFC	15	Gislason
natural mortality M	0.045	BHAC
K<-	0.039	BHAC
Length 1st maturity Lmat	35	BHAC
L infinity L_inf	48	BHAC
Length of first capture LFC	33	BHAC
Age range	1-16	For FLadvice
L infinity L_inf	48	For FLadvice
k VB growth K	0.039	For FLadvice
LW relationship a	0.169	For FLadvice
LW relationship b	2.59	For FLadvice

Several estimates from these different approaches were available. Based on the DCAC method for Area VI an estimated catch of 88 tonnes would have been sustainable in the long term (See WKLIFE 2012). According to WGDEEP 2002 this is very similar to the output from a stock reduction model for Area VI which was estimated to be around 90 tons. The output of the DCAC method suggest that in VII an estimated catch of 350 and 500 t (depending on input parameters) would have been sustainable over the long term but this is based on uncertain assumptions of the ratio between virgin biomass and depleted biomass.

The output of the other methods that were explored are summarized in the table below:

Method/Estimate	FMAX	F0.1	F30%SPR	F40%SPR	Fmsy
Gislason spreadsheet (WKLIFE) with AFC=15	2	2	2	2	2
BHAC (WKLIFE)	0.63	0.06	0.04		0.06
FLAdvice (WKLIFE) based on Linf and K	0.17	0.04	0.04	0.06	
FLAdvice (WKLIFE) based on Linf, K and LW parameters		0.04	0.04	0.06	

Comments on the assessment

DCAC method: It should be noted that the DCAC approach should be considered as representing what could have been the sustainable yield on orange roughy on fishing grounds where the standing biomass was depleted to low level. In Division VI, this is likely to represent quite closely the actual depletion of the biomass along the West of Scotland slope. It is less clear if there was orange roughy on other grounds of Subarea VI, e.g. the around the Rockall Bank and whether it was depleted in all locations. In Subarea VII, there are possible aggregations remaining. However the main issue regarding this species is that due to the fact that the size of populations per seamount is unknown this method is not appropriate to be used for management.

Gislason, BHAC and FLAdvice: The Gislason method which is based on L_{inf} and age of first capture is based on the assumption that body size i.e. L_{max} can be used as a proxy of vulnerability to fishing. It overestimates k and the method is clearly not appropriate for species such as orange roughy. Explorations of methods such as BHAC and FLadvice which take the growth parameters into consideration are more appropriate. The outputs of these two methods are similar and suggest that ORY can only sustain very low Fs. As the fishery for orange roughy is closed in VI and VII, this should be seen in particular in the context of mixed fisheries considerations, in which orange roughy can be a potential bycatch.

	TYPE	VALUE	TECHNICAL BASIS
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

No biological reference points have been defined.

H. Other issues

H.1. Historical overview of previous assessment methods

I. References

9.2 Roundnose grenadier in Vb, VI, VII and XIIb

Stock	Roundnose grenadier (*Coryphaenoides rupestris*) in Division Vb and Subareas VI, VII and Division XIIb
Working Group	WKDEEP
Date	11th March 2010
Revised by	Lionel Pawlowski and Pascal Lorance

A. General

A.1. Stock definition

ICES WGDEEP has in the past proposed four assessment units of roundnose grenadier in the NE Atlantic (Figure 1):

Skagerrak (IIIa)The Faroe–Hatton area;

Celtic sea (Divisions Vb and XIIb, Subareas VI, VII);

Mid-Atlantic Ridge 'MAR' (Divisions Xb, XIIc, Subdivisions Va1, XIIa1, XIVb1);

All other areas (Subareas I, II, IV, VIII, IX, Division XIVa, Subdivisions Va2, XIVb2).

Roundnose grenadier is widely distributed in the North Atlantic. Its area stretches from Norway to northwest Africa in the east to the Canadian-Greenland coasts and the Gulf of Mexico in the west, and from Iceland in the north to the areas south of the Azores in the south (Parr, 1946; Andriyashev, 1954; Leim and Scott, 1966; Zilanov *et al*., 1970; Geistdoerfer, 1977; Gordon, 1978; Parin *et al*., 1985; Pshenichny *et al*., 1986; Sauskan, 1988; Eliassen, 1983). Aggregations of this species are found on the continental slope of Europe and Canada, on the MAR seamounts, in the Faroe-Hatton area (banks Hatton, Rockall, Louzy, Bill Baileys, etc.) and in the Skagerrak and Norwegian fjords.

Some studies have allowed observing fish in all maturity stages in all the distribution area (Allain, 2001; Kelly *et al*., 1996, 1997; Shibanov, 1997; Vinnichenko *et al*., 2004), therefore allowing for several populations to exist.

No genetic results are available to validate the hypothetical stock structure presented above. Several authors also consider that roundnose grenadier is a poor swimmer and is therefore unlikely to make extended migrations. No pattern in seasonal density variation has been observed from surveys or from fisheries. However, there are no data available to indicate whether or not individuals move around during their lifespan.

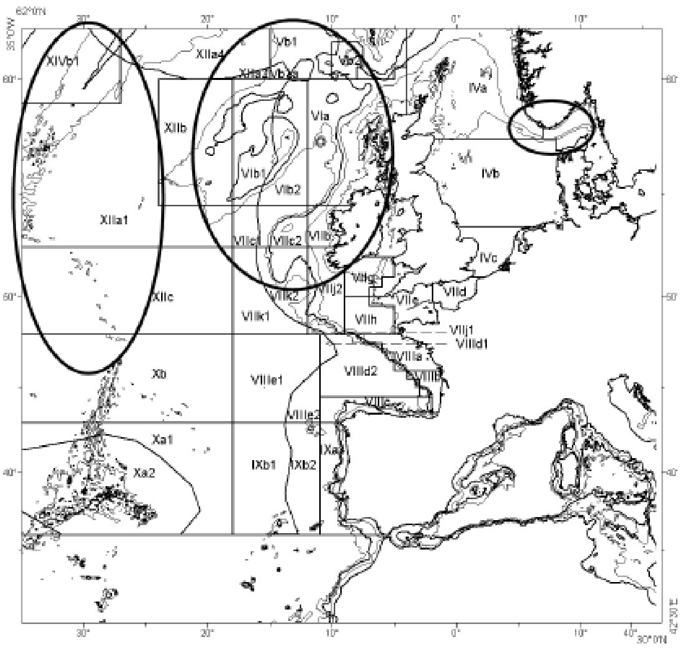


Figure 1. Areas of the main fisheries for roundnose grenadier, Skagerrak, west of the British Isles and Mid-Atlantic Ridge. The isobaths displayed are 100, 200, 1000 and 2000 m (from Lorance *et al.*, 2008).

The current perception is based on what is believed to be natural restrictions to the dispersal of all life stages. The Wyville Thomson Sill may separate populations further south on the banks and slopes off the British Isles and Europe from those distributed to the north along Norway and in the Skagerrak. Considering the general water circulation in the North Atlantic, populations from the Icelandic slope may be separated from those distributed to the west of the British Isles.

It has been postulated that a single population occurs in all the areas south of the Faroese slopes, including also the slopes around the Rockall Trough and the Rockall and Hatton Banks but the biological basis for this remains hypothetical.

Published results on length (11.5–12.5 cm pre-anal fin length, PAFL) and age (9–14 years) at first maturity of females to the West of British Isles and in the Skagerrak (Allain, 2001; Bergstad, 1990; Kelly *et al.*, 1996; 1997) do not seem to clearly discriminate these two groups, although they are most likely to be demographically different unit.

Some studies have detected genetic differentiation in at least parts of the species range and indicating the presence of distinct populations within the species (Logvinenko *et al.*, 1983; Duschenko, 1989).

In 2007, WGDEEP examined the available evidence of stock discrimination in this species based on length distribution, commercial catch, cpue, age, maturity, reproduction. Length distribution, catch and cpue data were considered too aggregated or too dependent on external factors (e.g. fleet dynamics, depth) to be usable to discriminate stocks. Analyses on age data on longevity were unable to conclude if the differences of longevity from one region to another were local changes or the effect of exploitation.

New genetic studies are likely to become available in the forthcoming months. Preliminary results were presented in the ICES symposium "Issues confronting the Deep Oceans" (Horta, Azores, 27–30 April 2009). Microsatellite DNA was used to characterize the large-scale population structure from samples spanning over the entire North Atlantic. Samples of ca. 800 individuals were analysed for eight microsatellite loci. Roundnose grenadier was found to display a trend of increasing genetic differentiation with distance among samples. In absolute terms the amount of genetic differentiation among roundnose grenadier samples was considerably higher than in other deep-sea fish species, such as Greenland halibut (Knutsen *et al*., 2007) and tusk (Knutsen *et al*., submitted) over comparable distances. The gene flow appeared restricted also among relatively closely situated localities (less than 500 km) (Knutsen *et al*., 2009). If these preliminary results are confirmed, the current stock structure used for assessment and primarily based upon bathymetry and hydrology will need revision towards a structuring at smaller spatial scale.

A.2. Fishery

The majority of landings of roundnose grenadier from this area are taken by bottom trawlers. To the west of the British Isles, in Divisions Vb, VIa, VIb2 and Subareas VII, French trawlers catch roundnose grenadier in a multispecies deep-water fishery. The Spanish trawl fleet operates further offshore along the western slope of the Hatton Bank in ICES Divisions VIb1 and XIIb.

French trawlers began to land increasing amounts of roundnose grenadier, from the west of Scotland in 1987 (Charuau *et al*., 1995). Landings of these species have been reported separately in French landings statistics since 1989 (Lorance *et al*., 2001). The quantities landed in 1987 and 1988 are not known with accuracy but they are believed to be less compared with landings in the 1990s.

The activity of the Spanish fishery in international waters is poorly known. New information on landings data in Division VIb and Subarea XII from the Spanish fisheries for the years 2005, 2007 and 2008 have been made available. These newly obtained data are from the freezer fleet operating mostly in those regions. Data from 2006 are incomplete and of no use for stock assessment. The main problem associated to Spanish official landing data for roundnose grenadier is the uncertainty regarding their accuracy. The disagreement between observer catch data and official landings data suggests that catches of this species might be reported as corresponding to several species. Roughhead grenadier is mostly absent from observer data despite recorded annual catches above 1000 tonnes in 2005 and 2007. Similarly, roughsnout grenadier is absent from observer data although apparently between 1300 and 4800 tonnes where landed in the years 2005, 2007 and 2008. Gunther´s grenadier was recorded by the observers but not in the logbooks. The distribution of the catch and effort are poorly known. Effort directed at deep-water species increased from 1989 to 1996 (Lorance and Dupouy, 2001). In 1995 an effort regulation was introduced but was not a constraint to this fleet. TACs and a new effort regulation was introduced in 2003 (Council Regulation (EC) No 2347/2002 of 16 December 2002) and the fishery has reduced. Part of the fishing time of the licensed fleet is expended on the shelf mainly in the Celtic Sea.

A.3. Ecosystem aspects

Roundnose grenadier is a slow-moving species, which prefers grounds with slow currents. Vertical diurnal migrations are also observed, the pattern of which depends on feeding (Savvatimsky, 1969) and water circulation and meteorological processes (Shibanov and Vinnichenko, 2007).

There is no direct evidence of long distance migrations made by adult fish. The distribution and dispersal of the eggs and larval stages is poorly known, except in the Skagerrak (Bergstad and Gordon, 1994). Juveniles grenadier of 2–8 cm pre-anal length were caught in the midwater by 120–840 m over bottoms of 1200–3200 m along Greenland slope, on the Mid-Atlantic Ridge, Hatton Bank, in the Irminger and Labrador Seas suggesting that some passive migrations of juveniles in the open ocean occurs (Vinnichenko and Khlivnoy, 2007).

In the Skagerrak (ICES Division IIIa), available information indicates that roundnose grenadier spawn in the late autumn (Bergstad, 1990a). Eggs (diameter 2.4–2.6 mm), postlarvae and pelagic juveniles have been caught with plankton net from 150 to 550 m. The newly hatched larvae appear very primitive and the pelagic phase is extensive. The mean size of larvae, assumed to belong to the same cohort sampled repeatedly in the same year, increased from February to October, when they attained a demersal stage of life cycle (Bergstad and Gordon, 1994). To the west of the British Isles, females with maturing ovaries have been observed from February to December, but they were more abundant from May to October and spawning appears to extend at least from May to November (Kelly *et al*., 1996; Allain, 2001). Studies in Icelandic waters indicate year-round spawning, with no obvious peaks (Magnússon *et al*., 2000). There appear thus to be differences in the timing of spawning between areas, perhaps reflecting varying environmental conditions. Roundnose grenadier is a batch spawner with a fecundity of 4000–70 000 oocytes per batch (Allain, 2001).

There is a lack of knowledge of the distribution and dispersal of the eggs and larval stages, except in the Skagerrak (Bergstad and Gordon, 1994), and so the biological basis for the current hypothetical population structure must await the results from future studies of genetics and otolith microchemistry. To date, only a single study of whole otolith microchemistry of roundnose grenadier from a wide area of the Atlantic (Mid-Atlantic Ridge, Reykjanes Ridge, Hatton Bank, Porcupine Seabight, Rockall Trough, Skagerrak and two Norwegian fjords) has been carried out using solution-based, inductively coupled, plasma mass spectrometry (SO-ICPMS) (Gordon *et al*., 2001). Discriminant analysis of eight elements separated samples from the Norwegian fjords and the Skagerrak from those from the NE Atlantic areas. Differences between samples from six areas of the Atlantic (Hatton Bank, Rockall Trough, Porcupine Seabight, Mid-Atlantic Ridge, and Reykjanes Ridge) were small, and elemental concentrations overlapped. Therefore, this study supports the view that populations in the NE Atlantic are separate from the Norwegian fjords and the Skagerrak, but does not demonstrate any difference in populations between the Mid-Atlantic Ridge and the remainder of the NE Atlantic.

B. Data

B.1. Commercial catch

Landings time-series data per ICES areas are available.

Landings data by ICES statistical rectangle are available from France, Norway and UK (England and Wales and Scotland). No other country provided data by rectangle. Landings by ICES division are available from other countries.

Catch in Subarea XII are allocated to Division XIIb (western Hatton Bank) or XIIa,c (Mid-Atlantic Ridge) according to knowledge of the fisheries from WG members. For each country, the time-series of landings are checked and revised if needed according to StatLand data. StatLand reports landings in Subarea XII consistently with what this working group did in the past.

Catch and discards by haul are available from observer programmes. From the French observer programme, total catch, landings and discards and catch, landings and discards of roundnose grenadier are available on a haul by haul basis for 2004–2006.

Discard data (quantities and length distribution) are also available from the on-board observation of the French fishery, 2004–ongoing, from French on-board observations on French vessels in 1997–1998 and from Scottish observers on board of French vessels, 1997–2001. The length distributions of discards from all these observations seem quite consistent.

Based on EU observer programme 2004–2005, about 30% by weight and 50% by number of the catch of roundnose grenadier is discarded, because of small size. This figure is higher than in previous sampling where the discarding rate in the French fisheries was estimated slightly above 20% from sampling in 1997-1998 (Allain *et al.*, 2003). The change may come from a combination of changes in the depth distribution of the fishing effort and a decrease in the abundance of larger fish as visible in the landings. The modal discarded length has remained constant.

The mode of the length distribution of the discards from the Spanish fleet in Divisions VIb and XIIb is slightly smaller, probably because of different sorting habits in relation to different markets. It is therefore important that length distribution of the landings and discards are provided to the working group by all fleets exploiting the stock. Larger variations in discards levels have been reported between species and between observers and vessels.

Misreporting or underreporting is not known to have been a problem in the French trawling fleet. Concerns have been repeatedly expressed that misreporting could occur in international waters (NEAFC regulatory area). There are also been regular complains from the French Industry that IUU fish was landed in France and was pulling the prices down. This seems to have disappeared in recent years. Misreporting is not an issue that scientists have the power to inquire and this should stay in hand on management and regulation authorities to monitor misreporting. No quantitative data on misreporting is available.

The landings data were however considered uncertain in Division XIIb, because unreported landings may occur in international waters. In addition to this, all national landings data were not reported by new ICES divisions and some landings were allocated to divisions according to knowledge of the fisheries from the working group. Lastly significant unallocated landings occurred in 2005. This has led the working group to remove in 2008, XIIb from the exploratory assessments although the stock definition consider the Faroe–Hatton area, Celtic Sea catches (Divisions Vb and XIIb, Subareas VI, VII) belonging to the same stock.

B.2. Biological data

Size–frequency data (and corresponding weight data) for roundnose grenadier are available for French catches for every year since 1990. Historic length–frequency series from sampling on board French trawlers by French and Scottish observer is presented in Figures 2 and 3.

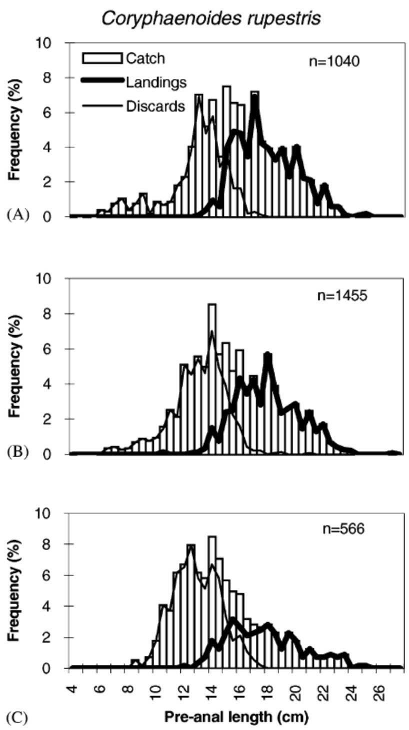


Figure 2. Length distribution of the discards and landings of roundnose grenadier in 1996–1997 by depth, A) 800–1000 m, B) 1000–1200 m, C) 1200–1400 m, sampled on board French vessels, (redrawn from Allain, 2003).

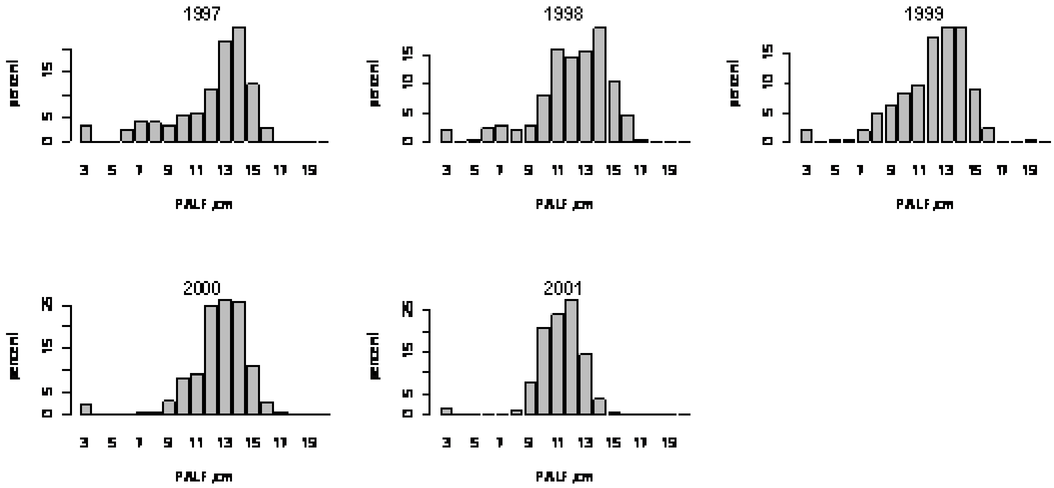


Figure 3. Length distribution of the discards of the French fleet, sampled on board French vessels by Scottish observers, 1997–2001.

Age estimates were available from France. This dataset may be heterogeneous, because three different readers estimated the age over these different years and also because measuring the fish on board may lead to different age–length relationship than measuring the landed fish that may have lost water for some days in ice. Large discrepancies between readers were observed in a recent otolith reading exchange and workshop (ICES, 2007a).

Age composition of the French landings has been routinely estimated since 2001. Formerly age–length keys (ALK) were derived from a cruise in 1999 and from sampling on board of commercial trawler in 1996–1997 (Lorance *et al.*, 2001; 2003). Preliminary analysis of the length-at-age data demonstrated that ALK is very stable over years. ALK for years 1999 and 2001–2004 were very similar, the ALK for 2005 appeared different and the change was ascribed to a change of the reader.

These data are based upon ALK from age estimates in 1996, 1999 and 2002–2005. Otoliths from 1996 and 1999 were collected respectively on board of commercial trawlers and during a scientific cruise; otoliths for 2002–2005 were routinely sampled from the landings.

No new data on maturity and natural mortality has been collected in recent years. Natural mortality was previously estimated from catch curves and an estimated M=0.1 was used by the Working Group since 2002. It should be kept in mind than this estimate is based on limited data.

B.3. Surveys

Only one cruise relevant to roundnose grenadier is currently carried out on a yearly basis by FRS (Scotland). Stock indicators were derived from this survey (Neat and Burns, in press) but have not yet been formally integrated into stock assessment.

Another cruise has been carried out since 2006 on the RV Celtic explorer every year during autumn. The surveys aim to collect biological data on the main deep-water fish species and invertebrates along the continental slope in Subareas VI and VII north. Fishing tows were carried out at four depths, 500 m, 1000 m, 1500 m and 1800 m in three distinct areas. The effective fishing time, from when the net touched the bottom, was set at two hours. Tows were carried out along the depth contour. At each station the entire catch was sorted to species level and weighed. Full biological sampling, i.e. length, weight, sex, maturity, and age, was carried out on specific commercial species. Additional biological sampling, without age, was carried out on an *ad-hoc* basis on other species.

B.4. Commercial cpue

Time-series of French fishing effort are available based upon logbook data (1987–2009). Following their requirement under the Data Collection Regulation (DCF), VMS data (starting back from 2003) are made available from 2010. Lpues data based upon French tallybooks are available from 2000 based upon a voluntary participation of fishermen. These data are used in the working group as indicators of trends and also in the assessment.

Time-series of fishing effort of past years can be improved from tallybooks. In EU logbooks, fishing operations (individual tows and lines and net setting) carried out in the same day and rectangle are cumulated. For the French trawling fleet, tallybooks of haul by haul data were provided by the industry and allowed for better account of all factors in lpues (Lorance *et al.*, 2009). Applied to all fleets such data would allow effort to be properly handled. Electronic logbooks are under development on French vessels and data will be reported haul by haul including depth. It should be noted that this improvement is particular to deep-water fisheries where depth may vary a lot in a single statistical rectangle. Therefore haul by haul data and fishing depth are much more crucial in deep-water fisheries than in shelf fisheries were most of the depth information is conveyed by the statistical rectangle.

VMS data also allows for improvement of effort data as is allows for some particular uses such as estimating the fishery footprint and fine scale changes in effort distribution. Nevertheless, data such as tallybooks provided to Ifremer by the industry includes all the effort information (tow duration, depth, location) coupled with catch, while using VMS requires assumptions to identify fishing and steaming activities and coupling catch to VMS data is an unresolved issue.

Overall the knowledge of the fleet activity at sea is reliable in Division Vb and Subareas VI and VII, the situation is poorer in Divisions VIb and XIIb. Distribution of catch and effort at the resolution of ICES rectangle has been available, from France, Ireland and UK (ICES, 2006; ICES, 2007b).

The French fleet is known based upon the licensing scheme since 2003. Before this time, catch composition was used to identify which vessels were fishing in the deep water. Therefore, composition of the fleet, number of vessels can be considered available since the early 1980s.

B.5. Other relevant data

No other source of data is used in the assessment.

C. Historical stock development

Past assessments

Based upon what is believed to be natural restrictions to the dispersal of all life stages, the area of this stock is considered to include Divisions Vb and XIIb and Subareas VI and VII. Due to uncertainties in the catch in Division XIIb, assessment has been restrained to Vb, VI, VII. Therefore only a portion of the regions of this stock has been assessed in 2008 and 2009.

Given the lack of data, assessments have only been exploratory until 2009. Exploratory assessments focused on integrating discard data into the assessment (WGDEEP, 2008) and rebuilding catch at the beginning of the fishery (WGDEEP, 2009; Pawlowski and Lorance, 2009). The assessment model used was the Separable VPA. The main criticisms against the use of this model were the short time-series of available data and the uncertainties around the age- and length-based approach for this species.

The Bayesian Surplus Production model, Multiyear Catch Curve model and other indicators of trends are currently used for assessment until the next Benchmark Workshop.

Bayesian surplus production model

In 2010, WKDEEP considered the Bayesian Surplus Production Model as the most parsimonious short-term approach. Such an approach can be informative on relative trends such as changes in exploitation biomass and depletion. However, interpreting absolute levels are inappropriate with the current data.

Multiyear catch curve model

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

M=0.1 (depending on model setting)

Coefficient of variations of the recruitment (CVrec= 0.1)

Coefficient of variations of the landings or catch (CVo=0.1 : CV of observations

Other indicators of trends

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

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

Stock assessment parameters

Assessment Model used: Surplus Production Model (based on Pella Tomlinson biomass dynamic model)

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

Model Options chosen:

Initial parameters

Age-at-maturity: 11 (variance 0.1)

Longevity: 50 (variance 0.1)

Priors for Q (logQ.mean = 0, loqQ.var = 100)

Priors for K (K.mean = log(100000) , K.var = 1)

Priors for r (r.mean = mean(log(r.mc)), r.var = mean(var(r.mc)))

sigma.shape = 2

sigma.rate = 1

Input data types and characteristics:

Landings data are used from 1988 in Vb, VI, VII and XIIb when available.

Lpues from French tallybooks from 2000 (past lpues may be included when data will be available). Lpues are provided by region and are combined. The weight of each region is the proportion between the local and the total landings.

D. Short-term projection

No projections are performed.

E. Medium-term projections

No projections are performed.

F. Long-term projections

No projections are performed.

G. Biological reference points

The current data are inappropriate to provide MSY absolute estimates from the Bayesian Surplus Production model.

H. Other issues

Landings and effort data in Division XIIb should be included into the assessment if they become reliable. A separate assessment for Division XIIb should be carried out separately from the one for Division Vb, and Subareas VI, VII.

As the performance of this model is dependent on the length of the time-series, separate exploratory runs may be performed to evaluate the effects of new datasets or datapoints.

Because discarding is no longer allowed for this species (ref), all catch should be landed in the forthcoming years and will be integrated into the assessment.

New stock identity results are likely to become available in the next few years and should be considered to evaluate the assessment area.

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9.3 Roundnose grenadier in Division IIIa

Stock	Roundnose grenadier (*Coryphaenoides rupestris*) in Division IIIa
Working Group	WGDEEP
Date	March/2011
Revised by	WGDEEP/

A. General

A.1. Stock definition

Roundnose grenadier (*Coryphaenoides rupestris*) in Division IIIa is treated as one stock separated from three other stocks within the distribution area in Northeast Atlantic.

The current perception is based on what is believed to be natural restrictions to the dispersal of all life stages. The stock in Skagerrak (Division IIIa) is thought to be separated from the other stocks through the Wyville-Thomson Sill.

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 of population substructure and local adaptation to depth. An ongoing study, to be published soon (Knutsen *et al*., in prep), covers a larger geographic range and finds indication for population structure throughout the species' distribution range. More specifically, they found that stock structure is clearly evident in the outskirts of the distribution range (Canada and Norway) however, significant but weaker structure, is found among some pairwise samples in the central distribution areas like MAR, west of UK and Greenland (Oral presentation by Knutsen *et al*., 2010 ICELAND DSBS).

A.2. Fishery

For many years the grenadier was only taken as bycatch in bottom-trawl fisheries for *Pandalus borealis* and perhaps *Nephrops*, and it is uncertain if all catches were landed. The interest in marketing bycatches and developing targeted fisheries grew in the 1980s, probably stimulated by the new fisheries to the west of the British Isles and marketing opportunities in e.g. France. The potential for landing and marketing grenadier for human consumption was explored and exploratory surveys were conducted, but a major sustained fishery never developed in this area.

The stock of roundnose grenadier found in the deep parts of Skagerrak (IIIa) was then the basis for commercial exploitation by a few Danish vessels from the late 1980s until 2006, in some years mainly by a single vessel. This directed fishery began in 1987 as an exploratory fishery. Up to 2003 landings increased gradually, from around 1000 t to 4000 t with fluctuations. However, in 2004 and 2005 exceptionally high catches were reported. The catches were landed mainly for reduction. The fishery and catches were both mainly conducted in the Norwegian economic zone of Skagerrak. This directed fishery stopped in 2006 due to implementation of new agreed regulations between EU and Norway concerning this fishery (Bergstad, 2006). Roundnose grenadier is also taken as bycatch in the Danish fisheries for *Pandalus*, in IIIa. However, the landings of this bycatch (also for reduction) are generally insignificant.

Other countries bycatches of roundnose grenadier in IIIa, from such as the Norwegian *Pandalus borealis* fishery, is minor due to a introduction of sorting grid in this fishery since the mid-1990s.

Only Denmark has contributed significantly to this fishery and since 2007 landings have been negligible.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

Landings have been reported to WGDEEP since 1988. Prior to 1988 landings were small or at the level observed in the early 1990s. Danish landings were always dominant, and Norway and Sweden and all other nations reported very minor landings. Until 2000 the landings were mostly below 2500 tonnes per year. Subsequently, the Danish fishery expanded, and in 2005 the landings reported to WGDEEP reached almost 12 000 tonnes. The landings declined again in 2006 to very low levels and have since been stable reflecting only bycatches from other fisheries.

The total Danish landings of this species split in landings for H.C. and for reduction is shown in Table 10.3.1. These landings figures have been estimated on basis of reported logbook records combined with samples of the landed catches for reduction. They differ slightly from the logbook recorded catches, which generally overestimate the true landings. For the period 2001–2006 peak landings within a year were recorded in March–April.

Data are given on the geographical distribution of this fishery from 2006 (Figure 10.3.1). This fishery had a very small geographical distribution and landings was mainly from a very few rectangles in Norwegian zone of Skagerrak.

Table 10.3.1. Danish landings, 1996–2006 of roundnose grenadier split into H.C. landings and landings for reduction.

	Landings of roundnose grenadier (kg)		Total landings
year	H. C.	Reduction	(tons)
1996	6493	2 207 000	2213
1997		1 356 280	1356
1998	635	1 489 000	1490
1999		3 113 000	3113
2000	315	2 400 000	2400
2001	6401	3 061 000	3067
2002	4	4 195 738	4196
2003	7	4 301 661	4302
2004	3129	9 870 664	9874
2005	17 056	1 904 545	11 922
2006	2448	2 259 000	2261

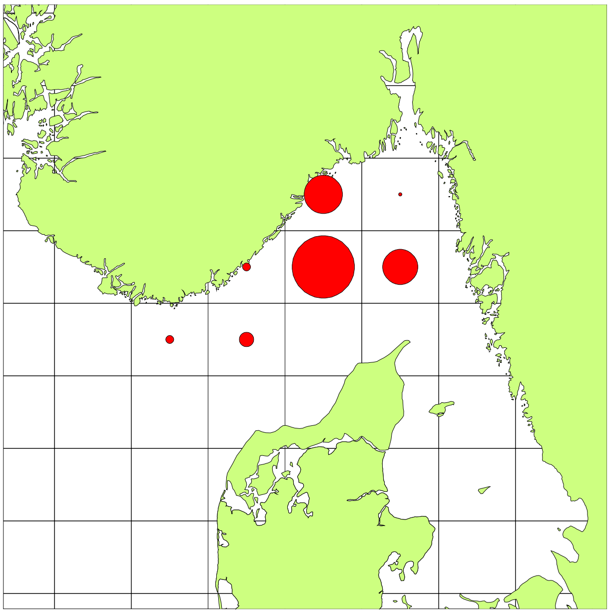

Figure 10.3.1. Geographical distribution of the fishery for roundnose grenadier in IIIa in 2006.

B.2. Biological

Length–frequency data for roundnose grenadier in IIIa are available from a 1987 survey by the Danish research vessel and an experimental Danish fishery in the same year. Samples of the Danish landings 2004–2006 have provided information of the size composition in landings during the major expansion of the fishery, see Figure 10.3.2.

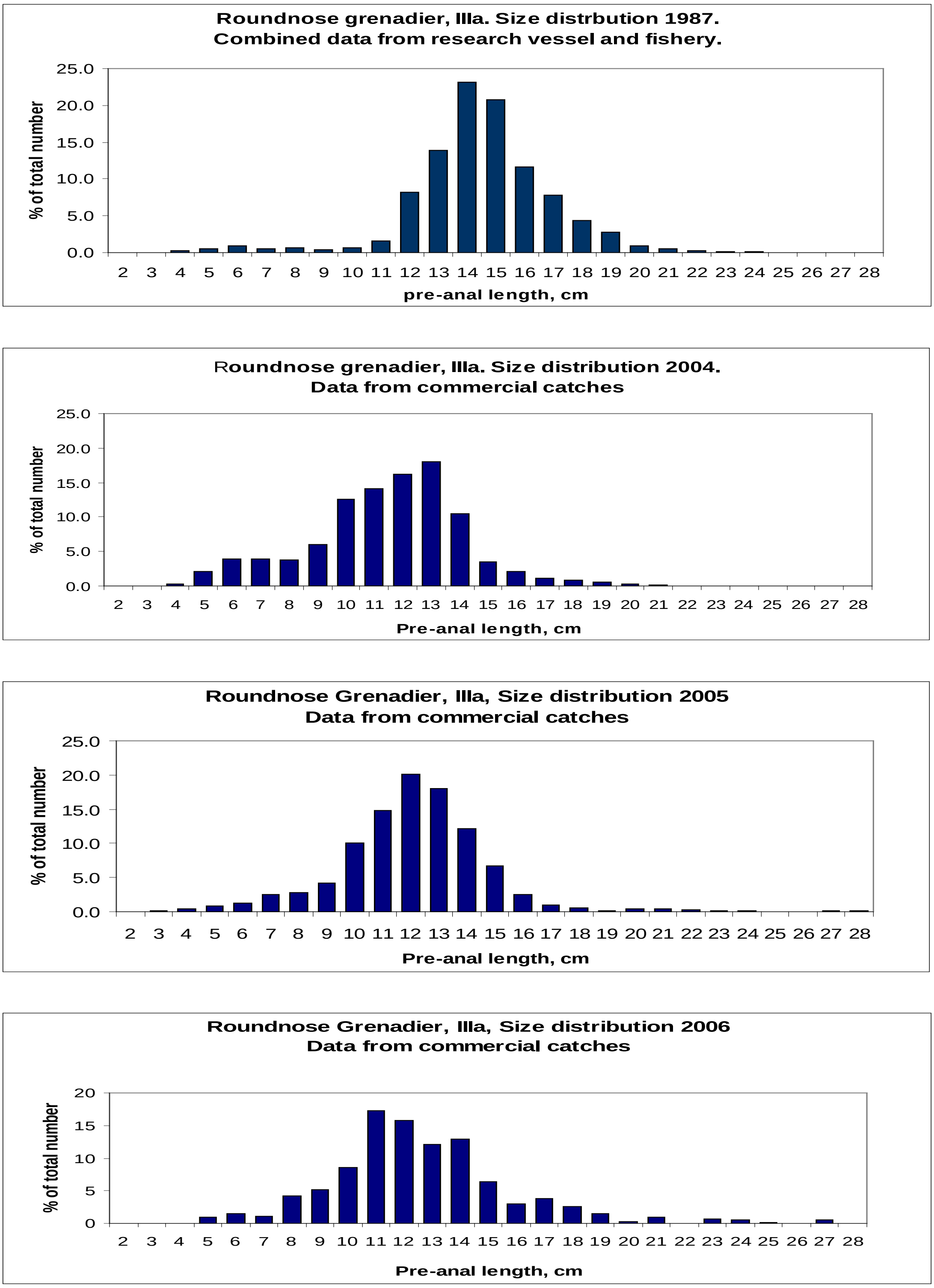

Figure 10.3.2. Size compositions from Danish commercial catches in 1987, 2004–2006.

B.3. Surveys

B.3.1. *Pandalus borealis* survey

An annual *Pandalus borealis* shrimp survey performed by the Institute of Marine Research has been conducted in the area since 1984. The survey is a depth stratified research survey with approximately 25% of the stations deeper than 300 m (depth range 110–520 m). The stations are placed at random within strata and subareas, and the same sites area sampled every year. The survey is thought to have a representative sampling for roundnose grenadier although the survey originally was designed primarily for sampling shrimp. Although some changes occurred over the years, the overall standardization was maintained throughout the time-series (Bergstad *et al.*, 2009 and 2011, WDs to WGDEEP). At present, data from this survey are the only fishery-independent information on this stock from this area.

Biomass and abundance was calculated as mean of all stations at depths >300 m including the stations with zero catches (Figure 10.3.3). Percentage length distributions were standardized to catch size and trawling distance for all stations >300 m with positive catches (Figure 10.3.4).

B.3.2. Other survey data

Investigations by Bergstad (1990) based on data from 1987 in Skagerrak suggest very slow growth and consequently the age distributions in catches could span over 20–30 years.

B.4. Commercial cpue

The overall trends in logbook recorded catch, effort and cpue for the Danish directed fishery on this stock for the period 1996–2006 is showed in Table 10.3.2a–c. A number of different mesh sizes were used in the fishery. The evaluation of the Danish cpue data is presented in ICES (2007) together with suggestive comments. Here it suffices to state, that these cpue figures (Tables 10.3.2a–c) do not provide any clear indications of stock development and status for that period (Figure 10.3.5).

Table 10.3.2a–c. The Danish fishery for roundnose grenadier in IIIa. Trends in catch, effort and cpue by major ICES rectangle, see text.

(A) Total catch (tons) by ICES rectangle

year	44F8	44F9	45F8	45F9	46F9	Total
1996	80	40	25	709	98	951
1997	28	0	115	1088	163	1393
1998	238	235	180	1483	1112	3248
1999	0	25	61	704	1353	2143
2000	0	0	40	893	854	1787
2001	105	11	65	862	956	1999
2002	165	79	0	928	1531	2702
2003	0	120	545	1223	1769	3657
2004	1104	5786	215	1704	1721	10 529
2005	518	4073	682	4739	2823	12 834
2006	26	517	40	1067	487	2136

(B) Total effort (days) by ICES rectangle

year	44F8	44F9	45F8	45F9	46F9	Total
1996	5	23	2	59	6	95
1997	3		7	67	5	82
1998	7	9	4	54	32	106
1999		2	4	43	65	114
2000		2	4	57	48	111
2001	5	8	3	49	65	130
2002	11	7		42	70	130
2003		5	17	70	96	188
2004	99	391	9	74	65	638
2005	47	178	9	107	77	418
2006	2	19	2	24	20	67

(C) Total cpue (tons/day) by ICES rectangle

year	44F8	44F9	45F8	45F9	46F9	Average
1996	16.0	1.7	12.5	12.0	16.3	10.0
1997	9.2		16.4	16.2	32.5	17.0
1998	34.0	26.1	45.0	27.5	34.8	30.6
1999		12.5	15.3	16.4	20.8	18.8
2000		0.0	10.0	15.7	17.8	16.1
2001	21.0	1.4	21.7	17.6	14.7	15.4
2002	15.0	11.3		22.1	21.9	20.8
2003		24.0	32.1	17.5	18.4	19.5
2004	11.2	14.8	23.9	23.0	26.5	16.5
2005	11.0	22.9	75.7	44.3	36.7	30.7
2006	12.8	27.2	20.0	44.5	24.3	31.9

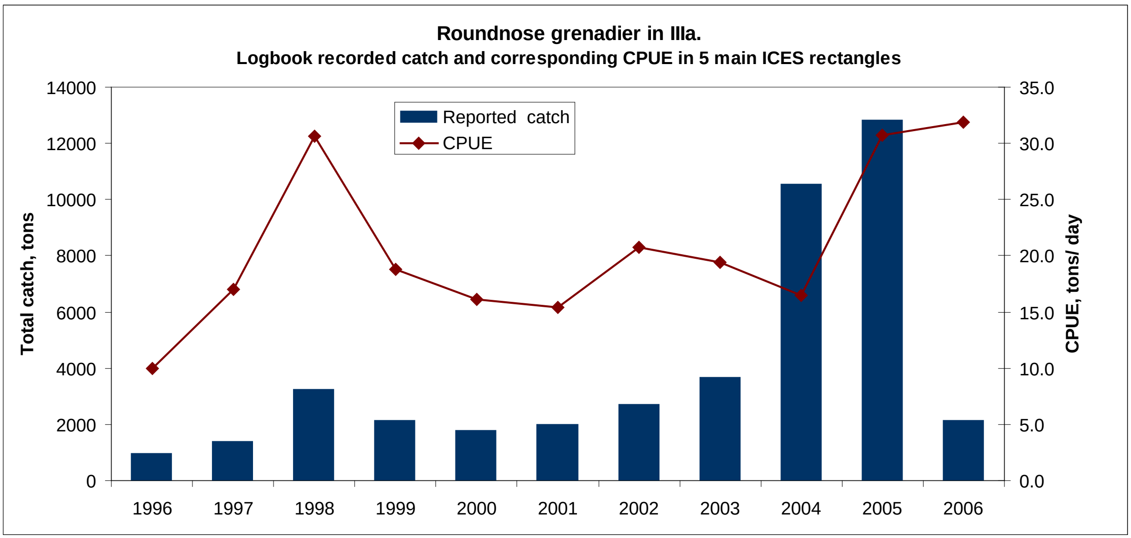

Figure 10.3.5. Danish catches and cpue by main ICES rectangle. Based on logbook records.

B.5. Other relevant data

C. Assessment: data and method

Model used: Survey trends, landings and size distribution from landings during directed fishery.

Software used:

Model Options chosen:

Input data types and characteristics:

Type	Name	Year range	Split on countries	Variable from year to year Yes/No
Landings	Catches in tonnes	1988-2010	Yes	No
Danish cpue commercial catches	Tonnes/day	1996-2006	Danish only	No
Danish commercial length compositions	% of total number	1987 and 2004–2006	Danish only	Yes
Survey catch rate	Kg/hour	1984–2010	Norwegian only	No
Survey length compositions	% of total number	1984–2010	Norwegian only	No
West	Weight at age of the spawning stock at spawning time.			
Mprop	Proportion of natural mortality before spawning			
Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:

6) Weight-at-age in the catch:

7) Exploitation pattern:

8) Intermediate year assumptions:

9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

	Type	Value	Technical basis
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

No biological reference points have been set.

H. Other issues

H.1. Historical overview of previous assessment methods

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9.4 Roundnose grenadier in the Mid-Atlantic Ridge

Stock	Roundnose grenadier (*Coryphaenoidesrupestris*) in Divisions Xb, XIIc and Subdivisions Va1, XIIa1, XIVb1
Working Group	WGDEEP
Date	31th March 2012
Revised by	Vladimir Vinnichenko

A. General

A.1. Stock definition

See annex "Roundnose grenadier in Vb, VI, VII and XIIb".

A.2. 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 seamounts between 46 and 62°N but only 30 of them were commercially important and subsequently exploited. The fishery is mainly conducted using pelagic trawls although on some seamounts it is possible to use bottom gear.

The greatest annual catch of roundnose grenadier (almost 30 000 t) on the MAR was taken by the Soviet Union in 1975, fluctuating in subsequent years between 2800 to 22 800 t. The fishery for grenadier declined after the dissolution of the Soviet Union in 1992. In the last 15 years, there has been a sporadic fishery 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). In 2010 Spain started new target fishery of grenadiers (*M. berglax* and *C. rupestris*) were 1618 t. In 2011 Spanish catch of roundnose grenadier already amounted 3366 t. Grenadier has also been taken as bycatch in the Faroese orange roughy fishery and Spanish blue ling and roughhead grenadier 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.

A.3. Ecosystem aspects

The depth in most of Divisions Xb, XIIc and Subdivisions Va1, XIIa1, XIVb1 is >ca. 4000 m and abyssal is not exploited by fisheries. The major topographic feature is the northern part of the MAR, located between Iceland and the Azores. Numerous seamounts of variable heights occur all long this ridge along with isolated seamounts in other areas such as Altair and Antialtair. The physical structure of seamounts often amplify water currents and create unique hard substrata environments that are densely populated by filter-feeding epifauna such as sponges, bivalves, 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 orange roughy and alfonsinos, and a number of seamounts have been targeted by commercial fleets. Such habitats are however highly susceptible to damage by mobile bottom fishing gear and the fish stocks can be rapidly depleted due to the life-history traits of the species which are slow growing and longer-living than non-seamount species.

The MAR is isolated from the continental slope except for the relatively continuous shallower connections via the Greenland and Scotland ridges, and some seamount chains, e.g. the New England seamounts. 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 populations of both fish and benthic organisms are isolated from the others in the North Atlantic and endemism.

B. Data

B.1. Commercial catch

Landings time-series data per ICES Subareas are available for whole fishery period. Landings by ICES division are available by countries. Landings data by ICES statistical rectangle are not available.

Catch in Subarea XII are allocated to MAR (Divisions XIIa,c) and western Hatton Bank (XIIb) according to knowledge of the fisheries from WG members.

There were no discards of roundnose grenadier on Russian trawlers where smallest fish and waste were used for fishmeal processing. There is no information on discards by other countries vessels.

B.2. Biological data

Size–frequency data (total length distribution) for roundnose grenadier are available for Russian catches for 1972–1990 (Shibanov, 1997). Age estimates were available from Russia for 1974–1990 (Shibanov, 1997).

According to retrospective Russian data, maturation of roundnose grenadier starts when fish are at least 50 cm long total length. Mean length-at-maturity of males and females being 76 and 79 cm (TL) respectively (Savvatimsky, 1992). Some individuals mature at age 6, though some fish may remain immature until age 20 (Savvatimsky, 1969; Shibanov, 1985). No new data on maturity have been collected in recent years.

No specific information is available from the Mid-Atlantic Ridge but natural mortality of 0.1 has been used for roundnose grenadier in Vb, VI, VII and XIIb since 2002. This is based on catch curves from pre exploitation surveys.

B.3. Surveys

There have been number of investigations from the Soviet Union on the northern MAR in the 1972–1990 including trawl acoustic surveys and underwater observations (Shibanov *et al.*, 2002). According to surveys data and analytical assessments in the 1970–1980s a stock size was estimated as 400 000–800 000 t (Baidalinov, 1986; Pavlov *et al.*, 1991; Shibanov, 1997). In the 1990s no research of roundnose grenadier was conducted in the area.

In recent years the MAR-ECO project yielded some biological data (length, age maturity) for roundnose grenadier on the northern MAR.

Trawl acoustic surveys on the MAR were resumed in 2003, when Russian RV *Atlantida* investigated area between 47° and 58°N. According to results of this survey the biomass of the pelagic component of the grenadier only amounted to about 130 000 t (Gerber *et al.*, 2004). It was concluded that the depths of aggregations and the number of small immature fish may have increased as compared to 1970–1980s. Last conclusion was related primarily to northern part of surveyed area (50–58°N). Similar research was carried out again in 2010 in the area between 44° and 50°N (Shnar *et al.*, 2011).

B.4. Commercial cpue

Only nominal catch per fishing day are available from the Soviet/Russian official data from 1974 to 2010. There are gaps in the series due to the lack of catch statistics for 1973 and 1982 as well as absence or too limited of target fishery in 1994–1995 and 2006–2010. These data must be treated with caution because catch rates might be sensitive to several factors (distribution of pelagic concentrations, experience of vessel crew, environmental conditions, etc.) that could not be taken in account so far.

B.5. Other relevant data

No other source of data is used in the assessment.

C. Assessment: data and method

No analytical assessments are used.

D. Short-term projection

No projections are performed.

E. Medium-term projections

No projections are performed.

F. Long-term projections

No projections are performed.

G. Biological reference points

	TYPE	VALUE	TECHNICAL BASIS
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

The current data are inappropriate to provide MSY estimates.

H. Other issues

Because of the particular environmental conditions on the MAR and roundnose grenadier occurring in large concentration, unlike in other areas where it is rather a dispersed species, it may remain impossible to assess the biomass reliably without extensive acoustic surveys.

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10.2 Black scabbardfish in Vb, VI, VII and XIIb

Stock	Black scabbard fish in Subareas Vb and XIIb and Di visions VI and VII
Working Group	WGDEEP
Date	March 2011
Revised by	WGDEEP/Ivone Figueiredo

A. General

A.1. Stock definition

The species is distributed on both sides of the North Atlantic and on seamounts and ridges south to about 30˚N. It occurs only sporadically north of the Scotland-Iceland-Greenland ridges. Juveniles are mesopelagic and adults are bentho-pelagic. It is admitted that the species life cycle is not completed in just one area and also that either small or large-scale migrations occur seasonally. It has been postulated that fish caught to the west of the British Isles are pre-adults that migrate further south (possibly down to Madeira) as they reach maturity.

The stock structure is uncertain. Three management units are considered:

i) Northern (Divisions Vb and XIIb and Subareas VI and VII);

ii) Southern (Subareas VIII and IX);

iii) Other areas (Divisions IIIa and Va Subareas I, II, IV, X, and XIV).

A.2. Fishery

The Faroese fisheries take mostly place in Subarea Vb with a minor activity in Subarea VI. The Faroese deep-sea trawl fishery started in the late 1970s as a mixed redfish, blue ling, grenadier and black scabbardfish fishery; a more directed black scabbard fishery began in the late 1980s (1988) as a result of improvements of the gear and handling of the fish. And from 1993 onwards some of the otter board trawlers have targeted black scabbardfish either seasonally or throughout the year. The main fishing grounds for the species are located on the bank area southwest of the Faroes Islands. The fleet of otter board trawlers (the so called deep-sea trawlers) consist of 13 vessels >1000 HP, but only 1–3 trawlers >2000 HP are targeting black scabbardfish. Landings are mostly derived from Division Vb and the values (about 1400 t) were registered in 2001 and 2002.

In ICES Subarea VI a Scottish mixed deep-water trawl fishery included some catches of black scabbard fish between 1999–2005. This fishery has decreased since the introduction of TACs in 2003.

Following the decline of target orange roughy Irish trawl fishery, landings of black scabbardfish derived from ICES Subareas VI and VII reached about 1000 t in 2002. In the recent years (2008–2010) Irish landings have been null.

The French deep-water fishery operates mainly in Subareas VI and VII targeting roundnose grenadier, black scabbardfish, blue ling and deep-water sharks. Over recent years, the landings of black scabbardfish have declined but landings of other deep-water species (roundnose grenadier, orange roughy, deep-water sharks) have declined in a larger proportion.

The Spanish fishery in Hatton Bank started in 1996, triggered by the decline in catches in traditional fishing grounds. Durán Muñoz and Román Marcote (2001) described the beginning of this fishery and the fleet operating in Hatton. A total of 48 vessels have logged in fishing days at Hatton for the period 2002–2009, but the maximum number of vessels in the fishing grounds in any given month is 16. Most often, and on average, vessels stayed in Division VIb less than two weeks per month, but stayed in Division XII between three and four weeks.

The Northern component comprises fish exploited mainly by trawl fisheries.

Total landings from the ICES Subareas Vb and Divisions VI, VII and XII show a markedly increasing trend from 1999 to 2002 followed by a decreasing trend till 2005. There was a peak in 2006 and then there was a decrease mainly due continuous decreases of landings from ICES Divisions VI and VII.

A.3. Ecosystem aspects

A large proportion of deep-water trawl catches (upwards of 50%) can consist of unpalatable species and numerous small species, including juveniles of the target species, which are usually discarded (Allain *et al*., 2003). The main species in the discards of the trawl fishery in by far the Baird's smoothhead (*Alepocephalus bairdii*) however, a large number of other non-marketable bentho-pelagic species are discarded. The survival of these discards is unknown, but believed to be virtually zero because of fragility of these species and the effects of pressure changes during retrieval (Gordon, 2001). Therefore such fisheries tend to deplete the whole fish community biomass. Depletion of dominant species can induce major changes to fish communities through removing key predatory or forage species.

A study of the impacts of deep-water fishing to the West of Britain using historical survey data found some evidence of changes in size spectra and a decline in species diversity between pre- and post-exploitation data, but the scarce and unbalanced nature of the time-series hampered firm conclusions (Basson *et al*., 2001).

The effects of fishing on the benthic habitat relates to the physical disturbance by the gear used. This includes the removal of physical features, reduction in complexity of habitat structure and resuspension of sediment. More attention has been paid to biogenic habitat that occurs along the slope, mainly the cold-water coral. The main reef building species is *L. pertusa*. Any long-lived sessile organisms that stand proud of the seabed will be highly vulnerable to destruction by towed demersal fishing gear. There are a number of documented reports of damage to Lophelia reefs in various parts of the Northeast Atlantic by trawl gear where trawl scars and coral rubble have been observed (e.g. Hall-Spencer *et al*., 2002). Damage can also be caused on a smaller scale by static gears such as gillnets and longlines (Grehan *et al*., 2003).

In Divisions VI, VII and XIIb there are a number of known areas of cold-water corals. These include the shelf break to the west and north of Scotland, Rockall Bank, Hatton Bank and the Porcupine Bank. The best known site is the Darwin Mounds, located at 1000 m to the south of the Wyville Thompson Ridge. Some of these areas have been heavily impacted by deep-water trawling activities (Hall-Spencer, 2002; Grehan *et al*., 2003).

B. Data

B.1. Commercial catch

The landings from Spanish trawling fleet operating on the Northern and Western Hatton Bank (Divisions VIb1 and XIIb) are available in a routine way since 2004.

Landings from other fleets are available from 1988.

Discard: Discard data from Spanish bottom otter trawl métiers operating Hatton Bank are available from the `Spanish observer Programme' carried out by the IEO since 1996. Trip was the sampling unit, being raised to fleet level using using fishing effort as auxiliary variable.

No data are available on discarding from other fisheries.

B.2. Biological

Since 2003 French length data of black scabbardfish by depth are available based on data from on-board observations of French trawlers.

French length distributions of back scabbardfish by depth have been provided (Figure 11.2.3). Data were derived from on-board observations of French trawlers.

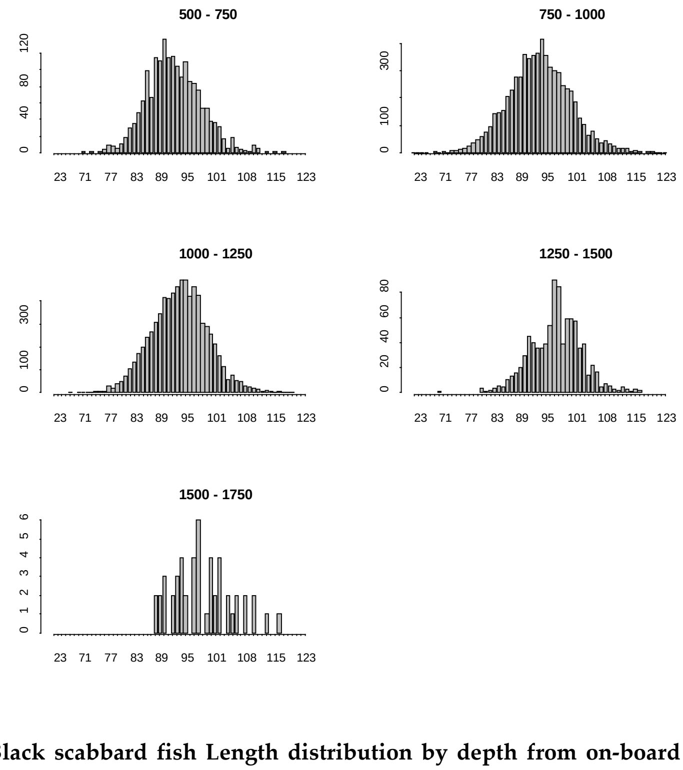

Figure 11.2.3. Black scabbard fish Length distribution by depth from on-board observations of French trawlers in Subarea VI. Numbers were raised to total numbers in haul where black scabbardfish were measured. 2003–2005 combined data.

Length–frequency distributions for the period 1996–2001 (Figure 11.2.4.) have been provided from observers on board Spanish trawling fleet operating on the Northern and Western Hatton Bank (Divisions VIb1 and XIIb).

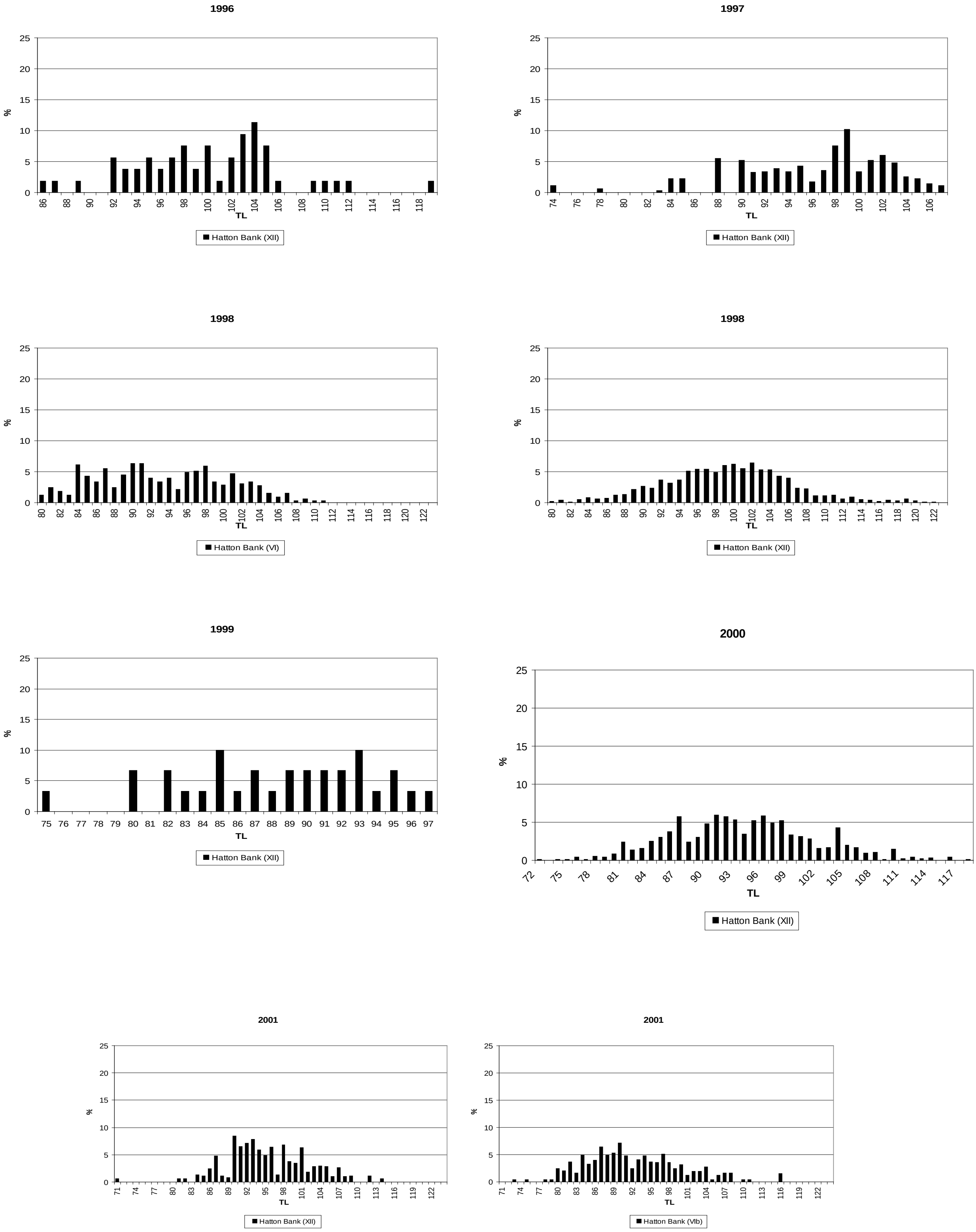

Figure 11.2.4. Black scabbard fish length–frequency distribution by year from on-board observations of Spanish trawlers.

Length on data from Soviet exploratory fishing surveys at late 1970s at Lauzy Bank, Anthon-Dorn Bank and Anthon-Dorn Bank and the Hatton-Rockall Plateau showed that the size range of the species (70–130 cm with higher frequencies at lengths varying between 96–110 cm) do not greatly differ among areas (Vinnichenko *et al.*, 2003).

LHC	Best estimate	Derived from?	Other estimates
Maximum observed length	1510 mm	Figueiredo *et al.*, 2003	
Maximum observed age	32 y	Kelly *et al.*, 1998	15 y (Anon. 2000)
Length at 50% maturity	1028 mm (females)	Figueiredo *et al.* 2003	1095 mm (males) and 1144 mm (females) (Pajuelo *et al.*, 2008).
Growth parameters: (von Bertalanffy parameters: B_0,T_0, L infinity, for example)	(Madeira) Females: Linf = 142 cm; k = 0.260 y^{-1}; t_0 = -2.079 y. Males: Linf = 155.3 cm; k = 0.155 y^{-1}; t_0 = -3.265 y.	Morales-Nin and Sena-Carvalho, 1996	Males: Linf = 1410 mm; k = 0.263 y^{-1}; t_0 = -3.507 y. Females: Linf = 1483 mm; k = 0.196 y^{-1}; t_0 = -4.467 y. All: Linf = 1477 mm; k = 0.200 y^{-1}; t_0 = -4.58 y. (Canary Islands, Pajuelo *et al.*, 2008)
Fecundity, egg size, etc.	73–373 oocytes g^{-1} female (Madeira). Vitellogenic oocytes ranged from 0.60 to 1.50 mm.	Neves *et al.* (2009)	

B.3. Surveys

Survey data on the species are available both from Scottish and Irish surveys. The former is conducted by the Marine Scotland-Science [formerly Fisheries Research Services, (FRS)] along the continental shelf/slope to the northwest of Scotland. The survey was initiated in 1996 with strictly comparable data available between 1998 and 2008. The core area is surveyed between 55–59°N, with trawling undertaken at depths ranging from 300 to 1900 m with most of the hauls being conducted at fixed stations, at depths of around 500 m, 1000 m, 1500 m and 1800 m. Further hauls have been made on seamounts in the area, and on the slope around Rockall Bank, but these are exploratory, irregular and not included in the survey dataset.

The Irish deep-water trawl survey sampled the fish community of the continental shelf slope to west and northwest of Ireland since 2006. Methodology and trawl gear is standardized in accordance with the Scottish deep-water survey with trawling at fixed stations around 500 m, 1000 m, 1500 m and 1800 m.

Length data from Scottish and Irish deep-water surveys were analysed. Mean length by depth stratum shows that smaller length classes are preferentially distributed at depths shallower than 1000 m deep (Figure 4).

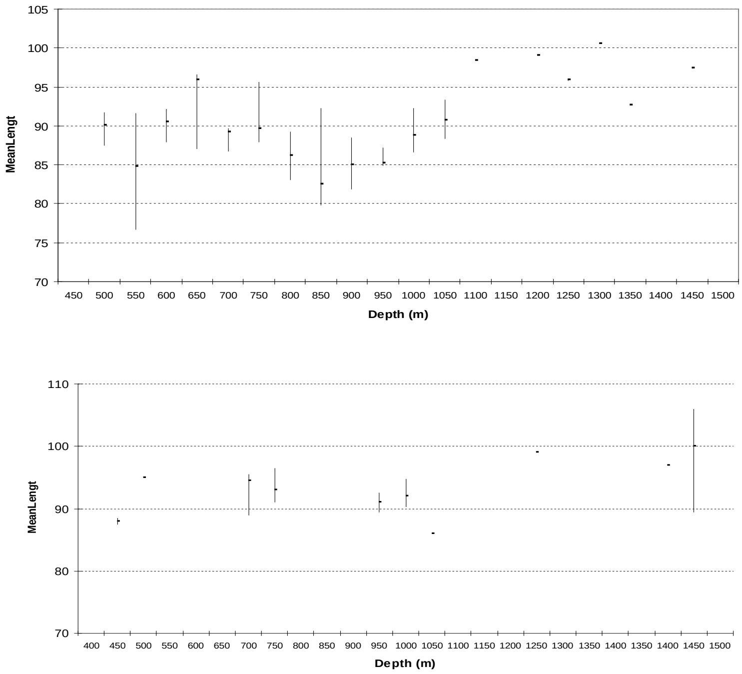

Figure 4. Black scabbard fish mean length per depth stratum from Scottish (upper) and Irish(lower) deep-water surveys.

Annual mean catch rates (kg/h) at depths shallower than 1000 m using on Scottish survey data is presented in Figure 5. The analysis of this suggests the existence of pulses of entrance of smaller specimens. This aspect should be further explored using appropriate statistical tools that enter into consideration the spatial correlation aspects.

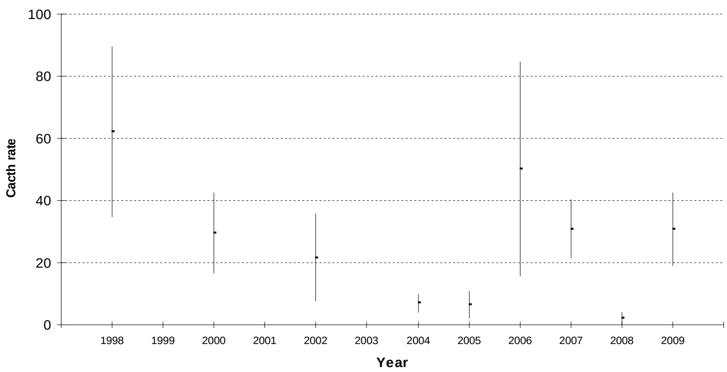

Figure 5. Black scabbard fish average catch rates +/- standard error along years based on Scottish survey data for fishing held at depth shallower than 1000 m.

B.4. Commercial cpue

An lpue series for black scabbardfish was presented based upon the French tallybooks (Pawlowski *et al.*, WD 2009). The tallybook (from skipper own logbooks) database provided by the French industry (PROMA/PMA a producers organization and EURONOR a ship owner), has the advantage in relation to logbook of having the records on a haul by haul resolution and on having fishing depth available (Pawlowski *et al.*, WD 2009).

Lpues estimated for areas to west of the British Isles as defined by Biseau, 2006WD and for the all ICES rectangles are presented in Figures 6 and 7. Estimates show rather wide confidence intervals with no clear trends during the 2000s.

Unstandardized cpue series were determined for the Spanish trawlers operating Hatton Bank using the available data on annual catch and nominal effort (number fishing days). Figure 9. Cpue estimates were presented for Subdivisions VIb1 and XIIb separately, as well as, for the two combined.

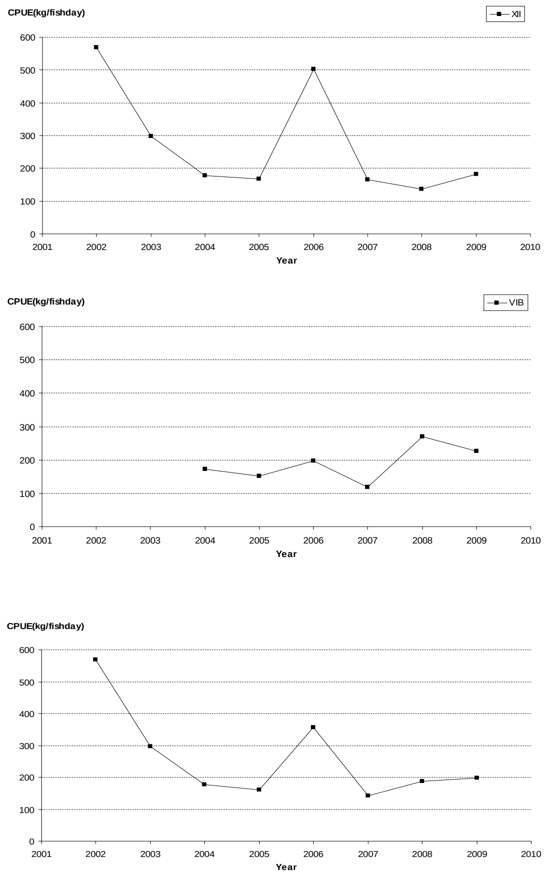

Figure 9. Black scabbard fish cpue (kg/fishing days) in VIb (upper left). XIb (upper right) and the two subareas combined (center) from Spanish trawlers.

B.5. Other relevant data

Information available for ICES Subareas Vb, VI, VII and XII consistently points out to the predominance of small and absence of mature specimens.

C. Assessment: data and method

Model used:

The stock is evaluated based on cpue trends.

Lpues for black scabbardfish are estimated based upon French skippers' tallybooks. The lpue estimates based on tallybooks demonstrate rather wide confidence intervals and do not indicate significant trends during the 2000s. Both the Spanish and the Faroese cpue series were not standardized and both covered a small time range of years.

Software used:

Model Options chosen:

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes			
Canum	Catch-at-age in numbers			
Weca	Weight at age in the commercial catch			
West	Weight at age of the spawning stock at spawning time.			
Mprop	Proportion of natural mortality before spawning			
Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

	Type	Value	Technical basis
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

No biological reference points have been defined.

H. Other issues

H.1. Historical overview of previous assessment methods

The previous assessment trials were done taking into consideration a unique stock in NE Atlantic. However due to the different nature of fisheries in the northern and southern areas and lack of information on migration, the stock has traditionally been divided into northern and southern components for management purposes.

Year	Assessment type[3]	Assessment method(s) used	Assessment package/ program used	Reference
1998	Exploratory	Scheafer Production model	CEDA	WGDEEP 1998
2006	Exploratory	Dynamic Production model	ASPIC	WGDEEP 2006
2006	Exploratory	Bayesian approach to Production model	Winbugs	WGDEEP 2006

I. References

3 Exploratory, Benchmark (to identify best practise), Update (repeat of previous years' assessment using same method and settings but with the addition of data for another year).

10.3 Black scabbardfish in VIII and IX

Stock	Black scabbard fish in Subareas VIII, IX
Working Group	WGDEEP
Date	March 2011
Revised by	WGDEEP/Ivone Figueiredo

A. General

A.1. Stock definition

The species is distributed on both sides of the North Atlantic and on seamounts and ridges south to about 30°N. It occurs only sporadically north of the Scotland-Iceland-Greenland ridges. Juveniles are mesopelagic and adults are bentho-pelagic. It is admitted that the species life cycle is not completed in just one area and also that either small or large-scale migrations occur seasonally. It has been postulated that fish caught to the west of the British Isles are pre-adults that migrate further south (possibly down to Madeira) as they reach maturity.

The stock structure is uncertain. Three management units are considered:

i) Northern (Divisions Vb and XIIb and Subareas VI and VII);

ii) Southern (Subareas VIII and IX);

iii) Other areas (Divisions IIIa and Va Subareas I, II, IV, X, and XIV).

A.2. Fishery

The main fishery taking place in these Subareas is derived from the Portuguese longliners.

In the early 1980s, an artisanal longline fishery targeting this species initiated in Portuguese continental waters. The fishery takes at grounds around Sesimbra port (south of Lisboa, latitude 38°20′N), following a series of exploratory surveys conducted by the Portuguese Fisheries Research Institute (former IPIMAR) in close collaboration with professionals from the fisheries sector some of them from Madeira. These surveys were oriented towards the search of new fishing grounds for the species, the environmental characterization of the ocean layer where black scabbardfish occurs, the experimentation of longline fishing gears and preliminary studies on the biology of the species. For this venture, fishermen from Madeira with large experience in deep-sea longline fishing have greatly contributed. The number of vessels involved in this fishery has rapidly increased, with the fleet comprising a total of 15 longline vessels in 1984.

The fishing method and gear presented by the black scabbardfish longline fleet have developed soon after the initial fishing trials off the Sesimbra coast by fishermen from Madeira. Gear design has been modified from the one initially used (similar to the Madeira traditional longline fishing gears) to catch the species in continental waters to a different configuration, setting horizontal bottom longline, where alternating floats and sinkers occur at constant intervals on the main line (Figure 3). This rearrangement aims to match the intricate vertical distribution exhibited by the species in the slopes and to prevent gear loss on the hard grounds (Henriques, 1997).

At the beginning of the fishery, the fleet was composed by small artisanal vessels, having an average LOA around 11 m and an average tonnage of ca. 16 GRT. In 1988, vessels showed there was a slight increase in both size and engine's power of vessels. However, from 1992 to 1995, average LOA and engine's power characteristics registered the highest raise in relation to 1988, about 30%. In 2000, the fleet experienced again technological improvements, indicated by the increase of engine's power, tonnage and LOA average values. Such improvements were experienced by a limited number of vessels (four), fact also reflected by the increase in standard deviation estimates.

The number of fleet vessels registered its highest value in 1986, but decreased from 1995 to 2004, when the fleet presented the same number of vessels exhibited twenty years before. In the period 1995–2004, the number of new vessels that entered the fleet attained its maximum in 1997 before an equal number of vessels left the fleet in 1998. During the same period, the number of vessels that remained in the fleet has decreased from 17 to 14.

The number of hooks by fishing gear varied since the beginning of the fishery till present days. In the first years of the fishery, gears used 3600 to 4000 hooks (Martins, *et al*., 1989), while, in 1996, its number ranged from 4800 to 5400 (Henriques, 1997). More recently in 2004, the number of hooks by gear varied between 4000 and 10 000. The No. 5 Hook has been commonly used in fishing gears since the beginning of the fishery. The most common bait of the gear is sardine (*Sardina pilchardus*), however, chub mackerel (*Scomber japonicus*) can also be used when sardine is less available or its market price increases. The process of gear preparation, including disentangling, baiting and coiling of the main line into the tubs is carried out ashore by people hired for these tasks and by crewmen when they are not at sea (Henriques, 1997). All the work is performed by hand and is very intensive and laboriously.

Fishing operations usually start at dusk following a well-defined pattern: vessels leave the port early in the night, carrying a previously equipped longline gear, and navigate offshore for a period that varies between one to almost six hours (depending on the vessel and location of the fishing ground). When the vessel is at the fishing ground, two fishing operations generally occur: 1) the longline gear is deployed into the sea and set, 2) another longline gear previously set in the last 24–48 hours (average around 38 hours) is recovered with the aid of a hauling winch installed on board. The occasional presence of cetaceans, whose species and numbers are still to be confirmed, can result in a great economic loss for the fishermen as these marine mammals are attracted by the catch when it reaches the surface and feed on the fish captured.

Fishing takes place on hard bottoms along the slopes of canyons at depths normally ranging from 800 to 1200 m and may attain 1450 m.

The French bottom trawlers operating in subareas mainly VI and VII have a small marginal activity in Subarea VIII.

A.3. Ecosystem aspects

The Bay of Biscay and Iberian Coast region is situated in temperate latitudes with a climate that is strongly influenced by the inflow of oceanic water from the Atlantic Ocean and by the large-scale westerly air circulation which frequently contains low pressure system. The bottom topography of region is highly variable, from continental shelf to abyssal plain. Some remarkable topographic features such as seamounts, banks and submarine canyons can be found. The coastline is also highly diversified with estuaries, rias and wetlands, which all support extremely productive ecosystems.

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

In Division IXa some sporadic information available suggests the existence of coral and sponges. The topography of the region reveals the existence of seamount and canyons usually considered as VMEs.

B. Data

B.1. Commercial catch

Landing data from Subareas VIII and IX are available to WGDEEP. Almost all landings are derived from the Portuguese longline fishery that takes place in Subarea IXa.

The artisanal segment of the commercial fishing fleet of mainland Portugal is responsible for the largest landings' quantities of deep-water species. The on-board discard sampling for longline Portuguese commercial fleet started in mid-2005 and is integrated in the Portuguese Discard Sampling programme, included in the EU DCR/NP. On-board sampling in longline commercial vessels is carried out in a monthly basis to get discards and trip information.

B.2. Biological

Length data: In the scope of the National Minimum Landings Sampling Programme, length frequency and biological samples from Portuguese landing port at Sesimbra were collected on a monthly basis along years.

Ageing: Sectioned otoliths were considered more appropriate for age assignment because growth increments are more evident and ageing of larger specimens is easier than in whole otoliths. In addition although vertebrae are not the most appropriate structure for age assignment, this structure may be useful in the absence of otoliths. The growth parameter estimates of the von Bertalanffy model for Portugal Mainland (ICES Subarea IXa) and Madeira, as well as, for sex separated (Vieira *et al.*, 2009) are:

in parenthesis.

Area	Sex	L_∞ (mm)	k (year^{-1})	T_0 (year)	r
Mainland	females	1354 (42.68)	0.170 (0.022)	−2.040 (0.378)	0.952
	males	1240 (28.99)	0.208 (0.021)	−1.654 (0.284)	0.941
Madeira	females	1586 (41.37)	0.119 (0.009)	−2.282 (0.224)	0.971
	males	1461 (12.78)	0.146 (0.004)	−1.441 (0.065)	0.965

Figure 1.- Von Bertalanffy growth model estimates for *Aphanopus carbo* caught off mainland Portugal and Madeira. Standard deviation in parentheses (Vieira *et al.*, 2009).

Females, particularly those from Madeiran waters, presented a lower growth rate than those from Mainland (ICES Subarea IXa). This reduction in the growth rate seems to be related to the reproductive effort. The differential growth pattern between the females from mainland Portugal (non-reproductive females) and Madeira (reproductive females) may reflect the optimization of the energetic balances (Vieira *et al.*, 2009).

Maturity: In ICES Subarea IXa only immature and early developing specimens have been observed (Figueiredo, 2009 WD). Mature individuals only occurred in Madeira

(Figueiredo *et al*., 2003) and in the Canary Islands (Pajuelo *et al*., 2008) and the north-west coast of Africa although it is possible that two species may occur in these areas.

In Madeira the spawning season takes place from September to December, and females had a GSI peak in November while males achieved theirs a month early. Such high GSI values are typical of synchronous spawners which, according to Tyler and Sumpter (1996) usually present GSI values ranging between 18 and 25 in mature female.

An increase in the relative weight of the liver just before the increase in weight of gonads in females was very conspicuous in Madeira, but it could also be perceived in mainland females. Such strategy is typical of thin fish in which the majority of the energy necessary to maturity is stored in the liver and, after the maturation is reached, the HSI present a sharp decrease. In males, the HSI did not follow the same conspicuous pattern shown in females since the energy needed for their reproduction has lower energy costs than females'.

The HSI revealed a correlation with GSI in females but not in males and no relation of the Fulton's condition factor with the reproduction in both sexes was perceived.

Length of first maturity: The length at first maturity was estimated as 1078 mm for females and 1062 mm for males. This estimative was larger than the one presented by Figueiredo *et al*. (2003) in Madeira waters (1028 mm) but lower to the one found by Pajuelo *et al*. (2008) in the Canary Islands (1095 mm for males and 1144 mm for females). It is probable that individuals from Canary Islands mature at larger sizes than those in Madeira, influenced by the fact that in the former archipelago they are distributed deeper and that they are subjected to different exploitation levels and regional oceanographic conditions (Morales-Nin *et al*., 2002).

Fecundity: Black scabbardfish has a determinate fecundity strategy the relative fecundity estimates ranged from 73 to 373 oocytes/female weight(g). Skipped spawning was also considered to occur in this species; the percentages of non-reproductive females between 21% and 37% (Vieira *et al*., 2009).

B.3. Surveys

No independent-fishery data are available for this stock.

B.4. Commercial cpue

The commercial daily landings from Portuguese longline vessels have been used to derive black scabbardfish monthly lpue values. Data have been provided by the Portuguese General Directorate of Fisheries and Aquaculture.

Monthly lpue are calculated for each vessel as the *ratio* total landed weight (kg)/ number of fishing trips. Only vessels having total monthly landings >= 1000 kg and a monthly number of fishing trips >= five were considered in the analysis.

Although there is no information on the number of hooks used per trip, it is known from interviews with the fishermen that each vessel uses the same number of hooks on each trip (Bordalo-Machado and Figueiredo, 2008). Hence, the effect of the number of hooks on the effort estimates is extracted from the model when we extract the effect of the vessel.

Standardized monthly effort of the fleet is estimated based on the adjustment of GLM model. Factors considered are YEAR, MONTH and VESSEL and the model is expressed as:

$$g(lpue_{ijkl}) = \alpha_i YEAR_i + \beta_j MONTH_j + \lambda_k VESSEL_k + \varepsilon_{ijkl}, \quad (1)$$

where α_i (i = 1995,…, last year), β_j (j = 1,…,12) and λ_k (k = 1,…,33) are coefficients to be determined. The most appropriate distribution the expected or a function of the expected response variable was chosen among the exponential family group of distributions. The quality of the model adjustment was evaluated by quantile residuals analysis.

B.5. Other relevant data

Weight–length relationship: The weight (total weight W) length (Total length TL) relationship for the species (Morales-Nin and Carvalho, 1996) estimated for the species has the following expression:

males W= 0.000154 TL 3.4519, r2 = 0.95
females W= 0.000201 TL 3.3906, r2 = 0.95

Seasonal effect on abundance: Monthly standardized black scabbardfish lpue from the longline fleet operating in Subarea IXa were estimated for the period 1995–2009 (Figueiredo and Farias, 2010 WD). The monthly lpue estimates and the corresponding confidence intervals are shown in Figure 2.

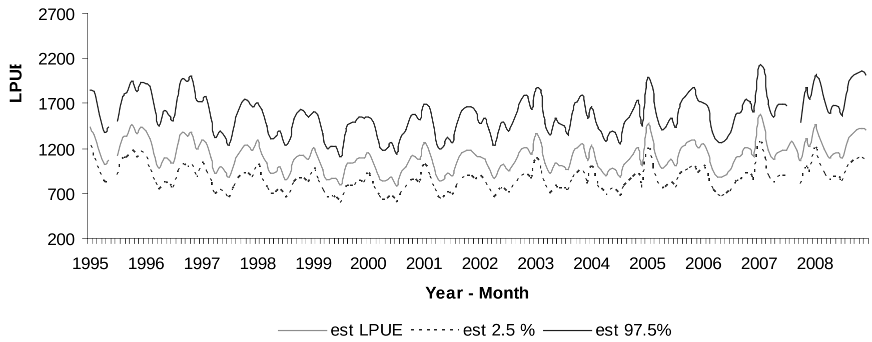

Figure 2. Monthly lpue estimates for ICES Subarea IXa with 95% confidence intervals from the adjusted GLM model (Figueiredo and Farias, WD 2010).

The monthly lpue estimates did not show any marked long-term trend and seem to follow a seasonal pattern along the period in analysis.

C. Assessment: data and method

Model used:

The stock is evaluated based on cpue trends.

The lpue estimate, as well as, other information on the species for the southern component and other components will be analysed under DEEPFISHMAN Project aiming to the development of new approaches that take into consideration spatial stock dynamics.

Software used:

Model Options chosen:

Input data types and characteristics: (table below is just an example; adapt the description of input accordingly).

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes			
Canum	Catch-at-age in numbers			
Weca	Weight-at-age in the commercial catch			
West	Weight-at-age of the spawning stock at spawning time.			
Mprop	Proportion of natural mortality before spawning			
Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used*:*

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

	Type	Value	Technical basis
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

No biological reference points have been defined.

H. Other Issues

H.1. Historical overview of previous assessment methods

The previous assessment trials were done taking into consideration a unique stock in NE Atlantic. However due to the different nature of fisheries in the northern and southern areas and lack of information on migration, the stock has traditionally been divided into northern and southern components for management purposes.

Year	Assessment type3	Assessment method(s) used	Assessment package/ program used	Reference
1998	Exploratory	Scheafer Production model	CEDA	WGDEEP 1998
2006	Exploratory	Dynamic Production model	ASPIC	WGDEEP 2006
2006	Exploratory	Bayesian approach to Production model	Winbugs	WGDEEP 2006

I. References

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Figueiredo, I., P. Bordalo-Machado, S. Reis, D. Sena-Carvalho, T. Blasdale, A. Newton and L.S. Gordo. 2003. Observations on the reproductive cycle of the black scabbardfish (*Aphanopus carbo* Lowe, 1839) in the NE Atlantic. ICES J. Mar. Sci., 60(4): 774–779.

Henriques. 1997.

Martins, M. R., M. M. Martins and F. Cardador. 1989. Portuguese fishery of Black scabbard fish (*Aphanopus carbo* Lowe, 1839) off Sesimbra waters. ICES Demersal Fish committee CM1989/G:38, 29 pp.

Morales-Nin, B, A. Canha, M. Casas, I. Figuereido, L.S. Gordo, J. Gordon, E. Gouveia, C.G. Pineiro, S. Reis, A. Reis and S.C. Swan. 2002. Intercalibration of age readings of deepwater black scabbardfish, *Aphanopus carbo* (Lowe, 1839). ICES J. Mar. Sci., 59(2):352–364.

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3 Exploratory, Benchmark (to identify best practise), Update (repeat of previous years' assessment using same method and settings but with the addition of data for another year).

Pajuelo, J.G., J.A. González, J.I Santana, J.M. Lorenzo, A. García-Mederos and V. Tuset. 2008. Biological parameters of the bathyal fish black scabbardfish (*Aphanopus carbo* Lowe, 1839) off the Canary Islands, Central East Atlantic. Fish. Res., 92(2-3): 140–147.

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Vieira, A.R.Farias, I. Figueiredo, I., Neves, A. Morarales-Nnin, B., Sequeirara, V., Martins, R. ang Gordo, L.S. 2009. Age and growth of black scabbardfish (*Aphanopus carbo* Lowe, 1839) in the southern NE Atlantic Scientia Marina 73Ss.

10.4 Black scabbardfish in other areas

Stock	Black scabbardfish other areas (I, II, IIIa, IV, X, Va, XIV).
Working Group	WGDEEP
Date	March 2011
Revised by	WGDEEP/Ivone Figueiredo

A. General

A.1. Stock definition

The species is distributed on both sides of the North Atlantic and on seamounts and ridges south to about 30°N. It occurs only sporadically north of the Scotland-Iceland-Greenland ridges. Juveniles are mesopelagic and adults are bentho-pelagic. It is admitted that the species life cycle is not completed in just one area and also that either small or large-scale migrations occur seasonally. It has been postulated that fish caught to the west of the British Isles are pre-adults that migrate further south (possibly down to Madeira) as they reach maturity.

The stock structure is uncertain. Three management units are considered:

i) Northern (Divisions Vb and XIIb and Subareas VI and VII);

ii) Southern (Subareas VIII and IX);

iii) Other areas (Divisions IIIa and Va Subareas I, II, IV, X, and XIV).

A.2. Fishery

The fisheries in the other areas have been taken place in different ICES subareas and different years.

In ICES Division IXa2 (Azorean EEZ) black scabbardfish fishery in the Azores has received sporadic experimental activity despite previous indications that a potential for a fishery exists (Vinnichenko, 1998; Hareide and Garnes, 2001). The absence of a local market and the complexity of the gear and labour requirements for its operation have thus far limited the development of the fishery. The commercial value of the species is, however, well-established in other regions.

A Faroese exploratory trawl fishery took place in 2008 in the Mid-Atlantic Ridge area. This fishery was mainly targeting at orange roughy and black scabbardfish, and was undertaken in the period 13 February to 9 March 2008 in ICES Areas X and XII according to a resolution adopted at the 26th Annual Meeting of NEAFC on management measures for orange roughy. The fishery was performed with one trawler (M/S Ran TG0752) with many years participation in the Faroese orange roughy fishery. The gear used was a bottom trawl. Locations of catches of black scabbardfish are shown in Figure 3.

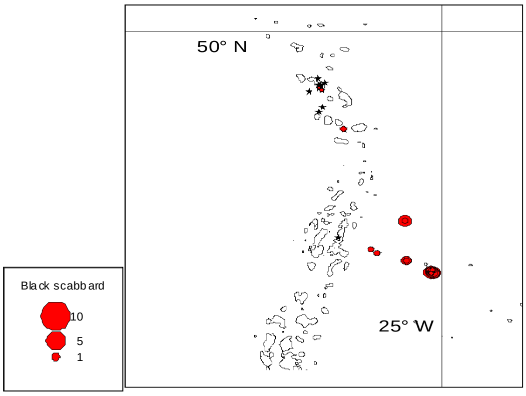

Figure 3. Faroese exploratory survey total catches of black scabbardfish (tonnes).

Total landings in "other areas" were quite variable along the years under analysis. Such variability seems to clearly reflect the ICES subarea where fisheries took place.

Landings from 1989 to 1992 were mainly derived from French trawlers operating at ICES Subarea IV (this may be misreported). In Faroese landings derived from ICES Subarea X (370 t) had significantly contributed for the maximum observed.

Landings from 1998 to 2000 were mainly derived from Portuguese longliners operating in ICES Subarea X. From 2004 onwards landings were mainly derived from Faroese trawlers both operating in ICES Subarea X. In 2009 the Faroese landings attained nearly 160 t.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

Landing data are available from 1989 to present but these are derived from experimental fisheries that have been taken place in different ICES subareas and different years.

In Subareas II, IV and XIV reported landings are considered to be misreported although the extent of this is unknown.

Two species of Trichiuridae occur in the Azores, *Aphanopus. carbo* and *Aphanopus intermedius.* Landings in Subarea X may contain a mixture of these two species.

B.2. Biological

Considerable general information is available in the life-history characteristics of this species.

Recent genetic studies have shown that two species two species of Trichiuridae occurred in the Azores; *A. carbo* and *Aphanopus intermedius* and that in Pico *A. intermedius* dominated, characterized by smaller fish (Stefanni and Knutsen, 2007).

Length: Length–frequency distribution based on data collected at 2008 Faroese exploratory survey for the all hauls pooled is shown in Figure 2. This distribution mainly reflects the length composition of the species from western seamounts of ICES Subarea Xb.

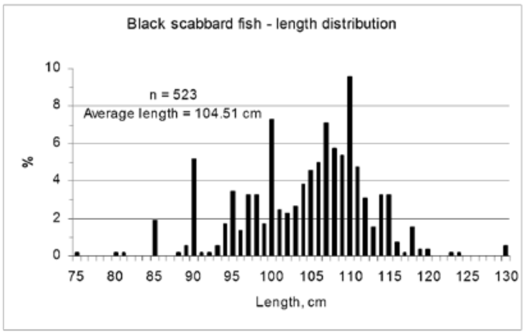

Figure 2. Faroese exploratory survey in Subarea X, 2009. Black scabbardfish. Total length distribution in all hauls.

Reproduction: ICES Subarea X. In Azorean waters females in spawning condition (GSI >3 up to 9) with total lengths between 108 and 137 cm occurred predominantly in October and in November (J. Pereira, pers. comm.). The length 108 cm corresponds to the estimate of first maturity determined for Madeira specimens. Spawners were observed around the Azores from November to April (Vinnichenko, 2002).

B.3. Surveys

No surveys are available for this stock.

B.4. Commercial cpue

No data are available for this stock.

B.5. Other relevant data

The spatial coverage of the EC TAC management units for this species does not correspond to the assessment units considered by ICES (Figure 4).

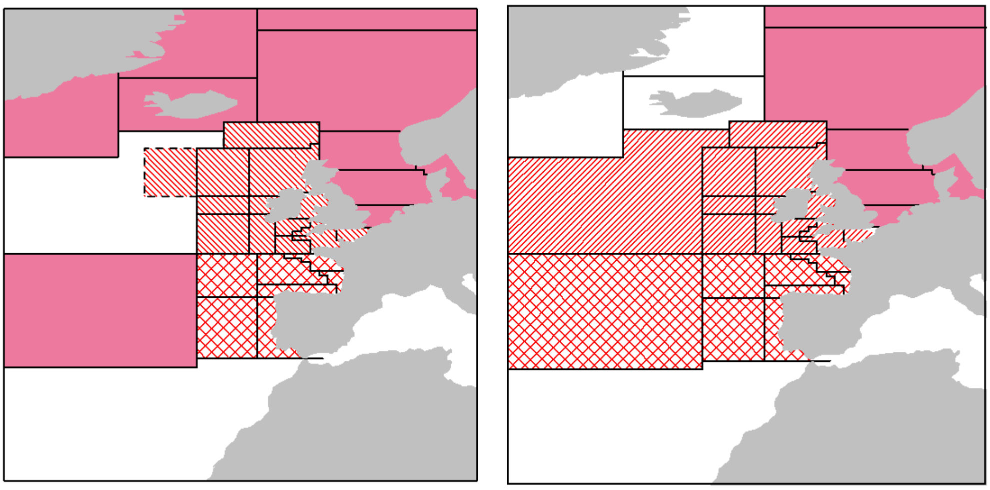

Figure 4. Black scabbardfish in other areas. ICES assessment units (left) (solid pink I, II, III, IV, Va, X, XIV; diagonal lines Vb, VI, VII, XIIb; cross-hatched VIII, IX). Management areas for EU TAC, excluding CECAF areas, are shown to the right (solid pink I, II, III, IV; diagonal lines V, VI, VII, XII; cross-hatched VII, XI, X).

C. Assessment: data and method

Model used:

Only landings data available.

Software used:

Model Options chosen:

Input data types and characteristics: (table below is just an example; adapt the description of input accordingly).

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes			
Canum	Catch-at-age in numbers			
Weca	Weight at age in the commercial catch			
West	Weight at age of the spawning stock at spawning time.			
Mprop	Proportion of natural mortality before spawning			
Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

	Type	Value	Technical basis
MSY	**MSY $B_{trigger}$**	**xxx t**	**Explain**
Approach	**F_{MSY}**	**Xxx**	**Explain**
	B_{lim}	**xxx t**	**Explain**
Precautionary	**B_{pa}**	**xxx t**	**Explain**
Approach	**F_{lim}**	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

No reference points are defined for this assessment unit.

H. Other issues

H.1. Historical overview of previous assessment methods

I. References

Hareide N. R., Garnes G. 2001. The distribution and catch rates of deep-water fish along the Mid-Atlantic Ridge from 43 to 61°N. Fisheries Research;51:297–310.

Vinnichenko V. I.ICES Document CM 1998/O: 18. 1998. Russian investigations and fishery on seamounts in the Azores area; p. 19.

Stefanni S., Knutsen H. 2007. Phylogeography and demographic history of the deep-sea fish, *Aphanopus carbo*, in the NE Atlantic: vicariance followed by secondary contact or speciation? Molecular Phylogeny and Evolution; 42:38–46.

Vinnichenko. 2002.

Reinert. 2010. WD

11 Greater forkbeard all areas

Stock	Greater forkbeard in all ecoregions
Working Group	WGDEEP
Date	March 2013
Revised by	WGDEEP 2013/Guzman Diez

A. General

A.1. Stock definition

The greater forkbeard is a gadoid fish which is widely distributed in the Northeastern Atlantic from Norway and Iceland to Cape Blanc in West Africa and the Mediterranean (Svetovidov, 1986; Cohen *et al*., 1990). It is distributed along the continental shelf and slope in depths ranging between 60 and 800 meters but recent observations on board of commercial longliners and research surveys extend the depth range to below 1000 m (Stefanescu *et al*., 1992).

Unfortunately very little is known about stock structure of the species. Currently ICES considered greater forkbeard as a single stock for all the ICES area greater forkbeard in the Northeast Atlantic. Probably the stocks structure is more complex, but further studies needs to be implemented to allow a scientific basis for the stock structure.

A.2. Fishery

Greater forkbeard is as a bycatch species in the traditional demersal trawl and longline mixed fisheries targeting species such as hake, megrim, monkfish, ling, and blue ling in Subareas VI, VII, VIII and IX.

Since 1988, 71% of landings have come from Subareas VI and VII. Spanish, French 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 20% of landings in this period come 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 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 other 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 1% of total deep-water landings in the last three years, can be considered as bycatch.

A.3. Ecosystem aspects

For greater forkbeard can be applied the same ecosystem considerations of other deep-water fisheries in the areas defined for the stocks. Fishing is a major disturbance factor of the continental shelf communities of the regions. As the fishery of greater forkbeard is mainly a bycatch of trawler fishery in all ecoregions, the main affections on the ecosystem is the impact on the sediment compound.

B. Data

B.1. Commercial catch

Commercial catch are available from the Basque Country trawler fleet (OTB and LLS) operating in Subareas VI, VII and VIII from 2006 to 2012. Owing to the bycatch status of the species, they may be unreliable and significant discards occur in some fisheries, in particular on the shelf where juvenile greater forkbeard occur.

B.2. Biological

The biology of the species is poorly known. In general most of biological data are not reliable or not available (e.g. age composition, maturity, growth, natural mortality…). In Tables 3 and 4 a compilation of biological available data are shown. (WGDEEP 2001 (ICES C.M. 2001/ACFM: 23; Lorance 2010)). The spawning areas and seasonality are also not well (or at all) identified. Only historical series of length frequencies from surveys were available.

Biological reference points based on the L_{MAX} and AFC from Casas and Piñeiro, 2000 [1] (VIIIc and IXa) and Muus and Nielsen, 1999 [2] (Mediterranean Sea):

		Lmax	AFC	Linf	k	M	t0	Agemax	Agemat
Greater forkbeard	females	84 [1]	1y [1]	113.3 (1)	0.0886 [1]		0.663 [1]	14 [1]	3–4 y [2]
	males	44 [1]	1y [1]	54.9 [1]	0.217 [1]		0.556 [1]	6 [1]	3–4 y [2]

The following BRP have been extracted from the Table 1, Gislason *et al*., 2008:

	Lmax	Linf	k	Age Mat	Fmax	F0.1	F10	F20	F30	F35	F40
females	84	86.6	0.181215	3.1	0.24	0.14	0.34	0.22	0.15	0.13	0.11
males	44	45.8	0.272311	2	0.48	0.26	0.61	0.38	0.27	0.23	0.2

WKLIFE Gislason spreadsheet was applied using values for L_{max} and AFC derived from Casas and Pineiro, 2000 and Muus and Nielsen, 1999. Some of the parameters estimated by the model (L_{inf}, k,) were different from those derived by those authors. Notwithstanding, if $F_{40\%SPR}$ is adopted as a proxy for F_{MSY} the values obtained do not seem unrealistic.

Table 3. Life-history characteristics of greater forkbeard (from WGDEEP 2001 (ICES C.M. 2001/ACFM: 23; Lorance, 2010).

LHC	SEX	ESTIMATE	AREA (MONTH)	REFERENCE
Maximum observed length (TL, cm)	combined	50	VIIIc and IXa	Sanchez *et al.*, 1995
	female	84	VIIIc and IXa	Casas and Piñeiro, 2000
	male	44	VIIIc and IXa	Casas and Piñeiro, 2000
Maximum observed age (year)	female	14	VIIIc and IXa	Casas and Piñeiro, 2000
	male	6	VIIIc and IXa	Casas and Piñeiro, 2000
	combined	2	Atlantic	Cohen *et al.*, 1990
	female	9	NE Atlantic	Kelly, 1997
	male	7		
	combined	15	NE Atlantic	EC FAIR, 1999, Sub-t. 5.12, Doc.55
Length at 50% maturity (PAFL, cm)	female	33 cm	NE Atlantic	Cohen *et al.*, 1990(1,2)
	male	18 cm	Mediterranean	Cohen *et al.*, 1990(1,2)
	female	32 cm	NE Atlantic	Kelly, 1997
	male	31 cm	Mediterranean	
Age at 50% maturity Combined (year)	combined	3–4 yrs	Mediterranean sea	Muus and Nielsen, 1999
Length of smallest individuals caught (TL)	combined	6 cm	VIIIc and IXa	Casas and Piñeiro, 2000
		8 cm	VIIIa,b,d (October–November)	Data from French western IBTS
		8 cm	VIIg–k (Octtober–November)	Data from French western IBTS
Age of youngest individuals caught (year)	combined	<1yr	VIIIc and IXa	Casas and Piñeiro, 2000
Length of the first mode of the length distribution	combined	13.9 cm	VIIIc, IXa (April)	Casas and Piñeiro, 2000
		16.9 cm	VIIIc, IXa (September)	Casas and Piñeiro, 2000
		17.4 cm	VIIIc, IXa (October)	Casas and Piñeiro, 2000
		16 cm	VIIIa,b,d (October–November)	Data from French western IBTS

Unclear whether it is mean length at first maturity or length of smallest mature individual.

Table 4. Growth parameters of greater forkbeard. (from WGDEEP 2001 (ICES C.M. 2001/ACFM:23; Lorance, 2010)).

SEX	L∞	K	T0	AREA	REFERENCE
Male	41.7	0.208	N/A	Gulf of Lions (Med.)	Nony, 1983 (from FishBase)
Female	51.2	0.258	N/A	Gulf of Lions (Med.)	Nony, 1983 (from FishBase)
Combined	57.7	0.168	-0.66	Aegean sea (Med.)	Papaconstantinou *et al.*, 1993
Male	54.9	0.217	-0.663	VIIIc and IXa	Casas and Piñeiro, 2000
Female	113.3	0.0886	-0.556	VIIIc and IXa	Casas and Piñeiro, 2000

B.3. Surveys

Data of abundance, length frequencies of *P. blennoides* and area covered by hauls from the of Spanish survey in Porcupine and data of length frequencies from Spanish Cantabrian sea and French western and Scottish IBTS and Irish surveys has been used in the assessment.

Data from surveys are available in the DATRAS database and at national level. Most surveys do not cover the deeper part of the depth distribution of the species.

B.4. Commercial effort and cpue

Commercial effort (fishing days) and cpue (kg/fishing days) are available from the Spanish fleet in 2012.

B.5. Other relevant data

Landings and effort data in XIIb should be included into the assessment if they become reliable. Landings and discards from all areas and fisheries where greater forkbeard occur should be compiled. Because greater forkbeard is a bycatch in shelf and slope fisheries and is subject to discards data on total catch are essential to assess the stock(s).

Greater forkbeard is caught in a number of surveys that are likely to provide reliable trends in either total abundance, recruitment of both. It is recommended that survey data are used to assess stocks trends.

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

C. Assessment: data and method

Model used:

Survey trends-based assessment

Software used: Not applicable

Model Options chosen: Not applicable

Input data types and characteristics: (table below is just an example; adapt the description of input accordingly).

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes			
Canum	Catch-at-age in numbers			
Weca	Weight at age in the commercial catch			
West	Weight at age of			

	the spawning stock at spawning time.
Mprop	Proportion of natural mortality before spawning
Fprop	Proportion of fishing mortality before spawning
Matprop	Proportion mature at age
Natmor	Natural mortality

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Not applicable.

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Not applicable.

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-Term Projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

Based on the LMAX and AFC from Casas and Piñeiro, 2000 (1) (VIIIc and IXa) and Muus and Nielsen, 1999 (2) (Mediterranean Sea).

		Lmax	AFC	Linf	k	M	t0	Agemax	Agemat
Greater forkbeard	females	84 (1)	1y (1)	113.3 (1)	0.0886 (1)		0.663 (1)	14 (1)	3–4 y (2)
	males	44 (1)	1y (1)	54.9 (1)	0.217 (1)		0.556 (1)	6 (1)	3–4 y (2)

The following BRP have been extracted from the Table 1, Gislason *et al.*, 2008:

	Lmax	Linf	k	Age Mat	Fmax	F0.1	F10	F20	F30	F35	F40
females	84	86.6	0.181215	3.1	0.24	0.14	0.34	0.22	0.15	0.13	0.11
males	44	45.8	0.272311	2	0.48	0.26	0.61	0.38	0.27	0.23	0.2

WKLIFE Gislason spreadsheet was applied using values for L_{max} and AFC derived from Casas and Pineiro, 2000 and Muus and Nielsen, 1999. Some of the parameters estimated by the model (L_{inf}, k,) were different from those derived by those authors. Notwithstanding, if $F_{40\%SPR}$ is adopted as a proxy for F_{MSY} the values obtained do not seem unrealistic.

H. Other issues

H.1. Historical overview of previous assessment methods

I. References

12 Alfonsinos

Stock	Alfonsinos/Golden eye perch (*Beryx* spp.)
Working Group	WGDEEP
Date	March/2011
Revised by	WGDEEP 2011 and 2012/Mário Pinho)

A. General

A.1. Stock definition

The alfonsinos *Beryx* spp. are deep-water species that occur throughout the world's tropical and temperate waters, in depths from 25 to 1300 meters. The 2004 WGDEEP Report made reference to preliminary genetic results for *B. splendens* suggesting that significant genetic differentiation may occur between populations of the species within the North Atlantic, which may have some implications for future management of the fisheries. No further information is available. Because very little is known about stock structure of these species, the WG has assumed single stocks of both *B. splendens* and *B. decadactylus* in the North Atlantic.

A.2. 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. Historical time-series by species is only available from the Azores fishery.

From 1988 to 1993 almost only the Azores (Subdivision Xa) was involved on the fishery (representing 94% of the landings). The Azores deep-water fishery is a multispecies (up to 20 or more) and multigear fishery dominated by the main target species *Pagellus bogaraveo*. This fishery has continued throughout the period from 1994 onwards.

During 1994 to 2000, Russian pelagic trawlers were responsible for high catches in Subdivision Xb (a seamount fishery on Mid-Atlantic Ridge) and some minor landings as bycatch in fisheries targeting other species since 2000.

Other ICES subareas with important catches from the mixed demersal and deep-water fisheries (mainly trawlers and longliners) are VI and VII, with an average contribution of around 10–20% of the total reported catch to ICES during 1996 to 2007 and Areas VIII and IX, which landings averaged around 30% of the total from 1997 to 2007.

A.3. Ecosystem aspects

The Azores (Division Xa) are considered a "seamount ecosystem area" because of its high seamount density. The deep-water fishery in the Azores is mostly a seamount fishery where only bottom longlines and handlines are used (there is a trawl ban area implemented on the Azores EEZ (ICES Xa2) under the CFP. There are NEAFC regulations of effort in the fisheries for deep-water species and closed areas to protect vulnerable habitats.

B. Data

B.1. Commercial catch

For this species data are available from commercial fisheries reported to ICES for the different ICES subareas from 1988 to present. Landings data are usual aggregated by species. More detailed data by species is available from the Azores (Division Xa). Azorean data from commercial fisheries include landings (auction data) and some effort data from longliners inquires (since 1990), logbooks and observers (from large longliners and for recent years) (WD Pereira, 2006a, 2010a).

Discards from this fishery have been increased in the recent years, due to quota restrictions and minimum length measures. Information on discarding in the Azores has been made available to the WG since 2007 (ICES, 2006, 2010).

B.2. Biological

Length compositions and biological information including (ageing, weights, sex ratio and maturity) by species have been collected since 2002, analysed and reported to ICES (WD Pereira, 2006b, 2010b).

Considerable general information is available on the life-history characteristics of this species.

B.3. Surveys

Annually survey (ARQDAÇO) data are available from the Azores, since 1995. The survey was conducted annually each spring (usually from April to June) since 1995, with exception of the years 1998, 2006 and 2009. The survey followed a stratified design (six statistical areas and 12 depth strata) and covered the Azores archipelago around the islands, and major seamounts). The survey is design for abundance estimation of red (blackspot) sea bream, covering the depth strata from 50 to 600 m. During 2004 this depth was extended to 800 m in order to cover the depth range of the species. Additionally depth from 800 to 1200 m is covered in one transect by statistical area for ecological studies. Details of the survey design can be found Menezes *et al.* (2006) and a resume of the survey design can be found on the ICES WGNEACS 2010 report.

Abundance index time-series (computed for the depth range 50–600 m) is available by species. For *Beryx splendens* the survey sampled all the species depth habitat, however concerns about the reliability of this index as a proxy of North Atlantic stock have been expressed by the WG, because it may be not adjusted to the species behaviour (bentho-pelagic, highly mobile and aggregative) and the sampled area represented a very small part of the species distribution. Length composition and several biological data (sex, weight, otoliths and maturity) have been also collected and reported to ICES.

B.4. Commercial cpue

Standardized cpue was presented to ICES in 2006. Since then only nominal cpue has been available (WD Pereira, 2006c; WD Pereira and Pinho, 2010).

B.5. Other relevant data

C. Assessment: data and method

D. Short-term projection

E. Medium-term projections

F. Long-term projections

G. Biological reference points

	TYPE	VALUE	TECHNICAL BASIS
MSY	**MSY $B_{trigger}$**	**?**	**Unknown**
Approach	**F_{MSY}**	**?**	**Unknown**
	B_{lim}	**?**	**Unknown**
Precautionary	**B_{pa}**	**?**	**Unknown**
Approach	**F_{lim}**	**?**	**Unknown**
	F_{pa}	**?**	**Unknown**

Reference points

Tools available from the WKLIFE were explored for the *Beryx splendens* last year. The analysis was not performed for *Beryx decadactylus*.

- YPR using FLR code (BHAC). The input parameters: Loo=46.1, K=0.12, M=0.23, cm(L_{mat}/L_{inf})=0,65 and c(Lc/L_{inf})=0,45).
- Z was estimated from a catch curve applied to the fishery length frequency.
- Froese and Binolhan, 2000 method assuming the mean fishery length composition over the period 1995 to 2010.
- Results from WKLIFE Gislason spreadsheet was applied using an L_{MAX} of 53 cm and AFC = 6.

Results are summarized in the table.

Method	AFC	Lmax	Linf	k	To	Age Mat	Fmax	F0.1	F20%	F30%	F35%	F40%
Gislason spreadsheet	6	53	55.1	0.24		2,3	1.11	0,42	2	2	2	2
BHAC	6		56,7	0,13	-1,46	4	-	0,3	0.59	0,36	0,28	0,23

Data used for this exercise refers to information published from the area and so results may be valid if we consider the population structure from the Azores as representative of the North Atlantic population. Conflict results are found in the literature, with length of first maturity ranging from 23 cm to 35 cm fork length. We adopt the value of 23 cm.

Gislason method estimate high values for almost of the reference points. The most conservative is the $F_{0.1}$ equal to 0.42. Bhac estimates suggest values on a range of 0.2 to 0.3, correspondent to F_{40}, $F_{35\%}$ and $F_{0.1}$.

No biological reference points have been defined.

H. Other issues

H.1. Historical overview of previous assessment methods

I. References

ICES. 2006. Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources. ICES CM 2006/ACFM:28.

ICES. 2010. Working Group for Northeast Atlantic Continental Slope Survey. ICES CM 2010/SSGESST:16, REF. SCICOM, ACOM.

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Meneses, G. M., M. F. Sigler, H. M. Silva, and M. R. Pinho. 2006. Structure and zonation of demersal and deep-water fish assemblages off the Azores Archipelago (Mid-Atlantic). Marine Ecology Progress Series, 324:241–260.

Pereira. 2006a. Statistical data on selected deep sea species from the Azores fishery. WD WGDEEP 2006.

Pereira. 2006b. Statistics and biological data on the Alfonsinos, *Beryx decadactylus* and *Beryx splendens* from the Azores. WD WGDEEP 2006.

Pereira. 2006c. Standardized cpue for the Alfonsino *Beryx splendens* from ICES Area X. WD WGDEEP 2006.

Pereira. 2010a. Statistical data on selected deep sea species from the Azores fishery. WD WGDEEP 2010.

Pereira. 2010b. Updated statistics and biological data on the Alfonsinos, *Beryx decadactylus* and *Beryx splendens* from the Azores.

13.2 Red sea bream in Subareas VI, VII and VIII

Stock	Red Sea bream (*Pagellus Bogaraveo*) in Subareas VI, VII and VIII
Working Group	WGDEEP
Date	March 2013
Revised by	WGDEEP 2011/Guzman Diez

A. General

A.1. Stock definition

"*Stock limits are generally determined not only by biological considerations but also by agreed boundaries and coordinates. ICES considered three different components for this species: a) Areas VI, VII, and VIII; b) Area IX, and c) Area X (Azores region). This separation does not pre-suppose that there are three different stocks of red (blackspot) sea bream, but it offers a better way of recording the available information*" (ICES, 2007).

In fact, the interrelationships of the red (blackspot) sea bream (*Pagellus bogaraveo*) from Subareas VI, VII, and VIII, and the northern part of Division IXa, and their migratory movements within these sea areas have been confirmed by tagging results (Gueguen, 1974). Possible links between red (blackspot) sea bream from the Azores region (Subarea X) with the others areas are not yet fully studied. However, recent studies show that there are no genetic differences between populations from different ecosystems within the Azores region (east, central and west group of islands, and Princesa Alice Bank) but there are genetic differences between Azores (ICES Subarea X) and mainland Portugal (ICES Division IXa) (Stockley *et al*., 2005). These results, combined with the known distribution of the species by depth and tagging information, suggest that Subarea X component of this stock can be considered as a separate management unit.

A.2. Fishery

The fishery in Subareas VI, VII and VIII strongly declined in the mid-1970s, and the stock is seriously depleted. Since 1988 the landings from Subarea VIII represents the 67% and VI and VII the 23% of total accumulated landings. At present red sea bream catches in these areas are almost all bycatches of LLS and OTB fleets. Small artisanal and recreational landings from Bay of Biscay from are not reported to the working group.

A.3. Ecosystem aspects

The red blackspot sea bream is found in the Northeast Atlantic, from south of Norway to Cape Blanc, in the Mediterranean Sea, and in the Azores, Madeira, and Canary Archipelagos (Desbrosses, 1938; Pinho and Menezes, 2005**)**. Hareide (2002) reported also occasional occurrence of this species along the Mid-Atlantic Ridge (north and south of the Azores).

Red sea bream is a bentho-pelagic species that inhabits various types of bottom (rock, sand, and mud) down to a depth of 900 m. The vertical distribution of this species varies according to individual size, and season of the year. Blackspot sea bream undertakes a vertical spawning migration, with the adults moving from deeper to shallower waters during the spawning season and forming aggregations.

B. Data

B.1. Commercial catch

Landing series were performed from two different sources. The first source has been updated from a table performed in WGDEEP 2004 (S1) (Figure 14.2.1), and the second one come from several data sources compiled by Lorance (2010) (S2) (Figure 14.2.2). According the source S2 landings *of P. bogaraveo* in Areas VI–VIII were on the order of 10–30 thousand t/year during 1950–1980, and between 10–15 thousand t/year according the source S1. In spite of the different level of landings showing both series, in the period in which the series coincides the historical trend is very similar, giving a clear perspective of the important decline of this fishery in Northeast Atlantic in last 30 years.

The information of observers in the Basque country fleet in Subareas VI, VII and VIII indicates that there was no discard for this species in the period 2003–2010.

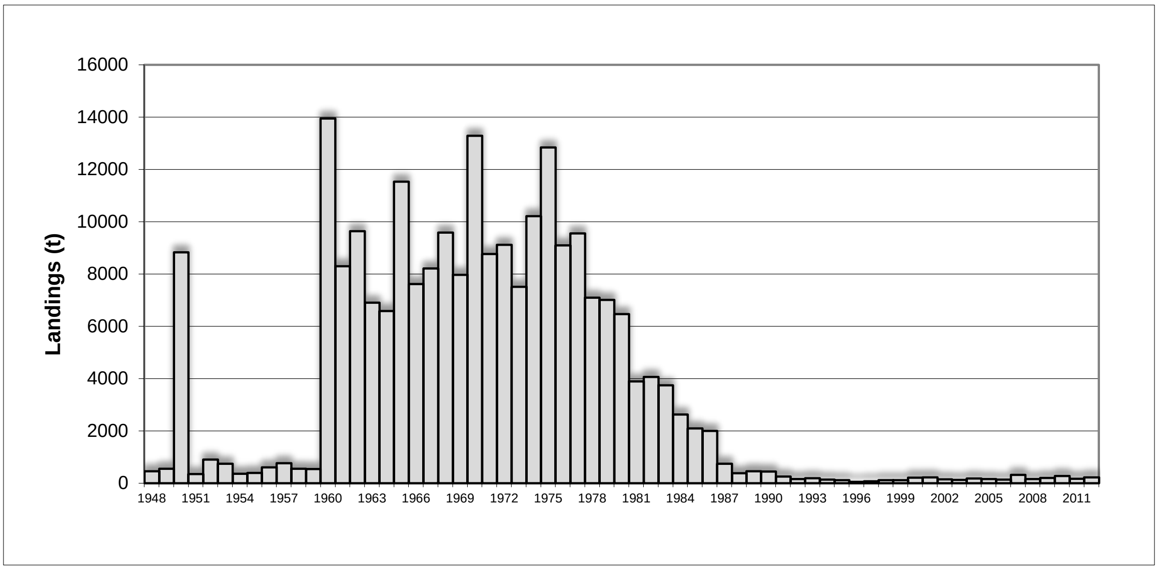


Figure 14.2.1. Historical series of red sea bream landings since 1948 in Northeast Atlantic (Subareas VI, VII and VIII).

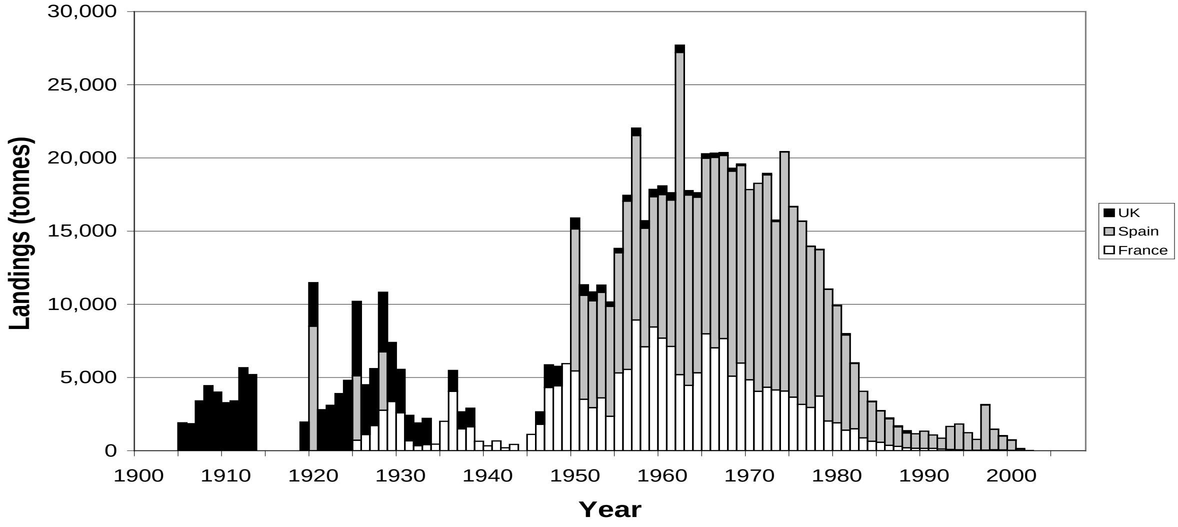


Figure 14.2.2. Reconstructed time-series of landings of red sea bream by country from the Bay of Biscay population (catch from ICES Subareas VI, VII and VIII). Lorance (2010).

B.2. Biological

Pagellus bogaraveo is a protandric hermaphrodite species changing from males to females. Sexing and staging this species may be sometimes problematic because macroscopic scales are not validated with microscopic observations. Red (blackspot) sea bream is considered a slow growing species. Gueguen (1969b) reported a maximum age of 20 years. Natural Mortality of 0.2 estimated by Lorance (2010) was derived from the presumed longevity in the population according the rule M ¼ 4.22/t maximum, where t is the maximum age in the population derived from data from many populations (Hewitt and Hoenig (2005)). According to this rule the 1% of the population survives to 23 years.

Table 1. Von Bertalanffy growth coefficient for *P. bogaraveo* for the Bay of Biscay. From Lorance, 2010.

K	L	To	N	ICES Area	
0.092	56.8	–2.92		VIII	Walford method from Guéguen (1969[b])
0.162	48.3	–0.72	10 186[a]	VIII	New fit using data from Guéguen (1969[b])
0.137	51.4	–0.97	20[b]	VIII	New fit to mean length-at-ages from Guéguen (1969[b])
0.209	51.56	–0.53	530	VIIIc	Sánchez (1983)
0.174	53.9	–0.66		VIIIc	Ramos and Cendrero (1967)
0.196	48.06	–0.47		VIIIc	Alcazar *et al.* (1987)
0.174	54.2	–0.66		VIIIB,c	Castro Uranga (1990)

[a] Size at age derived from back calculation (Guéguen, 1969b).

[b] Number of age groups.

B.3. Surveys

In the current Western IBTS time-series, only a few individuals (zero in some years) are caught which reflects that the stock remains at very low levels compared to historical abundance.

In two French surveys in 1973 and 1976, conducted with the same protocols as the current western IBTS survey in the Bay of Biscay, red sea bream was caught in significant numbers. In the current Western IBTS time-series, only a few individuals (zero in some years) are caught which reflects that the stock remains at very low levels compared to historical abundance.

B.4. Commercial cpue

No effort and commercial cpue data were available to the working group.

B.5. Other relevant data

C. Assessment: data and method

No assessment has been carried out before for this stock.

Model used: Not applicable

Software used: Not applicable

Model Options chosen: Not applicable

Input data types and characteristics: (table below is just an example; adapt the description of input accordingly)

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes			
Canum	Catch-at-age in numbers			
Weca	Weight at age in the commercial catch			
West	Weight at age of the spawning stock at spawning time.			
Mprop	Proportion of natural mortality before spawning			
Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

No HCR has been adopted for this stock.

D. Short-term projection

Not applicable.

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Not applicable.

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:

9) Stock–recruitment model used:

F. Long-term projections

Not applicable.

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. 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.

H. Other issues

Its peculiar reproductive biology and aggregative distribution makes red sea bream especially vulnerable to fishing.

Because of the sex-changing in red sea bream only the old ages contribute significantly to the production of oocytes. Therefore if young fish that are sexually immature then males are exploited the proportion of fish reaching the female stage may become very low. It is therefore essential that avoid catching small fish (red sea bream forms shoals that can be targeted). This is the reason for the minimum landing size at 35 cm.

In the 1920s and 1930s, it was reported that juveniles were widely distributed on the coasts of Brittany and in the Western Chanel French and UK coasts.

H.1. Historical overview of previous assessment methods

13.3 Red sea bream in Subarea IX

Stock	Red sea bream in ICES Subarea IX
Working Group	WGDEEP
Date	March 2011
Revised by	WGDEEP/Juan Gil

A. General

A.1. Stock definition:

Stock limits are generally determined not only by biological considerations but also by agreed boundaries and coordinates. ICES considered three different components for this species: a) Areas VI, VII, and VIII; b) Area IX, and c) Area X (Azores region). This separation does not pre-suppose that there are three different stocks of red sea bream, but it offers a better way of recording the available information" (ICES, 2007). The inter-relationships of the red 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 fishery currently occurs. Tagging has been done also in the Strait of Gibraltar area, where the majority of the fishery currently occurs. No significant movements are reported, although local migrations are also observed: feeding grounds are distributed along the entire Strait of Gibraltar and the species seems to remain in this area as a resident population (Gil, 2006). In 2007, Piñera *et al.*, 2007 suggests no significant genetic differences are present along Spanish coasts (Mediterranean and Atlantic areas).

Besides, in the case of the Strait of Gibraltar red sea bream also inhabit in Morocco waters. In fact recaptures of tagged fish were also notified by Morocco fishermen.

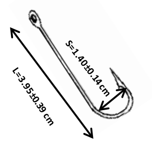
A.2. Fishery

Although *Pagellus bogaraveo* is caught by Spanish and Portuguese fleets in Subarea IX, only a more complete description of one of the fisheries has been provided to the working group, the corresponding to the Spanish fishery in the southern part of Subarea IX, close to the Strait of Gibraltar.

The majority of landings on deep-water species at mainland Portugal are conducted by the artisanal fleet, mainly longline fisheries. These operated in the Portuguese continental slope and located in ports as Peniche, Sesimbra and Sagres. Red sea bream landings reflect a seasonal activity probably related with a larger availability of the species or market demands that lead fishermen to spend some time targeting this species (Ivone Figueiredo, pers. com.).

In relation to the Spanish fishery in the southern ICES Subarea IXa, an updated description of it has been presented to the working group by Gil *et al*. (WD 2011), that complete the information offered in the previous WGs (Gil *et al*., 2000; 2003, 2005, 2006, 2007, 2008, 2009 and 2010; Gil and Sobrino, 2001, 2002 and 2004). This artisanal longline fishery targeted red sea bream has been developed along the Strait of Gibraltar area. Actually this fishery covers more than the 70% of the landings for the species in the Subarea IX. The base and landing ports are two: Algeciras and mainly Tarifa (Cádiz, SW Spain). The "*voracera*", a particular mechanised hook and line baited with sardine, is the gear used by the fleet (Table 1). The mean technical characteristics of this fleet by port are 8.95 and 6.52 meters length and 5.84 and 4.0 tons G.T.R. for Tarifa and Algeciras, respectively (Gil *et al*., 2000). Currently around 100 boats are involved in the fishery. Fishing grounds are located at both sides of the Strait of Gibraltar and quite close to the main ports (Figure 1). Fishing is carried out taking advantage of the turnover of the tides in depths from 200 to 400 fathoms. Landings are distributed in categories due to the wide range of sizes and to market reasons (these categories have varied in time but from 2000 onwards still the same).

Table 1. Red sea bream Spanish fishery of the Strait of Gibraltar: Fleet and gear summary descriptive.

Fleet ID	Gear type	Nº boats	Number of lines	Hook type and size	Mean soaktime	Effort (days at sea)
LHM_DEF	Vertical mechanized handline ("voracera")	±100	Maximum of 30 lines per day (each line attached a maximum of 100 hooks, usually ±70)	L=3.95±0.39 cm S=1.40±0.14 cm 	±30 min	Maximum 140 days

From 2002 onwards artisanal boats from other port, Conil, have begun to direct its fishing activity to *P. bogaraveo* in different fishing grounds and with different fishing gear (longlines) than the "*voracera*" fleet boats. Nowadays, only around six boats are developing this fishery.

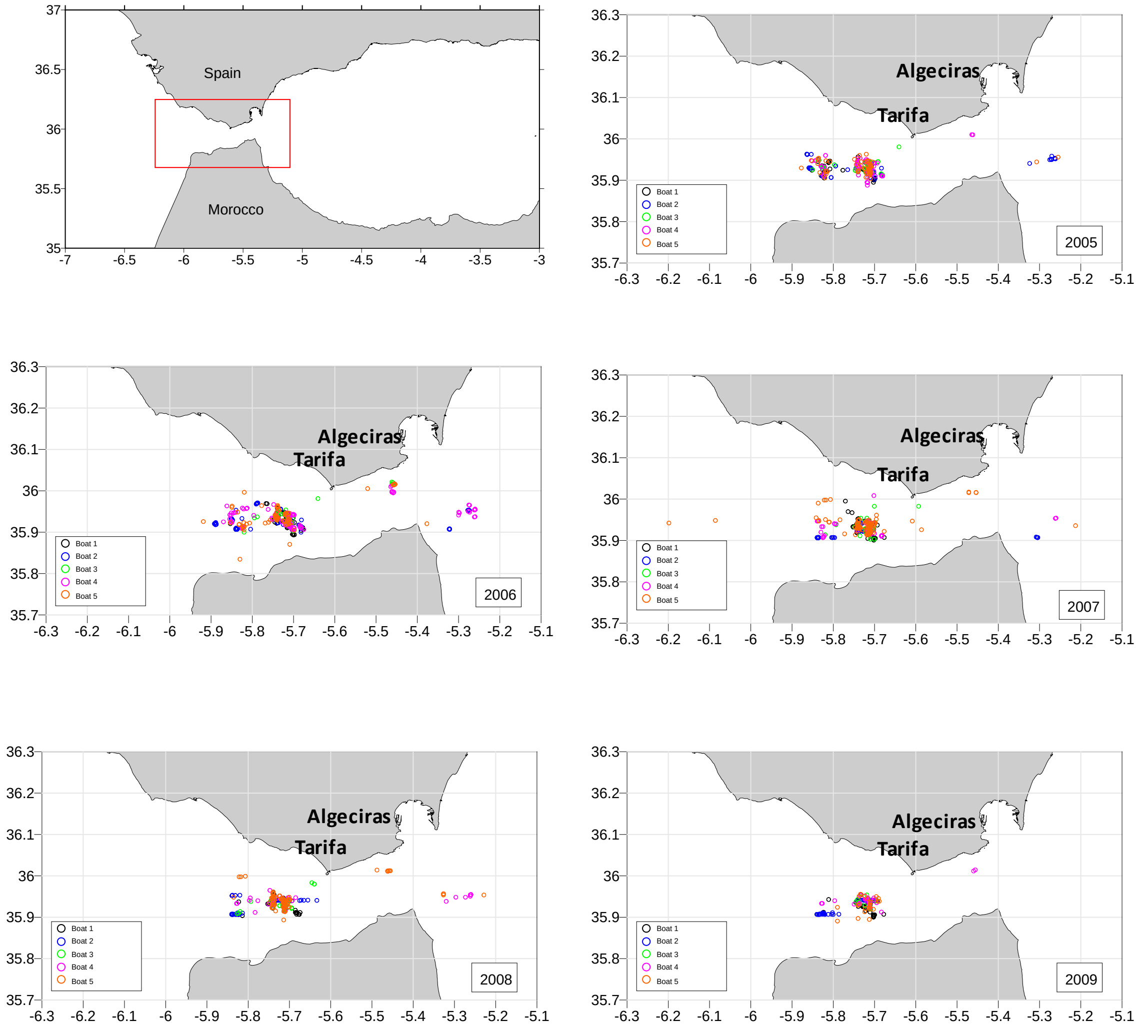


Figure 1. Red sea bream Spanish fishery of the Strait of Gibraltar: Yearly soaking positions footprints from observers on board programme (from Gil *et al.*, WD 19).

A.3. Ecosystem aspects

Red sea bream is a bentho-pelagic species that inhabits various types of bottom (rock, sand, and mud) down to a depth of 900 m. It is found in the Northeast Atlantic, from South of Norway to Cape Blanc, in the Mediterranean Sea, and in the Azores, Madeira and Canary Archipelagos (Desbrosses, 1938; Pinho and Menezes, 2005**)**. Hareide (2002) reported also occasional occurrence of this species along the Mid-Atlantic Ridge (north and south of the Azores).

Feeding habit of this species has been little studied. Morato *et al*. (2001) describes the diet of *Pagellus bogaraveo* and *Pagellus acarne* in the Azores and Olaso and Pereda (1986) describe the diet of 22 demersal fish in the Cantabrian Sea including *Pagellus bogaraveo*. In the Strait of Gibraltar fishery, feeding studies presents the difficult of the use of bait (sardine), which should be ignored to describe the feeding habit of the species. A total of 1106 red sea bream stomachs contents were analysed: 725 stomachs were empty and 381 were full. Vacuity index (VI) was 66%. The trophic spectrum is composed of 24 prey taxa, six orders, eleven families and 15 species and genera are represented. Despite the trophic spectrum diversity observed, the overall diet is not very diverse. Red sea bream in the Strait of Gibraltar has only a main prey, *Sergia robusta* (Polonio *et al*., in preparation).

Main red sea bream predators are unknown in the Strait of Gibraltar waters but maybe dolphins' predation should be taken into account (personal communication from Ceuta veterinary). Studies in Azores (Gomes *et al*., 1998) cite that *Conger conger*, *Raja clavata* and *Galeorhinus galeus* must be considered as potential predators (all three species are present in Strait of Gibraltar area).

Deep-sea coral ecosystems represent true biodiversity hot spots. OSPAR identified cold-water coral ecosystems as one of the most vulnerable ecosystems where action is required now to mitigate further loss of biodiversity. Figure 2 shows the deep-water coral occurrences in the Strait of Gibraltar.

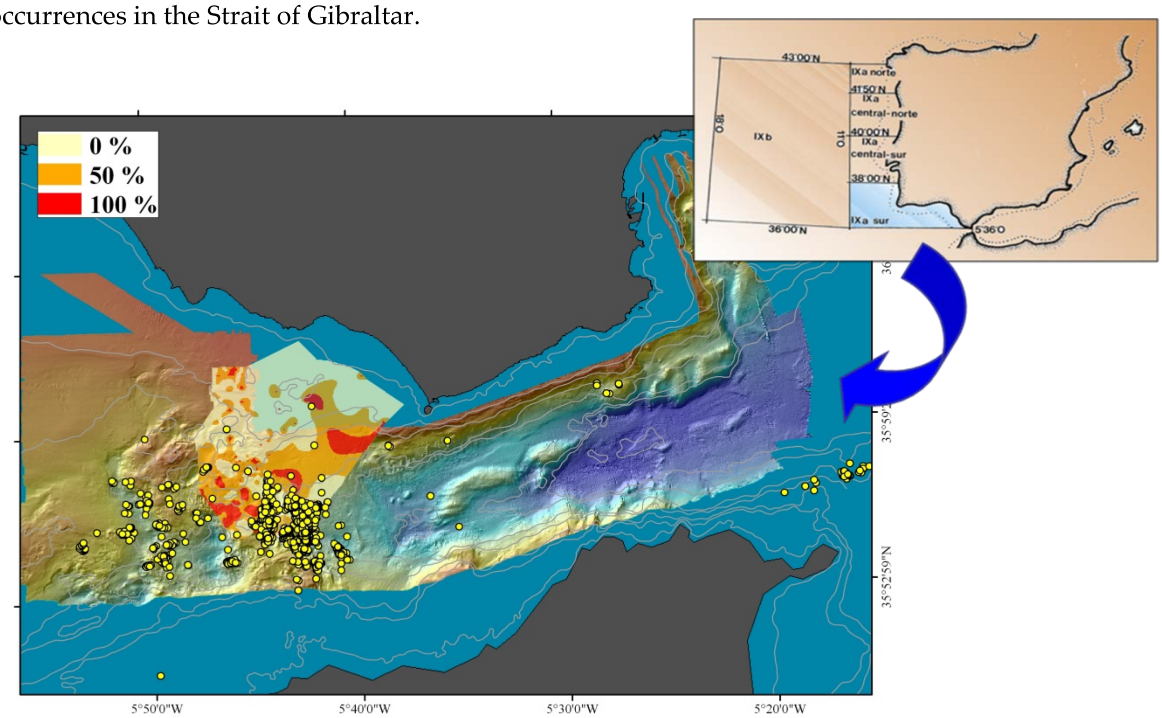


Figure 2. Coral distribution in the Strait of Gibraltar (adapted from Álvarez-Pérez *et al*., 2005 in Freiwald and Roberts Eds.). Yellow points correspond to "*voracera*" fleet fishing grounds from observers' on-board programme. Legend refers to percentage cover of coral.

B. Data

B.1. Commercial catch

In Subarea IX, catches, most of them taken by lines, correspond to Spain (72%) and Portugal (28%). Spanish landings data from this area are available from 1983 and Portuguese from 1988 onwards. The maximum catch in this period was obtained in 1993–1994 and 1997 (about 1000 t) and the minimum in 2002 (359 t). Catches in 2009 amount to 718 t, but decreases again (484 t) along the last year.

Almost all Spanish catches in this area are taken in waters close to the Gibraltar Strait. Until 2002 they were restricted to two ports (Tarifa and Algeciras), but from 2002 significant catches were obtained also by artisanal Spanish boats of a third port (Conil) in different fishing grounds of the same area. An increasing trend in landings was observed but since 2008 it only rates an average of 15 t, lower than in the early years.

In the Portuguese landings no clear tendency is observed. The maximum values took place in 1988 (370 t) and in 1998 (357 t) and the minimum one in 2000 (83 t). In 2010 landings were 105 t.

Length frequencies of landings are only available for the Spanish red sea bream fishery in the Strait of Gibraltar (1983–2010). Figure 14.3.1 shows the updated length distribution data (Gil *et al*., 2011, WD 19). There is a decrease of the mean size from 1995 to 1998. It is necessary to point out that the red sea bream may have a variable length distribution depending on its geographic and bathymetric distribution, as suggests the different mean length of landings measured in ports (Tarifa and Algeciras). The mean length of the landings increases steadily in both ports from 1999 onwards then decreased but has been increasing again between 2006 and 2009. The mean length from both landing ports declined in 2010. However the median value is lower than the mean since 1995, and very close to the minimum landing size in Algeciras.

A Kolmogorov-Smirnoff test reflects significant differences ($p<0.05$) between the length distributions from Spain and Morocco (Belcaid *et al*., WD 20) and also within Spain (Gil *et al*., WD 19). Differences among the sampling protocols may be the explanation to the observed difference. In Morocco and Spanish observers programme the sampling covers certain the boats (random sampling) while in the Spanish first sale fish market the sampling covers the 4 market categories (stratified sampling). So raising the random sampling weight to the total landings did not take into account the difference due to the variability of the length composition related to bathymetric distribution of the species and the stratified sampling seems to be more appropriate.

B.2. Biological

Red sea bream is a protandric hermaphrodite species changing from males to females. Red sea bream have a low productivity and they change sex as they age, starting as males and becoming females between ages 4 and 6. Measures to ensure balanced exploitation between younger fish (males) and older fish (females) are essential.

An annual reproductive cycle has been described for the species in this area (Gil, 2006). The spawning season seems to take place during the first quarter of the year. The smallest specimens are mainly males, maturing at a L_{50}=30.15 cm. At about 32.5 cm in total length, an important percentage of individuals change sex and became females, maturing at L_{50}=35.73 cm. Thus, from age 5 all individuals can be considered mature, whether they are males or females.

Red sea bream is considered a slow growing species. A combined ALK was obtained by three agreed readings from 1497 otoliths collected from 2003 to 2008 (Gil *et al.*, 2009). It comprises lengths from 24 to 54 cm and ages between three and ten, but it has not been validated yet. According to the available information the maximum age recorded in Subarea IX is ten years. However, the ages of older fish may be underestimated and it is possible that this species may be slower growing and longer-lived than current studies indicate. In fact, there was one recapture from tagging surveys notified more than ten years after its release (J. Gil, *pers. com*.). Table 2 presents different estimates of von Bertalanffy Growth Function (VBGF) parameters available from otoliths readings or tag–recapture data.

Table 2. Red sea bream of the Strait of Gibraltar: VBGF parameter estimates.

					L_∞
Sobrino and Gil, 2001	Strait of Gibraltar	Otholits reading	-0.67	0.169	58.00*
Gil *et al.*, 2008	Strait of Gibraltar	Otholits reading	-1.23	0.169	62.00*
Gil *et al.*, 2009	Strait of Gibraltar	Otholits reading	-0.34	0.162	62.00*
Gil *et al.*, 2008	Strait of Gibraltar	Recaptures (1)		0.079	62.00*
Gil *et al.*, 2008	Strait of Gibraltar	Recaptures (2)		0.098	62.00*
Gil *et al.*, 2008	Strait of Gibraltar	Recaptures (3)		0.161	62.00*
Gil *et al.*, 2008	Strait of Gibraltar	Recaptures (4)		0.080	62.00*

(1)Gulland y Holt, 1959 (2)Munro, 1982 (3)Fabens, 1965 (4)Appeldoorn, 1987.

***Fixed (from the largest observed sample).**

Padillo *et al*. (2011, WD17) present new information based on Discriminant Analysis of several of the samples used to make the ALK, combining morphometric and morphological variables to re-estimate red sea bream ages. The reclassification success percentage was 85.3%, well above from the 70% adopted by other authors (Palmer *et al*., 2004; Galley *et al*., 2006). Changes in otolith shape could be related to the growth rate and be also strongly influenced by environmental components. Therefore, future work should include the analysis of such factors throughout years and cohorts.

The natural mortality of *Pagellus bogaraveo* is uncertain because there is no data available to estimate M directly. A mortality rate of 0.2 year^{-1} has been adopted by several authors in several studies from other areas (Silva, 1987; Silva *et al*., 1994; Krug, 1994; Pinho *et al*., 1999; Pinho, 2003) and also by Gil (2006) for the Strait of Gibraltar.

B.3. Surveys

Only tagging surveys were carried out in the Strait of Gibraltar area. Since 1997, 7066 samples were tagged (juveniles + adults) and at the moment 396 recaptures were notified. Recaptures from tagged juveniles show significant displacements from south Mediterranean breeding areas toward the Strait of Gibraltar. However, recaptures from tagged adults did not reflect big displacements, which are limited to feeding movements between the different fishing grounds where the "*voracera*" fleet works (Gil, 2006).

B.4. Commercial cpue

It should be noted that the effort unit from the historical series, number of sales, may be inappropriate, as it fails to consider the missing effort from boats that have not caught enough fish to go to the market. Thus, in the years this missing effort has increased substantially (fishing vessels with no catches and no sale sheet to be recorded) and its lpue values may be overestimated.

Gil *et al*. (2011, WD19) presents a short series of cpue (2005–2009) from the observers on-board programme in the red sea bream fishery of the Strait of Gibraltar. Sampling level was five boats and three trips per month. Number and length measurements of caught species were recorded. Values vary around three red sea bream per ±70 hooks but the general trend seems to be slightly decreasing throughout the years. Further work should be done to standardize the cpue.

B.5. Other relevant data

C. Assessment: data and method

Model used: No model was adopted for the assessment yet. Till the moment the assessments attempts were no accepted and only several trends (landings and length distributions) were used for the scientific advice.

Software used: None

Model Options chosen: None

Input data types and characteristics: (table below is just an example; adapt the description of input accordingly).

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes			
Canum	Catch-at-age in numbers			
Weca	Weight at age in the commercial catch			
West	Weight at age of the spawning stock at spawning time.			
Mprop	Proportion of natural mortality before spawning			
Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-term projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:
7) Exploitation pattern:
8) Intermediate year assumptions:
9) Stock–recruitment model used:

F. Long-term projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

	TYPE	VALUE	TECHNICAL BASIS
MSY	**MSY $B_{trigger}$**	**N/A**	
Approach	**F_{MSY}**	**$F_{0.1}$=**	**YpR Analysis**
	B_{lim}	**N/At**	
Precautionary	**B_{pa}**	**N/A**	
Approach	**F_{lim}**	**N/A**	
	F_{pa}	**N/A**	

No biological reference points have been defined.

H. Other issues

H.1. Historical overview of previous assessment methods

Historical series of landings data available to the working group have been exploratory assess by the WGDEEP since 2006. No discard data were available to the working group, but for this species this could be considered minor. The landings data used in the assessment exercise of red sea bream in IX included Spanish and Portuguese landings from 1990 onwards.

New assessment exercises were presented to the WG in 2011. An Extended Survivors Analysis (XSA) attempt with the Strait of Gibraltar Spanish red sea bream fishery data is described by González and Gil (2011, WD18). Belcaid *et al*. (2011, WD20) presents the results obtained by a Yield-per-recruit analysis from 2005–2007 Spanish and Morocco landings length distribution available information from the Strait of Gibraltar area.

I. References

13.4 Red sea bream in Division X

Stock	Red (blackspot) sea bream (*Pagellus bogaraveo*) in Sub area X
Working Group	WKDEEP
Date	February, 2010 WKDEEP 2010
Revised by	Mario Pinho

A. General

A.1. Stock definition

"*Stock limits are generally determined not only by biological considerations but also by agreed boundaries and coordinates. ICES considered three different components for this species: a) Areas VI, VII, and VIII; b) Area IX, and c) Area X (Azores region). This separation does not pre-suppose that there are three different stocks of red (blackspot) sea bream, but it offers a better way of recording the available information*" (ICES, 2007).

In fact, the interrelationships of the red (blackspot) sea bream (*Pagellus bogaraveo*) from Subareas VI, VII, and VIII, and the northern part of Division IXa, and their migratory movements within these sea areas have been confirmed by tagging results (Gueguen, 1974). Possible links between red (blackspot) sea bream from the Azores region (Subarea X) with the others areas are not yet fully studied. However, recent studies show that there are no genetic differences between populations from different ecosystems within the Azores region (East, Central and West group of Islands, and Princesa Alice Bank) but there are genetic differences between Azores (ICES Subarea X) and mainland Portugal (ICES Division IXa) (Stockley *et al*., 2005). These results, combined with the known distribution of the species by depth and tagging information, suggest that Subarea X component of this stock can be considered as a separate management unit.

A.2. Fishery

Blackspot sea bream has been exploited in the Azores (Subdivision Xa2), at least, since the XVI century, as part of the demersal fishery (Silva and Pinho, 2007).

The Azorean fishery is a multispecies and multigear/fleet one (demersal mixed hook and lines). About 104 species belonging to 49 families were caught and identified during the spring demersal longline surveys from 1995–2006 (Menezes *et al.,* 2006). This demersal community is structured by assemblages according depth (Pinho and Menezes, 2005; Menezes *et al.,* 2006). Three main assemblages can be defined according depth: Shallow (<200 m), Intermediate (200–700 m) and Deep (>700 m). The key species of this fishery is red (blackspot) sea bream (*Pagellus bogaraveo*) and bluemouth (*Helicolenus dactylopterus*), which are distributed from shallow (<50 m) to deep depth strata (1000 m). The fishery is also considered as small-scale because the highest proportion (about 80%) comprises small vessels (<12 m).

The directed fishery is a mixed hook and line fishery where two components of the fleet can be defined: the artisanal (handlines) and the longliners. The artisanal fleet is composed of small open (sometimes closed) deck boats (<12 m) that operate on local areas near the coast of the islands using several types of handlines and covering depth until 800 m. Longliners are closed deck boats (>12 m) that operate in all areas (except within 3 miles of island coasts), including banks and seamounts (Pinho and Menezes, 2005; Silva and Pinho, 2007; Pinho and Menezes, 2009). In the past, the tuna fishery has also caught juveniles (age 0) of blackspot sea bream for use as live bait, in a seasonal and irregular way, depending on tuna abundance and on the occurrence of other preferred bait species, like *Trachurus picturactus* (Pinho *et al*., 1995). This practice has been reduced significantly during the last decade, particularly since the introduction of the TACs.

The operational regime of each vessel type varies considerably. Small open-deck vessels usually operate in areas near the coast, using mainly handlines. They make daily trips and target mainly shallow (<200 m) and intermediate (200–700 m) depth species (see Pinho and Menezes, 2005). On average, this component makes between 70 and 150 fishing days per year, depending on the island base of the vessel. Some open-deck vessels (9–12 m) based in St Miguel Island operates in a larger area including banks near the coast (to 50 miles). These vessels make about 200 fishing days per year. Small closed-deck vessels (<14 m) are considered the main component of the fleet targeting deep-water species and cover almost all areas and depth strata. They use mainly deep longlines and handlines, operating in coastal areas of the islands and in the main banks and seamounts. These vessels operate in all strata but preferentially target species from 200–800 m strata, making on average between three and seven fishing days per trip, with one set a day, though occasionally more, using from six to ten thousands hooks by set. On average they make about 200 fishing days per year. Industrial vessels operate mainly on banks and seamounts, inside or outside the EEZ, including the ICES and CECAF areas, using deep longlines. They usually fish in the intermediate (200–700 m) and deep-water strata (>700 m). These vessels make trips, on average of seven days, with one (or more) sets a day of about 14 000 hooks per set. They make on average 250 fishing days per year. However, the fleet exhibits a very high level of absenteeism (many vessels operate on a no- regular basis and with many interruptions in landings with time), particularly for the small vessel size component, probably related with the subsistence characteristic of this component where the fishers are also farmers.

Although the predominant gears are the demersal longline and handlines, the fleet, particularly the local open (or close) deck component, is very plastic and can operate opportunistically and on seasonal way to other species like crustaceans (using traps), small pelagic (using nets) and squids or tunas (live and bait), as a function of abundance and price (Pinho and Menezes, 2009). Each vessel usually has permits to use different gears.

A.3. Ecosystem aspects

The red blackspot sea bream is found in the Northeast Atlantic, from south of Norway to Cape Blanc, in the Mediterranean Sea, and in the Azores, Madeira, and Canary Archipelagos (Desbrosses, 1938; Pinho; Menezes, 2005**)**. Hareide (2002) reported also occasional occurrence of this species along the Mid-Atlantic Ridge (north and south of the Azores). The Azores region (Subdivision Xa2) is considered a management unit based on genetic studies and tagging data (ICES, 2007).

Blackspot sea bream is a bentho-pelagic species that inhabits various types of bottom (rock, sand, and mud) down to a depth of 900 m. The vertical distribution of this species varies according to individual size and season of the year. In the Azores, this species is found in all habitats (coastal areas of islands, banks, and seamounts) down to 900 m depth. Local distribution is directly correlated with depth, with juveniles inhabiting littoral and shallow waters (0–30 m), young immature individuals inhabiting depths less than 300 m, and large adults inhabiting areas between 300–700 m depth (Menezes *et al.*, 2005).

Blackspot sea bream undertakes a vertical spawning migration, with the adults moving from deeper to shallower waters during the spawning season (December–March) and forming aggregations (Krug, 1990; 1998). The dynamic of the spatial distribution in the Azores region is not yet very well understood. Data from the survey show that juveniles (age 0–1 years) are almost absent from the main seamounts, but are found in the coastal areas throughout the year, suggesting area interactions (Pinho, 2003).

The Azores is an oceanic region where the deep-water ecosystem is predominant. The major topography feature is the Mid-Atlantic Ridge (MAR) which follows a sinuous course southwards from Iceland to the Azores. Islands and seamounts are other prominent topographic features, which are characterized by very specific circulation patterns and play an important role in the ocean biological system (Bashmachnikov *et al.*, 2005; 2009a; 2009b; Silva and Pinho, 2007; Morato *et al.*, 2008). This ecosystem is poorly known and important dynamics of the *Pagellus bogaraveo* population are dependent of environmental dynamics at different scales.

The essential fishing habitat of *Pagellus bogaraveo* comprises littoral and deep-water areas. The distribution of this habitat around the Azores is much discontinued.

B. Data

For this species data are available from commercial fisheries and from surveys reported to ICES. Data from commercial fisheries include landings (auction data) and biological port sampling. There are also inquiries and logbooks and observers (from large longliners) available to compute fishing effort.

Annual landings are computed from the diary sales of fresh fish on the auctions. Landing information does not include discards. Biological sampling is made on the most important fisheries ports, which usually incorporate an inquiry to the captain. From these data are computed the annual fishery length composition and fishing effort. Standardized catch rates, exploring several explanatory variables (year, port, season and vessel type), have been estimated since 2006.

Biological fishery data, including ageing and maturity, are available and have been collected annually since 2002, under the EU data collection regulation, and since 2009, under the EU Data Collection Framework.

Demersal longline survey data are available since 1995 (Pinho, 2003; Menezes *et al.*, 2006). An annual abundance index and biological data (length composition, sex, age and maturity) from the survey are available and the time-series have been presented to WGDEEP.

Data are supplied from databases maintained by Department of Oceanography and Fisheries (DOP/UAç). An informatics routine to compute these basic output data specific for the WGDEEP is under development.

The data used in the assessments are considered as the best available data at the working group time of the year.

B.1. Commercial catch

Landings data (in weight and value) from the Azores have been reported to ICES. Landings are collected directly from the first sale of fresh fish at the auctions. Information on discards has been collect in recent years, but it is not relevant to red (blackspot) sea bream because the species is rarely discarded.

Complete official landings are available since 1982; however detailed landings by vessel are only available since 1990. An incomplete time-series from 1948 is available to be used for illustrative development of the fishery.

Landing data disaggregated by gear type, area and depth are lacking or are incomplete.

B.2. Biological

The information available for *Pagellus bogaraveo*, Azores ICES Subdivision Xa2, is presented in Table 1.

Annual length composition from the fishery (1990–2008) and survey (1995–2008) are available. In general length composition covers a range of lengths from 10 to 57 cm with a mode around 30 cm.

Pagellus bogaraveo is a protandric hermaphrodite species changing from males to females. Sexing and staging this species may be sometimes problematic because macroscopic scales are not validated with microscopic observations.

Spawning in Subdivision Xa2 occurs from December to March, with a mode on January/March.

Maturity information is only available for some periods (1982–1986, 1991 and 2002–2008).

Red (blackspot) sea bream is considered a slow-growing species. Gueguen (1969) reported a maximum age of 20 years, Ramos and Cendero (1967) and Coupé (1954) reported twelve years, Sanchez (1983) reported ten years, Ana *et al*. (2006) reported nine years and Gil and Sobrino (2002) reported eight years. In the Azores a maximum age of 15 years was observed in a 56 cm length fish (Krug, 1994). However, no age validation was obtained by examining structures from fish of a known age (e.g. from mark–recapture studies with conventional tags or tetracycline method).

Ageing data are available from the fishery and from surveys. Annual ALKs are available for the survey (1996–2008) and fishery (2002–2008). Growth parameters have been estimated for sex combined (Pinho *et al.*, 2006).

B.3. Surveys

Survey data available from the Azores for *Pagellus bogaraveo* is resumed in Table 1.

The Azorean longline survey was conducted annually each spring (usually from April to June) from 1995 to 2008, with exception of the years 1998 and 2009. The survey followed a stratified design (six statistical areas and 12 depth strata) and covered the Azores archipelago around the islands, banks, and major seamounts (Figure 1). The survey is design for abundance estimation of red (blackspot) sea bream, covering the depth strata from 50 to 600 m. Depth coverage was extended to 800 m since 2004. Additionally, depths from 800 to 1200 m are covered in one transept by statistical area for ecological studies. Details of the survey design can be found in Pinho (2003) and Menezes *et al.* (2006).

The catch per hook value (cpue) was calculated for each species, area, and station stratum, and an index of relative abundance in number (RPN) (or weight-RPW) was obtained by multiplying each of these cpue values by the corresponding area size.

The average RPN value for each area and stratum was then calculated. The abundance values for each area and for the Azores were computed by summing the abundance index values across strata and across areas, respectively.

Length data were collected for all survey years following a random stratified design. Length samples were stratified by station, statistical area and depth strata, and then weighted by the area-stratum size. The resultant length distributions were averaged within each area-stratum and summed across strata and areas to estimate total length frequency.

B.4. Commercial cpue

Nominal commercial catch rates are estimated by trip from the fishery landing enquiries data, collected by interviews with the fishermen during landing. So, the catch data for each trip correspond to the landings information collect by the auction market. The effort data are recorded by shore based samplers that inquire the fishing masters in order collect detailed information on fishing operations, including the number of hooks per set, number of sets per trip, gear characteristics, etc. Each record also includes information on date, geographical area of the catch and catch in weight for each species landed. The total fishing effort per trip is usually estimated as the product of the mean number of hooks per set multiplied by the number of sets per trip. Nominal catch rates were estimated as the kg of blackspot sea bream caught per 1000 hooks.

This catch rates are affected by the abundance but also by other factors, like season, gear configuration, boat type and fishing target species. The effects of the different factors in the catch rates have been estimated, using GLM-generalized linear models, since 2006 (Pereira, 2006). This standardized cpue covered the considered "fully exploited phase" of the fishery (since 1990) and presented a relatively stable trend. There is no information available for the ancient times of the fishery.

B.5. Other relevant data

C. Historical stock development

The first attempt to assess the resource was performed during 1996 SGDEEP meeting using the SVPA and Laurec-Shepherd on the matrix of catch-at-age from the period 1982–1993 and the Azorean effort fleet. Concerns related to the annual age compositions, maturity ogives and lack of convergence were expressed and the assessment was not validated (ICES, 1996). A new attempted was made during the 2006 WGDEEP meeting using Separable VPA, *Ad hoc* VPA tuning and XSA (ICES, 2006). The results from the exploratory assessment performed in 2006 were considered unreliable.

Agreed data and assessment at the Benchmark (WKDEEP, 2010)

Annual landing data from 1990 and onwards and standardized cpue from 1990 and onwards. Standardized fishery cpue derived by applying the GLM delta lognormal model distribution to inquiry data (landing and effort data by trip and vessel).

Azorean longline survey abundance indices from 1995–onwards.

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

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

For the survey data indices of abundance (cpue weighted by the area size) by length classes were computed. These annual data were then disaggregated by sexes assuming a sex change dynamic proposed by Krug (1990; 1998). The sexes include: Females, males, hermaphrodites and undifferentiated.

To split the annual length composition by sex the following equations were used to describe the sex-ratio of each sex:

$$P = \frac{1}{1+e^{(6.56-0.1816*LF)}} \quad \text{Females}$$

$$P = \frac{1}{1+e^{(-5.180+0.227*LF)}} \quad \text{Males}$$

$$P = 0.388*(-23.688+LF)e^{[-0.225*(-23.688+LF)]} \quad \text{Hermaphrodites}$$

$$P = e^{(16.68-0.71*LF)} \quad \textit{Undifferentiated}$$

Where P is the proportion of each sex category and LF is the fork length.

To split these annual length compositions by mature and immature length compositions the following maturity ogives for males and females were adopted:

$$P = \frac{1}{1+e^{(-21.43+0.66*LF)}} \quad \text{Females}$$

$$P = \frac{1}{1+e^{(-13.46+0.476*LF)}} \quad \text{Males}$$

Where P is the proportion of mature of each sex and LF fork length.

$L_{50\%\ \text{values}}$ derived from the ogives calculated as above were 28 cm for males and 32 cm for females. A midpoint between these two values was assumed for hermaphrodites. A knife edge was adopted to separate mature from immature fish by sex type (see table below).

Sex	Mature	Immature
Males	>28 cm	<28 cm
Females	>32 cm	<32 cm
Hermaphrodites	>30 cm	<30 cm
Undifferentiated	-	All

This analysis should be carried out for the entire survey area and survey statistical areas.

D. Short-term projection

No short-term projection is conducted for this stock.

E. Medium-term projection

No medium-term projection is conducted for this stock.

F. Long-term projection

No long-term projection is conducted for this stock.

G. Biological reference points

Tools available from the WKLIFE were explored during 2011 meeting:

- YPR using FLR code (BHAC). The input parameters: Loo=56.7, K=0.13, To=-1.96, M=0.2, cm(L_{mat}/L_{inf})=0,5 and c(Lc/L_{inf})=0,5).
- Z was estimated from a catch curve applied to the fishery length–frequency or age data.
- Froese and Binolhan, 2000 method assuming the mean fishery length composition over the period 1995 to 2010.
- Results from WKLIFE Gislason spreadsheet were applied using an L_{MAX} of 63 cm and AFC = 4.

Method	AFC	Lmax	Linf	k	To	Age Mat	Fmax	F0.1	F20%	F30%	F35%	F40%
Gislason spreadsheet	4	63	65,27	0,22	-	2,6	0,75	0,29	1,28	0,58	0,44	0,35
BHAC	4		56,7	0,13	-1,46	4	-	0,30	0,59	0,35	0,28	0,23

Results are summarized on the table. Both methods estimate similar value of $F_{0.1}$, however BHAC tends to underestimate the estimates of the others reference points due to the different growth parameters adopted. $F_{40\%}$ or $F_{0.1}$ seems to be the appropriate F_{MSY} proxy for the species corresponding to a fishing mortality of between F=0.2 and 0.3 respectively.

The Z estimates from the catch curve fall within the range 0.4 to 0.7. A mean value of Z=0.5 was adopted, corresponding to a current F=0.3.

Results from yield-per-recruit suggest that the stock is fully exploited with the actual F at the level of $F_{0.1}$.

Based on new information from tagging results from other area (IXa) it is considered that the growth parameters used in this analysis may be overestimated.

H. Other issues

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Table 1. Time-series from fishery and survey available for the assessment of *Pagellus bogaraveo*, ICES, Area X. Data in brackets refers to a period.

DATA	FIHERY	SURVEY
Length composition (sex combined)	1990–2008	1995–2008
ALK (otholits)	(2002–2008)	1995–2008
Maturity ogives	(1982–1986); 1991; (2002–2008)	-
Sex-ratio	Same as maturity ogives	1995–2008
Abundance index	1990–2008	1995–2008
Landings (weight)	1980–2008	-

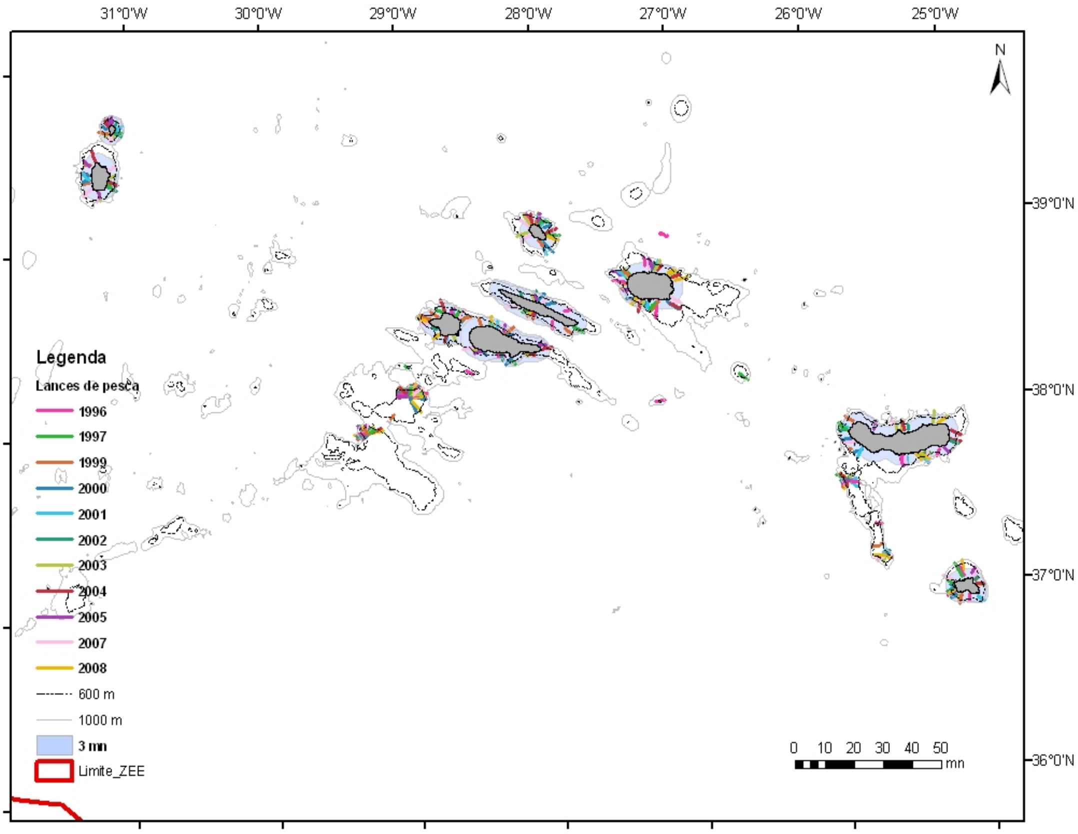

Figure 1. Statistical areas covered by the Azorean spring demersal longline survey. Annual transepts are represented on the graph for illustration. The three mile (shadow) island coast box area and the 600 m and 1000 m contour are also shown. Adapted from Rosa (1999).